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The Relationship between the Resource Curse and Genuine Savings as an Indicator for Weak Sustainability

Theoretical Background and Empirical Evidence

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ABSTRACT

This dissertation deals with the relationship between the **Resource Curse (RC)** – the empirically proven paradox that countries with abundant natural resources often show slower economic growth – and a measure for the substitution of natural resource depletion by other forms of capital, the World Bank's **Genuine Savings (GS).** In four logically successive parts, which are all published papers, this work analyzes the "alarming picture [that most] [c]ountries with a large percentage of mineral and energy rents of GNI typically have lower genuine saving rates" (VAN DER PLOEG 2011: 396-397) as well as its background determinants and transmission channels.

The first part establishes a critical survey on GS and its calculation components and is intended as an introduction to its theoretical and methodical background. The WORLD BANK (2011) adjusts Net National Savings for human and natural capital, but as an indicator of real world sustainability GS has several shortcomings, which are discussed at length. For example, there are natural resources that are omitted due to empirical and methodological reasons such as fisheries, biodiversity or diamonds. Part one discusses possible extensions and ideas for future development, but the most important finding is the necessity for more analyses of possible factors determining the development of GS rates.

With this background, part two establishes a theoretical model of the relationship between the RC and GS. Since both the RC and GS depend on the amount of resource depletion and exports, a possible relation seems clear. Therefore, part two uses the exogenous and endogenous explanations from countless studies contributing to the research on the RC and its determinants and relates them to GS and its calculation components. For example, the volatility of international commodity markets affects the natural resource rents within the calculation of GS immensely, or the migration of employees to the resource sector has a clear impact on the education expenditures used to determine human capital.

In part three, these findings and the resulting theoretical model are used to show the empirical relationships between the RC and GS in cross-country regressions. For example, the mentioned terms-of-trade volatility in resource-dependent countries affects the calculation of GS on multiple levels. Overall, results show that factors leading to the RC are also useful explanatory variables for GS. Hence, part three of this dissertation shows that the theoretical framework from part two holds true in comprehensive cross-country regressions with a variety of dependent and independent variables.

To complete the analysis, part four examines Zambia as a case study of a RC-affected country. Between 1964 and 2012 Zambia depended on copper exports at an average 33% of

its GNI and suffered a decline of its real per capita income in the same period, and importantly showed an average GS rate of -3%. The study demonstrates that most of the theories relating the RC to GS apply to the Zambian situation. Its GS developed with high volatility and completely in line with world copper prices and to a lesser but not negligible extent with political developments. Following parts two and three, this case study completes the picture on the deep relationship between the RC and GS and closes the loop of a theoretical model with cross-sectional empirical research as well as a research design which allows for a more qualitative discussion.

KURZFASSUNG

Die vorliegende Dissertation beschäftigt sich mit dem Zusammenhang zwischen dem **Ressourcenfluch (RF)** – dem empirisch nachgewiesenen Paradox, dass ressourcenabhängige Länder meist geringeres Wirtschaftswachstum aufweisen – und einem Indikator für die Substitution natürlicher Ressourcen durch andere Kapitalformen, die **Genuine Savings (GS)** der Weltbank. In vier aufeinander aufbauenden veröffentlichten Papern analysiert diese Arbeit das „alarmierende Bild, [dass die meisten] Länder mit einem großen Anteil an Renten von Mineralen oder Energieressourcen in ihrem BIP typischerweise niedrigere Genuine Savings Raten aufweisen" (van der Ploeg 2011: 396-397) und die dazugehörigen Hintergrunddeterminanten und Übertragungskanäle.

Der erste Teil bildet einen kritischen Überblick über GS und ihre Berechnungsbestandteile und ist als Einleitung über den theoretischen und methodischen Hintergrund gedacht. Die WELTBANK (2011) erweitert nationale Netto-Ersparnisse um Human- und Naturkapital, als Indikator für reale Nachhaltigkeit weisen GS aber einige Defizite auf, die ausführlich diskutiert werden. Beispielsweise werden natürliche Ressourcen wie Fischbestände, Biodiversität oder Diamanten aufgrund von empirischen und methodischen Problemen außen vor gelassen. Teil eins diskutiert mögliche Erweiterungen und Ideen für zukünftige Entwicklungen, aber die wichtigste Erkenntnis ist die Notwendigkeit vermehrter Analysen möglicher Determinanten der Entwicklung von GS-Raten.

Vor diesem Hintergrund bildet Teil zwei ein theoretisches Modell des Zusammenhangs zwischen dem RF und den GS. Da beide von der Höhe des Ressourcenabbaus und -exports abhängig sind, erscheint ein möglicher Zusammenhang offensichtlich. Daher nutzt Teil zwei exogene und endogene Erklärungen aus den zahllosen Studien zum RF und seinen Determinanten und bringt diese mit den GS und ihren Berechnungsanteilen zusammen. Beispielsweise beeinflusst die Volatilität internationaler Rohstoffmärkte die Renten von natürlichen Ressourcen innerhalb der Berechnung von GS immens oder die Arbeitskräftewanderung zum Ressourcensektor hat einen klaren Einfluss auf die Bildungsausgaben, die zur Präsentation des Humankapitals genutzt werden.

Im dritten Teil werden diese Erkenntnisse und das resultierende Theoriemodel genutzt, um die empirischen Zusammenhänge zwischen dem RF und den GS in Querschnittsregressionen aufzuzeigen. Beispielsweise beeinflusst die erwähnte Volatilität der Terms-of-Trade in ressourcenabhängigen Ländern die Berechnung der GS auf mehreren Ebenen. Insgesamt zeigen die Ergebnisse, dass Faktoren die zum RF führen auch als nützliche erklärende Variablen für GS dienen können. Daher zeigt Teil drei dieser Dissertation, dass der

theoretische Rahmen aus Teil zwei auch in einer umfangreichen Querschnittsregression mit einer Vielfalt abhängiger und unabhängiger Variablen gilt.

Um die Analyse zu komplettieren untersucht Teil vier Sambia als eine Fallstudie eines vom RF betroffenen Landes. Zwischen 1964 und 2012 war Sambia mit durchschnittlich 33% seines Bruttonationaleinkommens abhängig von Kupferexporten und erlitt im selben Zeitraum einen Rückgang seines realen Pro-Kopf-Einkommens, außerdem eine durchschnittliche GS-Rate von -3%. Die Studie zeigt, dass die meisten Theorien, die den RF und die GS zueinander in Verbindung setzen, auch für die Sambische Situation gelten. Sambias GS entwickelte sich höchst volatil und komplett parallel mit den Weltkupferpreisen und zu einem geringeren aber nicht vernachlässigbaren Ausmaß mit den politischen Entwicklungen. Nach den Teilen zwei und drei komplettiert diese Fallstudie das Bild des tiefgehenden Zusammenhangs zwischen dem RF und den GS und schließt den Kreis aus theoretischem Modell, empirischer Querschnittsanalyse sowie einem Forschungsdesign, das eine mehr qualitative Diskussion erlaubt.

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List of Acronyms

ANS	Adjusted Net Savings
GDP	Gross Domestic Product
GNI	Gross National Income
GNS	Gross National Savings
GS	Genuine Savings
HDI	Human Development Index
MDRI	Multilateral Debt Relief Initiative
MMD	Movement for Multi-Party Democracy
NIE	New Institutional Economics
NNS	Net National Savings
ODA	Official Development Assistance
RC	Resource Curse
UNIP	United National Independence Party
WB	World Bank
WS	Weak Sustainability

1. INTRODUCTION

1.1. The Resource Curse Thesis and Genuine Savings

GELB (1988) and AUTY (1993) introduced the term **Resource Curse (RC)** for the empirically proven paradox that countries with abundant mineral resources often show slower economic growth. Even after controlling for variables, which they identify to be important for economic growth, SACHS and WARNER (1995/1997) prove a significant empirical relationship between the resource dependency of countries (measured in terms of the ratio of primary exports to Gross National Income (GNI)) and their low growth rates. In the two decades since then a vast amount of literature – especially in development economics – has been published with a wealth of explanations ranging from the volatility of world markets to the quality of institutions. One of the consistently most important is the fact that natural resources generate rents that are independent of a country's economic performance, which can lead to suboptimal reinvestments of the income from the consumption of this natural capital.

This is closely related to the discussion about the substitutability of natural capital by physical or human capital and therefore is also related to the literature on "weak" sustainability. Analogous to the discussion on the RC, another branch of literature – especially in environmental economics – developed formal models of **Genuine Savings (GS)** to measure the substitution of natural resource depletion by other forms of capital (HAMILTON 1997; HAMILTON and CLEMENS 1999).[1] Obeying the "Hartwick Rule" of reinvesting all resource rents, GS measures the adjustment of investments in physical and human capital to compensate for the depletion of natural resources. It is defined as the Net National Savings (NNS) deducted by the depletion of resources and the emission of pollution, adding expenditures for education to measure the increase in human capital. According to HAMILTON (2001), GS can be seen as the net change in total wealth (physical, human and natural capital) of a nation in the accounting period.

At first glance, this is a reasonable measure for the reinvestment of resource rents and therefore for the perception of the RC itself, especially since one could also discuss whether or not the value of deducted rents for the depreciation of natural capital (usually in % of GNI) is not a better measure of resource dependence than the above mentioned ratio of primary exports to GNI by SACHS and WARNER (1995/1997).

[1] The World Bank (WB) releases GS retrospectively since 1970 under the label of Adjusted Net Savings (ANS) (Bolt 2002; World Bank 2006, 2011a).

Currently, a possible negative relationship between the RC and GS is discussed in multidisciplinary publications considering either development in resource-abundant countries (such as AUTY 2001 or HEAL 2007) or sustainability (HAMILTON and ATKINSON 2006 or AUTY 2007). Additionally, the survey on the hypotheses and evidence behind the RC by VAN DER PLOEG (2011: 396-397) includes a section on the "alarming picture [that most] [c]ountries with a large percentage of mineral and energy rents of GNI typically have lower genuine saving rates". However, none of these publications analyzes the relationship between the RC and GS in a structured and detailed manner including all involved determinants and transmission channels.

To my knowledge only three papers deal directly with the connection between the RC and GS: ATKINSON and HAMILTON (2003) use cross-country regressions to provide evidence that especially the dependence on resource exports is one of the main reasons for unsustainable development and negative GS rates. DE SOYSA and NEUMAYER (2005) show that economic openness and political stability are strong transition channels through which resource abundance influences GS rates. And DIETZ ET AL. (2007) emphasize the systematic coherence between the abundance of natural resources and negative GS rates. They identify the quality of institutions (especially corruption) as the main determinant that influences GS in resource-dependent countries. However, all three papers analyze single aspects of the relationship between the RC and GS.

Additionally, HESS (2010) analyzes GS determinants in developing countries and shows a significant influence of the share of fuels, ores, and metals in merchandise exports. A study by NEUMAYER (2004) reproduces the original RC study by SACHS and WARNER (1995/1997) using the growth rate of his so-called genuine income and shows the same negative effect as on GDP per capita growth.

Based on these earlier publications and results the dissertation at hand approaches this aspect by providing a detailed investigation of the relationship between the RC and GS, both theoretically and empirically, in four logically successive parts, which are all peer-reviewed and published papers:

1. BOOS, A. (2015): Genuine Savings as an Indicator for "Weak" Sustainability: Critical Survey and Possible Ways forward in Practical Measuring. In: *Sustainability*, 7 (4), pp. 4146-4182.
2. BOOS, A. and HOLM-MÜLLER, K. (2012): A theoretical overview of the relationship between the resource curse and genuine savings as an indicator for "weak"

sustainability. In: *Natural Resources Forum – A United Nations Sustainable Development Journal*, 36 (3), pp. 145-159.

3. BOOS, A. and HOLM-MÜLLER, K. (2013): The Relationship Between the Resource Curse and Genuine Savings: Empirical Evidence. In: *Journal of Sustainable Development*, 6 (6), pp. 59-72.
4. BOOS, A. and HOLM-MÜLLER, K. (2015): The Zambian Resource Curse and its influence on Genuine Savings as an indicator for "weak" sustainable development. In: *Environment, Development and Sustainability*, 17 (3), Online first on 16 May 2015, pp. 1-39.

The following gives a short summary of these four papers and therefore the theoretical and empirical framework behind the considerations of the dissertation as a whole. This introductory chapter serves to explain the theoretical relationships behind the analyses (and the case study) and the content of the four parts, with each successive part building on the previous.

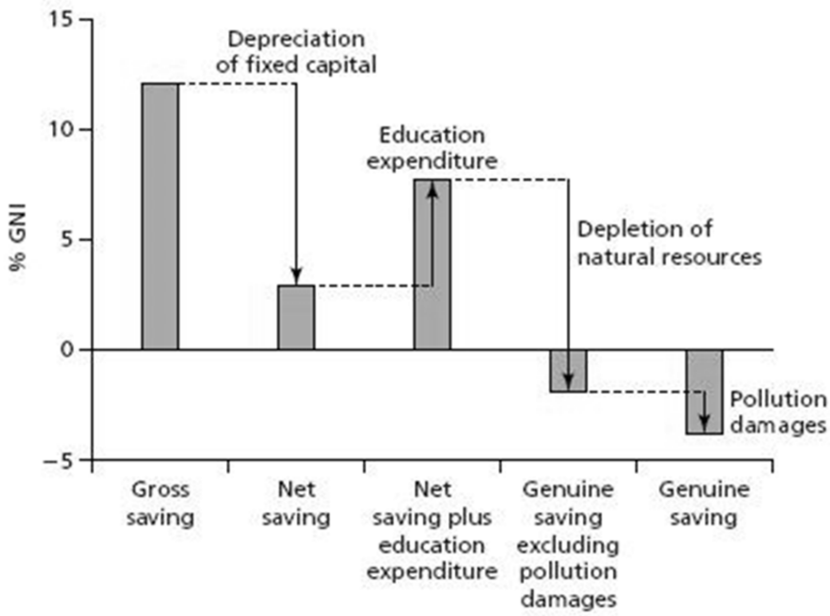
1.2. Part 1: Genuine Savings as an indicator for "weak" sustainability: Critical survey and possible ways forward in practical measuring

The theory of "weak" sustainability requires that the sum of changes in all forms of capital, thus depletion, depreciation and investment, is above zero, which constitutes a generalization of the so-called "Hartwick-rule" (NEUMAYER 2010). Therefore, PEARCE and ATKINSON (1993) begin their "intuitive rule for determining whether a country is on or off a sustainable development path" with the neoclassical assumption of possible substitution between natural and man-made capital and the resulting rule that savings have to be more "than the combined depreciation on the two forms of capital" (PEARCE and ATKINSON 1993).

HAMILTON (1994) and HAMILTON ET AL. (1997) expand the model by PEARCE and ATKINSON (1993) with investments in human capital as well as CO_2 emission damages as part of the depreciation of natural capital. HAMILTON (1994) also introduces the term "genuine" "to distinguish genuine savings, which refers to all utility-relevant stocks of capital including natural capital, human capital as well as (in principle at least) social capital, from traditional net savings, which refers only to man-made or produced capital" (NEUMAYER 2010). HAMILTON ET AL. (1997), HAMILTON and CLEMENS (1999) and NEUMAYER (2010) develop formal models for GS in closed and open economies.

From these, the WORLD BANK (2006, 2008, 2011a) builds a practical calculation method for GS. It uses the traditional measure of precaution for a country's next generation, the Gross National Savings (GNS) which is GNI plus net current transfers minus public and private consumption and therefore constitutes only savings or, at least theoretically, investment in physical capital. However, physical capital is depreciating over time. Therefore, the World Bank subtracts this depreciation of physical (fixed) capital and achieves Net National Savings (NNS), which is closer to a measure of "weak" sustainability than GNS. In using the aforementioned model by HAMILTON and CLEMENS (1999), the World Bank adjusts NNS for other forms of capital than the mere produced capital. For the investment in human capital, current education expenditures are added and, for the consumption of natural capital, the depletion of different natural resources and the damages from air pollution are subtracted (WORLD BANK 2006, 2011a).

Figure 1: Informal Calculation of Genuine Savings by the World Bank.



Source: WORLD BANK (2006).

The conventional way to denote GS is in % of GNI to have comparability even between countries with highly diverging GNI. Theoretically a GS of exactly zero implies an equal substitution of natural capital through other forms of capital and therefore a necessary but not sufficient condition for sustainable development or compliance with the "Hartwick-rule".

Permanently negative GS rates imply an unsustainable development path and, due to the reason that some assets are still not included in the calculation of GS, even positive ones only point in the direction of "weak" sustainability (HAMILTON 2006). "[G]lobal GS has been consistently positive, [but] over the whole […] period [since 1970] GS rates have been alarmingly low and consistently negative in certain countries […]. Significantly, these countries are also often resource-rich" (DIETZ ET AL. 2007). ATKINSON and HAMILTON (2003) verify an average GS of -2.6% for "resource-rich" countries in contrast to 9.2% in "resource-poor" countries.

Clearly the use of GS as an indicator of real world sustainability has several shortcomings, the theoretical foundations of which will be discussed at length in this first part and briefly in the case study on Zambia in part four. According to the WORLD BANK (2006) itself, there are natural resources that are omitted due to empirical and methodological reasons. These include fisheries, soil erosion, biodiversity, and water quality among others.[2] The paper especially highlights the case of Botswana, which would see its GS rate drop by more than 20% if the rents from diamond depletion were subtracted (BANK OF BOTSWANA 2014). Additionally, damages from pollution only contain carbon dioxide and particulate emissions, which minimizes the significance of this measure.

Further fundamental problems are the unrealistic assumption of constant population and the valuation of human capital (HAMILTON 2006). GS measures changes in total wealth but not per capita wealth, which implies that even positive GS rates could be unsustainable if they are lower than population growth. Additionally, the investment of one US$ as a current expenditure on education is, due to the quality of teaching staff, educational material and various other factors, not exactly equivalent to one US$ in additional human capital and differs widely between countries (BOLT 2002).

Therefore, the paper that makes up the first part discusses possible extensions not yet discussed or underrepresented in current research. It is thought as an introduction to the theoretical and methodical background of the GS calculation and a consideration for the potential development of this indicator in the future. In this part, I mainly suggest a discussion of additional items that could be included in GS and show that both the global average and individual country levels of GS would change immensely by including these recommendations.

[2] To give an example, while fish stocks are important for the wealth of some countries, their value changes over time and is difficult to measure due to mobility and undefined international property rights (WORLD BANK 2006).

1.3. Part 2: A theoretical overview of the relationship between the Resource Curse and Genuine Savings as an indicator for "weak" sustainability

In their analyses of the macroeconomic policies of different oil-exporting countries, GELB ET AL. (1988) and AUTY (1990) show two fundamental problems: the political difficulties for governments in saving (and not spending) oil rents and the lack of capacity and resources to use this income for the diversification of their industry. AUTY (1993) analyses six ore-exporting countries which all failed in their efforts to use their resource abundance efficiently, amongst them the case study from part four of this dissertation, Zambia, as an example for the mismanagement of rich copper reserves (AUTY 1993).

SACHS and WARNER (1995/1997) show in their cross-country analysis that the average ratio of primary exports to GNI of countries is 13% and through the increase of one unit (13%), the growth rate of GDP per capita declines by almost 1%. Since this publication, countless studies and authors have contributed to the study of this relationship and generated hype surrounding the RC and its determinants, which are separated in exogenous and endogenous variables.

Exogenous explanations lie, for example, within the short- and medium-term volatility of international commodity markets (NURSKE 1958) and the long-run terms-of-trade (ToT) effects, the so-called Prebisch-Singer thesis (PREBISCH 1950; SINGER 1950). VAN DER PLOEG and POELHEKKE (2009) demonstrate a significant negative relationship between the volatility of international resource markets and the economic growth of resource-dependent countries. The more a country is resource dependent, the more it becomes vulnerable to economic shocks (ROSS 2003), while its resource rents in GS (which are calculated through world market prices) are rather erratic and vary significantly.

Another exogenous explanation is the so-called Dutch disease, which is by far the most discussed topic in all RC literature. It originates from a 1977 edition of "The Economist" concerning the decline of the Dutch manufacturing sector after the discovery of natural gas sources in the North Sea in 1959. The theory behind the classic economic model by CORDEN and NEARY (1982) assumes that a boom in the resource sector – induced by the discovery of new reserves or an increase in world market prices – results in higher export revenues and increasing demand from other sectors. While this additional demand can be met by imports as long as it is manufactured, physical and human capital move from this sector into the resource and service sector, which causes direct and indirect deindustrialization (BARBIER 2007).

The education expenditures used to present human capital in the GS calculation are highly influenced by this migration because in the majority of cases the resource sector requires more unskilled employees than in other sectors. Though the Dutch disease is one of the most important factors of the RC thesis it is also clear that an export boom of natural resources can have positive effects if the adaptation process is slow enough and the revenues are used in a sustainable manner (SACHS and WARNER 1999), as described in the original GS model by HAMILTON and CLEMENS (1999).

SACHS and WARNER (1995/1997) already use trade openness as a proxy for state intervention and the rule of law to represent the quality of institutions. These examples of endogenous explanations developed in a multitude of econometric studies by authors such as ROBINSON ET AL. (2006) or MEHLUM ET AL. (2006). They demonstrate that resource abundance affects institutions negatively and that the RC is more likely in countries with weak institutions.

For example, the level of corruption – mostly divided in two different models, rent-seeking and patronage – is one of the most important endogenous determinants in resource abundant countries. Rent-seeking behavior encourages private agents to compete for resource rents instead of using these resources for the development of the country (KOLSTAD and SOREIDE 2009). And patronage reflects the easy access of political leaders or others who control the resources to use the country's wealth to maintain the status quo and retain their power or possessions (HUMPHREYS ET AL. 2007). In general, rents from resource depletion are consumed and not invested as the GS model would anticipate. Corruption therefore reduces not only GS in principal as DIETZ ET AL. (2007) show, it also reduces the productivity of investment (ROSS 2003).

The second part (and paper) shows the strong relationship between the factors that lead to the RC and factors that lead to a decline of GS. It discusses whether the RC hampers possibilities for resource-abundant countries to obtain sufficiently high rates of GS, and finds many reasons why resource-dependent countries have problems achieving positive GS rates. Both areas of research are surveyed, emphasizing the influence of the exogenous and endogenous determinants of economic growth, which are typically used to theoretically and empirically explain the RC relating to the three different forms of capital considered by GS. This second theoretical part specifies why most countries suffering from the RC have negative GS rates and explain in detail where the linkages are. The third part (and paper) uses this theoretical framework for an empirical analysis of the relationship between the RC and GS.

1.4. Part 3: The relationship between the Resource Curse and Genuine Savings: Empirical evidence

NEUMAYER (2003) states that “[t]he main message from the [World] Bank’s GS computations is [...] that many developing countries that are dependent on resource exploitation are weakly unsustainable”. As shown before, this is also the conclusion of the two empirical analyses by ATKINSON and HAMILTON (2003) and DIETZ ET AL. (2007). Part (and paper) three of this dissertation uses the theoretical overview of the relationship between the RC explanations and the model and measurement of GS from part two to show the empirical relationships in cross-country regressions using such earlier analyses as lead to adequate explanatory variables. Part three shows interestingly that, despite more control variables, the share of resource exports in GNI influences GS more negatively and significantly than GDP in the above cited analysis by SACHS and WARNER (1995/1997).

Especially the long-term ToT decline explained in part two affects the calculation of GS on multiple levels and contradicts the original GS-model, which assumes that resource rents grow constantly at the rate of interest. Import-based consumption and investment either decline quantitatively or remain constant while the monetary terms, which are used in the measurement of GNS, increase. Export-based income declines or remains constant in monetary terms while the extracted quantities increase to achieve the same rents, which factors into the measurement of the depletion of natural resources (VINCENT ET AL. 1997). Therefore, the regressions in part three show that ToT influence GS negatively – as the theory from part two would expect – due to the positive influence of prices on the changes in depletion of natural capital (δK_N): Higher resource prices result in increasing depletion, which decreases GS as soon as there is no sufficient reinvestment.

This is related to the effects of Dutch disease, which influence GS in various ways. A boom in the resource sector crowds out investment in other sectors and even in human capital. The boom results in higher rents from the depletion of natural capital (δK_N), which decreases GS rates. Through the so-called spending effect these additional revenues increase the demand from other sectors and thus change the relationship between consumption and investment in physical and human capital, resulting in an appreciation of the real exchange rate (AUTY 2007; FRANKEL 2010). Therefore, wages in the resource and service sectors rise and employees move from manufacturing to these two other sectors. This decreases investment in human capital due to more unskilled production processes in these two sectors and investment in physical capital due to more labour-intensive services (GYLFASON 2001a, 2001b; DIETZ ET AL. 2007).

The regressions in part three find a highly significant negative influence of resource exports on NNS and therefore on investments in physical capital. The average growth rate of the official exchange rate also negatively influences investment in K_P and total GS. The migration of workers from the manufacturing into the resource and service sectors is proxied by the share of employment in the service sector and shows the expected negative influence on K_P.

As described above, endogenous factors from the political economy are difficult to define selectively, whereby their relationship to GS is much more difficult to describe than it is for exogenous determinants. For example, the trade regime plays an important role in the following case study (in part four) because Zambia depends on imports and trade taxes and has had many different trade regimes and degrees of protectionism, which according to SACHS and WARNER (1997) cut “Africa off from the growth dynamism of world markets”.

Furthermore, the level of corruption and other indicators for the quality of institutions affect GS in many ways, as DIETZ ET AL. (2007) demonstrate. The regressions in part three use the same indices for corruption, the rule of law and bureaucratic quality used by DIETZ ET AL. (2007) and show, as expected, that higher institutional quality is linked to less depletion of natural capital (δK_N) and higher investment in human capital (δK_H). Additionally, this part shows that in total the democratic status of a country positively influences its GS rate.

The objective of part three is therefore to contribute to research on the determinants of GS by investigating its relationship to the RC. Not only could the recommendations from part one be supported by structured research on the determinants which influence the different capital forms in the calculation of GS, but cross-sectional analyses as in part three and especially case studies as in part four could also benefit from a clearer understanding of the influences GS rates are exposed to.

The cross-country analysis therefore examines the influence of determinants and transmission channels identified to cause the RC on GS and its components. Results show that factors leading to the RC are also useful explanatory variables for GS. The analysis estimates a decrease ranging between 1.4% and 3.5% in the average GS rate for a 10% increase in the average share of primary exports in GNI between 1970 and 2008. Hence, part three of this dissertation shows that the theoretical framework from part two holds true in comprehensive cross-country regressions with a variety of dependent and independent variables: Two empirical frameworks and twelve different models show exactly the theories from part two.

SACHS and WARNER (1997) refine their analysis (SACHS and WARNER 1995/1997) by only using Sub-Saharan Africa as their research subject in the investigation of the RC and show that endogenous policies especially cause the slow growth of this region. To complete the analysis in this dissertation, part (and paper) four examines Zambia as a case study of a RC-affected country from this region to accompany the theoretical and empirical analyses.

1.5. Part 4: The Zambian Resource Curse and its influence on Genuine Savings as an indicator for "weak" sustainable development

The RC is in many ways confirmed by the case of Zambia. HABER and MENALDO (2011) even identify Zambia's dependence on copper exports, amounting to an average 33% of its GNI between 1964 and 2012 in the face of declining real per capita income in the same period, as one of the world's most striking examples of a country suffering from the RC. Part (and paper) four adds to the theoretical and empirical analysis of the relationship between the RC and GS from parts two and three with a case study of Zambia.

To my knowledge, this is the first case study investigating the development of determinants causing the RC and the relationship to the GS rate of a resource-dependent country. Contrary to cross sectional studies, a detailed discussion within a case study provides additional opportunities to examine this relationship qualitatively without being constrained by the structures and assumptions of econometric models. Nevertheless, one could argue that the cross-country analysis in part three already identifies relationships between the RC and GS and therefore a case study of only one country could not add valuable insights.

However, cross-country studies only examine the research question from a broader angle using averages across the analyzed data set. And while the global average of positive GS rates lies within an acceptable area, namely 9% of GNI for the period from 1964 to 2012, Zambia, an extremely copper dependent country, featured a GS rate of -3%. With this GS rate, Zambia ranks among the bottom twenty countries over this period, but is by far the one with the most available data in this timeframe for an analysis on the relationship between the RC and GS.

Since the first extensive analysis on the RC (AUTY 1993), Zambia has been a frequent case study for mineral-dependent countries, but none of these examines the relationship to GS. The case study at hand provides the possibility to discuss the theories and empirical results from parts two and three following the practical example of the Zambian economic history from independence in 1964 to the most recent data in 2012. Therefore, on the one hand part four contributes to the case study research on the Zambian RC and on the other hand provides a case study on the determinants of a country's GS rate. For the purpose of this dissertation it especially provides a qualitatively conducted discussion on the relationship between the RC and GS.

The study shows that most of the theories relating the RC to GS apply to the Zambian situation. Zambian GS developed with high volatility and completely in line with world copper prices and to a lesser but not negligible extent with political developments. Zambia's copper exports and thus depletion values evolved in line with these copper prices. The depletion rents reflecting this development resulted in volatile GS rates with the highest fluctuations between the years 1999 and 2012. In this period Zambia rapidly increased its income from copper. This additional income increased the demand for goods and services from other sectors and resulted in a shift of investment and employment from the manufacturing into the resource and service sectors. Besides slow democratic development, corruption is still a major problem that featured in the entire analyzed period and this is deeply related to the quality of Zambia's judiciary and bureaucracy. On the whole, Zambia's GS rate is influenced by the dependence on copper through multiple transmission channels.

While the research on the RC and GS did not require any further proof for the negative relationship of resource dependency and GS rates, at least not following parts (and papers) two and three, part four goes further through the research design of a case study. Typical case studies on the RC have used similar theories and hypotheses to explain the RC, but have also used typical indicators such as GDP to analyze their influence on a country's development. This case study is the first detailed analysis of the relationship between the RC and GS in a resource-dependent country. However, in line with its two predecessors this case study illustrates a theoretical and empirical framework for further research on this special relationship.

1.6. Overview of research design

NEUMAYER (2003) and DIETZ and NEUMAYER (2004, 2006) were they first to criticize the theory and formal model behind the GS calculation in detail. However, all critical reviews and advancements such as from BOLT ET AL. (2002), PEZZEY (2004), the WORLD BANK (2006) or ATKINSON and HAMILTON (2007) add different formal and practical points, which **part (and paper) one** consolidates and expands by extensive discussions and new approaches. In cases such as the individual denotation of pollution damages or the revaluation of human capital these are completely new suggestions to enhance GS as an indicator for "weak" sustainability.

As part one concludes that research on the determinants of GS is needed to advance the development of its calculation and theoretical foundation, **part (and paper) two** uses the intuitive relationship of GS to resource dependency for a structured analysis of its determinants. The relationship between theories and hypotheses behind the RC and the individual calculation components of GS are theoretically investigated in detail. This has not yet been done and findings such as the logical negative influence of a country's ToT on GS are presented for the first time in topical literature. Especially the drafting of a complete theoretical framework of the relationship between the RC and GS for a structured analysis is an extension of the existing research literature.

Part (and paper) three utilizes the framework of the relationship between the RC explanations and the model and measurement of GS to show in cross-country regressions their empirical relationship. The methodology in this part builds on the studies by SACHS and WARNER (1995/1997) and NEUMAYER (2004), using similar but extended models. These extended models use GS and its individual calculation parts – the different forms of capital – as dependent variables and build their explanatory variables on the theoretical framework from part two. This part shows clearly and for the first time in literature that GS is more closely related to the different determinants of the RC than the typically used dependent variable GDP. Despite using more control variables, the share of resource exports in GNI influences GS more negatively and significantly than GDP per capita growth in the analysis by SACHS and WARNER (1995/1997).

The findings from parts two and three merge into the case study of Zambia in **part (and paper) four**. Zambia is a highly RC affected country with a dependence on copper exports of a yearly average 33% of its GNI between 1964 and 2012, while its real per capita income decreased in this period. To my knowledge, this is the first case study investigating the development of determinants causing the RC and its relationship to the GS rate and the design of a case study provides the possibility to discuss these qualitative links in detail. Part four shows extensively that the theories relating the RC to GS from part two and the empirical relationships from part three completely apply to Zambia.

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2. Genuine Savings as an indicator for "weak" sustainability: Critical survey and possible ways forward in practical measuring

Abstract Published by the World Bank (as "Adjusted Net Savings") for around 160 countries, Genuine Savings (GS) presents the most respected but also the most debated indicator for "weak" sustainability. It originates from the so-called "Hartwick rule" for the re-investment of rents from the depletion of natural in reproducible forms of capital. Coming from the theoretical reasoning behind GS, this paper discusses possible extensions either not yet discussed or underrepresented in current research. Mainly, I suggest a discussion of additional items that could be included in GS and show that both the global average and individual country levels of GS would change immensely by including these recommendations.

2.1. Introduction

This paper has two goals: first to provide an overview of the growing literature on Genuine Savings (GS) and its development, as it is the most important indicator for "weak" sustainability; second to critically discuss this indicator and suggest possible modifications. Typical critical reviews of GS, such as by DIETZ and NEUMAYER (2004, 2006), discuss unrealistic assumptions or exogenous shocks to the GS model, as well as the problems in measuring the depreciation of natural capital. I discuss this, but concentrate on further problems in the actual calculation of GS, suggesting possible extensions thus far not discussed in GS literature.

Dividing GS into its individual calculation components, I discuss different ideas and examples for the potential modification of the indicator, in order to contribute to the stagnating discussion on GS calculation with real world data. In contrast with earlier publications, I do not concentrate primarily on natural capital, as this is discussed comprehensively in literature, rather I also discuss the two other forms of capital. I suggest that the discussion on GS should step back and determine not only what parts of natural capital depletion should be substituted and how to calculate this, but also which contents of physical and human capital could additionally be included.

Thoughts on sustainable development (SD) emerged centuries ago and found their first clear expression in Carlowitz's "Sylvicultura Oeconomica" from 1713 (CARLOWITZ 2009) and Malthus' essay on exponential population growth from 1798 (MALTHUS 1798) (for historical overviews see, for example, RAO (2000), ELLIOTT (2006) or ROGERS ET AL. (2008)). The Malthusian vision on "Limits to Growth" (MEADOWS 1972) resulted in a substantial scientific, especially economic, discussion on intergenerational equity in the 1970s (see DASGUPTA and HEAL (1974), SOLOW (1974a; 1974b) and STIGLITZ (1974), and for a review PEZZEY (1992)). From this, HARTWICK (1977) formulated a rule-of-thumb for a fair intergenerational handling of exhaustible resources: Keep the total capital stock of a country at least constant over time by "invest(ing) all profits or rents from exhaustible resources in reproducible capital such as machines". This is rooted in the idea that—population given—it is the sum of total capital, and not its single components, that is most decisive for production capacities and thus the basis for future development (for overviews of all of these topics see HARRIS (2001) and the "Handbook of Sustainable Development" by ATKINSON ET AL. (2008)). GS combines the net investment in physical and human capital with the depletion of natural capital to provide an indicator for this so-called "Hartwick rule" as a paradigm for "weak" sustainability.

The World Bank ("Adjusted Net Savings" in World Bank terms to distinguish between the GS model and the actual calculation) subtracts consumption and the depreciation of physical capital from Gross National Income (GNI) to illustrate the net investment in physical capital. Besides the usual critique on the depreciation method, I discuss possible extensions, such as durable consumption goods, which could be considered sustainable investments. After reducing GNI by consumption and depreciation, the World Bank adds current education expenditures to indicate investment in human capital. I argue that human capital is also depreciating through death and, as a consequence, health expenditures that increase life expectancy could also be seen as increasing human capital.

After adjusting for education expenditures, the World Bank subtracts the rents of natural resources and damages by air pollution as depletion of natural capital. Natural resources are divided into the categories of energy, mineral and forest depletion, and are calculated by the ratio of the present value of rents to the exhaustion time of the resource. I discuss which natural resources should be included and show their influence on the GS of individual countries. The inclusion of air pollution is surveyed and discussed from the viewpoint of a whole line of literature that considers a broader base of pollution damages, as well as the critique that GS should not include pollution but concentrate on pure natural resource depletion.

2.2. Weak Sustainability

The most commonly cited definition of sustainable development (SD) (for a review of journal articles about sustainability see PEZZEY and TOMAN (2002a)) is found in the Brundtland Report of the United Nations WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT (1987), which states that "(s)ustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (for an overview of the manifold definitions and approaches, see for example RAO (2000), BAKER (2006) or BELL and MORSE (2008)). Built upon this foundation and its advancement as a development path with non-declining welfare, one of the most plausible definitions by NEUMAYER (2010) states that SD is development that "does not decrease the capacity to provide non-declining per capita utility for infinity".

The two opposing paradigms of "weak" and "strong" SD discuss what this capacity should exhibit (for the distinction between weak and strong sustainability see the rather famous "Blueprint for a Green Economy" by PEARCE ET AL. (1989) and the comprehensive discussion by NEUMAYER (2010)): the concept of "strong" SD as coined by DALY (1992) in 1977 in his "Steady-state economics", assumes substitution between non-renewable and renewable resources within the framework of natural capital when possible, but states that SD cannot be achieved by re-investing income from the depletion of natural resources into other forms of capital (AYRES 2007).

Conversely, the theory of "weak" sustainability (WS) assumes that different forms of capital are in principle substitutable and only the maintenance of the total capital stock is important to provide future utility. The so-called "Hartwick rule" (HARTWICK 1977, 1978, 1990, 1993, 1995) or "Solow-Hartwick rule" (Solow 1974a, 1974b, 1986, 1991, 1993) provides a general rule for WS (for a short overview of the development of this rule by Robert Solow and John Hartwick, see HARTWICK (2009) and the "Introduction" by HARTWICK (2010) in the "Handbook of Environmental Accounting"): Keep a country's total capital stock at least constant by investing in all forms of capital at the same level of all forms of capital consumption to allow for sustained consumption over time (NEUMAYER 2010); this creates a "rule of thumb" for the absolute minimum condition to ensure a fair chance of guaranteeing future sustainability (COSTANZA and DALY 1992).

Besides natural capital providing us with resources as input for production processes and services such as air cleaning, there are man-made or produced forms of capital, namely physical capital such as machines, roads or buildings and human capital such as skills and knowledge that allow for increased productivity of labor. Substitutability between different forms of capital is one of the major unresolved discussions in sustainability literature: To what extent is the loss of natural capital substitutable by the production of man-made capital?

The basic assumption behind the paradigm of "weak" sustainability is that the social welfare of a society depends on its total wealth–determined in capital values–and adjustments to this wealth change the path of SD. Therefore, the present value of future utility, which should determine the value of capital, is at least theoretically equal to social welfare. Therefore, if net investment in all existing forms of a country's capital stock (physical, human and natural) is positive, the capacity to provide future utility is also positive. If this is accepted, the logical follow-up question addresses the means of measuring the capital stock of a country or changes in this stock beyond the traditional forms of capturing economic processes (ATKINSON and HAMILTON 2007; HAMILTON and CLEMENS 1999; PEARCE and ATKINSON 1993) (the WORLD BANK (2006, 2011a, 2011b) has its own program of Environmental Economics and Indicators, estimating (besides GS) the total wealth of countries, such as intangible institutional capital).

2.3. Genuine Savings (GS)

HAMILTON and CLEMENS (1999) develop a formal model for Genuine Savings (GS) by starting with the assumption of a simple closed economy, the resource input of which can be used for consumption or investment in produced, man-made capital (in principal this model is an extension of the model by HARTWICK (1990, 1993). For an extensive derivation of the dynamic optimization model for GS, see also NEUMAYER (2010)). Produced capital is divided into physical capital and human capital. The production of physical capital is afflicted with pollution:

$$F(K_P, K_H, \delta K_N) = C + \delta K_P + \delta K_H + PA \qquad (1)$$

The stock of the three forms of capital (physical (K_P), human (K_H) and natural (K_N)) depends on the one hand on the composition of C in terms the consumption of K_N and K_P, and on the other hand the investment in physical (δK_P) and human capital (δK_H) as well as pollution abatement costs (PA). Consumer utility is a function of consumption (C) and environmental services (B), U = U(C, B). A country's wealth depends on the maximization of this utility function with a constant rate of discount (NEUMAYER 2010), and is subject to investment in physical capital:

$$\delta K_P = F - C - PA - \delta K_H \qquad (2)$$

depletion or consumption of natural capital:

$$\delta K_N = resource\ growth - resource\ depletion \quad (3)$$

pollution emissions or their abatement expenditures, respectively:

$$PA = pollution\ emissions - natural\ dissipation \quad (4)$$

and investment in human capital measured by current operating education expenditures, which could also be seen as endogenous technological progress (HAMILTON and CLEMENS 1999):

$$\delta K_H = total\ education\ expenditures - investment\ in\ buildings\ and\ equipment \quad (5)$$

The model by HAMILTON and CLEMENS (1999) evolves from the original comparison of savings, which in a closed economy should equal investments, and the combined depreciation of physical and natural capital as evidence of "weak" sustainability in the definition by PEARCE and ATKINSON (1993). In their view, an economy is sustainable if the savings are higher than the combined depreciation of all different forms of capital. For this constraint, WSI as a "weak" sustainability index has to be positive:

$$WSI = \left(\frac{S}{Y}\right) - \left(\frac{\delta K_P}{Y}\right) - \left(\frac{\delta K_N}{Y}\right) \quad (6)$$

δK_P is depreciation of physical capital, and δKN the depletion of natural capital. HAMILTON (1996), PEARCE ET AL. (1996), ATKINSON ET AL. (1997), and, as shown, HAMILTON and CLEMENS (1999) expand on Equation (6) by adding investment in human capital (δK_H) as additional savings for the future and pollution emission damages as additional depletion of K_N. Since emissions not only negatively influence natural capital but also physical – for example through damages to the facades of buildings – and human capital – through adverse effects on health – the total capital stock of a country is influenced. I therefore denote this as N_K for negative capital, which influences all capital forms as social costs:

$$WSI = \left(\frac{S}{Y}\right) - \left(\frac{\delta K_P}{Y}\right) + \left(\frac{\delta K_H}{Y}\right) - \left(\frac{\delta K_N}{Y}\right) - \left(\frac{\delta N_K}{Y}\right) \quad (7)$$

In a nutshell, GS illustrates a mix of consumption and savings. Following ATKINSON ET AL. (1997) it can be considered "genuine" since it is "saving over and above the value of asset consumption" (ATKINSON 2000). These savings could theoretically be seen as re-investment of depleted natural capital (and social costs by environmental degradation) into other forms of capital, resulting in the net investment into a country's total capital stock (HARTWICK 2003; DIETZ ET AL. 2007).

HAMILTON ET AL. (1997) shows that negative GS at one "point in time means that future utility must be less than current utility over some period on the optimal path", or in other words, negative GS presents a clear sign of non-sustainability (HAMILTON and CLEMENS 1999). Contrary to their first approaches, authors such as HAMILTON and ATKINSON (1999), ATKINSON (2000), HARTWICK (2003) or HARTWICK ET AL. (2003) point out that GS is a one-sided indicator, showing "unsustainability, not sustainability" (PEZZEY 2004) since negative GS rates demonstrate an unsustainable re-investment of natural capital into other forms of capital.

To translate this into calculations with real data, HAMILTON and ATKINSON (1996a, 1996b), HAMILTON (2000) and a number of official WB publications (WORLD BANK 2006, 2011a) select the traditional Gross National Income (GNI) as the starting point for the Genuine Savings (GS) calculation:

$$GNI = I_P + I_G + C_P + C_G + net\ exports + net\ income\ from\ abroad \qquad (8)$$

GNI comprises total investment in physical capital (differentiated into private (I_P) and public (governmental) investment (I_G)), private (C_P) and public consumption (C_G), net exports and foreign earnings. The assumption that this in principal shows the distribution between investment and consumption of a society serves as the foundation for the calculation of Gross National Savings (GNS) in Equation (9), which subtracts total consumption from GNI to achieve the remaining gross savings:

$$GNS = GNI - C_P - C_G + net\ current\ transfers \qquad (9)$$

The addition of net current transfers (NCT) includes all goods and services, income and both incoming and outgoing financial items without a quid pro quo. In total, GNS comprises all items increasing a country's savings beyond what is left from GNI once consumption has been subtracted.

The next step of the calculation subtracts the depreciation of physical capital (δK_P) – "the replacement value of capital used up in the process of production" (WORLD BANK 2011a) – from GNS to achieve the net investment in physical capital, Net National Savings (NNS):

$$NNS = GNS - depreciation\ of\ physical\ capital\ (\delta K_P) \qquad (10)$$

NNS shows whether new investment in physical capital is higher than the consumption of the existing capital stock. However, physical capital (K_P) is not the only capital upon which a country's wealth and development hinges. A population's knowledge and skills, its so-called human capital, is comprehensively addressed in theoretical discussions, though its measurement remains elusive. Therefore, in the calculation of GS, investment in human capital (δK_H) is proxied by current operating education expenditures (COEE), including wages and salaries and excluding capital investments in building and equipment, as this is already found in K_P (WORLD BANK 2011a, 2011b). Certain COEE components, such as the purchase of books or payment of teachers' salaries, are traditionally treated as consumption and therefore subtracted in C_G in Equation (9). For Education Adjusted National Savings (EANS) these components are reincluded:

$$EANS = NNS + COEE\ (\delta K_H) \qquad (11)$$

Building on theories of green national accounting, in the next step GS deducts the rents from the depletion of natural resources (R_N) calculated by multiplying the actual world market prices (P) minus region-specific average production costs (AC) to show the decrease of the natural capital stock:

$$R_N = ((P - AC) * production\ volume) \qquad (12)$$

Following official WB publications (WORLD BANK 2011a, 2012) this was adjusted in 2011 by setting the present value (PV) of R_N (discounted at 4%) in relation to the remaining resource stock:

$$\delta K_N = PV\ \frac{R_N}{exhaustion\ time\ of\ the\ resource\ stock\ (\min\left(25 years, \frac{reserves}{production}\right))} \qquad (13)$$

To date, this methodical extension has only been realized for the latest two "World Development Indicators" (WORLD BANK 2011b, 2012a), whereas previous editions since 1970 are only affected theoretically, while the data itself has not yet been adjusted.

According to the aforementioned "Hartwick rule" (HARTWICK 1977) these rents should be completely reinvested into the two other forms of capital. Essentially, net investment in K_P and K_H should be higher than δK_N. The "World Development Indicators" (WORLD BANK 2014a) divide depleted natural capital into energy (to date, this covers coal, crude oil, and natural gas), mineral (this covers bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver) and net forest depletion ("net forest depletion is calculated as the product of unit resource rents and the excess of roundwood harvest over natural growth" (WORLD BANK 2014a)), clearly omitting not only several forms of natural capital such as fish or soil stocks, but also individual resources such as diamonds (WORLD BANK 2006).

In my definition from Equation (7) – following argumentations by FANKHAUSER (1994a, 1994b) and the explanation in the calculation manual by BOLT ET AL. (2002) – air pollution damages are social costs negatively influencing all forms of capital (δN_K) (HAMILTON and CLEMENS 1999; WORLD BANK 2006, 2011a). The analysis of air pollution is difficult due to deficits in the data (see discussion in Section 4.6.4), therefore only the damages from carbon dioxide and particulate emissions are currently included. Marginal global CO_2 damage "is estimated to be \$20 per ton of carbon (the unit damage in 1995 U.S. dollars) times the number of tons of carbon emitted" (WORLD BANK 2014a) and particulate emission damage is estimated as the willingness to pay to avoid mortality attributable to PM_{10}.

Genuine Savings (GS) – Adjusted Net Savings in World Bank terms "measures the change in value of a specified set of assets, that is, the investment/disinvestment in different types of capital (produced, human, natural)" (WORLD BANK 2011a):

$$Genuine\ Savings\ (GS) = (GNI - C_P - C_G + NCT) - \delta K_P + \delta K_H - \delta K_N - \delta N_K \qquad (14)$$

In the following section, I discuss the critiques that emerge in relevant literature combined with my own arguments and examples for simple modifications. The literature mainly concentrates on the theoretical background and the well-known problem of population growth, with which I also start my discussion. One additional debate surrounding GS, addressed by most of the publications considered, is the calculation of rents from natural resource depletion. I raise this topic but concentrate on the inclusion of further natural resources and pollution damages. I show possible extensions to the individual calculation steps of GS and the resulting different capital forms.

2.4. Critique and Possible Extensions

2.4.1 Theoretical Background

HAMILTON and CLEMENS (1999) show in their formal model that the inclusion of net depletion of natural capital and the cost of atmospheric pollution as well as the accumulation of human capital puts GS in the position to equal changes in a country's social welfare (SOYSA ET AL.

2010). To accept this, one has to "adopt a neoclassical stance and assume the possibility of substitution between "natural" (K_N) and "man-made" (K_P) capital" (PEARCE and ATKINSON 1993), which could be discussed from the viewpoint of "strong" sustainability. However, for a look at the substitutability of different forms of capital I point to the discussion between "strong" and "weak" sustainability by NEUMAYER (1999a, 2003, 2010) or DIETZ and NEUMAYER (2004, 2006) as the most detailed critical reviews of GS, as well as my own overview in Section 2. These earlier analyses concentrate on assumption problems within the GS model and measurement problems in the actual GS calculation. I proceed in the same way, excluding the fundamental debate on substitutability.[3]

One of the harshest criticisms of GS stems from the fact that the indicator is theoretically built on a perfect competition model. Since it is clear that the assumptions of an inter-temporally efficient economy that develops along an optimal path in a perfectly competitive market do not hold in reality, GS as a measure for WS is to treat with caution. "Markets fail, especially inter-temporally, and natural assets exhibit public goods characteristics" (2004), wherefore resource prices can be substantially different from optimal ones. For the GS calculation, which uses world market prices in Equation (12), this means that GS rates could be positively influenced while resource depletion is unsustainable. Over-depletion of natural resources should decrease their prices below the optimal level (and quantities above this level), but with proper re-investment GS would still remain positive (NEUMAYER 2010). Or in more simple terms: If world market prices (P) are lower than the actual value of a resource (due to incorrect exceptions or excessive supply, for example), the depletion of this resource increases to achieve the same profit, while the rents (R_N) in Equations (12) and (13) remain constant. As follows, if investment in physical and human capital also remains constant, GS stays the same even while the consumption of natural resources rises.

HAMILTON and ATKINSON (1996), HAMILTON ET AL. (1997) or HAMILTON and HARTWICK (2005) state that GS at least indicates the right direction due to the argument that over-depleted states that move in the direction of optimization increase their GS. However, Neumayer (2010) argues that this holds true only in a partial equilibrium analysis and not in a general analysis that sustainability attempts to address. The same is true for externalities not incorporated in the model or other effects that shift quantities and prices away from the optimal level. Therefore, it is rather unclear how over or under-depletion influences GS, especially if positive and increasing GS could result from unsustainable resource use and environmental degradation

[3] This debate has already been carried out by others such as BECKERMAN (1994, 1995), JACOBS (1995), DALY (1995), NEUMAYER (2000) and SIMPSON ET AL. (2005).

(PEZZEY and TOMAN 2002a, 2002b; NEUMAYER 2010). Therefore, as pointed out by PEZZEY (2004), only negative GS can function as a one-sided unsustainability test while positive GS at one "point in time does not indicate that future utility is everywhere non-declining" (HAMILTON and BOLT 2008). Or simply, positive GS provides an encouraging sign, especially given that a goal of a country's policies can yield sustainability but not more.

2.4.2 Population Growth and GS per Capita

One of the major discussion topics in topical literature is the assumption of a constant population in the model and therefore in the calculation of the rate of change of a country's total wealth (DIETZ and NEUMAYER 2004, 2006). This change is divided into the three described capital forms, but only for whole countries and not per capita. This contradicts the argument that social welfare depends on per capita utility and not only on total values (NEUMAYER 2010). Not without reason, traditional welfare indicators such as GDP or GNI as the calculation base for GS are shown in per capita terms, while "genuine saving could be positive even though per capita wealth is declining" (HAMILTON 2003). DASGUPTA (2001) predicts constant population in the long run, but in the average of the last five decades (1960–2010) only the population growth of Bulgaria, Curacao, and Serbia was slighty negative, and only eighteen countries had average positive rates below 0.5%. Therefore, since most populations are not static, per capita welfare should be sustained and GS should measure real changes in assets per capita rather than total capital (ARROW ET AL. 2012). Negative GS are a clear sign of declining wealth, both in total and per capita terms (WORLD BANK 2006). However, if GS is positive there should be an easy and practical way to also calculate the per capita value.

While the first attempts to include population growth into the GS calculation by DASGUPTA (2001), DASGUPTA and MÄLER (2001) or HAMILTON (2002) were rudimentary, a whole line of research by the team surrounding ARROW ET AL. (2003, 2004, 2010, 2012) discusses the population of a country as an additional capital asset. Put simply, a rising population increases opportunities to build human capital and in the long run increase a country's workforce and therefore the amount of consumers. This could be seen as a capital form itself which I discuss again in Section 4.5.3 on human capital.

Authors such as HAMILTON (2003), HAMILTON and ATKINSON (2006) or the WORLD BANK (2006) later recommend dividing GS by total population, deducting a so-called Malthusian correction term multiplying wealth per capita by the population growth rate (DIETZ and NEUMAYER 2004) for per capita wealth changes:

$$\Delta\left(\frac{GS}{P}\right) = \frac{\delta GS}{P} - \left(\left(\frac{\delta P}{P}\right) * \left(\frac{W}{P}\right)\right) \qquad (15)$$

Intuitively, Equation (15) shows that GS per capita increases if the growth of GS is higher than that of population. The only comprehensive estimation of per capita GS by HAMILTON (2003) comes to the conclusion that most developing countries show declining per capita wealth, even if total GS rates are positive, since their population grows faster than their GS rates. However, although PEZZEY (2004), the WORLD BANK (2006, 2011a), HAMILTON (2005) and FERREIRA and VINCENT (2005) argue that sustainability has to be measured in per capita utility, to date the World Bank only publishes total GS rates. In traditional accounts GNI from Equation (8) is presented in per capita terms by dividing it by total population:

$$GNI\ per\ capita = \frac{total\ GNI}{midyear\ population} \qquad (16)$$

Hamilton (2002, 2003), who derives Equation (15) in his model uses a similar simplified formula to show changes in per capita wealth with real world data since comprehensive yearly values for a country's wealth are not yet available:

$$GS\ per\ capita = \frac{total\ GS}{total\ population} \qquad (17)$$

Concerning Equation (17) I argue that population growth is implicitly included in yearly changing population figures and by dividing total GS by the total population one achieves at least preliminary GS rates per capita until complete data for national wealth is available. While negative GS indicates unsustainability as shown in PEZZEY (2004), positive GS divided by the midyear population level at least shows whether the capital stock per capita is changing or not. Whether this is enough to hold utility constant is not addressed by Equation (17), but it at the very least indicates a trend and enables a comparison with other countries. The World Bank already has calculated comprehensive per capita wealth for the three years 1995, 2000 and 2005, and sees GS as the indicator which captures "the dynamic behavior that drives wealth changes from one point to the next" (WORLD BANK 2011a). In this definition, GS "measures the annual change in a country's national wealth" (WORLD BANK 2011a) and if the (positive) growth rate of this change is higher than population growth, wealth per capita is then increasing. Until wealth accounting is consistent worldwide and continuously possible, the

World Bank could provide a per capita "weak" sustainability index by juxtaposing these growth rates as indicated:

$$WSI = \frac{growth\ rate\ total\ GS}{growth\ rate\ total\ population} \qquad (18)$$

Since the World Bank also publishes the population growth rate (in %) for all countries for which it publishes GS rates (WORLD BANK 2012a), Equation (18) is a possible indicator to show the development of "weak" sustainability over time.

It is disputable which method is most sound, but overall it seems advisable to consider population size; discussing how exactly this should be done is an emerging research goal (DIETZ and NEUMAYER 2004, 2006). GS remains an incomplete and imperfect indicator, which additionally has to be extended by further parts of the three presented capital forms. Further limitations of the theoretical GS model are raised by the volatility of natural resource prices and therefore volatile terms of trade of resource exporters and importers.

2.4.3 Open Economies and Volatile Terms of Trade (ToT)

Exogenous shocks to the GS model, such as technological progress or unexpected resource discoveries, change the prices in open economies (DIETZ and NEUMAYER 2006; NEUMAYER 2010). Especially the effects of changing terms of trade (ToT) influence GS rates immensely; VINCENT ET AL. (1997) argue that investment rules for resource-trading countries have to be adjusted by the present-value of anticipated future ToT shifts. The unrealistic assumption of a closed economy in the original "Hartwick rule" is adjusted to open economies and changing prices for resource exports by ASHEIM (1986), HARTWICK (1995), SEFTON and WEALE (1996) and VINCENT ET AL. (1997). The GS model for open economies is derived in HAMILTON ET AL. (1997), HAMILTON and CLEMENS (1999) and NEUMAYER (2010).

Variable world market prices change ToT and thereby affect the sustainable level of re-investments: In the model, higher ToT serve to decrease the net saving corrections that resource exporters have to undertake, given that the physical amount of depleted resources results in higher additional income and therefore increases GNI and, besides higher consumption expenditures, also potentially the investment in physical capital (NEUMAYER 2010; HAMILTON ET AL. 1997). Several studies on economic growth in resource-abundant countries, such as SACHS and WARNER (1995/1997) or NEUMAYER (2004), also show that increasing ToT positively influence a country's income. The empirical study by BOOS and HOLM-MÜLLER

(2013), which includes ToT as an explanatory variable for GS and its components, comes to a contrary conclusion regarding the relationship between ToT and GS rates. Since δK_N in Equation (13) is built on rents from natural resource depletion, which rise with higher resource prices, changing ToT influence GS rates substantially and contrary to GNI.

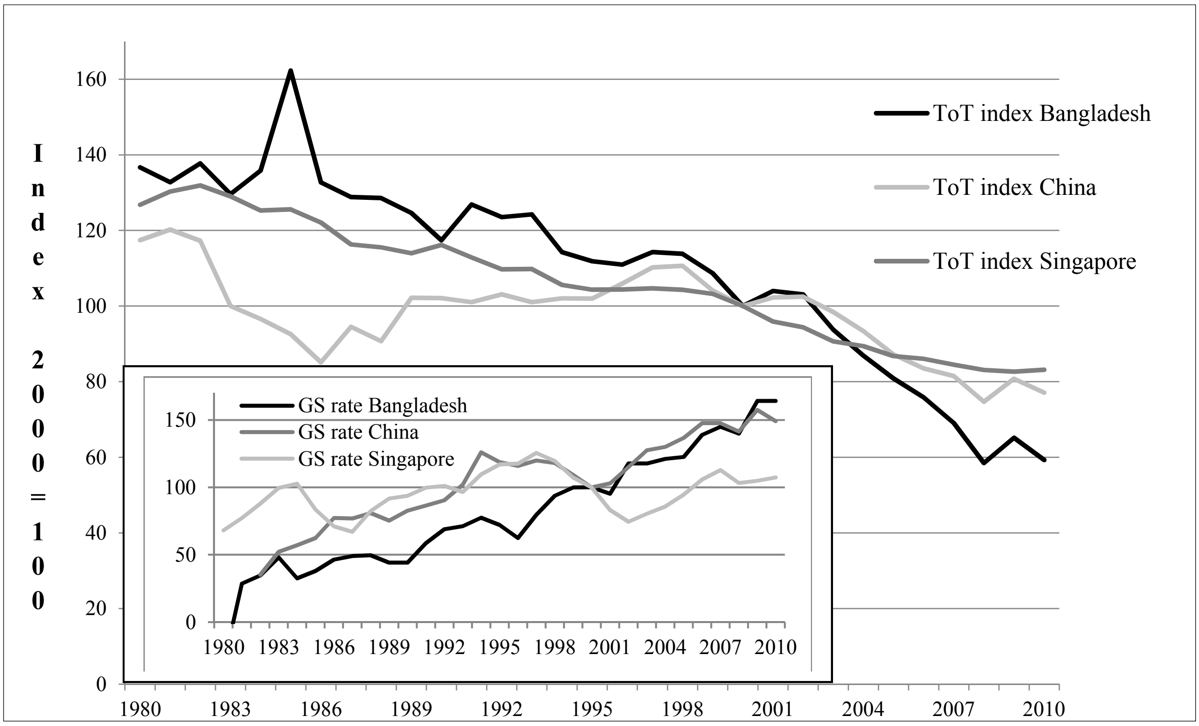
In countries that deplete natural capital, large amounts of income from δK_N are primarily obtained through exports, while parts of investment in K_P are determined by the demand for imported consumption and capital goods. Independently of whether the ToT of a country develop positively or negatively, they affect the ratio between the depletion of natural capital (δK_N) (through exports) and the change in physical capital (δK_P) (through the investment in imports). ToT are usually expressed as P_X/P_M, the price indices for exports and imports, and therefore $\delta K_N/\delta K_P$ change in the same direction as a country's ToT (BOOS and HOLM-MÜLLER 2012, 2013).

According to the calculation method in Equation (14), the depletion of natural capital (δK_N) is subtracted, with higher rents negatively influencing GS, while reinvestment in physical capital that is higher than its depreciation (δK_P) positively influences GS. In total, this means that increasing ToT should affect GS negatively, in contrast to the positive influence on GDP growth noted in SACHS and WARNER (1995/1997; BOOS and HOLM-MÜLLER 2012, 2013). This implies that shares of reinvestment that are higher than consumption in the usage of additional income from increasing prices for the same amount of natural resources could be too small to fulfil the "Hartwick rule". In summary, increasing resource prices should result in reinvestment at the same level, otherwise it will influence GS negatively (BOOS and HOLM-MÜLLER (2015) show in a case study on Zambia that in this specific example of a copper-dependent country, the increasing world market prices since the mid-2000s result not only in rapidly rising depletion of δK_N and therefore rising ToT, but also decreasing GS rates).

Since the ToT effects counterbalance each other on a global scale over a cross-section of countries, I cannot show world averages, but I illustrate, in Figures 2 and 3, the different effects of changing ToT on the GS rates of individual country samples. In Figure 2 I use Bangladesh, China and Singapore as country examples that are extremely dependent on natural resource imports. These countries show clear positive trends of decreasing ToT on GS. As a result, the decline of ToT, at least in these individual cases, is correlated with positive GS rates for resource importers.

Additionally, Figure 3 shows the negative influence of increasing ToT on the GS of Ghana, Guinea and South Africa, which depend on resource exports. In Figure 3 this relationship is not as clear as in Figure 2, but in all six countries the ToT and GS rates are negatively correlated, all with coefficients of more than 0.5, and in two cases surpassing 0.9. Naturally, none of these cases provides definitive proof of a common relationship in all countries over time. However, this seems to support the theoretical argumentation of BOOS and HOLM-MÜLLER (2012) that the ToT of a country have a significant negative influence on its GS rate. Authors such as VINCENT ET AL. (1997) or HAMILTON ET AL. (1998) recommend the inclusion of the present value of future ToT shifts, but without predictable long-term trends, for now this remains impossible.

Figure 2: GS and ToT in Bangladesh, China and Singapore.

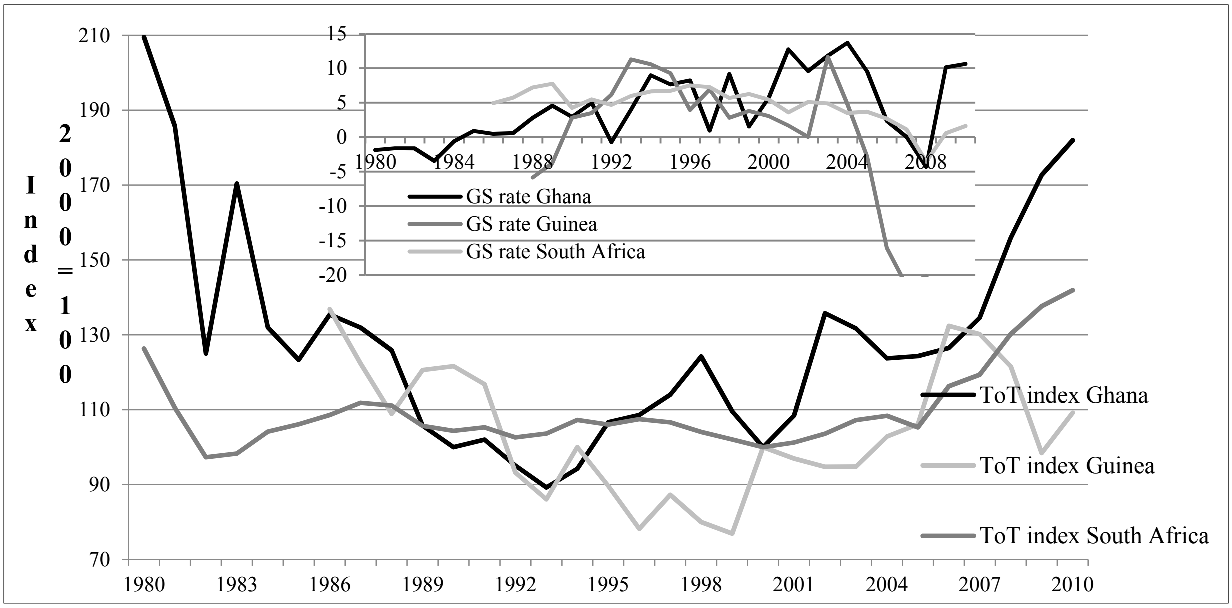


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

This shall only serve as an example for a discussion that should be addressed in further research. Especially for resource-dependent countries that export natural and import physical capital a discussion about the relation between these two is important for the calculation of GS. For example, a more detailed examination of the relationship between the determinants held responsible for the so-called Resource Curse and the GS rates of resource-dependent countries could support this discussion (see for example BOOS and HOLM-MÜLLER 2012, 2013, 2015).

However, the most important problem for these economies and especially their decision makers is the extreme volatility of world market prices of natural resources and the resulting uncertainties of future prices, and therefore the cost of resource imports and, especially, income from exports. According to NEUMAYER (2010) and BOOS and HOLM-MÜLLER (2012, 2013), problems typically arise if countries assume future rising prices and fail to anticipate or prepare for future unanticipated shocks and significant drops in international resource prices. Figure 4 shows with the example of Zambia, one of the world's last examples of a country suffering from the so-called Resource Curse according to HABER and MENALDO (2011), how the mineral depletion within δKN in Equation (14) develops almost parallel to world copper prices, Zambia's largest income source. Uncertainties that influence future investment planning are extremely high due to these volatile prices, which therefore result in similarly volatile GS rates that hinder a long-term consideration of "weak" sustainability.

Figure 3: GS and ToT in Ghana, Guinea and South Africa.

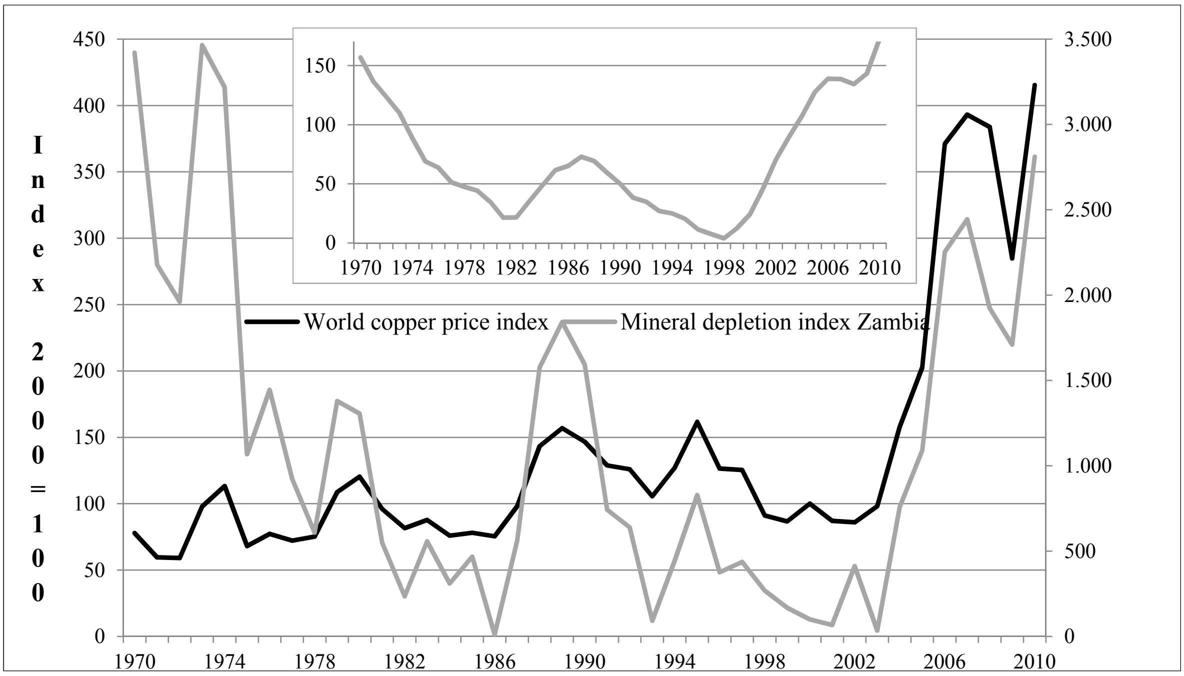


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

The World Bank could avoid these problematic effects in the calculation of GS at least partly by using average world market prices over more than one year, as shown for the Zambian example in the embedded chart in Figure 4. I use five-year averages and, as one can see, this preserves the long-term trends of Zambia's copper depletion but flattens δK_N within the GS calculation in Equation (14). The actual calculation of rents through world market prices in Equations (12) and (13) is theoretically a sound way to ascribe a value to depleted natural resources. In a situation such as that of Zambia or other examples such as Saudi Arabia, with dependency levels of more than 40% of their GNI from natural resource exports, such price volatilities also result in volatile δK_N and GS rates. Using averages could at least partially avoid this problematic and bring prices nearer to the real long-term value of depleted natural capital. Spikes or drops would change GS rates less rapidly and show a more realistic picture of the "weak" sustainability of re-investments.

Additionally, literature typically discusses whether it is fair to attribute the depreciation of natural resources completely to the resource exporters-which have mainly negative GS-without including an adjustment mechanism. PROOPS ET AL. (1999) show that GS rates change completely if resource exploitation was attributed to the countries that consume the natural resources and not to those that produce them. It is true that resource importers could therefore maintain a constant level of capital stock at the expense of resource exporters.

Figure 4: World copper prices and the mineral depletion of Zambia.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

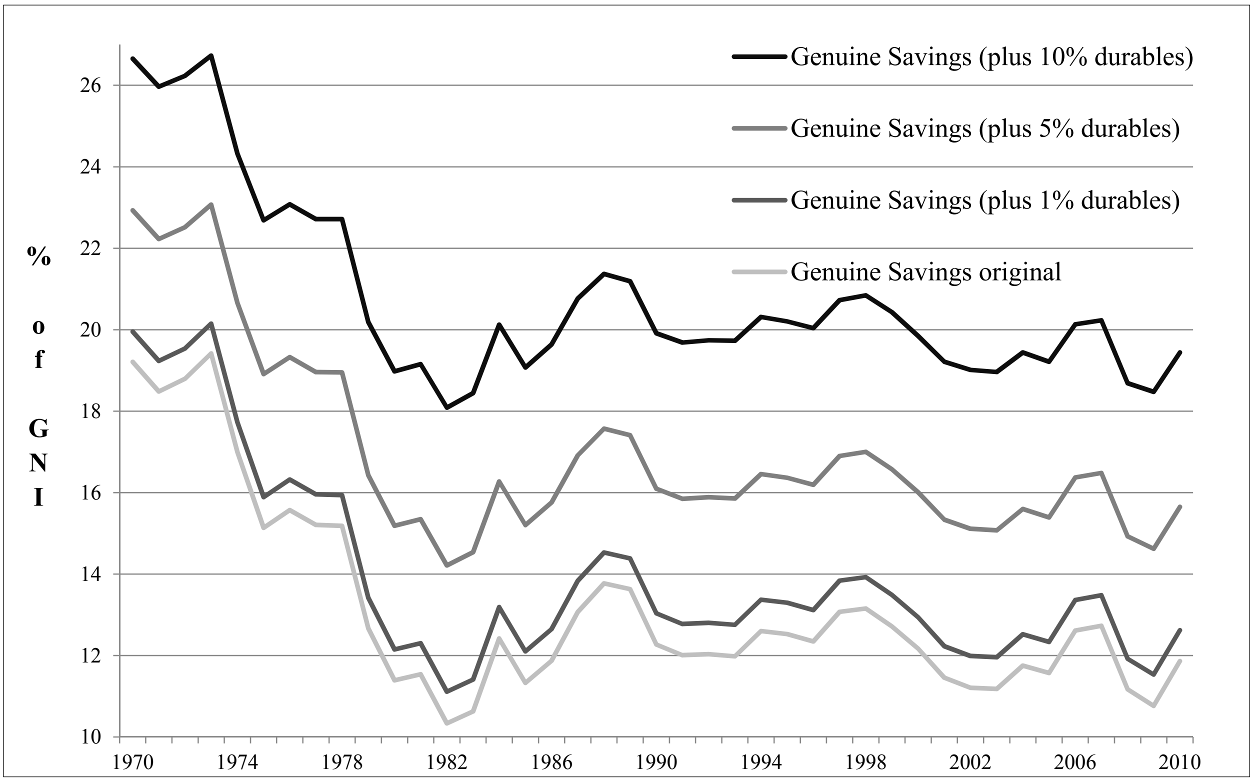
However, GS is not an indicator for the responsibility of natural capital depreciation but rather one which shows how the capital stock of a country is changing. In their own interest countries endowed with rich resource stocks should re-invest their rents sustainably to fulfil the "Hartwick rule" and maintain a constant capital stock by using income from responsible users (NEUMAYER 2010). Nonetheless, I discuss this topic in the section on damages from emissions, as there are different opinions on the inclusion of cross-border emissions as a negative contribution to the capital stock.

2.4.4 Gross National Savings (GNS)

2.4.4.1 Consumption versus Investment

As the first step of the GS calculation, GNS in Equation (9) subtracts total consumption from the capital stock of a country, leaving mainly investment in physical capital δK_P, as can be seen in Equations (7) and (8). However, as a point usually not discussed in GS literature, authors such as DALY and COBB (1994) or COBB and COBB (1994), STOCKHAMMER ET AL. (1997) or CASTANEDA (1999) argue in the discussion of the Index of Sustainable Economic Welfare (ISEW) that durable consumption goods such as cars or furniture also increase the physical capital stock (NEUMAYER 1999a, 1999b; LAWN 2003, 2006). Especially durable goods such as refrigerators in equatorial regions or buses in regions without public transportation function at least partly as investment in social welfare.

Figure 5: World GS rates including investment in durable goods.

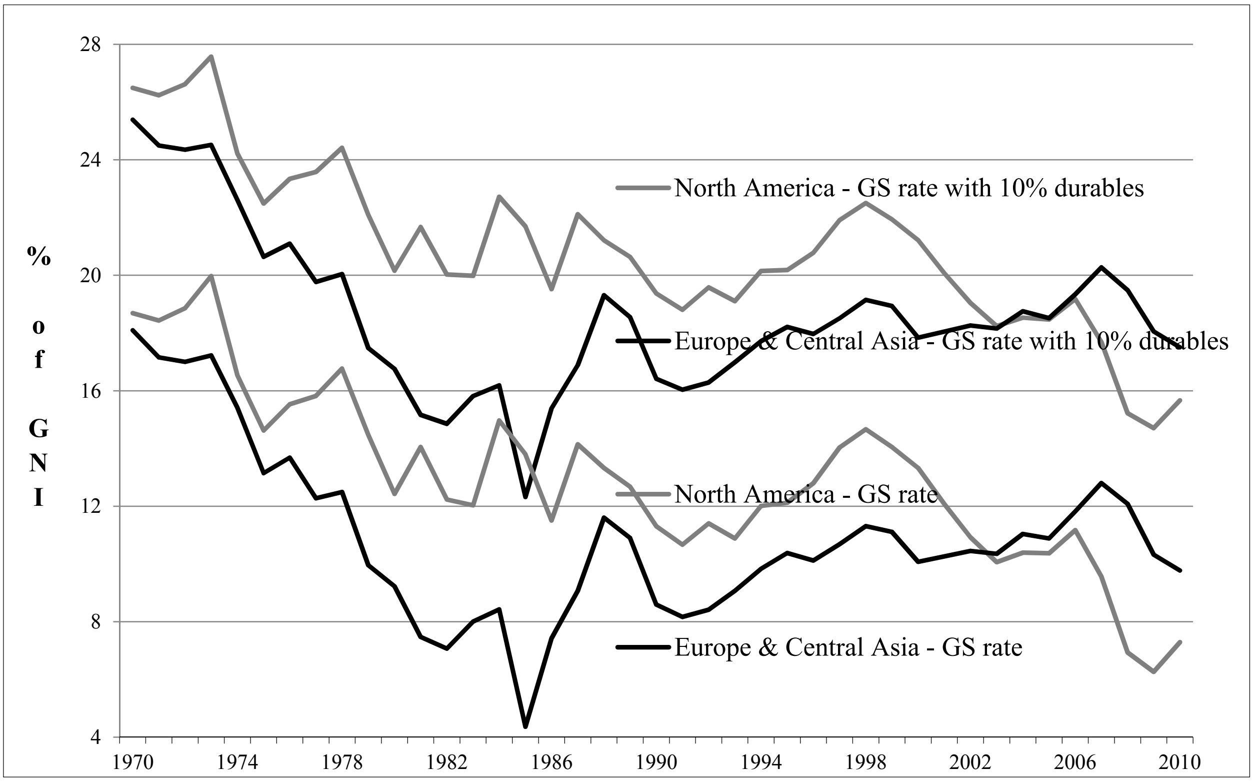


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Naturally, the discussion regarding which consumption expenses should be considered an investment is daunting, and a long-term theoretical discussion should be based on a systematic survey of durable consumption goods. Contrarily, there are also considerations as to whether similar amounts from the already included investments in K_P are so-called "white elephants", namely investment projects with negative social costs (ROBINSON 2005). Since this paper does not aim to discuss traditional national accounts or the definition of consumption itself, I recommend a discussion concerning the parts of consumption that could be considered investments that back sustainable development on the one hand, and those which could be seen as strictly detrimental on the other hand.

In Figure 5, I show that the considered fixed share of 10% from consumption for investment by DALY and COBB (1994) makes a considerable difference in total world aggregates; even a 5% portion of consumption expenditures allocated to investments shows an observable difference in the sum of world GS rates. A sensitivity analysis showed that these differences are not as large for individual countries, but the difference is especially immense for the developed and generally not resource exporting regions North America and Europe (as well as Central Asia). Figure 6 shows that the inclusion of 10% of consumption expenses in investment increases the total GS rates in both regions by more than 7%.

Figure 6: GS rates Europe and North America including investment in durable goods.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

2.4.4.2 Net Current Transfers (NCT)

Among other factors, net current transfers in Equation (9) include all forms of income exchange between countries without repayment, such as aid or remittances from migrants not only employed in another economy but also considered residents there. It is disputable whether the inclusion of aid or remittances into a county's capital stock can be seen as providing a contribution to its sustainable development. In principal, this increases the capital stock and could partly be seen as quid quo pro from net importers of natural resources. However, aid weakens macroeconomic and public expenditure policies through windfalls that are not tied to economic performance, while investments are often earmarked for projects and could therefore be invested in sectors that crowd out more important investments (PEARCE and ATKINSON 1993; ROBINSON and TORVIK 2005). However, the global average difference between GS with or without aid lies at only approximately 0.3% over the last three decades.

LÓPEZ-CÓRDOVA and OLMEDO (2006) provide a detailed overview of the developmental impacts of international migrant remittances that are proven to show a positive effect on private investments, especially in human capital (PEARCE ET AL. 1996). However, it is argued that remittances are produced by emigrants who remove human capital from their respective country's stock. These migrants use their human capital more gainfully, which results in private investments in either physical or human capital.

Therefore, it is difficult to distinguish between sustainable and unsustainable portions of remittances within the GS rates of a country. Nonetheless, remittances – 142 countries are net receivers – are an important source of foreign income. This seems especially dramatic in countries such as Jamaica (where remittances comprise more than 70% of the total value of GS rates between 1990 and 2009), Lebanon (65%), or Lesotho (more than 90%). Since remittances increase GS rates and could be used for investment, they influence "weak" SD either positively or negatively. However, BOOS and HOLM-MÜLLER (2013) show in a cross-country analysis a highly significant positive relationship between remittances and investment in physical capital, as well as the total GS rates of those countries. The example of remittances shows the need for more discussion on the contents of net current transfers (NCT). The contents of NCT should be examined in more detail, especially for most developing countries, to discuss whether these are individually contributing to "weak" sustainability or not.

2.4.5 Net National Savings

2.4.5.1 Depreciation of Physical Capital

The depreciation of physical capital or consumption of fixed capital (CFC), as defined in the "Handbook of National Accounting" (UNITED NATIONS 2003), is a normal cost of production, namely the decline in the stock of physical (fixed) capital (assets). Using a perpetual inventory method (PIM), CFC is calculated as "the difference between successive real market values of an asset over its lifetime" (OECD 2001). The PIM is recommended by the UN over the typical "depreciation used in business accounting in order to come closer to the actual cost of fixed capital used in production" (UNITED NATIONS 2000) by adjusting for inflation.

However, the PIM raises the same critique as business depreciation, since it assumes on the one hand constant depreciation rates and on the other that every investment is productive (HAMILTON ET AL. 1997; FERREIRA and VINCENT 2005). Both assumptions can be criticized since the consumption of physical capital in reality is not constant and not all capital goods are productive or even good for the physical capital stock. One example can be seen in so-called "white elephants", investment projects with negative social surplus but sinecures for certain interest groups (ROBINSON and TORVIK 2005). Improvements to both categories are difficult, especially the quantification of investment quality, but one way around this problem is at least to discuss the possible unsustainability of investments, such as in military infrastructure.

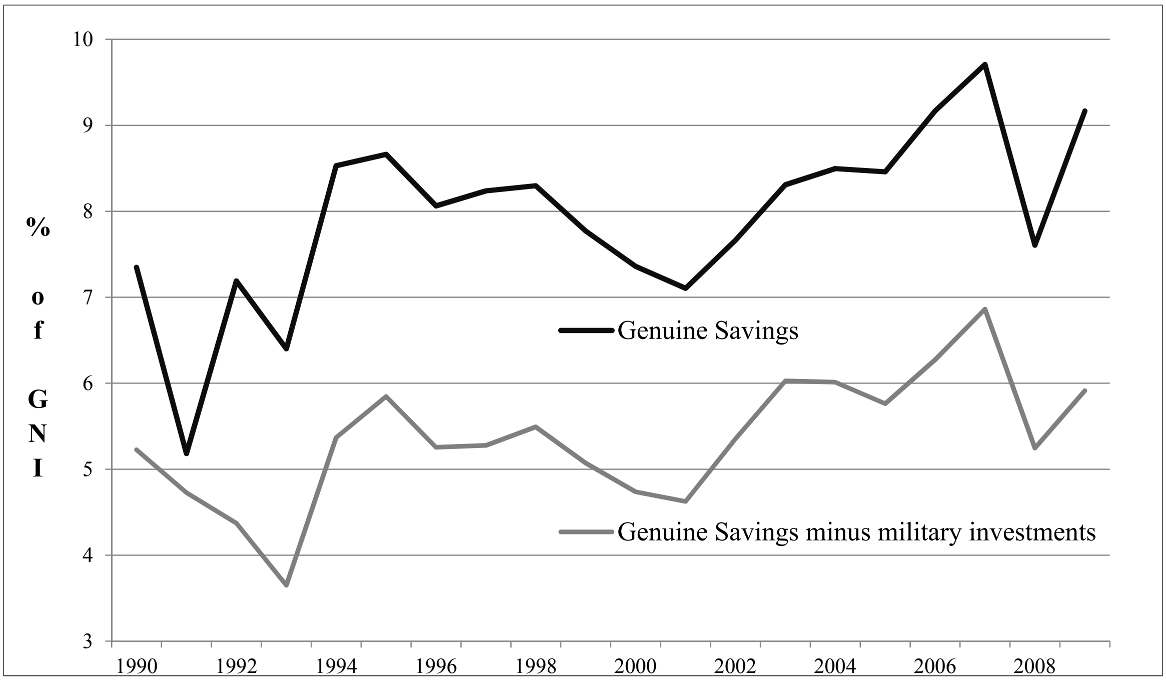
2.4.5.2 Defensive Investments

Other indices for sustainable development, such as the Index for Sustainable Economic Welfare (ISEW), exclude investments in physical capital that are used for defensive expenditures such as household pollution abatement costs, as well as the cost of car accidents, underemployment, or crime (LAWN 2003). A clear definition of defensive expenditures does not exist; early studies even exclude parts of education (JACOBS 1991) or health expenditures (COBB and COBB 1994) as defensive and not improving a country's welfare. A definition of defensive expenditures first published by DALY and COBB (1994) – expenditures that defend a population against externalities from production – does not exactly define what this means, therefore any consumption or capital good could be defensive (NEUMAYER 2010).

As a result, I do not follow this definition or the discussion in ISEW literature regarding which expenses should be deducted at what level (NEUMAYER 1999b). In a discussion of GS I have the advantage that consumption is already eliminated, leaving only defensive investments to consider. Investments such as those for combatting crime are still disputed and have to be clearly defined to determine the respective data from national accounts. Furthermore, depending on the region, investments in jails could be as important to sustainable development as other investments.

Figure 7 shows the change in global GS rates between 1990 and 2009 if investments in the development of military equipment, buildings and the like are deducted by allocating 10% of total military expenditures to investment, as is done in the GS calculation for education expenditures. It is rather interesting that GS decreases globally by 2.7% (of GNI) for this period if this 10% military investment is deducted. Conversely, this means that more than one third of NNS in Equation (10) – interpreted as investments in physical capital – in the global average GS from 1990 until 2009 was determined by military investments (average GS of 7.9% of GNI compared to military investment of 2.7%). However, the contribution of military investment to the SD of a country is a mere political or philosophical discussion. Its economic dimension requires further research together with other potential defensive investments, especially considering its significant contribution to the global average of GS.

Figure 7: GS excluding military investments between 1990 and 2009 (world average).



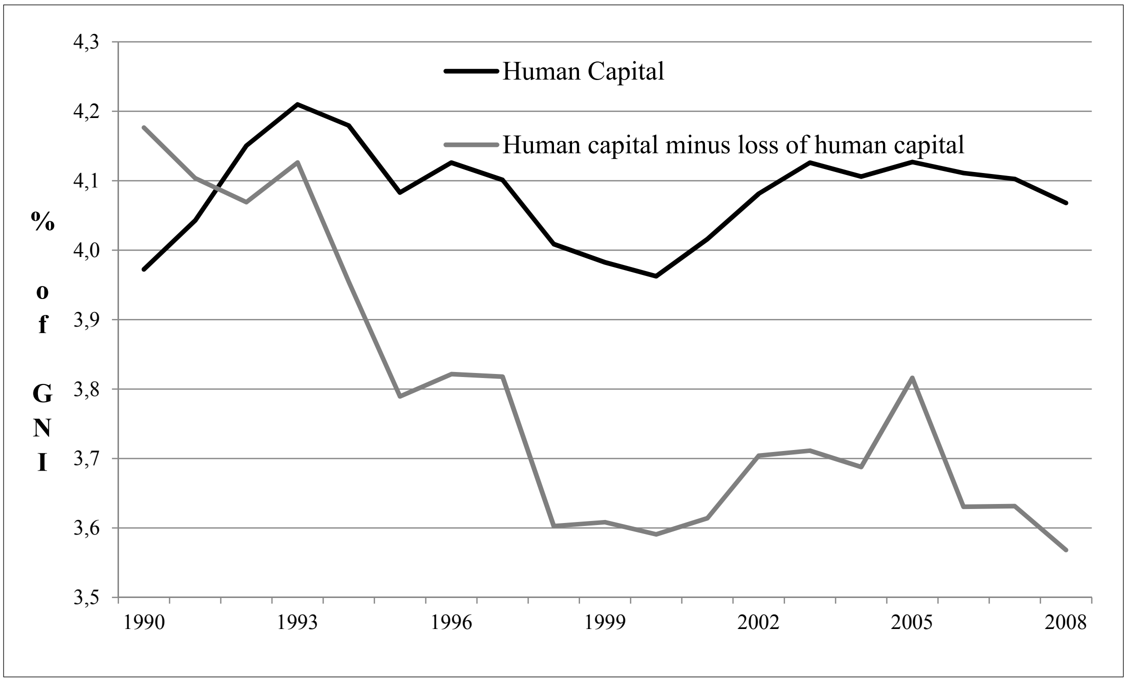
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

2.4.5.3 Human Capital

Human capital is defined as the total stock of competences and knowledge of all individuals within a country's population gained through education, training and experience used for daily economic life (O'SULLIVAN and SHEFFRIN 2007). The usual expression of human capital, first defined by Mincer (1974), is a log-linear relationship between earnings and years of schooling to show that higher human capital results in higher income (WORLD BANK 2011a). Investment into this capital stock is realized, for example, by teachers' salaries, expenditures for libraries or enrollment fees (MANKIW 2008). Therefore, HAMILTON and CLEMENS (1999) utilize a country's current education expenditures as an indicator for investment in human capital.

DASGUPTA (2001) criticizes this approach as an overestimation, since human capital also depreciates when educated employees leave the workforce or "die and take their human capital with them" (DASGUPTA 2001). However, NEUMAYER (2010) argues that education expenditures still undervalue real investment in human capital since other expenditures that build human capital are not quantifiable. DASGUPTA (2001) even discusses examples such as the effect of parents' time and effort with children or personal investments in strategic positions within social networks that increase one's value for employers.

Figure 8: Human capital minus loss between 1990 and 2008 (world average).



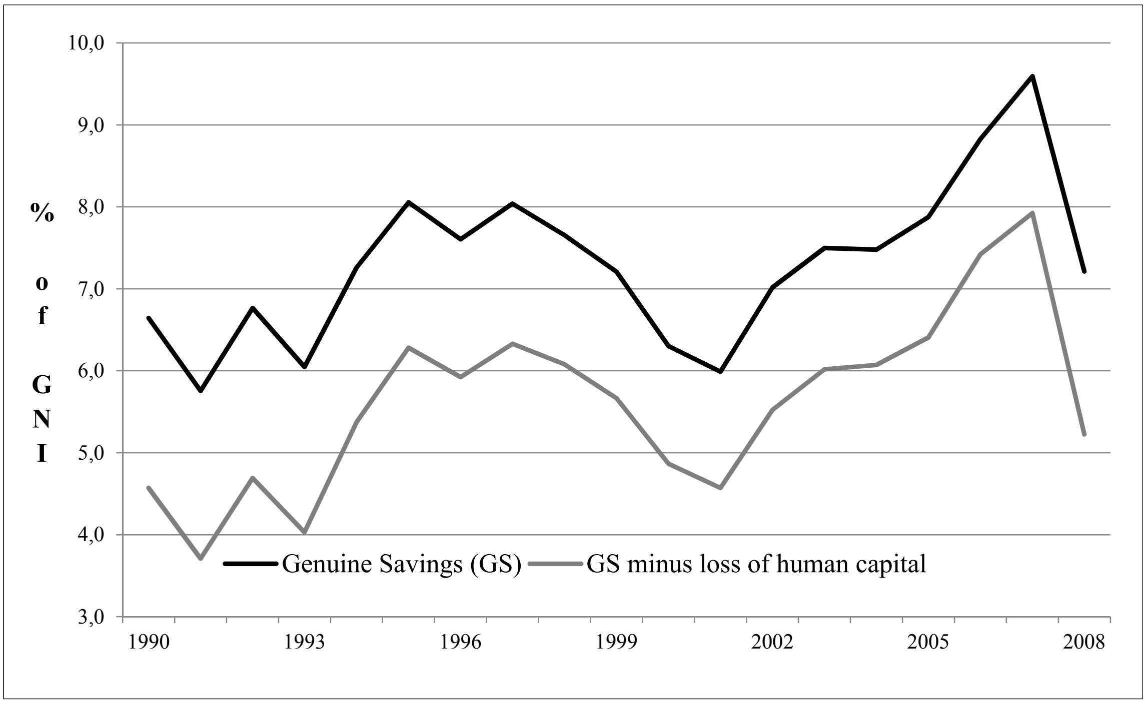
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

In general, I follow the argument that current education expenditures underestimate the real investment in or growth rate of human capital. However I also show two short examples demonstrating how GS could be influenced by including depreciation of human capital. One could argue that the extreme differences in life expectancies between countries are important when considering the return on investment in human capital (HARTWICK 1977; WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT 1987; WORLD BANK 2011a). Especially life expectancies that fall below the "normal" retirement age of 65 defined by Convention No. 102

of the INTERNATIONAL LABOR ORGANIZATION (2008) decrease the contribution of education expenditures on economic activity.

Figure 8 shows average global decreases in human capital and Figure 9 shows the total GS rate after subtracting the fraction of education expenditures that is not used for an entire working life. Since the age of a working life is defined from 15 to 65 I deduct 2.5% from current education expenditures for every year a country's life expectancy at birth is below 65 years. On average over the last two decades, 66 countries out of the 205 available in the "World Development Indicators" exhibit life expectancies under this age. Clearly the difference for the world average is immense if I use this simple extension to assign education expenditures to the average working years the population of a country is able to fulfil.

Figure 9: GS and the loss of human capital between 1990 and 2008 (world average).

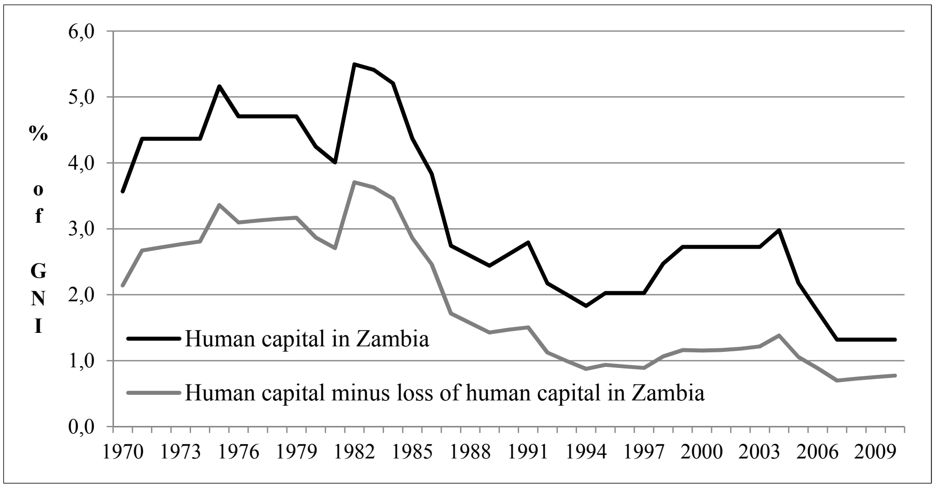


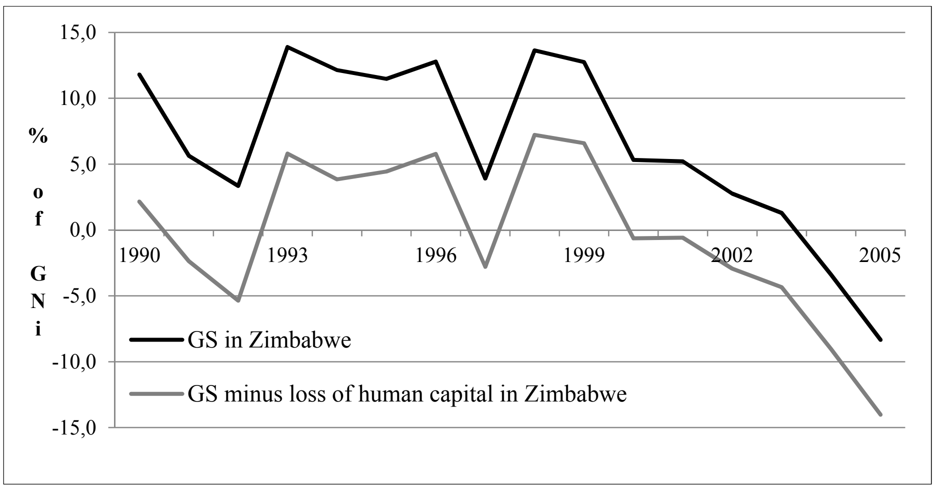
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

In Figure 10, I again use examples from Southern Africa, namely Zambia and Zimbabwe, in which the life expectancies fall below the international retirement age of 65. The example of Zimbabwe, with an average life expectancy of 49 years in the period from 1990 to 2005, shows a significant difference of more than 6% of GNI when measuring GS with and without the inclusion of life expectancies.

Therefore, different life expectancies clearly can have an effect on the human capital of a country. I argue along with ARROW ET AL. (2012) that life expectancies and quality of health are related and thereby health expenditures could also be seen as investment in human capital. In Figure 11, I show data for the five-year period from 2003 to 2007 to illustrate how health expenditures change GS. As in the case of education expenditures, I subtract 10% of health expenditures for investments in hospitals and other facilities already included in NNS and show that adding health expenditures increases world average GS values between 1% and 5%, depending on the inclusion of the loss of human capital. Such large increases appear slightly high for the additional incorporation of only a part of one capital form, but ARROW ET AL. (2012) even demonstrate in their five cases that the inclusion of health capital is more than twice as large as all other forms of capital combined. A capital form resulting in such a difference and so far underrepresented in the scientific discussion lends itself to future discussion on the calculation of GS.

Figure 10: Human capital minus loss between 1970 and 2010 in Zambia and between 1990 and 2005 in Zimbabwe.

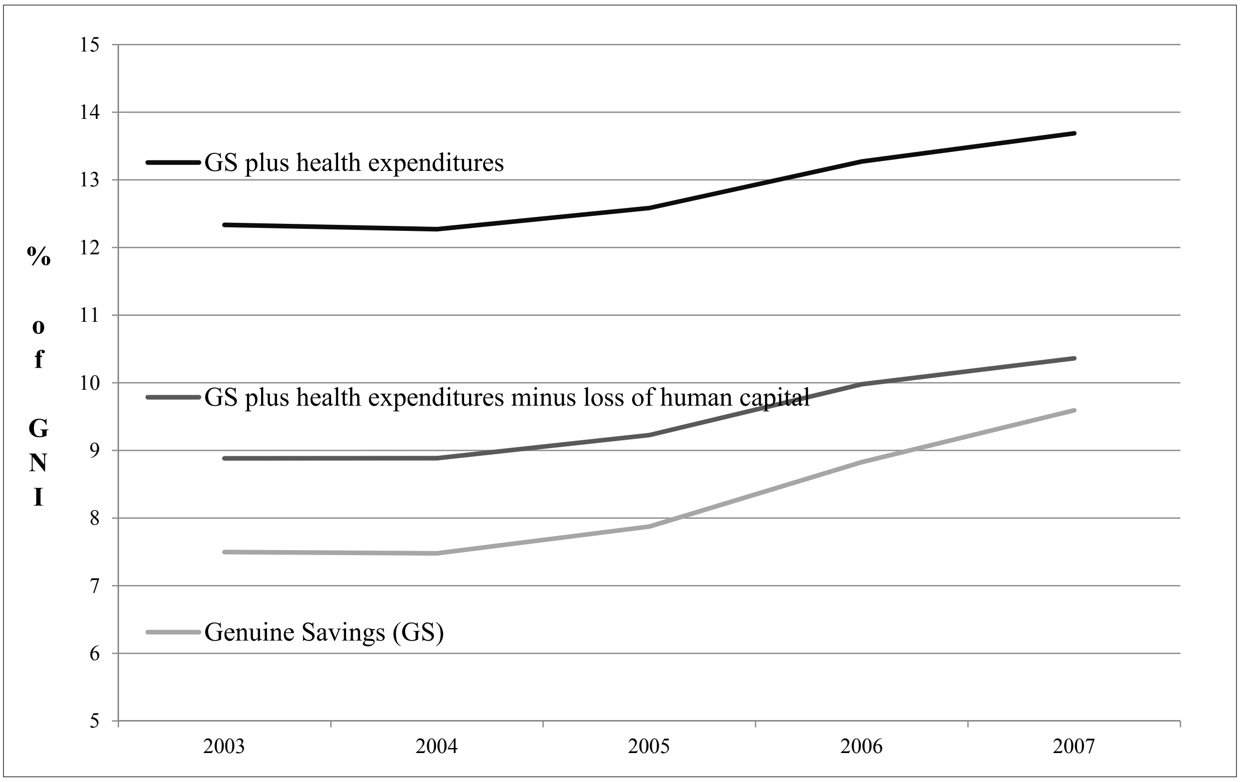




Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

The quality of education and health systems differs greatly. Thus, one dollar spent on education or health cannot be considered one dollar of additional human capital, as the returns are different from country to country. According to the WORLD BANK (2006, 2011a), social returns on education expenditures are almost two-thirds higher in developing countries compared to the industrialized world. The WORLD BANK (2006, 2011a) therefore suggests extending the proxy for human capital by other measures such as average years of education, but acknowledges the overall usefulness of the rate of returns on education. This paper shall only present critiques and possible extensions, as a fundamental discussion on all research topics behind the different calculation parts of GS would go beyond the scope of this work. In line with ARROW ET AL. (2012), I also argue that "the analysis of health capital is an innovation that will require much further study to understand".

Figure 11: GS plus health expenditures between 2003 and 2007.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

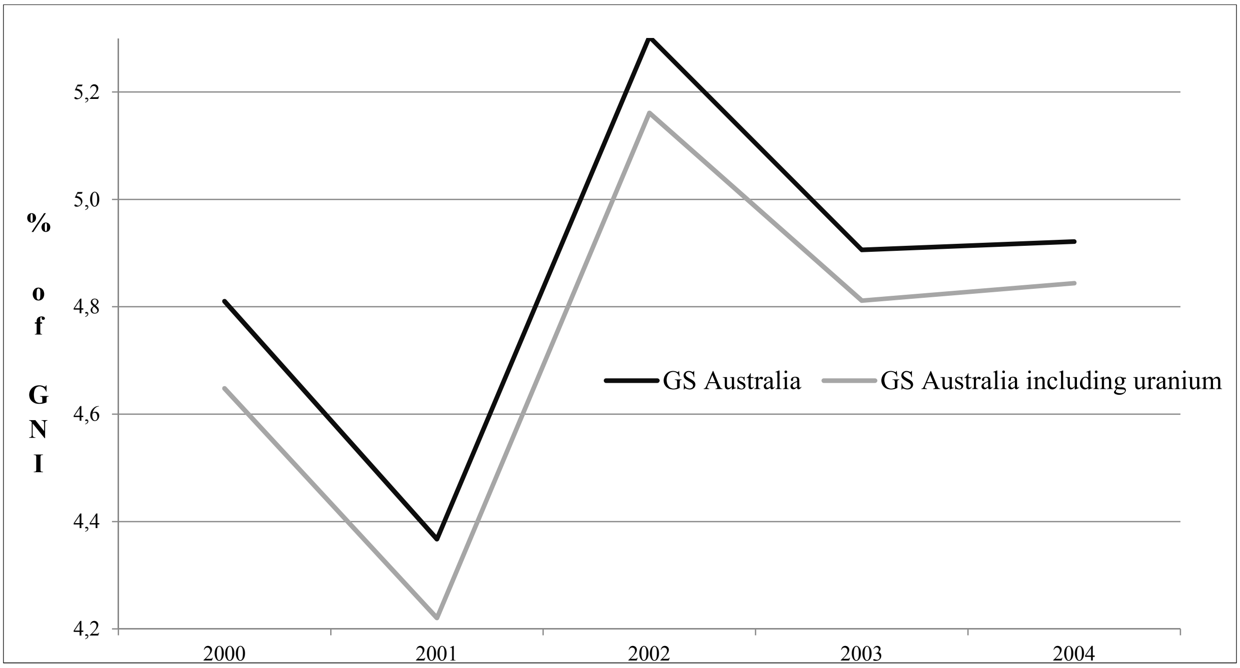
In the next section on natural capital, I deliberately abstain from a detailed discussion of the calculation method, instead choosing to show interesting examples of omitted resources that could be included.

2.4.6 Natural Capital

2.4.6.1 Energy Depletion

Rents from energy depletion include crude oil, natural gas, and hard as well as lignite coal, calculated as shown in Equation (12), where P is the international market price. However, other energy sources such as peat or uranium as input for nuclear power plants are absent from the calculation. The United Nations Statistics Division (UNSD) Industrial Commodity Statistics Database publishes production values only in metric tons, while world market prices and average production costs are difficult to obtain. Therefore, these energy resources and others for which no data is available are omitted by the WORLD BANK (2006, 2011a).

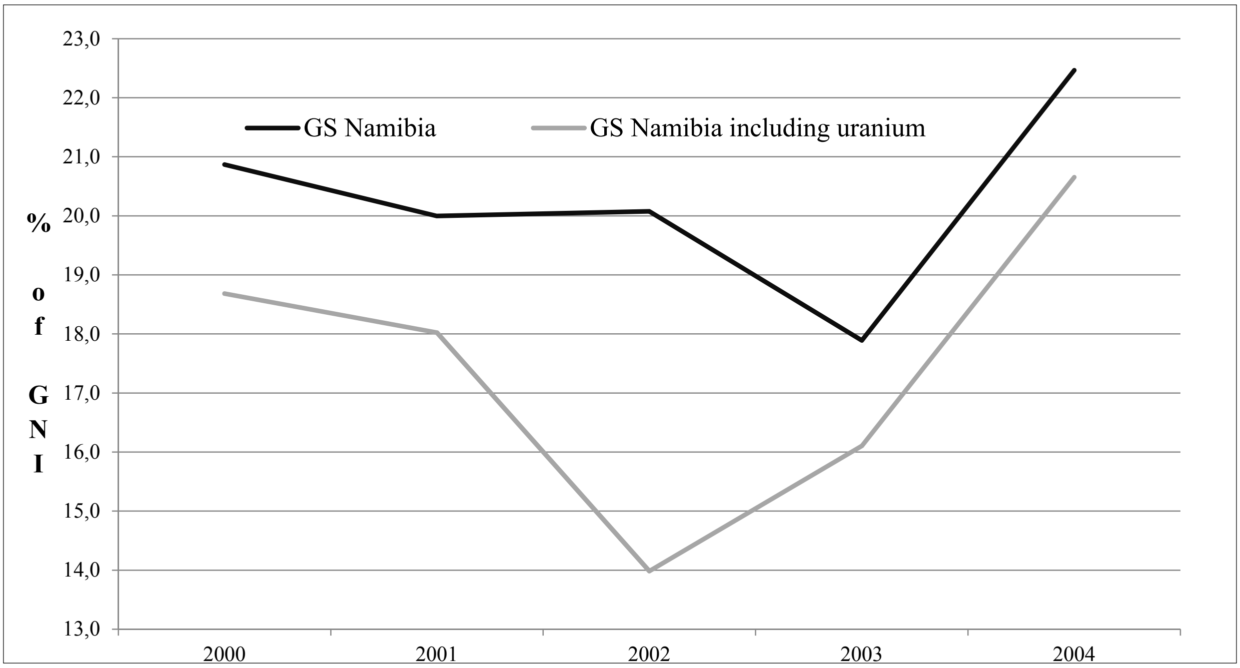
Figure 12: GS of Australia including uranium between 2000 and 2004.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

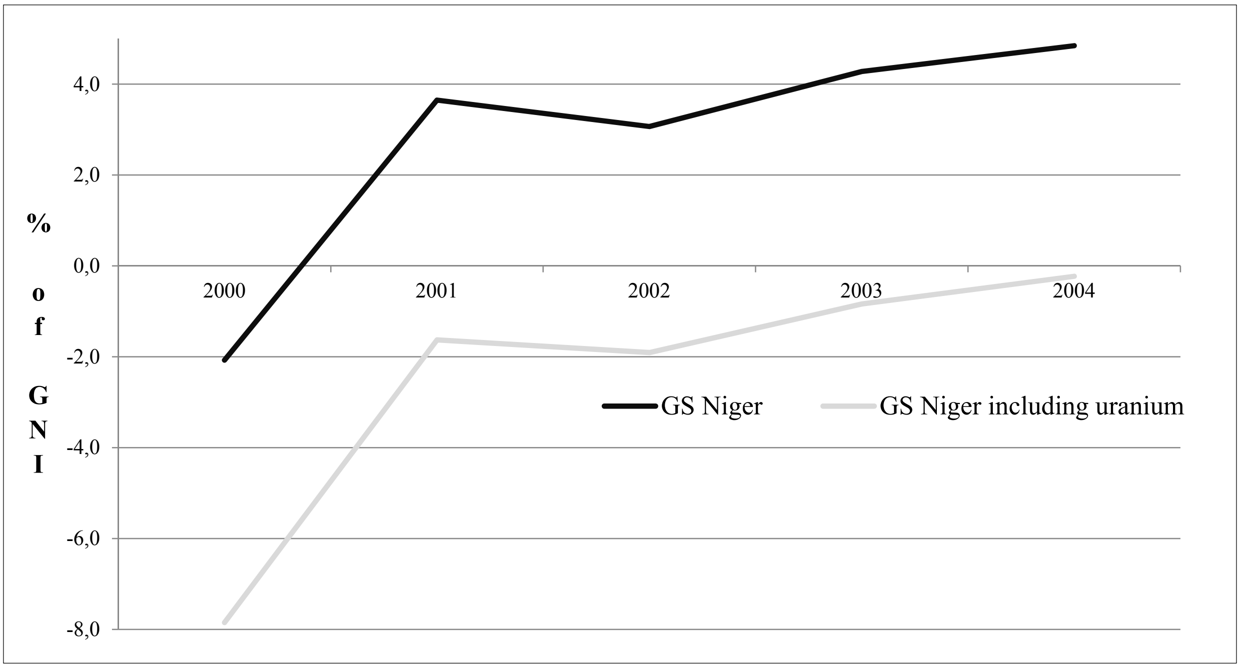
In total, there are only twelve countries that produce peat on a large scale: Albania, Argentina, Bangladesh, Belarus, Burundi, Estonia, Finland, Ireland, Russia, Rwanda, Senegal and Sweden. As an industrial energy source in plants it is only used extensively in Ireland, Finland and Sweden, while in a small number of developing countries immeasurable values are privately used as fuel. Therefore, I would suggest including peat rents into the GS of these bigger producers but to omit it in the marginal amounts most countries show. For P in Equation (12) individual country prices could be used if it is not possible to establish a world market price.

Figure 13: GS of Namibia including uranium between 2000 and 2004.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Figure 14: GS of Niger including uranium between 2000 and 2004.

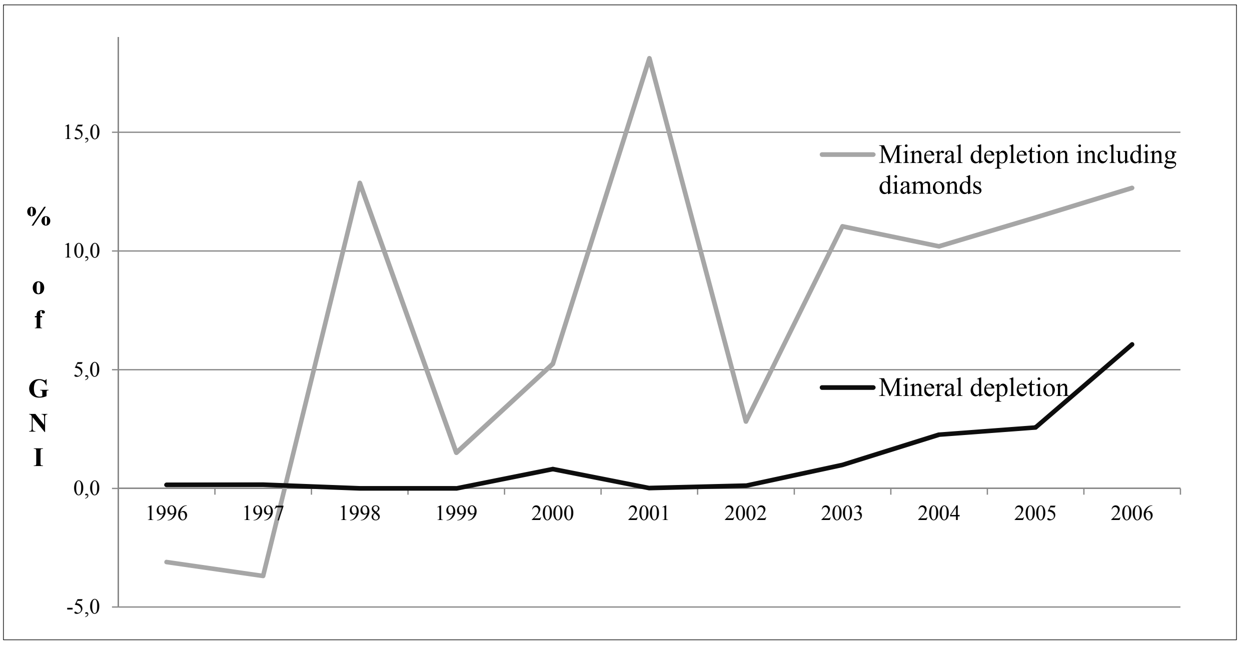


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Another case is uranium, which is only produced in 21 countries in a total of 42 mines. Moreover, only Australia, Canada, Kazakhstan, Namibia, Niger, the Russian Federation, the United States and Uzbekistan produce uranium in four-digit metric ton terms. Figures 12–14 show the three countries Australia, Namibia and Niger as those in which uranium makes a visible difference. These examples show that it could be advisable to include uranium in the calculation of the GS of such uranium-depleting countries. Especially the Nigerian GS rate decreases from positive to negative values by including the depletion of uranium, as Figure 14 shows.

2.4.6.2 Metal and Mineral Depletion

Figure 15: Mineral depletion of Botswana with and without diamonds between 1996 and 2006.



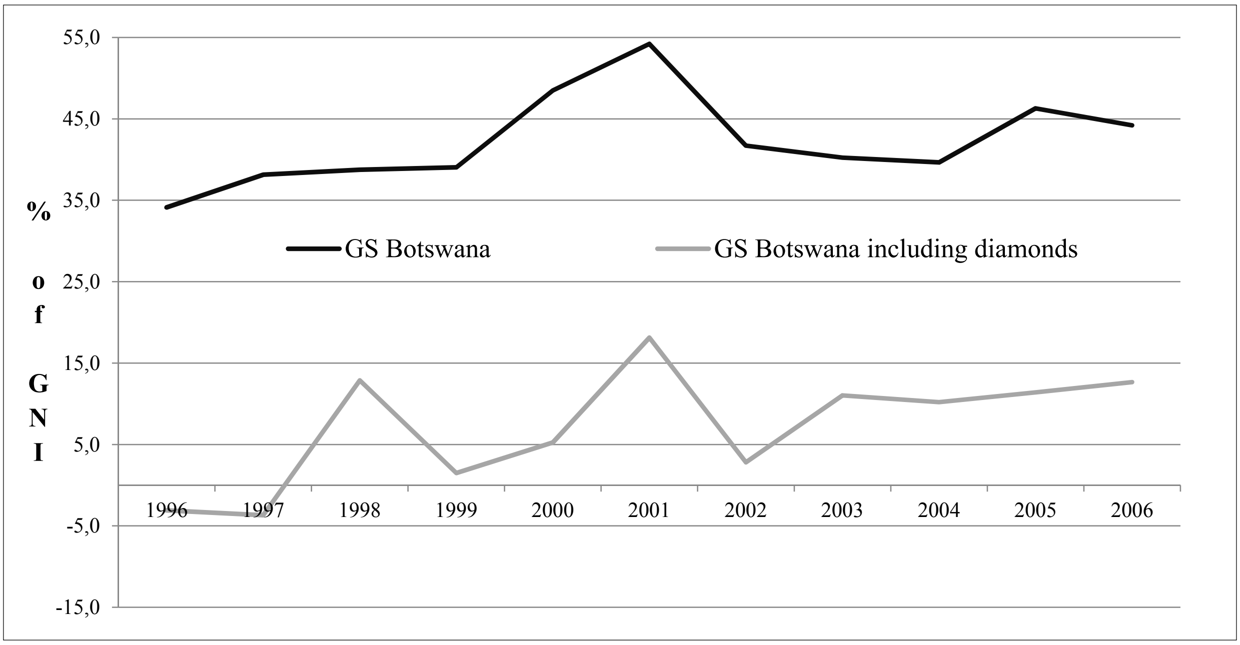
Source: Own calculation and illustration with data from World Bank (2012, 2014, 2014b), the Bank of Botswana (2014) and the Central Statistics Office of Botswana (2014).

Rents from metal and mineral depletion include the substances bauxite, copper, gold, iron, lead, nickel, phosphate, silver, tin and zinc calculated in the same manner as the aforementioned cases. To date, the following are omitted due to lack of sufficient data: platinum, chromium, molybdenum, fluorite, barytes, diamonds, natural abrasives, natural graphite and natural crystal. For most of these resources the Industrial Commodity Statistics Database provides US$ values for their production. Obtaining cost information remains more difficult. Most of these resources are depleted in significant amounts in a very limited number of countries. Since the same data problematic occurs as above, the merits of a survey of these resources should be discussed.

Platinum-group metals are only produced in 13 countries, which make them insignificant on a global scale but important for the GS of individual countries. For example, palladium, which had a weighted world market price of US$381 per troy ounce in 2008 and an insignificant world production value of around US$2 billion, is an important rent source for Russia (*ca*., US$1 billion of the country's total metal and mineral rents of around US$13 billion) and South Africa (*ca*., US$890 million out of total rents of US$7 billion).

Diamonds especially serve as an important natural resource for countries such as Angola, Botswana, the Democratic Republic of Congo, Namibia, the Russian Federation, and South Africa (WORLD BANK 2006). However, there is no world market price for diamonds and production costs are difficult to obtain. Figures 15 and 16 show the only example I was able to extract: The inclusion of diamond rents into the GS of Botswana between 1996 and 2006.

Figure 16: GS of Botswana with and without diamonds between 1996 and 2006.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014, 2014b), the BANK OF BOTSWANA (2014) and the UN COMTRADE DATABASE (2014).

Botswana's GNI increases on average over this period due to higher diamond extraction rates and therefore growing resource rents which are not subtracted in GS. If I include diamond rents, GS decreases drastically. As this example shows, the GS rates of all six diamond producers is lacking an important component of natural capital, leading to an incorrect estimation of the changing wealth of these countries. For Botswana, GS could not seriously be seen as an indicator for "weak" sustainability without including rents from diamonds. As Figure 16 shows, in 2001, the official GS rate of Botswana even crossed the 50% mark. No other country has ever reached this threshold, and Botswana would not have been the exception, had the rents from diamond depletion been considered in the calculation. Botswana's Central Statistics Office at least partially provides the data one would need to calculate the rents in Equation (12) for future research on the GS rate of the country.

For the benefit of countries that deplete natural resources to this extent, it would be important to include these values for δK_N. If it is not possible to extract this data to achieve cross-sectional global or regional averages, national statistical offices, as in the case of Botswana, could at least provide approximate values for δK_N to more realistically present their GS rates.

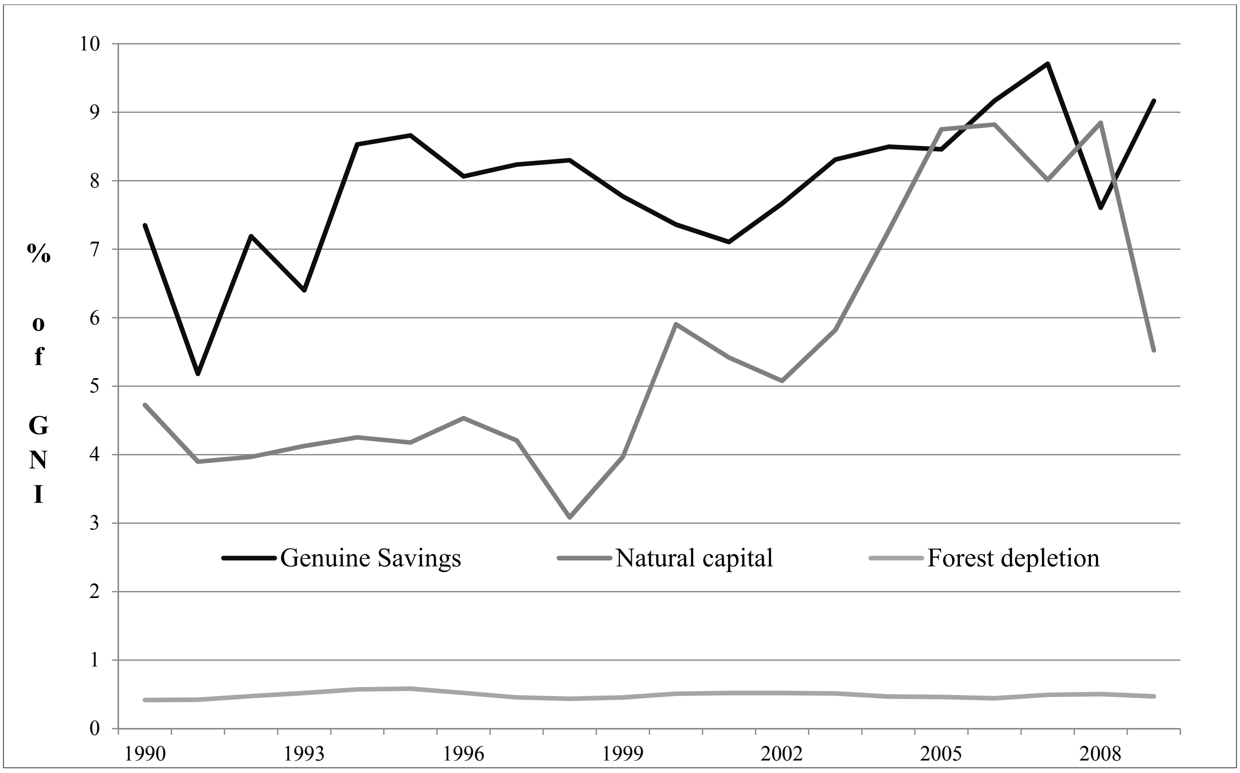
2.4.6.3 Net Forest Depletion

Carlowitz's "Sylvicultura Oeconomica" (1713/2009), the first publication using the concept of sustainability, examined sustainable forestry with the clear rule of limiting depletion to a level below the new growth of timber resources. In the GS method of the World Bank, wood is the only renewable resource included. The Bank subtracts the present discounted value of net forest depletion (NFD):

$$NFD = (roundwood\ production - increment) * P * rental\ rate \qquad (19)$$

If the first part in brackets is negative (positive growth rate) it is not included in GS (rather it is set to zero) (Bolt et al. 2002). The World Bank (2012, 2014a, 2014b) principally argues that growth that is greater than harvesting should be a positive calculation component of natural capital, but that most of this growth is in economically forested areas which are farmed for later depletion and therefore do not signify a real increase in natural capital (World Bank 2011a).

Figure 17: Natural capital and forest depletion between 1990 and 2009 (world average).

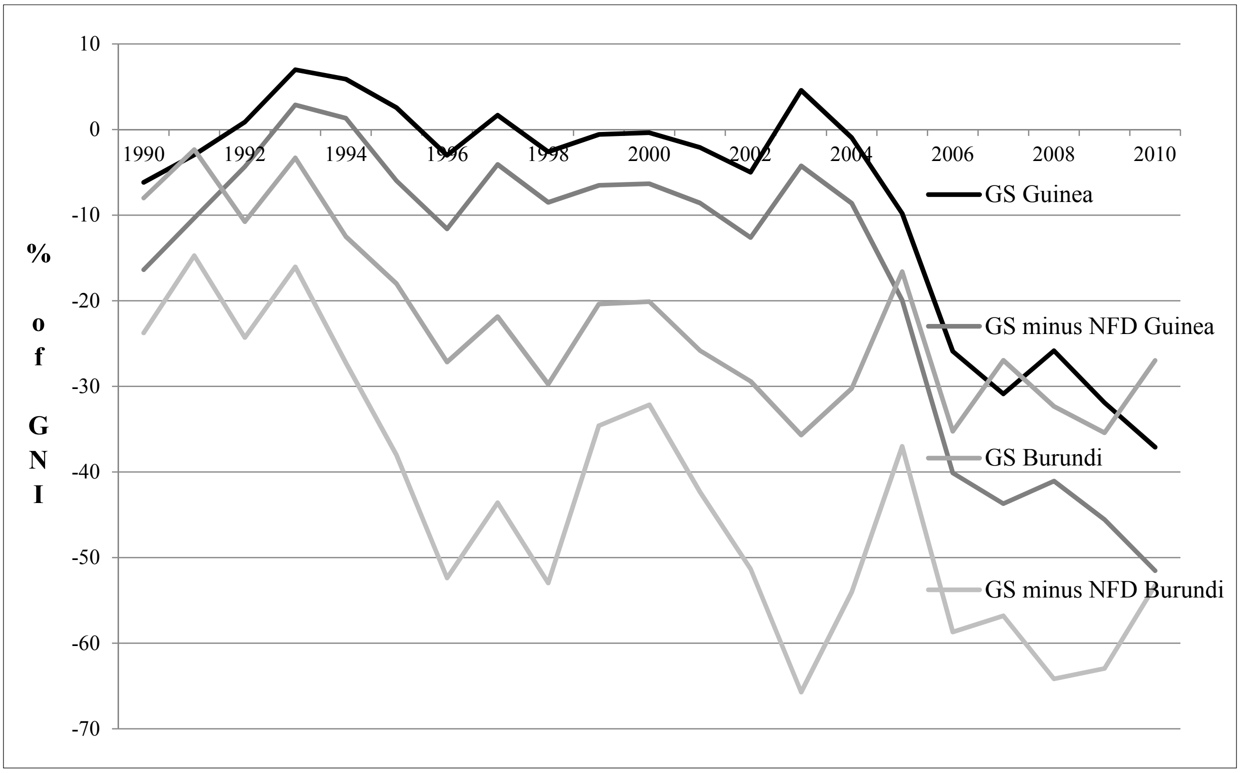


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

I argue otherwise. Despite the relative insignificance of timber resources on average globally, as Figure 17 shows, forests represent an important capital stock in some countries. Examples such as Burundi or Guinea in Figure 18 show that for some countries net forest depletion makes a noticeable difference in their GS rates (altogether, more than 15 countries deplete forest resources for more than 5% of their GNI). For the GS of these countries, this renewable resource is treated the same as all other exhaustible resources discussed above.

As long as forest depletion outweighs growth, this is not critical for the calculation of GS. However, from the point where reforestation outnumbers depletion—for example by investment of rents from forest depletion in reforestation rather than infrastructure or education—this positive effect on natural capital does not factor into the current calculation. As a result, forest growth for economic reasons does not increase the natural capital stock, and if these are used to earn more rents from forest depletion in the future, the rents are again subtracted from GS. Therefore, in the worst possible situation rents from forest depletion are subtracted twice without factoring in the replenished stock.

Figure 18: GS rates of Burundi and Guinea with and without forest depletion between 1990 and 2010.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

As Figure 17 shows, the proportion of forest depletion was only around 0.5% globally in the 1990s and 2000s. In the same decades, the share of forest in the total land area increased by more than 0.5% in almost 50 countries. Obtaining data on forestation is rather difficult, but a fair indicator measuring the capital stock of a country should include this along with other renewable resources.

As an overall issue in the GS calculation, it is not possible to include the net changes of other forms of renewable natural capital on an annual basis due to the lack of data (WORLD BANK 2011a, 2011b). The net depletion of fresh water or land resources, soil erosion, and other factors such as biodiversity and fish stocks most likely significantly influence the natural capital stock of enough countries to include it in their GS rates (WORLD BANK 2006). The WORLD BANK (2011a, 2011b) includes selected components of natural capital that it is able to measure in the inventory of the total capital stock of over 120 countries, although it is not yet included on an annual basis. Building on MERLO and CROITORU (2005), the Bank for example attributes US$129 per hectare in industrialized countries and US$27 in developing countries per annum for “(n)ontimber forest benefits such as minor forest products, hunting, recreation, and watershed protection” (WORLD BANK 2011a).

Fisheries especially provide a significant wealth stock for some countries. In Bangladesh, for example, the gross output from fisheries accounts for 3.9% of GDP, nearly 2% in Senegal, and over 4% in Vietnam. In Figure 18 I have shown the difference in GS rates of Guinea when excluding net forest depletion, whereas the GS of its neighboring countries would be greatly affected by the inclusion of rents from fisheries. According to the Fisheries and Aquaculture Department of the FAO (1999, 2006), the net exports of fish products from Guinea-Bissau amount to US$5.8 million (in 1999) and those of Sierra Leone stand at US$9.7 million (in 2006).

These figures include additional income from net exports of the fishing industry. Production costs have not been subtracted and there is no data on the recovery of the fish stock. However, these two countries provide representative examples for the problem this creates: The GNI of Guinea-Bissau reached US$210 million (in 1999) and that of Sierra Leone amounted to US$1.8 billion (in 2006), therefore income from fisheries accounted for 2.8% and 0.5% of GNI respectively, while GS rates were negative.

The argument that fish stocks are mobile and not only difficult to measure but also difficult to assign to an individual country, is similar to the criticism of the inclusion of transboundary pollution. In the next section, I discuss the inclusion in the GS rate of damages by air pollution. The World Bank deducts air pollution from the GS of the emitting and not the affected country. The same discussion and arguments could apply to mobile resource stocks such as fish.

2.4.6.4 Air Pollution Damages

In Equations (7) and (14), I define total air pollution damages as social costs which negatively influence all other forms of capital and denote it as δN_K. HAMILTON (1996) and HAMILTON and ATKINSON (1996a, 1996b) define these negative influences, and thereby implicitly δN_K, using abatement or defensive expenditures and argue that these are investments that “should be deducted in order to arrive at the measure of economic welfare” HAMILTON (1996). However, two decades after the first publications on GS only damages from carbon dioxide and particulate emissions are included. Marginal costs from CO_2 damages are estimated at US$20 per ton of carbon (the unit damage in 1995 U.S. dollars) and particulate emission damage is estimated as the willingness to pay defensive expenditures to avoid mortality attributable to PM_{10} (WORLD BANK 2006, 2011a, 2012, 2014a, 2014b).

DIETZ and NEUMAYER (2004, 2006) criticize the lack of data on damages from other forms of pollution, such as sulphur dioxide or water contamination. ATKINSON and HAMILTON (2007) provide a number of authors (MARKANDYA ET AL. 2000; HARTRIDGE and PEARCE 2001; AEA TECHNOLOGY 2004; WORLD BANK 2005; DEFRA 2005; KUNNAS ET AL. 2012) that analyze possibilities to measure other forms of air and water pollution as environmental degradation. PEARCE and ATKINSON (1993) or HAMILTON and CLEMENS (1999) address the depletion of natural capital. In these studies, sulfur dioxide (SO_2), particulate matter (PM) and ground-level ozone (O_3), nitrogen oxides (NO_X), non-methane volatile organic compounds and carbon monoxide are shown as percentages of GNI.

In the case of the UK, the inclusion of air pollutants would lower the GS rate in 2000 by 10% (ATKINSON and HAMILTON 2007). FERREIRA and MORO (2011) show that through the inclusion of SO_2 and NO_X in Ireland's GS rate for the decade between 1995 and 2005, only two years remain positive. They conclude that this is disturbing since SO_2 and NO_X values in Ireland are low relative to other countries.

Thus, the ongoing discussion on the inclusion of pollution damages in the calculation of GS should include a detailed survey on pollutants and the possibilities to express them in monetary terms. Similar to the discussion above on energy and mineral resources as well as the depletion of forests or other renewable parts of a countries natural capital, it should be possible to include a certain level of pollution damages as social costs. Otherwise, GS only appears as an imperfect and fragmented attempt to fill a theoretical model with real data that includes extractable data and excludes all other considerations.

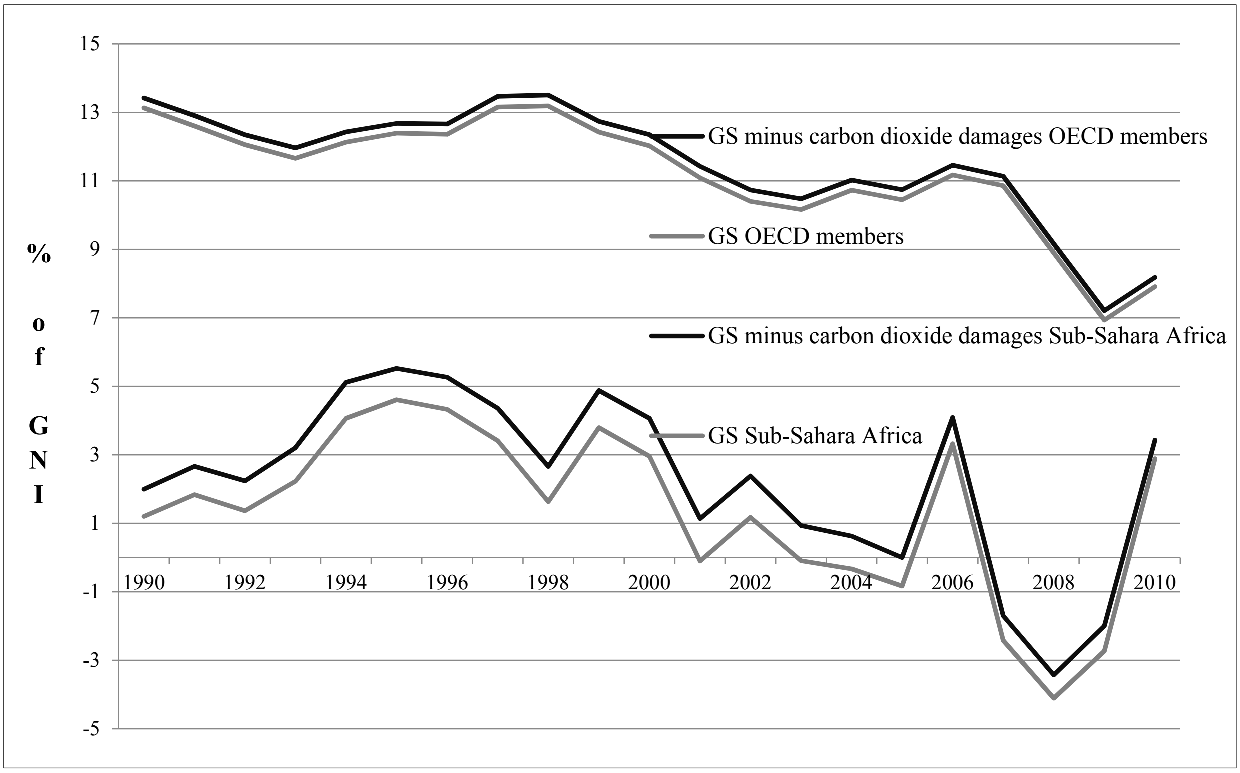
FERREIRA and VINCENT (2005) consider carbon dioxide as causing global damage and not depleting the natural capital of the emitting country, however it is rare to find a fundamental critique of the decision to include damages from air pollution in an indicator measuring a country's specific capital stock. Cross-border pollution is discussed in literature by DIETZ and NEUMAYER (2004, 2006) and NEUMAYER (2010), among others. However, it does not receive significant attention. The common opinion – also by the WORLD BANK itself (2006, 2011a) – is that the "polluter pays principle" applies to the calculation of GS rates. The metadata description of the WORLD BANK (2014a, 2014b) defines the present value of "the marginal social cost per unit multiplied by the increase in the stock of carbon dioxide (…) (as) global damage to economic assets and to human welfare over the time the unit of pollution remains in the atmosphere". Pollution in the atmosphere follows to a certain extent the argument by FERREIRA and VINCENT (2005) that carbon dioxide causes global damages by reducing the performance of the atmosphere as a natural (or social) capital stock from which these services result. One could ask which global damage results from pollution and distribute it between countries based on their size or proportion of global income, but to date there is no suggestion that includes a practical solution to this problem.

If one looks at the case of resource-abundant countries that suffer from the so-called Resource Curse, negative GS rates not only show that the exporting country is not investing the rents from natural resource depletion well enough. They also implicitly demonstrate that the importing consumers do not adjust for the extra pressure on the natural capital of the depleting country, with the exception of paying the world market price of the resource (at least in the calculation method of GS, as seen in Equations (12) and (13)). There are arguments that importing countries should somehow be debited for the depletion of natural capital of exporting countries. In addition, in the same line of argumentation, transboundary pollution is especially seen as damage that should be adjusted within the GS calculation (HAMILTON and ATKINSON 1996a, 1996b).

The "polluter pays principle" is a sound way to hold countries responsible for the damage they cause to global capital, and here I explicitly refer to total rather than natural capital. However, GS is an indicator for "weak" sustainability in terms of capital formation within countries. Resource-dependent and exporting countries should use their extra income from depleted natural capital to invest more in physical and human capital (DIETZ and NEUMAYER 2004, 2006) or renewable natural capital, as proposed above. In addition, while the measurement of CO_2 emissions especially seems a simple proxy for environmental offenses by individual countries, there are other methods, such as carbon footprints, to further approximate environmental damage.

Therefore, I hold the opinion that an indicator measuring the development of the total capital stock of a country should only measure the stock within the country and not transboundary pollution damages, which reduce natural capital on a different level than the depletion of sellable natural resources. If it were possible to individually measure the loss of depletion rents, for example, from the negative influence of Polish emissions on Swedish forests, then one could discuss this theoretical problem on another level. However, since the calculation of GS rates can only use assumptions about the social costs a polluting country causes, GS does not include depletion of natural capital within a country but rather assigns a debt based on global damages.

Figure 19: GS rates of OECD members and Sub-Sahara Africa with and without carbon dioxide damages between 1990 and 2010.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

However, Figure 19 shows GS rates using the example of OECD members and those of Sub-Saharan Africa with and without carbon dioxide damages. In the case of OECD countries, the differences are insignificant. The difference for Sub-Saharan Africa is higher than for the OECD countries since emissions have greater weight at a lower level of GS. Nevertheless, even this difference can be considered insignificant in terms of the broader results GS shows. I would suggest that the WORLD BANK (2014a, 2014b) provide a version of GS within its "World Development Indicators" with and without emission damages or other environmental degradation that goes beyond classical resource depletion. This would allow users to decide between a lean, capital-based version and one including abatement costs.

2.5. Conclusions

As stated in the introduction, this paper intends to provide an overview of the theoretical and methodological discussion on GS as the most important and developed indicator for "weak" sustainability. I discuss this indicator critically and suggest possible modifications.

In 2.3, I explain the calculation method in detail and recommend denoting the damages from air pollution independently from other forms of natural capital depletion by δN_K. Based on my observations, there is a clear difference between the depleted natural capital δK_N within a country and transboundary pollution damages δN_K which are only ascribed to the emitting country even though parts of this pollution contribute to capital depletion on a global scale. I would also suggest a separation of exhaustible and renewable natural capital, in the case that factors beyond the value of net forest depletion are included. If growth of renewable natural capital exceeds depletion, it could then show a positive effect of re-investment of rents from natural capital in further natural capital and not only other forms. The substitution of non-renewable resources with renewable resources would then also provide a positive effect on GS, similar to investments in physical or human capital. This would therefore serve as a more accurate indicator for countries acting more responsibly than others.

In 2.4, I begin with a discussion spearheaded by various authors about the difference between total and per capita GS. I argue alongside HAMILTON (2002, 2003) that the World Bank could use Equation (17) to calculate and present per capita GS until yearly values of wealth stocks are available. Similar to the calculation of the usual indicators GDP/GNI, calculations could be modified to divide total GS by midyear population as a starting point. Additionally, I suggest a "weak" sustainability index in Equation (18) which includes GS and population growth and would provide a simple inclusion for the WORLD BANK in its "World Development Indicators" (2012a, 2014a).

In 2.4.3, I discuss variable ToT within the context of continuously changing world market prices of "exported" natural capital and "imported" consumption and capital goods. While most authors, such as SACHS and WARNER (1995/1997), come to the conclusion that increasing ToT positively influence a country's income, I follow BOOS and HOLM-MÜLLER which show theoretically (2012) and empirically (2013) that $\delta K_N/\delta K_P$ changes in the same direction as a country's ToT. However, while it is an important point that ToT and GS demonstrate a negative relationship, the most important problem is their joint volatility and the resulting uncertainties. I recommend flattening the variable δK_N by using five-year averages for the calculated rents in Equation (12) to adjust GS rates for the extreme volatility of natural resource prices.

In 2.4.4 and 2.4.5, I discuss the subtraction of consumption from GNI. I suggest surveying and discussing durable consumption goods that could be considered positive investments in physical capital rather than negative parts of the GS calculation. However, until a detailed survey has been conducted at least a certain percentage could be removed from consumption for goods that are more investment-oriented than consumption-driven. In the case of current education expenditures, the World Bank deducts 10% for investments in school buildings and the like; the same could be done for total consumption. Additionally, I suggest a discussion of the exclusion of military and other defensive investments whose contribution to sustainable development is at least subject to discussion.

After reducing GNI by consumption and the depreciation of physical capital, the World Bank adds current education expenditures as an indicator for investment in human capital. I briefly discuss the depreciation of human capital in countries where the life expectancy lies below the international retirement age of 65. However, since I follow the argument that education expenditures used for the calculation of GS rates tend to underestimate real investments in human capital, this serves to substantiate the argument that health expenditures also increase K_H. I show that the inclusion of health expenditures would increase K_H and therefore average global GS by almost 5% for the years 2003 to 2007.

After adjusting for education expenditures the World Bank subtracts the rents of natural resources and damages by air pollution to indicate depletion of natural capital. To more completely capture natural capital, I propose the inclusion of natural resources such as peat, uranium or diamonds, and I show their influence on the GS of individual countries. In particular, the inclusion of diamond rents in the GS of Botswana stands out in these examples, since the country's GS would decrease by an average of 33% of GNI between 1996 and 2006. However, the example of uranium in Namibia or Niger also serves as a remarkable reminder that the GS calculation misses natural resources important for the capital stock of some countries. The World Bank concedes this gap of exhaustible natural resources in K_N and aims to continuously extend it (WORLD BANK 2006, 2011a). Simultaneously, I suggest including renewable parts of natural capital the World Bank is able to calculate, and allow for positive values if the renewed share is higher than the depleted portion.

The inclusion of air pollution is discussed from two viewpoints: on the one hand considering a broader base of pollution damages than only CO_2 and PM_{10}, or on the other hand concentrating on pure natural resource depletion and excluding emissions completely. While the first is mostly investigated by the World Bank itself, the discussion as to whether the GS calculation should include pollution damages is mainly carried out outside the Bank. Aside from consideration of carbon dioxide emissions as causing global damage or only depleting the natural capital of a single emitting country, I request a discussion on the merits of including emissions. I argue that GS is an indicator for "weak" sustainability in terms of capital formation within countries with the purpose of showing the handling and re-investment of extra income from depleted natural capital. Therefore, I hold the opinion that an indicator measuring the development of the total capital stock should only measure the real stock excluding pollution damages, which reduce natural capital on a different level than the depletion of sellable natural resources. Since this discussion is not likely to reach consensus promptly if ever, I suggest that the WORLD BANK (2014a, 2014b) provide a version of GS with and without emissions damages. Therefore, I hold the opinion that an indicator measuring the development of the total capital stock of a country should only measure the stock within the country and not transboundary pollution damages, On the whole, I recommend more detailed research on the relationship between the Resource Curse and GS rates of resource-dependent countries that suffer most from volatile world market prices, as knowing more about the determinants influencing GS could help to extend its applicability.

However, none of these arguments provide an overarching answer. In contrast, this paper should serve as a call to discuss these topics more thoroughly. GS is by far the most developed and discussed indicator to measure sustainability in monetary terms and could therefore serve as a complement to other common economic indicators. The calculation method for GDP is also constantly discussed and in the case of the European Union even adapted recently. What prevents us from using GS (in the two different versions) as an additional indicator for the state of the world and have it one day as a headline indicator next to a country's GDP?

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3. A theoretical overview of the relationship between the Resource Curse and Genuine Savings as an indicator for "weak" sustainability

Abstract The second paper shows the strong relation between the factors that lead to the Resource Curse (RC) and factors that lead to a decline of Genuine Savings (GS). There is substantial empirical evidence that economies that rely predominantly on their natural resources are also characterized by slower economic growth. This so-called RC is commonly traced back to the fact that natural resources' generate rents that are independent of a country's economic performance, which can lead to suboptimal reinvestments of this consumed natural capital. We argue that the factors responsible for the RC also have a negative effect on GS, a concept that measures "weak" sustainable development by considering reinvestment of natural capital rents in physical and human capital. We discuss whether the RC hampers possibilities for resource abundant countries to obtain sufficiently high rates of GS, and find indeed many reasons why resource-dependent countries have problems achieving positive GS rates. We survey both areas of research, emphasizing the influence of the exogenous and endogenous determinants of economic growth, which are usually used to theoretically and empirically explain the RC on the three different forms of capital considered by GS. We specify why most countries suffering from the RC have negative GS rates and explain in detail where the linkages are. This overview could help with potential advancements in the explanation of GS through the inclusion of RC effects.

3.1. Introduction

As early as 1776, ADAM SMITH (1998) argued that economic growth could not depend solely on natural capital endowment but also on the development of physical and human capital. Whereas over the next 200 years many peripheral countries such as Argentina or South Africa grew by exporting their rich natural resources to the industrializing world and using this income as an important first step to economic development, other resource-rich developing economies, such as Jamaica and the Philippines, stagnated.[4] In particular, following the mineral price shocks and oil booms in the 1970s as well as the structural changes within the world economy, the paradox emerged that countries endowed with rich natural resources often showed slower economic growth than resource poor countries.[5]

This so-called Resource Curse (RC) – after discussion of the Dutch disease in the 1980s (CORDEN and NEARY 1982; CORDEN 1984), case studies by GELB (1988), AUTY (1993), and the first empirical demonstrations in a cross-country analysis by SACHS and WARNER (1995/1997) – has been confirmed by a vast amount of literature, proving the significant negative relationship between some measure of resource-dependency and the growth rate of GDP per capita. These studies offer a wealth of theoretical and empirical explanations ranging from the volatility of natural resource prices to the quality of institutions and macroeconomic policies.[6] However, all this comes back to the handling of income from natural capital, especially its reinvestment in other forms of capital.

The "Hartwick rule" (HARTWICK 1977), the paradigm of "weak" sustainability, recommends exactly this reinvestment of "all profits or rents from exhaustible resources in reproducible capital" to compensate for the consumption of natural capital and ensure future welfare. A well-known rule of thumb developed from this, which states that the net investment in physical, human and natural capital should be non-negative and, for adequate lasting growth, a country's total capital stock should at least stay constant over time. The discussion stemming from the debate on how to measure this capital growth beyond the traditional measure of GDP led, among other developments, to the concept of Genuine Savings (GS). GS measures the difference between investments in physical and human capital and consumption of natural

4 Especially in the so-called "Golden Age of Resource-Based Development" (as BARBIER 2007, 2011, puts it), between 1870 and 1914, countries such as Germany or the United States built industrialization processes on their resource-abundance. Until the end of the 1960s many resource-dependent countries outperformed resource-poor countries (AUTY 1993, 2000, 2001).

5 The available data shows that growth rates in resource-dependent countries slowed in the 1970s compared to the 1960s, and SACHS and WARNER (1995/1997) prove additionally that the average negative effect of resource-abundance in the 1980s was almost double the level in the 1970s. GYLFASON (2001a) shows that until the end of the 1990s, out of 65 resourcedependent countries, only Botswana, Indonesia, Malaysia and Thailand realized continuously high investment and growth rates.

6 Authors such as LEDERMAN and MALONY (2007, 2008), BRUNNSCHWEILER (2008) and BRUNNSCHWEILER and BULTE (2008) dispute the Resource Curse Hypothesis which is not generally accepted. Most critiques on the existence of the RC are based on the measures of resource-dependence and econometric methods employed; an equal number of publications, for example VAN DER PLOEG and POELHEKKE (2010) or ANDERSEN and ROSS (2011), directly refute these counterarguments, guaranteeing an ongoing vital discussion. Furthermore, several authors, such as BULTE ET AL. (2005), MEHLUM ET AL. (2006) and ROBINSON ET AL. (2006), argue that the quality of institutions, rather than resource-dependence itself, is the main factor influencing a country's conversion of resource-abundance into economic growth. In the last decade since oil and mineral prices have risen extremely high, economic growth in RC-affected countries has been high, prompting HABER and MENALDO (2011) to even argue that Zambia constitutes the last global example of a country suffering from the curse.

capital. It is an indicator of whether a country's exploitation of its capital stock is weakly sustainable or not (HAMILTON and CLEMENS 1999). Empirical evidence suggests that many resource-rich countries exhibit negative GS rates. This indicates that rents from natural resources are not properly reinvested in reproducible capital to the detriment of future generations (HAMILTON and CLEMENS 1999; ATKINSON and HAMILTON 2003; VAN DER PLOEG 2011).

This relationship between the RC and GS is often discussed in multidisciplinary publications considering either development in resource abundant countries (such as AUTY 2001 or HEAL 2007) or sustainability (HAMILTON and ATKINSON 2006 or AUTY 2007). In focused studies on this topic by ATKINSON and HAMILTON (2003), NEUMAYER (2004) and DIETZ ET AL. (2007) this relationship is shown empirically. These papers analyze connections between the RC and GS, especially public expenditure policies that support the overconsumption of a country's capital stock and the quality of investment-related institutions (mainly those institutions that are influenced by corruption) and how these factors, in combination with resource-dependence, influence the rate of GS. Additionally, the authoritative survey on the hypotheses and evidence behind the RC by VAN DER PLOEG (2011) includes a section on the "alarming picture [that most] [c]ountries with a large percentage of mineral and energy rents of GNI typically have lower genuine saving rates". These studies mention different potential relationships between the RC and GS. To our knowledge, a comprehensive overview of the relationship between the various explanations behind the RC and the development of GS rates has not yet been discussed in detail.

Even the research on the determinants of GS, which is more or less accomplished independently of the RC literature by DE SOYSA and NEUMAYER (2005), DE SOYSA ET AL. (2010) and HESS (2010), analyses only the influence of single factors such as economic openness, democracy or "human development", rather than providing a survey of all potential GS determinants. All of these papers to a certain extent follow ATKINSON and HAMILTON (2003), who call for more research on the determinants of GS, but none use a holistic approach to explain GS or build on the relationship to the RC using a systematic and extensive method. With the exception of the discussions on corruption (DIETZ ET AL. 2007) or democracy (DE SOYSA ET AL. 2010) and its influence on GS, the theoretical background in most empirical analyses is rather cursory.

That is, direct research neither on GS nor on RC provides a comprehensive theoretical background on which to base its assumptions. This is where our paper starts: our intention is to lay a theoretical foundation for further empirical analysis and to ease the understanding of existing studies in a broader context. Therefore, we provide an extensive survey of the most prevalent exogenous and endogenous determinants identified by academic literature as causes of the RC and connect them to the different components of GS measurement.

As a starting point, we provide an overview of the content and calculation of GS to understand which of the three capital forms determining GS contains what kind of data. We then connect these three forms of capital to different hypotheses from the literature that address reasons why resource-dependence could negatively influence the development of a given country. On the one hand, we show the complicated relationship between the many factors leading to the RC and GS rates. Exogenous explanations such as the Dutch disease and endogenous ones such as the institutional quality of a country have similar effects on GS and on GDP or economic growth. Volatile world market prices and changing terms-of-trade play an even more important role for the rate of GS than for GDP growth, due to the fact that the depletion of natural capital is calculated with current world market prices. On the other hand, we show that the RC could be explained more comprehensively by using a combination of GS and its components as dependent variables, rather than by using GDP growth. HAMILTON and CLEMENS (1999) recommend using GS as an explanatory variable in RC models, but we show in our theoretical overview that it is more informative to use GS and its components as dependent variables alongside GDP, as is done by DE SOYSA ET AL. (2010) or BOOS (2011).

We conclude with a summary of theoretical relations that should be further investigated empirically. We suggest incorporating GS in existing models and empirical analyses of the RC as a new way of explaining the negative effects of resource abundance. Our overview of GS determinants, which are related to theories behind the RC, can be used as a guide for future theoretical and empirical studies and discussions.

3.2. Genuine Savings

"Weak" sustainability as the theory behind genuine savings (GS) is based on the assumption that different forms of capital are substitutable and that only the total capital stock is important to maintain "the capacity to provide […] utility non-declining for infinity" (NEUMAYER 2010). Thus, physical and human capital can basically replace depleted natural capital.[7] NEUMAYER

[7] This is in contrast to the paradigm of "strong" sustainability, which originates from DALY (1973, 1980, 1992) and assumes that this capacity is not provided by substituting natural with other forms of capital, but only by keeping the stock of natural capital itself at least constant over time. Some lines of this theory allow for substitution

(2010) therefore calls "weak" sustainability the "substitutability paradigm", which allows for the consumption of natural capital at any rate as long as this is substituted by investment in reproducible capital.

From this, PEARCE and ATKINSON (1993) developed a comparison of savings versus the combined depreciation of physical and natural capital as an indicator for sustainable development. Due to missing data, this indicator originally only included savings (as the indicator for investment in physical capital), depreciation of physical capital, and rents from the depletion of natural resources. Later HAMILTON (1994) and PEARCE ET AL. (1996) added investment in human capital as well as pollution emission damages as part of the depreciation of natural capital:

$$WSI = \frac{S}{Y} - \frac{\delta K_P}{Y} + \frac{\delta K_H}{Y} - \frac{\delta K_N}{Y} \qquad (20)$$

WSI is a weak sustainability index, S is gross savings, δK_P is depreciation of physical capital, δK_H is the increase in human capital, and δK_N the depletion of natural capital. δK_N includes damages from air pollution in addition to natural resource depletion. Divided by national income Y, this normalized indicator of net investment in all three forms of capital can be used to compare different countries. To make the distinction between this indicator and traditional net savings, which exclusively refers to physical capital, HAMILTON (1994) introduces the term genuine savings for this indicator.

It is important to note that a constant or increasing capital stock is a necessary but not a sufficient condition for sustainable development defined as non-decreasing utility over time. "Weak" sustainability only shows the possibility of sustainable development, but negative GS clearly indicates an unsustainable path (HAMILTON and CLEMENS 1999; PEZZEY 2004): If at one point in time GS is not positive, then this economy is unsustainable at that time (PEZZEY and TOMAN 2005). GS is a useful policy indicator and early warning sign to determine whether a country's exploitation of its capital stock is unsustainable (HAMILTON 2005).[8]

within natural capital, between non-renewable and renewable resources for example, but by no means does it allow for the reinvestment of depletion rents into produced capital. For the distinction between "weak" and "strong" sustainability, see PEARCE ET AL. (1989) and the comprehensive discussion by NEUMAYER (2010).

[8] For a descriptive rather informal derivation, see PEARCE and BARBIER (2001) and BARBIER (2007) and for detailed calculation descriptions, BOLT ET AL. (2002) and WORLD BANK (2011a).

HAMILTON and CLEMENS'S (1999) final specification of GS, which has since become the official calculation method for the World Bank GS-indicator "Adjusted Net Savings", is:[9]

$$Genuine\ Savings\ (GS) = (GNI - C_P - C_G + NCT) - \delta K_P + \delta K_H - \delta K_N \quad (21)$$

The first part constitutes gross national savings (GNS): gross national income (GNI) minus private (C_P) and public (governmental, C_G) consumption plus net current transfers (NCT).[10] Theoretically, this is seen as the equivalent to gross investment in the total capital stock of open economies: gross domestic investment (GDI) minus the current account balance after official transfers (net foreign borrowing plus net official transfers) (NEUMAYER 2010). However, physical capital such as roads or buildings also depreciates over time (in World Bank terms: consumption of fixed capital δK_P) and subtracting this from GNS leads to net national savings (NNS) (HAMILTON and CLEMENS 1999).[11]

The official World Bank data set of NNS already contains the physical part of total education expenditures, such as investments in school buildings. Other investments in human capital such as teachers' salaries or the purchase of school books are traditionally treated as consumption and therefore subtracted in CP and CG in (2) (WORLD BANK 2006). Therefore, independent of the ongoing human capital discussion in literature such as those by DASGUPTA (2004) or NEUMAYER (2010), GS only adds current operating expenditures on education as a rather crude approximation for investment in human capital (δK_H) due to data restrictions (HAMILTON and CLEMENS 1999).[12]

The World Bank considers changes in natural capital (δK_N) by subtracting the depletion of different tradable natural resources and some of the damage caused by air pollution (HAMILTON and CLEMENS 1999). The research on GS, especially that done by the Environment Department of the World Bank, consistently tends to extend this by using a broader base of natural capital

[9] In the middle of the 1990s, the World Bank began publishing GS retrospectively from 1970 onwards (WORLD BANK 1997) and included it for the first time in its "World Development Indicators" in 1999 (WORLD BANK 1999). From 1970 until 1989, the data for 149 countries is available in the "World Development Indicators" (WORLD BANK 2011a), in the twelve years since 1990 this grew to a total of 166 countries (with individual starting years depending on the country). Additionally, GS is available for seven geographic regions, five different income groups and three lending categories.

[10] The World Bank http://databank.worldbank.org/ddp/viewSourceNotes?REQUEST_TYPE=802&DIMENSION_AXIS= defines net current transfers (NCT) as part of "the balance of payments whenever an economy provides or receives goods, services, income, or financial items without a quid pro quo. All transfers not considered to be capital are current".

[11] In most countries, NNS is already part of official national accounts. However, the World Bank uses the United Nations Statistics Division's National Accounts to calculate "Consumption of Fixed Capital" following the United Nations System of National Accounts 2008.

[12] NEHRU ET AL. (1995) provide the basis, while the exact description can be found in BOLT ET AL. (2002). The World Bank receives its data on "Education Expenditures" from the UNESCO Institute for Statistics: http://www.uis.unesco.org/Pages/default.aspx.

data (WORLD BANK 2006, 2011b; ATKINSON and HAMILTON 2007).[13] However, currently the depletion of natural resources is composed of the rents of energy[14] and mineral[15] resources and that of net forest[16] depletion. The rents of these natural resources are the change in their asset value associated with their extraction over the accounting period. Although, in theory, this is only one of at least three competing methods, these rents are calculated as follows:

$$Resource\ Rent = Production\ Volume * (International\ Market\ Price - Average\ Unit\ Production\ Costs) \quad (22)$$[17]

Following the HOTELLING (1931) rule, at least in a competitive inter-temporally efficient closed economy, the marginal costs of production should be used for the calculation of resource rents (DIETZ and NEUMAYER 2006; NEUMAYER 2010). However, obtaining marginal values is complicated and even more difficult to obtain than average costs. Additionally, certain natural resources, which are decisive wealth stocks in a multitude of countries, are still omitted due to empirical and methodological reasons. These include biodiversity as well as arable land, fisheries, or diamonds[18] (WORLD BANK 2006). The available data only consist of the market-based resources that can be calculated by rents in US$ and can be assigned to an individual country.

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[13] However, in the last decade besides the introduction of particulate emission damages for the time series from 1990 on (downloadable in both versions, with or without), only the number of available countries increased, while the actual base of natural capital remained the same (except in theoretical discussions and some case studies, ATKINSON and HAMILTON 2007; FERREIRA and MORO 2011).

[14] Energy depletion covers crude oil, natural gas and coal.

[15] Mineral depletion refers to bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver.

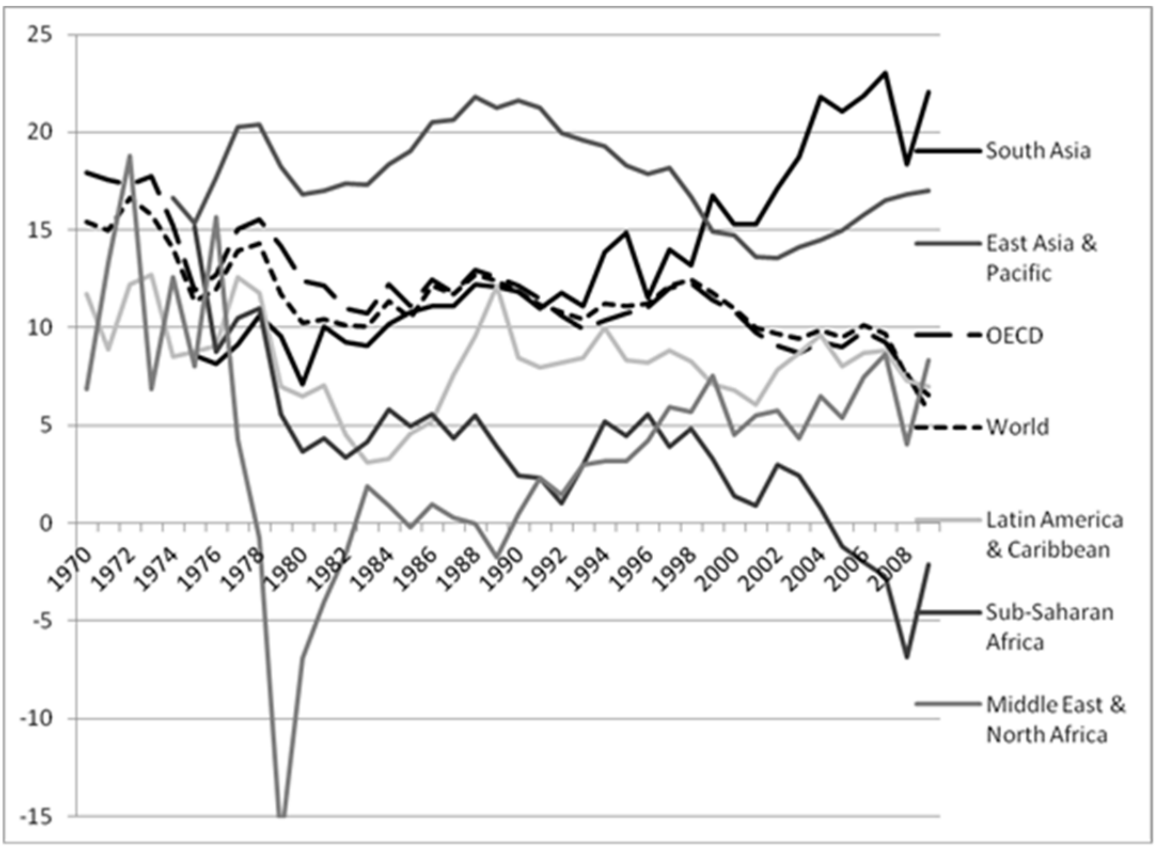
[16] Roundwood harvest minus natural growth; this is set to zero if growth exceeds depletion.

[17] Detailed descriptions can be found in BOLT ET AL. (2002) and WORLD BANK (2011a; b). Production data and world market prices (averages of all available prices) stem from different sources such as BP (2011), IEA (online at http://www.iea.org/stats/index.asp), UNdata (http://unstats.un.org/unsd/energy/edbase.htm), UNCTADstat (http://www.unctad.org/en/Pages/Statistics.aspx), USGS (http://minerals.usgs.gov/) or Natural Resources Canada (www.nrcan.gc.ca). Production costs are from the same plus national sources, but for most countries these are only available for a couple of years (in the case of oil mostly only for 1993) and the Bank deflates or inflates these for the remaining years. For example, looking at different oil exporters such as Saudi Arabia – depleting oil of around 30% of GNI in the last decade – or Angola – with rents of more than 40% - the WORLD BANK (2011a) inflates production costs from US$15 and US$40 (in 1993) to US$44 and US$117 (in 2008) per ton (JENKINS 1989; IEA 1995). In the case of the Saudi Arabian desert fields, which allow economies of scale, the IEA (2008) approximation of production costs between US$34 and US$51 agrees with this, but, in the case of offshore Angola, with increasing production costs, the IEA approximation of US$340 is extremely high compared to the one by the Bank. This results in critiques (see for example NEUMAYER 2010) and careful handling of the indicator in public discussion, at least compared to other more widespread sustainability indicators such as the "Human Development Index" or the "Ecological Footprint" (NEUMAYER 2001; MORSE 2003).

[18] For example, if we estimate diamond rents for Botswana, using data from their Central Statistical Office (http://www.cso.gov.bw/), and include them for the available time since 1996 into the data for mineral depletion, the GS of Botswana would decrease by around 50% (authors' estimation).

However, for a comparison with the RC, these rents are most important. Higher endowment and dependence on the depletion and exporting of natural resources has a negative influence on the GS of a country, since more resource rents are subtracted and higher international market prices increase these rents. World commodity markets are directly related to the rate of GS in most developing countries. It is notable that the usual discussion on the RC (starting with AUTY 1993; SACHS and WARNER 1995/1997) includes cash crops such as coffee or cotton (BEVAN ET AL. 1987), fisheries (JAMES and AADLAND 2011), and minerals such as diamonds (ACEMOGLU ET AL. 2002a), all of which are not accounted for in the depletion of natural capital within the GS calculation. However, energy, minerals and forest resources are accounted for in GS and especially oil, gas and copper have been traditional areas of focus in discussions on the RC. Total fuel exports account for around 2.5% of worldwide GNI in the last decade, while agricultural raw materials only realize 0.4% (WORLD BANK 2011a). Therefore, our paper focuses on the relationship between the dependency from energy and minerals and low GS rates. GS also includes damage from air pollution in the form of depreciation of natural capital. In practice this has so far been limited to carbon dioxide and particulate emissions, which have no relation to the RC.

Figure 20: Genuine savings for the period 1970-2009, subdivided by regions.



Source: Own calculation and illustration with data from WORLD BANK (2011b).

Seeing this gap caused by not considering the total natural capital stock in addition to the previously mentioned uncertainties, even positive GS rates should be interpreted cautiously (PEZZEY and TOMAN 2002; ARROW ET AL. 2004; NEUMAYER 2010). PEARCE and ATKINSON (1993), HAMILTON and ATKINSON (1996, 2006) and HAMILTON ET AL. (1997) state that GS rates are a step in the right direction and give at least a hint as to whether or not a country reinvests these rents in other forms of capital in a "weakly" sustainable manner. The WORLD BANK (2006) verifies GS as the most significant explanatory saving measure out of four tested and shows that, in the period from 1970 to 2000, on average only 22% of countries with positive GS at one point in time experienced declines in total real wealth and consumption per capita in later years. Since this paper focuses on relating theories behind the RC to determinants of GS – and not on criticizing GS (see for example DIETZ and NEUMAYER 2006) – we only point out that NNS could be overestimated, while δK_N is certainly underestimated. Therefore, a slightly positive rate of GS should also be interpreted as a negative sign for future welfare growth.

Since 1999, the World Bank (1999) has been publishing GS estimates retrospectively under "Adjusted Net Savings" for around 160 countries, with data going back to 1970. Figure 20 shows the development of GS, divided into important regions: due to the inclusion of more countries (also retrospectively from 1970) and therefore more data for the aggregation, as well as improvements in the methods of data acquisition, the rate of GS appears not to be as low as previously estimated. In earlier publications, such as DIETZ and NEUMAYER (2006) or NEUMAYER (2010), Sub-Saharan Africa and the Middle East and Northern Africa had negative GS for almost the entire time, while Latin America and the Caribbean was negative in the early 1980s.

In recent World Bank data, the Latin America and the Caribbean region has continuously positive GS rates from 1980 to 2008, while Sub-Saharan Africa only shows negative GS in 1992 and from 2005 to the present. After four negative years, one cannot speak of a long-term trend. However, the permanence of only slightly positive rates suggests that the negative years are not likely an anomaly. The Middle East and Northern Africa experienced a major drop at the end of the 1980s and another in 2000. For the remaining years, its values are rather high, in contrast to those noted in other publications and forecasts (NEUMAYER 2010). The high values in the OECD countries and Asia over the whole period ensure a positive worldwide GS rate.[19]

[19] Since the last discussion in NEUMAYER (2010), the WORLD BANK included 22 new countries in the set of GS time series: Bahrain, the Bahamas, Belize, Brunei Darussalam, Cape Verde, Comoros, Djibouti, Dominican Republic, Fiji, Guyana, Iceland, Liberia, Luxembourg, the Maldives, Seychelles, Slovenia, Solomon Islands, St. Vincent and the Grenadines, Suriname, Swaziland, Tonga and Vanuatu. At the same time it excluded: Cuba,

A total of 61 countries have negative average GS rates between 1970 and 2008, of which all export natural resources – for 33 of them natural resources compose more than 10% of GNI and for 21 of them more than 30%. Extreme negative outliers, such as Angola with a GS rate of -35.8% of GNI, the Republic of Congo with -33.9%, Guinea-Bissau with -15.6% and Liberia with -18%, show that many resource abundant countries in Sub-Saharan Africa would need to increase reinvestments of natural resource rents in other forms of capital in order to maintain their total capital stock (DIETZ and NEUMAYER 2006; DIETZ ET AL. 2007). The question remains whether it is in the hands of these countries to increase their GS rates or whether they are doomed to low rates of GS.

The next section examines the individual theories behind causes of the RC and connects them to the three forms of capital in GS to identify possible determinants of GS. We follow the typical structure in the literature and differentiate between exogenous and endogenous explanations, even if these clearly influence each other and newer publications mainly focus on endogenous and, more specifically, institutional factors.

3.3. The Resource Curse hypothesis

The Resource Curse (RC) hypothesis refers to the idea that countries richly endowed with natural resources often show slow economic growth. A classic model of the implications of resource dependency on other sectors and on economic growth itself was developed by Corden (1984) and called the Dutch disease. It originated from a 1977 edition of *The Economist* concerning the decline of the Dutch manufacturing sector after the discovery of natural gas sources (THE ECONOMIST 1977). The first denotation as a curse came from GELB ET AL. (1988) and AUTY (1993), who analyzed macroeconomic policies in different oil and ore exporting countries. They show the political difficulties for governments in saving (and not spending) resource rents and the lack of capacity and resources to reinvest this income efficiently.

SACHS and WARNER (1995/1997) show in their crosscountry analysis that an increase in the ratio of primary exports to GNI results in a decline of the growth rate of GDP per capita. Even

Haiti, Iraq, Libya, Nigeria, Papua New Guinea, Puerto Rico, the West Bank and Gaza, and Yemen for different reasons. Additionally, in the short period between the data on the "Adjusted Net Saving" homepage of the WORLD BANK (2008) and the "World Development Indicators 2011" (WORLD BANK 2011b), better data acquisition changed GS rates by an average of 0.3% over the 1970-2008 period. First, the entire time series of all calculation parts is updated every year and since 2009 the data for Gross National Savings is no longer gap-filled. Second, the data on "consumption of fixed capital" (CFC) is from UN data (online at http://data.un.org/) and exhibits gaps which are filled by applying coefficients from (CFC/GDP) regressions to GDP figures. And third, historical data availability improved, for example for mineral production (WORLD BANK 2012a).

after controlling for several other variables, which they identify to be important for economic growth, this significant negative relationship between resource dependency and growth holds true. SACHS and WARNER (2001) summarize the evidence throughout literature that the "[e]mpirical support for the curse of natural resources is not bulletproof, but […] quite strong". They refer to SALA-I-MARTIN (1997) and DOPPELHOFER ET AL. (2000) as studies that confirm natural resources as one of the ten most robust variables explaining economic growth. Since SACHS and WARNER (1995/1997), a vast number of studies have analyzed the RC from various points of view and identified multiple determinants and transmission channels (PAPYRAKIS and GERLAGH 2004). SACHS and WARNER (1995/1997) use growth of GDP per capita and determinants such as terms-of-trade, investment ratio or the rule of law, but mainly show that the ratio of primary exports to GDP is one of the most robust determinants for slower economic growth.

GYLFASON ET AL. (1999), ROSS (1999), AUTY (2001), GYLFASON (2001a), PAPYRAKIS and GERLAGH (2004), MEHLUM ET AL. (2006), VAN DER PLOEG and POELHEKKE (2009) and others identify channels by which a high dependency on natural resources may hamper economic development. To look into the influence of resource dependency on GS, we take up the most important of these channels, subdivided into exogenous factors (volatile world market prices, terms-of-trade, and the spending and movement effects of the Dutch disease) and endogenous factors (the political system and its macroeconomics and public expenditures, integration into world markets, and the quality of institutions). Many of these aspects have already been discussed either in the RC or GS literature, but we provide a first systematic analysis of the possible influences of the effect of RC determinants on GS.

3.4. The effects of the Resource Curse on Genuine Savings

3.4.1 Exogenous explanations

Varying world market prices strongly influence GS of resource-dependent countries through: (a) the short- and medium-term volatility of international commodity markets; and (b) the long-run terms-of-trade (ToT) effects.[20]

[20] While real commodity prices had a long-term downward trend of around 1% per year from 1862 to 1999, CASHIN and MCDERMOTT (2002) see a dominance on economic growth in the high variability of prices (volatility of prices determines growth by a much greater part than trends). Price shocks are long-lasting with high differences in durability (CASHIN ET AL. 2000), but the slumps definitely last longer than price booms (CASHIN ET AL. 1999). However, SOSA and CASHIN (2009) show in the example of the Eastern Caribbean that either positive or negative oil price shocks have negative influence on a country's GDP.

Starting with NURKSE (1958), various cross-country analyses reveal the adverse effect that the volatility of international commodity prices has on economic growth in resource-dependent countries (RAMEY and RAMEY 1995; BLATTMAN ET AL. 2007; KOREN and TENREYRO 2007). The GDP of resource-exporting countries fluctuates by several percentage points each year in conjunction with commodity prices (HAUSMANN and RIGOBON 2003). Since the depletion of natural capital is calculated through resource rents which depend on world market prices, their volatility is one of the most important impact factors for the GS rate of resource-dependent countries.

The periodic fluctuations not only lead to substantial changes in the depletion value of natural capital (δK_N) from year to year but also result in perverse private and public consumption and investment incentives in physical and human capital. Volatile rents from resource extraction cause uncertainty for reinvestments. Companies have little incentive to invest their revenues in an uncertain environment, as there is a high volatility of income. Governments not only have higher incentives for consumption rather than investment, but have little incentive to save during phases with high prices and income. They tend to align their public expenditure policies on these better phases, even in times with decreasing prices and income (ROSSER 2006).[21] Examining a sample of 44 developing countries, AIZENMAN and MARION (1999) prove that unrealistic assumptions about future prices even have positive effects on public investment in physical capital, resulting in a debt overhang and further volatile macroeconomic and public expenditure policies. However, in most countries, even these higher public investments and the additional public consumption, which positively influences education expenditures, are not high enough to compensate for the depletion of natural capital (δK_N), so that aggregated total investments are negatively correlated with volatility (FLUG ET AL. 1998; AIZENMAN and MARION 1999; MANZANO and RIGOBON 2001). The Prebisch-Singer thesis argues that the terms-of-trade of primary commodity exporters decrease in the long run due to a relative decline in international prices of primary commodities in relation to imported manufactured products and, as a result, the GDP of these countries also decreases (PREBISCH 1950; SINGER 1950; SACHS and WARNER 1995/1997; ROSS 1999). Empirical evidence is not as clear as one would expect. While some publications find negative trends (GRILLI and YANG 1988; REINHART and WICKHAM 1994), others (KELLARD and WOHAR 2006; BALAGTAS and HOLT 2009) hardly support the Prebisch-Singer thesis, and PAPYRAKIS and GERLAGH (2004) even show a positive influence of decreasing terms-of-trade on GDP, in their cross-country regressions. We argue that decreasing terms-of-trade as such are not problematic if, for

[21] The volatility explanation is discussed rather skeptically in DAVIS (2003) and FERREIRA and VINCENT (2005).

example, they are caused by technological progress through which a country can improve its world market position. However, decreasing terms-of-trade for resource exporters result in lower income from resource depletion, at least compared to the expenses for imports (DIAKOSAVVAS and SCANDIZZO 1991; ZANIAS 2005; BARBIER 2007). Incorporating the "Hotelling rule" (HOTELLING 1931), namely that prices of natural resources (should) increase at the interest rate due to their finite scarcity, the original GS-model assumes increasing prices for non-renewable resources. In principle, this can be offset by more rapid price increases for imported manufactured goods.

Independent of whether the terms-of-trade of a country develop positively or negatively in the long run, they affect the ratio between the depletion of natural capital (δK_N) (through exports) and the change in physical capital (δK_P) (through the consumption of and investment in imports). Terms-of-trade are usually expressed as P_X/P_M, the price indices for exports and imports, and therefore $\delta K_N/\delta K_P$ change in the same direction as a country's terms-of-trade (BOOS 2011). According to the calculation method shown in Equation (21), the depletion of natural capital (δK_N) is subtracted with higher rents, influencing GS more negatively, while reinvestments in physical capital that are higher than the depreciation of physical capital (δK_P) influence GS positively. In total, this means that increasing terms-of-trade should affect GS negatively, in contrast to the positive influence on GDP growth noted in SACHS and WARNER (1995/1997) (BOOS 2011).

The above-mentioned Dutch disease represents the origins and the most prominent topic in the discussion of a possible curse of natural resources. In the classic Dutch disease model, presented by CORDEN and NEARY (1982) and CORDEN (1984), a boom in the natural resource sector is either induced by the discovery of new reserves, exogenous technological progress or by increasing world market prices for the resources in question.

This boom results in higher export revenues and thus increasing rents within the calculation of natural capital depletion (δK_N). Through the so-called spending effect, the additional income increases the demand for goods from the other sectors and thus changes the relation of consumption and investment in physical and human capital (GYLFASON ET AL. 1999). The additional demand for manufactured goods must be met by imports, increasing the competition in this sector (KRUGMAN 1987; DAVIS 1995). In the Dutch disease model, the non-primary sectors are manufacturers of tradable goods and the service sector that produces non-tradable goods for which demand also rises (FARDMANESH 1991). However, while the manufacturing sector relies on world market prices, "the relative price of non-traded [service] goods must increase to preserve homemarket equilibrium" (BRUNO and SACHS 1982). This results in an appreciation of the real exchange rate, which further fosters competition from imports (AUTY 2007; FRANKEL 2010).

Therefore, wages in the resource and service sectors rise and employees consequentially move from manufacturing to these two sectors (AUTY 2007), via the process called resource movement or the crowding out effect (CORDEN and NEARY 1984; KRONENBERG 2004).[22] This decreases investments in human capital, due to more unskilled production processes in these two latter sectors; further, the service sector is more labour-intensive and needs relatively less investment in physical capital (GYLFASON 2001a; DIETZ ET AL. 2007). The capital-intensive mining sector attracts high investments in physical capital, but crowds out investment in more productive sectors. Private investments in physical capital decrease due to the decline in real returns on investment, while public investments in physical and consumption in human capital are negatively influenced by the fall of fiscal space in domestic currency.[23]

3.4.2 Endogenous explanations

Until the 1990s, these exogenous determinants were the most prominent economic explanations for the RC. The Dutch disease was especially regarded as a promising explanation of the RC for almost two decades. However, political and institutional explanations of the curse increased in importance and not only in the field of political science.[24] The case studies by GELB ET AL. (1988) and AUTY (1993) focus on macroeconomic policies, SACHS and WARNER (1995/1997) use an index for the rule of law in their crosscountry regressions, and MEHLUM ET AL. (2006) show "failed policies and weak institutions across the economy, including the lack of well-defined property rights, insecurity of contracts, corruption and general social instability" (BARBIER 2007) as the main reasons for the RC. Easily attainable resource rents increase the power of certain interest groups, cause myopia within the political class, and thus weaken political structures, macroeconomic policies and institutions (ROSS 1999). Weak institutions facilitate corruption, inhibit the rule of law, and decrease growth (MEHLUM ET AL. 2006). The question here is not only how endogenous factors, in combination with resource abundance,

[22] As SACHS and WARNER (2001) put it: "Natural Resources crowd out activity *x*. Activity *x* drives growth. Therefore Natural Resources harm growth".

[23] All of these reasons are also determined by the decline in relative prices of physical (manufactured) capital due to the emergence of China as a major global exporter (ZAFAR 2007; DI GIOVANNI ET AL. 2012).

[24] A high quality literature review is presented by ROSS (1999).

lead to the RC – a question that is not completely answered in the literature – but also if and how this is linked to GS.

According to a whole line of literature, such as PRZEWORSKI and LIMONGI (1993), ALESINA ET AL. (1996), BARRO (1996), HENISZ (2000) or JAMALI ET AL. (2007), the regime type of a country plays an important role in determining the structural principles behind economic development. Democracy supports economic growth (POURGERAMI 1988; HEO and TAN 2001) and since this is one of the pillars for sustainable development it could also influence GS rates positively, as DE SOYSA ET AL. (2010) show. The older the democracy, the more stable institutions and public investment in human or physical capital for the whole society tend to be. Newly democratizing countries are more often plagued by corruption and target their investments on government-backed interest groups (KEEFER 2007; KEEFER and VLAICU 2008).

Studies such as BULTE and DAMANIA (2008) or ANDERSEN and ASLAKSEN (2008) demonstrate that resource-dependent countries are less democratic, due, for example, to averted modernization and repression, which is enabled by resource wealth and preferential access to it by the political class that suppresses the democratization processes (ULFELDER 2007). Using cross-country regressions, ROSS (2001) shows that oil and non-fuel minerals are the most important resources both in the discussion of the RC and within the debate on how natural resource depletion (and the resulting slower GS rate) harms democracy. The greatest damage is seen in developing countries that combine resource-dependency and young democratic systems without strong checks and balances (COLLIER and HOEFFLER 2009).[25]

DE SOYSA ET AL. (2010) argue that democracy has a positive influence on GS because democratic governments deplete less natural capital and invest more in human capital. Their argument from the view of the RC is that democratic governments have to distribute the rents from natural capital more evenly across society, while autocracies have much less interest in their society and future generations, since autocratic governments do not have to fear their population at the ballot box.

Within this framework, the so-called "rentier effect" — that most resource abundant countries do not need domestic taxes — prevents governments from being accountable to their citizens (except for supporting interest groups) (LUCIANI 1987; ROSS 2001). This might make it easier to suppress democratization and social development and to marginalize less influential groups (HUNTINGTON 1991; HUMPHREYS ET AL. 2007). ROSS (2001) sees exactly this need to collect

[25] However, HABER and MENALDO (2011) criticize these approaches and demonstrate in their analysis that higher resource rents do not promote authoritarianism.

taxes as one of the main reasons for the development of strong institutions: He concludes that as long as resource rents are high enough, development will falter without domestic taxes, since public investment only has to satisfy regime supporters and not a broad populace of taxpayers.

There is broad consensus in the literature that poor macroeconomic and public expenditure policies are the main causes of slower growth in resource-dependent countries (ROSSER 2006) and negatively affect the GS rate due to ineffective reinvestment behaviour. ATKINSON and HAMILTON (2003) show that macroeconomics and the distribution of consumption and investment in public expenditures can offer a solid explanation for the RC. ROBINSON ET AL. (2006) state that politicians in resource abundant countries are confronted with incentives to consume rather than invest their rents from natural resources, since, independent of the political system, spending on public goods is auxiliary to retaining power. ATKINSON and HAMILTON (2003) show that there is significant evidence that public consumption and especially the wages and salaries of government employees, are negatively related to economic growth in resource-dependent countries. Public expenditures are inflated without an increase in productive physical and human capital. The level and quality of public and private investments are dependent on political macroeconomic decisions, ranging from those affecting the economic and financial system to those influencing labour market policies.

One of the most important endogenous explanations is the trade regime or its openness, which is related to GS in terms of integration into world markets. Exported natural resources and imported capital and non-durable goods (either public or private) influence all three forms of capital and thus GS. SACHS and WARNER (1995/1997) show that the dependency on primary exports first increases protectionism but later decreases it with greater dependency. Theoretically, this is based on the fear of the effects of Dutch disease, which disappear slowly with capital movement from the other sectors and the incapacity to further diversify to satisfy import-dependent market demand (SACHS and WARNER 1995/1997). Most resource abundant countries depend on imports and their governmental budget from trade taxes. The direct connection to a majority of the exogenous explanations is intuitive, as all of them are somehow related to trade. Traditional growth theory and empirical analyses predict openness and trade levels as having a highly positive influence on development (FRANKEL and ROMER 1999; IRWIN and TERVIÖ 2002), and DE SOYSA and NEUMAYER (2005) and BOOS (2011) show that a higher integration into world markets has the same positive effect on GS.

The quality of institutions is the foundation for political decisions and the general handling of natural capital abundance; it has been the factor discussed in most detail in RC literature since

ROSS (1999).[26] Several perverse incentives for the "wrong" behaviour of politicians and other responsible stakeholders cause policy and institutional failures. In a multitude of econometric or case studies, authors such as SALA-I-MARTIN and SUBRAMANIAN (2003), PAPYRAKIS and GERLAGH (2004) or ROBINSON ET AL. (2006) demonstrate that resource abundance affects institutions negatively and that the RC is more likely to affect countries with weak institutions. Most research refers to political and economic institutions without making a clear differentiation, while ACEMOGLU and ROBINSON (2008a, 2008b) show that high quality political institutions do not automatically result in the same quality of economic institutions. MEHLUM ET AL. (2006) show in cross-country regressions, following the original study by SACHS and WARNER (1995/1997); "that the quality of institutions determines whether countries avoid the resource curse or not". The following should serve as an initial overview and does not claim to be exhaustive.

The first and most important determinant for institutional quality is the level of corruption, which is officially defined as "the misuse of public or entrusted authority for personal gain" (KOLSTAD and SOREIDE 2009). The availability of resource rents and the easy access for private or public agents misusing their authority give rise to corruption (DIETZ ET AL. 2007). Furthermore, corruption is not only shown as decreasing economic growth but also as negatively influencing investment (MAURO 1995). DIETZ ET AL. (2007) prove a significant negative effect on GS: "Reducing corruption from the maximum to the minimum reduces the negative effect of resource abundance on […] GS […] by 61%" (DIETZ ET AL. 2007). All capital stocks are influenced by corruption. While received rents from the depletion of natural capital could be much lower than the global market prices within the GS calculation would indicate, their reinvestment is hindered by corrupt institutions clearly reducing the incentive to reinvest through the resulting uncertainties and higher transaction costs (BARDHAN 1997). Although there is no consistent definition of corruption in the case of GS, we have to distinguish between private and public abuse of natural capital (rents). In recent research, rent-seeking behaviour is separately discussed and isolated from mere corruption (LAMBSDORFF 2002). Rent-seeking encourages private agents to compete aggressively for resource rents and in so doing to use large shares of their own resources such as skills and time as well as capital.

[26] A complete line of literature, such as KNACK and KEEFER (1995), HALL and JONES (1999), ACEMOGLU ET AL. (2001, 2002b), EASTERLY and LEVINE (2003), DOLLAR and KRAAY (2003) or RODRIK ET AL. (2004) agrees on the importance of political institutions for economic growth; DIETZ ET AL. (2007), DE SOYSA ET AL. (2010) and BOOS (2011) show the same positive influence of institutional quality on GS. Also important to a discussion on their influence on GS is the argument by GLAESER ET AL. (2004) that good institutions are determined by policies which themselves depend on human capital. This reverse view would result in the opinion that the investment in human capital comes first: Higher GS would hereby influence institutions positively and not the other way around.

This is socially extremely costly and negatively affects GS. MEHLUM ET AL. (2006) show a decoupling of rent-seeking and productive activities because qualified agents can benefit more from being lobbyists or conducting similar work than from working in other sectors. BALAND and FRANCOIS (2000) and TORVIK (2002) show in their models that resource booms "result in more wasteful rent-seeking activity rather than greater entrepreneurship and investment in productive activities" (BARBIER 2007). If rent-seeking behaviour is not constricted enough due to weak political and legal institutions, these institutions are further weakened by the behaviour of the rent-seekers and, most importantly, the resource rents are disbursed instead of being reinvested. In general, the availability of resource depletion rents can generate corruption and reduce not only the investment itself but also its productivity (MAURO 1995).

Even rent-seeking within stable institutional structures without corruption could negatively influence GS. In the mining sector, rents tend to be concentrated in the hands of only a handful of economic agents and this could prevent efficient reinvestments in other sectors (BALDWIN 1956; BEVAN ET AL. 1987). Investment in physical or human capital other than in the mining sector is more productive if all rents from natural resources are fairly distributed throughout society (SALA-I-MARTIN and SUBRAMANIAN 2003; THE ECONOMIST 2003). Usually this distribution also depends strongly on institutional capacities (KARL 1997; ISHAM ET AL. 2005).

Patronage in the public sector reflects the relatively easy access of political leaders or others who control resources to use the country's resource wealth to maintain the status quo and retain their power or possessions (HUMPHREYS ET AL. 2007). "[N]atural resource rents offer governments both more opportunities and greater incentives to pay off political supporters to stay in power [and] since being in power tomorrow means having access to greater resource rents, politicians are willing to spend more today to stay in power" (KOLSTAD and SOREIDE 2009). Political leaders therefore avoid structural change and institutional development for the benefits of their own and their supporters. According to STEVENS and DIETSCHE (2008), the resulting conclusion is simple: strong institutions avoid patronage and political corruption, weak institutions instead support perverse incentives and have a negative impact on income and GS.

Directly connected with this public misuse of natural capital is the level of bureaucratic quality. A high proportion of resource-dependent countries, especially those affected by patronage, maintain a large inefficient bureaucratic apparatus to serve all interest groups and clans. This induces high transaction costs for users and a rather unreliable business environment. Important processes in business and investing are channeled through bureaucracies ranging from the registration of major contracts to small common procedures such as the registration of cars. The high level of uncertainty and slow processes hinder investment and consume significant resources in terms of time and costs (HUMPHREYS ET AL. 2007). Revenues from bureaucratic services – much like the absent taxes – are lower than in strong states, while more wages are publicly paid. Therefore, GS is indirectly determined by stalled investment decisions and human capital wasted in long processes, even if this is not demonstrable in the GS index. The composition of public and private consumption and investment also depends on the amount of publicly paid wages, and this directly influences the rate of GS (ATKINSON and HAMILTON 2003). Statistically, DIETZ ET AL. (2007) find no significant influence of a bureaucratic quality index on GS rates, while BOOS (2011) shows a positive relation between higher values of this index and GS.

The proxy for several determinants of institutional quality is the rule of law, which implies generally that “the law is sacred” and that checks and balances are in place to ensure its enforcement. Among other factors, the rule of law comprises the reliability of the judiciary system, political accountability and civil rights, property rights, and the security of contracts. In a sophisticated econometric analysis, NORMAN (2009) shows that higher initial resource stocks are related to the development of a lower quality rule of law. She shows that the rule of law is not directly influenced by higher resource exports, but rather functions as a transmission channel; countries with a weak rule of law suffer more from resource dependency. The connection to GS is also indirectly determined by “bad” policies, especially by insecure property rights (or contracts) and underlying risks for investors. Due to these insecurities, rents from natural resources are not reinvested. DIETZ ET AL. (2007) show that the rule of law does not have as significant an effect as corruption on the GS of resource-dependent countries. Nevertheless, they observe a decline of GS by 0.19% for 1% of additional resource exports if the rule of law is not present (worst index value). This corresponds with the original study by SACHS and WARNER (1995/1997) that approximates a small but highly significant positive influence of the rule of law on GDP growth. In the study by BOOS (2011), the same rule of law index shows a three times greater influence on GS rates than on GDP growth. A functioning rule of law seems more important for the “weakly” sustainable reinvestment of natural capital into the two other forms of capital than on short-term economic growth.

3.4.3 Remittances and the so-called aid curse

Two indirectly related sources of income that must be considered in a discussion of the RC are foreign aid and remittances. A large number of resource-dependent countries also depend on these two sources, which induce similar effects as the RC, since both are easily attainable as resource rents.

For example, by investigating their effects on different determinants of economic growth, BURNSIDE and DOLLAR (2000) find similar characteristics and consequences for the share of foreign aid of total GDP as for the share of natural resource rents, especially when examining the effect on the exchange rate. Yet there is no consensus on the influence of aid. BOONE (1996), for example, cannot find a significant relationship to investment or growth but instead finds one to the size of government. Analyses that include institutional quality find similar dynamics as in the endogenous explanations of the RC literature. Aid weakens macroeconomic and public expenditure policies through windfalls without economic performance, and due to their volatility, investment strategies are hard to plan (BULIR ET AL. 2008). Additionally, the investment of aid in physical and human capital is often earmarked for projects and could therefore be invested in sectors that crowd out more important investments (ROBINSON ET AL. 2006).

LÓPEZ-CÓRDOVA and OLMEDO (2006) provide a detailed overview of the developmental impacts of international migrant remittances. Recipient households are proven to invest more in human capital and to a smaller degree in small, productive, physical capital accumulating businesses. EDWARDS and URETA (2003) show a positive effect on private investment in human capital if the chance of migration is a possible option. However, it is argued that remittances are produced by emigrants who remove human capital from their respective country's stock, which affects governmental investment behaviour in education.

AMUEDO-DORANTES and POZO (2004) show the same appreciating effect of aid and remittances on the real exchange rate as in the case of Dutch disease. Additionally, ABDIH ET AL. (2008) develop a conjunction to the institutional quality by proving a negative relationship between the ratio of remittances to GDP and indices for corruption, government effectiveness and the rule of law. They argue that higher amounts of easily attainable foreign exchange increase the share of diverted funds by the government from both aid and remittances. This can therefore lead to the deterioration of institutional quality (ABDIH ET AL. 2008); DJANKOV ET AL. (2006) even show a reduction of the level of democracy in recipient countries. The World Bank itself sees the influence of donors on policies within aid-dependent countries as highly difficult and, considers the ex ante conditionality used until the end of the 1990s as failed (COLLIER and DOLLAR 2004). However, SACHS (1994), DOLLAR and SVENSSON (2000) and COLLIER (2006) show examples such as South Korea or Thailand where aid in combination with an *ex post* policy conditionality positively affected reform efforts and helped to improve institutions.

3.5. Conclusions

ATKINSON and HAMILTON (2003) recommend further work on the determinants of GS as its drivers are not sufficiently understood. To contribute to this line of research, this paper shows the strong relation between factors leading to the RC and factors leading to a decline of GS. The relevant prevailing literature deals mainly with single relationships. Therefore, we provide a comprehensive detailed overview of the complicated structural background of the intuitive relationship between the RC and GS as the most important indicator for "weak" sustainability.

Short-term volatility of resource prices in world markets cause planning uncertainty and therefore a higher ratio of consumption to investment of income from natural capital depletion. Even the positive long-term effects of increasing prices on the terms-of-trade of resource-dependent countries, usually positively related with economic growth, have a negative impact on GS since rents from resource exports are subtracted in its calculation. The directly related well-known theory of Dutch disease affects the composition of consumption and investment in physical and human capital through the appreciation of the real exchange rate and a movement effect of financial (physical capital) and workforce (human capital) related resources from manufacturing to the resource and service sectors.

The political system itself or the level of democracy play an important role for the rate of GS since democratic governments tend to deplete less natural capital and invest more in human capital. This depends in part on the quality of the participating institutions, but not entirely, as a high rate of resource depletion is possible even within strong institutional structures, since democratically elected governments are also prone to increase consumption expenses. However, institutional quality in terms of the level of corruption, bureaucratic services or the rule of law influences GS immensely because it changes the incentives and security of investments. Hence, the first phase of increasing institutional quality in resource-dependent countries with "bad" institutions could also increase natural capital depletion through a positive influence on investment in mining or other extraction infrastructure.

Reinvestment of rents from natural resource depletion in physical and human capital in adequate amounts (as measured by GS) and at a level of quality that supports development (not yet adequately measured), is one of the most important drivers of welfare growth and sustainable development. Resource-dependency and factors related to the RC strongly influence the three types of capital making up GS. Higher resource exports for the income of resource abundant countries automatically increase natural capital depletion, subtracted in GS. Every determinant summarized herein directly or indirectly influences reinvestment of rents from this natural capital depletion in physical and human capital. Our paper shows the most important channels through which the factors determining the RC might also influence the development of GS.

The first implication of the observation that countries with a high “level of natural resource extraction are also the poorest performers in terms of GS […]” seems obvious: These “[…] countries need to invest more of the proceeds of natural capital depletion into the formation of other forms of capital than they currently do” (HAMILTON and CLEMENS 1999). While this is certainly true, our determinants highly suggest that investment policies themselves may be affected by other exogenous and endogenous factors. Politicians must deal with an interdependent system of factors influencing each other. As summarized above, variances in world market prices and exchange rates, the political system and the quality of institutions directly influence “weak” sustainable development and its indicator, GS. In fact, these determinants shift investment behaviour; for example, weak institutions increase the probability that a government wastes rents from depletion of natural resources rather than reinvesting them sustainably.

Broadly speaking, strengthening political and institutional structures may be the most important prerequisite for resource-dependent countries to reinvest their rents from natural resources. The institutions related to natural capital depletion and its reinvestments are important for an appropriate reaction to the discussed exogenous factors that determine parts of GS and affect the endogenous possibilities of positively influencing GS development. Our study arrives at the overall conclusion that general policy implications are not easy to determine and most likely remain superficial. It reveals that the dependencies between single determinants are highly complex and dynamic. Furthermore, for resource dependent countries, country-specific characteristics might have an immense impact. For instance, if we look at individual resource-dependent countries with negative GS rates such as the democratic but extremely poor Zambia, with copper exports of around 40% of GNI, or the conflict ridden autocratic Syria with 20% oil exports, there is not a general answer to the question of how to increase GS rates in RC-affected countries. Human capital development and investment in infrastructure or other sectors than natural resources to push industrialization should at least provide an answer for a positive GS rate, but the channels to achieve these are different in every resource-dependent country.

Our paper provides a comprehensive theoretical overview of the relationship between the resource curse and genuine savings, bringing all possible approaches together. Further research should take a closer look at the extent and the direction of influential factors behind the RC on the development of GS rates, both generally and in specific cases and could use this theoretical overview as a guide.

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4. The relationship between the Resource Curse and Genuine Savings: Empirical evidence

Abstract The objective of this paper is to contribute to research on the determinants of Genuine Savings (GS) by investigating its relationship to the Resource Curse (RC). The substantial empirical evidence confirming that resource-abundant countries are often characterised by slower economic growth can be traced back to the argument that natural resources generate rents independent of economic performance. Recent studies show a negative relation of this so-called RC to GS, a concept that is meant to measure sustainability by considering reinvestments of exactly these rents from natural capital into physical and human capital. Our cross-country analysis examines the influence of determinants and transmission channels identified to cause the RC on GS and its components. Results show that factors leading to the RC are also useful explanatory variables for GS: A clear influence of the share of primary exports in GNI as well as of trade, consumption, quality of institutions, etc. is found. Via the migration of employees and appreciation of the exchange rate, Dutch disease is used to show how the RC works through the different types of capital that make up GS. As a side effect, this combination of dependent variables can explain the RC more comprehensively than GDP growth.

4.1. Introduction

"One of the surprising features of modern economic growth is that economies abundant in natural resources have tended to grow slower than economies without substantial natural resources" (SACHS and WARNER 1995/1997).

This so-called Resource Curse (RC) has been documented extensively, showing significant negative relationships between some measure of resource abundance and economic growth, usually the growth rate of per capita GDP.[27] The high shares of rents from natural capital depletion in the income of resource abundant countries links the RC to theories on sustainable

[27] Literature on this paradox offers a wealth of theoretical and empirical explanations ranging from the volatility of terms of trade and Dutch disease effects to the quality of institutions and the political system of a country. For literature reviews see for example ROSS (1999), ROSSER (2006), FRANKEL (2010), VAN DER PLOEG (2011), or BOOS and HOLM-MÜLLER (2012).

development, namely to the paradigm of weak sustainability: For lasting and weakly sustainable growth, the reinvestments of these rents in physical and human capital should at least equal the depletion of natural capital, thus holding a country's capital stock constant (NEUMAYER 2010).

Genuine Savings (GS)[28] as an indicator for "weak" sustainability measures the difference between the depletion of natural capital and investments in physical and human capital. As expected, it is comparatively low in resource-abundant countries. HAMILTON and CLEMENS (1999) suggest using this relationship to explain the RC. ATKINSON and HAMILTON (2003) demonstrate that countries will be particularly affected by the RC if natural resources, in combination with inappropriate public expenditure policies, lead to low GS rates. Thus, both papers conclude that GS is a good explanatory for the RC and provides an early warning for future declining economic growth. Consequently, this calls for research on determinants of the GS rate.

However, to a certain extent, it is an artefact to find a relation between an indicator such as GS that is by definition rather low in resource-abundant countries, due to their higher depletion of natural capital and a theoretical construct based on the dependence on income from natural resources. Therefore, in searching for GS determinants, we utilize this proven relation between GS and RC but interpret it differently: A variable that reflects a theory as such suggests itself as endogenous rather than exogenous. We build on this and analyze the determinants of the GS rate as well as its components by using factors already identified in literature to cause the RC. We confirm that theories and factors behind the RC are directly related to determinants of the GS rate. We also show how its single components are influenced by the curse.

The main objective of this paper is thus to contribute to the research on determinants of GS by investigating the empirical relationship between the RC and GS. In using Genuine Savings and the change rates of physical, human and natural capital that make up GS as dependent variables, we additionally illustrate that this combination of dependent variables is applicable to show the RC more comprehensively than GDP growth.

To our knowledge there are so far three studies on the determinants of GS and one on genuine income by the research team including de Soysa and Neumayer (NEUMAYER 2004; DE SOYSA and NEUMAYER 2005; DIETZ, NEUMAYER and DE SOYSA 2007; DE SOYSA, BAILEY and NEUMAYER 2010), whose results on economic openness and political stability are addressed in our empirical analysis. They all regard single aspects of the relationship between the RC and

[28] "Adjusted net savings" in World Bank terms.

GS. DIETZ ET AL. (2007) for example show the negative influence of corruption on GS in resource-abundant countries. Additionally, HESS (2010) analyzes GS determinants in developing countries and shows a significant influence of the share of fuels, ores, and metals in merchandise exports. However, to our knowledge no empirical study has investigated the relationship between the RC and GS systematically.

We methodically build on the study by NEUMAYER (2004): He reproduces the original RC study by SACHS and WARNER (1995/1997)[29] using the growth rate of genuine income and shows the same negative effect on GDP. His dependent variable originates from the World Bank's GS dataset but only deducts the depreciation of physical capital and parts of natural capital depletion from GDP. Additionally, GS subtracts consumption as well as damage from CO_2 emissions. However, the most important difference is the inclusion of investment in human capital by adding education expenditures. The aim of this paper is not to discuss these extensions. We think GS is useful despite some drawbacks, offset by its public availability and international comparability.[30] Nevertheless, our paper will add to the discussion of GS since its determinants are not sufficiently understood so far. A better understanding will support interpretation, criticism and further development. In using the intuitive relationship between this indicator and the RC, we contribute to its explanation.

Our study also starts with regressions analogous to the original by SACHS and WARNER (1995/1997), with GS as dependent variable. After showing that the RC still holds true for GS, even over an extended period, we expand the regressions by investigating the effects on the single capital types and by adding more explanatory variables. We show that GS is more closely related to the RC than GDP. The following chapter surveys the theoretical background; then we describe the empirical analysis and discuss the results in view of these theories.

4.2. The theoretical relationship between the RC and GS

The RC denotes the effect that countries richly endowed with natural resources often show slower economic growth. Research behind it seeks to find explanations for this paradox, varying the measures for resource-abundance from study to study but reporting a similar core message: Higher dependency on the income from natural resources causes slower per capita GDP growth, more or less independent from the other economic or policy variables used

[29] SACHS and WARNER (1995/1997) show for the first time in their renowned cross-country analysis that an increase in primary exports results in a decline of the growth rate of GDP per capita.

[30] For detailed discussions see ATKINSON and HAMILTON (2003) or NEUMAYER (2010).

(SACHS and WARNER 2001). GELB (1988) and AUTY (1993) show the political difficulty for governments to save (and not spend) the rents from natural capital and the lack of institutions to reinvest this income efficiently. The problem of insufficient reinvestment of resource-related profits links the RC and the theories behind it to the paradigm on weak sustainability and its indicator GS.

Weak sustainability is based on the assumption that different forms of capital are in principle substitutable and that only a country's total capital stock is important to "maintain the capacity to provide non-declining utility for infinity" (NEUMAYER 2010). The so-called "Hartwick rule" (HARTWICK 1977) provides a "rule of thumb" for weak sustainability: Keep a country's total capital stock at least constant to allow for sustained consumption over time and therefore "invest into all forms of capital at least as much as there is depreciation of all forms of capital" (NEUMAYER 2010). This can be traced to the concept of "Hicksian income" (HICKS 1946), which states that a country should only consider the interest on its capital stock as income. While the latter may be consumed, the stock has to stay constant to be as well off over time as at the beginning. GS illustrates basically this mix of consumption and savings, theoretically seen as the reinvestment of depleted natural capital into other forms of capital, the net investment into the total capital stock (DIETZ ET AL. 2007).

Resource-abundant countries deplete more natural capital and need to reinvest more to achieve positive GS rates. However, since the first case studies by GELB (1988) and AUTY (1993), we know that most resource abundant countries consume their income from resource exports rather than reinvest these rents. Theoretically, these countries live on their capital stock and decrease future welfare. Using their natural capital for present welfare erodes the basis for development by not investing this income into physical capital such as infrastructure or human capital such as education. Since this also results in decreasing future GDP, negative GS could be seen as early sign for a possible curse in resource-abundant countries (ATKINSON and HAMILTON 2003).

By dividing the analysis into the three forms of capital, it can be shown in more detail how theories and explanations behind the RC influence the respective GS components. In the following, we explain the calculation method of GS and link the different parts directly to the theories behind the RC: GS as an indicator for weak sustainability was developed by PEARCE and ATKINSON (1993), HAMILTON (1994), PEARCE ET AL. (1996) and HAMILTON and CLEMENS

(1999). Based on traditional gross national income (GNI), GS includes the change rates of the three forms of capital, physical (K_P), human (K_H) and natural (K_N):[31]

$$Genuine\ Savings\ (GS) = (GNI - C_P - C_G + NCT) - depreciation\ of\ K_P + education\ expenditures\ (\delta K_H) - natural\ resource\ depletion\ (\delta K_N) \qquad (23)$$[32]

Gross national income (GNI) minus private (C_P) and public (governmental) consumption (CG) plus net current transfers (NCT) refers to gross national savings (GNS). This is based on the aforementioned rule that only an optimal mix of consumption and savings (where income is principally divided into these two alternatives) can maximize intertemporal welfare (DIETZ ET AL. 2007). NCT comprise all exchanges with foreign countries of goods and services as well as income and financial items without a quid pro quo (WORLD BANK 2011a, b). The resulting GNS are theoretically seen as gross investment in physical capital.

However, physical capital also depreciates over time and subtracting this so-called consumption of already existing produced capital from GNS leads to net national savings (NNS), which - at least theoretically – is equivalent to **net investment** in **physical capital** (**δK_P**) (HAMILTON and CLEMENS 1999).

While NNS already contains the physical part of total education expenditures including investment in school buildings, other investments in human capital - such as the purchase of school books or payment of teachers' salaries - are traditionally treated as consumption (HAMILTON 2006). Therefore, GS adds current operating expenditures on education as a rather crude approximation for **investment** in **human capital** (**δK_H**).

Consumption of **natural capital** (**δK_N**) is considered by subtracting the depletion of different natural resources and the damages from CO_2 emissions (HAMILTON and CLEMENS 1999; HAMILTON 2006): The depletion of natural resources is composed of the rents of energy and mineral resources and that of net forest depletion.[33] These rents demonstrate the change in the natural resource asset value associated with their extraction over the accounting period and therefore the change in the natural capital stock (ATKINSON and HAMILTON 2007). Social costs from CO_2 emission damages are assumed to be US$20 (in 1990) per emitted metric ton

[31] Detailed calculation descriptions and definitions can be found in BOLT ET AL. (2002), HAMILTON (2006), or WORLD BANK (2011).

[32] http://data.worldbank.org/indicator/BN.TRF. CURR.CD.

[33] Resource Rent = Production Volume * (International Market Price – Average Unit Production Costs).
Energy depletion covers crude oil, natural gas and coal.
Mineral depletion refers to bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver.
Net forest depletion refers to roundwood harvest minus natural growth; this is set to zero if growth exceeds depletion.

(FANKHAUSER 1994a, 1994b). However, air pollution is not considered a direct depletion of a country's natural capital stock, rather a transboundary depletion of all forms of capital (ATKINSON and HAMILTON 2007). Therefore, an analysis bringing the RC and GS together should differentiate between natural capital and damages by carbon dioxide.

Since the depletion of energy, mineral and wood resources is calculated using actual world market prices, the **volatility** of primary commodity prices substantially influences the rents making up δK_N within GS without changing the actual amounts depleted in tons (BOOS and HOLM-MÜLLER 2012). In resource-abundant countries the depletion of natural capital δK_N primarily goes into exports while a large part of investment in K_P is determined by imported consumption and capital goods (BARBIER 2007). However, due to these volatile **terms of trade (ToT)**, investments in K_P suffer from planning uncertainty and a higher elasticity of demand for imported consumption than investment. Therefore increases in K_N turn out to be higher than in K_P (BLATTMAN ET AL. 2007; KOREN and TENREYRO 2007). Therefore, the ratio of δK_N to δK_P changes in the same direction as a country's ToT, since these represent the ratio between the price indices for exports and imports and – in contrast to GDP growth – GS rates are negatively influenced by increasing ToT (BOOS and HOLM-MÜLLER 2012).

This is directly related to the most famous exogenous explanation from the RC literature, **Dutch disease (DD)**: a boom in the natural resource sector - either induced by the discovery of new reserves or increasing world market prices - results in higher rents within the calculation of δK_N and increasing export revenues. This additional income on the one hand increases the demand for goods from the other sectors and thus changes the relation of consumption and investment. On the other hand it causes the real exchange rate to appreciate. The additional demand for manufactured goods has to be met by imports, increasing competition in this sector (DAVIS 1995) and further facilitated by the higher exchange rate (KRUGMAN 1987).

While manufacturing relies on world markets, the prices and therefore wages in the service sector rise due to additional demand and therefore employees move from manufacturing to the resource and service sector (AUTY 2007). While this decreases investments in K_H, due to more unskilled production processes in these two sectors, on the other hand the service sector is more labour-intensive and requires less investment in K_P (DIETZ ET AL. 2007). The capital-intensive mining sector attracts high investments in K_P but still crowds out investment in more productive sectors. In summary, due to DD effects, δK_N increases while reinvestments in the other two forms of capital are negatively influenced (GYLFASON 2001a).

These exogenous explanations could result in a higher integration into world markets, in traditional economics an important factor for growth (IRWIN and TERVIÖ 2002). **Trade openness** influences δK_N via income (rents) from exports, δK_P via imports for consumption and capital goods and the public budget via trade taxes. However, openness typically leads to a diversification of the economy, thus it is positively related to GS (DE SOYSA and NEUMAYER 2005; DE SOYSA ET AL. 2010).

Nonetheless, openness or exposure through integration into world markets is related to the **political system** itself and its transmission channels through the **quality of institutions**. Not only do various studies demonstrate that resource-abundant countries are less democratic (ROSS 2001; DE SOYSA and NEUMAYER 2005), DE SOYSA ET AL. (2010) also show that democracy has a positive influence on GS, because democratic governments deplete natural capital less and invest more in human capital. However, democracy has to be supported by strong institutions:

Weak **rule of law** decreases GS through insecure structures for daily economic behavior and investment due, for example, to an unreliable judiciary system or insecure property rights. The level of **corruption** - either private or public - has the worst effect on investment behavior and GS rates in the study by DIETZ ET AL. (2007). Resource rents constitute an easily attainable source of income and corrupt agents use these rents for consumption rather than investment. However, corruption is not only built on rents, political patronage to sinecure interest groups has similar negative effects on GS. Due to high transaction costs for private investors and decreasing public investment opportunities through higher publicly paid wages, a weak quality of **bureaucratic services** contaminated by patronage influences GS negatively. Finally, all of these factors influence **macroeconomic** and **public expenditure policies**, according to ATKINSON and HAMILTON (2003) the most important conjunction between the RC and GS, since they affect the composition of consumption and investment.

In summary, literature reveals the most important factors leading to RC as: higher incentives for consumption than investment, volatility, DD effects and quality of institutions. In the following, we consider the theoretical relations between the RC and GS empirically. We start by explaining our proceedings and close with a comprehensive discussion of the results from the view of these theoretical explanations.

4.3. Empirical Analysis

4.3.1 Research Design

Most data in this work stems from the World Bank's online Data Catalog for World Development Indicators and Global Development Finance.[34] We extract GDP, GS and its components (physical, human and natural capital as well as carbon dioxide damage), primary exports and total trade as well as data on consumption, interest and exchange rates, share of employees in the service sector and remittances from abroad in order to reflect theoretical influences described in the chapter above. Additionally, we use data on the investment share of real GDP from the Penn World Tables 6.3 (HESTON ET AL. 2009) and indices for the rule of law, corruption and bureaucratic quality from the International Country Risk Guide by the Political Risk Service (PRS).[35] In order to insert the quality of the political system, we drew the most respected democracy index Polity IV from the Colorado State University Polity IV Project.[36] Which series we finally use is described in the respective regression.

Following NEUMAYER (2004), our first step is repeating the basic regressions in which SACHS and WARNER (1995/1997) analyze the RC for the first time in a detailed cross-country analysis. This original study uses average data from 1970 to 1990 for a sample between 71 and 87 developing and industrialized countries depending on the applied explanatory variables. It shows that an increase in the average share of exports of primary products in GDP results in slower average growth rates of GDP per capita independent of the additional explanatory variables. NEUMAYER (2004) confirms that this also holds true for the period from 1970 to 1998 as well as for growth in genuine income.[37]

Since we use a longer period, 1970 to 2008, we have to replace some of the explanatory variables from these two original studies with analogous ones from a theoretical viewpoint, explained below. Table 1 in the next chapter, shows the results of six regressions in six columns. We start by mimicking the original model, then replace the endogenous with the average rate of GS and then investigate the different types of capital. In Table 2, we summarize the regressions with additional variables.

[34] http://data.worldbank.org/data-catalog.
[35] http://www.prsgroup.com/CountryData.aspx.
[36] http://www.systemicpeace.org/polity/ polity4.htm.
[37] In NEUMAYER (2004) genuine income is GDP minus the depreciation of produced and natural capital. Since this study by NEUMAYER (2004), the World Bank publishes genuine income as adjusted net national income in its World Development Indicators: http://data.worldbank. org/data-catalog.

In our first analysis (results in Table 1, regression 1), we regress the average annual growth rate of GDP per capita between 1970 and 2008 (**GDP7008**) on the initial GDP per capita in 1970 and the average share of exports of primary products (agricultural, mineral and energy resources) in GNI between 1970 and 2008 (**SXP7008**). Contrary to SACHS and WARNER (1995/1997), we use the average share over the whole period as our proxy for resource dependence, since the single base year 1970 used in the original study loses its applicability when analyzing across forty years.

For the integration into world markets, we apply the average share of total trade (imports and exports) in GDP – the typical proxy in empirical literature (BARRO and SALA-I-MARTIN 2004) – between 1970 and 2008 (**TRADE7008**). The openness index used by SACHS and WARNER (1995/1997) cannot be expanded beyond the year 1990. As in the original analyses, the investment share of real GDP (**INV7007**) from the Penn World Tables (HESTON ET AL. 2009) provides a proxy for the handling of natural resource income: the investment in produced capital.

The rule of law index from 1982 used by SACHS and WARNER (1995/1997) is today only available from 1984 on in the International Country Risk Guide. However, instead of only a single year we use the average index value between 1984 and 2008 (**RL8408**). The average growth rate of the net barter terms of trade index between 1980 and 2008 (**TOT8008**) by the World Bank completes the first regression.

In regression 2, GDP is replaced by GS. We regress the average rate of GS between 1970 and 2008 in % of GNI (**GS7008**) on the initial GS from the individual years for which it is first available (different years depending on the country), and the same five additional explanatory variables as in column 1. In regression 3, we use NNS in % of GNI as dependent variable for the average change rate in physical capital between 1970 and 2008 (**KP7008**). The average education expenditures in % of GNI comprise the average investment in human capital between 1970 and 2008 (**KH7008**) in regression 4. In regression 5 and 6, we differentiate the consumption of natural capital in the actual average depletion of natural resources (**KN7008**), which relates the RC directly to GS, and the damages by carbon dioxide (**CARB7008**), due to the argument that CO_2 emissions are not only a direct depletion of a country's natural capital, rather a transboundary one of all capital forms. By regressing the three forms of capital on their initial values and the same explanatory variables as in regressions 1 and 2, we show the influence of these determinants on the different components of GS. To our knowledge, only DE SOYSA ET AL. (2010) have used similar dependents, regressing on another set of determinants.

In Table 2, we add variables applicable as proxies for additional theories and hypotheses behind the RC, such as DD. Dependent variables, initial values, the average share of primary exports (SXP7008), total trade (TRADE7008), and the growth rate of the terms of trade index (TOT8008) remain constant as in Table 1. However, in Table 2, we complement the share of primary exports with easily attainable exogenous source of income by remittances received from migrant workers (**REMI7008**), since most resource-abundant countries also depend on them.

In Table 1, we test the argument that GS are net investments in the total capital stock of a country and therefore the investment share of real GDP (INV7007) theoretically has a positive influence on KP and the total GS rate. In Table 2, we then test the counterpart of this argument, that a higher share of consumption should affect GS negatively and exchange investment by the average consumption share of real GDP (**CON7008**) (due to multi-collinearity we cannot use both in the same regression).

Following arguments by ATKINSON and HAMILTON (2003), who state that macroeconomic policies and public expenditures have an important impact on the distribution of investment and consumption and therefore also on the relationship between the RC and GS, we use the average real interest rate (**INT7008**) as a proxy for a country's macroeconomics and as the average price for investment or compensation for savings, respectively.

As a proxy for DD's so-called spending effect, which states that additional income from resource exports should appreciate the real exchange rate, we use its average growth rate between 1970 and 2008 (**EXCH7008**). The hypothesis of the movement effect – that workers migrate from traditional sectors either to work in the booming resource or growing service sector – is proxied by the average share of employees in the service sector to total employment (**EMSER7008**).

As DIETZ ET AL. (2007) show, there are other important institutional factors influencing the rate of GS besides the rule of law. To have a more general institutional variable, we combine the index for the rule of law from Table 1 with indices for corruption and bureaucratic quality - all surveyed in the same scale by PRS – and create averages from these three indices from 1984 to 2008 (**IQ8408**). Multi-collinearity prevents us from using the individual indices together; therefore we additionally show the results separately. However, since the other coefficients only change slightly, we report the results for **RL8408**, **COR8408** and **BQ8408** separately and not the entirely new models. In the last row of Table 2, we exchange IQ8408 with the average value of the democracy index Polity IV (**POL7008**), since we know from DE SOYSA ET AL. (2010)

that democratic development influences GS rates positively. This index includes opportunities for political expression and gaining executive power through competitive elections, as well as its transfer and constraints.

4.3.2 Results and Discussion

In regression 1, we see that the main results by SACHS and WARNER (1995/1997) and NEUMAYER (2004) also hold for this longer period and for a larger sample. Detailed conclusions for GDP growth can be found in these studies. All variables apart from terms of trade stay significant with the same signs as in the original studies. It seems that terms of trade growth loses its positive link to GDP growth in the period between 1980 and 2008 used in our regressions compared with the period from 1970 until 1990 analyzed by SACHS and WARNER (1995/1997). Beside the average growth rate of the net barter terms of trade index (**TOT8008**), we also checked for the average index values and the average volatility rate of world market commodity prices between 1970 and 2008 without significant results. In the original study by SACHS and WARNER (1995/1997), it was only slightly significant at the 10% level (and no longer significant at any level in the study by NEUMAYER (2004)). Average international commodity prices were subject to 10.5% fewer fluctuations in the longer period from 1980 to 2008 used in our analysis. Therefore, this insignificance might be simply due to a lack of variance.

Regression 2 assigns the exogenous variables to the average rate of GS between 1970 and 2008 (**GS7008**). For most variables, the same signs apply but the initial values have a positive influence since GS rates are measured in % of GNI and not as growth rates. While a higher initial GDP level results in smaller growth rates, there is an intuitive relationship between the initial GS rate and its average value over the next 39 years. By nature of its calculation, the average GS rate between 1970 and 2008 is more negatively influenced by the share of primary exports in GNI than GDP: A 10% increase in the average share of primaries (**SXP7008**) is estimated as decreasing the average GS between 1970 and 2008 by around 1.4% compared with 0.3% for GDP growth (in the original 21-year analysis this is more than 1% (SACHS and WARNER 1995/1997)). However, it has to be kept in mind that this is sound to a certain limit since the GS rate is around 8% of GNI while the growth rate of GDP per capita is averagely around 2% over the whole sample.

As expected, the share of primary exports in GNI between 1970 and 2008 (**SXP7008**) increases the depletion of natural capital (in regression 5) but shows no significant relationship to the change rates of the two other forms of capital. The difference of the SXP7008 coefficients in 2 and 5 can be interpreted as the reinvestment realized in the two other forms of capital, as δK_N is subtracted in the calculation of GS. Looking at these numbers reveals that reinvestment is small, mirroring the discussion that resource-dependent countries "[…] need to invest more of the proceeds of natural capital depletion into the formation of other forms of capital than they currently do" (DIETZ and NEUMAYER 2006).

As DE SOYSA and NEUMAYER (2005) show, the economic openness of a country, here reflected by the integration into world markets (**TRADE7008**), positively influences the rate of GS. While the share of trade in GDP shows a significant positive influence on all calculation parts of GS in DE SOYSA ET AL. (2010), we estimate only a slightly positive influence on investment in physical capital (**KP7008**) and therefore the total GS rate; the integration into world markets results in diversification away from exclusively living from natural capital and decreases the prices of imported capital goods that comprise the basis for investment in KP. A 10% higher share of total trade in GDP increases GS by around 0.4%.

The investment share of real GDP (**INV7007**) influences GDP growth positively in the original studies as well as in regression 1. However, while the growth rate of genuine income in the analysis by NEUMAYER (2004) is also positively related to increasing investments, Table 1 shows its only link besides GDP to the damages from CO_2 emissions (in regression 6). That is, higher investments increase emissions, which could be related to investments in the manufacturing sector. Interestingly, INV7007, which measures the average gross investment in physical capital is not estimated to have an influence on KP7008 – theoretically intended to show the net investment in physical capital – or on GS itself.

Higher index values for a country's rule of law (**RL8408**) decrease CO_2 emissions, increase the investment in human capital (KH7008) and are therefore related to a higher total GS rate (regressions 2, 4 and 6). The average rule of law from 1984 to 2008 influences even the growth rate of GDP per capita more than in the original study by SACHS and WARNER (1995/1997), which only uses the index value for one year in 1982. Interestingly, the period average from 1982 to 1995 applied in the analysis by NEUMAYER (2004) does not show any effect on GDP or genuine income. Clearly, for the 1980s through the mid-1990s, rule of law was not as important for economic growth and sustainable development as it was for the remaining period until 2008.

Table 1: Dependent Variables: GDP, Genuine Savings and its components 1970-2008.

	1	2	3	4	5	6
	GDP7008	**GS7008**	**KP7008**	**KH7008**	**KN7008**	**CARB7008**
Initial	-0.0004	0.28	0.23	0.63	0.31	0.39
	(-3.57)***	(4.12)***	(4.0)***	(11.1)***	(3.51)***	(6.1)***
SXP7008	-3.05	-14.38	6.2	-0.1	16.01	0.34
	(-2.66)***	(-2.21)**	(1.16)	(-0.1)	(3.13)***	(1.24)
TRADE7008	0.82	3.87	2.76	-0.1	-0.82	-0.06
	(2.4)**	(2.16)**	(1.72)*	(-0.49)	(-0.42)	(-0.71)
INV7007	3.24	13.47	5.1	1.42	-9.78	1.06
	(2.07)**	(1.59)	(0.68)	(1.42)	(-1.52)	(2.75)***
RL8408	0.52	1.49	0.58	0.22	-0.66	-0.09
	(3.49)***	(2.36)**	(1.01)	(2.95)***	(-1.29)	(-2.9)***
TOT8008	0.02	-0.75	0.1	-0.0004	0.84	0.007
	(0.56)	(-3.17)***	(0.43)	(-0.016)	(4.19)***	(0.61)
N	107	103	104	104	99	108
Adjusted R2	0.32	0.48	0.28	0.67	0.65	0.42
F-statistic	9.2	16.94	7.62	35.11	31.09	13.67

*** Significant at 0.01 level, ** at 0.05 level, * at 0.10 level (t-values in parentheses)

The only different sign compared to the original study by SACHS and WARNER (1995/1997) appears in the growth rate of terms of trade (**TOT8008**). Their analysis finds it positively influencing GDP growth. The authors assign this to the Prebisch-Singer thesis arguing that decreasing terms of trade of primary commodity exporters slow economic growth (PREBISCH 1950; SINGER 1950). This is due to the composition of GS that terms of trade influence it negatively (in regression 2): KN (in regression 5) is positively affected since an increase of terms of trade means higher prices for exports at least relative to imports. Higher resource prices result in increasing depletion, either through real increases in depleted amounts or by the calculation method through world market prices. An increase of KN decreases GS as soon as there is no sufficient reinvestment. Therefore, a higher average growth rate of a country's terms of trade results on average in smaller GS.

In the extended regressions in Table 2, we keep SXP7008, TRADE7008 and TOT8008. They show the same signs as in Table 1 with minor differences: Despite more control variables, all of which are discussed in the following, the share of resource exports in GNI (**SXP7008**) influences GDP as well as GS more negatively and significantly than in Table 1. Additionally, there is a highly significant negative influence of resource exports on investments in physical capital (KP7008) (in regression 9). Although we did not find the same result in Table 1 this was theoretically expected due to the argument that investments in the resource sector crowd out those in more productive sectors. Therefore, a higher share of income from the export of natural resources in GNI decreases investments in physical capital at least relatively to the share of additional consumption. The above argued diversification by higher openness is additionally mirrored by the negative influence of **TRADE7008** on the depletion of natural capital in regression 11. The positive link between trade and GS is higher and more significant, as in Table 1.

Moreover, we use average net incoming remittances in % of GDP between 1970 and 2008 (REMI7008) to control for other exogenous income sources besides primary exports in order to ensure that the observed effects really stem from the dependence on the exports of natural resources. We also tested foreign aid and development assistance unsuccessfully, theoretically also negatively influencing the spending behavior in resource-dependent countries. All of these exogenous factors do not prevent the export of primary goods from being significant. Choosing remittances was logical since a great deal of resource-abundant countries also depend on this other foreign income source (LÓPEZ CÓRDOVA and OLMEDO 2006). Remittances are positively linked to GS through high investments in KP. Recipient households are proven to invest in private education and in small, productive businesses. However, the mere level of investment in KP also predicts high additional investments in, for example, the manufacturing sector.

Due to the argument that consumption should decrease GS since consumed income is not invested into a country's capital stock, we replace the insignificant share of investment from Table 1 with the average total consumption share of real GDP between 1970 and 2008 (**CON7008**). Increased consumption is significantly negatively related to GDP growth as well as the rate of GS (in regressions 7 and 8). Although both coefficients for GDP7008 and GS7008 have to be interpreted carefully due to partial identity problems,[38] these results support the theories behind the RC and GS concerning the consumption of natural capital: As expected, higher consumption negatively influences reinvestment in KP (in regression 9) and therefore the total rate of GS. Since increasing consumption is also statistically related to a decrease in the depletion of KN (in regression 11), the difference between these two coefficients almost count for the negative one of total GS (regression 8).

Following ATKINSON and HAMILTON (2003), we also tested public consumption due to their findings that "countries that have primarily used resource abundance to finance current consumption have fared far less well" than the ones whose governments "have used resource abundance to finance investments". Our results show no significant difference between public or total consumption. Therefore, we keep total consumption in the regressions based on the fact that private consumption also increases as the income elasticity of demand for the consumption of manufactured goods is higher than for investment in capital goods (BARBIER 2007).

Public expenditure policies dividing the governmental budget into consumption and investment depend on macroeconomic policies as do private saving and investment decisions. Therefore, in addition to the share of consumption, we use the average real interest rate (**INT7008**) as a proxy for a country's macroeconomics. As the average compensation for savings or the market price for investments respectively, this influences GS positively. Higher interest rates cause an increase in savings but there is no significant sign that smaller interest rates result in investment in other capital forms than natural. However, the negative link between the interest rate and KN7008 could serve as an argument that higher interest rates result in investments other than mining.

The average growth rate of the official exchange rate (**EXCH7008**), following the DD hypothesis of appreciation due to the increasing income influx from natural resource exports (or

[38] In both, somewhere along the calculation path, consumption is used as content and therefore, within regressions 1-2 and 7-8, this appears on both sides of the equation.

other income sources such as remittances), influence investment in KP (in regression 9) and total GS (in regression 8) negatively. Possible reasons for this include increasing consumption shares in income when imports become cheaper as well as a decreasing governmental budget for investments from trade taxes in domestic currency. Since GYLFASON ET AL. (1999) state that not only the pure appreciation has a negative impact on economic growth, but also uncertainties resulting from exchange rate volatility, we checked for this using a volatility index without significant results.

The other DD effect, the migration of workers from the manufacturing into the resource and the service sector shows through our proxy – the share of employment in the service sector in total employment (**EMSER7008**) – the expected negative influence on KP (in regression 9). This is logical since the service sector needs less investment in KP, but we did not find the expected negative effect on KH. Following the crowding out argument in the theory of the DD – as explained in 4.2 – worker migration should also decrease KH (in regression 10). Additionally, the higher negative coefficient on total GS compared with the one on KP indicates a negative background effect not shown in this model. However, since our sample not only includes resource-dependent but also industrialized countries with sophisticated service sectors such as finance or consulting that involve higher average investments in KH, this cancels any significant effects. Nevertheless, the positive link to the depletion of KN (in regression 11) additionally supports the theory of the DD.

As the only study known so far using GS as dependent variable in combination with explanatory variables for the RC, DIETZ ET AL. (2007) show that in interaction with resource-abundance, a lack of institutional quality is a serious factor for low rates of GS. They use a panel analysis to demonstrate that corruption is one of the major determinants negatively influencing GS and that a stronger rule of law also has a positive influence on GS. All three indices for corruption, rule of law and bureaucratic quality used by this analysis are measured in the same way.[39] Therefore, we put all three together to one index of institutional quality from 1984 to 2008 (IQ8408): As expected, higher institutional quality is linked to less depletion of KN (in regression 11) and higher education expenditures (in regression 10), showing that the total GS rate (in regression 8) is positively influenced by the quality of institutions. Clearly, good institutions are related to a greater diversification of the economy beyond depleting natural resources, which entails preserving parts of this stock and investing more in human capital for sophisticated production processes and services.

[39] Data is from the International Country Risk Guide by the Political Risk Service: http://www.prsgroup.com/CountryData.aspx.

Table 2: Dependent Variables: GDP, Genuine Savings and its components 1970-2008

	7	8	9	10	11	12
	GDP7008	**GS7008**	**KP7008**	**KH7008**	**KN7008**	**CARB7008**
Initial	-0.0006	0.22	0.14	0.57	0.31	0.61
	(2.52)**	(3.39)***	(2.9)***	(9.1)***	(2.65)***	(7.26)***
SXP7008	-5.82	-35.85	-12.01	0.84	25.77	0.47
	(-4.24)***	(-4.94)***	(-2.66)***	(0.91)	(4.54)***	(1.19)
TRADE7008	0.86	5.81	1.42	0.1	-3.82	-0.003
	(2.21)**	(2.9)***	(1.16)	(0.39)	(-2.49)**	(-0.03)
TOT8008	0.005	-0.57	-0.24	-0.002	0.22	0.003
	(0.1)	(-2.44)**	(-1.53)	(-0.05)	(1.23)	(1.41)
REMI7008	14.13	92.5	102.72	5.49	3.9	3.97
	(2.64)**	(3.64)***	(6.03)***	(1.52)	(0.21)	(2.58)**
CON7008	-10.18	-40.55	-68.24	0.09	-24.64	-0.73
	(-5.36)***	(-4.57)***	(-10.95)***	(0.07)	(-3.78)***	(-1.3)
INT7008	-0.21	20.68	3.83	-1.17	-12.85	0.11
	(-0.13)	(2.74)***	(0.75)	(-1.11)	(-2.29)**	(0.25)
EXCH7008	-0.02	-0.18	-0.15	0.01	0.02	0.0004
	(-1.44)	(-2.39)**	(-2.9)***	(0.48)	(0.4)	(0.1)
EMSER7008	-0.64	-13.75	-8.0	0.28	6.41	-0.38
	(-0.72)	(-3.45)***	(-3.0)***	(0.49)	(2.22)**	(-1.57)
IQ8408	0.13	0.42	-0.22	0.14	-0.51	-0.01
	(1.97)*	(1.95)*	(-1.59)	(4.5)***	(-2.81)***	(-1.0)
RL8408	0.54	1.24	-0.31	0.3	-0.1	-0.03
	(3.4)***	(2.11)**	(-0.79)	(3.22)***	(-2.1)**	(-0.87)
COR8408	0.27	1.45	-0.9	0.39	-2.11	-0.03
	(1.39)	(2.1)**	(-1.97)*	(3.65)***	(-3.7)***	(-0.73)
BQ8408	0.22	2.39	-1.1	0.74	-2.63	-0.1
	(0.78)	(2.58)**	(-1.76)*	(5.97)***	(-3.64)***	(-1.43)
POL7008	-0.01	0.41	0.02	0.05	-0.51	-0.002
	(-0.31)	(4.02)***	(0.22)	(3.45)***	(-4.87)***	(-0.37)
N	85	84	85	84	80	85
Adjusted R2	0.45	0.63	0.7	0.72	0.73	0.51
F-statistic	7.76	14.85	20.14	22.12	21.88	9.84

*** Significant at 0.01 level, ** at 0.05 level, * at 0.10 level (t-values in parentheses)

We also examine the single indices, only reporting their results and not the entirely new models, since the remaining outcome does not change substantially. In Table 1, rule of law (RL8408) positively influences GS through a decrease in the depletion of KN and higher investments in KH. Corruption (COR8408) shows the same signs but a stronger influence and an additional positive correlation to the investment in KP (in regression 9). Neither the coefficient nor the significance is high but it seems interesting that corruption could be related to further investment. Possible explanations are so-called "white elephants", investment projects with sinecures for certain interest groups but negative social surplus (ROBINSON and TORVIK 2005). While higher corruption, especially rent-seeking behavior, is directly related to higher depletion of KN (in regression 11), it also decreases investments in KH (in regression 10) and therefore the total GS rate (in regression 8). Bureaucratic quality (BQ8408) – related to corruption through patronage structures that hand official positions to interest groups – influences GS and its components slightly more in the same direction. In total, GS rates are positively influenced by higher quality institutions, but conversely to the study by DIETZ ET AL. (2007), bureaucratic quality plays the biggest role followed by corruption. This is not entirely unexpected due to large inefficient bureaucratic apparatuses created to serve various interest groups in resource-abundant countries, which increase the ratio of consumption through more publicly paid employees.

Additionally, due to evidence by DE SOYSA ET AL. (2010) that democracy influences GS rates positively, we exchange the quality of institutions with the democracy index Polity IV (**POL7008**). DE SOYSA ET AL. (2010) also use the individual components of GS as dependent variables, showing that democracies deplete less natural capital and invest more in human capital, as we also show in regressions 10 and 11. In total, the democratic status of a country positively influences its GS rate.

4.4. Summary

In using the average growth rate of GDP per capita, we show that the main results by SACHS and WARNER (1995/1997) hold true, also for the period from 1970 to 2008. By nature of its calculation, GS is intuitively more closely related to the exports of natural resources. Our analysis estimates a decrease between 1.4% (Table 1) and 3.5% (Table 2) in the average GS rate for a 10% increase in the average share of primary exports in GNI between 1970 and 2008. For most of the control variables, the same signs apply as in the original studies. However, the growth rate of terms-of-trade decreases GS due to the composition of exported K_N and imported consumption goods as well as capital goods as reinvestments in K_P. The consumption share of real GDP is highly significantly, negatively related to the rate of GS since higher consumption decreases reinvestments. Public expenditure policies dividing the governmental budget into consumption and investment as well as private saving and investment decisions depend partially on interest rates. Higher interest rates cause an increase in savings and have a positive effect on the total GS rate. The appreciation of the exchange rate influences GS negatively through decreasing investments in K_P caused by an increase in imported consumption. Migration of workers from the manufacturing sector into the service sector shows the expected negative influence on K_P since the service sector requires less investment in produced capital. The positive link to the depletion of K_N supports the theory of Dutch disease. Table 3 shows an overview of all significant coefficient signs from both tables.

As expected, better institutional quality is linked to less depletion of natural capital and higher education expenditures, showing that the total GS rate is positively influenced by the quality of institutions. Surprisingly, bureaucratic quality plays a more important role than in earlier studies. For the period investigated by our analysis, corruption-related patronage structures handing official positions to interest groups seem to influence GS and its components more than corruption itself or a functioning rule of law. Increased quality in bureaucratic services and institutions negatively influences reinvestment in K_P since most countries with high quality institutions already have large stocks in produced capital. However, countries with stable institutions and democratic structures deplete less natural capital and invest more in human capital and therefore have higher GS rates.

In summary, independent of the control variables used, the average share of primary exports in GNI between 1970 and 2008 negatively influence the average rate of GS as an indicator for sustainable development. Integration into international trade, its mere size as well as the proportion between exports and imports play an important role here, equal to the comparison between investment and consumption. Even if it is difficult to show Dutch disease effects empirically, higher ratios of consumption in additional income, an appreciation of the exchange rate as well as a higher ratio of employment in the service sector influences GS rates negatively. In contrast, democracy, a functioning rule of law, low rates of corruption and the quality of the bureaucratic apparatus influence sustainable development rather positively.

Table 3: Overview of regression results*

	GDP7008	GS7008	KP7008	KH7008	KN7008	CARB7008
Initial	-	+	+	+	+	+
SXP7008	-	-	-		+	
TRADE7008	+	+	+		-	
TOT8008		-			+	
REMI7008	+	+	+			+
INV7007	+					+
CON7008	-	-	-		-	
INT7008		+			-	
EXCH7008		-	-			
EMSER7008		-	-		+	
IQ8408	+	+		+	-	
RL8408	+	+		+	-	
COR8408		+	-	+	-	
BQ8408		+	-	+	-	
POL7008		+		+	-	

* Signs listed for coefficients that are at least significant at 10% level.

4.5. Conclusions

On the one hand, we show that the curse of natural resources does not only retard economic growth but also depreciates a country's capital stock and thereby its basis for future growth. We confirm that theories and factors behind the RC are assignable to the concept of GS. We also show how single components of a country's capital stock are influenced by the RC. Table 3 sums up possible determinants of this index concept for "weak" sustainability, suggesting further research in this direction, especially whether or not (and how) countries dependent on natural resource exports are able to realize positive GS rates. Therefore, structures for reinvestment in physical and human capital at least equalling the size of depleted natural capital have to be identified.

On the other hand, in using Genuine Savings and the changes in physical, human and natural capital as dependent variables, we additionally show that this combination of dependent variables is a more appropriate approach to explain the RC than regressions on GDP alone. We strongly recommend using a combination of GDP and GS as dependents in further studies on the RC, since not only the selection of explanatory variables is important to prove theoretical concepts.

Where our results differ from those derived from studies on GDP, the theoretical background offers an explanation. On the whole, the estimated results meet our expectations. We gain several insights into the mechanism of the RC via the division into the three capital types. However, we worked with a broad basis, testing several variables in order to confirm our theory and method. We do not dig deeper into special relationships apart from one example of Dutch disease. Therefore, we strongly recommend further investigation of GS and its components for two reasons: Shrinking GS constitute an early sign for eroding the capital stock for sustained development. Even without observable RC effects, this should be considered an economic warning for the respective country. Using the three types of capital allows learning more about the mechanisms behind the RC. Knowing these in more detail might enable us to better prevent economies from suffering. It facilitates gathering more a priori information for case studies. Overall, further research in this field supports better policy recommendations.

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5. The Zambian Resource Curse and its influence on Genuine Savings as an indicator for "weak" sustainable development

Abstract The empirical evidence that economies predominantly reliant on their natural resources are characterized by slower economic growth—the so-called Resource Curse (RC) – is in many ways confirmed by the case of Zambia. Haber and Menaldo (2011) identify Zambia's extreme dependence on copper exports as one of the worldwide most striking examples for a country suffering from this ''curse.'' In topical literature, the RC is traced back to the generation of natural resource rents regardless of economic performance, which among other problems leads to suboptimal reinvestment. The World Banks indicator for the ''weak'' sustainable development of a country—the so-called Genuine Savings (GS)—considers exactly this reinvestment of rents from the depletion of natural capital rents into physical or human capital. Although it has been shown empirically that countries dependent on primary exports on average feature negative GS rates and that the determinants of the RC influence both present economic growth and future sustainability as measured by GS, no case studies have been conducted to confirm this. Against this background, we qualitatively survey the relationship between the most discussed determinants causing the RC in Zambia and the country's GS rate. We show that all theoretical relationships between the GS rates of a country and RC determinants such as consumption behavior, volatile world market prices, the so-called Dutch disease as well as political and institutional structures apply to Zambia between 1964 and 2010: an extreme dependency on copper exports and insufficient reinvestments of income from the depletion of Zambia's natural capital constitutes one of the main reasons for slow growth and negative GS until the copper price booms in the second half of the 2000s.

"We are in part to blame, but this is the curse of being born with a copper spoon in our mouths."

Kenneth Kaunda

Former President of Zambia

5.1. Introduction[40]

SACHS and WARNER (1995/1997) show in their renowned cross-country analysis ‘‘that economies abundant in natural resources have tended to grow slower than economies without substantial natural resources.’’ This so-called Resource Curse (RC), namely that economies predominantly reliant on exports of their natural resources are characterized by slower economic growth, is in many ways confirmed by the case of Zambia. HABER and MENALDO (2011) identify Zambia’s extreme dependence on copper exports, reaching an average of 33 % of its Gross National Income (GNI) between 1964 and 2012, coupled with a decrease in real per capita income in the same period, as one of the world’s most striking examples of a country suffering from this ‘‘curse.’’ Theoretically, the RC can be traced back to the argument that natural resources generate rents regardless of economic performance, which leads among other problems to suboptimal reinvestment.

The WORLD BANK (2011a) indicator for the ‘‘weak’’ sustainable development of a country – the so-called Genuine Savings (GS) – considers exactly this reinvestment of rents from the depletion of natural capital into physical or human capital. Thereby, GS incorporates negative rents from the depletion of natural capital (K_N) and positive reinvestment in physical (K_P) and human capital (K_H) to represent investment in future development. As a result, positive GS rates theoretically forecast a sustainable development path (HAMILTON and ATKINSON 2006). However, recent studies such as ATKINSON and HAMILTON (2003) or NEUMAYER (2004) demonstrate the intuitive negative relationship between the RC and GS. Disproportionately high numbers of countries richly endowed with natural resources show negative GS rates (NEUMAYER 2010). However, only a few publications such as DIETZ ET AL. (2007) or SOYSA ET AL. (2010), but especially BOOS and HOLM-MÜLLER (2012, 2013), show a direct relation between GS rates and theories or hypotheses behind the RC.

These publications determine the relationship and use this information to analyze direct relations between determinants held responsible for the RC and the individual components in the calculation of GS. However, the relationship between the RC and GS has only been discussed theoretically and analyzed empirically in cross-country studies (BOOS and HOLM-MÜLLER 2012, 2013). None of these relationships has been discussed in detail or – as BOOS and

[40] If not noted otherwise, all data in this paper are taken from the World Development Indicators 2014 (WORLD BANK 2014a) found in the World Bank database: http://data.worldbank.org/data-catalog/worlddevelopment-indicators.

HOLM-MÜLLER (2013) use datasets of more than one hundred countries – analyzed in the isolated case of an individual country. To our knowledge, the paper at hand is the first case study investigating the development of determinants causing the RC and its relationship to the GS rate of a resource-dependent country. Contrary to cross-sectional studies, a detailed discussion within a case study provides additional opportunities to examine this relationship qualitatively without being constrained by the structures and assumptions of econometric models. For example, BOOS and HOLM-MÜLLER (2012) discuss the theoretical importance of short- and medium-term volatility of international market prices for the calculation of GS, but they are only able to prove this empirically by examining terms of trade over the long run (2013). In the case of Zambia, we are able to show that copper depletion and therefore GS rates reacted extremely volatile on copper prices, even in the short run.

Since the first extensive analysis on the RC, Zambia is a regular case study for mineral-dependent countries (AUTY 1993).[41] The most recent case studies on the Zambian RC by CALI and TE VELDE (2007) and WEEKS (2008) analyze the copper price boom in the 2000s, the resulting so-called Dutch disease.[42] More recently, the paper on upstream linkages by FESSEHAIE (2012) examines diversification in the Zambian mining industry, but addresses neither the country's copper dependence nor the resulting RC. Since GS is not analyzed in any of these publications, we on the one hand contribute to the case study research on the Zambian RC and on the other hand provide a case study on the determinants of a country's GS rate, to our knowledge the first case study in this area.

One could argue that existing cross-country analyses—as presented for example by DIETZ ET AL. (2007) or BOOS and HOLM-MÜLLER (2013)—already identify relationships between the RC and GS and therefore a case study of only one country could not contribute to the existing literature. However, cross-country studies only examine the research question from a broader angle using averages across the analyzed data set. And while the global average of positive GS rates lies within an acceptable area, namely 9 % of GNI for the period from 1964 to 2012, Zambia, as an extremely copper-dependent country, showed a GS rate of -3 %. With this GS rate, Zambia ranked as the seventeenth worst country over this period of more than for decades. Within the illustrious group of the bottom twenty, Zambia proved the country with the most available data for an analysis on the relationship between the RC and GS.

[41] Other case studies have been conducted by MCPHERSON (1993), SHAFER (1994), FOX and GREENBERG (2001), and the WORLD BANK (2011c).

[42] The Dutch disease model is the original and most prominent theory behind the RC presented by CORDEN and NEARY (1982) and CORDEN (1984), which we present and analyze in detail in Sect. 4.2.2.

We analyze the relationship between the RC and GS tracing the course of Zambian economic history from independence in 1964 to the most recent data in 2012, a period within which Zambia shows negative average GS rates. We analyze this entire period using the theories and hypotheses behind the RC and its relationship to the different forms of capital in the calculation of the Zambian GS rate. The hypothesis we aim to prove is that these theories and earlier empirical results could be used to explain the situation in resource-dependent countries such as Zambia better than conventional approaches, but the most important aim is to determine whether the theoretical framework and empirical model by BOOS and HOLM-MÜLLER (2012, 2013) still hold true in the individual analysis of a highly resource-dependent country affected by the Dutch disease. In contrast to the research design of cross-country analyses, this offers room for qualitative discussion that digs deeper into certain special relationships, and we show that most of the theories relating the RC to GS do in fact apply to the Zambian situation.

The methodology or research design of the paper follows this hypothesis. We begin with a short overview of Zambia and its dependence on copper exports, followed by the theoretical background and calculation method of GS. In this section, we directly present the data on Zambia’s GS rate and exhibit the relation between Zambia’s copper exports and mineral depletion within the GS calculation. After a short overview on the theoretical background of the RC, the main section of our case study analyzes the applicability of the theories and hypotheses behind the determinants held responsible to cause the RC on the development of Zambia’s GS rate. We therefore use the theoretical framework of BOOS and HOLM-MÜLLER (2012), separating the explanations into exogenous and endogenous parts. We demonstrate that the RC determinants influence Zambia exactly as the theory would expect.

5.2. A brief overview of Zambia

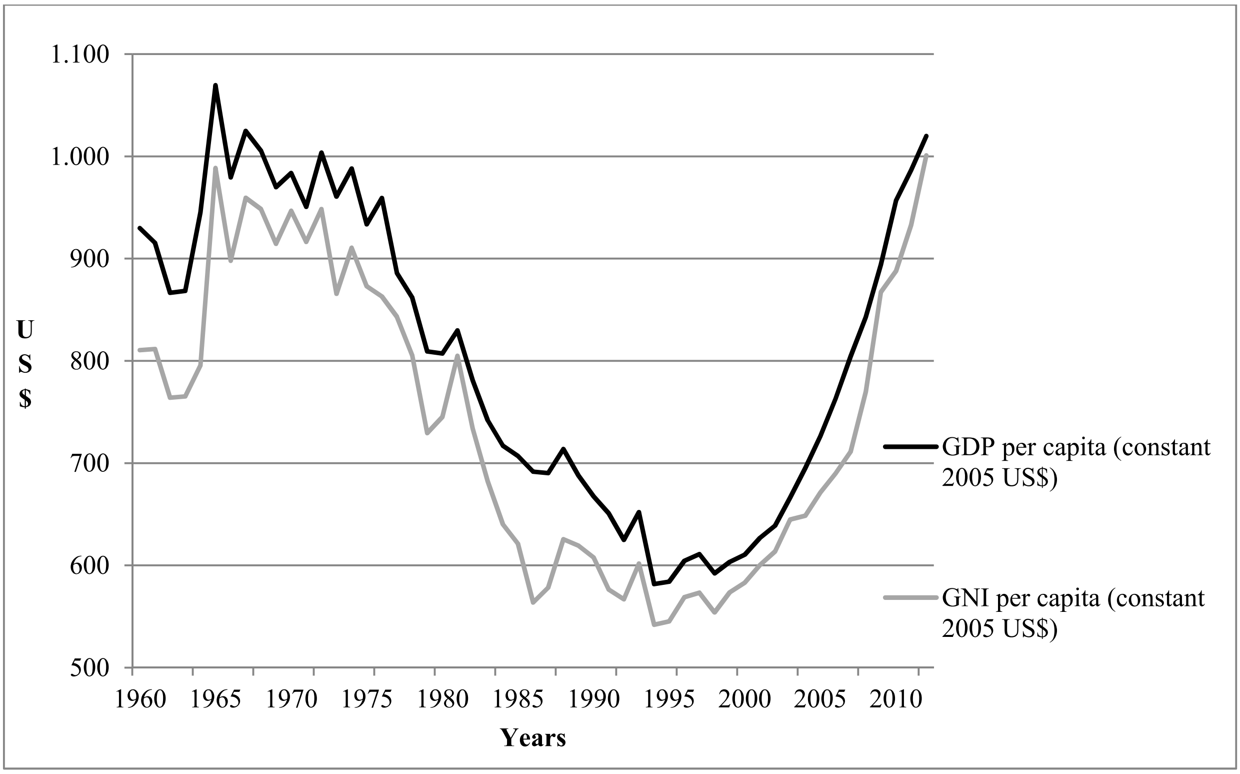
5.2.1 General considerations

Zambia is a tropical and landlocked country in Southern Africa with an area of 752,618 km^2 and a border totaling a length of 5.664 km.[43] It is mostly flat on a high plateau with few hills (the highest point is 2.301 m above sea level) and the origin of the Zambezi, Africa’s fourth longest river, which also constitutes, at 329 m, the lowest point in the country (HOLMES and WONG 2008). A total of 1.3 % is covered by water, while 30 % of Zambia consists of agricultural land and more than 60 % is covered by forest. According to MCPHERSON (2004a),

[43] Zambia borders on Angola, Botswana, DR Congo, Malawi, Mozambique, Tanzania and Zimbabwe.

agricultural output did not increase in the first two decades after independence. Due to population growth, food production per capita decreased. In the period analyzed here, agricultural outputs doubled between 1964 and 2012, while the population quadrupled. Only in the years since the mid-2000s has Zambia's food security begun to improve. The total population increased by a yearly average of around 3 % from 3.4 Mio. in 1964 to 14.1 Mio. in 2012, with a life expectancy at birth of only 48 years in the 2000s due in large part to an HIV/AIDS rate of 13.5 %.

Figure 21: Zambia's GDP and GNI per capita from 1960 to 2012.



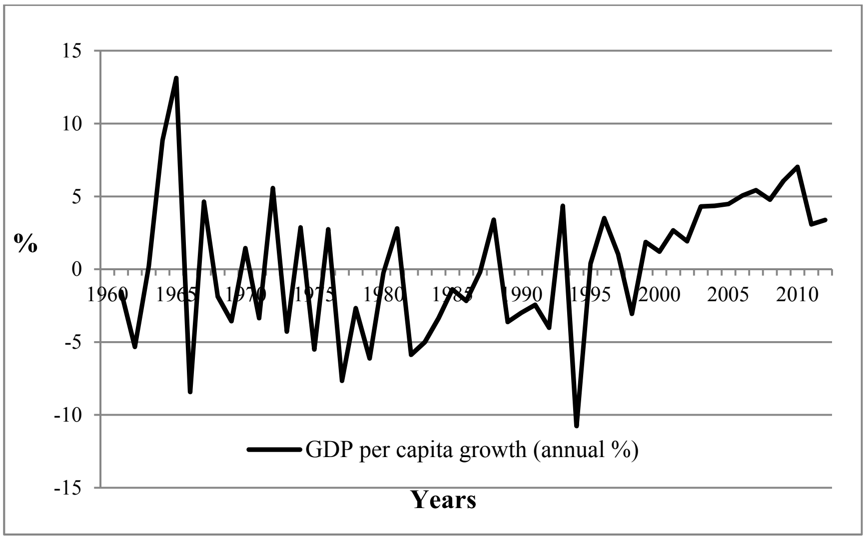
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

From World War II until the copper price shock in the mid-1970s, Zambia was one of the fastest growing economies worldwide. Permanent saving and investment rates reached more than 30 %, and in 1964 it became independent with one of the highest per capita incomes in Sub-Saharan Africa. However, today Zambia is not only one of the poorest countries worldwide, but the only country other than Iraq and North Korea that has seen its Human Development Index[44] decrease since the 1970s (HILL and MCPHERSON 2004). Over the period we examine, Zambia's real GDP per capita (in constant 2005 US$) decreased from US$ 1070 in

[44] The Human Development Index is an indicator provided by UNDP that includes life expectancy, education, and different income indices used to rank the human development of countries: In 2012 Zambia ranked 143 out of 187 countries.

1965 to US$ 1020 in 2012. Although it is difficult to compare the income of a country over four decades, Fig. 21 shows that Zambia's real GDP and GNI per capita only grew from the 1960s until the copper price shock in the mid-1970s, and again in the 2000s due to the increase in copper demand from China and India. GDP proved highly volatile and positive growth only stabilized in the 2000s, as Fig. 22 illustrates. In later sections, we show that these fluctuations relate strongly to the volatility of world copper prices. In the four decades considered in the following analysis, only the income in current US$ increased. While real income decreased, Zambia relied on copper exports at an average rate of 33 % of its GNI.

Figure 22: GDP growth from 1960 to 2012.

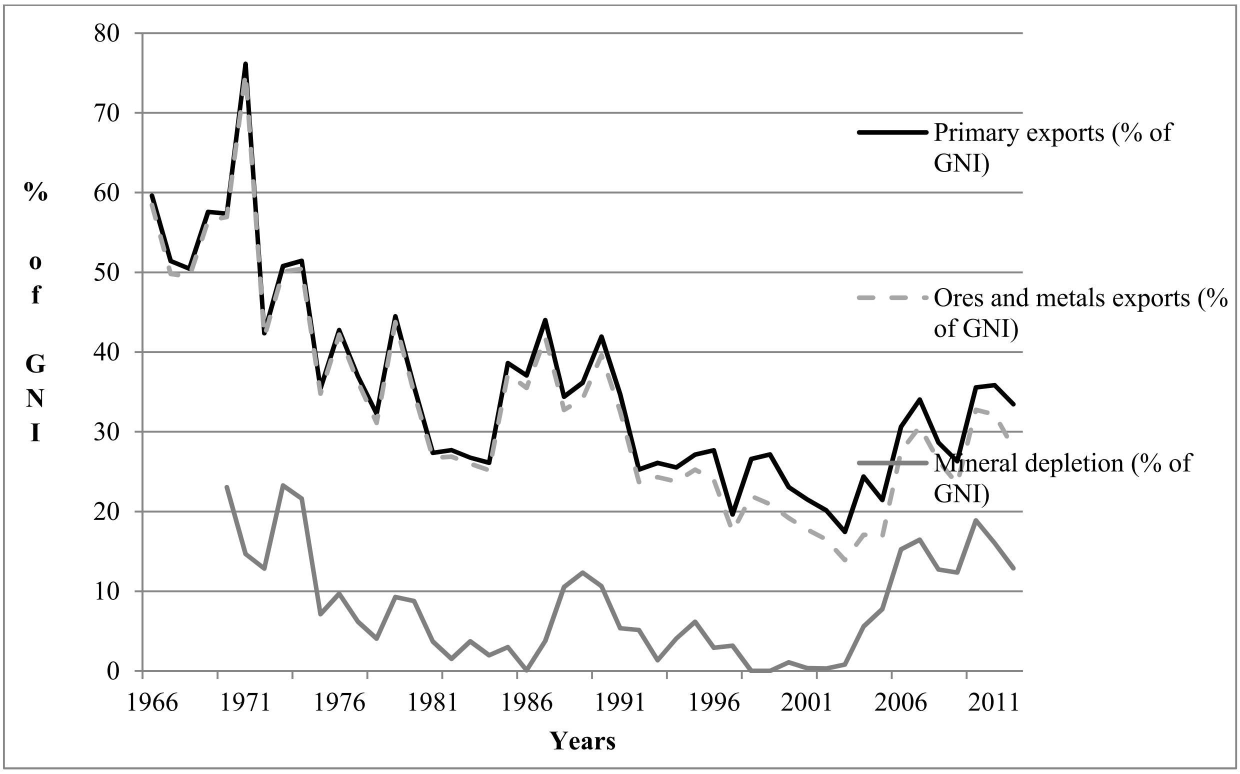


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

5.2.2 Zambia's dependence on copper

Copper production already started to decrease at the beginning of the 1970s due to mismanaged mines and a lack of investment in the period following independence. As Fig. 23 shows, ores and metals exports collapsed beginning with the copper price shock in the mid-1970s, and remained subdued in the following two decades. According to AUTY (1993), Zambia was unusually dependent on its copper reserves in the years after independence, with three-fifths of its revenues stemming from copper. In 1974, the dependence of Zambia's GNI on primary exports was still over 50 %, which decreased to 35 % in 1975 and remained below an average of 30 % until the increase in the mid-2000s (from 22 % in 2005 to 34 % in 2012), when prices again increased. As Fig. 24 shows, the real-world market prices of copper collapsed by almost 50 % between 1974 and 1975, and by another 50 % until the mid-1980s (MIKESELL 1988). This had a negative influence not only on copper exports, but also on Zambian GNI. In 1975, real income per capita decreased by 5.5 %, followed by a decade with an average decline of 3.3 % per year. Although income per capita again rose in the 2000s (by an average of 5.4 % annually), the period in between was characterized by volatile changes in income per capita, as shown in Fig. 22. Zambia's primary exports consisted mainly of ores and metals (95 % copper) for the period analyzed, which made up almost 98 % of total merchandise exports in 1966 (58 % of GNI). This increased to a peak of 99 % in 1970 (57 % of GNI), decreased to 63 % at the end of the 1990s (23 % of GNI), and grew rapidly to more than 80 % in the second half of the 2000s. The top three export commodities between 2008 and 2012 were different copper products, which accounted for more than 28 % of GNI on average over the last 5 years of our analysis.[45] Therefore, the share of primary exports in GNI – the key figure for the RC by SACHS and WARNER (1995/1997) – is extremely high in the case of Zambia and determines the depletion of the country´s natural capital (as one of the components of the calculation of GS).

Figure 23: Primary exports & mineral depletion from 1966 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

[45] In 2010, of a total of US$ 7.2 billion in commodity exports, the top ten primary exports account for US$ 6.4 billion; refined copper alone amounting to US$ 4.6 billion. Source: UNITED NATIONS COMTRADE INTERNATIONAL MERCHANDISE TRADE STATISTICS: http://comtrade.un.org/pb/CountryPagesNew.aspx?y=2010.

As the first to analyze the RC empirically in detail, Sachs and Warner (1995/1997) show in their renowned cross-country analysis that an increase in these share of primary exports in GNI results in a decline of per capita GDP growth.[46] As a general rule, the negative relationship between resource dependence and economic development is the key point of the RC that academics have sought to explain since. Figure 23 shows Zambia's high level of dependence on ores and metals exports and therefore mineral depletion, amounting to an average of 33 % and almost 8 % of GNI over the period from 1970 to 2012. Dependence to this extent can become a handicap for a country's own development, as industrial progress is not necessary to continue generating national income. Or as SACHS and WARNER (2001, p. 833) put it most precisely: ''Natural Resources crowd out activity x. Activity x drives growth. Therefore Natural Resources harm growth.'' In a classic model – dubbed the Dutch disease – CORDEN and NEARY (1982) and CORDEN (1984) show that a boom in the depletion of natural resources and thereby export revenues crowd out activities and development in non-primary sectors and therefore harm growth.[47] To simplify, the income from natural resources prevents engagement in other sectors and attracts investment and human capital needed to develop these sectors. In 2012, the income from primary exports amounted to more than US$ 8 billion, or 34 % of the Zambian GNI. However, with a GINI index of more than 57 in 2010, clearly this income does not disperse and benefit of the greater population, rather it flows to a small dominant clique with access to Zambia's copper mines.[48]

The case of Zambia is one of the most prominent RC examples in literature; nearly every general text on the topic lists the copper-dependent country as one of those affected by the RC. The general literature agrees on the importance of natural capital as a principal source of income for developing countries such as Zambia. A large number of publications, which we consider partially in our analysis later on, show general evidence that economic performance has frequently been inversely related to natural resource endowment. Regardless of country-specific reasons (or determinants) that result in the RC, consensus on one crucial point has been

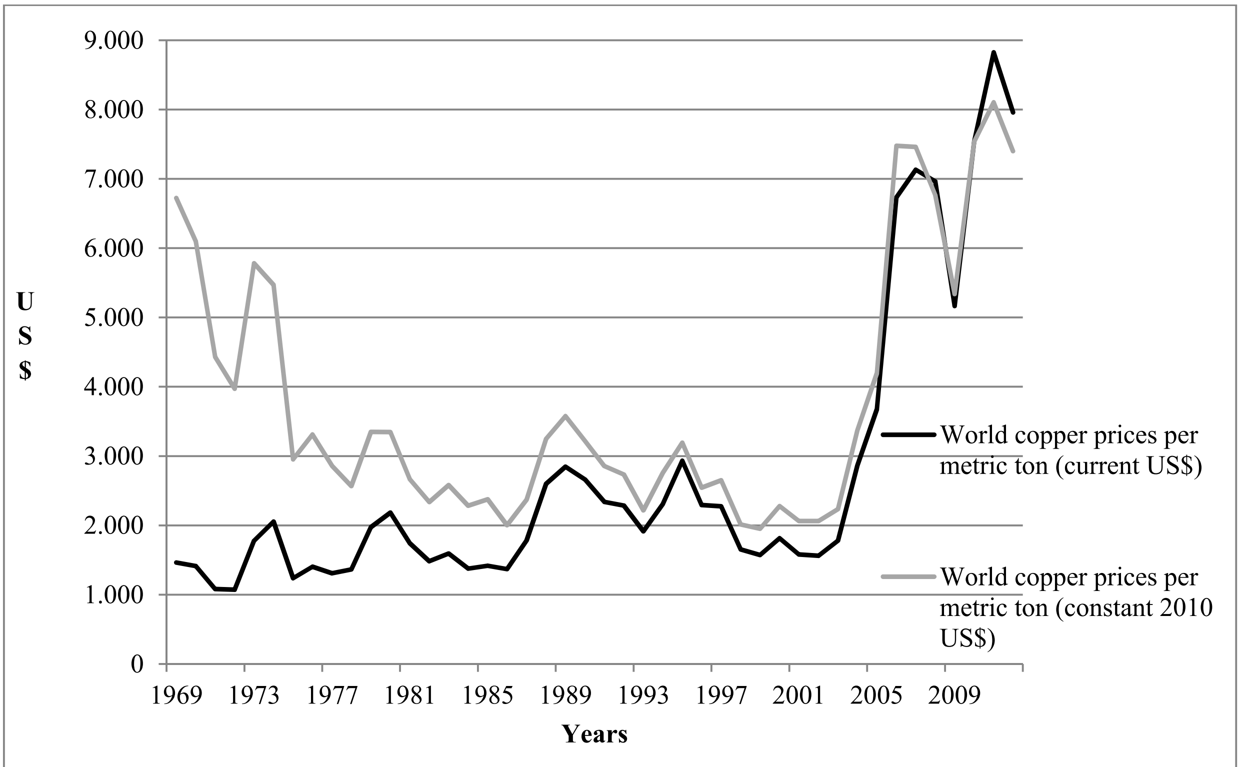
[46] SACHS and WARNER (1995/1997) show a consistent decrease of more than 1 % of GDP growth with a 10 % increase in the average share of primary exports in GNI, regardless of which additional explanatory variables are used in the model. This correlation is not as high in the study by BOOS and HOLM-MÜLLER (2013), who show only a 0.3 % decrease for a larger sample and longer time series. However, they demonstrate the additional relationship between primary exports and GS rates. With samples featuring between 84 and 103 countries in models with up to eleven explanatory variables, BOOS and HOLM-MÜLLER (2013) estimate an average decrease in GS rates by 1.4 % if primary exports increase by 10 %.

[47] The rather famous name of this model (described in detail in CORDEN 1984) – Dutch disease – originates from the decline in the Dutch manufacturing sector after the discovery of new sources of natural gas in the North Sea (THE ECONOMIST 1977).

[48] The GINI index measures the extent to which the distribution of income among households within an economy deviates from a perfectly equal distribution; a GINI index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

reached: ''for sustainable economic development, income from nonrenewable resources must be reinvested, not used to fund consumption'' (WORLD BANK 2011a, p. 15). In principle, Zambia should transform its natural capital, namely the income from copper, into other forms of more sustainable capital so that other sources of income exist once the copper supply is exhausted. The depletion of copper is not sustainable, but the income from it can be invested in other forms of capital (WORLD BANK 2011a).

Figure 24: Primary exports & mineral depletion from 1966 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

5.3. Genuine Savings in Zambia

5.3.1 Theory

GS is a concept that follows exactly this line of thought and attempts to make the idea of ''weak'' sustainability (WS) more concrete and measurable. The theory of WS assumes that different forms of capital are in principle substitutable and only the maintenance of the total capital stock – consisting of physical, human and natural capital – is important to provide future utility. The so-called ''HARTWICK rule'' (1977) provides a ''rule of thumb'' for WS: A country's total capital stock should be held at least at a constant level by investing as much or more into all forms of capital as consumption or depletion of all forms of capital, which in turn allows for sustained consumption over time (NEUMAYER 2010, p. 127). The WORLD BANK (2006, 2011a) estimated total capital stocks for more than 120 countries in 2005. Zambia was one of the poorest countries surveyed with a total capital stock of US$ 113 billion (US$ 9678 per capita). Its per capita wealth is comprised of US$ 1482 physical, US$ 2142 natural and US$ 6961 intangible capital (human, institutional, etc.).[49]

GS shows the reinvestment of depleted natural capital into other forms of capital (DIETZ ET AL. 2007) and is considered by the World Bank to show the annual changes in countries' total capital stock, or the ''wealth of nations'' (WORLD BANK 2006). Therefore, GS as calculated by the World Bank also provides information on the potential for future sustainable development in RC affected countries (BOOS and HOLM-MÜLLER 2012).

The first ''intuitive rule for determining whether a country is on or off a sustainable development path'' came from PEARCE and ATKINSON (1993, p. 104), who ''adopt a neoclassical stance and assume the possibility of substitution between 'natural' (K_N) and 'manmade' (K_P) capital,'' so that if ''the combined depreciation on the two forms of capital'' is lower than a country's savings (S), the condition for ''weak'' sustainability (WS) is fulfilled:

$$WS \geq 0 \;\; iff \;\; S \geq (\delta K_N + \delta K_P) \qquad (24)$$

Hamilton (1994), Pearce et al. (1996) and Hamilton and Clemens (1999) expand Equation (24) by investment in human capital and abatement costs for pollution damages. Based on Gross National Income (GNI), GS – based on the World Bank definition – theoretically includes the rates of change for the three forms of capital, physical (K_P), human (K_H) and natural (K_N) (Bolt et al. 2002; World Bank 2006, 2011a, 2014a). GNI minus private (C_P) and public (governmental) consumption (C_G) plus net current transfers (NCT)[50] results in Gross National Savings (GNS). The subtraction from GNS of the depreciation of K_P, such as buildings, machines or infrastructure, leads to a country's Net National Savings (NNS) (Hamilton and Clemens 1999). Investment in K_H is measured by current operating expenditures in education, including teachers' wages and salaries, but excluding capital investments in buildings and equipment. Together with NNS, investment in K_H must compensate for natural resource depletion to provide GS.

[49] The global average lies at a total of US$ 115,484 (physical: US$ 20,329; natural: US$ 7119; intangible: US$ 88,361) per capita (WORLD BANK 2011a).

[50] NCT comprise all exchanges with foreign countries of goods and services as well as income and financial items without a quid pro quo (WORLD BANK 2014a).

To deduct the depletion of natural resources (δK_N), GS uses the rents (R_N) from the disposal of energy,[51] mineral[52] and forest[53] resources. R_N is calculated by multiplying the actual world market prices (P) minus region-specific average production costs (AC) to demonstrate the decrease in the natural capital stock:

$$R_N = ((P - AC) * Production\ Volume) \qquad (25)$$

To adapt these current rents to the remaining natural resource stock, the present value (PV) of R_N (discounted at 4 %) is put in relation to the remaining resource stock:

$$\delta K_N = PV\ \frac{R_N}{exhaustion\ time\ of\ the\ resource\ stock}(reserves/\ production, capped\ at\ 25\ years) \qquad (26)$$

In total, GS is calculated as follows:

$$GS = (GNI - C_P - C_G + NCT) - depreciation\ of\ K_P + education\ expenditures\ (\delta K_H) - \delta K_N \qquad (27)$$

With:

$$WS \geq 0\ \ iff\ \ GS \geq 0 \qquad (28)$$

The direct relationship between determinants of a possible RC and the GS rates of a resource-dependent country is intuitive. Higher depletion of δK_N affects GS negatively. In the following, we show the development of the individual components of Zambia's GS rate.

5.3.2 Empirical information

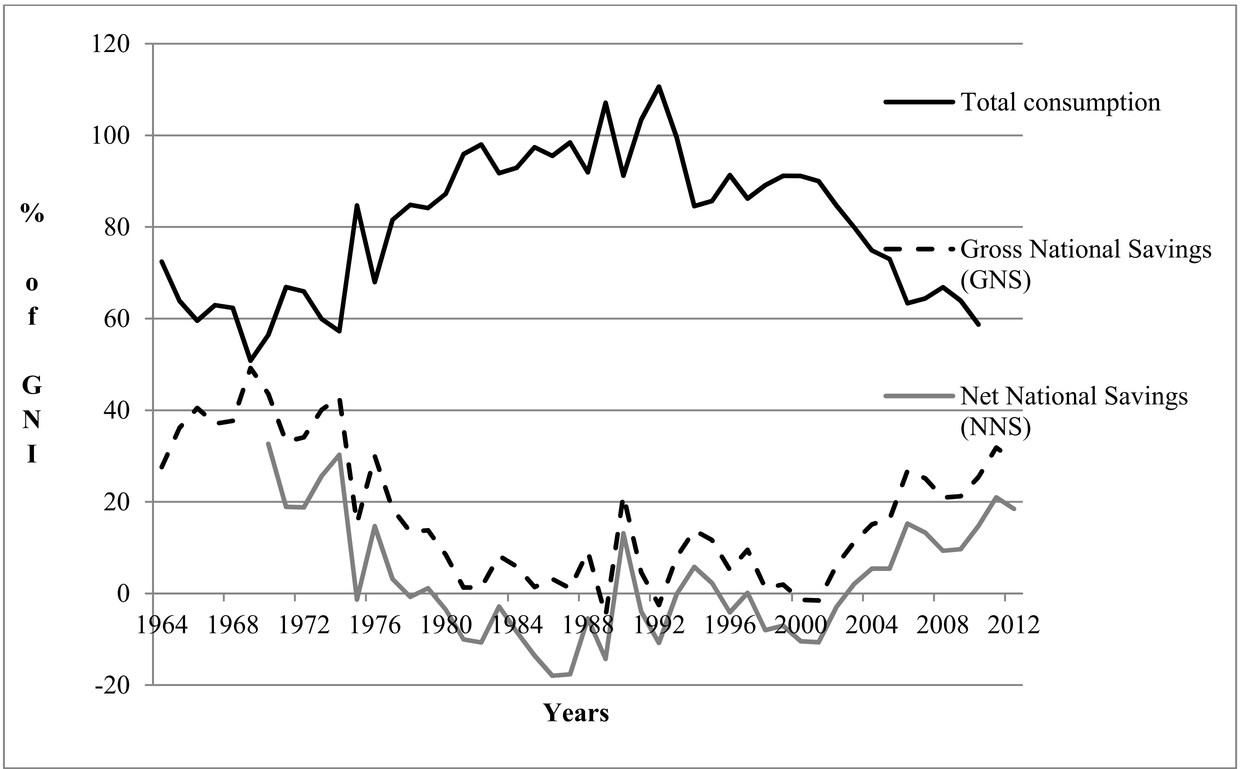
Gross National Savings (GNS), which decreased in the final years before independence as British capital left the country, was still at a high positive share of almost 28 % of GNI in 1964 and grew until the end of the decade. However, according to the calculation by the WORLD BANK (2014a), Zambia's GNS and NNS (available since 1970) both shrank in the 1970s, as shown in Fig. 25. According to MCPHERSON (2004a), domestic investment remained above 30 % of GNI until the mid-1970s, when GNS and NNS also collapsed. Total consumption expenditures, which initiated at an average of 65 % (50 % private and 15 % public) in the

[51] To date, this covers coal, crude oil, and natural gas.
[52] This covers bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver.
[53] Roundwood harvest minus natural growth; this is set to zero if growth exceeds depletion (WORLD BANK 2014a).

1960s, increased until partly even higher consumption than total GNI and declined again after 2002, as we show in Fig. 25.

As a result, GNS decreased until reaching negative values in 2000/2001.[54] A rather constant depreciation of K_P by an average of 11 % therefore resulted in a negative NNS rate over almost the entire analyzed period until 2002. Due to high demand by China and India, copper prices have risen since 2003 and – since higher income corresponds with increased spending – consumption almost quadrupled, but as a share of GNI it declined from an average of more than 95 % in the 1980s and 1990s to 74 % (63 % private and 11 % public) in the 2000s.[55] Therefore, GNS and NNS have been increasing since 2002: NNS was not only positive for nearly the first time since the end of the 1970s, it also increased immensely to an annual average of 11 % of GNI between 2003 and 2012. This could be interpreted as a sign that Zambia invested more in its K_P than it depreciated. However, until the start of the new millennium, consumption was extremely high relative to GNI, which came at the expense of investments.

Figure 25: Zambia's consumptions, GNS & NNS from 1964 to 2012.



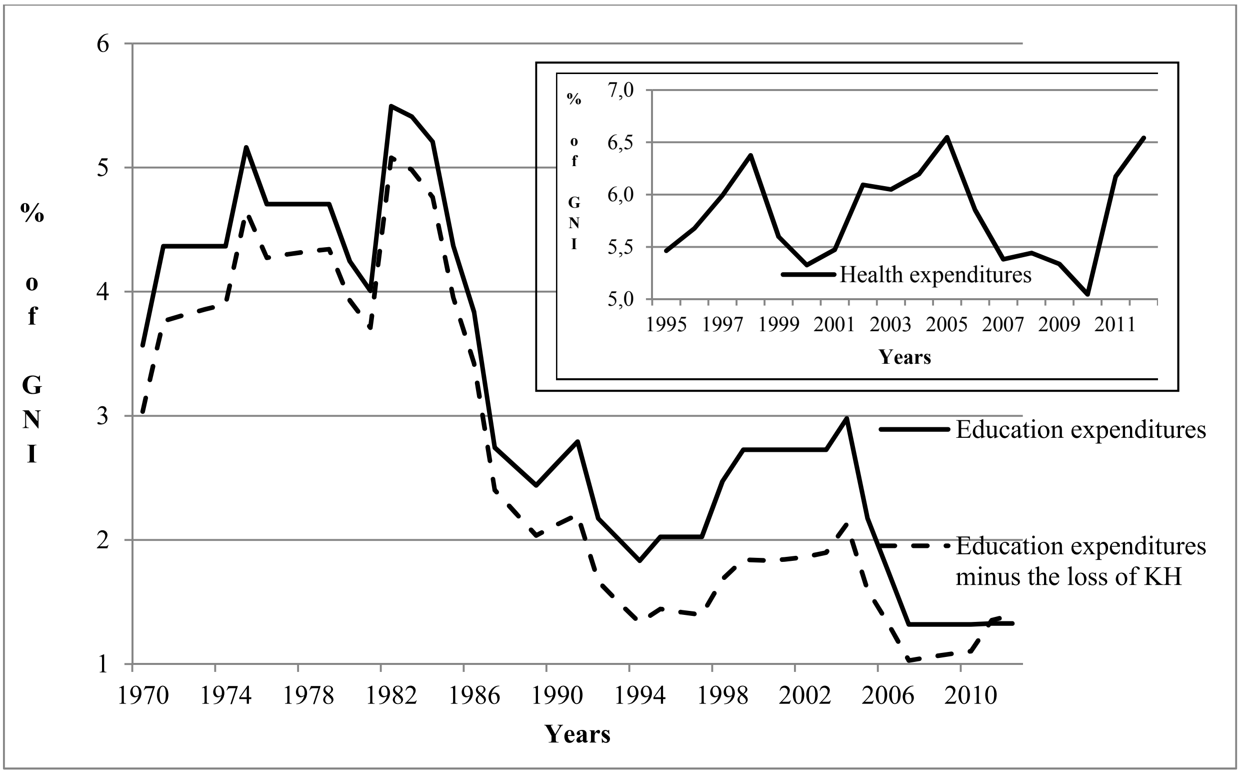
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

[54] The total average for the period between 1964 and 2012 was around 11 % of GNI, far below the world average of 23 %.

[55] The total average was approximately 80 %, below the world average of 85 % and only slightly above the 78 % average of the high-income OECD countries. Compared to other African countries such as neighboring Mozambique with an average of 110 %, this is rather low.

As the opposing trends of consumption and GNS in Figure 24 show, until the 1990s consumption increased while savings decreased. Directly after independence, the Zambian government invested in economic diversification and social development such as the education and healthcare system (TAYLOR 2006). Additionally, a mineral revenue stabilization fund was launched to save one-third of the income from copper to hedge against economic downturns (AUTY 2008). However, the mineral price shock arrived too soon after independence, so that revenues from mining decreased quickly without proper alternatives and the mineral revenue stabilization fund was rapidly consumed (AUTY 1993). In the mid-1980s, Zambia's president Kaunda apologized in the ''Times of Zambia'' (May 19, 1986), stating that the government subsidized consumption for too long at the expense of investment and economic diversification; conversely, he assured the population 3 years later that he would stop investments to fight the more urgent hunger problems (MCPHERSON 2004a). As we will see later on, Zambia's government mostly reacted to the development of copper prices, but lacked a vision to invest larger amounts in other sectors during periods of increasing prices.

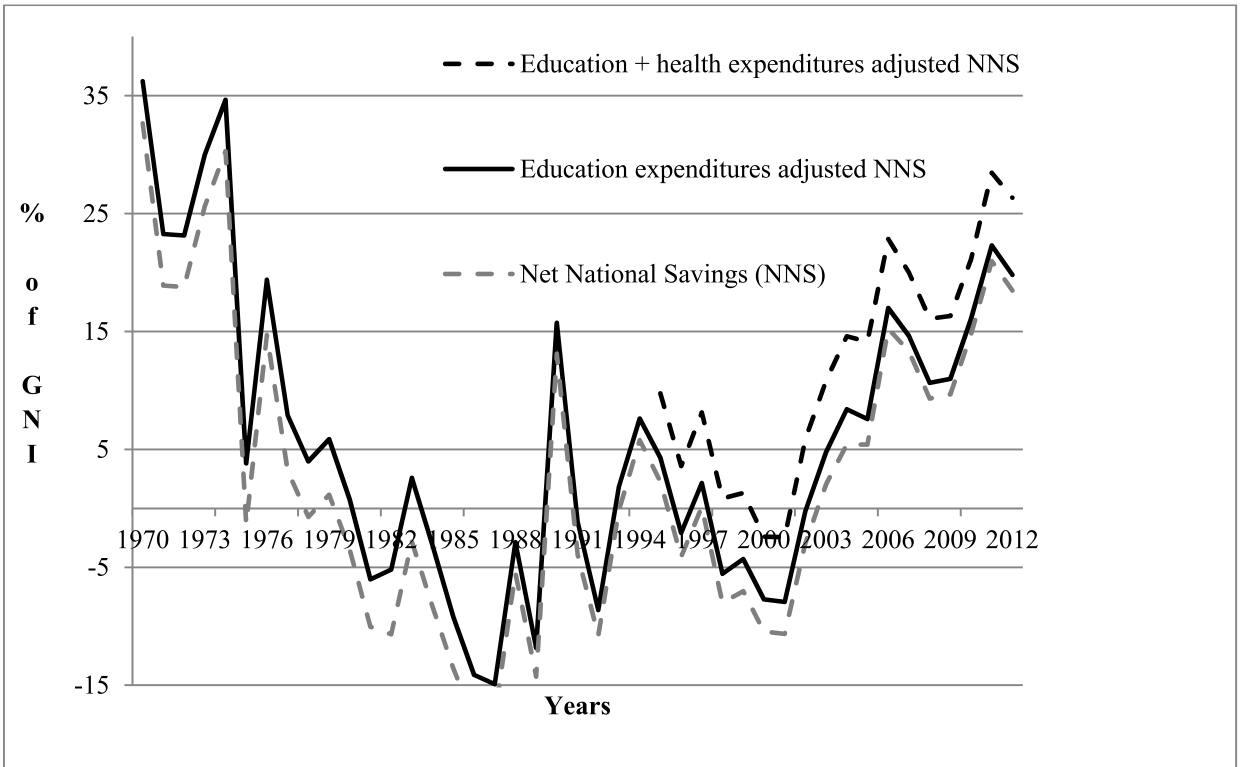
Figure 26: Education & health expenditures from 1970 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

It is clear that not only NNS will be negative if the depreciation of K_P is higher than the amount of investment in physical capital, but also that GS can only be positive if the Zambian government were to spend enough on human capital (K_H) to offset negative NNS and natural resource depletion. GS tallies current operating expenditures on education as a rather crude approximation for investment in K_H, as shown in the education expenditure-adjusted NNS (ANNS) in Fig. 27.[56] Figure 26 shows education expenditures used by the World Bank as well as our own version, which subtracts the loss of K_H due to low life expectancy rates. Figure 26 shows that the 3.1 % average investment in K_H between 1970 and 2012 would be consistently around 0.5 % lower if we deduct 2.5 %[57] of education expenditures for every year Zambia's life expectancy at birth is below the retirement age of 55. Life expectancy reached approximately 48 years in the 2000s. It increased slightly in the 1970s and 1980s and dropped again in the following decade, partly caused by the HIV/AIDS rate of 13.5 %, but also due to a rather desolate healthcare system with a child mortality rate of 11 % until the age of 5. On the whole, the average Zambian does not work until the retirement age of 55.

Figure 27: Human capital adjusted NNS from 1970 to 2012.



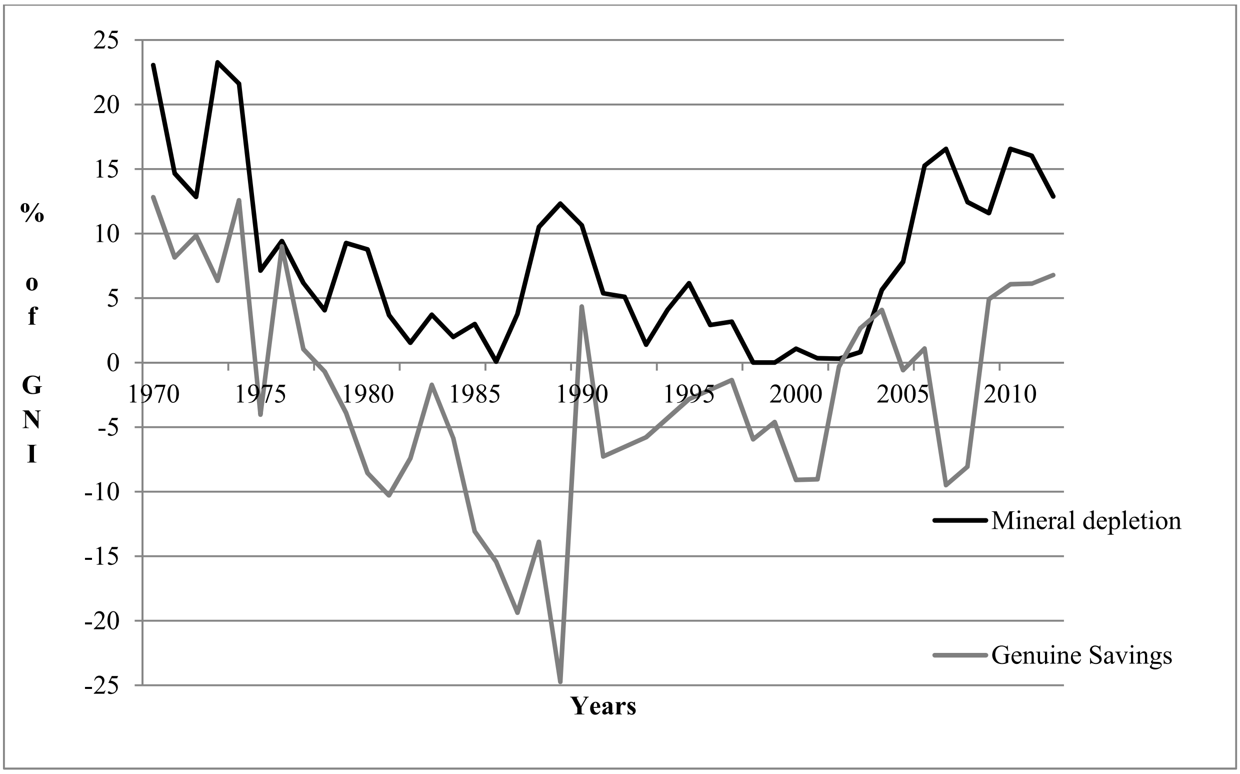
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

[56] We do not discuss the contents of GS in general, for a critique of the calculation method see BOOS (2015). However, it is disputable whether investment in K_H should only be defined by education expenditures and if this only counts for a working life or not (DASGUPTA 2004; O'SULLIVAN and SHEFFRIN 2007). We argue with BAIRD ET AL. (2011) that health and income are strongly related and in a situation like Zambia's, health expenditures also comprise investment in K_H. We also show in Figs. 26 and 27 not only the adjusted NNS (ANNS) with education, but also including health expenditures, which results in an average difference of 6.7 % of GNI (available since 1995).

[57] Dividing 100 % of expenditures by the average 40 years of a Zambian's working life (the Zambian retirement age of 55 minus the UNESCO definition of the beginning of a working life at 15) ascribes 2.5 % of education expenditures to every working year.

While Zambian health expenditures were neither extremely volatile nor below the world average (5.8 % of GNI from 1995 to 2012), education expenditures declined beginning in the 1980s. Due to strong efforts by the Zambian government to invest sufficiently in education to secure sustainable growth in the first two decades after independence, education expenditures, at an average of 4.5 % of GNI, remained only slightly below the world average of 5.2 % in this timeframe. In the following two decades this decreased to an average of 2.2 % and as far as 1.3 % in the last 5 years of our analysis.

Figure 28: Natural capital depletion and GS from 1970 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

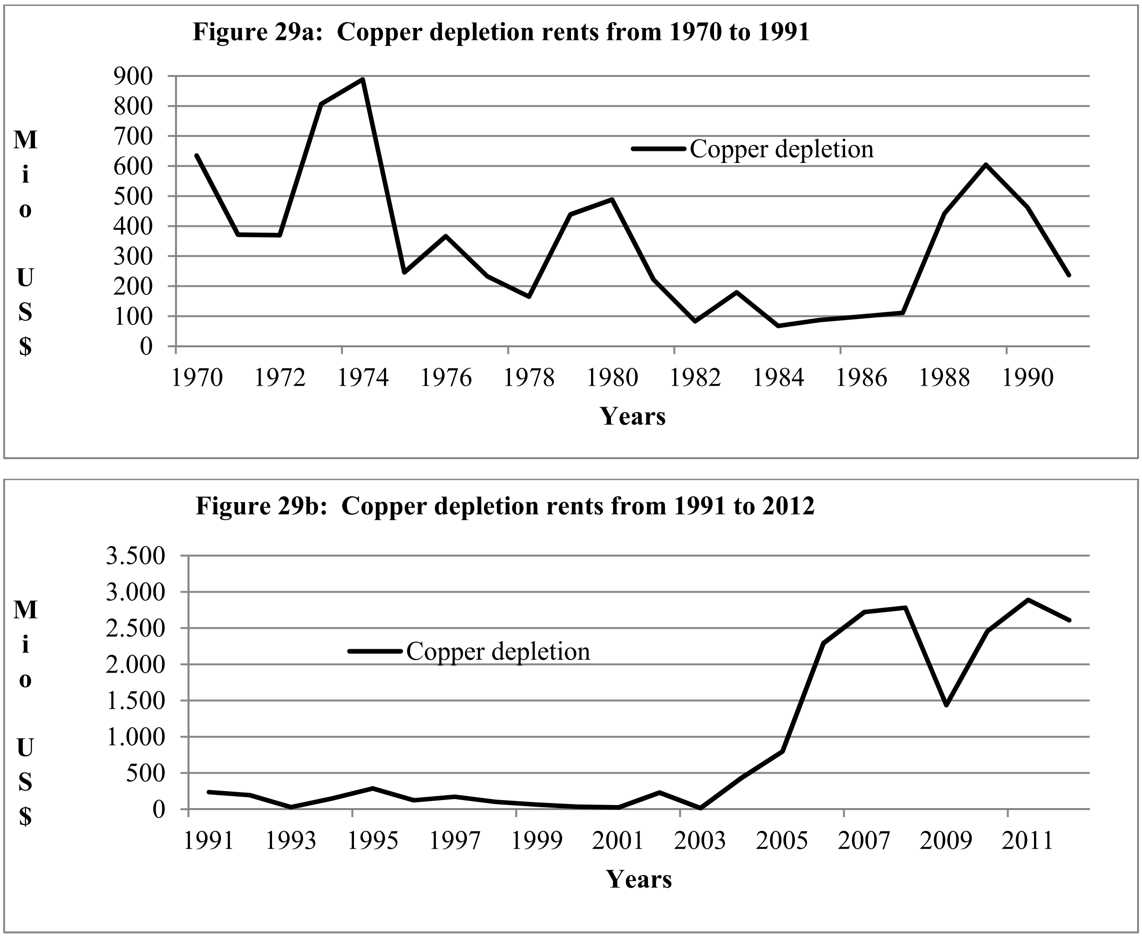
Figure 27 shows that the difference between NNS with and without education expenditures is rather small, especially in the last decade. Since copper prices in this timeframe increase, total consumption expenditures rise, while education expenditures remain almost constant and thereby decline in percentage terms since 2002. Education expenditures per pupil as % of GDP per capita even decreased from 7 % in 2000 to < 1 % in 2012.[58] This inadequate reinvestment of income from resource exports is reflected in the education status of Zambia's population: Though in the 2000s around 84 % of the total population completed primary education (still

[58] The difference between education expenditures and investment in K_H is explained by the exclusion of investment in K_P, such as school buildings, since it is already included in NNS.

low compared to 98 % in the OECD countries), the literacy rate was only around 80 % for Zambia's male population and 61 % for females.

After adding K_H, the GS calculation in (27) subtracts the depletion of K_N, considering the rents from (25) and (26) of energy and mineral resources and that of net forest depletion, as well as the damages from CO_2 emissions[59] (HAMILTON and CLEMENS 1999; WORLD BANK 2006, 2014a). Zambia's energy depletion and CO_2 emissions are both below an average of 1 %, rendering them negligible. Net forest depletion is at zero, since forest growth exceeds harvesting in official data and is therefore not shown.

Figure 29: Copper depletion rents from 1970 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

However, in Zambia's case, the rents and therefore income from mineral depletion are more important than anything else when assessing natural capital depletion. In the concept of GS, these rents are used to calculate the changes in the natural capital stock of a country. In the case of Zambia, this is represented by its stock of copper reserves (ATKINSON and HAMILTON 2007).

[59] Social costs from CO_2 emissions are assumed to be US$ 20 (in 1990 US$) per emitted metric ton (FANKHAUSER 1994).

Zambia's mineral rents started at a high level of 22 % in 1970, meaning that after subtracting production costs, minerals worth almost a quarter of the total income of the Zambian economy were consumed and an equivalent would have had to be invested in K_P or K_H to keep the total capital stock constant and fulfill the sustainability rule of GS.

A look at Figs. 23, 24, 25, 26, 27 and 28 shows that Zambia consumes more than it invests, at least over most of the period analyzed. As Fig. 28 shows, there were only a few periods in which Zambia realized sufficient reinvestments to attain positive GS rates. Zambia's GS rate had a negative average of around -2.6 % if we consider the whole period from 1970 to 2012; GS only started to increase in the beginning of the 2000s, reaching a positive average of 3 % in the last 5 years from 2008 to 2012. However, due to a high level of fluctuation, the average GS rate remained negative, amounting to -0.4 % from 2000 to 2012. To a large extent, the fluctuations of Zambia's GS rate result from volatile copper prices, which influence the value of mineral depletion subtracted in (27). Figure 29 shows that in total, copper depletion decreased from the mid-1970s until the price boom in the mid-2000s, with a short peak at the end of the 1980s and the beginning of the 1990s. This corresponds with the same peak in copper world market prices, as seen in Fig. 24. Copper depletion, which makes up an average of around 95 % of total depletion, increased to reach rents of nearly US$ 900 million at the beginning of the 1970s. Thereafter, it decreased until 2002 with the same peaks and, since 2003, rose again to US$ 2.5 billion at the end of the 2000s. In 2011 and 2012, it approached US$ 3 billion.

5.4. The RC and its influence on Zambian GS

5.4.1 Overview

Since CORDEN and NEARY (1982) and CORDEN (1984) developed a model of the implications of resource dependency on economic growth, the so-called Dutch disease,[60] the phenomenon that countries with rich natural resource endowment often show slower economic growth than resource-poor countries has been dubbed the RC. In their well-known cross-country analysis, SACHS and WARNER (1995/1997) show that an increase in the ratio of primary exports to GNI results in a decline of per capita income growth. Even after controlling for several other variables identified to be important for economic growth, this negative relationship remains significant. BOOS and HOLM-MÜLLER (2013) expand on this original study with a longer period

[60] This originated from an article by ''The Economist'' analyzing the decline in the Dutch manufacturing sector after the discovery of natural gas sources due to a crowding out of investments (THE ECONOMIST 1977).

of analysis and larger sample size as well as additional control variables, showing that not only the influence of primary exports on per capita income is similarly negative, but also that the negative impact on GS is high.

The first detailed RC case studies by GELB (1988) and AUTY (1993) show, on the one hand, the political difficulties for governments of natural resource-exporting countries such as Zambia in saving (and not spending) their rents and, on the other hand, the lack of capacity and resources to reinvest this income efficiently. The core problem is that natural resources do not need to be produced. Their depletion results in income without advanced development and requires large-scale investments in mining without further economic diversification.

The Zambian economy mainly centers on its income from copper. Between 2008 and 2012, the rents from copper depletion amounted to an annual average of 14 % of its GNI, whereby 28.5 % of GNI came from copper exports. However, a dependency such as that of Zambia does not automatically result in slower growth or negative GS, but AUTY (1993) shows that one of the biggest problems in Zambia is the inefficient handling of the easily attainable income from copper. Caused by overly optimistic expectations and failed state interventions, physical (K_P) and human (K_H) capital is transferred into sectors without foreign competitors, resulting in decreasing reinvestment.

There are, however, different explanations for the fact that resource-dependent countries reinvest inadequate amounts of their income from resources into other forms of capital. SACHS and WARNER (1995/1997) cite decreasing terms of trade and an instable rule of law as important reasons, but mainly show that the ratio of primary exports to GNI is one of the most robust determinants for slower economic growth. A multitude of studies such as SALA-I-MARTIN (1997) or DOPPELHOFER ET AL. (2000) confirm this and analyze the RC from various points of view, identifying multiple determinants as well as transmission channels (PAPYRAKIS and GERLAGH 2004), and constructing numerous theories and hypotheses concerning the ways in which resource dependence may hamper economic development (ROSS 1999; ROSSER 2006).[61] Overviews by VAN DER PLOEG (2011) or FRANKEL (2012) divide these theories in different exogenous and endogenous explanations, which BOOS and HOLM-MÜLLER (2012, 2013) relate to the individual calculation components of GS rates. We use these in the following to understand the relationship between volatile world market prices (Sect. 5.4.2.1) and the so-

[61] See for example GYLFASON ET AL. (1999), GYLFASON (2000, 2001a, b, 2006), AUTY (2001, 2007), MEHLUM ET AL. (2006), ROBINSON ET AL. (2006), VAN DER PLOEG and POELHEKKE (2009), HUMPHREYS ET AL. (2007), LEDERMAN and MALONEY (2007) or FRANKEL (2012) for a comprehensive overview of the discussion.

called Dutch disease (Sect. 5.4.2.2) as exogenous explanations[62] as well as the status of the political system (Sect. 5.4.3.1) and the quality of institutions (Sect. 5.4.3.2) as endogenous explanations[63] and Zambia's GS rate with its calculation components, namely the different forms of capital.

In summary, the elements of GS are affected by determinants of the RC; especially negative GS rates point to a possible ''curse'' in resource-dependent countries. GS rates provide an early warning system and if we assume that low or negative GS rates result in lower sustainable development in Zambia's future, it follows that its RC problematic will result in lower expected sustainability.

5.4.2 Exogenous explanations

5.4.2.1 Volatility of world market prices

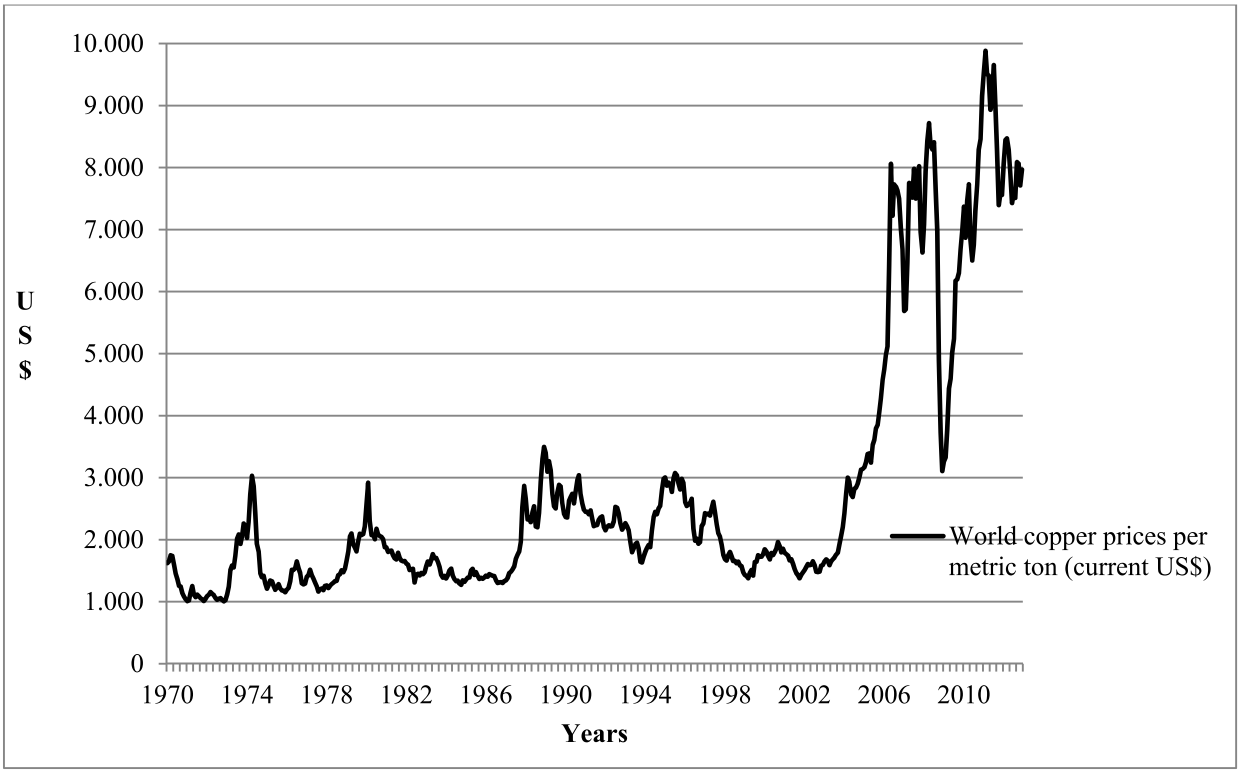
The first and foremost factor, as we have seen above, is the fluctuation of world market prices of copper. As seen in (25), the depletion of copper is calculated based on actual world market prices and therefore price volatility influences the rents that comprise natural resource depletion (δK_N) within the GS calculation in (27) (VAN DER PLOEG and POELHEKKE 2009; BOOS and HOLM-MÜLLER 2012, 2013). Starting with NURKSE (1958), a number of cross-country analyses reveal the adverse effects that the volatility of international commodity prices has on economic growth in resource-dependent countries (RAMEY and RAMEY 1995; BLATTMAN ET AL. 2007). HAUSMANN and RIGOBON (2003) or BARBIER (2007) show that the GDP of resource-dependent countries fluctuates by several percentage points each year. As Figs. 21 and 22 have already demonstrated, income growth fluctuates drastically in Zambia (by an average of 4.9 % per year), GDP per capita decreased as a result over our analyzed period. According to VAN DER PLOEG (2011) ''[v]olatility is bad for growth, but also for investment […] and educational attainment,'' as the theoretical discussion behind the relationship between the RC and GS

[62] The theoretical framework by BOOS and HOLM-MÜLLER (2012) divides exogenous explanations for the effects of the RC on GS into short- and medium-term volatility of international commodity markets as well as long-run terms of trade (ToT) effects, both of which we examine in the section on volatile world market prices (Sect. 5.4.2.1), and the Dutch disease with all its effects in Sect. 5.4.2.2.

[63] We follow the same framework (BOOS and HOLM-MÜLLER 2012) in dividing the endogenous explanations into the political system (Sect. 5.4.3.1) and the quality of institutions (Sect. 5.4.3.2), but one could argue that the distinction between politics and institutions is overly meticulous since the political system is a part of the institutions. However, we explicitly use this division since indeed both affect each other but simultaneously cause different rather independent effects from each other. Institutions can be instable and corrupt in democracies and vice versa. Even if both can only develop in the same direction, they have different effects on GS since the transmission channel through which the RC functions is different in the case of the quality of the political system itself or its bureaucratic apparatus.

would lead us to expect (BOOS and HOLM-MÜLLER 2012). As Fig. 28 shows, Zambia's GS rate fluctuated by an extremely high average of more than 100 %, due especially to periods such as the 2000s in which GS fluctuated by an annual average of 250 % and increased from -9.1 % of GNI in 2000 to 6.1 % in 2010 (6.8 % in 2012).

Figure 30: Monthly world copper prices per metric ton from 1970 to 2012.

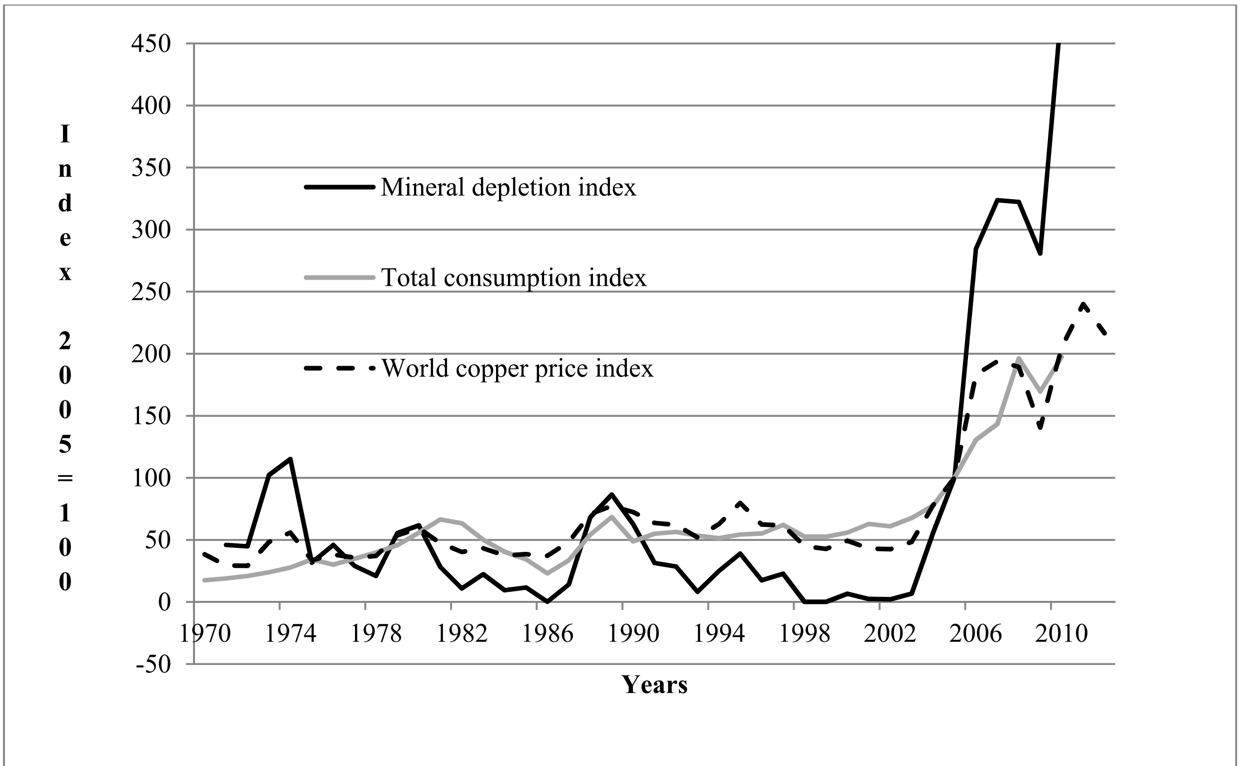


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

As shown in Fig. 30, world copper prices are volatile and vary from 1 month to the next by an average of almost 6 % in the years between 1970 and 2012. In 1974, the price per metric ton decreased by more than 60 % in the timeframe of only a few months; while from the beginning of 1980 until the summer of 1982, another drop of 55 % was recorded. Over the next 30 years, copper prices fluctuated enormously. Since the end of the 1990s, the broader trend has shown an increase, but even in this timeframe a sharp drop between the middle of 2008 and the end of 2009 was recorded. After three decades of relatively low copper prices, Figs. 29 and 30 illustrate the boom of more than 300 % from the lowest point in 2002, an average of US$ 1560 per metric ton, to a peak of US$ 8700 in April 2008, reaching more than US$ 9000 from the end of 2010 until mid-2011. Although the demand from China and India continues to rise, the upward price trend is not a long-term certainty; prices decreased again from US$ 9650 in July 2011 to US$ 7966 in December 2012. Since Zambian copper depletion (δK_N) varies with world market prices through copper rents, price volatility is one of the most important factors impacting Zambia's GS rate. Traditional indicators such as the GDP and GNI react not only in a delayed manner but also with less volatility than can be found in GS rates.

Copper depletion within Zambia's GS as well as primary exports followed the path of copper prices and increased in the last decade together with Zambian GDP. All three – world copper prices, copper depletion and exports – are positively correlated with coefficients of more than 0.9.[64] Figure 31 shows that, along with the prices for copper and therefore Zambia's mineral depletion, total consumption also increased. The correlation between the three is very strong. Since mineral depletion depends on copper prices, this relationship is intuitive, but the positive correlation to consumption is more striking.

Figure 31: Copper prices, mineral depletion and total consumption from 1970 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Consumption is a negative term in (27) along with mineral depletion; therefore, this positive correlation doubles the negative influence on GS. Rents from mineral depletion are used for consumption rather than investment in K_P or K_H. Volatility of natural resource income has two

[64] We use a simple Pearson correlation coefficient: This is defined as the covariance of two variables divided by the product of their standard deviations, showing a value in the range of -1 for a complete negative correlation to 1 for total positive correlation (GRIFFITHS ET AL. 2008). We only use these correlation coefficients through the rest of our analysis to emphasize our qualitative arguments without applying them within the discussion due to the possibility of error between only two variables. However, we have attempted different models with multiple variables without significant results to benefit our analysis.

effects that are relevant in the case of Zambia's GS, but also in comparing GS to the traditional indicators. On the one hand, the anticipation of better times, as VAN DER PLOEG (2010, 2011) puts it, results in consumption expenditures in times with decreasing copper prices that approach levels that correspond to better times. Consumption increases quickly with higher copper prices but decreases slower than rents as prices fall. Therefore, traditional GNI as an initial calculation point reacts in a delayed manner. On the other hand, the GS calculation depends on GNI, but reacts much more directly to the volatile development of income from natural resource rents and their conversion into consumption or investment (BOOS and HOLM-MÜLLER 2012). Therefore, GS cannot function solely as an early warning system, but serves as an additional indicator to explain the development of a country, as demonstrated by the Zambian example. Zambia's GS rate predicts unsustainable future development even if the traditional indicators GDP/GNI continue to grow, driven upward by a consumption-based use of rents from mineral depletion.

Shortly after independence at the end of the 1960s, the Zambian government nationalized the mining sector and concentrated public investment on the social sector and especially the education system, as Fig. 26 shows, but not in K_P. However, the government was faced with the decision of using foreign earnings to finance the social sector and fight food shortages in the 1970s and 1980s or reinvesting a portion of rents in its income-guaranteeing mining sector (LUNGU 2008).[65] GS rates and consumption in Figs. 25 and 28 show that Zambia consumed rents instead of investing in K_P and therefore not only weakened the mining sector during the resource price crisis, but the whole economy also suffered from low investments beginning with the copper price shock (FESSEHAIE 2012). In 1974, revenues from copper depletion, as shown in Fig. 29, collapsed to below US$ 100 million and stayed at this level until the 2000s. The government expected the price shock to be a short-term anomaly, but while copper prices stayed more or less constant over the long run, it chose to face ''the largest external shock the economy had experienced since the Great Depression'' (MCPHERSON 2004a) by financing the imbalances with additional debt, followed by an extreme downward spiral (FESSEHAIE 2012).

In general, governments of resource-dependent countries not only tend to consume rather than invest, but they also have little incentive to save during phases with higher resource prices (BOOS and HOLM-MÜLLER 2012). Particularly in a situation such as Zambia's, in which a single-party regime makes its case with larger, long-term visions, these additional expenditures also find justifications in phases with low copper prices. The various Zambian governments

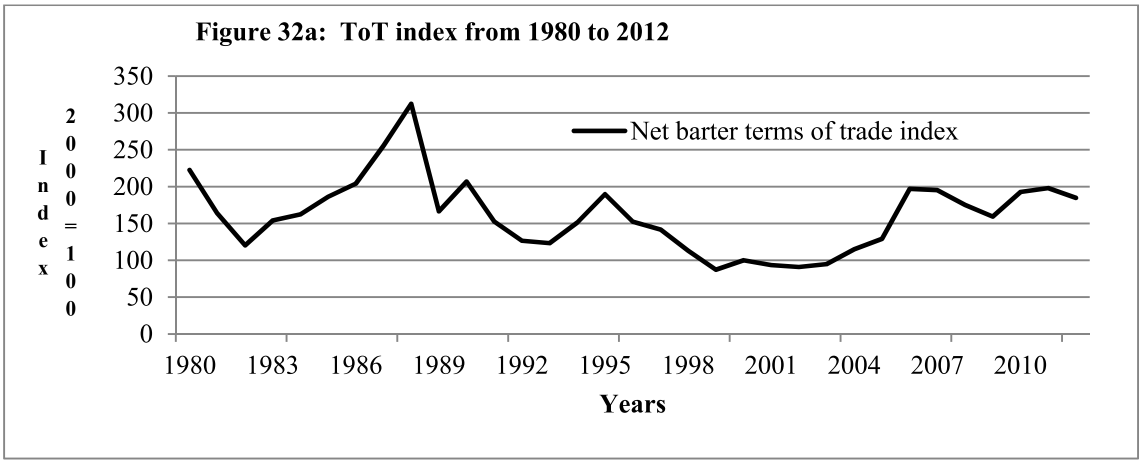
[65] The Zambian copper mines were nationalized into the Zambia Consolidated Copper Mines (ZCCM).

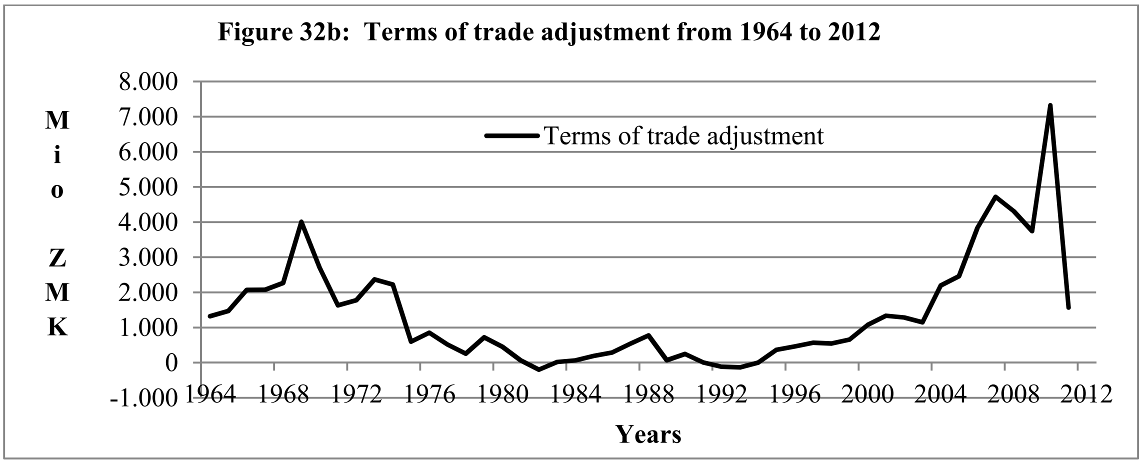
generally aligned their public expenditures with higher income phases, even in the face of decreasing prices, as they expected prices to rebound and increase over the long run. VAN DER PLOEG (2011) summarizes panel data estimations suggesting that the problems of many resource-dependent countries including Zambia originated from incorrect expectations, which during the 1970s and 1980s resulted in a debt crisis.

Zambia's public consumption also increased by an annual average of 6 % in a longer period from US$ 278 million in 1970 to US$ 683 million in 1997. Since its total GNI only increased by 4 %, the ratio of public consumption to GNI grew continuously. As Fig. 25 shows, Zambia's total consumption began at around 65 % of GNI after independence and increased to an extraordinary 95 % average in the 1990s. In nine of the 40 years between independence and the 2000s, Zambia's society consumed more than its available income. Thereby it seems difficult to follow a rule of a constant share of consumption in GNI, which is one of the typical recommendations within topical literature (AUTY 1993; HILL and MCPHERSON 2004; PAPYRAKIS ET AL. 2006). Indeed, the Zambian government could define a constant proportion of consumption and investment within GNI, which changes US$ expenses at a consistent ratio, but if Zambia requires its total GNI to finance consumption, investment in K_P is neglected. In particular the period at the end of the 1990s and the beginning of the 2000s, in which consumption accounted for almost the entirety of GNI, Zambia was one of the poorest countries worldwide and had greater societal problems than long-lasting investments.

The so-called Prebisch–Singer thesis predicts that the terms of trade (ToT) of resource exporters decrease in the long run due to a relative decline in world market prices of primary commodities in relation to imported manufactured products and, as a result, the GDP of these countries also declines (PREBISCH 1950; SINGER 1950; SACHS and WARNER 1995/1997). According to this thesis, this is due in part to decreasing income from resource depletion compared to the expenses for imports (ZANIAS 2005; BARBIER 2007). This relationship is important in the case of Zambia for two reasons: On the one hand, copper prices only decrease for the first three decades of our analysis and increase on the whole for the complete period between 1964 and 2012. The rising prices since 2003 demonstrate a rather short trend, but according to Fessehaie (2012), ''copper prices will remain high for some years to come.'' On the other hand, since ToT are calculated as the ratio between the price indices for exports and imports, these relationships are especially important for a resource-dependent country. In Zambia, copper and therefore the depletion of natural capital δK_N is primarily directed into exports while a large part of investment in K_P is determined by the demand for imported consumption and capital goods. Therefore Zambia's ToT develop on the same path as the ratio between δK_N and changes in physical capital δK_P. Due to the calculation method shown in (27), δK_N is subtracted, thus impacting GS negatively, while δK_P is added and influences GS positively. In total, this means that increasing ToT should affect GS negatively, in contrast to the positive influence on GDP growth noted in SACHS and WARNER (1995/1997) (BOOS and HOLM-MÜLLER 2012, 2013).

Figure 32: ToT index from 1980 to 2012 & ToT adjustment from 1964 to 2012.





Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Figure 32 shows that, except for a short increase in the mid-1980s, Zambia's ToT[66] decreased in total until 2002. Due to the copper price increase it has since risen. From 1964 to the end of the 1990s ToT adjustment[67] in constant Zambian Kwacha (ZMK)[68] decreased from 1.3 billion to 650 million. The price increase since 2002 not only positively influences GNI as an initial

[66] Net barter terms of trade index: percentage ratio of the export unit value indexes to the import unit value indexes measured relative to the base year 2000 and available since 1980 (WORLD BANK 2014a).

[67] Terms of trade adjustment: capacity to import less exports of goods and services in constant ZMK (WORLD BANK 2014b).

[68] The ZMK consists of 100 ngwee. Due to the extremely high inflation in the last two decades the government revalued the currency in 2013 and dropped three zeros.

calculation point of GS in (4) but also results in increasing ToT.[69] At the beginning of the price boom, GNI increased enough to also influence GS positively, but in the second half of the decade higher copper prices and therefore increasing δK_N (correlated to the ToT index with a high coefficient of 0.95) again result in a temporary drop of GS rates. Growth rates of imports and exports were equal in the 2000s (at an average of almost 13 %) and Zambia's external trade balance stayed in a small negative range, with an average of -2.2 % between 2000 and 2012. However, while prices for copper exports grew, the import price index decreased since 1999 and Zambia's ToT therefore increased even while import quantities rose faster than exports (BRAUTIGAM 2011). In the last decade of our period of analysis, the additional income (both Zambian GDP and GNI increased by an annual average of more than 7 %, 4.5 % in per capita terms, between 2002 and 2012) was not only large enough to increase GS rates even with higher copper prices and therefore δK_N, but also enough to move Zambia's investment strategy slightly away from only investing in the primary sector. However, a boost in the income from natural resource revenues, namely the rents from copper depletion, often results in a crowding out of investment in K_P and K_H.

Only with the progressive development of productive structures in less volatile sectors does the vulnerability to fluctuations decrease (KOREN and TENREYRO 2007). According to VAN DER PLOEG and POELHEKKE (2009), price and therefore income volatility is the key channel for the RC: They show in their regressions that higher dependence on natural resources increases the vulnerability to volatile market prices, development of productive structures stabilizes a country's economy against volatility. Therefore, the GDP and investments in resource-exporting OECD countries such as Norway are much less volatile, even though they also export natural resources with volatile world market prices. These countries grow more consistently and attract more investment while landlocked Africa and especially Zambia (emphasized by PLOEG and POELHEKKE 2009) is extremely vulnerable to price changes. In the view of VAN DER PLOEG and POELHEKKE (2009), ''[f]or resourcerich Africa the positive direct effect of resource dependence is more or less canceled out by the indirect effect through volatility.''

[69] As the theory would indicate (SACHS and WARNER 1995/1997; BOOS and HOLM-MÜLLER 2012), the correlation coefficients between ToT and GDP (independently of which measure is used) are all positive (by more than 0.5), while ToT is negatively correlated to GS rates (by more than -0.3).

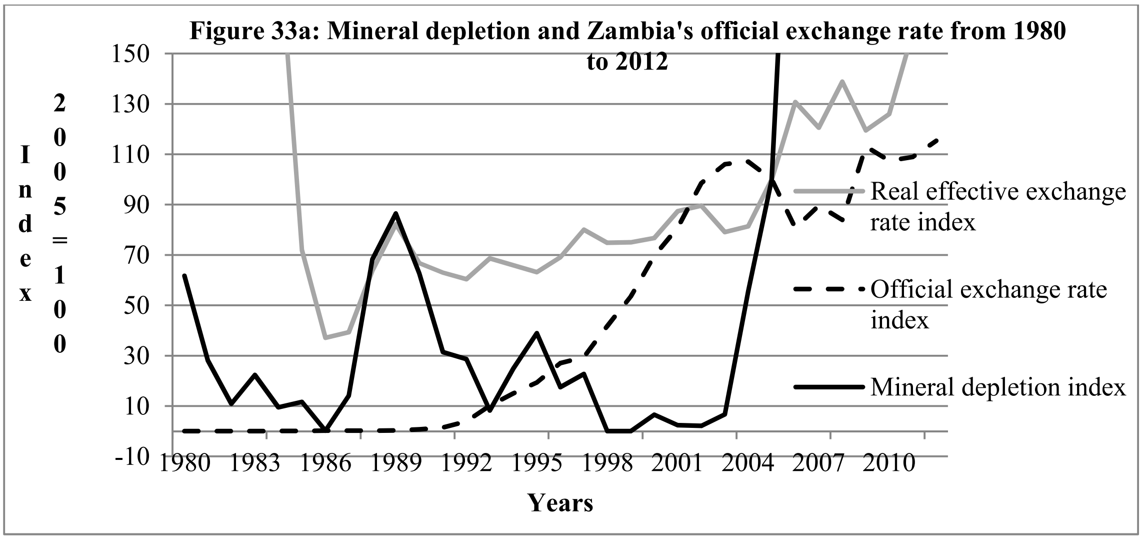
5.4.2.2 Dutch disease and crowding out effects

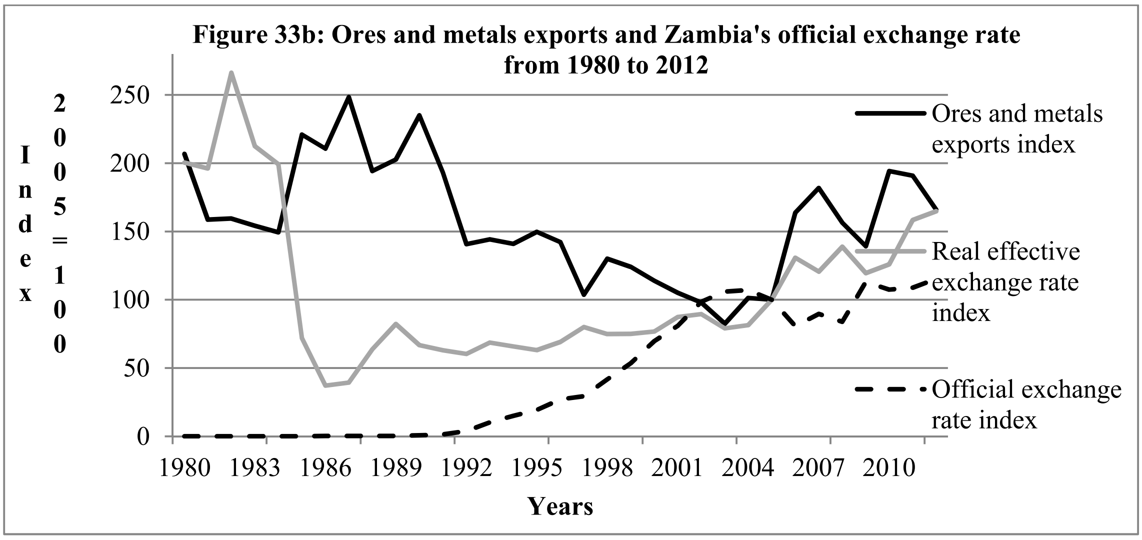
Structures for stable development independent of volatile copper prices have not yet been realized in Zambia, but in the 2000s the prices were rising, as shown in Figs. 30 and 31. From such a boom in world market prices and therefore increasing quantities of exported copper, effects of the so-called Dutch disease (DD) could arise. This represents the original and most prominent theory behind a possible natural RC. In this classic model presented by CORDEN and NEARY (1982) and CORDEN (1984), a boom in the natural resource sector – induced either by the discovery of new reserves, exogenous technological progress or simply by increasing resource prices (as Zambia experienced in the 2000s) – results in higher export revenues and thus increasing rents for δK_N.

Through the so-called spending effect, additional rents increase the demand for goods from sectors other than the primary sector. In the DD model, the non-primary sectors offer tradable goods that come almost completely from manufacturers and non-tradable goods mostly produced in the service sector. Via a process called resource movement or the crowding out effect, investment and employment move from this tradable sector into the resource and service sectors (CORDEN and NEARY 1982; AUTY 2007). This crowds out investments in K_P, since the service sector is more labor intensive, and K_H, since production processes are more unskilled in the resource sector compared to manufacturing (GYLFASON 2001a; BOOS and HOLM-MÜLLER 2012).

As shown above, the copper price boom resulted in higher income for Zambia; the correlation coefficients between GDP per capita (regardless of the calculation method) and world copper prices were always higher than 0.85 between the 1960s and 2012. Since 2003, a 40 % average annual growth of copper prices resulted in growth of GDP per capita of 4.5 %. Copper depletion (at an average of almost 8 % for the whole period) increased from values of < 1 % of GNI at the beginning to more than 16 % at the end of the 2000s. While Zambian copper rents were only slightly above US$ 30 million in 2000 (with a production volume of 250,000 metric tons at a price of US$ 1813), rents rose to almost US$ 2.5 billion at the end of the decade (560,000 metric tons at US$ 6956 in 2008). Therefore, Zambia increased its income from copper over a hundredfold within 8 years while only slightly more than doubling production. In other words, copper depletion and GS rates fluctuate without changing the depletion in metric tons. While the dependency rate on copper exports decreased from around 60 % of GNI to 32 % in 1978, and exports of ores and metals sank from US$ 1.2 billion in 1971 to US$ 820 million in 1978, these exports stayed constant in metric tons, even increasing from around 600 to 700 thousand metric tons after the hardest price shock in 1974 (MCPHERSON 2004a). This is one of the disadvantages of portraying ''weak'' sustainability by measuring GS: The amount a country has to reinvest in US$ can decline while the actual amount of depleted natural resources increase in metric tons (BOOS and HOLM-MÜLLER 2012). However, this paper does not seek to discuss the GS calculation. In our case study, higher prices decrease the metric tons Zambia's mining industry has to deplete for the same output in US$, while revenues flowing into the Zambian economy increase at constant quantities.

Figure 33: Mineral depletion & ores and metals exports and Zambia's official exchange rate from 1980 to 2012.





Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

This additional income increases the demand for goods from other sectors than the resource sector – called the spending effect – and thus changes the relationship between consumption and investment in K_P and K_H (GYLFASON ET AL. 1999). A part of the additional demand for manufactured goods must be met by imports, increasing competition in this sector (KRUGMAN 1987; DAVIS 1995) and blocking further investments (BOOS and HOLM-MÜLLER 2012). Additionally, while the manufacturing sector relies on world market prices, relative prices of non-traded goods increase to achieve home market equilibrium (BRUNO and SACHS 1982). This results in an appreciation of the real exchange rate, which on the one hand further fosters competition from imports, the prices of which decrease in ZMK (AUTY 2007; FRANKEL 2012), and on the other hand decreases the governmental budget for investments in K_P and K_H from trade taxes (WEEKS 2008).

First, Fig. 33 shows the extremely high growth of the official exchange rate from the end of the 1980s onwards. Between 1964 and 2012, the ZMK depreciated by a yearly average of 26 % from 70 Ngewee per US$ in 1964 to 5147 ZMK in 2012. Particularly in the decade between 2000 and 2010, the official exchange rate appreciated by a yearly average of almost 8 %, with a period of high volatility in the mid-2000s. As expected, Fig. 33b shows that this is negatively correlated to the amount of copper exports (with a coefficient of -0.75) and decreases with rising exports.

Second, as the theory behind DD predicts in such a price boom, the real effective exchange rate[70] is positively influenced by higher copper exports (correlation coefficient of 0.67 between 1980 (first available year) and 2012). In the 2000s, this real effective exchange rate developed parallel to copper exports (with a correlation coefficient of 0.86) and more than doubled from 2005 to 2012. Using monthly values by the Bank of Zambia, CALI and TE VELDE (2007) show the relationship between copper prices and the real effective exchange rate with coefficients of 0.5 for the period from 1985 to 2006 and higher ones of more than 0.9 from 2003 to 2006. Figure 33b shows that after 2003, exports of ores and metals and the real effective exchange rate grew together, resulting from the copper price increases shown in earlier figures. In addition to the small positive influence on investment in imported K_P, WEEKS (2008) shows a significant negative impact on public income and thereby affecting public investment in K_P and K_H.

Zambia increased its imports by a yearly average of 15 % since the mid-1990s. Therefore, net trade was negative until the mid-2000s and even in the last years of the decade it only fluctuated between positive values of US$ 500 million and US$ 2 billion, while Zambia's

[70] The World Bank's ''real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs'' (WORLD BANK 2014a).

copper exports ranged from US$ 3 billion to US$ 7 billion from the mid-2000s until 2012. However, this only served to increase investment options and wages in the resource as well as the service sector, while the tradable sector decreased due to competition from imported consumption goods (BOVA 2012). Therefore, investments as well as employees move to these two growing sectors – called the resource movement or crowding out effect (CORDEN and NEARY 1982) – crowding out investments in K_P since the service sector is more labor intensive, and partially also K_H since production processes are mostly unskilled in the resource sector (GYLFASON 2001a; BOOS and HOLM-MÜLLER 2012). Figure 26 shows that the portion of education expenditures decreased in particular, but also the necessary investment in the development and diversification of the Zambian economy failed. This resulted in a creeping de-industrialization of already existing sectors such as the clothing industry (HILL and MCPHERSON 2004).

Additionally, in a special case such as Zambia's in which the service sector mainly consists of basic unskilled services, movement to the service sector also results in decreasing investments in K_H (ARNOLD and MATTOO 2007). While the service sector share of total GDP grew by a yearly average of 5 % in the 2000s, from an average of 39.7 % of GDP (value added) in the 1990s to 47.4 % in the following decade,[71] the share of Zambian official employment remained constant at around only 20 %. According to ARNOLD and MATTOO (2007), official employment data do not show any significant movement of employees from manufacturing to services. However, at least the portion of official employment in industry decreased from 11 to 7 % between 1990 and 2005, although the mining industry grew in this period. It is nevertheless rather difficult to show changes within the employment structure of a country with a large informal sector, as is the case in Zambia. Some authors, such as ARNOLD and MATTOO (2007) or DE LUNA MARTINEZ (2007), assume that around 90 % of the Zambian workforce is employed in the informal economy.

However, if it is true that the movement of employees from the tradable to the resource and service sector serves to decrease investment in human capital – due to less skilled production processes in these two latter sectors – it follows that in the last decade education expenditures should exhibit a contraction: Regardless of the index used, education expenditures and therefore investment in K_H decreased since 2000. Average expenditures per primary-school pupil (in % of GDP per capita) decreased by more than 3 percentage points (from 8.9 to 5.4 %) within 1

[71] Official data by the ''Central Statistical Office Zambia'' show US$ 5.4 billion (46.5 %) in 2007 and US$ 6.9 billion (46.5 %) in 2008: http://www.zamstats.gov.zm/real.php. ARNOLD and MATTOO (2007) even cite a 64 % service sector share of Zambian GDP.

year between 2004 and 2005. Education expenditures (in % of GNI), which is deduced from NNS by the World Bank, decreased from 2.7 % in 2000 to a constant average of 1.3 % from 2007 to 2012.

While δK_H as a positive calculation component in (27) decreased relative to GNI, δK_N increased by a yearly average of 85 %from around 1 %of GNI in 2000 to an annual average of 14 % between 2005 and 2012. Thus, higher rents from mineral depletion are subtracted. Since GNI increased rapidly in current US$, education expenditures more than doubled in this decade, increasing from US$ 84 million in 2000 to US$ 188.5 million in 2010 and surpassing US$ 200 million in 2012. However, in the same decade, mineral depletion increased from US$ 33.6 million in 2000 to US$ 2.5 billion in 2010 (US$ 2.6 billion in 2012). Therefore, the reinvestment ratio between δK_N and δK_H decreased from 2004 on, the year in which δK_N was higher than investment in human capital δK_H for the first time. As a result, in 2012 only 7.8 % of δK_N were reinvested in δK_H (1.3 %in education, 6.5 %in health expenditures), an obvious sign of the crowding out of human capital.

Furthermore, the service sector is more labor intensive and requires relatively little investment in K_P (GYLFASON 2001a; DIETZ ET AL. 2007). The capital-intensive mining sector attracts greater investments in K_P, but crowds out investment in other parts of the manufacturing sector. In total, DD effects result in decreasing GS rates: Although copper prices rose exponentially, and thus GNI as an initial calculation point of GS in (27) increased by a yearly average of 7 % in the 2000s (4.5 % in per capita terms), the subtracted rents of δK_N also rise and have a negative impact on total GS. The Zambian GS rate reacts mainly as the theory would expect, but shows positive GS in parts of the 2000s despite extreme rises in copper prices. We could explain this with two factors: first, it could be caused by time-delayed reactions, especially since this explanation would apply to almost the entire analyzed time series. Second, at the beginning of a price boom the increasing GNI results in higher GS rates before the lack of investments reduces GS.

However, literature on the RC agrees on the importance of endogenous political and institutional explanations in addition to these exogenous ones (ROSS 1999; MEHLUM ET AL. 2006; BARBIER 2011; BOOS and HOLM-MÜLLER 2012). Neither the RC itself nor its link to the GS rates of resource-dependent countries can be completely explained by exogenous factors. It is equally important that, for example, easily attainable resource rents increase the power of interest groups, cause myopia within the political class, and thus weaken political structures and institutions.

5.4.3 Endogenous explanations

5.4.3.1 The political system

Literature proves that democracy supports economic growth (BARRO 1996; HEO and TAN 2001; BARRO and SALA-I-MARTIN 2004; JAMALI ET AL. 2007). DE SOYSA ET AL. (2010) and BOOS and HOLM-MÜLLER (2013) show empirically that democratic structures also increase GS rates. The older the democracy, the more stable a country's institutions and public investments prove to be. Newly democratizing countries are more often plagued by corruption and target their investments to satisfy interest groups (KEEFER 2007; KEEFER and VLAICU 2008). Studies such as BULTE and DAMANIA (2008) demonstrate that resource-dependent countries in general are less democratic, due, for example, to averted modernization and repression, which are enabled by resource wealth and preferential access to it by the political class (BOOS and HOLM-MÜLLER 2012).

Concerning Zambia, this causes two issues: the question to what extent the dependence on copper influenced democratic development, and to what degree it is still negatively affected (AUTY 1993). Furthermore, the results by DE SOYSA ET AL. (2010) and BOOS and HOLM-MÜLLER (2013) – stating that a higher democratic status influences GS positively – are a contentious point with respect to Zambia's history, as its political system shows rather low values in existing indices for democratic development combined with similarly low GS rates, at least as periodic averages. Figure 34 brings together two of the most accepted political indices, the ''Polity IV'' (PIV) index[72] (available from 1964 on) and the ''Freedom in the World'' (FitW) index[73] (available from 1972 on). PIV began at low but positive values at independence, decreasing over the period of the so-called First Republic (1964–1972) and turning sharply negative for the Second Republic (1972–1990). During the Third Republic (1991–present), the PIV index increased, reaching positive to high values at the end of the 2000s. Over the whole period, PIV is correlated to GS with a coefficient of 0.5. The FitW index by Freedom House began as ''partly free'' for both the political rights (PR)[74] and civil liberties (CL)[75] indices,

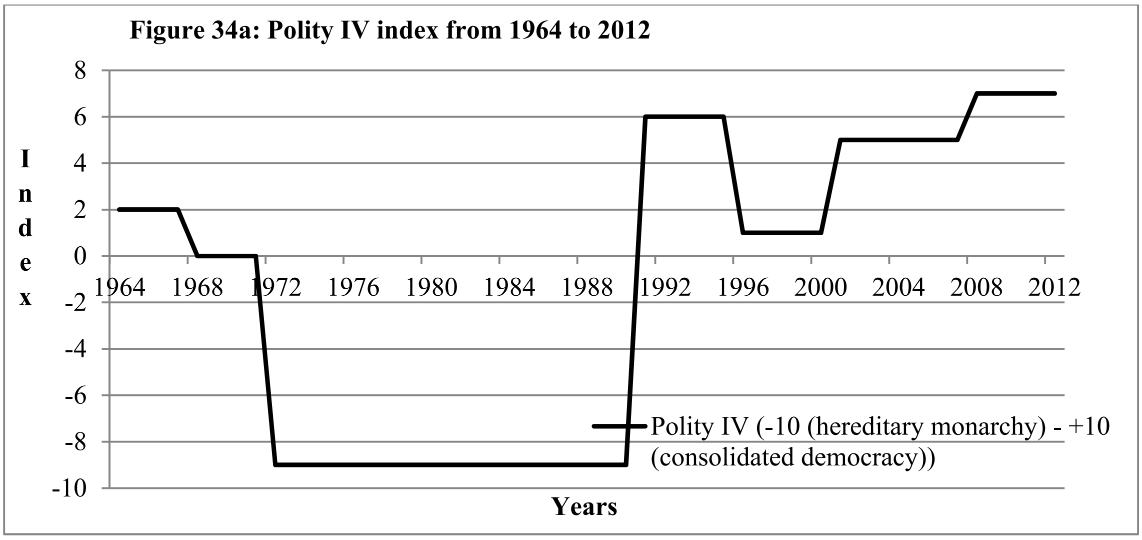
[72] PIV shows the quality of ''democratic and autocratic authority in governing institutions […] from fully institutionalized autocracies through mixed, or incoherent, authority regimes […] to fully institutionalized democracies. The 'Polity Score' captures this […] spectrum […] from -10 (hereditary monarchy) to +10 (consolidated democracy)'': http://www.systemicpeace.org/polity/polity4.htm.

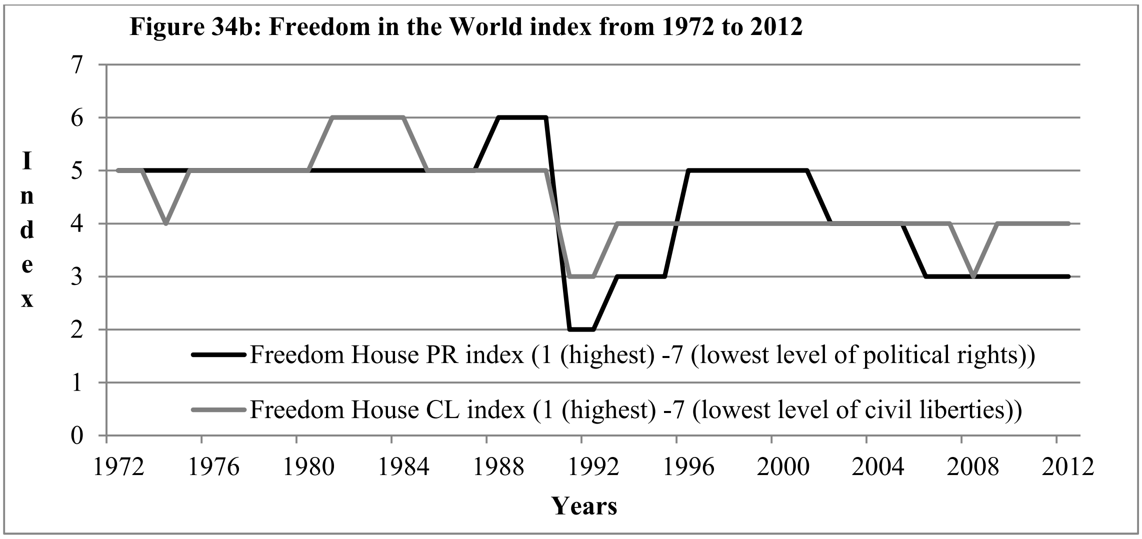
[73] Freedom House rates political rights and civil liberties individually from 1 (highest) to 7 (lowest level of freedom) and values the status of free (1.0–2.5), partly free (3.0–5.5), or not free (5.5–7.0) from 1972 on: http://www.freedomhouse.org/report/freedom-world-2012/methodology.

[74] ''Political rights […] are based on an evaluation of three subcategories: electoral process, political pluralism and participation, and functioning of government'' (PUDDINGTON 2013).

remained more or less constant with minor fluctuations until 1990, and improved through the mid-1990s. However, shortly after the first democratic election, FitW worsened again; the average between PR and CL is correlated to GS with a coefficient of 0.4.

Figure 34: Polity IV index from 1964 to 2012 & Freedom in the World index from 1972 to 2012.





Source: Own illustration with data from POLITY IV (2010, 2014); FREEDOM HOUSE (2011, 2012).

In the cross-country model by BOOS and HOLM-MÜLLER (2013), PIV demonstrates a highly significant positive relationship to investments in K_P and total GS rates, whereas the depletion of K_N decreases with more stable democratic structures. Figure 34a shows that this developed similarly in Zambia. In 1964, Kenneth Kaunda and his United National Independence Party

[75] ''Civil liberties […] are based on an evaluation of four subcategories: freedom of expression and belief, associational and organizational rights, rule of law, and personal autonomy and individual rights'' (PUDDINGTON 2013).

(UNIP) were the first to form a democratic government within the so-called First Republic (1964–1972) (TORDOFF 1974). However, literature agrees upon the wide-reaching powers of Kaunda, who was the dominant leader in an only nominal multiparty system (TAYLOR 2006). From 1964 to 1967, the PIV stood at a rather high positive value for a newly independent colony, but this quickly dropped to zero for the regime Kaunda developed slowly in the years from 1968 to 1971. FREEDOM HOUSE (2011, 2012) calls the democratic structure until 1972 a de facto one-party rule by UNIP, which was controlled tightly by Kaunda. However, the government invested income from high copper prices in K_H. The ENCYCLOPEDIA OF THE NATIONS (2012) speaks of an increase in the availability of education services and an expansion of hospitals by 50 % and of health clinics by 100 %, as at least partially shown by the consumption expenditures in Fig. 25 together with the expenditures for K_H in Fig. 26. Investment in K_H was rather high until the beginning of the 1980s, which was certainly an achievement of the Kaunda regime.

To organize the growing public sector, civil service expanded and acted as a mechanism for the UNIP to offer sinecures to interest groups. Civil servants became the nation's highest earning income group regardless of overemployment in the public sector and the shortage of professional manpower (TORDOFF 1974). And while GDP per capita increased in the initial period after independence, the diversification of the economy away from copper was not significant enough to create a balance to the public sector. The UNIP indeed based a development strategy of the other sectors on the income from copper exports, but neither quickly nor resolutely enough (BONNICK 1997). When Kaunda in 1972 banned all other parties and declared a so-called ''one-party participatory democracy,'' the imbalance between the public and private sectors was already a large problem, since virtually all mid- to high-income salaries were paid out of the national budget (TORDOFF 1974). The Second Republic (1972–1990) began with a copper price crash while these public expenses already overburdened the national budget (ENCYCLOPEDIA OF THE NATIONS 2012). BAYLIES and SZEFTEL (1992) depict the UNIP government in the Second Republic as a powerful presidency within a centralized autocracy with an obtrusive security apparatus, which nonetheless refrained from brutality against its opponents. The UNIP was rapidly overburdened by its own standards and did not realize investments in K_P at a level sufficient enough to compensate consumption expenditures, at least in relation to GNI (as seen in Fig. 25). Zambian GS was only positive until 1977, but decreased to -0.7 % in 1978 and remained negative for the rest of the Second Republic.

In 1990, Kaunda was forced to agree to democratic elections by political pressure from a continuously strengthening opposition and an economic crisis that featured a serious collapse of all indicators. Figure 21 shows the decrease in the traditional GDP/GNI indicators in the mid-1980s, and Fig. 28 shows the counterpart of negative GS rates. Although copper prices increased, economic development and GS rates only recovered for a brief moment in 1990 due to positive expectations surrounding the regime change. In 1991, free presidential and parliamentary elections brought Frederick Chiluba and his MMD into power, a broad-based opposition formed by trade unions, business interests, intellectuals and students (RAKNER 2003). While the new government rushed to fulfill its campaign pledge of economic ‘‘liberalization,’’ democratic development was limited. The economic program began quickly with a number of measures, including the removal of consumer and agricultural subsidies, the increase in import tariffs and the privatization of a number of public entities, which resulted in a 24 % decrease in official employment.

The MMD initiated a Structural Adjustment Program with the help of the IMF and the World Bank to return to a free market economy, which included the privatization of the copper mines (LOXLEY 1990; SAASA 1996; SIMUTANYI 1996; INTERNATIONAL MONETARY FUND (IMF) 1999).[76] But after decades of mismanagement, not only in the mining sector but across the entire economy, the MMD faced so many challenges that selling the mines was not the first priority, especially at a time with comparatively high copper prices accompanying the political changes at the end of the 1980s and early 1990s (HILL and MCPHERSON 2004). The MMD needed the income from copper mines to finance its other reforms and hesitated to sell Zambia's ‘‘crown jewels’’ before consolidation of their power base (MCPHERSON 2004b). However, during this adjustment phase, copper prices decreased rapidly while the new and unprepared government hesitated and pursued a delay tactic.[77]

Chiluba, using existing structures from the Second Republic, formed his own personalized patrimony shortly after elections, initially within the MMD and later throughout the whole

[76] Structural Adjustment Programs in general are not without their critics and especially in Zambia's case – where where all five formal programs with the IMF between 1976 and 1991 collapsed (MCPHERSON 2004c; WHITE and EDSTRAND 1994) – the nature of the country's economic structure and the weakness of world commodity markets made short-term gains impossible (LOXLEY 1990; CALLAGHY 1990). The abandonment of the program in favor of a ‘‘growth from own resources’’ program also failed (KAYIZZI-MUGERWA 1990). The economic performance after this last Structural Adjustment Program at the beginning of the 1990s was especially alarming. Following World Bank/IMF standards much progress in liberalization was accomplished, but the manufacturing output decreased by 10 % and GDP per capita shrank by a yearly average of 2.8 % from the end of the 1980s to the mid-1990s (SAASA 1996).

[77] For example, the so-called Keinbaum Report was neglected, which provided a detailed analysis of privatization options and recommended the rapid unbundling and selling of the mines, while a World Bank report by twelve mining specialists, which called for an immediate revival of the mines, was never released (MCPHERSON 2004b).

country (LARMER 2011). A weak opposition was unable to offer a reasonable alternative and Chiluba was supported by Western donors, which praised ''Zambia as an exemplary model of economic reform, rhetorically critici[zing] deviations from democratic practice but not pressure[ing] […] the MMD to bring about improvements'' (LARMER 2011). The Third Republic (1991–present; under Chiluba 1991–2001) began with high scores in the political indices, but decreased as early as the mid-1990s. Coefficients show a high negative correlation of more than -0.7 between the quality of Zambian democracy and its GS rate (average of -5.3 % between 1991 and 2001) in the first period of MMD government. Although such correlations are not clear enough to prove causality, the level supports our theoretical reasoning that decreasing democratic strength is negatively related to the ''weak'' sustainable development of Zambia.

In 1996, the MMD won the second legislative period in a landslide victory, but international observers reported misbehavior by ''the Chiluba government [who] was willing to compromise the rule of law, was intolerant to criticism and willing to exploit its majority position and control of government resources to undermine its opponents'' (RAKNER 2003). By the late 1990s, in light of improvements in civil society and the independent media, protests arose and forced Chiluba to resign. In the third consecutive elections, Levy Mwanawasa (Chiluba's vice-president between 1991 and 1994) achieved a close victory with only 29 % of the votes (BURNELL 2002; POLITY IV 2010; LARMER 2011). Although none of the eleven opposition parties presented a reasonable alternative to the MMD (RAKNER 2003), their sheer number, relative size, differences in political direction and interactions demonstrated an ongoing movement from a dominant to a competitive party system with a more balanced and fragmented parliament (RAKNER and SVASAND 2004). In the first term of Mwanawasa, the government was forced to cooperate with the opposition, increasing the democratic status of the Zambian political system in the indices shown in Fig. 34. Democratic status and political rights increased in the 2000s, but civil liberties remained constant from the early 1990s onwards. BRATTON ET AL. (1999), BURNELL (2001) or RAKNER and SVASAND (2004) show clearly that the status of Zambian democracy and political freedom of its population increased while civil liberties showed no improvements. However, compared to the critique of Zambian democracy in the 1990s, the Zambian democracy index values increased beginning with the election in 2001. Mwanawasa initiated reforms, dissociated himself from Chiluba and dismissed supporters of the former president (SEDDON and SEDDON-DAINES 2005).

In 2006, Mwanawasa continued with an election victory of 44 %, although serious opposition parties such as the Patriotic Front ran against MMD (KELLY ET AL. 2008). In the beginning of his second term, Mwanawasa continued to increase governmental integrity and democratic rights (FREEDOM HOUSE 2011). As Fig. 34 shows, both indices increased around the 2006 elections due to the introduction of more serious election rules, such as transparent ballot boxes and voter identification cards with photos. Still, loyalties were more important than service to the voter, shown, for example, in the lacking professionalism and access to official representatives (FREEDOM HOUSE 2007). However, in total under the presidency of Mwanawasa, democracy and GS increased together.

In October 2008, Vice President Rupiah Banda won the next election for the MMD after Mwanawasa suddenly died from a stroke. Banda was elected with 40 % of the votes over 38 % for Sata of the Patriotic Front, although MMD used state resources for campaigns and some observers noted electoral inconsistencies. Banda's government – which only lasted to the next election in September 2011,[78] the official end of Mwanawasa's legislative period – backpedaled on several reforms of the previous government. Among other things, corruption charges against former president Chiluba were abandoned, allowing mistrust of the judicial system to return. Additionally, pressure on civil society and the independent media increased, while the constitutional reform process stagnated (FREEDOM HOUSE 2011, 2012). However, especially the country's PIV increased in the years after 2008 from values consistent with an anocracy in the period of Mwanawasa's government, to values representing a democracy under Banda (MARSHALL and COLE 2011). Most interestingly, these can be attributed to an increase in institutional quality, which we discuss in the following section. Political rights increased, while civil liberties remain constant, mainly due to human rights abuses by the police and prison employees (PUDDINGTON 2013).

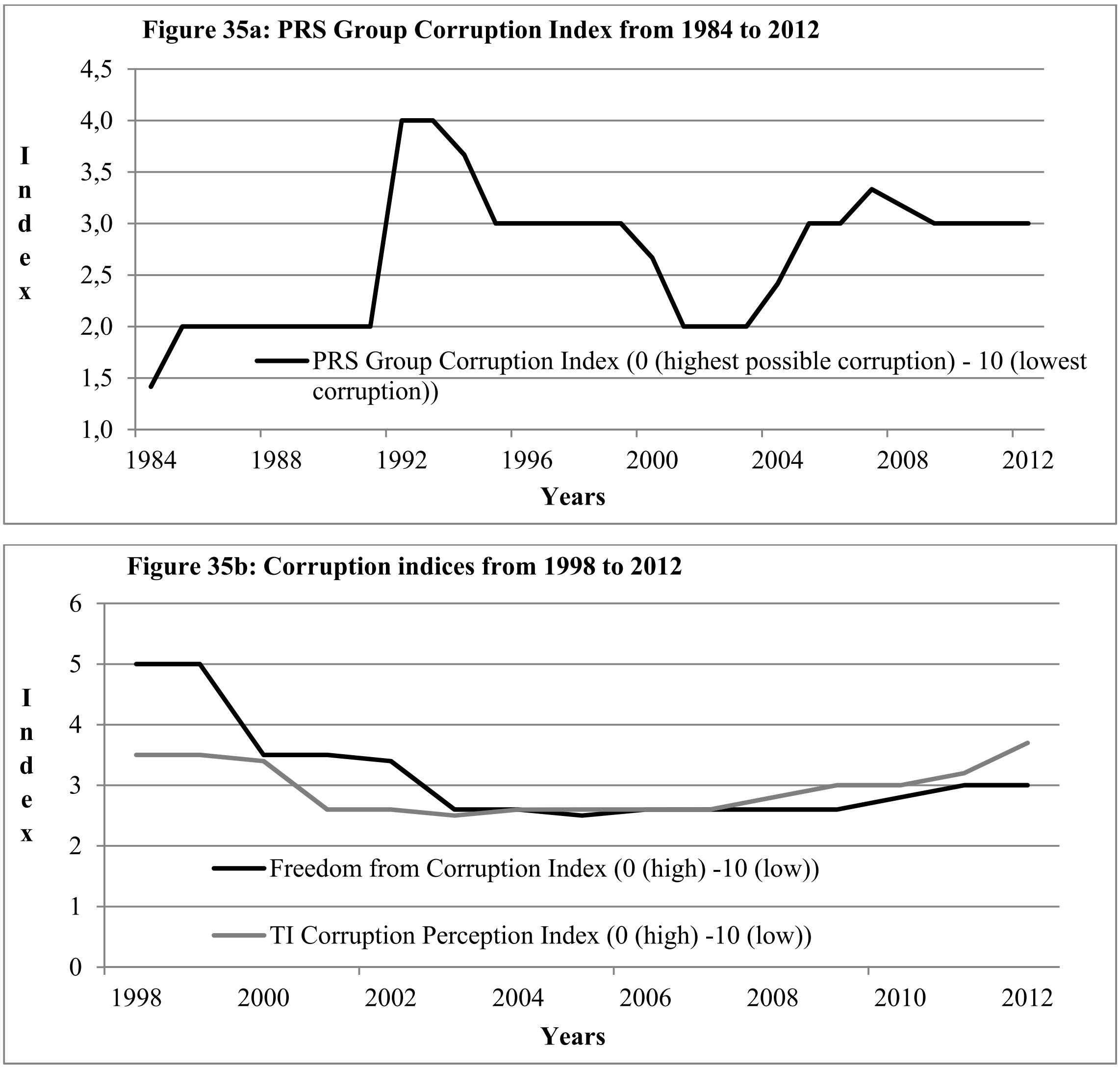
5.4.3.2 Institutional quality

In addition to Zambia's level of democracy, its institutional quality plays an important role in its copper curse as well as the development of its GS rate. The quality of a country's institutions is the foundation for political decisions and the general handling of natural capital (ROSS 1999). The rents from natural resources cause perverse incentives for the ''wrong'' behavior of

[78] In September 2011, Michael Sata was elected as the fifth Zambian president. Since none of the decisive indicators changed and Sata's reforms did not properly start by the end of our analysis in 2012, we chose to leave out this last year in the political discussion. Additionally, none of Sata's plans to develop the economy were ever quite realized since he died in office in October 2014.

politicians and other stakeholders, which then result in policy and institutional failures. PAPYRAKIS and GERLAGH (2004) or ROBINSON ET AL. (2006) demonstrate that on the one hand, resource dependence negatively influences institutions and that on the other hand, the RC is more likely to affect countries with weak institutions. Furthermore, a complete line of literature agrees on the importance of institutions for economic growth (ACEMOGLU ET AL. 2002b; EASTERLY and LEVINE 2003; RODRIK ET AL. 2004; MEHLUM ET AL. 2006). DIETZ ET AL. (2007), SOYSA ET AL. (2010) and BOOS and HOLM-MÜLLER (2013) show the same positive influence of institutional quality on GS.

Figure 35: Corruption indices from 1984 to 2012.



Source: Own illustration with data from THE HERITAGE FOUNDATION (2015); TRANSPARENCY INTERNATIONAL (2012); THE POLITICAL RISK GROUP (2013).

In particular the analysis by DIETZ ET AL. (2007), which shows a direct negative influence of corruption on GS, highlights one of the most important and in Zambia traditionally dominant determinants of institutional quality. The relatively easy access to resource rents gives rise to the misuse of authority in order to use this income for personal gain (KOLSTAD and SOREIDE 2009). SZEFTEL (2000) characterizes Zambia as an interesting case study for the relationship between constitutional change and corruption, since corrupt structures have accompanied all three republics. As Fig. 35 shows, the corruption index published by ‘‘The Political Risk Group’’[79] increased at the end of Kaunda's Second Republic and reached its highest level around the time of the system change. However, only during the decade of Chiluba's rule from 1991 onwards did corruption become entrenched and murkily intertwined with the political class. The close link between political engagement, access to natural capital and other privileges connected to the easily attainable income from the country's resources has changed the loyalty and ideals of many politicians and shaped Zambia's development (MOMBA 2007).

Particularly patronage – a particular, generally non-financial form of corruption consisting of providing supporters and interest groups with lucrative and secure positions in public administration and private businesses – has undermined positive development (SZEFTEL 2000). The negative relationship to GS is intuitive: Higher consumption expenditures for unnecessary salaries negatively influence GNS in (27). At the beginning of the Third Republic corruption decreased shortly for a few years, but rose again until the end of Chiluba's presidency. The positive correlation between the ‘‘Freedom from Corruption Index’’[80] and Zambia's GS rate shows a high coefficient of more than 0.8 in the second term of Chiluba's government from 1996 to 2001; in this period, increased levels of corruption were related to negative GS rates. Mwanawasa began to fight these corrupt structures, which during his rule had already permeated public services in all areas, especially activities related to the copper sector. The efforts to privatize the financially pressed Zambia Consolidated Copper Mines (ZCCM) were used by insiders to receive side-payments and extract capital assets. Rising prices resulted directly in rising opportunities for abuse, which were exploited by several agents involved (MCPHERSON 2004b).[81] Mwanawasa ‘‘set up a Task Force to investigate and prosecute plunderers of national resources’’ (MWENDA 2007), following his disillusionment with the work of the Zambian Anti-Corruption Commission. This Task Force performed ‘‘well below

[79] The ‘‘International Country Risk Guide’’ by ‘‘The Political Risk Group’’ (PRS) monitors 22 variables based on expert assessments in more than 140 countries. The index of corruption is part of its ‘‘Political Risk Rating’’ and uses a scale from 0 (highest possible corruption) to 10 (lowest corruption) (DIETZ ET AL. 2007; THE POLITICAL RISK GROUP 2013).

[80] ‘‘Freedom from Corruption’’ is part of the ‘‘Index of Economic Freedom’’ by THE HERITAGE FOUNDATION (2015), which monitors 10 variables from property rights to entrepreneurship from 0 (highest possible corruption) to 10 (lowest corruption).

[81] The correlation coefficient between international copper prices and the ‘‘Corruption Perceptions Index’’ by ‘‘Transparency International’’ was at 0.78 from the end of the 1990s to 2012: http://archive.transparency.org/policy_research/surveys_indices/cpi.

expectations […] and struggled without much success'' (NORAD (Norwegian Agency for Development Cooperation) 2011).

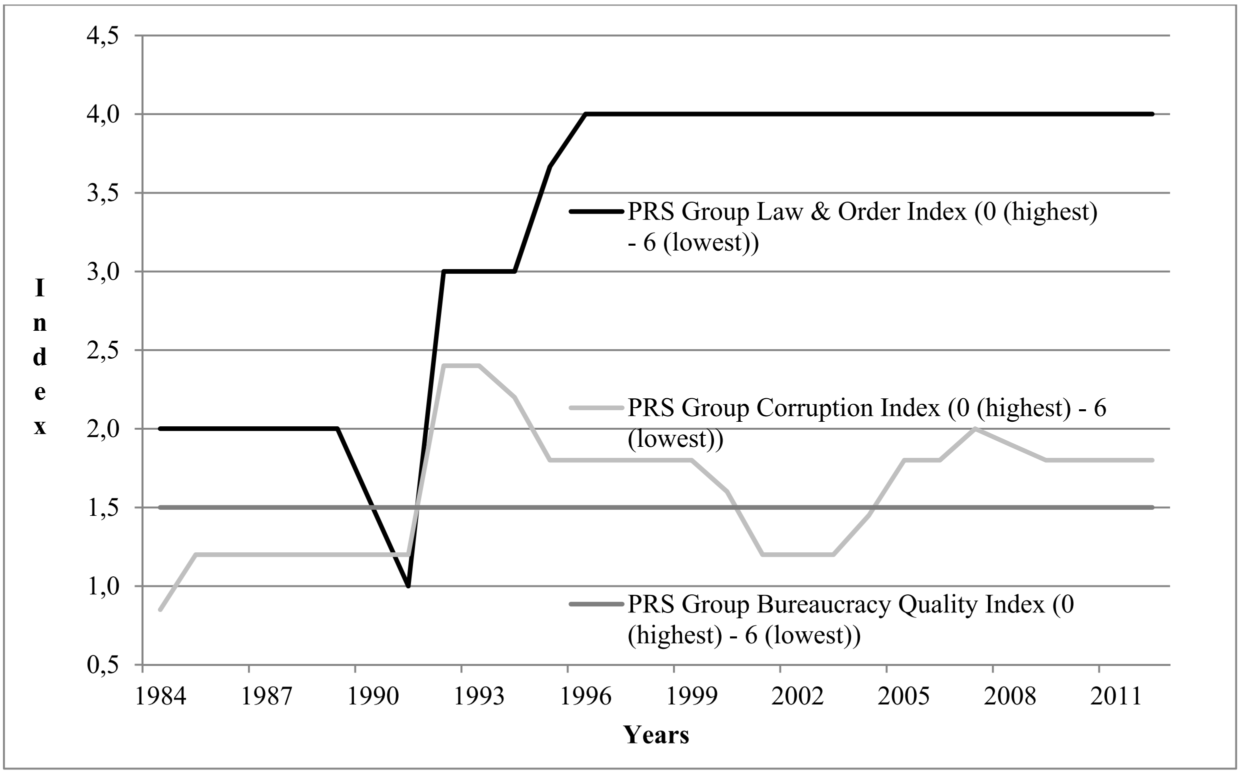
Figure 35b shows that the most renowned indicator, the ''Corruption Perception Index''[82] (CPI) published by Transparency International (TI) and available from 1998 onwards, rated Zambia initially at 3.5, which decreased to 2.5 in the mid-2000s. By 2012 the value had again increased to 3.7, which confirms that even the governments after Chiluba did not change the corrupt structures to any great extent. The ANTI-CORRUPTION RESOURCE CENTRE (2008) of TI points out, however, that certain ''Governance Indicators'' by the WORLD BANK (2013) – among others the index for the ''Control of Corruption'' – increased from 2002 onwards. Between two surveys conducted by the Bank in 2002 and 2007, the share of firms expecting to pay informal payments to public officials decreased from 45 % to 15 %, and the view of corruption as a major constraint for business dropped from 46 to 12.5 %. This corresponds with the overall increasing income per capita in the second half of the 2000s and the development of Zambia's GS rate. However, it is difficult to draw a direct connection between Zambia's corruption ratings and its GS rate, as the correlation coefficient between the CPI and GS is only slightly negative at -0.25, among other constraints.

Patronage in the public sector was discernibly high at the end of the 1990s during the country's privatization efforts (SZEFTEL 2000) and increased during the 2000s to support the power base at the local level (LEIDERER 2011). According to KOLSTAD and SOREIDE (2009), ''natural resource rents offer governments both more opportunities and greater incentives to pay off political supporters to stay in power [and] since being in power tomorrow means having access to greater resource rents, politicians are willing to spend more today to stay in power. ''From Chiluba to Mwanawasa the budget expenditures on public sector salaries increased from an already high portion of 35 % of total public expenses to almost 40 %. In the 2000s, Zambia ranked in the top third of public salary spending worldwide (average of 25 %), which increased to more than 43 % by the end of the decade. These figures support the theory that a large proportion of resource-dependent countries, especially those affected by patronage, maintain a large inefficient bureaucratic apparatus to serve various interest groups (DIETZ ET AL. 2007; BOOS and HOLM-MÜLLER 2012). Rents from copper depletion are simpler to disperse among supporters by paying salaries; especially local elites and their apparatus are appreciative receivers of public support, providing voters to the national government (BALDWIN 2013). By

[82] The ''Corruption Perception Index'' (CPI) by ''Transparency International'' (TI) captures the ''perceptions of corruption of those in a position to offer assessments of public sector corruption'' drawn ''from independent institutions specializing in governance and business climate analysis'' from 0 to 10 (TRANSPARENCY INTERNATIONAL 2012).

taking this detour, rents from δK_N find their way into consumption, thereby negatively influencing GS rates in (27).

Figure 36: Institutional quality from 1984 to 2012.



Source: Own illustration with data from THE POLITICAL RISK GROUP (2013).

The POLITICAL RISK GROUP (2013) describes bureaucratic quality as a shock absorber in countries where it ‘‘tends to be somewhat autonomous from political pressure. ’’In contrast, patronage in Zambia is a vehicle to transfer rents from the mining industry to the supporters within public services. Therefore, high transaction costs and an unreliable business environment result from an inflated apparatus, which on the one hand consumes the national budget for investments and on the other hand creates an environment in which poorly paid public officials offer low services and increase corruption (MCSHANE and NILSSON 2010). The thereby arising uncertainties and slow processes hinder investment and consume significant resources in terms of time and costs. While topical literature agrees on the negative impact of low-quality bureaucratic services on economic growth (EVANS and RAUCH 1999; OTO-PERALÍAS and ROMERO-ÁVILA 2013) and GS rates of a country (DIETZ ET AL. 2007; BOOS and HOLM-MÜLLER 2012, 2013), GS is also indirectly determined by stalled investment decisions and publicly paid wages (ATKINSON and HAMILTON 2003).

Zambia's large inefficient bureaucracy serves various interest groups, which increase the ratio of consumption through an increased number of publicly paid employees. BOOS and HOLM-MÜLLER (2013) show in cross-country regressions that higher bureaucratic quality influences GS positively. However, in the case of Zambia, the index for bureaucratic quality remained consistently low, at a constant level of 1.5 for the entire available period from 1984 onwards. There is therefore no recognizable development, and as LEVY (2012) expresses: ‘‘Zambia's bureaucracy […] remains chronically weak and has been impervious to repeated efforts at reform.’’

However, while public services are of poor quality and bureaucratic processes eroded by corruption, Zambia's rule of law remains secure. The rule of law, which implies that checks and balances are in place – and comprises among others the reliability of the judiciary system, political accountability and civil rights, property rights, and the security of contracts – is the traditional proxy for institutional quality used in various studies. NORMAN (2009) shows that the rule of law – here presented by the ‘‘Law & Order Index’’ of the Political Risk Group – is not directly influenced by higher resource exports, but rather functions as a transmission channel; countries with a weak rule of law suffer more from resource dependency. DIETZ ET AL. (2007) observe a decline in GS by 0.19 % for 1 % of additional resource exports if the rule of law is not present (worst index value).

Figure 36 shows that the period of the Third Republic from 1991 until 2012 was characterized by a consistently weak bureaucracy and corruption that fluctuated but increased overall, while the rule of law increased from low values in 1991 to a fair level in 1996, which remained stable through 2012. As we have seen, Zambia's political system and democratization status is secure and has consistently ranked in the middle of the pack globally since the 2000s. ABDI ET AL. (2005) see the functioning rule of law in Zambia as one of the most important variables for good governance. Elected governments are therefore legitimated while law and order are in place, therefore Zambian civil society is able to grow (DIAMOND 1994). BRATTON (2007) not only shows that young democracies such as Zambia only develop with a strong rule of law, but also that the Zambian population trusts the laws and the legal framework in place since the Third Republic. BAUER and TAYLOR (2005) see Zambia as much more stable and advanced in the democratization process and implementation of the rule of law compared to its neighbors.

In the last decade, the stable rule of law did not translate to similarly stable GS rates. Highly volatile changes characterized the 2000s. On the whole, as we summarize and discuss again in the following section, Zambia's GS rate recovered in the mid-2000s and was only slightly negative in the second half of the decade, featuring an average of -1 % (0.9 % from 2005 to 2012).

5.5. Conclusions

Zambia is highly copper dependent and one of the world's last examples of a country suffering from the so-called RC. In the analyzed period between 1964 and 2012, an average of more than a third of Zambia's income depended on copper exports, while its real per capita income decreased. However, after posting negative values in the 1990s, Zambia's GDP per capita growth recovered to an average of more than 4 % in the 2000s due to higher copper prices (4.1 % from 2000 to 2012). As a result of these latter years, economic growth is present. Following the concept of GS, ''weak'' sustainable development does not only depend on economic growth but also on the total capital stock of a country, which should remain (at least) constant. As we have shown, Zambia's copper depletion rents amounted to an average proportion of 8 % of Zambian GNI and even increased to 13 % in the second half of the 2000s (14 % in the last 5 years from 2008 to 2012). To ensure ''weak'' sustainable development Zambia would have had to reinvest the equivalent of its natural capital depletion (δK_N) in the increase of physical (δK_P) or human (δK_H) capital, such as infrastructure or education. Zambia rarely realized reinvestments sufficient to achieve positive GS, as Fig. 28 shows. Zambian GS proved highly volatile and completely dependent on world copper prices and to a lesser extent on political developments. In the paper at hand, we show that the theoretical framework and empirical model by BOOS and HOLM-MÜLLER (2012, 2013) still hold true in the individual case of copper-dependent Zambia. Most of the theories relating the RC to GS also apply to the Zambian situation.

Due to extreme copper price fluctuation, Zambia's terms of trade (ToT) became highly variable and therefore hardly predictable. Zambia's copper exports and thus its depletion values evolved in line with world copper prices. The depletion rents reflecting this development within the GS calculation resulted in volatile GS rates with the greatest fluctuation between the years 1999 and 2010. However, a more long-term look reveals that copper prices more or less remained constant until the end of the 1990s and only rose in the new millennium due to additional demand from China and India. We have shown that the ratio between δK_N and δK_P moves on the same path as Zambia's ToT and therefore higher ToT results in lower GS due to an also increasing $\delta K_N/\delta K_P$. Therefore, the rising prices in the 2000s not only positively influenced GNI but also led to increasing $\delta K_N/\delta K_P$ and ToT, which resulted in decreasing GS rates in the middle of the decade, as depletion of K_N was higher than investment. To achieve constant GS Zambia should therefore have invested more of its rents from natural resources into the formation of K_P and K_H. However, while investment in infrastructure or the education system is in large part a sphere of activity for public organs, copper rents are not incorporated directly into the national budget other than through taxes. Therefore, one common recommendation repeated emphatically in the literature on the RC in Zambia is to utilize the tax system to invest income from natural resources in favor of K_P or K_H and to save a share of the copper rents for worse times (HILL and MCPHERSON 2004).

As we have shown, Zambia rapidly increased its income from copper in the 2000s. This additional income from copper rents increased the demand for goods and services from other sectors and resulted in a shift of investment and employment from the manufacturing into the resource and service sectors. This crowded out investments in K_P – since the service sector is more labor intensive – and K_H – since production processes are more unskilled in the resource sector compared with manufacturing. On the one hand, the capital-intensive mining sector attracts investment in K_P, but on the other hand it crowds out investment in the K_P of more productive sectors. Since the service sector mainly consists of basic informal services using more unskilled work, investment in K_H additionally decreased after 2000. While the share of δK_N increased from around 1 % of GNI in 2000 to 12.8 % in 2012, education expenditures decreased from 2.7 to 1.3 % of GNI.

Basic problems for the Zambian GS rate still lie within the political and institutional system, which though showing improvements, which remains alarmingly problematic in comparison with other countries. Almost half a century after independence, Zambia is in the lowest thirty of 165 countries covered in the ''State Fragility Index 2010'' by Polity IV (MARSHALL and COLE 2011). Peaceful and with moderately functioning democratic structures and polls, Zambia is still politically fragile enough to find itself in the company of countries such as Kyrgyzstan or Pakistan. The continuous demand for more democracy from almost all stakeholders, but especially the growing civil society, has to be reinforced and backed by international partners. However, currently Zambia's political system is not stable enough to develop its economy past copper dependence and divert the income from K_N into industrialization and diversification. On the one hand, Zambia is stable and is improving its democratic values. On the other hand, there is still a great deal to be achieved to reach higher levels of democracy and – even though the relationship is not bulletproof – to higher and especially more stable GS rates.

Despite slow but promising democratic developments, corruption is still a major problem that casts a shadow over all three republics and most of our analyzed period. Particularly patronage inflates consumption expenditures and decreases GS rates. Corruption index values varied but in total deteriorated until 2001 and were highly correlated to Zambia's GS rate. In the 2000s, the situation improved, but the governments after Chiluba did not extensively change the corrupt structures. Patronage in the public sector was high during privatization efforts and even increased in the 2000s. At the end of the decade Zambia ranked in the top third globally in terms of spending on public salaries. However, in the 2000s, Zambia's functioning rule of law resulted in a fairly secure political system and democratization status, but it is ''generally agreed on by all stakeholders that the judicial system needs reform to make it more accountable, independent and able to deliver justice efficiently'' (NDULO 2013). Different studies show a positive relationship between a country's rule of law and its GS rates, since most investments require a secure legal framework. Since the quality of Zambia's judiciary and bureaucracy is deeply related to the corruption problematic, one potential solution could be a fixed portion of investment from δK_N into anti-corruption activities, for example, through education expenditures.

In total, Zambia's GS rates are influenced by the dependence on copper through multiple transmission channels. Development, either sustainable or not, is only possible through diversification and a reduction of dependence on an exhaustible income source such as copper. Therefore, all discussed explanations as well as a variety of further structural problems have to be dealt with. The key recommendation is that Zambia should use all possible applicable income from copper and should invest reasonably in K_P and K_H, including investments in infrastructure and education or similar development projects to the best knowledge of all decision-makers. However, since positive GS rates at least forecast future well-being, all interest groups should work together to decouple the Zambian GS from copper and the effects of the RC to increase GS permanently.

Research on the RC and GS did not require any further proof for the negative relationship of resource dependency and GS rates. However, where the paper on one hand goes further is the research design of a case study, since to our knowledge none has been conducted so far to examine this relationship. Typical case studies on the RC have used the same or similar theories and hypotheses to explain the RC, but have applied standard indicators such as GDP to analyze the influence on a country's development. This case study is the first detailed analysis of the relationship between the RC and GS in a resource-dependent country. The determinants causing the RC in Zambia influence the country's GS rate exactly as the theory behind this relationship would expect. Zambia's dependency on copper exports and insufficient reinvestments of income from the depletion of Zambia's natural capital constitute one of the main causes of slow growth and negative trends in GS. Zambia's GS rate depends on copper prices and the handling of rents within the economy, but all other theories behind the relationship between the RC and GS, as well as the determinants BOOS and HOLM-MÜLLER (2012, 2013) identify as influencing GS, also hold true in the detailed analysis of Zambia.

The bottom line is that we recommend the World Bank to further investigate this relationship since GS seems to function as a useful indicator for countries dependent on the rents from natural capital, such as Zambia, in order to analyze their situation in more detail. For countries in other situations it is, however, not particularly applicable.[83] GS and its individual calculation components could be used to illustrate the resource dependency of a country. SACHS and WARNER (1995/1997) use primary exports, but these are gross values while the resource depletion figures provided by the WORLD BANK (2014a) are adjusted for production costs. Also, GS demonstrates the handling of resource rents and especially their distribution between consumption and investment. Leaving aside possible extensions of the GS calculation (for example, presented in BOOS 2015), the data for the separate components of GS highlight the exposure of a resource-dependent country with its abundance and is therefore most interesting in the case of countries depleting natural resources. Future research on GS could further examine this relationship and use, for example, the research design we present in this paper to explain the situation in other resource-dependent countries.

[83] Most industrialized countries have positive GS rates (in 2012, only 6 % of the high and upper middle income countries had negative GS rates) while developing countries more frequently suffer from low or negative GS, in which resource-dependent play a particular role. In 2012, of a total of 45 countries with more than 10 % natural resources depletion (12.9 % in Zambia) only ten countries had positive GS rates higher than 10 % of GNI (6.8 % in Zambia) (WORLD BANK 2014a).

6. CONCLUSIONS

6.1. Summary

The dissertation at hand has conducted a detailed analysis of the relationship between the so-called Resource Curse (RC), the paradox that resource abundant countries often show slower economic growth, and the World Bank's indicator for "weak" sustainability, the so-called Genuine Savings (GS). In four logically successive parts, all peer-reviewed and published papers, GS is critically surveyed and its relationship to the RC is theoretically discussed, empirically analyzed and qualitatively investigated in the case study of Zambia, a highly resource-dependent country with negative GS rates.

As highlighted in the introductory chapter, the RC developed mainly from an empirical study by SACHS and WARNER (1995/1997) in which they prove a significant relationship between the resource dependency of countries (measured in terms of the ratio of primary exports to Gross National Income (GNI)) and their low growth rates. Together with authors such as GELB (1988) and AUTY (1993) and the models by CORDEN and NEARY (1982) and CORDEN (1984) this forms the basis of the theory behind a phenomenon which THE ECONOMIST (1977) first called "The Dutch Disease" and AUTY (1993) later relabeled "The Recourse Curse Thesis".

Building on this, a vast amount of literature concentrates on the background of the RC. One of the consistently most important explanations is the fact that natural resources generate rents that are independent of a country's economic performance. Therefore, this work relates the RC to GS as the most developed indicator for "weak" sustainability, which includes exactly these rents from the depletion of natural capital alongside the typically indicated man-made capital.

The first part of this work critically surveys the theoretical reasoning behind this GS and discusses possible extensions either not yet discussed or underrepresented in current research. It presents additional items that could be included in GS and shows that both the global average and individual country levels of GS would change immensely by including these recommendations. It serves as an introduction to GS and starts with the theoretical background and especially the calculation method, continuing with critique derived from literature and my own extensions. It examines the problematic calculation of GS per capita, the handling of volatile terms-of-trade (ToT), the differentiation between durable consumption and investment goods, defensive investments, the calculation of human capital and much more. In a nutshell, this part emphasizes the need to further develop GS to realize a more complete indicator for "weak" sustainability. One conclusion that emerges from the discussion is to analyze the determinants influencing GS, a method to develop this indicator that has been rarely used so far. And while publications discussing a possible development of GS are scarce, literature especially lacks a structured analysis of determinants influencing GS.

Therefore, part two theoretically derives and discusses possible determinants which come from the theories and explanations behind the RC. It builds on the assumption that GS as an indicator which is verifiably lower in RC-effected countries should also be negatively affected by the factors responsible for the RC. Part two surveys both areas of research, emphasizing the influence of the exogenous and endogenous determinants of economic growth that are usually used to theoretically and empirically explain the RC on the three different forms of capital considered by GS.

It discusses whether the RC hampers possibilities for resource-abundant countries to obtain sufficiently high rates of GS and finds many reasons why resource-dependent countries have problems achieving positive GS rates. The complete model (or picture) of exogenous and endogenous explanations is used to explain in detail where the linkages are. On the one hand this model builds a framework to analyze GS in a resource-driven context or in research relations in which the effects behind the indicator are important. On the other hand it presents a handy tool to use in empirical studies either on the RC or GS, or – as in this dissertation – the relationship between both.

As a result, in part three these explanations are used for an extensive empirical analysis. In a total of twelve regression models this part builds two different cross-country analyses to examine the influence of exogenous and endogenous explanations identified to cause the RC on GS and its components. The results show that the determinants leading to the RC, theoretically derived and discussed in part two, are useful explanatory variables for GS. A clear influence of the share of primary exports in GNI as well as of trade, consumption, quality of institutions and the migration of employees is found. Part three also shows that models using this combination of dependent variables (the different calculation exponents of GS) can explain the RC more comprehensively than the typically cited GDP growth.

In total, part three verifies the theoretical relationships between the RC and GS from part two in a large cross-country analysis and shows that the discussed framework can be used for extensive models with multiple dependent variables. It shows complete conformity between the theoretical model in part two and the empirical results. However, the cross-country analysis examines the research question at hand from a broader angle using averages across the analyzed data set. And while these global averages also include all resource-poor countries and those with positive GS rates, it lacks a differentiated analysis of resource-dependent countries with negative GS rates.

Therefore, part four examines the case of Zambia, an extremely copper-dependent country. It analyzes the relationship between the RC and GS tracing the course of Zambian economic history from independence in 1964 to the most recent data in 2012, a period within which Zambia shows negative average GS rates. It uses the theories and hypotheses behind the RC from part two and three and its relationship to the different forms of capital in the calculation of the Zambian GS rate. This case study is used to explain the theories and earlier empirical results in more detail in the situation of a resource-dependent country. Part four shows that the theoretical framework and empirical models from parts two and three still hold true in the individual analysis of a resource-dependent country. It shows that most of the theories relating the RC to GS do in fact apply to the Zambian situation.

However, what additional value do all these findings imply? On balance, the whole work follows two intentions: On the one hand to support the development of GS by investigating its determinants rather than only the mere calculation method and on the other hand to show and prove the deep relationship between the RC and GS. A relationship which is rather intuitive, but not analyzed in detail in topical literature, for which the dissertation at hand offers an extensive research and explanation model with multiple dependent variables.

6.2. Discussion

Part (and paper) one discusses the calculation of the different capital forms that comprise GS, but neither with the claim of an exhaustive discussion nor the intention to present a sophisticated way to develop GS. It rather shows that in all parts of its calculation there are topics still up to discussion and that the approach to deliberate part by part and consider new possible contents is often not academically objective but rather dependent on data availability and the preferences of the involved researchers. If one follows the main findings from this part, the conclusion would be that there is need for a more structured way to extend GS.

However, I formulate some extensions, such as the separation of exhaustible and renewable natural capital as well as natural capital depletion and pollution damages or the inclusion of the depreciation of human capital, without bringing up all discussions from literature but presenting a couple of new ideas. The discussion about the inclusion of natural resources such as peat, uranium or especially diamonds shows the data gaps in the GS calculation, distorting GS values in countries such as Botswana. The various renewable resources contain the same problematic, though their development should be included into the GS calculation in addition to the provided net forest depletion. The example of net fish depletion would make a real difference for several coastal countries or, for example, the developing region around Lake Victoria.

GS is by far the most developed and discussed indicator to measure sustainability in monetary terms and could in the future serve as a complement to GDP. The image that newscasts worldwide present GS alongside GDP growth as a development indicator is not completely far-fetched. However, it therefore needs a methodically structured way to properly develop its calculation method. In a subsequent paper after their commission on "The Measurement of Economic Performances and Social Progress", FITOUSSI and STIGLITZ (2011) hold the view that a "lack of an indicator of sustainability may lead us to an unsustainable path, but a partial measure may lead us to wrong policies which would eventually jeopardize the sustainability of an economy". Therefore a much more detailed advancement of the leading indicator GS is necessary, as it is thus far not used in a standardized manner by politicians or their advisors.

The typical discussion on the extension of GS is rather mathematically driven or depends on the data availability of natural resources or pollution damages. A good example is the discussion on the calculation of GS per capita, which is drifted to a pure discussion of the model, with a maximum of ten participants worldwide. To date, the World Bank only presents total values of GS, even though all discussion participants agree that this implies a danger for misinterpretation of positive GS rates. Researchers who are not experts in this field are excluded from this discussion and cannot understand why the World Bank does not use easy solutions such as those suggested in equations (17) and (18) in part one, at least until the discussion finds a better solution.

Complex detailed discussions such as this example are carried out about all calculation parts of GS, but there is no actual discussion on the whole indicator and its components such as in part one. Part one is therefore a proposal to step back and consider the issues from a broader angle, discussing for example the components and calculation of human capital besides forms of natural capital or whether or not pollution damages should be part of an indicator measuring the total capital of a country. And while the research on GS focuses its energy on, for example, the search for more pollution damage data to include, a simple basic discussion is missing, which would address whether or not it is reasonable to include these datasets. Or, to address the most important point of this dissertation: Why is it intuitively clear that GS is affected by resource dependency, but the World Bank and the entire research behind GS has not been able yet to analyze this relationship in detail?

We know that GS is negatively correlated to resource abundance and research discusses possible adjustment mechanisms. However, the discussion lacks a structured approach to analyzing the relationship between the negative effects of resource abundance and the calculation of GS, thereby also missing arguments that warrant inclusion. One possible path to solving some open questions is the structured analysis of factors determining GS. And one possible way to structure the search for determinants of GS is the analysis of factors leading to the RC. This is the selected approach of this dissertation.

In principle, parts two and three support the same findings, with part three empirically proving the theories from part two: a few reasons that inhibit resource-dependent countries from achieving positive GS rates are the same factors that slow GDP growth. However, some reasons are more influential on GS than on GDP and some also affect GS inversely. The most prominent example are the terms-of-trade, which so far are treated in literature as if they would affect GS in the same way they affect GDP, though the results in part two show otherwise. Positive long-term trends of increasing prices for resource exports, usually positively related to economic growth, influence GS negatively since the rents are subtracted in its calculation. Additionally, short-term volatility of resource prices causes planning uncertainty and therefore a higher ratio of consumption compared to investment.

The directly related theory of Dutch disease affects the composition of consumption and investment in physical and human capital through the appreciation of the real exchange rate and the movement of financial (physical capital) and workforce (human capital) resources from manufacturing to the resource and service sectors. The discussion as to whether resource-abundant countries benefit from increasing world market prices is already carried out in the literature. However, in this dissertation an additional discussion is carried out regarding whether GS rates benefit from increasing resource prices.

In most studies on the RC – as in this dissertation – and in the calculation of GS, Gross National Income (GNI) is used since the rents from domestically depleted natural capital earned by foreign companies outside the country is excluded. Therefore, the GNI of resource-abundant countries is in the majority of cases lower than GDP. However, economic growth is usually measured in GDP per capita, therefore often leads to a distortion of the overall picture. Countries earning much of their income through the export of resources and therefore the sale of depleted domestic natural capital abroad are always confronted with not only the problematic of re-investing enough of the generated rents but also of maintaining a fair amount within the country's own borders. Naturally, there are resource-abundant countries such as Kuwait whose GNI is higher than their GDP since they deliberately invest their rents abroad. However, most countries in Sub-Sahara Africa, especially Zambia and its neighboring countries, suffer from a drain of their natural capital.

Therefore, the political system and its institutional quality play a further important role. For example, democratic governments tend to deplete less natural capital and invest more in human capital. This depends in part on the quality of the participating institutions in terms of the level of corruption, bureaucratic services or the rule of law. As expected, better institutional quality based on these indicators is linked in part three to less depletion of natural capital and higher education expenditures, showing that the total GS rate is positively influenced by the quality of institutions. However, politicians must deal with an interdependent system of factors influencing each other. Broadly speaking, strengthening political and institutional structures may be the most important prerequisite for resource-dependent countries to reinvest their rents from natural resources.

Part four shows this in the example of Zambia, a country which uses the lion’s share of its resource rents for consumption. The country's economy eroded for example by patronage and ranked in the top third globally in terms of spending on public salaries. However, this has developed historically since colonialism and has proven difficult to repeal in a country in which public employees make up almost the complete middle class of the population. The intuitive recommendation that countries such as Zambia “need to invest more of the proceeds of natural capital depletion into the formation of other forms of capital than they currently do” (HAMILTON and CLEMENS 1999) would detract public salaries and resulting consumption in favor of investments in infrastructure and education or similar development projects. This would create a power risk for the country’s elite, wherefore they always look out for cost neutral solutions. For example, resource-rich developing countries such as Zambia could obligate foreign mining companies to invest a fixed percentage of their profit within the country alongside paying taxes.

However, all affected countries deal with a complicated combination of problems and possible solutions. Therefore, an extended investigation of GS and its components could satisfy multiple requirements: Shrinking GS constitute an early sign for the erosion of the capital stock required for sustained development. Even without observable RC effects, this should be considered an economic warning for the respective country. Using the three types of capital allows one to learn more about the mechanisms behind the RC. This approach facilitates gathering more a priori information for case studies. Overall, further research in this field supports better policy recommendations since governments can function as the balancing actors that invest rents into education, health or other sectors that support development. Contrarily, using RC determinants allows one to learn more about the problems behind the GS calculation. If GS as an indicator for "weak" sustainability should be taken seriously, it needs further development in a structured manner. The analysis of factors which determine its calculation parts is the first helpful instrument for this structure.

6.3. Outlook

The first words of this dissertation were written in the middle of 2009 and by this time it initiated with the rather famous citation of the abstract by SACHS and WARNER (1995/1997):

"One of the surprising features of modern economic growth is that economies with abundant natural resources have tended to grow less rapidly than natural-resource-scarce economies."

In 2015, just as I concluded the last words of this work, Jeffrey Sachs published his highly respected book "The Age of Sustainable Development" (SACHS 2015) accompanying his globally successful lecture series under the same name. It ends with an equally suitable quote:

"Now it's our turn to see if we can move the world toward sustainable development."

He does not use GS to show sustainable development (SD), but other indicators such as the "Human Development Index" and discusses that SD must be more clearly measurable. However, in the six years that my work continued I had the suspicion that the development of indicators stagnated. Only around fifteen qualified and recognizable articles which contain GS in their title were published between 2009 and 2015. This could simply be a sign for the concentration of research on other possible indicators to measure sustainability, but overall publications on the measurement of sustainability in general decreased. Although this is admittedly more difficult to detect, all interesting keyword combinations used in "Google Scholar" such as "sustainability indicator" or "sustainability measure" dropped by more than half from the period 2004-2009 to 2009-2015. And as far as I am aware, there has been no noticeable development to one of the other indicators such as the "Human Development Index" or the "Ecological Footprint". This is by far not a breakthrough discovery, but a small disturbing sign for a world driven by the desire to develop sustainably, and to have control over its development. To know whether the world moves in the direction of SD or not, it needs a more complete indicator than available to date.

However, the re-investment of rents from natural resource depletion in physical and human capital in adequate amounts and at a level of quality that supports development is one of the most important drivers of welfare growth and sustainable development. To conclude and summarize the line of argumentation from SACHS and WARNER (1995/1997) to SACHS (2015): Those countries which export their natural capital could turn to SD if they use their rents for investments in diversification, infrastructure, education, health and all the other possible sectors which are proven to support development. And an indicator that should measure sustainable re-investment in the total capital stock of countries should include these possible sectors.

Independently of the nature and composition of a country's total capital stock, GS is a helpful instrument to forecast and interpret possible future development trends and the exposure with a country's own capital stock. Therefore, the next steps should use the results from this dissertation to further develop GS. One way would be to make GS more publicized in a first step - not necessarily directly to the general public but at least more familiar to researchers around the world. The research on SD has fallen behind on developing GS, what has to be compensated by more dissertations and research projects. And after the structured extension of GS, the next step could include the following image: In a couple of years news anchors present the growth in GDP per capita as the indicator of economic development and the trend of GS rates as the achievement of "weak" sustainable development.

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ABSTRACT

This dissertation deals with the relationship between the **Resource Curse (RC)** – the empirically proven paradox that countries with abundant natural resources often show slower economic growth – and a measure for the substitution of natural resource depletion by other forms of capital, the World Bank's **Genuine Savings (GS).** In four logically successive parts, which are all published papers, this work analyzes the "alarming picture [that most] [c]ountries with a large percentage of mineral and energy rents of GNI typically have lower genuine saving rates" (VAN DER PLOEG 2011: 396-397) as well as its background determinants and transmission channels.

The first part establishes a critical survey on GS and its calculation components and is intended as an introduction to its theoretical and methodical background. The WORLD BANK (2011) adjusts Net National Savings for human and natural capital, but as an indicator of real world sustainability GS has several shortcomings, which are discussed at length. For example, there are natural resources that are omitted due to empirical and methodological reasons such as fisheries, biodiversity or diamonds. Part one discusses possible extensions and ideas for future development, but the most important finding is the necessity for more analyses of possible factors determining the development of GS rates.

With this background, part two establishes a theoretical model of the relationship between the RC and GS. Since both the RC and GS depend on the amount of resource depletion and exports, a possible relation seems clear. Therefore, part two uses the exogenous and endogenous explanations from countless studies contributing to the research on the RC and its determinants and relates them to GS and its calculation components. For example, the volatility of international commodity markets affects the natural resource rents within the calculation of GS immensely, or the migration of employees to the resource sector has a clear impact on the education expenditures used to determine human capital.

In part three, these findings and the resulting theoretical model are used to show the empirical relationships between the RC and GS in cross-country regressions. For example, the mentioned terms-of-trade volatility in resource-dependent countries affects the calculation of GS on multiple levels. Overall, results show that factors leading to the RC are also useful explanatory variables for GS. Hence, part three of this dissertation shows that the theoretical framework from part two holds true in comprehensive cross-country regressions with a variety of dependent and independent variables.

To complete the analysis, part four examines Zambia as a case study of a RC-affected country. Between 1964 and 2012 Zambia depended on copper exports at an average 33% of

its GNI and suffered a decline of its real per capita income in the same period, and importantly showed an average GS rate of -3%. The study demonstrates that most of the theories relating the RC to GS apply to the Zambian situation. Its GS developed with high volatility and completely in line with world copper prices and to a lesser but not negligible extent with political developments. Following parts two and three, this case study completes the picture on the deep relationship between the RC and GS and closes the loop of a theoretical model with cross-sectional empirical research as well as a research design which allows for a more qualitative discussion.

KURZFASSUNG

Die vorliegende Dissertation beschäftigt sich mit dem Zusammenhang zwischen dem **Ressourcenfluch (RF)** – dem empirisch nachgewiesenen Paradox, dass ressourcenabhängige Länder meist geringeres Wirtschaftswachstum aufweisen – und einem Indikator für die Substitution natürlicher Ressourcen durch andere Kapitalformen, die **Genuine Savings (GS)** der Weltbank. In vier aufeinander aufbauenden veröffentlichten Papern analysiert diese Arbeit das „alarmierende Bild, [dass die meisten] Länder mit einem großen Anteil an Renten von Mineralen oder Energieressourcen in ihrem BIP typischerweise niedrigere Genuine Savings Raten aufweisen" (van der Ploeg 2011: 396-397) und die dazugehörigen Hintergrunddeterminanten und Übertragungskanäle.

Der erste Teil bildet einen kritischen Überblick über GS und ihre Berechnungsbestandteile und ist als Einleitung über den theoretischen und methodischen Hintergrund gedacht. Die WELTBANK (2011) erweitert nationale Netto-Ersparnisse um Human- und Naturkapital, als Indikator für reale Nachhaltigkeit weisen GS aber einige Defizite auf, die ausführlich diskutiert werden. Beispielsweise werden natürliche Ressourcen wie Fischbestände, Biodiversität oder Diamanten aufgrund von empirischen und methodischen Problemen außen vor gelassen. Teil eins diskutiert mögliche Erweiterungen und Ideen für zukünftige Entwicklungen, aber die wichtigste Erkenntnis ist die Notwendigkeit vermehrter Analysen möglicher Determinanten der Entwicklung von GS-Raten.

Vor diesem Hintergrund bildet Teil zwei ein theoretisches Modell des Zusammenhangs zwischen dem RF und den GS. Da beide von der Höhe des Ressourcenabbaus und -exports abhängig sind, erscheint ein möglicher Zusammenhang offensichtlich. Daher nutzt Teil zwei exogene und endogene Erklärungen aus den zahllosen Studien zum RF und seinen Determinanten und bringt diese mit den GS und ihren Berechnungsanteilen zusammen. Beispielsweise beeinflusst die Volatilität internationaler Rohstoffmärkte die Renten von natürlichen Ressourcen innerhalb der Berechnung von GS immens oder die Arbeitskräftewanderung zum Ressourcensektor hat einen klaren Einfluss auf die Bildungsausgaben, die zur Präsentation des Humankapitals genutzt werden.

Im dritten Teil werden diese Erkenntnisse und das resultierende Theoriemodel genutzt, um die empirischen Zusammenhänge zwischen dem RF und den GS in Querschnittsregressionen aufzuzeigen. Beispielsweise beeinflusst die erwähnte Volatilität der Terms-of-Trade in ressourcenabhängigen Ländern die Berechnung der GS auf mehreren Ebenen. Insgesamt zeigen die Ergebnisse, dass Faktoren die zum RF führen auch als nützliche erklärende Variablen für GS dienen können. Daher zeigt Teil drei dieser Dissertation, dass der

theoretische Rahmen aus Teil zwei auch in einer umfangreichen Querschnittsregression mit einer Vielfalt abhängiger und unabhängiger Variablen gilt.

Um die Analyse zu komplettieren untersucht Teil vier Sambia als eine Fallstudie eines vom RF betroffenen Landes. Zwischen 1964 und 2012 war Sambia mit durchschnittlich 33% seines Bruttonationaleinkommens abhängig von Kupferexporten und erlitt im selben Zeitraum einen Rückgang seines realen Pro-Kopf-Einkommens, außerdem eine durchschnittliche GS-Rate von -3%. Die Studie zeigt, dass die meisten Theorien, die den RF und die GS zueinander in Verbindung setzen, auch für die Sambische Situation gelten. Sambias GS entwickelte sich höchst volatil und komplett parallel mit den Weltkupferpreisen und zu einem geringeren aber nicht vernachlässigbaren Ausmaß mit den politischen Entwicklungen. Nach den Teilen zwei und drei komplettiert diese Fallstudie das Bild des tiefgehenden Zusammenhangs zwischen dem RF und den GS und schließt den Kreis aus theoretischem Modell, empirischer Querschnittsanalyse sowie einem Forschungsdesign, das eine mehr qualitative Diskussion erlaubt.

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List of Acronyms

ANS	Adjusted Net Savings
GDP	Gross Domestic Product
GNI	Gross National Income
GNS	Gross National Savings
GS	Genuine Savings
HDI	Human Development Index
MDRI	Multilateral Debt Relief Initiative
MMD	Movement for Multi-Party Democracy
NIE	New Institutional Economics
NNS	Net National Savings
ODA	Official Development Assistance
RC	Resource Curse
UNIP	United National Independence Party
WB	World Bank
WS	Weak Sustainability

1. INTRODUCTION

1.1. The Resource Curse Thesis and Genuine Savings

GELB (1988) and AUTY (1993) introduced the term **Resource Curse (RC)** for the empirically proven paradox that countries with abundant mineral resources often show slower economic growth. Even after controlling for variables, which they identify to be important for economic growth, SACHS and WARNER (1995/1997) prove a significant empirical relationship between the resource dependency of countries (measured in terms of the ratio of primary exports to Gross National Income (GNI)) and their low growth rates. In the two decades since then a vast amount of literature – especially in development economics – has been published with a wealth of explanations ranging from the volatility of world markets to the quality of institutions. One of the consistently most important is the fact that natural resources generate rents that are independent of a country's economic performance, which can lead to suboptimal reinvestments of the income from the consumption of this natural capital.

This is closely related to the discussion about the substitutability of natural capital by physical or human capital and therefore is also related to the literature on "weak" sustainability. Analogous to the discussion on the RC, another branch of literature – especially in environmental economics – developed formal models of **Genuine Savings (GS)** to measure the substitution of natural resource depletion by other forms of capital (HAMILTON 1997; HAMILTON and CLEMENS 1999).[1] Obeying the "Hartwick Rule" of reinvesting all resource rents, GS measures the adjustment of investments in physical and human capital to compensate for the depletion of natural resources. It is defined as the Net National Savings (NNS) deducted by the depletion of resources and the emission of pollution, adding expenditures for education to measure the increase in human capital. According to HAMILTON (2001), GS can be seen as the net change in total wealth (physical, human and natural capital) of a nation in the accounting period.

At first glance, this is a reasonable measure for the reinvestment of resource rents and therefore for the perception of the RC itself, especially since one could also discuss whether or not the value of deducted rents for the depreciation of natural capital (usually in % of GNI) is not a better measure of resource dependence than the above mentioned ratio of primary exports to GNI by SACHS and WARNER (1995/1997).

[1] The World Bank (WB) releases GS retrospectively since 1970 under the label of Adjusted Net Savings (ANS) (Bolt 2002; World Bank 2006, 2011a).

Currently, a possible negative relationship between the RC and GS is discussed in multidisciplinary publications considering either development in resource-abundant countries (such as AUTY 2001 or HEAL 2007) or sustainability (HAMILTON and ATKINSON 2006 or AUTY 2007). Additionally, the survey on the hypotheses and evidence behind the RC by VAN DER PLOEG (2011: 396-397) includes a section on the "alarming picture [that most] [c]ountries with a large percentage of mineral and energy rents of GNI typically have lower genuine saving rates". However, none of these publications analyzes the relationship between the RC and GS in a structured and detailed manner including all involved determinants and transmission channels.

To my knowledge only three papers deal directly with the connection between the RC and GS: ATKINSON and HAMILTON (2003) use cross-country regressions to provide evidence that especially the dependence on resource exports is one of the main reasons for unsustainable development and negative GS rates. DE SOYSA and NEUMAYER (2005) show that economic openness and political stability are strong transition channels through which resource abundance influences GS rates. And DIETZ ET AL. (2007) emphasize the systematic coherence between the abundance of natural resources and negative GS rates. They identify the quality of institutions (especially corruption) as the main determinant that influences GS in resource-dependent countries. However, all three papers analyze single aspects of the relationship between the RC and GS.

Additionally, HESS (2010) analyzes GS determinants in developing countries and shows a significant influence of the share of fuels, ores, and metals in merchandise exports. A study by NEUMAYER (2004) reproduces the original RC study by SACHS and WARNER (1995/1997) using the growth rate of his so-called genuine income and shows the same negative effect as on GDP per capita growth.

Based on these earlier publications and results the dissertation at hand approaches this aspect by providing a detailed investigation of the relationship between the RC and GS, both theoretically and empirically, in four logically successive parts, which are all peer-reviewed and published papers:

1. BOOS, A. (2015): Genuine Savings as an Indicator for "Weak" Sustainability: Critical Survey and Possible Ways forward in Practical Measuring. In: *Sustainability*, 7 (4), pp. 4146-4182.
2. BOOS, A. and HOLM-MÜLLER, K. (2012): A theoretical overview of the relationship between the resource curse and genuine savings as an indicator for "weak"

sustainability. In: *Natural Resources Forum – A United Nations Sustainable Development Journal*, 36 (3), pp. 145-159.

3. BOOS, A. and HOLM-MÜLLER, K. (2013): The Relationship Between the Resource Curse and Genuine Savings: Empirical Evidence. In: *Journal of Sustainable Development*, 6 (6), pp. 59-72.
4. BOOS, A. and HOLM-MÜLLER, K. (2015): The Zambian Resource Curse and its influence on Genuine Savings as an indicator for "weak" sustainable development. In: *Environment, Development and Sustainability*, 17 (3), Online first on 16 May 2015, pp. 1-39.

The following gives a short summary of these four papers and therefore the theoretical and empirical framework behind the considerations of the dissertation as a whole. This introductory chapter serves to explain the theoretical relationships behind the analyses (and the case study) and the content of the four parts, with each successive part building on the previous.

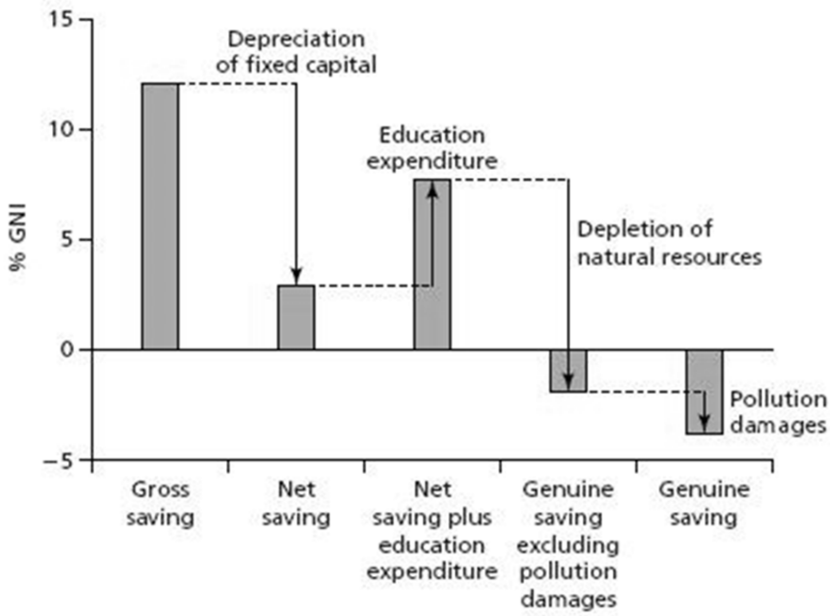
1.2. Part 1: Genuine Savings as an indicator for "weak" sustainability: Critical survey and possible ways forward in practical measuring

The theory of "weak" sustainability requires that the sum of changes in all forms of capital, thus depletion, depreciation and investment, is above zero, which constitutes a generalization of the so-called "Hartwick-rule" (NEUMAYER 2010). Therefore, PEARCE and ATKINSON (1993) begin their "intuitive rule for determining whether a country is on or off a sustainable development path" with the neoclassical assumption of possible substitution between natural and man-made capital and the resulting rule that savings have to be more "than the combined depreciation on the two forms of capital" (PEARCE and ATKINSON 1993).

HAMILTON (1994) and HAMILTON ET AL. (1997) expand the model by PEARCE and ATKINSON (1993) with investments in human capital as well as CO_2 emission damages as part of the depreciation of natural capital. HAMILTON (1994) also introduces the term "genuine" "to distinguish genuine savings, which refers to all utility-relevant stocks of capital including natural capital, human capital as well as (in principle at least) social capital, from traditional net savings, which refers only to man-made or produced capital" (NEUMAYER 2010). HAMILTON ET AL. (1997), HAMILTON and CLEMENS (1999) and NEUMAYER (2010) develop formal models for GS in closed and open economies.

From these, the WORLD BANK (2006, 2008, 2011a) builds a practical calculation method for GS. It uses the traditional measure of precaution for a country's next generation, the Gross National Savings (GNS) which is GNI plus net current transfers minus public and private consumption and therefore constitutes only savings or, at least theoretically, investment in physical capital. However, physical capital is depreciating over time. Therefore, the World Bank subtracts this depreciation of physical (fixed) capital and achieves Net National Savings (NNS), which is closer to a measure of "weak" sustainability than GNS. In using the aforementioned model by HAMILTON and CLEMENS (1999), the World Bank adjusts NNS for other forms of capital than the mere produced capital. For the investment in human capital, current education expenditures are added and, for the consumption of natural capital, the depletion of different natural resources and the damages from air pollution are subtracted (WORLD BANK 2006, 2011a).

Figure 1: Informal Calculation of Genuine Savings by the World Bank.



Source: WORLD BANK (2006).

The conventional way to denote GS is in % of GNI to have comparability even between countries with highly diverging GNI. Theoretically a GS of exactly zero implies an equal substitution of natural capital through other forms of capital and therefore a necessary but not sufficient condition for sustainable development or compliance with the "Hartwick-rule".

Permanently negative GS rates imply an unsustainable development path and, due to the reason that some assets are still not included in the calculation of GS, even positive ones only point in the direction of "weak" sustainability (HAMILTON 2006). "[G]lobal GS has been consistently positive, [but] over the whole […] period [since 1970] GS rates have been alarmingly low and consistently negative in certain countries […]. Significantly, these countries are also often resource-rich" (DIETZ ET AL. 2007). ATKINSON and HAMILTON (2003) verify an average GS of -2.6% for "resource-rich" countries in contrast to 9.2% in "resource-poor" countries.

Clearly the use of GS as an indicator of real world sustainability has several shortcomings, the theoretical foundations of which will be discussed at length in this first part and briefly in the case study on Zambia in part four. According to the WORLD BANK (2006) itself, there are natural resources that are omitted due to empirical and methodological reasons. These include fisheries, soil erosion, biodiversity, and water quality among others.[2] The paper especially highlights the case of Botswana, which would see its GS rate drop by more than 20% if the rents from diamond depletion were subtracted (BANK OF BOTSWANA 2014). Additionally, damages from pollution only contain carbon dioxide and particulate emissions, which minimizes the significance of this measure.

Further fundamental problems are the unrealistic assumption of constant population and the valuation of human capital (HAMILTON 2006). GS measures changes in total wealth but not per capita wealth, which implies that even positive GS rates could be unsustainable if they are lower than population growth. Additionally, the investment of one US$ as a current expenditure on education is, due to the quality of teaching staff, educational material and various other factors, not exactly equivalent to one US$ in additional human capital and differs widely between countries (BOLT 2002).

Therefore, the paper that makes up the first part discusses possible extensions not yet discussed or underrepresented in current research. It is thought as an introduction to the theoretical and methodical background of the GS calculation and a consideration for the potential development of this indicator in the future. In this part, I mainly suggest a discussion of additional items that could be included in GS and show that both the global average and individual country levels of GS would change immensely by including these recommendations.

[2] To give an example, while fish stocks are important for the wealth of some countries, their value changes over time and is difficult to measure due to mobility and undefined international property rights (WORLD BANK 2006).

1.3. Part 2: A theoretical overview of the relationship between the Resource Curse and Genuine Savings as an indicator for "weak" sustainability

In their analyses of the macroeconomic policies of different oil-exporting countries, GELB ET AL. (1988) and AUTY (1990) show two fundamental problems: the political difficulties for governments in saving (and not spending) oil rents and the lack of capacity and resources to use this income for the diversification of their industry. AUTY (1993) analyses six ore-exporting countries which all failed in their efforts to use their resource abundance efficiently, amongst them the case study from part four of this dissertation, Zambia, as an example for the mismanagement of rich copper reserves (AUTY 1993).

SACHS and WARNER (1995/1997) show in their cross-country analysis that the average ratio of primary exports to GNI of countries is 13% and through the increase of one unit (13%), the growth rate of GDP per capita declines by almost 1%. Since this publication, countless studies and authors have contributed to the study of this relationship and generated hype surrounding the RC and its determinants, which are separated in exogenous and endogenous variables.

Exogenous explanations lie, for example, within the short- and medium-term volatility of international commodity markets (NURSKE 1958) and the long-run terms-of-trade (ToT) effects, the so-called Prebisch-Singer thesis (PREBISCH 1950; SINGER 1950). VAN DER PLOEG and POELHEKKE (2009) demonstrate a significant negative relationship between the volatility of international resource markets and the economic growth of resource-dependent countries. The more a country is resource dependent, the more it becomes vulnerable to economic shocks (ROSS 2003), while its resource rents in GS (which are calculated through world market prices) are rather erratic and vary significantly.

Another exogenous explanation is the so-called Dutch disease, which is by far the most discussed topic in all RC literature. It originates from a 1977 edition of "The Economist" concerning the decline of the Dutch manufacturing sector after the discovery of natural gas sources in the North Sea in 1959. The theory behind the classic economic model by CORDEN and NEARY (1982) assumes that a boom in the resource sector – induced by the discovery of new reserves or an increase in world market prices – results in higher export revenues and increasing demand from other sectors. While this additional demand can be met by imports as long as it is manufactured, physical and human capital move from this sector into the resource and service sector, which causes direct and indirect deindustrialization (BARBIER 2007).

The education expenditures used to present human capital in the GS calculation are highly influenced by this migration because in the majority of cases the resource sector requires more unskilled employees than in other sectors. Though the Dutch disease is one of the most important factors of the RC thesis it is also clear that an export boom of natural resources can have positive effects if the adaptation process is slow enough and the revenues are used in a sustainable manner (SACHS and WARNER 1999), as described in the original GS model by HAMILTON and CLEMENS (1999).

SACHS and WARNER (1995/1997) already use trade openness as a proxy for state intervention and the rule of law to represent the quality of institutions. These examples of endogenous explanations developed in a multitude of econometric studies by authors such as ROBINSON ET AL. (2006) or MEHLUM ET AL. (2006). They demonstrate that resource abundance affects institutions negatively and that the RC is more likely in countries with weak institutions.

For example, the level of corruption – mostly divided in two different models, rent-seeking and patronage – is one of the most important endogenous determinants in resource abundant countries. Rent-seeking behavior encourages private agents to compete for resource rents instead of using these resources for the development of the country (KOLSTAD and SOREIDE 2009). And patronage reflects the easy access of political leaders or others who control the resources to use the country's wealth to maintain the status quo and retain their power or possessions (HUMPHREYS ET AL. 2007). In general, rents from resource depletion are consumed and not invested as the GS model would anticipate. Corruption therefore reduces not only GS in principal as DIETZ ET AL. (2007) show, it also reduces the productivity of investment (ROSS 2003).

The second part (and paper) shows the strong relationship between the factors that lead to the RC and factors that lead to a decline of GS. It discusses whether the RC hampers possibilities for resource-abundant countries to obtain sufficiently high rates of GS, and finds many reasons why resource-dependent countries have problems achieving positive GS rates. Both areas of research are surveyed, emphasizing the influence of the exogenous and endogenous determinants of economic growth, which are typically used to theoretically and empirically explain the RC relating to the three different forms of capital considered by GS. This second theoretical part specifies why most countries suffering from the RC have negative GS rates and explain in detail where the linkages are. The third part (and paper) uses this theoretical framework for an empirical analysis of the relationship between the RC and GS.

1.4. Part 3: The relationship between the Resource Curse and Genuine Savings: Empirical evidence

NEUMAYER (2003) states that "[t]he main message from the [World] Bank's GS computations is [...] that many developing countries that are dependent on resource exploitation are weakly unsustainable". As shown before, this is also the conclusion of the two empirical analyses by ATKINSON and HAMILTON (2003) and DIETZ ET AL. (2007). Part (and paper) three of this dissertation uses the theoretical overview of the relationship between the RC explanations and the model and measurement of GS from part two to show the empirical relationships in cross-country regressions using such earlier analyses as lead to adequate explanatory variables. Part three shows interestingly that, despite more control variables, the share of resource exports in GNI influences GS more negatively and significantly than GDP in the above cited analysis by SACHS and WARNER (1995/1997).

Especially the long-term ToT decline explained in part two affects the calculation of GS on multiple levels and contradicts the original GS-model, which assumes that resource rents grow constantly at the rate of interest. Import-based consumption and investment either decline quantitatively or remain constant while the monetary terms, which are used in the measurement of GNS, increase. Export-based income declines or remains constant in monetary terms while the extracted quantities increase to achieve the same rents, which factors into the measurement of the depletion of natural resources (VINCENT ET AL. 1997). Therefore, the regressions in part three show that ToT influence GS negatively – as the theory from part two would expect – due to the positive influence of prices on the changes in depletion of natural capital (δK_N): Higher resource prices result in increasing depletion, which decreases GS as soon as there is no sufficient reinvestment.

This is related to the effects of Dutch disease, which influence GS in various ways. A boom in the resource sector crowds out investment in other sectors and even in human capital. The boom results in higher rents from the depletion of natural capital (δK_N), which decreases GS rates. Through the so-called spending effect these additional revenues increase the demand from other sectors and thus change the relationship between consumption and investment in physical and human capital, resulting in an appreciation of the real exchange rate (AUTY 2007; FRANKEL 2010). Therefore, wages in the resource and service sectors rise and employees move from manufacturing to these two other sectors. This decreases investment in human capital due to more unskilled production processes in these two sectors and investment in physical capital due to more labour-intensive services (GYLFASON 2001a, 2001b; DIETZ ET AL. 2007).

The regressions in part three find a highly significant negative influence of resource exports on NNS and therefore on investments in physical capital. The average growth rate of the official exchange rate also negatively influences investment in K_P and total GS. The migration of workers from the manufacturing into the resource and service sectors is proxied by the share of employment in the service sector and shows the expected negative influence on K_P.

As described above, endogenous factors from the political economy are difficult to define selectively, whereby their relationship to GS is much more difficult to describe than it is for exogenous determinants. For example, the trade regime plays an important role in the following case study (in part four) because Zambia depends on imports and trade taxes and has had many different trade regimes and degrees of protectionism, which according to SACHS and WARNER (1997) cut "Africa off from the growth dynamism of world markets".

Furthermore, the level of corruption and other indicators for the quality of institutions affect GS in many ways, as DIETZ ET AL. (2007) demonstrate. The regressions in part three use the same indices for corruption, the rule of law and bureaucratic quality used by DIETZ ET AL. (2007) and show, as expected, that higher institutional quality is linked to less depletion of natural capital (δK_N) and higher investment in human capital (δK_H). Additionally, this part shows that in total the democratic status of a country positively influences its GS rate.

The objective of part three is therefore to contribute to research on the determinants of GS by investigating its relationship to the RC. Not only could the recommendations from part one be supported by structured research on the determinants which influence the different capital forms in the calculation of GS, but cross-sectional analyses as in part three and especially case studies as in part four could also benefit from a clearer understanding of the influences GS rates are exposed to.

The cross-country analysis therefore examines the influence of determinants and transmission channels identified to cause the RC on GS and its components. Results show that factors leading to the RC are also useful explanatory variables for GS. The analysis estimates a decrease ranging between 1.4% and 3.5% in the average GS rate for a 10% increase in the average share of primary exports in GNI between 1970 and 2008. Hence, part three of this dissertation shows that the theoretical framework from part two holds true in comprehensive cross-country regressions with a variety of dependent and independent variables: Two empirical frameworks and twelve different models show exactly the theories from part two.

SACHS and WARNER (1997) refine their analysis (SACHS and WARNER 1995/1997) by only using Sub-Saharan Africa as their research subject in the investigation of the RC and show that endogenous policies especially cause the slow growth of this region. To complete the analysis in this dissertation, part (and paper) four examines Zambia as a case study of a RC-affected country from this region to accompany the theoretical and empirical analyses.

1.5. Part 4: The Zambian Resource Curse and its influence on Genuine Savings as an indicator for "weak" sustainable development

The RC is in many ways confirmed by the case of Zambia. HABER and MENALDO (2011) even identify Zambia's dependence on copper exports, amounting to an average 33% of its GNI between 1964 and 2012 in the face of declining real per capita income in the same period, as one of the world's most striking examples of a country suffering from the RC. Part (and paper) four adds to the theoretical and empirical analysis of the relationship between the RC and GS from parts two and three with a case study of Zambia.

To my knowledge, this is the first case study investigating the development of determinants causing the RC and the relationship to the GS rate of a resource-dependent country. Contrary to cross sectional studies, a detailed discussion within a case study provides additional opportunities to examine this relationship qualitatively without being constrained by the structures and assumptions of econometric models. Nevertheless, one could argue that the cross-country analysis in part three already identifies relationships between the RC and GS and therefore a case study of only one country could not add valuable insights.

However, cross-country studies only examine the research question from a broader angle using averages across the analyzed data set. And while the global average of positive GS rates lies within an acceptable area, namely 9% of GNI for the period from 1964 to 2012, Zambia, an extremely copper dependent country, featured a GS rate of -3%. With this GS rate, Zambia ranks among the bottom twenty countries over this period, but is by far the one with the most available data in this timeframe for an analysis on the relationship between the RC and GS.

Since the first extensive analysis on the RC (AUTY 1993), Zambia has been a frequent case study for mineral-dependent countries, but none of these examines the relationship to GS. The case study at hand provides the possibility to discuss the theories and empirical results from parts two and three following the practical example of the Zambian economic history from independence in 1964 to the most recent data in 2012. Therefore, on the one hand part four contributes to the case study research on the Zambian RC and on the other hand provides a case study on the determinants of a country's GS rate. For the purpose of this dissertation it especially provides a qualitatively conducted discussion on the relationship between the RC and GS.

The study shows that most of the theories relating the RC to GS apply to the Zambian situation. Zambian GS developed with high volatility and completely in line with world copper prices and to a lesser but not negligible extent with political developments. Zambia’s copper exports and thus depletion values evolved in line with these copper prices. The depletion rents reflecting this development resulted in volatile GS rates with the highest fluctuations between the years 1999 and 2012. In this period Zambia rapidly increased its income from copper. This additional income increased the demand for goods and services from other sectors and resulted in a shift of investment and employment from the manufacturing into the resource and service sectors. Besides slow democratic development, corruption is still a major problem that featured in the entire analyzed period and this is deeply related to the quality of Zambia’s judiciary and bureaucracy. On the whole, Zambia’s GS rate is influenced by the dependence on copper through multiple transmission channels.

While the research on the RC and GS did not require any further proof for the negative relationship of resource dependency and GS rates, at least not following parts (and papers) two and three, part four goes further through the research design of a case study. Typical case studies on the RC have used similar theories and hypotheses to explain the RC, but have also used typical indicators such as GDP to analyze their influence on a country’s development. This case study is the first detailed analysis of the relationship between the RC and GS in a resource-dependent country. However, in line with its two predecessors this case study illustrates a theoretical and empirical framework for further research on this special relationship.

1.6. Overview of research design

NEUMAYER (2003) and DIETZ and NEUMAYER (2004, 2006) were they first to criticize the theory and formal model behind the GS calculation in detail. However, all critical reviews and advancements such as from BOLT ET AL. (2002), PEZZEY (2004), the WORLD BANK (2006) or ATKINSON and HAMILTON (2007) add different formal and practical points, which **part (and paper) one** consolidates and expands by extensive discussions and new approaches. In cases such as the individual denotation of pollution damages or the revaluation of human capital these are completely new suggestions to enhance GS as an indicator for “weak” sustainability.

As part one concludes that research on the determinants of GS is needed to advance the development of its calculation and theoretical foundation, **part (and paper) two** uses the intuitive relationship of GS to resource dependency for a structured analysis of its determinants. The relationship between theories and hypotheses behind the RC and the individual calculation components of GS are theoretically investigated in detail. This has not yet been done and findings such as the logical negative influence of a country's ToT on GS are presented for the first time in topical literature. Especially the drafting of a complete theoretical framework of the relationship between the RC and GS for a structured analysis is an extension of the existing research literature.

Part (and paper) three utilizes the framework of the relationship between the RC explanations and the model and measurement of GS to show in cross-country regressions their empirical relationship. The methodology in this part builds on the studies by SACHS and WARNER (1995/1997) and NEUMAYER (2004), using similar but extended models. These extended models use GS and its individual calculation parts – the different forms of capital – as dependent variables and build their explanatory variables on the theoretical framework from part two. This part shows clearly and for the first time in literature that GS is more closely related to the different determinants of the RC than the typically used dependent variable GDP. Despite using more control variables, the share of resource exports in GNI influences GS more negatively and significantly than GDP per capita growth in the analysis by SACHS and WARNER (1995/1997).

The findings from parts two and three merge into the case study of Zambia in **part (and paper) four**. Zambia is a highly RC affected country with a dependence on copper exports of a yearly average 33% of its GNI between 1964 and 2012, while its real per capita income decreased in this period. To my knowledge, this is the first case study investigating the development of determinants causing the RC and its relationship to the GS rate and the design of a case study provides the possibility to discuss these qualitative links in detail. Part four shows extensively that the theories relating the RC to GS from part two and the empirical relationships from part three completely apply to Zambia.

Published as

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2. Genuine Savings as an indicator for "weak" sustainability: Critical survey and possible ways forward in practical measuring

Abstract Published by the World Bank (as "Adjusted Net Savings") for around 160 countries, Genuine Savings (GS) presents the most respected but also the most debated indicator for "weak" sustainability. It originates from the so-called "Hartwick rule" for the re-investment of rents from the depletion of natural in reproducible forms of capital. Coming from the theoretical reasoning behind GS, this paper discusses possible extensions either not yet discussed or underrepresented in current research. Mainly, I suggest a discussion of additional items that could be included in GS and show that both the global average and individual country levels of GS would change immensely by including these recommendations.

2.1. Introduction

This paper has two goals: first to provide an overview of the growing literature on Genuine Savings (GS) and its development, as it is the most important indicator for "weak" sustainability; second to critically discuss this indicator and suggest possible modifications. Typical critical reviews of GS, such as by DIETZ and NEUMAYER (2004, 2006), discuss unrealistic assumptions or exogenous shocks to the GS model, as well as the problems in measuring the depreciation of natural capital. I discuss this, but concentrate on further problems in the actual calculation of GS, suggesting possible extensions thus far not discussed in GS literature.

Dividing GS into its individual calculation components, I discuss different ideas and examples for the potential modification of the indicator, in order to contribute to the stagnating discussion on GS calculation with real world data. In contrast with earlier publications, I do not concentrate primarily on natural capital, as this is discussed comprehensively in literature, rather I also discuss the two other forms of capital. I suggest that the discussion on GS should step back and determine not only what parts of natural capital depletion should be substituted and how to calculate this, but also which contents of physical and human capital could additionally be included.

Thoughts on sustainable development (SD) emerged centuries ago and found their first clear expression in Carlowitz's "Sylvicultura Oeconomica" from 1713 (CARLOWITZ 2009) and Malthus' essay on exponential population growth from 1798 (MALTHUS 1798) (for historical overviews see, for example, RAO (2000), ELLIOTT (2006) or ROGERS ET AL. (2008)). The Malthusian vision on "Limits to Growth" (MEADOWS 1972) resulted in a substantial scientific, especially economic, discussion on intergenerational equity in the 1970s (see DASGUPTA and HEAL (1974), SOLOW (1974a; 1974b) and STIGLITZ (1974), and for a review PEZZEY (1992)). From this, HARTWICK (1977) formulated a rule-of-thumb for a fair intergenerational handling of exhaustible resources: Keep the total capital stock of a country at least constant over time by "invest(ing) all profits or rents from exhaustible resources in reproducible capital such as machines". This is rooted in the idea that—population given—it is the sum of total capital, and not its single components, that is most decisive for production capacities and thus the basis for future development (for overviews of all of these topics see HARRIS (2001) and the "Handbook of Sustainable Development" by ATKINSON ET AL. (2008)). GS combines the net investment in physical and human capital with the depletion of natural capital to provide an indicator for this so-called "Hartwick rule" as a paradigm for "weak" sustainability.

The World Bank ("Adjusted Net Savings" in World Bank terms to distinguish between the GS model and the actual calculation) subtracts consumption and the depreciation of physical capital from Gross National Income (GNI) to illustrate the net investment in physical capital. Besides the usual critique on the depreciation method, I discuss possible extensions, such as durable consumption goods, which could be considered sustainable investments. After reducing GNI by consumption and depreciation, the World Bank adds current education expenditures to indicate investment in human capital. I argue that human capital is also depreciating through death and, as a consequence, health expenditures that increase life expectancy could also be seen as increasing human capital.

After adjusting for education expenditures, the World Bank subtracts the rents of natural resources and damages by air pollution as depletion of natural capital. Natural resources are divided into the categories of energy, mineral and forest depletion, and are calculated by the ratio of the present value of rents to the exhaustion time of the resource. I discuss which natural resources should be included and show their influence on the GS of individual countries. The inclusion of air pollution is surveyed and discussed from the viewpoint of a whole line of literature that considers a broader base of pollution damages, as well as the critique that GS should not include pollution but concentrate on pure natural resource depletion.

2.2. Weak Sustainability

The most commonly cited definition of sustainable development (SD) (for a review of journal articles about sustainability see PEZZEY and TOMAN (2002a)) is found in the Brundtland Report of the United Nations WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT (1987), which states that "(s)ustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (for an overview of the manifold definitions and approaches, see for example RAO (2000), BAKER (2006) or BELL and MORSE (2008)). Built upon this foundation and its advancement as a development path with non-declining welfare, one of the most plausible definitions by NEUMAYER (2010) states that SD is development that "does not decrease the capacity to provide non-declining per capita utility for infinity".

The two opposing paradigms of "weak" and "strong" SD discuss what this capacity should exhibit (for the distinction between weak and strong sustainability see the rather famous "Blueprint for a Green Economy" by PEARCE ET AL. (1989) and the comprehensive discussion by NEUMAYER (2010)): the concept of "strong" SD as coined by DALY (1992) in 1977 in his "Steady-state economics", assumes substitution between non-renewable and renewable resources within the framework of natural capital when possible, but states that SD cannot be achieved by re-investing income from the depletion of natural resources into other forms of capital (AYRES 2007).

Conversely, the theory of "weak" sustainability (WS) assumes that different forms of capital are in principle substitutable and only the maintenance of the total capital stock is important to provide future utility. The so-called "Hartwick rule" (HARTWICK 1977, 1978, 1990, 1993, 1995) or "Solow-Hartwick rule" (Solow 1974a, 1974b, 1986, 1991, 1993) provides a general rule for WS (for a short overview of the development of this rule by Robert Solow and John Hartwick, see HARTWICK (2009) and the "Introduction" by HARTWICK (2010) in the "Handbook of Environmental Accounting"): Keep a country's total capital stock at least constant by investing in all forms of capital at the same level of all forms of capital consumption to allow for sustained consumption over time (NEUMAYER 2010); this creates a "rule of thumb" for the absolute minimum condition to ensure a fair chance of guaranteeing future sustainability (COSTANZA and DALY 1992).

Besides natural capital providing us with resources as input for production processes and services such as air cleaning, there are man-made or produced forms of capital, namely physical capital such as machines, roads or buildings and human capital such as skills and knowledge that allow for increased productivity of labor. Substitutability between different forms of capital is one of the major unresolved discussions in sustainability literature: To what extent is the loss of natural capital substitutable by the production of man-made capital?

The basic assumption behind the paradigm of "weak" sustainability is that the social welfare of a society depends on its total wealth–determined in capital values–and adjustments to this wealth change the path of SD. Therefore, the present value of future utility, which should determine the value of capital, is at least theoretically equal to social welfare. Therefore, if net investment in all existing forms of a country's capital stock (physical, human and natural) is positive, the capacity to provide future utility is also positive. If this is accepted, the logical follow-up question addresses the means of measuring the capital stock of a country or changes in this stock beyond the traditional forms of capturing economic processes (ATKINSON and HAMILTON 2007; HAMILTON and CLEMENS 1999; PEARCE and ATKINSON 1993) (the WORLD BANK (2006, 2011a, 2011b) has its own program of Environmental Economics and Indicators, estimating (besides GS) the total wealth of countries, such as intangible institutional capital).

2.3. Genuine Savings (GS)

HAMILTON and CLEMENS (1999) develop a formal model for Genuine Savings (GS) by starting with the assumption of a simple closed economy, the resource input of which can be used for consumption or investment in produced, man-made capital (in principal this model is an extension of the model by HARTWICK (1990, 1993). For an extensive derivation of the dynamic optimization model for GS, see also NEUMAYER (2010)). Produced capital is divided into physical capital and human capital. The production of physical capital is afflicted with pollution:

$$F(K_P, K_H, \delta K_N) = C + \delta K_P + \delta K_H + PA \qquad (1)$$

The stock of the three forms of capital (physical (K_P), human (K_H) and natural (K_N)) depends on the one hand on the composition of C in terms the consumption of K_N and K_P, and on the other hand the investment in physical (δK_P) and human capital (δK_H) as well as pollution abatement costs (PA). Consumer utility is a function of consumption (C) and environmental services (B), U = U(C, B). A country's wealth depends on the maximization of this utility function with a constant rate of discount (NEUMAYER 2010), and is subject to investment in physical capital:

$$\delta K_P = F - C - PA - \delta K_H \qquad (2)$$

depletion or consumption of natural capital:

$$\delta K_N = resource\ growth - resource\ depletion \qquad (3)$$

pollution emissions or their abatement expenditures, respectively:

$$PA = pollution\ emissions - natural\ dissipation \qquad (4)$$

and investment in human capital measured by current operating education expenditures, which could also be seen as endogenous technological progress (HAMILTON and CLEMENS 1999):

$$\delta K_H = total\ education\ expenditures - investment\ in\ buildings\ and\ equipment \quad (5)$$

The model by HAMILTON and CLEMENS (1999) evolves from the original comparison of savings, which in a closed economy should equal investments, and the combined depreciation of physical and natural capital as evidence of "weak" sustainability in the definition by PEARCE and ATKINSON (1993). In their view, an economy is sustainable if the savings are higher than the combined depreciation of all different forms of capital. For this constraint, WSI as a "weak" sustainability index has to be positive:

$$WSI = \left(\frac{S}{Y}\right) - \left(\frac{\delta K_P}{Y}\right) - \left(\frac{\delta K_N}{Y}\right) \qquad (6)$$

δK_P is depreciation of physical capital, and δKN the depletion of natural capital. HAMILTON (1996), PEARCE ET AL. (1996), ATKINSON ET AL. (1997), and, as shown, HAMILTON and CLEMENS (1999) expand on Equation (6) by adding investment in human capital (δK_H) as additional savings for the future and pollution emission damages as additional depletion of K_N. Since emissions not only negatively influence natural capital but also physical – for example through damages to the facades of buildings – and human capital – through adverse effects on health – the total capital stock of a country is influenced. I therefore denote this as N_K for negative capital, which influences all capital forms as social costs:

$$WSI = \left(\frac{S}{Y}\right) - \left(\frac{\delta K_P}{Y}\right) + \left(\frac{\delta K_H}{Y}\right) - \left(\frac{\delta K_N}{Y}\right) - \left(\frac{\delta N_K}{Y}\right) \qquad (7)$$

In a nutshell, GS illustrates a mix of consumption and savings. Following ATKINSON ET AL. (1997) it can be considered "genuine" since it is "saving over and above the value of asset consumption" (ATKINSON 2000). These savings could theoretically be seen as re-investment of depleted natural capital (and social costs by environmental degradation) into other forms of capital, resulting in the net investment into a country's total capital stock (HARTWICK 2003; DIETZ ET AL. 2007).

HAMILTON ET AL. (1997) shows that negative GS at one "point in time means that future utility must be less than current utility over some period on the optimal path", or in other words, negative GS presents a clear sign of non-sustainability (HAMILTON and CLEMENS 1999). Contrary to their first approaches, authors such as HAMILTON and ATKINSON (1999), ATKINSON (2000), HARTWICK (2003) or HARTWICK ET AL. (2003) point out that GS is a one-sided indicator, showing "unsustainability, not sustainability" (PEZZEY 2004) since negative GS rates demonstrate an unsustainable re-investment of natural capital into other forms of capital.

To translate this into calculations with real data, HAMILTON and ATKINSON (1996a, 1996b), HAMILTON (2000) and a number of official WB publications (WORLD BANK 2006, 2011a) select the traditional Gross National Income (GNI) as the starting point for the Genuine Savings (GS) calculation:

$$GNI = I_P + I_G + C_P + C_G + net\ exports + net\ income\ from\ abroad \qquad (8)$$

GNI comprises total investment in physical capital (differentiated into private (I_P) and public (governmental) investment (I_G)), private (C_P) and public consumption (C_G), net exports and foreign earnings. The assumption that this in principal shows the distribution between investment and consumption of a society serves as the foundation for the calculation of Gross National Savings (GNS) in Equation (9), which subtracts total consumption from GNI to achieve the remaining gross savings:

$$GNS = GNI - C_P - C_G + net\ current\ transfers \qquad (9)$$

The addition of net current transfers (NCT) includes all goods and services, income and both incoming and outgoing financial items without a quid pro quo. In total, GNS comprises all items increasing a country's savings beyond what is left from GNI once consumption has been subtracted.

The next step of the calculation subtracts the depreciation of physical capital (δK_P) – "the replacement value of capital used up in the process of production" (WORLD BANK 2011a) – from GNS to achieve the net investment in physical capital, Net National Savings (NNS):

$$NNS = GNS - depreciation\ of\ physical\ capital\ (\delta K_P) \qquad (10)$$

NNS shows whether new investment in physical capital is higher than the consumption of the existing capital stock. However, physical capital (K_P) is not the only capital upon which a country's wealth and development hinges. A population's knowledge and skills, its so-called human capital, is comprehensively addressed in theoretical discussions, though its measurement remains elusive. Therefore, in the calculation of GS, investment in human capital (δK_H) is proxied by current operating education expenditures (COEE), including wages and salaries and excluding capital investments in building and equipment, as this is already found in K_P (WORLD BANK 2011a, 2011b). Certain COEE components, such as the purchase of books or payment of teachers' salaries, are traditionally treated as consumption and therefore subtracted in C_G in Equation (9). For Education Adjusted National Savings (EANS) these components are reincluded:

$$EANS = NNS + COEE\ (\delta K_H) \qquad (11)$$

Building on theories of green national accounting, in the next step GS deducts the rents from the depletion of natural resources (R_N) calculated by multiplying the actual world market prices (P) minus region-specific average production costs (AC) to show the decrease of the natural capital stock:

$$R_N = ((P - AC) * production\ volume) \qquad (12)$$

Following official WB publications (WORLD BANK 2011a, 2012) this was adjusted in 2011 by setting the present value (PV) of R_N (discounted at 4%) in relation to the remaining resource stock:

$$\delta K_N = PV\ \frac{R_N}{exhaustion\ time\ of\ the\ resource\ stock\ (\min\left(25 years, \frac{reserves}{production}\right))} \qquad (13)$$

To date, this methodical extension has only been realized for the latest two "World Development Indicators" (WORLD BANK 2011b, 2012a), whereas previous editions since 1970 are only affected theoretically, while the data itself has not yet been adjusted.

According to the aforementioned "Hartwick rule" (HARTWICK 1977) these rents should be completely reinvested into the two other forms of capital. Essentially, net investment in K_P and K_H should be higher than δK_N. The "World Development Indicators" (WORLD BANK 2014a) divide depleted natural capital into energy (to date, this covers coal, crude oil, and natural gas), mineral (this covers bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver) and net forest depletion ("net forest depletion is calculated as the product of unit resource rents and the excess of roundwood harvest over natural growth" (WORLD BANK 2014a)), clearly omitting not only several forms of natural capital such as fish or soil stocks, but also individual resources such as diamonds (WORLD BANK 2006).

In my definition from Equation (7) – following argumentations by FANKHAUSER (1994a, 1994b) and the explanation in the calculation manual by BOLT ET AL. (2002) – air pollution damages are social costs negatively influencing all forms of capital (δN_K) (HAMILTON and CLEMENS 1999; WORLD BANK 2006, 2011a). The analysis of air pollution is difficult due to deficits in the data (see discussion in Section 4.6.4), therefore only the damages from carbon dioxide and particulate emissions are currently included. Marginal global CO_2 damage "is estimated to be $20 per ton of carbon (the unit damage in 1995 U.S. dollars) times the number of tons of carbon emitted" (WORLD BANK 2014a) and particulate emission damage is estimated as the willingness to pay to avoid mortality attributable to PM_{10}.

Genuine Savings (GS) – Adjusted Net Savings in World Bank terms "measures the change in value of a specified set of assets, that is, the investment/disinvestment in different types of capital (produced, human, natural)" (WORLD BANK 2011a):

$$Genuine\ Savings\ (GS) = (GNI - C_P - C_G + NCT) - \delta K_P + \delta K_H - \delta K_N - \delta N_K \qquad (14)$$

In the following section, I discuss the critiques that emerge in relevant literature combined with my own arguments and examples for simple modifications. The literature mainly concentrates on the theoretical background and the well-known problem of population growth, with which I also start my discussion. One additional debate surrounding GS, addressed by most of the publications considered, is the calculation of rents from natural resource depletion. I raise this topic but concentrate on the inclusion of further natural resources and pollution damages. I show possible extensions to the individual calculation steps of GS and the resulting different capital forms.

2.4. Critique and Possible Extensions

2.4.1 Theoretical Background

HAMILTON and CLEMENS (1999) show in their formal model that the inclusion of net depletion of natural capital and the cost of atmospheric pollution as well as the accumulation of human capital puts GS in the position to equal changes in a country's social welfare (SOYSA ET AL.

2010). To accept this, one has to "adopt a neoclassical stance and assume the possibility of substitution between "natural" (K_N) and "man-made" (K_P) capital" (PEARCE and ATKINSON 1993), which could be discussed from the viewpoint of "strong" sustainability. However, for a look at the substitutability of different forms of capital I point to the discussion between "strong" and "weak" sustainability by NEUMAYER (1999a, 2003, 2010) or DIETZ and NEUMAYER (2004, 2006) as the most detailed critical reviews of GS, as well as my own overview in Section 2. These earlier analyses concentrate on assumption problems within the GS model and measurement problems in the actual GS calculation. I proceed in the same way, excluding the fundamental debate on substitutability.[3]

One of the harshest criticisms of GS stems from the fact that the indicator is theoretically built on a perfect competition model. Since it is clear that the assumptions of an inter-temporally efficient economy that develops along an optimal path in a perfectly competitive market do not hold in reality, GS as a measure for WS is to treat with caution. "Markets fail, especially inter-temporally, and natural assets exhibit public goods characteristics" (2004), wherefore resource prices can be substantially different from optimal ones. For the GS calculation, which uses world market prices in Equation (12), this means that GS rates could be positively influenced while resource depletion is unsustainable. Over-depletion of natural resources should decrease their prices below the optimal level (and quantities above this level), but with proper re-investment GS would still remain positive (NEUMAYER 2010). Or in more simple terms: If world market prices (P) are lower than the actual value of a resource (due to incorrect exceptions or excessive supply, for example), the depletion of this resource increases to achieve the same profit, while the rents (R_N) in Equations (12) and (13) remain constant. As follows, if investment in physical and human capital also remains constant, GS stays the same even while the consumption of natural resources rises.

HAMILTON and ATKINSON (1996), HAMILTON ET AL. (1997) or HAMILTON and HARTWICK (2005) state that GS at least indicates the right direction due to the argument that over-depleted states that move in the direction of optimization increase their GS. However, Neumayer (2010) argues that this holds true only in a partial equilibrium analysis and not in a general analysis that sustainability attempts to address. The same is true for externalities not incorporated in the model or other effects that shift quantities and prices away from the optimal level. Therefore, it is rather unclear how over or under-depletion influences GS, especially if positive and increasing GS could result from unsustainable resource use and environmental degradation

[3] This debate has already been carried out by others such as BECKERMAN (1994, 1995), JACOBS (1995), DALY (1995), NEUMAYER (2000) and SIMPSON ET AL. (2005).

(PEZZEY and TOMAN 2002a, 2002b; NEUMAYER 2010). Therefore, as pointed out by PEZZEY (2004), only negative GS can function as a one-sided unsustainability test while positive GS at one “point in time does not indicate that future utility is everywhere non-declining” (HAMILTON and BOLT 2008). Or simply, positive GS provides an encouraging sign, especially given that a goal of a country’s policies can yield sustainability but not more.

2.4.2 Population Growth and GS per Capita

One of the major discussion topics in topical literature is the assumption of a constant population in the model and therefore in the calculation of the rate of change of a country’s total wealth (DIETZ and NEUMAYER 2004, 2006). This change is divided into the three described capital forms, but only for whole countries and not per capita. This contradicts the argument that social welfare depends on per capita utility and not only on total values (NEUMAYER 2010). Not without reason, traditional welfare indicators such as GDP or GNI as the calculation base for GS are shown in per capita terms, while “genuine saving could be positive even though per capita wealth is declining” (HAMILTON 2003). DASGUPTA (2001) predicts constant population in the long run, but in the average of the last five decades (1960–2010) only the population growth of Bulgaria, Curacao, and Serbia was slighty negative, and only eighteen countries had average positive rates below 0.5%. Therefore, since most populations are not static, per capita welfare should be sustained and GS should measure real changes in assets per capita rather than total capital (ARROW ET AL. 2012). Negative GS are a clear sign of declining wealth, both in total and per capita terms (WORLD BANK 2006). However, if GS is positive there should be an easy and practical way to also calculate the per capita value.

While the first attempts to include population growth into the GS calculation by DASGUPTA (2001), DASGUPTA and MÄLER (2001) or HAMILTON (2002) were rudimentary, a whole line of research by the team surrounding ARROW ET AL. (2003, 2004, 2010, 2012) discusses the population of a country as an additional capital asset. Put simply, a rising population increases opportunities to build human capital and in the long run increase a country’s workforce and therefore the amount of consumers. This could be seen as a capital form itself which I discuss again in Section 4.5.3 on human capital.

Authors such as HAMILTON (2003), HAMILTON and ATKINSON (2006) or the WORLD BANK (2006) later recommend dividing GS by total population, deducting a so-called Malthusian correction term multiplying wealth per capita by the population growth rate (DIETZ and NEUMAYER 2004) for per capita wealth changes:

$$\Delta\left(\frac{GS}{P}\right) = \frac{\delta GS}{P} - \left(\left(\frac{\delta P}{P}\right) * \left(\frac{W}{P}\right)\right) \qquad (15)$$

Intuitively, Equation (15) shows that GS per capita increases if the growth of GS is higher than that of population. The only comprehensive estimation of per capita GS by HAMILTON (2003) comes to the conclusion that most developing countries show declining per capita wealth, even if total GS rates are positive, since their population grows faster than their GS rates. However, although PEZZEY (2004), the WORLD BANK (2006, 2011a), HAMILTON (2005) and FERREIRA and VINCENT (2005) argue that sustainability has to be measured in per capita utility, to date the World Bank only publishes total GS rates. In traditional accounts GNI from Equation (8) is presented in per capita terms by dividing it by total population:

$$GNI\ per\ capita = \frac{total\ GNI}{midyear\ population} \qquad (16)$$

Hamilton (2002, 2003), who derives Equation (15) in his model uses a similar simplified formula to show changes in per capita wealth with real world data since comprehensive yearly values for a country's wealth are not yet available:

$$GS\ per\ capita = \frac{total\ GS}{total\ population} \qquad (17)$$

Concerning Equation (17) I argue that population growth is implicitly included in yearly changing population figures and by dividing total GS by the total population one achieves at least preliminary GS rates per capita until complete data for national wealth is available. While negative GS indicates unsustainability as shown in PEZZEY (2004), positive GS divided by the midyear population level at least shows whether the capital stock per capita is changing or not. Whether this is enough to hold utility constant is not addressed by Equation (17), but it at the very least indicates a trend and enables a comparison with other countries. The World Bank already has calculated comprehensive per capita wealth for the three years 1995, 2000 and 2005, and sees GS as the indicator which captures "the dynamic behavior that drives wealth changes from one point to the next" (WORLD BANK 2011a). In this definition, GS "measures the annual change in a country's national wealth" (WORLD BANK 2011a) and if the (positive) growth rate of this change is higher than population growth, wealth per capita is then increasing. Until wealth accounting is consistent worldwide and continuously possible, the

World Bank could provide a per capita "weak" sustainability index by juxtaposing these growth rates as indicated:

$$WSI = \frac{growth\ rate\ total\ GS}{growth\ rate\ total\ population} \qquad (18)$$

Since the World Bank also publishes the population growth rate (in %) for all countries for which it publishes GS rates (WORLD BANK 2012a), Equation (18) is a possible indicator to show the development of "weak" sustainability over time.

It is disputable which method is most sound, but overall it seems advisable to consider population size; discussing how exactly this should be done is an emerging research goal (DIETZ and NEUMAYER 2004, 2006). GS remains an incomplete and imperfect indicator, which additionally has to be extended by further parts of the three presented capital forms. Further limitations of the theoretical GS model are raised by the volatility of natural resource prices and therefore volatile terms of trade of resource exporters and importers.

2.4.3 Open Economies and Volatile Terms of Trade (ToT)

Exogenous shocks to the GS model, such as technological progress or unexpected resource discoveries, change the prices in open economies (DIETZ and NEUMAYER 2006; NEUMAYER 2010). Especially the effects of changing terms of trade (ToT) influence GS rates immensely; VINCENT ET AL. (1997) argue that investment rules for resource-trading countries have to be adjusted by the present-value of anticipated future ToT shifts. The unrealistic assumption of a closed economy in the original "Hartwick rule" is adjusted to open economies and changing prices for resource exports by ASHEIM (1986), HARTWICK (1995), SEFTON and WEALE (1996) and VINCENT ET AL. (1997). The GS model for open economies is derived in HAMILTON ET AL. (1997), HAMILTON and CLEMENS (1999) and NEUMAYER (2010).

Variable world market prices change ToT and thereby affect the sustainable level of re-investments: In the model, higher ToT serve to decrease the net saving corrections that resource exporters have to undertake, given that the physical amount of depleted resources results in higher additional income and therefore increases GNI and, besides higher consumption expenditures, also potentially the investment in physical capital (NEUMAYER 2010; HAMILTON ET AL. 1997). Several studies on economic growth in resource-abundant countries, such as SACHS and WARNER (1995/1997) or NEUMAYER (2004), also show that increasing ToT positively influence a country's income. The empirical study by BOOS and HOLM-MÜLLER

(2013), which includes ToT as an explanatory variable for GS and its components, comes to a contrary conclusion regarding the relationship between ToT and GS rates. Since δK_N in Equation (13) is built on rents from natural resource depletion, which rise with higher resource prices, changing ToT influence GS rates substantially and contrary to GNI.

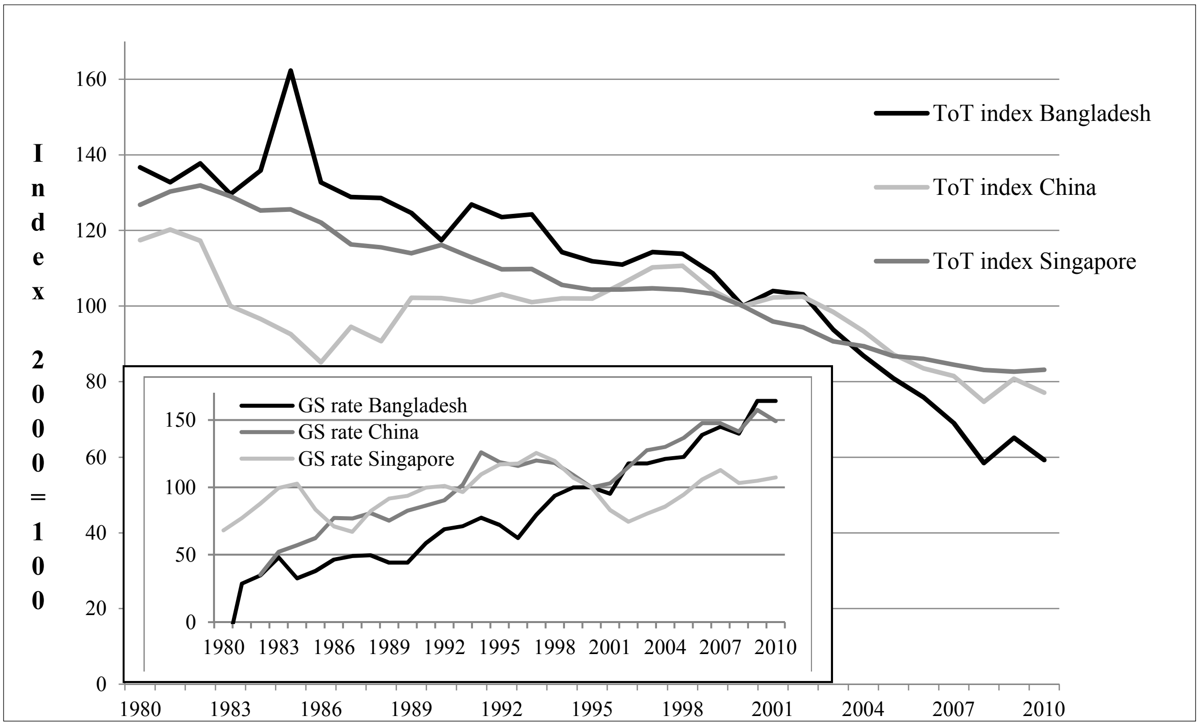
In countries that deplete natural capital, large amounts of income from δK_N are primarily obtained through exports, while parts of investment in K_P are determined by the demand for imported consumption and capital goods. Independently of whether the ToT of a country develop positively or negatively, they affect the ratio between the depletion of natural capital (δK_N) (through exports) and the change in physical capital (δK_P) (through the investment in imports). ToT are usually expressed as P_X/P_M, the price indices for exports and imports, and therefore $\delta K_N/\delta K_P$ change in the same direction as a country's ToT (BOOS and HOLM-MÜLLER 2012, 2013).

According to the calculation method in Equation (14), the depletion of natural capital (δK_N) is subtracted, with higher rents negatively influencing GS, while reinvestment in physical capital that is higher than its depreciation (δK_P) positively influences GS. In total, this means that increasing ToT should affect GS negatively, in contrast to the positive influence on GDP growth noted in SACHS and WARNER (1995/1997; BOOS and HOLM-MÜLLER 2012, 2013). This implies that shares of reinvestment that are higher than consumption in the usage of additional income from increasing prices for the same amount of natural resources could be too small to fulfil the "Hartwick rule". In summary, increasing resource prices should result in reinvestment at the same level, otherwise it will influence GS negatively (BOOS and HOLM-MÜLLER (2015) show in a case study on Zambia that in this specific example of a copper-dependent country, the increasing world market prices since the mid-2000s result not only in rapidly rising depletion of δK_N and therefore rising ToT, but also decreasing GS rates).

Since the ToT effects counterbalance each other on a global scale over a cross-section of countries, I cannot show world averages, but I illustrate, in Figures 2 and 3, the different effects of changing ToT on the GS rates of individual country samples. In Figure 2 I use Bangladesh, China and Singapore as country examples that are extremely dependent on natural resource imports. These countries show clear positive trends of decreasing ToT on GS. As a result, the decline of ToT, at least in these individual cases, is correlated with positive GS rates for resource importers.

Additionally, Figure 3 shows the negative influence of increasing ToT on the GS of Ghana, Guinea and South Africa, which depend on resource exports. In Figure 3 this relationship is not as clear as in Figure 2, but in all six countries the ToT and GS rates are negatively correlated, all with coefficients of more than 0.5, and in two cases surpassing 0.9. Naturally, none of these cases provides definitive proof of a common relationship in all countries over time. However, this seems to support the theoretical argumentation of BOOS and HOLM-MÜLLER (2012) that the ToT of a country have a significant negative influence on its GS rate. Authors such as VINCENT ET AL. (1997) or HAMILTON ET AL. (1998) recommend the inclusion of the present value of future ToT shifts, but without predictable long-term trends, for now this remains impossible.

Figure 2: GS and ToT in Bangladesh, China and Singapore.

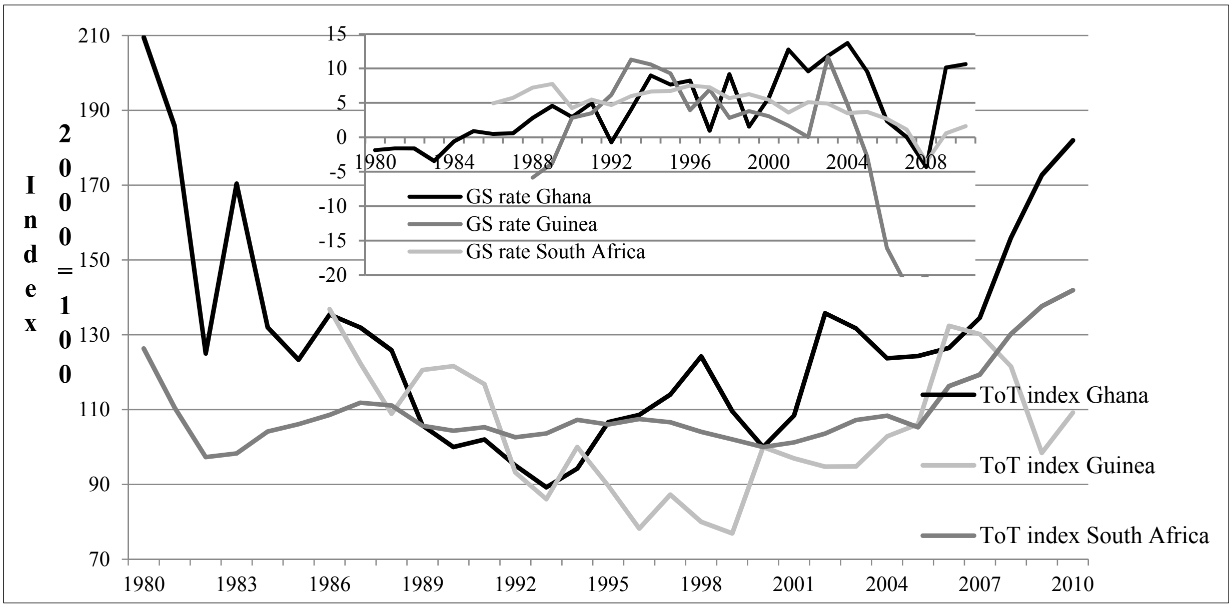


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

This shall only serve as an example for a discussion that should be addressed in further research. Especially for resource-dependent countries that export natural and import physical capital a discussion about the relation between these two is important for the calculation of GS. For example, a more detailed examination of the relationship between the determinants held responsible for the so-called Resource Curse and the GS rates of resource-dependent countries could support this discussion (see for example BOOS and HOLM-MÜLLER 2012, 2013, 2015).

However, the most important problem for these economies and especially their decision makers is the extreme volatility of world market prices of natural resources and the resulting uncertainties of future prices, and therefore the cost of resource imports and, especially, income from exports. According to NEUMAYER (2010) and BOOS and HOLM-MÜLLER (2012, 2013), problems typically arise if countries assume future rising prices and fail to anticipate or prepare for future unanticipated shocks and significant drops in international resource prices. Figure 4 shows with the example of Zambia, one of the world's last examples of a country suffering from the so-called Resource Curse according to HABER and MENALDO (2011), how the mineral depletion within δKN in Equation (14) develops almost parallel to world copper prices, Zambia's largest income source. Uncertainties that influence future investment planning are extremely high due to these volatile prices, which therefore result in similarly volatile GS rates that hinder a long-term consideration of "weak" sustainability.

Figure 3: GS and ToT in Ghana, Guinea and South Africa.

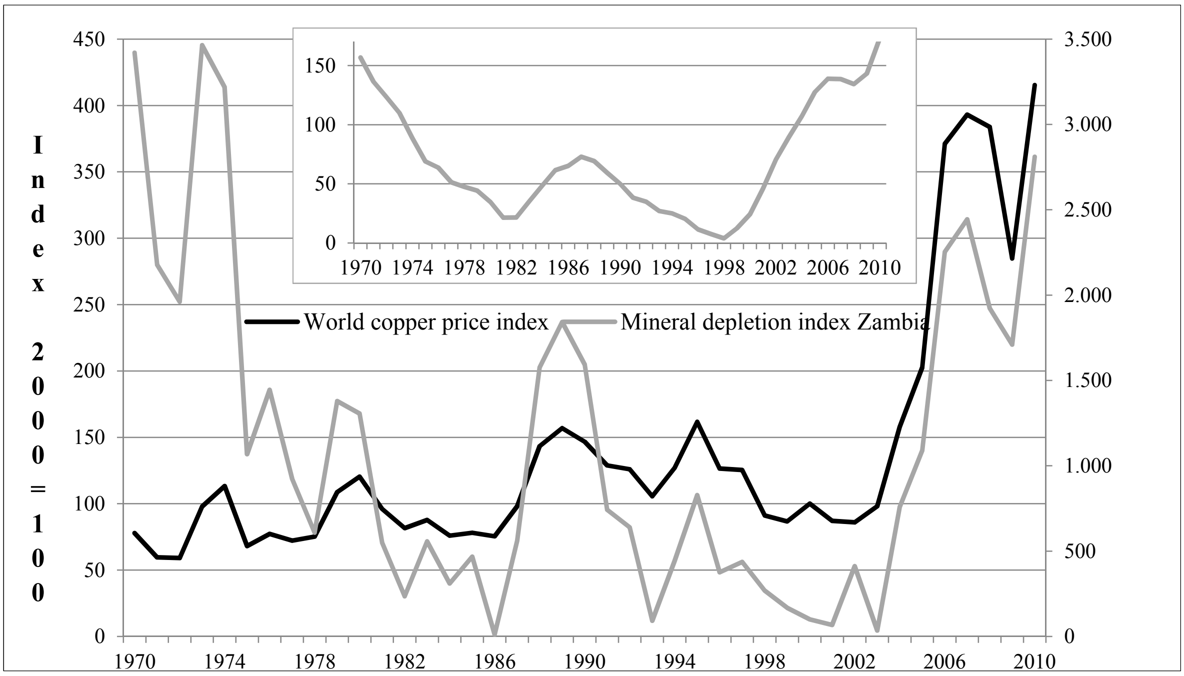


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

The World Bank could avoid these problematic effects in the calculation of GS at least partly by using average world market prices over more than one year, as shown for the Zambian example in the embedded chart in Figure 4. I use five-year averages and, as one can see, this preserves the long-term trends of Zambia's copper depletion but flattens δK_N within the GS calculation in Equation (14). The actual calculation of rents through world market prices in Equations (12) and (13) is theoretically a sound way to ascribe a value to depleted natural resources. In a situation such as that of Zambia or other examples such as Saudi Arabia, with dependency levels of more than 40% of their GNI from natural resource exports, such price volatilities also result in volatile δK_N and GS rates. Using averages could at least partially avoid this problematic and bring prices nearer to the real long-term value of depleted natural capital. Spikes or drops would change GS rates less rapidly and show a more realistic picture of the "weak" sustainability of re-investments.

Additionally, literature typically discusses whether it is fair to attribute the depreciation of natural resources completely to the resource exporters-which have mainly negative GS-without including an adjustment mechanism. PROOPS ET AL. (1999) show that GS rates change completely if resource exploitation was attributed to the countries that consume the natural resources and not to those that produce them. It is true that resource importers could therefore maintain a constant level of capital stock at the expense of resource exporters.

Figure 4: World copper prices and the mineral depletion of Zambia.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

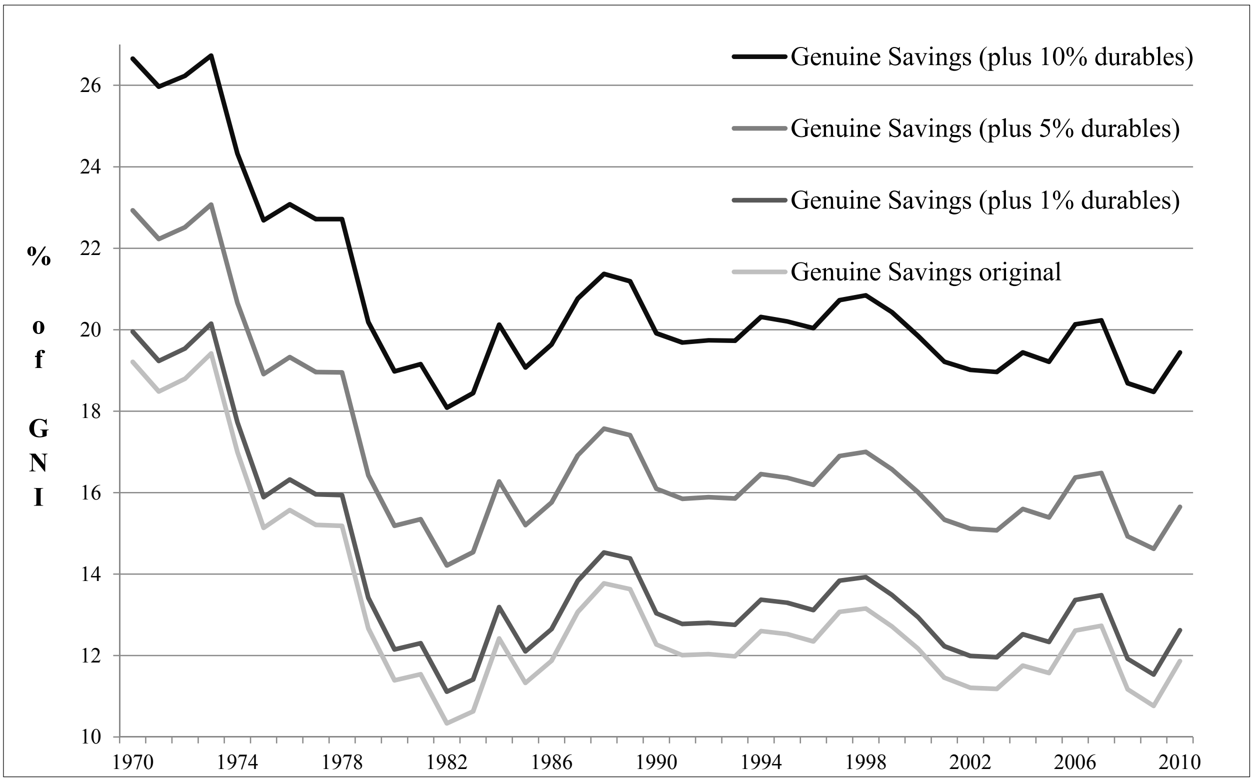
However, GS is not an indicator for the responsibility of natural capital depreciation but rather one which shows how the capital stock of a country is changing. In their own interest countries endowed with rich resource stocks should re-invest their rents sustainably to fulfil the "Hartwick rule" and maintain a constant capital stock by using income from responsible users (NEUMAYER 2010). Nonetheless, I discuss this topic in the section on damages from emissions, as there are different opinions on the inclusion of cross-border emissions as a negative contribution to the capital stock.

2.4.4 Gross National Savings (GNS)

2.4.4.1 Consumption versus Investment

As the first step of the GS calculation, GNS in Equation (9) subtracts total consumption from the capital stock of a country, leaving mainly investment in physical capital δK_P, as can be seen in Equations (7) and (8). However, as a point usually not discussed in GS literature, authors such as DALY and COBB (1994) or COBB and COBB (1994), STOCKHAMMER ET AL. (1997) or CASTANEDA (1999) argue in the discussion of the Index of Sustainable Economic Welfare (ISEW) that durable consumption goods such as cars or furniture also increase the physical capital stock (NEUMAYER 1999a, 1999b; LAWN 2003, 2006). Especially durable goods such as refrigerators in equatorial regions or buses in regions without public transportation function at least partly as investment in social welfare.

Figure 5: World GS rates including investment in durable goods.

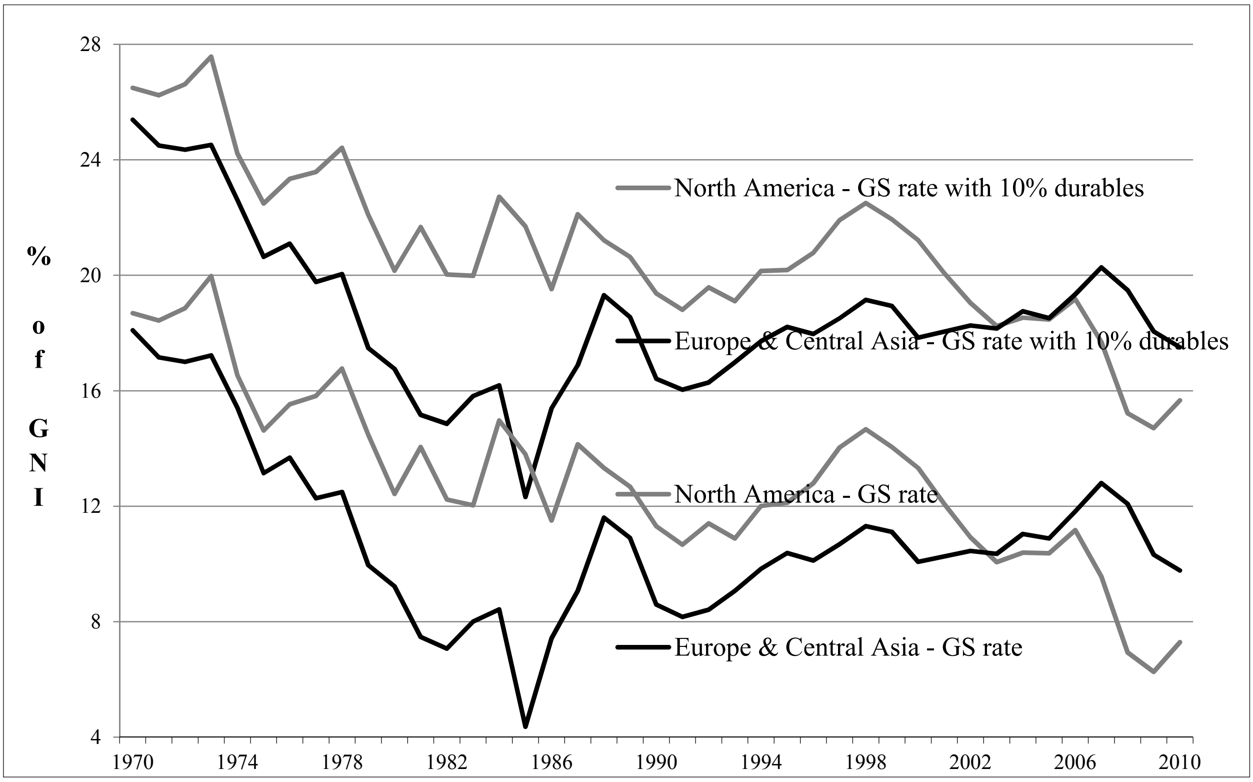


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Naturally, the discussion regarding which consumption expenses should be considered an investment is daunting, and a long-term theoretical discussion should be based on a systematic survey of durable consumption goods. Contrarily, there are also considerations as to whether similar amounts from the already included investments in K_P are so-called "white elephants", namely investment projects with negative social costs (ROBINSON 2005). Since this paper does not aim to discuss traditional national accounts or the definition of consumption itself, I recommend a discussion concerning the parts of consumption that could be considered investments that back sustainable development on the one hand, and those which could be seen as strictly detrimental on the other hand.

In Figure 5, I show that the considered fixed share of 10% from consumption for investment by DALY and COBB (1994) makes a considerable difference in total world aggregates; even a 5% portion of consumption expenditures allocated to investments shows an observable difference in the sum of world GS rates. A sensitivity analysis showed that these differences are not as large for individual countries, but the difference is especially immense for the developed and generally not resource exporting regions North America and Europe (as well as Central Asia). Figure 6 shows that the inclusion of 10% of consumption expenses in investment increases the total GS rates in both regions by more than 7%.

Figure 6: GS rates Europe and North America including investment in durable goods.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

2.4.4.2 Net Current Transfers (NCT)

Among other factors, net current transfers in Equation (9) include all forms of income exchange between countries without repayment, such as aid or remittances from migrants not only employed in another economy but also considered residents there. It is disputable whether the inclusion of aid or remittances into a county's capital stock can be seen as providing a contribution to its sustainable development. In principal, this increases the capital stock and could partly be seen as quid quo pro from net importers of natural resources. However, aid weakens macroeconomic and public expenditure policies through windfalls that are not tied to economic performance, while investments are often earmarked for projects and could therefore be invested in sectors that crowd out more important investments (PEARCE and ATKINSON 1993; ROBINSON and TORVIK 2005). However, the global average difference between GS with or without aid lies at only approximately 0.3% over the last three decades.

LÓPEZ-CÓRDOVA and OLMEDO (2006) provide a detailed overview of the developmental impacts of international migrant remittances that are proven to show a positive effect on private investments, especially in human capital (PEARCE ET AL. 1996). However, it is argued that remittances are produced by emigrants who remove human capital from their respective country's stock. These migrants use their human capital more gainfully, which results in private investments in either physical or human capital.

Therefore, it is difficult to distinguish between sustainable and unsustainable portions of remittances within the GS rates of a country. Nonetheless, remittances – 142 countries are net receivers – are an important source of foreign income. This seems especially dramatic in countries such as Jamaica (where remittances comprise more than 70% of the total value of GS rates between 1990 and 2009), Lebanon (65%), or Lesotho (more than 90%). Since remittances increase GS rates and could be used for investment, they influence "weak" SD either positively or negatively. However, BOOS and HOLM-MÜLLER (2013) show in a cross-country analysis a highly significant positive relationship between remittances and investment in physical capital, as well as the total GS rates of those countries. The example of remittances shows the need for more discussion on the contents of net current transfers (NCT). The contents of NCT should be examined in more detail, especially for most developing countries, to discuss whether these are individually contributing to "weak" sustainability or not.

2.4.5 Net National Savings

2.4.5.1 Depreciation of Physical Capital

The depreciation of physical capital or consumption of fixed capital (CFC), as defined in the "Handbook of National Accounting" (UNITED NATIONS 2003), is a normal cost of production, namely the decline in the stock of physical (fixed) capital (assets). Using a perpetual inventory method (PIM), CFC is calculated as "the difference between successive real market values of an asset over its lifetime" (OECD 2001). The PIM is recommended by the UN over the typical "depreciation used in business accounting in order to come closer to the actual cost of fixed capital used in production" (UNITED NATIONS 2000) by adjusting for inflation.

However, the PIM raises the same critique as business depreciation, since it assumes on the one hand constant depreciation rates and on the other that every investment is productive (HAMILTON ET AL. 1997; FERREIRA and VINCENT 2005). Both assumptions can be criticized since the consumption of physical capital in reality is not constant and not all capital goods are productive or even good for the physical capital stock. One example can be seen in so-called "white elephants", investment projects with negative social surplus but sinecures for certain interest groups (ROBINSON and TORVIK 2005). Improvements to both categories are difficult, especially the quantification of investment quality, but one way around this problem is at least to discuss the possible unsustainability of investments, such as in military infrastructure.

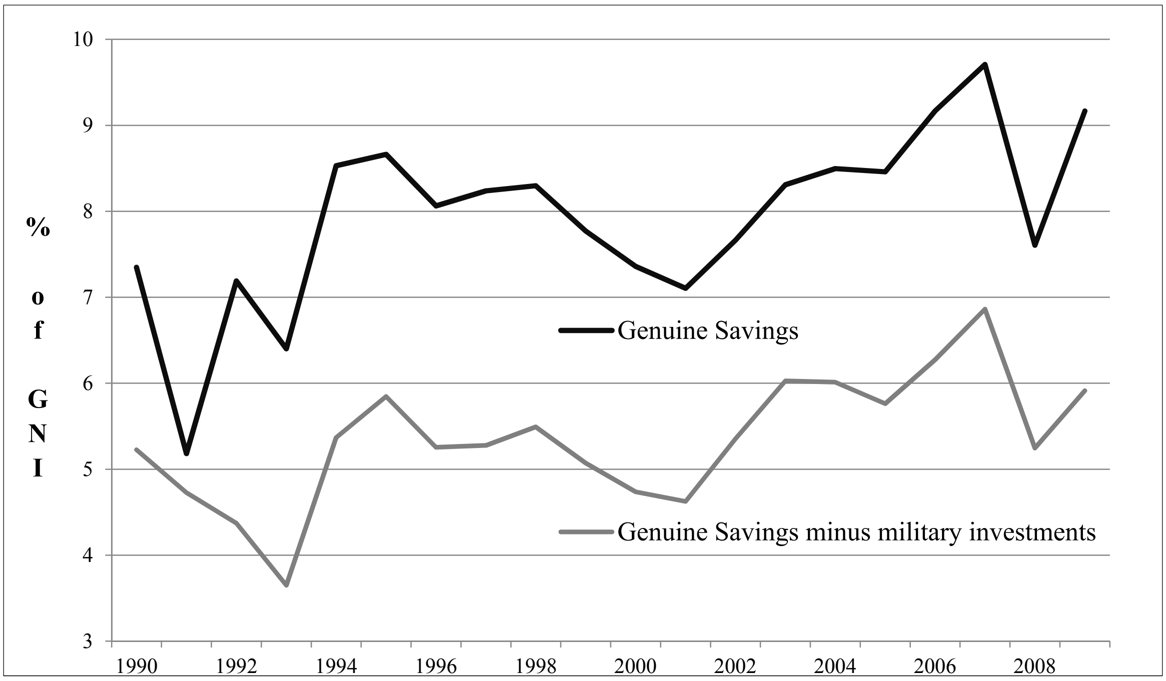
2.4.5.2 Defensive Investments

Other indices for sustainable development, such as the Index for Sustainable Economic Welfare (ISEW), exclude investments in physical capital that are used for defensive expenditures such as household pollution abatement costs, as well as the cost of car accidents, underemployment, or crime (LAWN 2003). A clear definition of defensive expenditures does not exist; early studies even exclude parts of education (JACOBS 1991) or health expenditures (COBB and COBB 1994) as defensive and not improving a country's welfare. A definition of defensive expenditures first published by DALY and COBB (1994) – expenditures that defend a population against externalities from production – does not exactly define what this means, therefore any consumption or capital good could be defensive (NEUMAYER 2010).

As a result, I do not follow this definition or the discussion in ISEW literature regarding which expenses should be deducted at what level (NEUMAYER 1999b). In a discussion of GS I have the advantage that consumption is already eliminated, leaving only defensive investments to consider. Investments such as those for combatting crime are still disputed and have to be clearly defined to determine the respective data from national accounts. Furthermore, depending on the region, investments in jails could be as important to sustainable development as other investments.

Figure 7 shows the change in global GS rates between 1990 and 2009 if investments in the development of military equipment, buildings and the like are deducted by allocating 10% of total military expenditures to investment, as is done in the GS calculation for education expenditures. It is rather interesting that GS decreases globally by 2.7% (of GNI) for this period if this 10% military investment is deducted. Conversely, this means that more than one third of NNS in Equation (10) – interpreted as investments in physical capital – in the global average GS from 1990 until 2009 was determined by military investments (average GS of 7.9% of GNI compared to military investment of 2.7%). However, the contribution of military investment to the SD of a country is a mere political or philosophical discussion. Its economic dimension requires further research together with other potential defensive investments, especially considering its significant contribution to the global average of GS.

Figure 7: GS excluding military investments between 1990 and 2009 (world average).



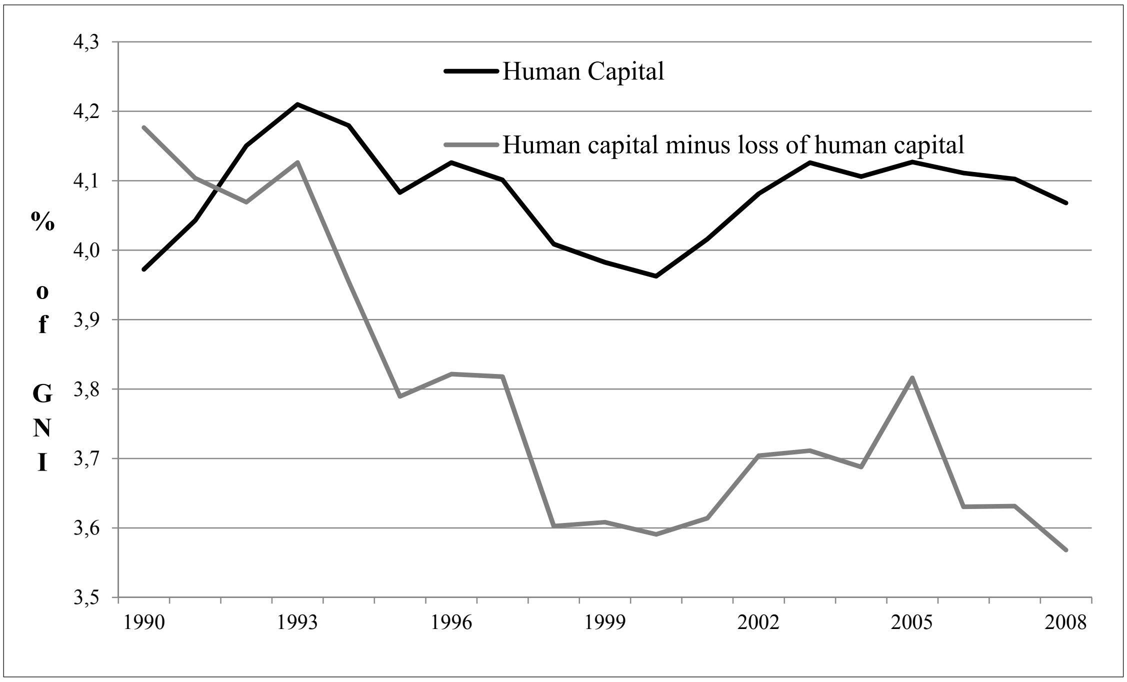
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

2.4.5.3 Human Capital

Human capital is defined as the total stock of competences and knowledge of all individuals within a country’s population gained through education, training and experience used for daily economic life (O’SULLIVAN and SHEFFRIN 2007). The usual expression of human capital, first defined by Mincer (1974), is a log-linear relationship between earnings and years of schooling to show that higher human capital results in higher income (WORLD BANK 2011a). Investment into this capital stock is realized, for example, by teachers' salaries, expenditures for libraries or enrollment fees (MANKIW 2008). Therefore, HAMILTON and CLEMENS (1999) utilize a country's current education expenditures as an indicator for investment in human capital.

DASGUPTA (2001) criticizes this approach as an overestimation, since human capital also depreciates when educated employees leave the workforce or "die and take their human capital with them" (DASGUPTA 2001). However, NEUMAYER (2010) argues that education expenditures still undervalue real investment in human capital since other expenditures that build human capital are not quantifiable. DASGUPTA (2001) even discusses examples such as the effect of parents' time and effort with children or personal investments in strategic positions within social networks that increase one's value for employers.

Figure 8: Human capital minus loss between 1990 and 2008 (world average).



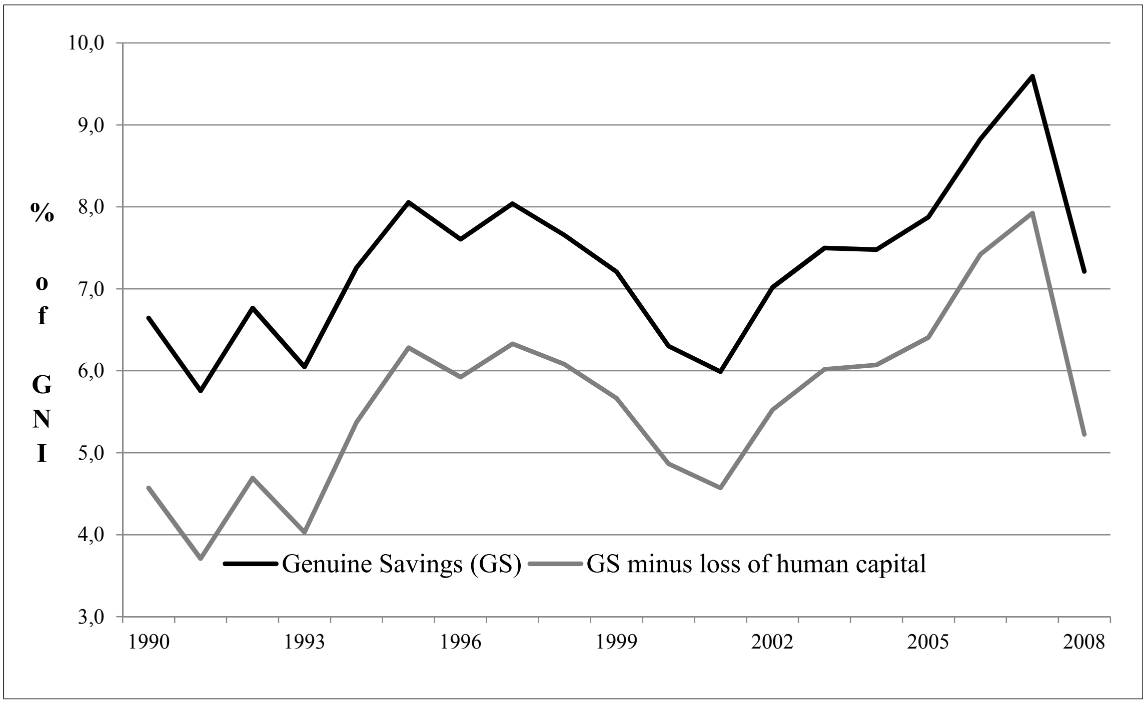
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

In general, I follow the argument that current education expenditures underestimate the real investment in or growth rate of human capital. However I also show two short examples demonstrating how GS could be influenced by including depreciation of human capital. One could argue that the extreme differences in life expectancies between countries are important when considering the return on investment in human capital (HARTWICK 1977; WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT 1987; WORLD BANK 2011a). Especially life expectancies that fall below the "normal" retirement age of 65 defined by Convention No. 102

of the INTERNATIONAL LABOR ORGANIZATION (2008) decrease the contribution of education expenditures on economic activity.

Figure 8 shows average global decreases in human capital and Figure 9 shows the total GS rate after subtracting the fraction of education expenditures that is not used for an entire working life. Since the age of a working life is defined from 15 to 65 I deduct 2.5% from current education expenditures for every year a country’s life expectancy at birth is below 65 years. On average over the last two decades, 66 countries out of the 205 available in the “World Development Indicators” exhibit life expectancies under this age. Clearly the difference for the world average is immense if I use this simple extension to assign education expenditures to the average working years the population of a country is able to fulfil.

Figure 9: GS and the loss of human capital between 1990 and 2008 (world average).

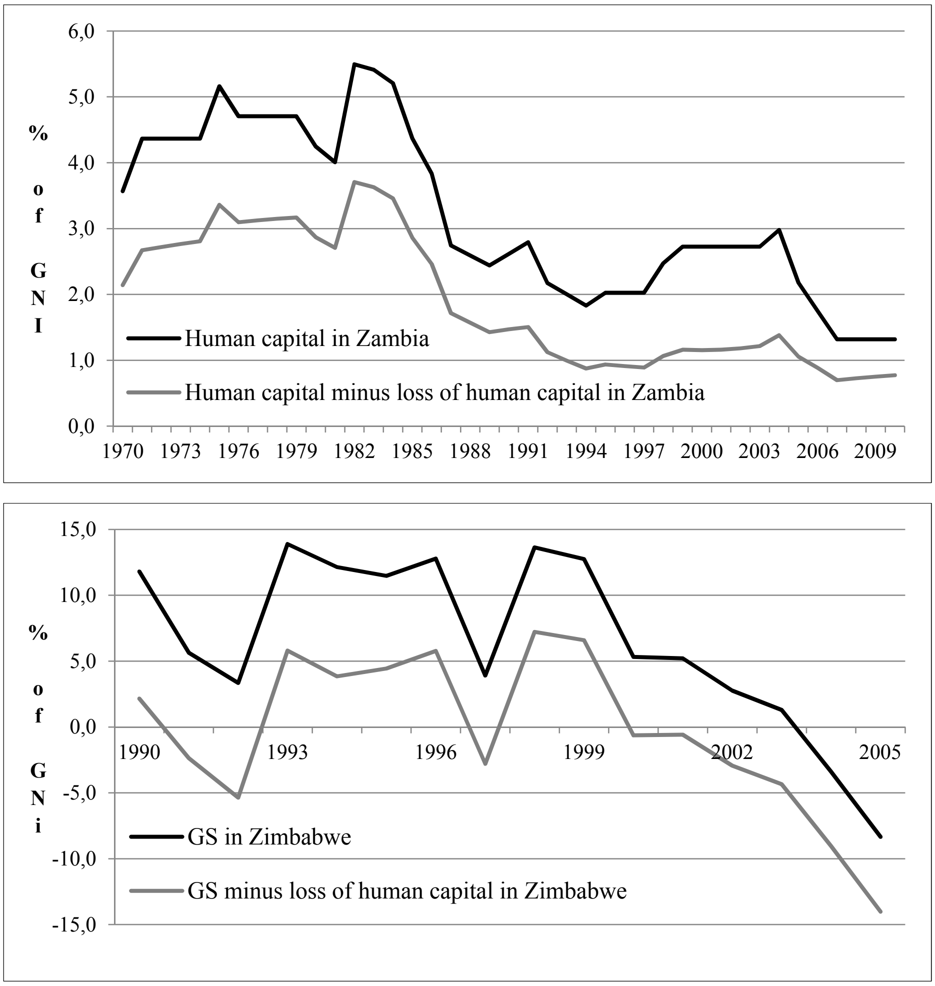


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

In Figure 10, I again use examples from Southern Africa, namely Zambia and Zimbabwe, in which the life expectancies fall below the international retirement age of 65. The example of Zimbabwe, with an average life expectancy of 49 years in the period from 1990 to 2005, shows a significant difference of more than 6% of GNI when measuring GS with and without the inclusion of life expectancies.

Therefore, different life expectancies clearly can have an effect on the human capital of a country. I argue along with ARROW ET AL. (2012) that life expectancies and quality of health are related and thereby health expenditures could also be seen as investment in human capital. In Figure 11, I show data for the five-year period from 2003 to 2007 to illustrate how health expenditures change GS. As in the case of education expenditures, I subtract 10% of health expenditures for investments in hospitals and other facilities already included in NNS and show that adding health expenditures increases world average GS values between 1% and 5%, depending on the inclusion of the loss of human capital. Such large increases appear slightly high for the additional incorporation of only a part of one capital form, but ARROW ET AL. (2012) even demonstrate in their five cases that the inclusion of health capital is more than twice as large as all other forms of capital combined. A capital form resulting in such a difference and so far underrepresented in the scientific discussion lends itself to future discussion on the calculation of GS.

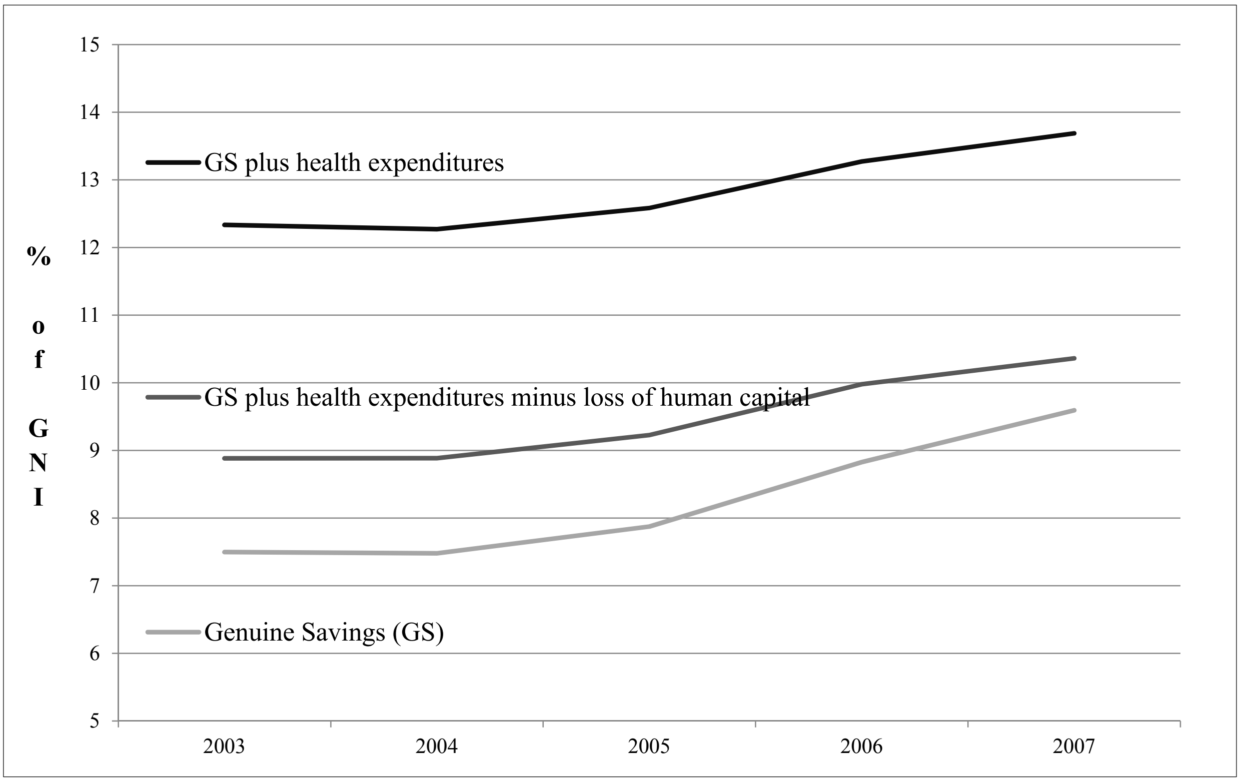
Figure 10: Human capital minus loss between 1970 and 2010 in Zambia and between 1990 and 2005 in Zimbabwe.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

The quality of education and health systems differs greatly. Thus, one dollar spent on education or health cannot be considered one dollar of additional human capital, as the returns are different from country to country. According to the WORLD BANK (2006, 2011a), social returns on education expenditures are almost two-thirds higher in developing countries compared to the industrialized world. The WORLD BANK (2006, 2011a) therefore suggests extending the proxy for human capital by other measures such as average years of education, but acknowledges the overall usefulness of the rate of returns on education. This paper shall only present critiques and possible extensions, as a fundamental discussion on all research topics behind the different calculation parts of GS would go beyond the scope of this work. In line with ARROW ET AL. (2012), I also argue that "the analysis of health capital is an innovation that will require much further study to understand".

Figure 11: GS plus health expenditures between 2003 and 2007.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

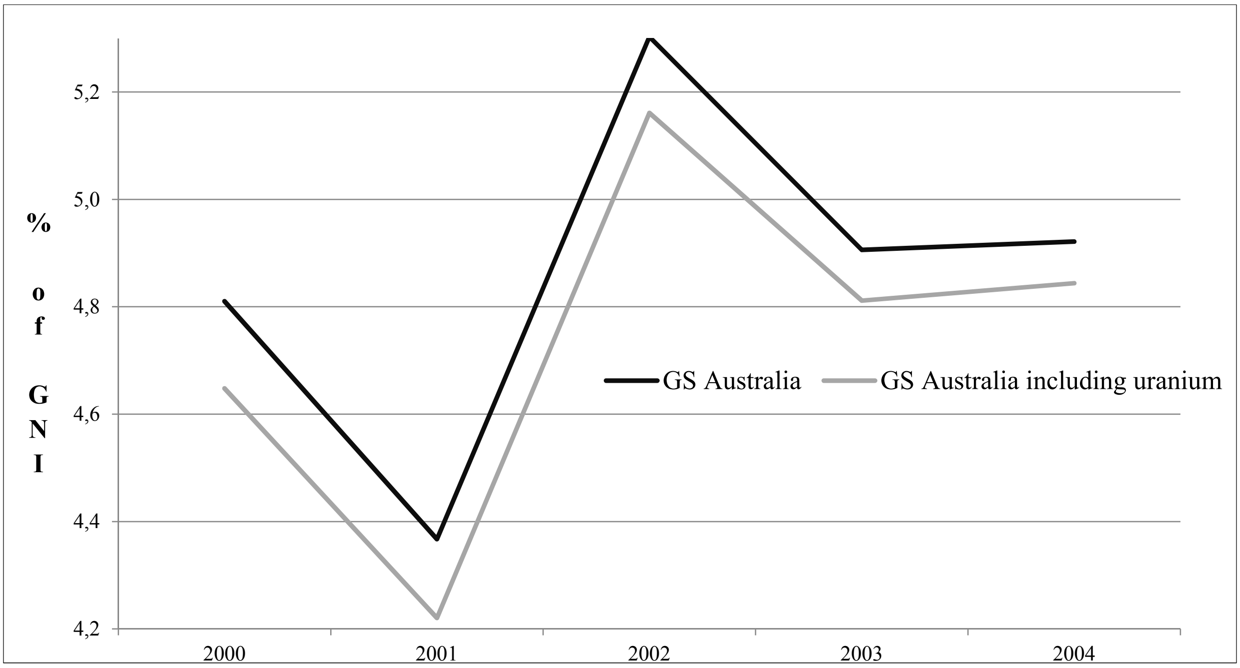
In the next section on natural capital, I deliberately abstain from a detailed discussion of the calculation method, instead choosing to show interesting examples of omitted resources that could be included.

2.4.6 Natural Capital

2.4.6.1 Energy Depletion

Rents from energy depletion include crude oil, natural gas, and hard as well as lignite coal, calculated as shown in Equation (12), where P is the international market price. However, other energy sources such as peat or uranium as input for nuclear power plants are absent from the calculation. The United Nations Statistics Division (UNSD) Industrial Commodity Statistics Database publishes production values only in metric tons, while world market prices and average production costs are difficult to obtain. Therefore, these energy resources and others for which no data is available are omitted by the WORLD BANK (2006, 2011a).

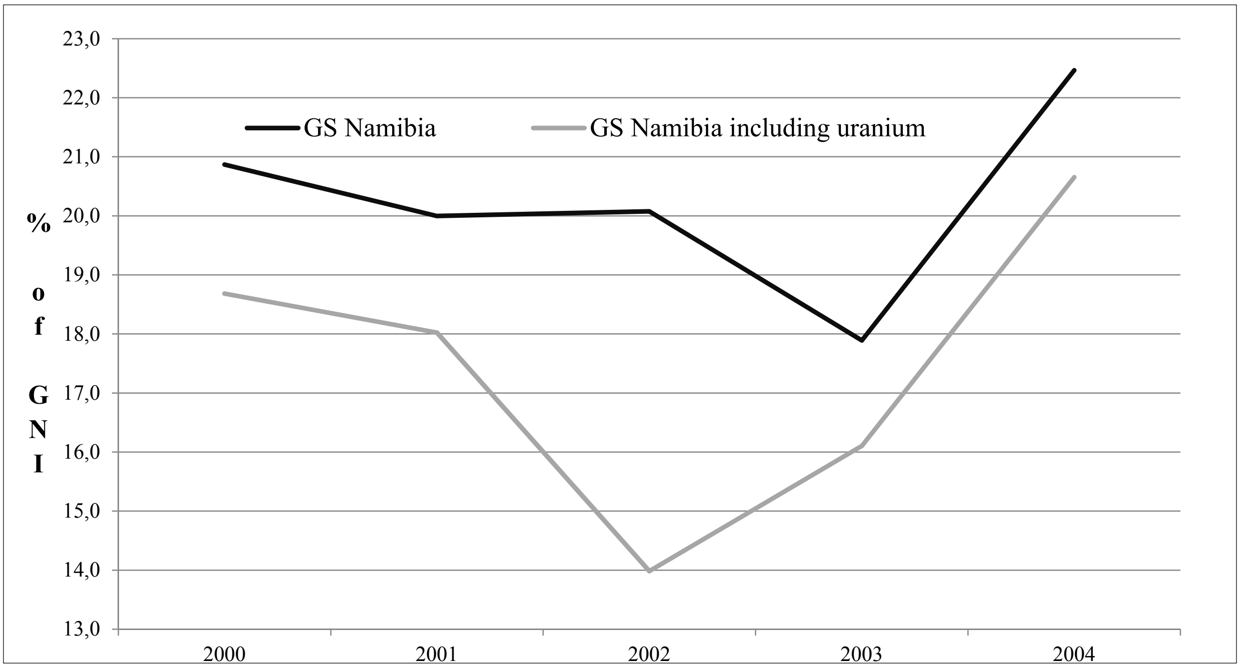
Figure 12: GS of Australia including uranium between 2000 and 2004.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

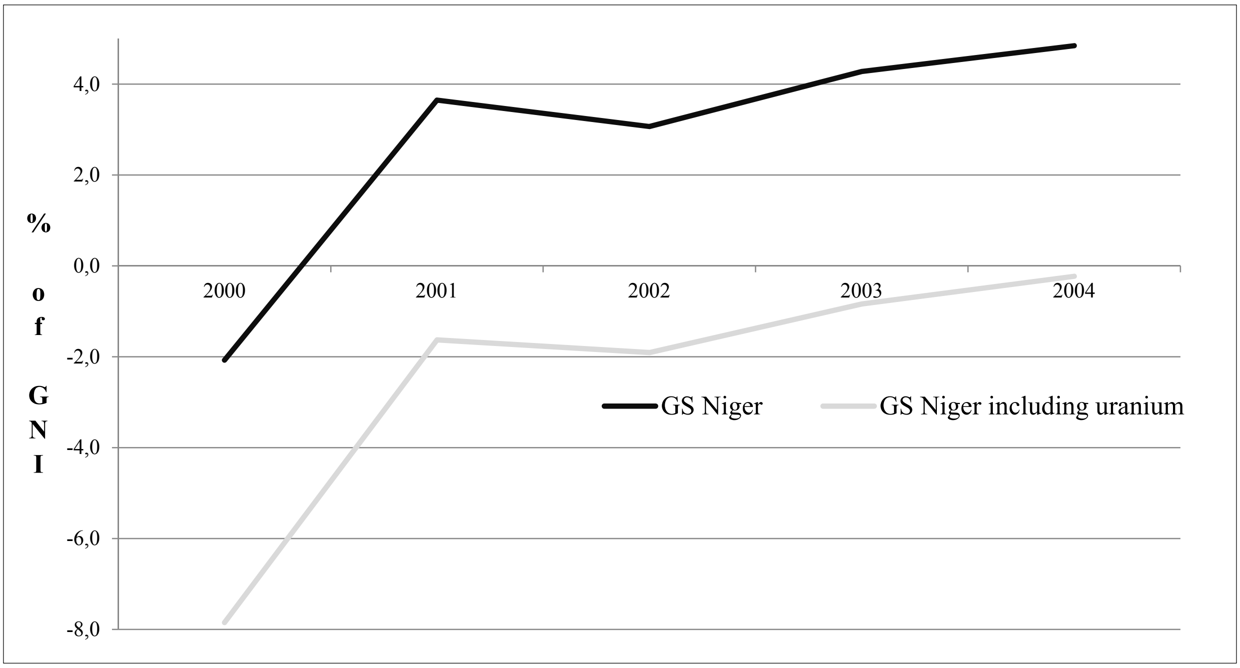
In total, there are only twelve countries that produce peat on a large scale: Albania, Argentina, Bangladesh, Belarus, Burundi, Estonia, Finland, Ireland, Russia, Rwanda, Senegal and Sweden. As an industrial energy source in plants it is only used extensively in Ireland, Finland and Sweden, while in a small number of developing countries immeasurable values are privately used as fuel. Therefore, I would suggest including peat rents into the GS of these bigger producers but to omit it in the marginal amounts most countries show. For P in Equation (12) individual country prices could be used if it is not possible to establish a world market price.

Figure 13: GS of Namibia including uranium between 2000 and 2004.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Figure 14: GS of Niger including uranium between 2000 and 2004.

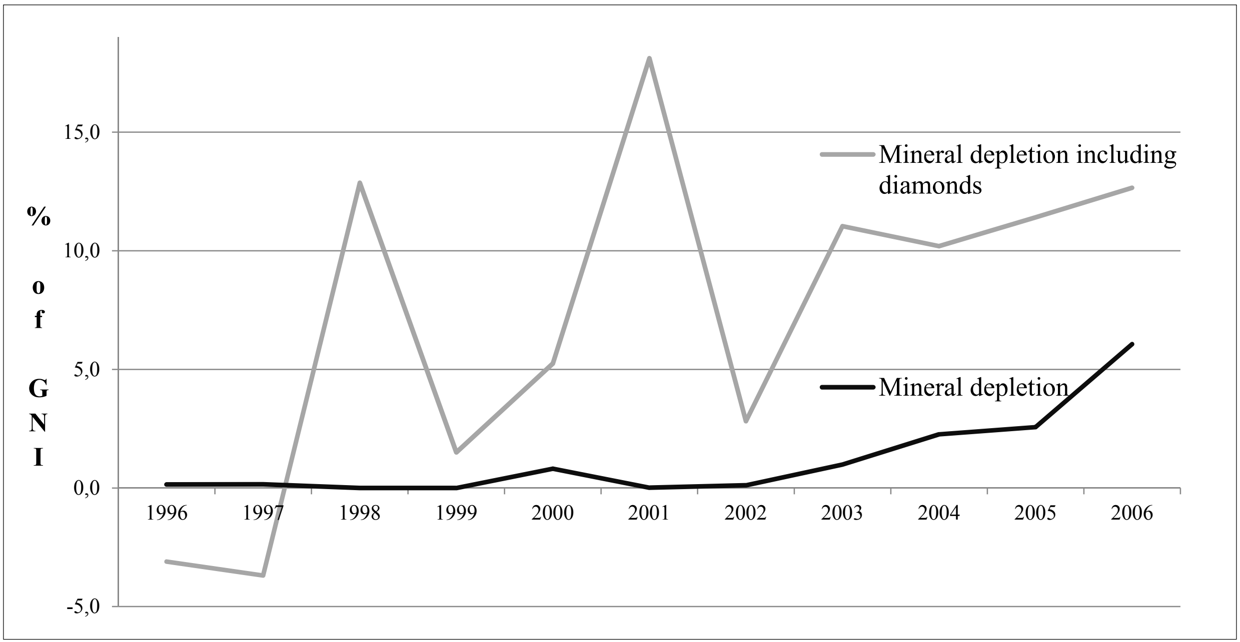


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Another case is uranium, which is only produced in 21 countries in a total of 42 mines. Moreover, only Australia, Canada, Kazakhstan, Namibia, Niger, the Russian Federation, the United States and Uzbekistan produce uranium in four-digit metric ton terms. Figures 12–14 show the three countries Australia, Namibia and Niger as those in which uranium makes a visible difference. These examples show that it could be advisable to include uranium in the calculation of the GS of such uranium-depleting countries. Especially the Nigerian GS rate decreases from positive to negative values by including the depletion of uranium, as Figure 14 shows.

2.4.6.2 Metal and Mineral Depletion

Figure 15: Mineral depletion of Botswana with and without diamonds between 1996 and 2006.



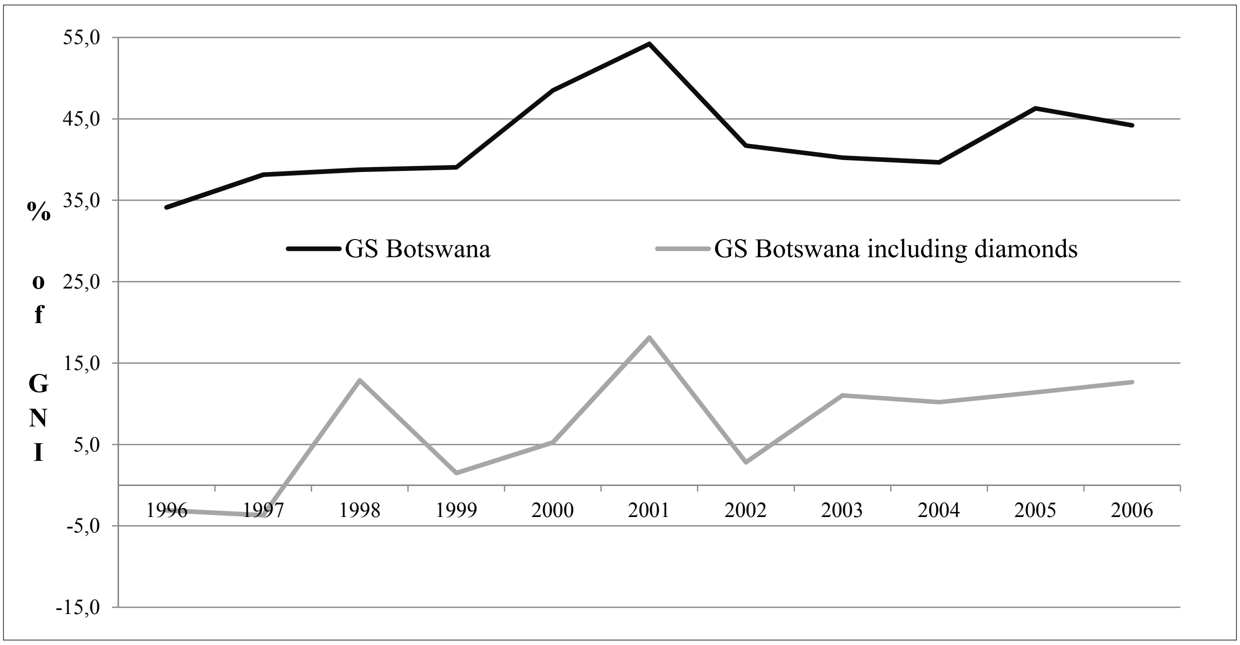
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014, 2014b), the BANK OF BOTSWANA (2014) and the CENTRAL STATISTICS OFFICE OF BOTSWANA (2014).

Rents from metal and mineral depletion include the substances bauxite, copper, gold, iron, lead, nickel, phosphate, silver, tin and zinc calculated in the same manner as the aforementioned cases. To date, the following are omitted due to lack of sufficient data: platinum, chromium, molybdenum, fluorite, barytes, diamonds, natural abrasives, natural graphite and natural crystal. For most of these resources the Industrial Commodity Statistics Database provides US$ values for their production. Obtaining cost information remains more difficult. Most of these resources are depleted in significant amounts in a very limited number of countries. Since the same data problematic occurs as above, the merits of a survey of these resources should be discussed.

Platinum-group metals are only produced in 13 countries, which make them insignificant on a global scale but important for the GS of individual countries. For example, palladium, which had a weighted world market price of US$381 per troy ounce in 2008 and an insignificant world production value of around US$2 billion, is an important rent source for Russia (*ca*., US$1 billion of the country's total metal and mineral rents of around US$13 billion) and South Africa (*ca*., US$890 million out of total rents of US$7 billion).

Diamonds especially serve as an important natural resource for countries such as Angola, Botswana, the Democratic Republic of Congo, Namibia, the Russian Federation, and South Africa (WORLD BANK 2006). However, there is no world market price for diamonds and production costs are difficult to obtain. Figures 15 and 16 show the only example I was able to extract: The inclusion of diamond rents into the GS of Botswana between 1996 and 2006.

Figure 16: GS of Botswana with and without diamonds between 1996 and 2006.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014, 2014b), the BANK OF BOTSWANA (2014) and the UN COMTRADE DATABASE (2014).

Botswana's GNI increases on average over this period due to higher diamond extraction rates and therefore growing resource rents which are not subtracted in GS. If I include diamond rents, GS decreases drastically. As this example shows, the GS rates of all six diamond producers is lacking an important component of natural capital, leading to an incorrect estimation of the changing wealth of these countries. For Botswana, GS could not seriously be seen as an indicator for "weak" sustainability without including rents from diamonds. As Figure 16 shows, in 2001, the official GS rate of Botswana even crossed the 50% mark. No other country has ever reached this threshold, and Botswana would not have been the exception, had the rents from diamond depletion been considered in the calculation. Botswana's Central Statistics Office at least partially provides the data one would need to calculate the rents in Equation (12) for future research on the GS rate of the country.

For the benefit of countries that deplete natural resources to this extent, it would be important to include these values for δK_N. If it is not possible to extract this data to achieve cross-sectional global or regional averages, national statistical offices, as in the case of Botswana, could at least provide approximate values for δK_N to more realistically present their GS rates.

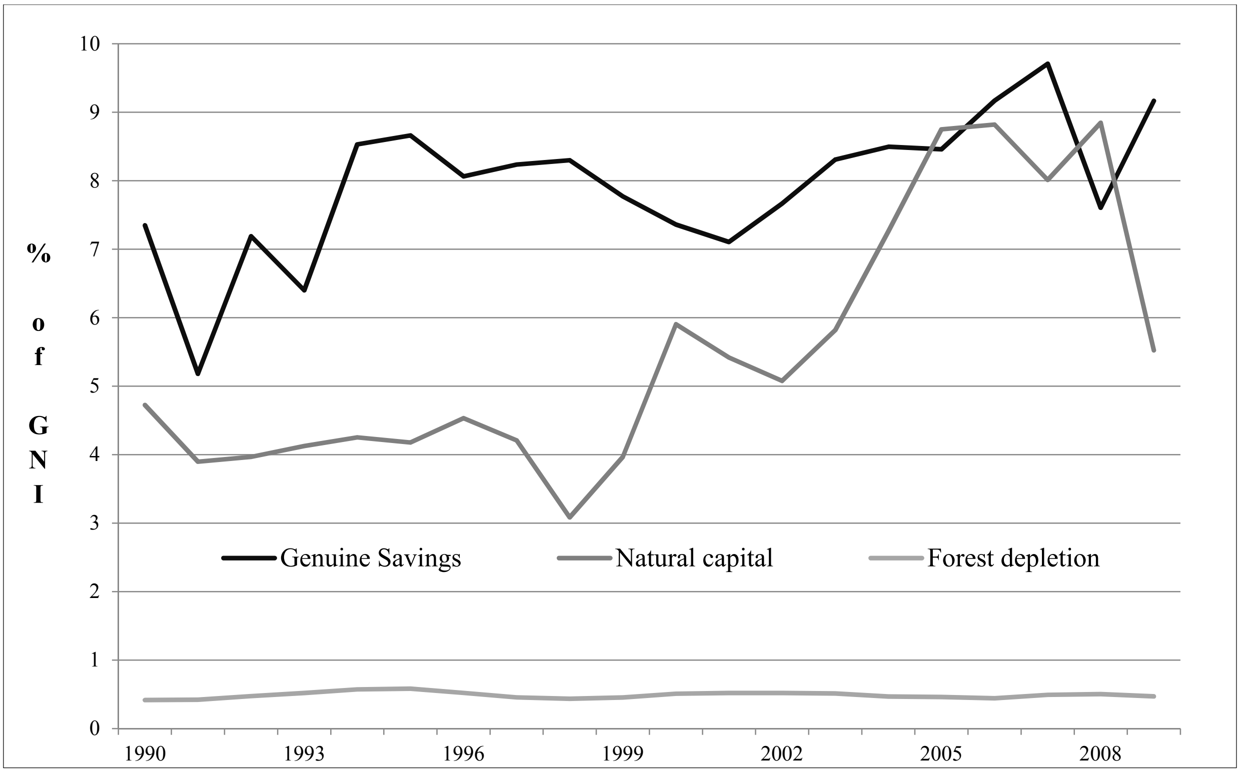
2.4.6.3 Net Forest Depletion

Carlowitz's "Sylvicultura Oeconomica" (1713/2009), the first publication using the concept of sustainability, examined sustainable forestry with the clear rule of limiting depletion to a level below the new growth of timber resources. In the GS method of the World Bank, wood is the only renewable resource included. The Bank subtracts the present discounted value of net forest depletion (NFD):

$$NFD = (roundwood\ production - increment) * P * rental\ rate \qquad (19)$$

If the first part in brackets is negative (positive growth rate) it is not included in GS (rather it is set to zero) (BOLT ET AL. 2002). The WORLD BANK (2012, 2014a, 2014b) principally argues that growth that is greater than harvesting should be a positive calculation component of natural capital, but that most of this growth is in economically forested areas which are farmed for later depletion and therefore do not signify a real increase in natural capital (WORLD BANK 2011a).

Figure 17: Natural capital and forest depletion between 1990 and 2009 (world average).

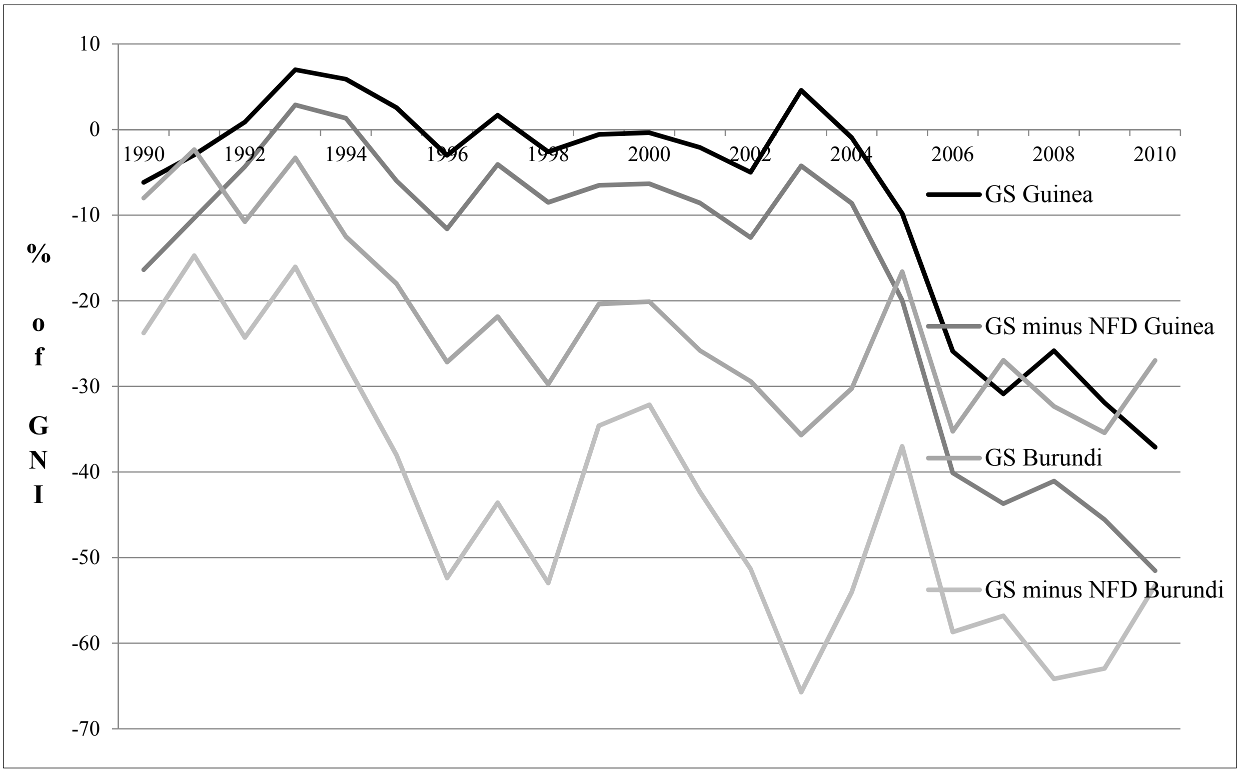


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

I argue otherwise. Despite the relative insignificance of timber resources on average globally, as Figure 17 shows, forests represent an important capital stock in some countries. Examples such as Burundi or Guinea in Figure 18 show that for some countries net forest depletion makes a noticeable difference in their GS rates (altogether, more than 15 countries deplete forest resources for more than 5% of their GNI). For the GS of these countries, this renewable resource is treated the same as all other exhaustible resources discussed above.

As long as forest depletion outweighs growth, this is not critical for the calculation of GS. However, from the point where reforestation outnumbers depletion—for example by investment of rents from forest depletion in reforestation rather than infrastructure or education—this positive effect on natural capital does not factor into the current calculation. As a result, forest growth for economic reasons does not increase the natural capital stock, and if these are used to earn more rents from forest depletion in the future, the rents are again subtracted from GS. Therefore, in the worst possible situation rents from forest depletion are subtracted twice without factoring in the replenished stock.

Figure 18: GS rates of Burundi and Guinea with and without forest depletion between 1990 and 2010.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

As Figure 17 shows, the proportion of forest depletion was only around 0.5% globally in the 1990s and 2000s. In the same decades, the share of forest in the total land area increased by more than 0.5% in almost 50 countries. Obtaining data on forestation is rather difficult, but a fair indicator measuring the capital stock of a country should include this along with other renewable resources.

As an overall issue in the GS calculation, it is not possible to include the net changes of other forms of renewable natural capital on an annual basis due to the lack of data (WORLD BANK 2011a, 2011b). The net depletion of fresh water or land resources, soil erosion, and other factors such as biodiversity and fish stocks most likely significantly influence the natural capital stock of enough countries to include it in their GS rates (WORLD BANK 2006). The WORLD BANK (2011a, 2011b) includes selected components of natural capital that it is able to measure in the inventory of the total capital stock of over 120 countries, although it is not yet included on an annual basis. Building on MERLO and CROITORU (2005), the Bank for example attributes US$129 per hectare in industrialized countries and US$27 in developing countries per annum for "(n)ontimber forest benefits such as minor forest products, hunting, recreation, and watershed protection" (WORLD BANK 2011a).

Fisheries especially provide a significant wealth stock for some countries. In Bangladesh, for example, the gross output from fisheries accounts for 3.9% of GDP, nearly 2% in Senegal, and over 4% in Vietnam. In Figure 18 I have shown the difference in GS rates of Guinea when excluding net forest depletion, whereas the GS of its neighboring countries would be greatly affected by the inclusion of rents from fisheries. According to the Fisheries and Aquaculture Department of the FAO (1999, 2006), the net exports of fish products from Guinea-Bissau amount to US$5.8 million (in 1999) and those of Sierra Leone stand at US$9.7 million (in 2006).

These figures include additional income from net exports of the fishing industry. Production costs have not been subtracted and there is no data on the recovery of the fish stock. However, these two countries provide representative examples for the problem this creates: The GNI of Guinea-Bissau reached US$210 million (in 1999) and that of Sierra Leone amounted to US$1.8 billion (in 2006), therefore income from fisheries accounted for 2.8% and 0.5% of GNI respectively, while GS rates were negative.

The argument that fish stocks are mobile and not only difficult to measure but also difficult to assign to an individual country, is similar to the criticism of the inclusion of transboundary pollution. In the next section, I discuss the inclusion in the GS rate of damages by air pollution. The World Bank deducts air pollution from the GS of the emitting and not the affected country. The same discussion and arguments could apply to mobile resource stocks such as fish.

2.4.6.4 Air Pollution Damages

In Equations (7) and (14), I define total air pollution damages as social costs which negatively influence all other forms of capital and denote it as δN_K. HAMILTON (1996) and HAMILTON and ATKINSON (1996a, 1996b) define these negative influences, and thereby implicitly δN_K, using abatement or defensive expenditures and argue that these are investments that "should be deducted in order to arrive at the measure of economic welfare" HAMILTON (1996). However, two decades after the first publications on GS only damages from carbon dioxide and particulate emissions are included. Marginal costs from CO_2 damages are estimated at US$20 per ton of carbon (the unit damage in 1995 U.S. dollars) and particulate emission damage is estimated as the willingness to pay defensive expenditures to avoid mortality attributable to PM_{10} (WORLD BANK 2006, 2011a, 2012, 2014a, 2014b).

DIETZ and NEUMAYER (2004, 2006) criticize the lack of data on damages from other forms of pollution, such as sulphur dioxide or water contamination. ATKINSON and HAMILTON (2007) provide a number of authors (MARKANDYA ET AL. 2000; HARTRIDGE and PEARCE 2001; AEA TECHNOLOGY 2004; WORLD BANK 2005; DEFRA 2005; KUNNAS ET AL. 2012) that analyze possibilities to measure other forms of air and water pollution as environmental degradation. PEARCE and ATKINSON (1993) or HAMILTON and CLEMENS (1999) address the depletion of natural capital. In these studies, sulfur dioxide (SO_2), particulate matter (PM) and ground-level ozone (O_3), nitrogen oxides (NO_X), non-methane volatile organic compounds and carbon monoxide are shown as percentages of GNI.

In the case of the UK, the inclusion of air pollutants would lower the GS rate in 2000 by 10% (ATKINSON and HAMILTON 2007). FERREIRA and MORO (2011) show that through the inclusion of SO_2 and NO_X in Ireland’s GS rate for the decade between 1995 and 2005, only two years remain positive. They conclude that this is disturbing since SO_2 and NO_X values in Ireland are low relative to other countries.

Thus, the ongoing discussion on the inclusion of pollution damages in the calculation of GS should include a detailed survey on pollutants and the possibilities to express them in monetary terms. Similar to the discussion above on energy and mineral resources as well as the depletion of forests or other renewable parts of a countries natural capital, it should be possible to include a certain level of pollution damages as social costs. Otherwise, GS only appears as an imperfect and fragmented attempt to fill a theoretical model with real data that includes extractable data and excludes all other considerations.

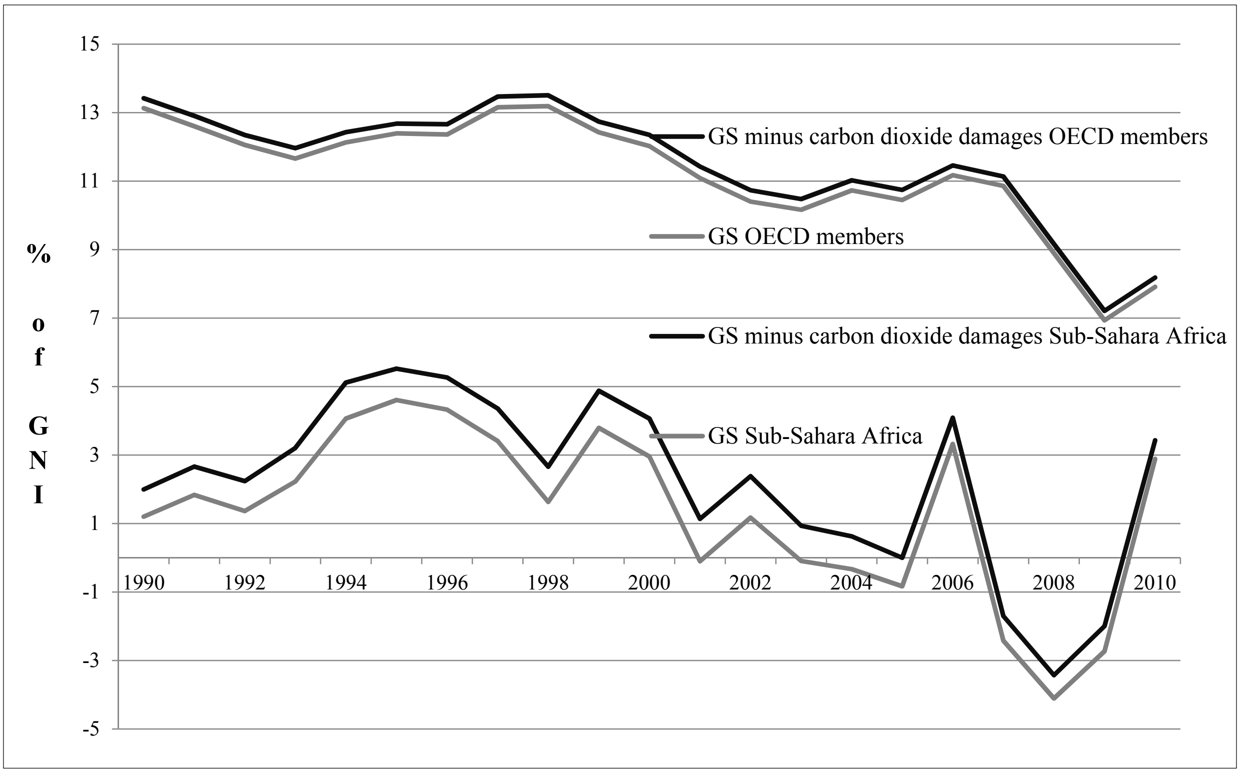
FERREIRA and VINCENT (2005) consider carbon dioxide as causing global damage and not depleting the natural capital of the emitting country, however it is rare to find a fundamental critique of the decision to include damages from air pollution in an indicator measuring a country’s specific capital stock. Cross-border pollution is discussed in literature by DIETZ and NEUMAYER (2004, 2006) and NEUMAYER (2010), among others. However, it does not receive significant attention. The common opinion – also by the WORLD BANK itself (2006, 2011a) – is that the “polluter pays principle” applies to the calculation of GS rates. The metadata description of the WORLD BANK (2014a, 2014b) defines the present value of “the marginal social cost per unit multiplied by the increase in the stock of carbon dioxide (…) (as) global damage to economic assets and to human welfare over the time the unit of pollution remains in the atmosphere". Pollution in the atmosphere follows to a certain extent the argument by FERREIRA and VINCENT (2005) that carbon dioxide causes global damages by reducing the performance of the atmosphere as a natural (or social) capital stock from which these services result. One could ask which global damage results from pollution and distribute it between countries based on their size or proportion of global income, but to date there is no suggestion that includes a practical solution to this problem.

If one looks at the case of resource-abundant countries that suffer from the so-called Resource Curse, negative GS rates not only show that the exporting country is not investing the rents from natural resource depletion well enough. They also implicitly demonstrate that the importing consumers do not adjust for the extra pressure on the natural capital of the depleting country, with the exception of paying the world market price of the resource (at least in the calculation method of GS, as seen in Equations (12) and (13)). There are arguments that importing countries should somehow be debited for the depletion of natural capital of exporting countries. In addition, in the same line of argumentation, transboundary pollution is especially seen as damage that should be adjusted within the GS calculation (HAMILTON and ATKINSON 1996a, 1996b).

The "polluter pays principle" is a sound way to hold countries responsible for the damage they cause to global capital, and here I explicitly refer to total rather than natural capital. However, GS is an indicator for "weak" sustainability in terms of capital formation within countries. Resource-dependent and exporting countries should use their extra income from depleted natural capital to invest more in physical and human capital (DIETZ and NEUMAYER 2004, 2006) or renewable natural capital, as proposed above. In addition, while the measurement of CO_2 emissions especially seems a simple proxy for environmental offenses by individual countries, there are other methods, such as carbon footprints, to further approximate environmental damage.

Therefore, I hold the opinion that an indicator measuring the development of the total capital stock of a country should only measure the stock within the country and not transboundary pollution damages, which reduce natural capital on a different level than the depletion of sellable natural resources. If it were possible to individually measure the loss of depletion rents, for example, from the negative influence of Polish emissions on Swedish forests, then one could discuss this theoretical problem on another level. However, since the calculation of GS rates can only use assumptions about the social costs a polluting country causes, GS does not include depletion of natural capital within a country but rather assigns a debt based on global damages.

Figure 19: GS rates of OECD members and Sub-Sahara Africa with and without carbon dioxide damages between 1990 and 2010.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

However, Figure 19 shows GS rates using the example of OECD members and those of Sub-Saharan Africa with and without carbon dioxide damages. In the case of OECD countries, the differences are insignificant. The difference for Sub-Saharan Africa is higher than for the OECD countries since emissions have greater weight at a lower level of GS. Nevertheless, even this difference can be considered insignificant in terms of the broader results GS shows. I would suggest that the WORLD BANK (2014a, 2014b) provide a version of GS within its "World Development Indicators" with and without emission damages or other environmental degradation that goes beyond classical resource depletion. This would allow users to decide between a lean, capital-based version and one including abatement costs.

2.5. Conclusions

As stated in the introduction, this paper intends to provide an overview of the theoretical and methodological discussion on GS as the most important and developed indicator for “weak” sustainability. I discuss this indicator critically and suggest possible modifications.

In 2.3, I explain the calculation method in detail and recommend denoting the damages from air pollution independently from other forms of natural capital depletion by δN_K. Based on my observations, there is a clear difference between the depleted natural capital δK_N within a country and transboundary pollution damages δN_K which are only ascribed to the emitting country even though parts of this pollution contribute to capital depletion on a global scale. I would also suggest a separation of exhaustible and renewable natural capital, in the case that factors beyond the value of net forest depletion are included. If growth of renewable natural capital exceeds depletion, it could then show a positive effect of re-investment of rents from natural capital in further natural capital and not only other forms. The substitution of non-renewable resources with renewable resources would then also provide a positive effect on GS, similar to investments in physical or human capital. This would therefore serve as a more accurate indicator for countries acting more responsibly than others.

In 2.4, I begin with a discussion spearheaded by various authors about the difference between total and per capita GS. I argue alongside HAMILTON (2002, 2003) that the World Bank could use Equation (17) to calculate and present per capita GS until yearly values of wealth stocks are available. Similar to the calculation of the usual indicators GDP/GNI, calculations could be modified to divide total GS by midyear population as a starting point. Additionally, I suggest a “weak” sustainability index in Equation (18) which includes GS and population growth and would provide a simple inclusion for the WORLD BANK in its “World Development Indicators” (2012a, 2014a).

In 2.4.3, I discuss variable ToT within the context of continuously changing world market prices of “exported” natural capital and “imported” consumption and capital goods. While most authors, such as SACHS and WARNER (1995/1997), come to the conclusion that increasing ToT positively influence a country’s income, I follow BOOS and HOLM-MÜLLER which show theoretically (2012) and empirically (2013) that $\delta K_N/\delta K_P$ changes in the same direction as a country’s ToT. However, while it is an important point that ToT and GS demonstrate a negative relationship, the most important problem is their joint volatility and the resulting uncertainties. I recommend flattening the variable δK_N by using five-year averages for the calculated rents in Equation (12) to adjust GS rates for the extreme volatility of natural resource prices.

In 2.4.4 and 2.4.5, I discuss the subtraction of consumption from GNI. I suggest surveying and discussing durable consumption goods that could be considered positive investments in physical capital rather than negative parts of the GS calculation. However, until a detailed survey has been conducted at least a certain percentage could be removed from consumption for goods that are more investment-oriented than consumption-driven. In the case of current education expenditures, the World Bank deducts 10% for investments in school buildings and the like; the same could be done for total consumption. Additionally, I suggest a discussion of the exclusion of military and other defensive investments whose contribution to sustainable development is at least subject to discussion.

After reducing GNI by consumption and the depreciation of physical capital, the World Bank adds current education expenditures as an indicator for investment in human capital. I briefly discuss the depreciation of human capital in countries where the life expectancy lies below the international retirement age of 65. However, since I follow the argument that education expenditures used for the calculation of GS rates tend to underestimate real investments in human capital, this serves to substantiate the argument that health expenditures also increase K_H. I show that the inclusion of health expenditures would increase K_H and therefore average global GS by almost 5% for the years 2003 to 2007.

After adjusting for education expenditures the World Bank subtracts the rents of natural resources and damages by air pollution to indicate depletion of natural capital. To more completely capture natural capital, I propose the inclusion of natural resources such as peat, uranium or diamonds, and I show their influence on the GS of individual countries. In particular, the inclusion of diamond rents in the GS of Botswana stands out in these examples, since the country's GS would decrease by an average of 33% of GNI between 1996 and 2006. However, the example of uranium in Namibia or Niger also serves as a remarkable reminder that the GS calculation misses natural resources important for the capital stock of some countries. The World Bank concedes this gap of exhaustible natural resources in K_N and aims to continuously extend it (WORLD BANK 2006, 2011a). Simultaneously, I suggest including renewable parts of natural capital the World Bank is able to calculate, and allow for positive values if the renewed share is higher than the depleted portion.

The inclusion of air pollution is discussed from two viewpoints: on the one hand considering a broader base of pollution damages than only CO_2 and PM_{10}, or on the other hand concentrating on pure natural resource depletion and excluding emissions completely. While the first is mostly investigated by the World Bank itself, the discussion as to whether the GS calculation should include pollution damages is mainly carried out outside the Bank. Aside from consideration of carbon dioxide emissions as causing global damage or only depleting the natural capital of a single emitting country, I request a discussion on the merits of including emissions. I argue that GS is an indicator for "weak" sustainability in terms of capital formation within countries with the purpose of showing the handling and re-investment of extra income from depleted natural capital. Therefore, I hold the opinion that an indicator measuring the development of the total capital stock should only measure the real stock excluding pollution damages, which reduce natural capital on a different level than the depletion of sellable natural resources. Since this discussion is not likely to reach consensus promptly if ever, I suggest that the WORLD BANK (2014a, 2014b) provide a version of GS with and without emissions damages. Therefore, I hold the opinion that an indicator measuring the development of the total capital stock of a country should only measure the stock within the country and not transboundary pollution damages, On the whole, I recommend more detailed research on the relationship between the Resource Curse and GS rates of resource-dependent countries that suffer most from volatile world market prices, as knowing more about the determinants influencing GS could help to extend its applicability.

However, none of these arguments provide an overarching answer. In contrast, this paper should serve as a call to discuss these topics more thoroughly. GS is by far the most developed and discussed indicator to measure sustainability in monetary terms and could therefore serve as a complement to other common economic indicators. The calculation method for GDP is also constantly discussed and in the case of the European Union even adapted recently. What prevents us from using GS (in the two different versions) as an additional indicator for the state of the world and have it one day as a headline indicator next to a country's GDP?

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3. A theoretical overview of the relationship between the Resource Curse and Genuine Savings as an indicator for "weak" sustainability

Abstract The second paper shows the strong relation between the factors that lead to the Resource Curse (RC) and factors that lead to a decline of Genuine Savings (GS). There is substantial empirical evidence that economies that rely predominantly on their natural resources are also characterized by slower economic growth. This so-called RC is commonly traced back to the fact that natural resources' generate rents that are independent of a country's economic performance, which can lead to suboptimal reinvestments of this consumed natural capital. We argue that the factors responsible for the RC also have a negative effect on GS, a concept that measures "weak" sustainable development by considering reinvestment of natural capital rents in physical and human capital. We discuss whether the RC hampers possibilities for resource abundant countries to obtain sufficiently high rates of GS, and find indeed many reasons why resource-dependent countries have problems achieving positive GS rates. We survey both areas of research, emphasizing the influence of the exogenous and endogenous determinants of economic growth, which are usually used to theoretically and empirically explain the RC on the three different forms of capital considered by GS. We specify why most countries suffering from the RC have negative GS rates and explain in detail where the linkages are. This overview could help with potential advancements in the explanation of GS through the inclusion of RC effects.

3.1. Introduction

As early as 1776, ADAM SMITH (1998) argued that economic growth could not depend solely on natural capital endowment but also on the development of physical and human capital. Whereas over the next 200 years many peripheral countries such as Argentina or South Africa grew by exporting their rich natural resources to the industrializing world and using this income as an important first step to economic development, other resource-rich developing economies, such as Jamaica and the Philippines, stagnated.[4] In particular, following the mineral price shocks and oil booms in the 1970s as well as the structural changes within the world economy, the paradox emerged that countries endowed with rich natural resources often showed slower economic growth than resource poor countries.[5]

This so-called Resource Curse (RC) – after discussion of the Dutch disease in the 1980s (CORDEN and NEARY 1982; CORDEN 1984), case studies by GELB (1988), AUTY (1993), and the first empirical demonstrations in a cross-country analysis by SACHS and WARNER (1995/1997) – has been confirmed by a vast amount of literature, proving the significant negative relationship between some measure of resource-dependency and the growth rate of GDP per capita. These studies offer a wealth of theoretical and empirical explanations ranging from the volatility of natural resource prices to the quality of institutions and macroeconomic policies.[6] However, all this comes back to the handling of income from natural capital, especially its reinvestment in other forms of capital.

The "Hartwick rule" (HARTWICK 1977), the paradigm of "weak" sustainability, recommends exactly this reinvestment of "all profits or rents from exhaustible resources in reproducible capital" to compensate for the consumption of natural capital and ensure future welfare. A well-known rule of thumb developed from this, which states that the net investment in physical, human and natural capital should be non-negative and, for adequate lasting growth, a country's total capital stock should at least stay constant over time. The discussion stemming from the debate on how to measure this capital growth beyond the traditional measure of GDP led, among other developments, to the concept of Genuine Savings (GS). GS measures the difference between investments in physical and human capital and consumption of natural

[4] Especially in the so-called "Golden Age of Resource-Based Development" (as BARBIER 2007, 2011, puts it), between 1870 and 1914, countries such as Germany or the United States built industrialization processes on their resource-abundance. Until the end of the 1960s many resource-dependent countries outperformed resource-poor countries (AUTY 1993, 2000, 2001).

[5] The available data shows that growth rates in resource-dependent countries slowed in the 1970s compared to the 1960s, and SACHS and WARNER (1995/1997) prove additionally that the average negative effect of resource-abundance in the 1980s was almost double the level in the 1970s. GYLFASON (2001a) shows that until the end of the 1990s, out of 65 resourcedependent countries, only Botswana, Indonesia, Malaysia and Thailand realized continuously high investment and growth rates.

[6] Authors such as LEDERMAN and MALONY (2007, 2008), BRUNNSCHWEILER (2008) and BRUNNSCHWEILER and BULTE (2008) dispute the Resource Curse Hypothesis which is not generally accepted. Most critiques on the existence of the RC are based on the measures of resource-dependence and econometric methods employed; an equal number of publications, for example VAN DER PLOEG and POELHEKKE (2010) or ANDERSEN and ROSS (2011), directly refute these counterarguments, guaranteeing an ongoing vital discussion. Furthermore, several authors, such as BULTE ET AL. (2005), MEHLUM ET AL. (2006) and ROBINSON ET AL. (2006), argue that the quality of institutions, rather than resource-dependence itself, is the main factor influencing a country's conversion of resource-abundance into economic growth. In the last decade since oil and mineral prices have risen extremely high, economic growth in RC-affected countries has been high, prompting HABER and MENALDO (2011) to even argue that Zambia constitutes the last global example of a country suffering from the curse.

capital. It is an indicator of whether a country's exploitation of its capital stock is weakly sustainable or not (HAMILTON and CLEMENS 1999). Empirical evidence suggests that many resource-rich countries exhibit negative GS rates. This indicates that rents from natural resources are not properly reinvested in reproducible capital to the detriment of future generations (HAMILTON and CLEMENS 1999; ATKINSON and HAMILTON 2003; VAN DER PLOEG 2011).

This relationship between the RC and GS is often discussed in multidisciplinary publications considering either development in resource abundant countries (such as AUTY 2001 or HEAL 2007) or sustainability (HAMILTON and ATKINSON 2006 or AUTY 2007). In focused studies on this topic by ATKINSON and HAMILTON (2003), NEUMAYER (2004) and DIETZ ET AL. (2007) this relationship is shown empirically. These papers analyze connections between the RC and GS, especially public expenditure policies that support the overconsumption of a country's capital stock and the quality of investment-related institutions (mainly those institutions that are influenced by corruption) and how these factors, in combination with resource-dependence, influence the rate of GS. Additionally, the authoritative survey on the hypotheses and evidence behind the RC by VAN DER PLOEG (2011) includes a section on the "alarming picture [that most] [c]ountries with a large percentage of mineral and energy rents of GNI typically have lower genuine saving rates". These studies mention different potential relationships between the RC and GS. To our knowledge, a comprehensive overview of the relationship between the various explanations behind the RC and the development of GS rates has not yet been discussed in detail.

Even the research on the determinants of GS, which is more or less accomplished independently of the RC literature by DE SOYSA and NEUMAYER (2005), DE SOYSA ET AL. (2010) and HESS (2010), analyses only the influence of single factors such as economic openness, democracy or "human development", rather than providing a survey of all potential GS determinants. All of these papers to a certain extent follow ATKINSON and HAMILTON (2003), who call for more research on the determinants of GS, but none use a holistic approach to explain GS or build on the relationship to the RC using a systematic and extensive method. With the exception of the discussions on corruption (DIETZ ET AL. 2007) or democracy (DE SOYSA ET AL. 2010) and its influence on GS, the theoretical background in most empirical analyses is rather cursory.

That is, direct research neither on GS nor on RC provides a comprehensive theoretical background on which to base its assumptions. This is where our paper starts: our intention is to lay a theoretical foundation for further empirical analysis and to ease the understanding of existing studies in a broader context. Therefore, we provide an extensive survey of the most prevalent exogenous and endogenous determinants identified by academic literature as causes of the RC and connect them to the different components of GS measurement.

As a starting point, we provide an overview of the content and calculation of GS to understand which of the three capital forms determining GS contains what kind of data. We then connect these three forms of capital to different hypotheses from the literature that address reasons why resource-dependence could negatively influence the development of a given country. On the one hand, we show the complicated relationship between the many factors leading to the RC and GS rates. Exogenous explanations such as the Dutch disease and endogenous ones such as the institutional quality of a country have similar effects on GS and on GDP or economic growth. Volatile world market prices and changing terms-of-trade play an even more important role for the rate of GS than for GDP growth, due to the fact that the depletion of natural capital is calculated with current world market prices. On the other hand, we show that the RC could be explained more comprehensively by using a combination of GS and its components as dependent variables, rather than by using GDP growth. HAMILTON and CLEMENS (1999) recommend using GS as an explanatory variable in RC models, but we show in our theoretical overview that it is more informative to use GS and its components as dependent variables alongside GDP, as is done by DE SOYSA ET AL. (2010) or BOOS (2011).

We conclude with a summary of theoretical relations that should be further investigated empirically. We suggest incorporating GS in existing models and empirical analyses of the RC as a new way of explaining the negative effects of resource abundance. Our overview of GS determinants, which are related to theories behind the RC, can be used as a guide for future theoretical and empirical studies and discussions.

3.2. Genuine Savings

"Weak" sustainability as the theory behind genuine savings (GS) is based on the assumption that different forms of capital are substitutable and that only the total capital stock is important to maintain "the capacity to provide […] utility non-declining for infinity" (NEUMAYER 2010). Thus, physical and human capital can basically replace depleted natural capital.[7] NEUMAYER

[7] This is in contrast to the paradigm of "strong" sustainability, which originates from DALY (1973, 1980, 1992) and assumes that this capacity is not provided by substituting natural with other forms of capital, but only by keeping the stock of natural capital itself at least constant over time. Some lines of this theory allow for substitution

(2010) therefore calls "weak" sustainability the "substitutability paradigm", which allows for the consumption of natural capital at any rate as long as this is substituted by investment in reproducible capital.

From this, PEARCE and ATKINSON (1993) developed a comparison of savings versus the combined depreciation of physical and natural capital as an indicator for sustainable development. Due to missing data, this indicator originally only included savings (as the indicator for investment in physical capital), depreciation of physical capital, and rents from the depletion of natural resources. Later HAMILTON (1994) and PEARCE ET AL. (1996) added investment in human capital as well as pollution emission damages as part of the depreciation of natural capital:

$$WSI = \frac{S}{Y} - \frac{\delta K_P}{Y} + \frac{\delta K_H}{Y} - \frac{\delta K_N}{Y} \qquad (20)$$

WSI is a weak sustainability index, S is gross savings, δK_P is depreciation of physical capital, δK_H is the increase in human capital, and δK_N the depletion of natural capital. δK_N includes damages from air pollution in addition to natural resource depletion. Divided by national income Y, this normalized indicator of net investment in all three forms of capital can be used to compare different countries. To make the distinction between this indicator and traditional net savings, which exclusively refers to physical capital, HAMILTON (1994) introduces the term genuine savings for this indicator.

It is important to note that a constant or increasing capital stock is a necessary but not a sufficient condition for sustainable development defined as non-decreasing utility over time. "Weak" sustainability only shows the possibility of sustainable development, but negative GS clearly indicates an unsustainable path (HAMILTON and CLEMENS 1999; PEZZEY 2004): If at one point in time GS is not positive, then this economy is unsustainable at that time (PEZZEY and TOMAN 2005). GS is a useful policy indicator and early warning sign to determine whether a country's exploitation of its capital stock is unsustainable (HAMILTON 2005).[8]

within natural capital, between non-renewable and renewable resources for example, but by no means does it allow for the reinvestment of depletion rents into produced capital. For the distinction between "weak" and "strong" sustainability, see PEARCE ET AL. (1989) and the comprehensive discussion by NEUMAYER (2010).

[8] For a descriptive rather informal derivation, see PEARCE and BARBIER (2001) and BARBIER (2007) and for detailed calculation descriptions, BOLT ET AL. (2002) and WORLD BANK (2011a).

HAMILTON and CLEMENS'S (1999) final specification of GS, which has since become the official calculation method for the World Bank GS-indicator "Adjusted Net Savings", is:[9]

$$Genuine\ Savings\ (GS) = (GNI - C_P - C_G + NCT) - \delta K_P + \delta K_H - \delta K_N \quad (21)$$

The first part constitutes gross national savings (GNS): gross national income (GNI) minus private (C_P) and public (governmental, C_G) consumption plus net current transfers (NCT).[10] Theoretically, this is seen as the equivalent to gross investment in the total capital stock of open economies: gross domestic investment (GDI) minus the current account balance after official transfers (net foreign borrowing plus net official transfers) (NEUMAYER 2010). However, physical capital such as roads or buildings also depreciates over time (in World Bank terms: consumption of fixed capital δK_P) and subtracting this from GNS leads to net national savings (NNS) (HAMILTON and CLEMENS 1999).[11]

The official World Bank data set of NNS already contains the physical part of total education expenditures, such as investments in school buildings. Other investments in human capital such as teachers' salaries or the purchase of school books are traditionally treated as consumption and therefore subtracted in CP and CG in (2) (WORLD BANK 2006). Therefore, independent of the ongoing human capital discussion in literature such as those by DASGUPTA (2004) or NEUMAYER (2010), GS only adds current operating expenditures on education as a rather crude approximation for investment in human capital (δK_H) due to data restrictions (HAMILTON and CLEMENS 1999).[12]

The World Bank considers changes in natural capital (δK_N) by subtracting the depletion of different tradable natural resources and some of the damage caused by air pollution (HAMILTON and CLEMENS 1999). The research on GS, especially that done by the Environment Department of the World Bank, consistently tends to extend this by using a broader base of natural capital

[9] In the middle of the 1990s, the World Bank began publishing GS retrospectively from 1970 onwards (WORLD BANK 1997) and included it for the first time in its "World Development Indicators" in 1999 (WORLD BANK 1999). From 1970 until 1989, the data for 149 countries is available in the "World Development Indicators" (WORLD BANK 2011a), in the twelve years since 1990 this grew to a total of 166 countries (with individual starting years depending on the country). Additionally, GS is available for seven geographic regions, five different income groups and three lending categories.

[10] The World Bank http://databank.worldbank.org/ddp/viewSourceNotes?REQUEST_TYPE=802&DIMENSION_AXIS= defines net current transfers (NCT) as part of "the balance of payments whenever an economy provides or receives goods, services, income, or financial items without a quid pro quo. All transfers not considered to be capital are current".

[11] In most countries, NNS is already part of official national accounts. However, the World Bank uses the United Nations Statistics Division's National Accounts to calculate "Consumption of Fixed Capital" following the United Nations System of National Accounts 2008.

[12] NEHRU ET AL. (1995) provide the basis, while the exact description can be found in BOLT ET AL. (2002). The World Bank receives its data on "Education Expenditures" from the UNESCO Institute for Statistics: http://www.uis.unesco.org/Pages/default.aspx.

data (World Bank 2006, 2011b; Atkinson and Hamilton 2007).[13] However, currently the depletion of natural resources is composed of the rents of energy[14] and mineral[15] resources and that of net forest[16] depletion. The rents of these natural resources are the change in their asset value associated with their extraction over the accounting period. Although, in theory, this is only one of at least three competing methods, these rents are calculated as follows:

$$Resource\ Rent = Production\ Volume * (International\ Market\ Price - Average\ Unit\ Production\ Costs) \quad (22)$$[17]

Following the Hotelling (1931) rule, at least in a competitive inter-temporally efficient closed economy, the marginal costs of production should be used for the calculation of resource rents (Dietz and Neumayer 2006; Neumayer 2010). However, obtaining marginal values is complicated and even more difficult to obtain than average costs. Additionally, certain natural resources, which are decisive wealth stocks in a multitude of countries, are still omitted due to empirical and methodological reasons. These include biodiversity as well as arable land, fisheries, or diamonds[18] (World Bank 2006). The available data only consist of the market-based resources that can be calculated by rents in US$ and can be assigned to an individual country.

[13] However, in the last decade besides the introduction of particulate emission damages for the time series from 1990 on (downloadable in both versions, with or without), only the number of available countries increased, while the actual base of natural capital remained the same (except in theoretical discussions and some case studies, Atkinson and Hamilton 2007; Ferreira and Moro 2011).

[14] Energy depletion covers crude oil, natural gas and coal.

[15] Mineral depletion refers to bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver.

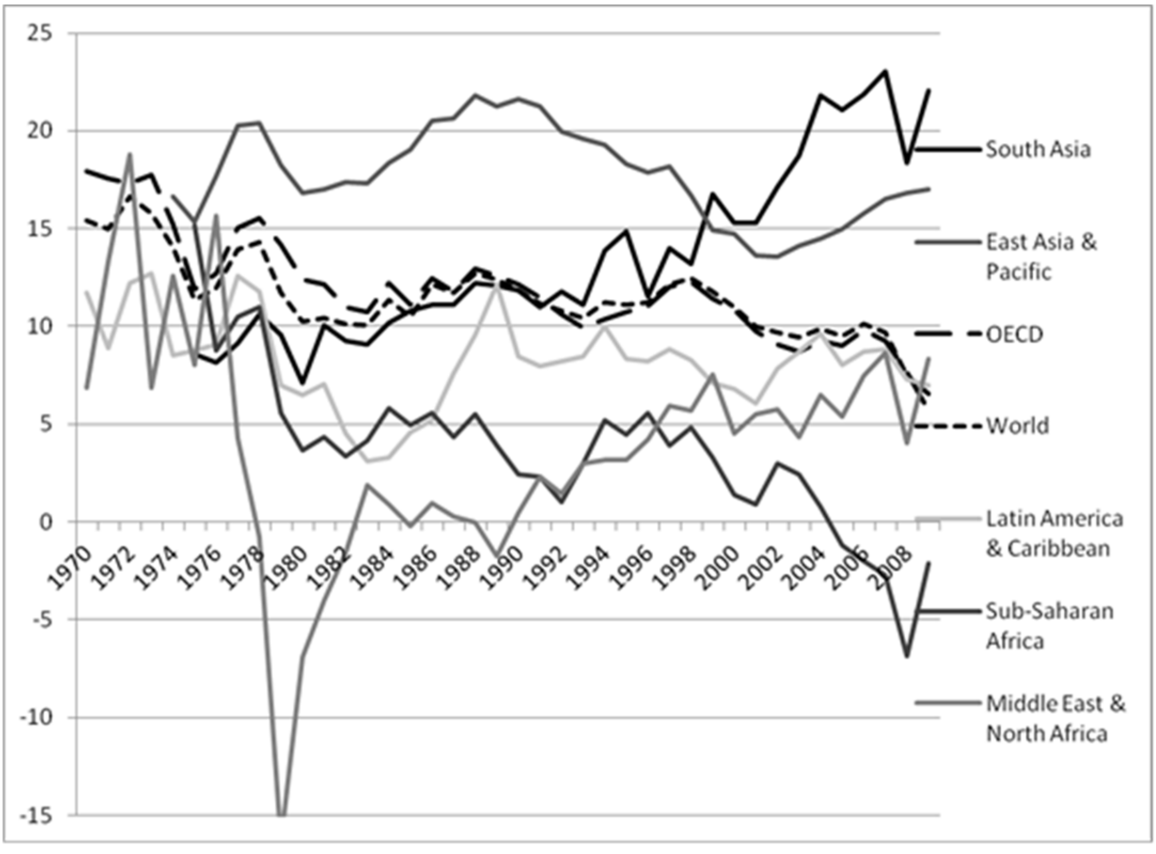
[16] Roundwood harvest minus natural growth; this is set to zero if growth exceeds depletion.

[17] Detailed descriptions can be found in Bolt et al. (2002) and World Bank (2011a; b). Production data and world market prices (averages of all available prices) stem from different sources such as BP (2011), IEA (online at http://www.iea.org/stats/index.asp), UNdata (http://unstats.un.org/unsd/energy/edbase.htm), UNCTADstat (http://www.unctad.org/en/Pages/Statistics.aspx), USGS (http://minerals.usgs.gov/) or Natural Resources Canada (www.nrcan.gc.ca). Production costs are from the same plus national sources, but for most countries these are only available for a couple of years (in the case of oil mostly only for 1993) and the Bank deflates or inflates these for the remaining years. For example, looking at different oil exporters such as Saudi Arabia – depleting oil of around 30% of GNI in the last decade – or Angola – with rents of more than 40% - the World Bank (2011a) inflates production costs from US$15 and US$40 (in 1993) to US$44 and US$117 (in 2008) per ton (Jenkins 1989; IEA 1995). In the case of the Saudi Arabian desert fields, which allow economies of scale, the IEA (2008) approximation of production costs between US$34 and US$51 agrees with this, but, in the case of offshore Angola, with increasing production costs, the IEA approximation of US$340 is extremely high compared to the one by the Bank. This results in critiques (see for example Neumayer 2010) and careful handling of the indicator in public discussion, at least compared to other more widespread sustainability indicators such as the "Human Development Index" or the "Ecological Footprint" (Neumayer 2001; Morse 2003).

[18] For example, if we estimate diamond rents for Botswana, using data from their Central Statistical Office (http://www.cso.gov.bw/), and include them for the available time since 1996 into the data for mineral depletion, the GS of Botswana would decrease by around 50% (authors' estimation).

However, for a comparison with the RC, these rents are most important. Higher endowment and dependence on the depletion and exporting of natural resources has a negative influence on the GS of a country, since more resource rents are subtracted and higher international market prices increase these rents. World commodity markets are directly related to the rate of GS in most developing countries. It is notable that the usual discussion on the RC (starting with AUTY 1993; SACHS and WARNER 1995/1997) includes cash crops such as coffee or cotton (BEVAN ET AL. 1987), fisheries (JAMES and AADLAND 2011), and minerals such as diamonds (ACEMOGLU ET AL. 2002a), all of which are not accounted for in the depletion of natural capital within the GS calculation. However, energy, minerals and forest resources are accounted for in GS and especially oil, gas and copper have been traditional areas of focus in discussions on the RC. Total fuel exports account for around 2.5% of worldwide GNI in the last decade, while agricultural raw materials only realize 0.4% (WORLD BANK 2011a). Therefore, our paper focuses on the relationship between the dependency from energy and minerals and low GS rates. GS also includes damage from air pollution in the form of depreciation of natural capital. In practice this has so far been limited to carbon dioxide and particulate emissions, which have no relation to the RC.

Figure 20: Genuine savings for the period 1970-2009, subdivided by regions.



Source: Own calculation and illustration with data from WORLD BANK (2011b).

Seeing this gap caused by not considering the total natural capital stock in addition to the previously mentioned uncertainties, even positive GS rates should be interpreted cautiously (PEZZEY and TOMAN 2002; ARROW ET AL. 2004; NEUMAYER 2010). PEARCE and ATKINSON (1993), HAMILTON and ATKINSON (1996, 2006) and HAMILTON ET AL. (1997) state that GS rates are a step in the right direction and give at least a hint as to whether or not a country reinvests these rents in other forms of capital in a "weakly" sustainable manner. The WORLD BANK (2006) verifies GS as the most significant explanatory saving measure out of four tested and shows that, in the period from 1970 to 2000, on average only 22% of countries with positive GS at one point in time experienced declines in total real wealth and consumption per capita in later years. Since this paper focuses on relating theories behind the RC to determinants of GS – and not on criticizing GS (see for example DIETZ and NEUMAYER 2006) – we only point out that NNS could be overestimated, while δK_N is certainly underestimated. Therefore, a slightly positive rate of GS should also be interpreted as a negative sign for future welfare growth.

Since 1999, the World Bank (1999) has been publishing GS estimates retrospectively under "Adjusted Net Savings" for around 160 countries, with data going back to 1970. Figure 20 shows the development of GS, divided into important regions: due to the inclusion of more countries (also retrospectively from 1970) and therefore more data for the aggregation, as well as improvements in the methods of data acquisition, the rate of GS appears not to be as low as previously estimated. In earlier publications, such as DIETZ and NEUMAYER (2006) or NEUMAYER (2010), Sub-Saharan Africa and the Middle East and Northern Africa had negative GS for almost the entire time, while Latin America and the Caribbean was negative in the early 1980s.

In recent World Bank data, the Latin America and the Caribbean region has continuously positive GS rates from 1980 to 2008, while Sub-Saharan Africa only shows negative GS in 1992 and from 2005 to the present. After four negative years, one cannot speak of a long-term trend. However, the permanence of only slightly positive rates suggests that the negative years are not likely an anomaly. The Middle East and Northern Africa experienced a major drop at the end of the 1980s and another in 2000. For the remaining years, its values are rather high, in contrast to those noted in other publications and forecasts (NEUMAYER 2010). The high values in the OECD countries and Asia over the whole period ensure a positive worldwide GS rate.[19]

[19] Since the last discussion in NEUMAYER (2010), the WORLD BANK included 22 new countries in the set of GS time series: Bahrain, the Bahamas, Belize, Brunei Darussalam, Cape Verde, Comoros, Djibouti, Dominican Republic, Fiji, Guyana, Iceland, Liberia, Luxembourg, the Maldives, Seychelles, Slovenia, Solomon Islands, St. Vincent and the Grenadines, Suriname, Swaziland, Tonga and Vanuatu. At the same time it excluded: Cuba,

A total of 61 countries have negative average GS rates between 1970 and 2008, of which all export natural resources – for 33 of them natural resources compose more than 10% of GNI and for 21 of them more than 30%. Extreme negative outliers, such as Angola with a GS rate of -35.8% of GNI, the Republic of Congo with -33.9%, Guinea-Bissau with -15.6% and Liberia with -18%, show that many resource abundant countries in Sub-Saharan Africa would need to increase reinvestments of natural resource rents in other forms of capital in order to maintain their total capital stock (DIETZ and NEUMAYER 2006; DIETZ ET AL. 2007). The question remains whether it is in the hands of these countries to increase their GS rates or whether they are doomed to low rates of GS.

The next section examines the individual theories behind causes of the RC and connects them to the three forms of capital in GS to identify possible determinants of GS. We follow the typical structure in the literature and differentiate between exogenous and endogenous explanations, even if these clearly influence each other and newer publications mainly focus on endogenous and, more specifically, institutional factors.

3.3. The Resource Curse hypothesis

The Resource Curse (RC) hypothesis refers to the idea that countries richly endowed with natural resources often show slow economic growth. A classic model of the implications of resource dependency on other sectors and on economic growth itself was developed by Corden (1984) and called the Dutch disease. It originated from a 1977 edition of *The Economist* concerning the decline of the Dutch manufacturing sector after the discovery of natural gas sources (THE ECONOMIST 1977). The first denotation as a curse came from GELB ET AL. (1988) and AUTY (1993), who analyzed macroeconomic policies in different oil and ore exporting countries. They show the political difficulties for governments in saving (and not spending) resource rents and the lack of capacity and resources to reinvest this income efficiently.

SACHS and WARNER (1995/1997) show in their crosscountry analysis that an increase in the ratio of primary exports to GNI results in a decline of the growth rate of GDP per capita. Even

Haiti, Iraq, Libya, Nigeria, Papua New Guinea, Puerto Rico, the West Bank and Gaza, and Yemen for different reasons. Additionally, in the short period between the data on the "Adjusted Net Saving" homepage of the WORLD BANK (2008) and the "World Development Indicators 2011" (WORLD BANK 2011b), better data acquisition changed GS rates by an average of 0.3% over the 1970-2008 period. First, the entire time series of all calculation parts is updated every year and since 2009 the data for Gross National Savings is no longer gap-filled. Second, the data on "consumption of fixed capital" (CFC) is from UN data (online at http://data.un.org/) and exhibits gaps which are filled by applying coefficients from (CFC/GDP) regressions to GDP figures. And third, historical data availability improved, for example for mineral production (WORLD BANK 2012a).

after controlling for several other variables, which they identify to be important for economic growth, this significant negative relationship between resource dependency and growth holds true. SACHS and WARNER (2001) summarize the evidence throughout literature that the "[e]mpirical support for the curse of natural resources is not bulletproof, but […] quite strong". They refer to SALA-I-MARTIN (1997) and DOPPELHOFER ET AL. (2000) as studies that confirm natural resources as one of the ten most robust variables explaining economic growth. Since SACHS and WARNER (1995/1997), a vast number of studies have analyzed the RC from various points of view and identified multiple determinants and transmission channels (PAPYRAKIS and GERLAGH 2004). SACHS and WARNER (1995/1997) use growth of GDP per capita and determinants such as terms-of-trade, investment ratio or the rule of law, but mainly show that the ratio of primary exports to GDP is one of the most robust determinants for slower economic growth.

GYLFASON ET AL. (1999), ROSS (1999), AUTY (2001), GYLFASON (2001a), PAPYRAKIS and GERLAGH (2004), MEHLUM ET AL. (2006), VAN DER PLOEG and POELHEKKE (2009) and others identify channels by which a high dependency on natural resources may hamper economic development. To look into the influence of resource dependency on GS, we take up the most important of these channels, subdivided into exogenous factors (volatile world market prices, terms-of-trade, and the spending and movement effects of the Dutch disease) and endogenous factors (the political system and its macroeconomics and public expenditures, integration into world markets, and the quality of institutions). Many of these aspects have already been discussed either in the RC or GS literature, but we provide a first systematic analysis of the possible influences of the effect of RC determinants on GS.

3.4. The effects of the Resource Curse on Genuine Savings

3.4.1 Exogenous explanations

Varying world market prices strongly influence GS of resource-dependent countries through: (a) the short- and medium-term volatility of international commodity markets; and (b) the long-run terms-of-trade (ToT) effects.[20]

[20] While real commodity prices had a long-term downward trend of around 1% per year from 1862 to 1999, CASHIN and MCDERMOTT (2002) see a dominance on economic growth in the high variability of prices (volatility of prices determines growth by a much greater part than trends). Price shocks are long-lasting with high differences in durability (CASHIN ET AL. 2000), but the slumps definitely last longer than price booms (CASHIN ET AL. 1999). However, SOSA and CASHIN (2009) show in the example of the Eastern Caribbean that either positive or negative oil price shocks have negative influence on a country's GDP.

Starting with NURKSE (1958), various cross-country analyses reveal the adverse effect that the volatility of international commodity prices has on economic growth in resource-dependent countries (RAMEY and RAMEY 1995; BLATTMAN ET AL. 2007; KOREN and TENREYRO 2007). The GDP of resource-exporting countries fluctuates by several percentage points each year in conjunction with commodity prices (HAUSMANN and RIGOBON 2003). Since the depletion of natural capital is calculated through resource rents which depend on world market prices, their volatility is one of the most important impact factors for the GS rate of resource-dependent countries.

The periodic fluctuations not only lead to substantial changes in the depletion value of natural capital (δK_N) from year to year but also result in perverse private and public consumption and investment incentives in physical and human capital. Volatile rents from resource extraction cause uncertainty for reinvestments. Companies have little incentive to invest their revenues in an uncertain environment, as there is a high volatility of income. Governments not only have higher incentives for consumption rather than investment, but have little incentive to save during phases with high prices and income. They tend to align their public expenditure policies on these better phases, even in times with decreasing prices and income (ROSSER 2006).[21] Examining a sample of 44 developing countries, AIZENMAN and MARION (1999) prove that unrealistic assumptions about future prices even have positive effects on public investment in physical capital, resulting in a debt overhang and further volatile macroeconomic and public expenditure policies. However, in most countries, even these higher public investments and the additional public consumption, which positively influences education expenditures, are not high enough to compensate for the depletion of natural capital (δK_N), so that aggregated total investments are negatively correlated with volatility (FLUG ET AL. 1998; AIZENMAN and MARION 1999; MANZANO and RIGOBON 2001). The Prebisch-Singer thesis argues that the terms-of-trade of primary commodity exporters decrease in the long run due to a relative decline in international prices of primary commodities in relation to imported manufactured products and, as a result, the GDP of these countries also decreases (PREBISCH 1950; SINGER 1950; SACHS and WARNER 1995/1997; ROSS 1999). Empirical evidence is not as clear as one would expect. While some publications find negative trends (GRILLI and YANG 1988; REINHART and WICKHAM 1994), others (KELLARD and WOHAR 2006; BALAGTAS and HOLT 2009) hardly support the Prebisch-Singer thesis, and PAPYRAKIS and GERLAGH (2004) even show a positive influence of decreasing terms-of-trade on GDP, in their cross-country regressions. We argue that decreasing terms-of-trade as such are not problematic if, for

[21] The volatility explanation is discussed rather skeptically in DAVIS (2003) and FERREIRA and VINCENT (2005).

example, they are caused by technological progress through which a country can improve its world market position. However, decreasing terms-of-trade for resource exporters result in lower income from resource depletion, at least compared to the expenses for imports (DIAKOSAVVAS and SCANDIZZO 1991; ZANIAS 2005; BARBIER 2007). Incorporating the "Hotelling rule" (HOTELLING 1931), namely that prices of natural resources (should) increase at the interest rate due to their finite scarcity, the original GS-model assumes increasing prices for non-renewable resources. In principle, this can be offset by more rapid price increases for imported manufactured goods.

Independent of whether the terms-of-trade of a country develop positively or negatively in the long run, they affect the ratio between the depletion of natural capital (δK_N) (through exports) and the change in physical capital (δK_P) (through the consumption of and investment in imports). Terms-of-trade are usually expressed as P_X/P_M, the price indices for exports and imports, and therefore $\delta K_N/\delta K_P$ change in the same direction as a country's terms-of-trade (BOOS 2011). According to the calculation method shown in Equation (21), the depletion of natural capital (δK_N) is subtracted with higher rents, influencing GS more negatively, while reinvestments in physical capital that are higher than the depreciation of physical capital (δK_P) influence GS positively. In total, this means that increasing terms-of-trade should affect GS negatively, in contrast to the positive influence on GDP growth noted in SACHS and WARNER (1995/1997) (BOOS 2011).

The above-mentioned Dutch disease represents the origins and the most prominent topic in the discussion of a possible curse of natural resources. In the classic Dutch disease model, presented by CORDEN and NEARY (1982) and CORDEN (1984), a boom in the natural resource sector is either induced by the discovery of new reserves, exogenous technological progress or by increasing world market prices for the resources in question.

This boom results in higher export revenues and thus increasing rents within the calculation of natural capital depletion (δK_N). Through the so-called spending effect, the additional income increases the demand for goods from the other sectors and thus changes the relation of consumption and investment in physical and human capital (GYLFASON ET AL. 1999). The additional demand for manufactured goods must be met by imports, increasing the competition in this sector (KRUGMAN 1987; DAVIS 1995). In the Dutch disease model, the non-primary sectors are manufacturers of tradable goods and the service sector that produces non-tradable goods for which demand also rises (FARDMANESH 1991). However, while the manufacturing sector relies on world market prices, "the relative price of non-traded [service] goods must increase to preserve homemarket equilibrium" (BRUNO and SACHS 1982). This results in an appreciation of the real exchange rate, which further fosters competition from imports (AUTY 2007; FRANKEL 2010).

Therefore, wages in the resource and service sectors rise and employees consequentially move from manufacturing to these two sectors (AUTY 2007), via the process called resource movement or the crowding out effect (CORDEN and NEARY 1984; KRONENBERG 2004).[22] This decreases investments in human capital, due to more unskilled production processes in these two latter sectors; further, the service sector is more labour-intensive and needs relatively less investment in physical capital (GYLFASON 2001a; DIETZ ET AL. 2007). The capital-intensive mining sector attracts high investments in physical capital, but crowds out investment in more productive sectors. Private investments in physical capital decrease due to the decline in real returns on investment, while public investments in physical and consumption in human capital are negatively influenced by the fall of fiscal space in domestic currency.[23]

3.4.2 Endogenous explanations

Until the 1990s, these exogenous determinants were the most prominent economic explanations for the RC. The Dutch disease was especially regarded as a promising explanation of the RC for almost two decades. However, political and institutional explanations of the curse increased in importance and not only in the field of political science.[24] The case studies by GELB ET AL. (1988) and AUTY (1993) focus on macroeconomic policies, SACHS and WARNER (1995/1997) use an index for the rule of law in their crosscountry regressions, and MEHLUM ET AL. (2006) show "failed policies and weak institutions across the economy, including the lack of well-defined property rights, insecurity of contracts, corruption and general social instability" (BARBIER 2007) as the main reasons for the RC. Easily attainable resource rents increase the power of certain interest groups, cause myopia within the political class, and thus weaken political structures, macroeconomic policies and institutions (ROSS 1999). Weak institutions facilitate corruption, inhibit the rule of law, and decrease growth (MEHLUM ET AL. 2006). The question here is not only how endogenous factors, in combination with resource abundance,

[22] As SACHS and WARNER (2001) put it: "Natural Resources crowd out activity *x*. Activity *x* drives growth. Therefore Natural Resources harm growth".

[23] All of these reasons are also determined by the decline in relative prices of physical (manufactured) capital due to the emergence of China as a major global exporter (ZAFAR 2007; DI GIOVANNI ET AL. 2012).

[24] A high quality literature review is presented by ROSS (1999).

lead to the RC – a question that is not completely answered in the literature – but also if and how this is linked to GS.

According to a whole line of literature, such as PRZEWORSKI and LIMONGI (1993), ALESINA ET AL. (1996), BARRO (1996), HENISZ (2000) or JAMALI ET AL. (2007), the regime type of a country plays an important role in determining the structural principles behind economic development. Democracy supports economic growth (POURGERAMI 1988; HEO and TAN 2001) and since this is one of the pillars for sustainable development it could also influence GS rates positively, as DE SOYSA ET AL. (2010) show. The older the democracy, the more stable institutions and public investment in human or physical capital for the whole society tend to be. Newly democratizing countries are more often plagued by corruption and target their investments on government-backed interest groups (KEEFER 2007; KEEFER and VLAICU 2008).

Studies such as BULTE and DAMANIA (2008) or ANDERSEN and ASLAKSEN (2008) demonstrate that resource-dependent countries are less democratic, due, for example, to averted modernization and repression, which is enabled by resource wealth and preferential access to it by the political class that suppresses the democratization processes (ULFELDER 2007). Using cross-country regressions, ROSS (2001) shows that oil and non-fuel minerals are the most important resources both in the discussion of the RC and within the debate on how natural resource depletion (and the resulting slower GS rate) harms democracy. The greatest damage is seen in developing countries that combine resource-dependency and young democratic systems without strong checks and balances (COLLIER and HOEFFLER 2009).[25]

DE SOYSA ET AL. (2010) argue that democracy has a positive influence on GS because democratic governments deplete less natural capital and invest more in human capital. Their argument from the view of the RC is that democratic governments have to distribute the rents from natural capital more evenly across society, while autocracies have much less interest in their society and future generations, since autocratic governments do not have to fear their population at the ballot box.

Within this framework, the so-called "rentier effect" — that most resource abundant countries do not need domestic taxes — prevents governments from being accountable to their citizens (except for supporting interest groups) (LUCIANI 1987; ROSS 2001). This might make it easier to suppress democratization and social development and to marginalize less influential groups (HUNTINGTON 1991; HUMPHREYS ET AL. 2007). ROSS (2001) sees exactly this need to collect

[25] However, HABER and MENALDO (2011) criticize these approaches and demonstrate in their analysis that higher resource rents do not promote authoritarianism.

taxes as one of the main reasons for the development of strong institutions: He concludes that as long as resource rents are high enough, development will falter without domestic taxes, since public investment only has to satisfy regime supporters and not a broad populace of taxpayers.

There is broad consensus in the literature that poor macroeconomic and public expenditure policies are the main causes of slower growth in resource-dependent countries (ROSSER 2006) and negatively affect the GS rate due to ineffective reinvestment behaviour. ATKINSON and HAMILTON (2003) show that macroeconomics and the distribution of consumption and investment in public expenditures can offer a solid explanation for the RC. ROBINSON ET AL. (2006) state that politicians in resource abundant countries are confronted with incentives to consume rather than invest their rents from natural resources, since, independent of the political system, spending on public goods is auxiliary to retaining power. ATKINSON and HAMILTON (2003) show that there is significant evidence that public consumption and especially the wages and salaries of government employees, are negatively related to economic growth in resource-dependent countries. Public expenditures are inflated without an increase in productive physical and human capital. The level and quality of public and private investments are dependent on political macroeconomic decisions, ranging from those affecting the economic and financial system to those influencing labour market policies.

One of the most important endogenous explanations is the trade regime or its openness, which is related to GS in terms of integration into world markets. Exported natural resources and imported capital and non-durable goods (either public or private) influence all three forms of capital and thus GS. SACHS and WARNER (1995/1997) show that the dependency on primary exports first increases protectionism but later decreases it with greater dependency. Theoretically, this is based on the fear of the effects of Dutch disease, which disappear slowly with capital movement from the other sectors and the incapacity to further diversify to satisfy import-dependent market demand (SACHS and WARNER 1995/1997). Most resource abundant countries depend on imports and their governmental budget from trade taxes. The direct connection to a majority of the exogenous explanations is intuitive, as all of them are somehow related to trade. Traditional growth theory and empirical analyses predict openness and trade levels as having a highly positive influence on development (FRANKEL and ROMER 1999; IRWIN and TERVIÖ 2002), and DE SOYSA and NEUMAYER (2005) and BOOS (2011) show that a higher integration into world markets has the same positive effect on GS.

The quality of institutions is the foundation for political decisions and the general handling of natural capital abundance; it has been the factor discussed in most detail in RC literature since

ROSS (1999).[26] Several perverse incentives for the "wrong" behaviour of politicians and other responsible stakeholders cause policy and institutional failures. In a multitude of econometric or case studies, authors such as SALA-I-MARTIN and SUBRAMANIAN (2003), PAPYRAKIS and GERLAGH (2004) or ROBINSON ET AL. (2006) demonstrate that resource abundance affects institutions negatively and that the RC is more likely to affect countries with weak institutions. Most research refers to political and economic institutions without making a clear differentiation, while ACEMOGLU and ROBINSON (2008a, 2008b) show that high quality political institutions do not automatically result in the same quality of economic institutions. MEHLUM ET AL. (2006) show in cross-country regressions, following the original study by SACHS and WARNER (1995/1997); "that the quality of institutions determines whether countries avoid the resource curse or not". The following should serve as an initial overview and does not claim to be exhaustive.

The first and most important determinant for institutional quality is the level of corruption, which is officially defined as "the misuse of public or entrusted authority for personal gain" (KOLSTAD and SOREIDE 2009). The availability of resource rents and the easy access for private or public agents misusing their authority give rise to corruption (DIETZ ET AL. 2007). Furthermore, corruption is not only shown as decreasing economic growth but also as negatively influencing investment (MAURO 1995). DIETZ ET AL. (2007) prove a significant negative effect on GS: "Reducing corruption from the maximum to the minimum reduces the negative effect of resource abundance on […] GS […] by 61%" (DIETZ ET AL. 2007). All capital stocks are influenced by corruption. While received rents from the depletion of natural capital could be much lower than the global market prices within the GS calculation would indicate, their reinvestment is hindered by corrupt institutions clearly reducing the incentive to reinvest through the resulting uncertainties and higher transaction costs (BARDHAN 1997). Although there is no consistent definition of corruption in the case of GS, we have to distinguish between private and public abuse of natural capital (rents). In recent research, rent-seeking behaviour is separately discussed and isolated from mere corruption (LAMBSDORFF 2002). Rent-seeking encourages private agents to compete aggressively for resource rents and in so doing to use large shares of their own resources such as skills and time as well as capital.

[26] A complete line of literature, such as KNACK and KEEFER (1995), HALL and JONES (1999), ACEMOGLU ET AL. (2001, 2002b), EASTERLY and LEVINE (2003), DOLLAR and KRAAY (2003) or RODRIK ET AL. (2004) agrees on the importance of political institutions for economic growth; DIETZ ET AL. (2007), DE SOYSA ET AL. (2010) and BOOS (2011) show the same positive influence of institutional quality on GS. Also important to a discussion on their influence on GS is the argument by GLAESER ET AL. (2004) that good institutions are determined by policies which themselves depend on human capital. This reverse view would result in the opinion that the investment in human capital comes first: Higher GS would hereby influence institutions positively and not the other way around.

This is socially extremely costly and negatively affects GS. MEHLUM ET AL. (2006) show a decoupling of rent-seeking and productive activities because qualified agents can benefit more from being lobbyists or conducting similar work than from working in other sectors. BALAND and FRANCOIS (2000) and TORVIK (2002) show in their models that resource booms "result in more wasteful rent-seeking activity rather than greater entrepreneurship and investment in productive activities" (BARBIER 2007). If rent-seeking behaviour is not constricted enough due to weak political and legal institutions, these institutions are further weakened by the behaviour of the rent-seekers and, most importantly, the resource rents are disbursed instead of being reinvested. In general, the availability of resource depletion rents can generate corruption and reduce not only the investment itself but also its productivity (MAURO 1995).

Even rent-seeking within stable institutional structures without corruption could negatively influence GS. In the mining sector, rents tend to be concentrated in the hands of only a handful of economic agents and this could prevent efficient reinvestments in other sectors (BALDWIN 1956; BEVAN ET AL. 1987). Investment in physical or human capital other than in the mining sector is more productive if all rents from natural resources are fairly distributed throughout society (SALA-I-MARTIN and SUBRAMANIAN 2003; THE ECONOMIST 2003). Usually this distribution also depends strongly on institutional capacities (KARL 1997; ISHAM ET AL. 2005).

Patronage in the public sector reflects the relatively easy access of political leaders or others who control resources to use the country's resource wealth to maintain the status quo and retain their power or possessions (HUMPHREYS ET AL. 2007). "[N]atural resource rents offer governments both more opportunities and greater incentives to pay off political supporters to stay in power [and] since being in power tomorrow means having access to greater resource rents, politicians are willing to spend more today to stay in power" (KOLSTAD and SOREIDE 2009). Political leaders therefore avoid structural change and institutional development for the benefits of their own and their supporters. According to STEVENS and DIETSCHE (2008), the resulting conclusion is simple: strong institutions avoid patronage and political corruption, weak institutions instead support perverse incentives and have a negative impact on income and GS.

Directly connected with this public misuse of natural capital is the level of bureaucratic quality. A high proportion of resource-dependent countries, especially those affected by patronage, maintain a large inefficient bureaucratic apparatus to serve all interest groups and clans. This induces high transaction costs for users and a rather unreliable business environment. Important processes in business and investing are channeled through bureaucracies ranging from the registration of major contracts to small common procedures such as the registration of cars. The high level of uncertainty and slow processes hinder investment and consume significant resources in terms of time and costs (HUMPHREYS ET AL. 2007). Revenues from bureaucratic services – much like the absent taxes – are lower than in strong states, while more wages are publicly paid. Therefore, GS is indirectly determined by stalled investment decisions and human capital wasted in long processes, even if this is not demonstrable in the GS index. The composition of public and private consumption and investment also depends on the amount of publicly paid wages, and this directly influences the rate of GS (ATKINSON and HAMILTON 2003). Statistically, DIETZ ET AL. (2007) find no significant influence of a bureaucratic quality index on GS rates, while BOOS (2011) shows a positive relation between higher values of this index and GS.

The proxy for several determinants of institutional quality is the rule of law, which implies generally that "the law is sacred" and that checks and balances are in place to ensure its enforcement. Among other factors, the rule of law comprises the reliability of the judiciary system, political accountability and civil rights, property rights, and the security of contracts. In a sophisticated econometric analysis, NORMAN (2009) shows that higher initial resource stocks are related to the development of a lower quality rule of law. She shows that the rule of law is not directly influenced by higher resource exports, but rather functions as a transmission channel; countries with a weak rule of law suffer more from resource dependency. The connection to GS is also indirectly determined by "bad" policies, especially by insecure property rights (or contracts) and underlying risks for investors. Due to these insecurities, rents from natural resources are not reinvested. DIETZ ET AL. (2007) show that the rule of law does not have as significant an effect as corruption on the GS of resource-dependent countries. Nevertheless, they observe a decline of GS by 0.19% for 1% of additional resource exports if the rule of law is not present (worst index value). This corresponds with the original study by SACHS and WARNER (1995/1997) that approximates a small but highly significant positive influence of the rule of law on GDP growth. In the study by BOOS (2011), the same rule of law index shows a three times greater influence on GS rates than on GDP growth. A functioning rule of law seems more important for the "weakly" sustainable reinvestment of natural capital into the two other forms of capital than on short-term economic growth.

3.4.3 Remittances and the so-called aid curse

Two indirectly related sources of income that must be considered in a discussion of the RC are foreign aid and remittances. A large number of resource-dependent countries also depend on these two sources, which induce similar effects as the RC, since both are easily attainable as resource rents.

For example, by investigating their effects on different determinants of economic growth, BURNSIDE and DOLLAR (2000) find similar characteristics and consequences for the share of foreign aid of total GDP as for the share of natural resource rents, especially when examining the effect on the exchange rate. Yet there is no consensus on the influence of aid. BOONE (1996), for example, cannot find a significant relationship to investment or growth but instead finds one to the size of government. Analyses that include institutional quality find similar dynamics as in the endogenous explanations of the RC literature. Aid weakens macroeconomic and public expenditure policies through windfalls without economic performance, and due to their volatility, investment strategies are hard to plan (BULIR ET AL. 2008). Additionally, the investment of aid in physical and human capital is often earmarked for projects and could therefore be invested in sectors that crowd out more important investments (ROBINSON ET AL. 2006).

LÓPEZ-CÓRDOVA and OLMEDO (2006) provide a detailed overview of the developmental impacts of international migrant remittances. Recipient households are proven to invest more in human capital and to a smaller degree in small, productive, physical capital accumulating businesses. EDWARDS and URETA (2003) show a positive effect on private investment in human capital if the chance of migration is a possible option. However, it is argued that remittances are produced by emigrants who remove human capital from their respective country's stock, which affects governmental investment behaviour in education.

AMUEDO-DORANTES and POZO (2004) show the same appreciating effect of aid and remittances on the real exchange rate as in the case of Dutch disease. Additionally, ABDIH ET AL. (2008) develop a conjunction to the institutional quality by proving a negative relationship between the ratio of remittances to GDP and indices for corruption, government effectiveness and the rule of law. They argue that higher amounts of easily attainable foreign exchange increase the share of diverted funds by the government from both aid and remittances. This can therefore lead to the deterioration of institutional quality (ABDIH ET AL. 2008); DJANKOV ET AL. (2006) even show a reduction of the level of democracy in recipient countries. The World Bank itself sees the influence of donors on policies within aid-dependent countries as highly difficult and, considers the ex ante conditionality used until the end of the 1990s as failed (COLLIER and DOLLAR 2004). However, SACHS (1994), DOLLAR and SVENSSON (2000) and COLLIER (2006) show examples such as South Korea or Thailand where aid in combination with an *ex post* policy conditionality positively affected reform efforts and helped to improve institutions.

3.5. Conclusions

ATKINSON and HAMILTON (2003) recommend further work on the determinants of GS as its drivers are not sufficiently understood. To contribute to this line of research, this paper shows the strong relation between factors leading to the RC and factors leading to a decline of GS. The relevant prevailing literature deals mainly with single relationships. Therefore, we provide a comprehensive detailed overview of the complicated structural background of the intuitive relationship between the RC and GS as the most important indicator for "weak" sustainability.

Short-term volatility of resource prices in world markets cause planning uncertainty and therefore a higher ratio of consumption to investment of income from natural capital depletion. Even the positive long-term effects of increasing prices on the terms-of-trade of resource-dependent countries, usually positively related with economic growth, have a negative impact on GS since rents from resource exports are subtracted in its calculation. The directly related well-known theory of Dutch disease affects the composition of consumption and investment in physical and human capital through the appreciation of the real exchange rate and a movement effect of financial (physical capital) and workforce (human capital) related resources from manufacturing to the resource and service sectors.

The political system itself or the level of democracy play an important role for the rate of GS since democratic governments tend to deplete less natural capital and invest more in human capital. This depends in part on the quality of the participating institutions, but not entirely, as a high rate of resource depletion is possible even within strong institutional structures, since democratically elected governments are also prone to increase consumption expenses. However, institutional quality in terms of the level of corruption, bureaucratic services or the rule of law influences GS immensely because it changes the incentives and security of investments. Hence, the first phase of increasing institutional quality in resource-dependent countries with "bad" institutions could also increase natural capital depletion through a positive influence on investment in mining or other extraction infrastructure.

Reinvestment of rents from natural resource depletion in physical and human capital in adequate amounts (as measured by GS) and at a level of quality that supports development (not yet adequately measured), is one of the most important drivers of welfare growth and sustainable development. Resource-dependency and factors related to the RC strongly influence the three types of capital making up GS. Higher resource exports for the income of resource abundant countries automatically increase natural capital depletion, subtracted in GS. Every determinant summarized herein directly or indirectly influences reinvestment of rents from this natural capital depletion in physical and human capital. Our paper shows the most important channels through which the factors determining the RC might also influence the development of GS.

The first implication of the observation that countries with a high "level of natural resource extraction are also the poorest performers in terms of GS […]" seems obvious: These "[…] countries need to invest more of the proceeds of natural capital depletion into the formation of other forms of capital than they currently do" (HAMILTON and CLEMENS 1999). While this is certainly true, our determinants highly suggest that investment policies themselves may be affected by other exogenous and endogenous factors. Politicians must deal with an interdependent system of factors influencing each other. As summarized above, variances in world market prices and exchange rates, the political system and the quality of institutions directly influence "weak" sustainable development and its indicator, GS. In fact, these determinants shift investment behaviour; for example, weak institutions increase the probability that a government wastes rents from depletion of natural resources rather than reinvesting them sustainably.

Broadly speaking, strengthening political and institutional structures may be the most important prerequisite for resource-dependent countries to reinvest their rents from natural resources. The institutions related to natural capital depletion and its reinvestments are important for an appropriate reaction to the discussed exogenous factors that determine parts of GS and affect the endogenous possibilities of positively influencing GS development. Our study arrives at the overall conclusion that general policy implications are not easy to determine and most likely remain superficial. It reveals that the dependencies between single determinants are highly complex and dynamic. Furthermore, for resource dependent countries, country-specific characteristics might have an immense impact. For instance, if we look at individual resource-dependent countries with negative GS rates such as the democratic but extremely poor Zambia, with copper exports of around 40% of GNI, or the conflict ridden autocratic Syria with 20% oil exports, there is not a general answer to the question of how to increase GS rates in RC-affected countries. Human capital development and investment in infrastructure or other sectors than natural resources to push industrialization should at least provide an answer for a positive GS rate, but the channels to achieve these are different in every resource-dependent country.

Our paper provides a comprehensive theoretical overview of the relationship between the resource curse and genuine savings, bringing all possible approaches together. Further research should take a closer look at the extent and the direction of influential factors behind the RC on the development of GS rates, both generally and in specific cases and could use this theoretical overview as a guide.

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4. The relationship between the Resource Curse and Genuine Savings: Empirical evidence

Abstract The objective of this paper is to contribute to research on the determinants of Genuine Savings (GS) by investigating its relationship to the Resource Curse (RC). The substantial empirical evidence confirming that resource-abundant countries are often characterised by slower economic growth can be traced back to the argument that natural resources generate rents independent of economic performance. Recent studies show a negative relation of this so-called RC to GS, a concept that is meant to measure sustainability by considering reinvestments of exactly these rents from natural capital into physical and human capital. Our cross-country analysis examines the influence of determinants and transmission channels identified to cause the RC on GS and its components. Results show that factors leading to the RC are also useful explanatory variables for GS: A clear influence of the share of primary exports in GNI as well as of trade, consumption, quality of institutions, etc. is found. Via the migration of employees and appreciation of the exchange rate, Dutch disease is used to show how the RC works through the different types of capital that make up GS. As a side effect, this combination of dependent variables can explain the RC more comprehensively than GDP growth.

4.1. Introduction

"One of the surprising features of modern economic growth is that economies abundant in natural resources have tended to grow slower than economies without substantial natural resources" (SACHS and WARNER 1995/1997).

This so-called Resource Curse (RC) has been documented extensively, showing significant negative relationships between some measure of resource abundance and economic growth, usually the growth rate of per capita GDP.[27] The high shares of rents from natural capital depletion in the income of resource abundant countries links the RC to theories on sustainable

[27] Literature on this paradox offers a wealth of theoretical and empirical explanations ranging from the volatility of terms of trade and Dutch disease effects to the quality of institutions and the political system of a country. For literature reviews see for example ROSS (1999), ROSSER (2006), FRANKEL (2010), VAN DER PLOEG (2011), or BOOS and HOLM-MÜLLER (2012).

development, namely to the paradigm of weak sustainability: For lasting and weakly sustainable growth, the reinvestments of these rents in physical and human capital should at least equal the depletion of natural capital, thus holding a country's capital stock constant (NEUMAYER 2010).

Genuine Savings (GS)[28] as an indicator for "weak" sustainability measures the difference between the depletion of natural capital and investments in physical and human capital. As expected, it is comparatively low in resource-abundant countries. HAMILTON and CLEMENS (1999) suggest using this relationship to explain the RC. ATKINSON and HAMILTON (2003) demonstrate that countries will be particularly affected by the RC if natural resources, in combination with inappropriate public expenditure policies, lead to low GS rates. Thus, both papers conclude that GS is a good explanatory for the RC and provides an early warning for future declining economic growth. Consequently, this calls for research on determinants of the GS rate.

However, to a certain extent, it is an artefact to find a relation between an indicator such as GS that is by definition rather low in resource-abundant countries, due to their higher depletion of natural capital and a theoretical construct based on the dependence on income from natural resources. Therefore, in searching for GS determinants, we utilize this proven relation between GS and RC but interpret it differently: A variable that reflects a theory as such suggests itself as endogenous rather than exogenous. We build on this and analyze the determinants of the GS rate as well as its components by using factors already identified in literature to cause the RC. We confirm that theories and factors behind the RC are directly related to determinants of the GS rate. We also show how its single components are influenced by the curse.

The main objective of this paper is thus to contribute to the research on determinants of GS by investigating the empirical relationship between the RC and GS. In using Genuine Savings and the change rates of physical, human and natural capital that make up GS as dependent variables, we additionally illustrate that this combination of dependent variables is applicable to show the RC more comprehensively than GDP growth.

To our knowledge there are so far three studies on the determinants of GS and one on genuine income by the research team including de Soysa and Neumayer (NEUMAYER 2004; DE SOYSA and NEUMAYER 2005; DIETZ, NEUMAYER and DE SOYSA 2007; DE SOYSA, BAILEY and NEUMAYER 2010), whose results on economic openness and political stability are addressed in our empirical analysis. They all regard single aspects of the relationship between the RC and

[28] "Adjusted net savings" in World Bank terms.

GS. DIETZ ET AL. (2007) for example show the negative influence of corruption on GS in resource-abundant countries. Additionally, HESS (2010) analyzes GS determinants in developing countries and shows a significant influence of the share of fuels, ores, and metals in merchandise exports. However, to our knowledge no empirical study has investigated the relationship between the RC and GS systematically.

We methodically build on the study by NEUMAYER (2004): He reproduces the original RC study by SACHS and WARNER (1995/1997)[29] using the growth rate of genuine income and shows the same negative effect on GDP. His dependent variable originates from the World Bank's GS dataset but only deducts the depreciation of physical capital and parts of natural capital depletion from GDP. Additionally, GS subtracts consumption as well as damage from CO_2 emissions. However, the most important difference is the inclusion of investment in human capital by adding education expenditures. The aim of this paper is not to discuss these extensions. We think GS is useful despite some drawbacks, offset by its public availability and international comparability.[30] Nevertheless, our paper will add to the discussion of GS since its determinants are not sufficiently understood so far. A better understanding will support interpretation, criticism and further development. In using the intuitive relationship between this indicator and the RC, we contribute to its explanation.

Our study also starts with regressions analogous to the original by SACHS and WARNER (1995/1997), with GS as dependent variable. After showing that the RC still holds true for GS, even over an extended period, we expand the regressions by investigating the effects on the single capital types and by adding more explanatory variables. We show that GS is more closely related to the RC than GDP. The following chapter surveys the theoretical background; then we describe the empirical analysis and discuss the results in view of these theories.

4.2. The theoretical relationship between the RC and GS

The RC denotes the effect that countries richly endowed with natural resources often show slower economic growth. Research behind it seeks to find explanations for this paradox, varying the measures for resource-abundance from study to study but reporting a similar core message: Higher dependency on the income from natural resources causes slower per capita GDP growth, more or less independent from the other economic or policy variables used

[29] SACHS and WARNER (1995/1997) show for the first time in their renowned cross-country analysis that an increase in primary exports results in a decline of the growth rate of GDP per capita.

[30] For detailed discussions see ATKINSON and HAMILTON (2003) or NEUMAYER (2010).

(SACHS and WARNER 2001). GELB (1988) and AUTY (1993) show the political difficulty for governments to save (and not spend) the rents from natural capital and the lack of institutions to reinvest this income efficiently. The problem of insufficient reinvestment of resource-related profits links the RC and the theories behind it to the paradigm on weak sustainability and its indicator GS.

Weak sustainability is based on the assumption that different forms of capital are in principle substitutable and that only a country's total capital stock is important to "maintain the capacity to provide non-declining utility for infinity" (NEUMAYER 2010). The so-called "Hartwick rule" (HARTWICK 1977) provides a "rule of thumb" for weak sustainability: Keep a country's total capital stock at least constant to allow for sustained consumption over time and therefore "invest into all forms of capital at least as much as there is depreciation of all forms of capital" (NEUMAYER 2010). This can be traced to the concept of "Hicksian income" (HICKS 1946), which states that a country should only consider the interest on its capital stock as income. While the latter may be consumed, the stock has to stay constant to be as well off over time as at the beginning. GS illustrates basically this mix of consumption and savings, theoretically seen as the reinvestment of depleted natural capital into other forms of capital, the net investment into the total capital stock (DIETZ ET AL. 2007).

Resource-abundant countries deplete more natural capital and need to reinvest more to achieve positive GS rates. However, since the first case studies by GELB (1988) and AUTY (1993), we know that most resource abundant countries consume their income from resource exports rather than reinvest these rents. Theoretically, these countries live on their capital stock and decrease future welfare. Using their natural capital for present welfare erodes the basis for development by not investing this income into physical capital such as infrastructure or human capital such as education. Since this also results in decreasing future GDP, negative GS could be seen as early sign for a possible curse in resource-abundant countries (ATKINSON and HAMILTON 2003).

By dividing the analysis into the three forms of capital, it can be shown in more detail how theories and explanations behind the RC influence the respective GS components. In the following, we explain the calculation method of GS and link the different parts directly to the theories behind the RC: GS as an indicator for weak sustainability was developed by PEARCE and ATKINSON (1993), HAMILTON (1994), PEARCE ET AL. (1996) and HAMILTON and CLEMENS

(1999). Based on traditional gross national income (GNI), GS includes the change rates of the three forms of capital, physical (K_P), human (K_H) and natural (K_N):[31]

$$Genuine\ Savings\ (GS) = (GNI - C_P - C_G + NCT) - depreciation\ of\ K_P + education\ expenditures\ (\delta K_H) - natural\ resource\ depletion\ (\delta K_N) \quad (23)$$[32]

Gross national income (GNI) minus private (C_P) and public (governmental) consumption (CG) plus net current transfers (NCT) refers to gross national savings (GNS). This is based on the aforementioned rule that only an optimal mix of consumption and savings (where income is principally divided into these two alternatives) can maximize intertemporal welfare (DIETZ ET AL. 2007). NCT comprise all exchanges with foreign countries of goods and services as well as income and financial items without a quid pro quo (WORLD BANK 2011a, b). The resulting GNS are theoretically seen as gross investment in physical capital.

However, physical capital also depreciates over time and subtracting this so-called consumption of already existing produced capital from GNS leads to net national savings (NNS), which - at least theoretically – is equivalent to **net investment** in **physical capital** (**δK_P**) (HAMILTON and CLEMENS 1999).

While NNS already contains the physical part of total education expenditures including investment in school buildings, other investments in human capital - such as the purchase of school books or payment of teachers' salaries - are traditionally treated as consumption (HAMILTON 2006). Therefore, GS adds current operating expenditures on education as a rather crude approximation for **investment** in **human capital** (**δK_H**).

Consumption of **natural capital** (**δK_N**) is considered by subtracting the depletion of different natural resources and the damages from CO_2 emissions (HAMILTON and CLEMENS 1999; HAMILTON 2006): The depletion of natural resources is composed of the rents of energy and mineral resources and that of net forest depletion.[33] These rents demonstrate the change in the natural resource asset value associated with their extraction over the accounting period and therefore the change in the natural capital stock (ATKINSON and HAMILTON 2007). Social costs from CO_2 emission damages are assumed to be US$20 (in 1990) per emitted metric ton

[31] Detailed calculation descriptions and definitions can be found in BOLT ET AL. (2002), HAMILTON (2006), or WORLD BANK (2011).

[32] http://data.worldbank.org/indicator/BN.TRF. CURR.CD.

[33] Resource Rent = Production Volume * (International Market Price – Average Unit Production Costs).
Energy depletion covers crude oil, natural gas and coal.
Mineral depletion refers to bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver.
Net forest depletion refers to roundwood harvest minus natural growth; this is set to zero if growth exceeds depletion.

(FANKHAUSER 1994a, 1994b). However, air pollution is not considered a direct depletion of a country's natural capital stock, rather a transboundary depletion of all forms of capital (ATKINSON and HAMILTON 2007). Therefore, an analysis bringing the RC and GS together should differentiate between natural capital and damages by carbon dioxide.

Since the depletion of energy, mineral and wood resources is calculated using actual world market prices, the **volatility** of primary commodity prices substantially influences the rents making up δK_N within GS without changing the actual amounts depleted in tons (BOOS and HOLM-MÜLLER 2012). In resource-abundant countries the depletion of natural capital δK_N primarily goes into exports while a large part of investment in K_P is determined by imported consumption and capital goods (BARBIER 2007). However, due to these volatile **terms of trade (ToT)**, investments in K_P suffer from planning uncertainty and a higher elasticity of demand for imported consumption than investment. Therefore increases in K_N turn out to be higher than in K_P (BLATTMAN ET AL. 2007; KOREN and TENREYRO 2007). Therefore, the ratio of δK_N to δK_P changes in the same direction as a country's ToT, since these represent the ratio between the price indices for exports and imports and – in contrast to GDP growth – GS rates are negatively influenced by increasing ToT (BOOS and HOLM-MÜLLER 2012).

This is directly related to the most famous exogenous explanation from the RC literature, **Dutch disease (DD)**: a boom in the natural resource sector - either induced by the discovery of new reserves or increasing world market prices - results in higher rents within the calculation of δK_N and increasing export revenues. This additional income on the one hand increases the demand for goods from the other sectors and thus changes the relation of consumption and investment. On the other hand it causes the real exchange rate to appreciate. The additional demand for manufactured goods has to be met by imports, increasing competition in this sector (DAVIS 1995) and further facilitated by the higher exchange rate (KRUGMAN 1987).

While manufacturing relies on world markets, the prices and therefore wages in the service sector rise due to additional demand and therefore employees move from manufacturing to the resource and service sector (AUTY 2007). While this decreases investments in K_H, due to more unskilled production processes in these two sectors, on the other hand the service sector is more labour-intensive and requires less investment in K_P (DIETZ ET AL. 2007). The capital-intensive mining sector attracts high investments in K_P but still crowds out investment in more productive sectors. In summary, due to DD effects, δK_N increases while reinvestments in the other two forms of capital are negatively influenced (GYLFASON 2001a).

These exogenous explanations could result in a higher integration into world markets, in traditional economics an important factor for growth (IRWIN and TERVIÖ 2002). **Trade openness** influences δK_N via income (rents) from exports, δK_P via imports for consumption and capital goods and the public budget via trade taxes. However, openness typically leads to a diversification of the economy, thus it is positively related to GS (DE SOYSA and NEUMAYER 2005; DE SOYSA ET AL. 2010).

Nonetheless, openness or exposure through integration into world markets is related to the **political system** itself and its transmission channels through the **quality of institutions**. Not only do various studies demonstrate that resource-abundant countries are less democratic (ROSS 2001; DE SOYSA and NEUMAYER 2005), DE SOYSA ET AL. (2010) also show that democracy has a positive influence on GS, because democratic governments deplete natural capital less and invest more in human capital. However, democracy has to be supported by strong institutions:

Weak **rule of law** decreases GS through insecure structures for daily economic behavior and investment due, for example, to an unreliable judiciary system or insecure property rights. The level of **corruption** - either private or public - has the worst effect on investment behavior and GS rates in the study by DIETZ ET AL. (2007). Resource rents constitute an easily attainable source of income and corrupt agents use these rents for consumption rather than investment. However, corruption is not only built on rents, political patronage to sinecure interest groups has similar negative effects on GS. Due to high transaction costs for private investors and decreasing public investment opportunities through higher publicly paid wages, a weak quality of **bureaucratic services** contaminated by patronage influences GS negatively. Finally, all of these factors influence **macroeconomic** and **public expenditure policies**, according to ATKINSON and HAMILTON (2003) the most important conjunction between the RC and GS, since they affect the composition of consumption and investment.

In summary, literature reveals the most important factors leading to RC as: higher incentives for consumption than investment, volatility, DD effects and quality of institutions. In the following, we consider the theoretical relations between the RC and GS empirically. We start by explaining our proceedings and close with a comprehensive discussion of the results from the view of these theoretical explanations.

4.3. Empirical Analysis

4.3.1 Research Design

Most data in this work stems from the World Bank's online Data Catalog for World Development Indicators and Global Development Finance.[34] We extract GDP, GS and its components (physical, human and natural capital as well as carbon dioxide damage), primary exports and total trade as well as data on consumption, interest and exchange rates, share of employees in the service sector and remittances from abroad in order to reflect theoretical influences described in the chapter above. Additionally, we use data on the investment share of real GDP from the Penn World Tables 6.3 (HESTON ET AL. 2009) and indices for the rule of law, corruption and bureaucratic quality from the International Country Risk Guide by the Political Risk Service (PRS).[35] In order to insert the quality of the political system, we drew the most respected democracy index Polity IV from the Colorado State University Polity IV Project.[36] Which series we finally use is described in the respective regression.

Following NEUMAYER (2004), our first step is repeating the basic regressions in which SACHS and WARNER (1995/1997) analyze the RC for the first time in a detailed cross-country analysis. This original study uses average data from 1970 to 1990 for a sample between 71 and 87 developing and industrialized countries depending on the applied explanatory variables. It shows that an increase in the average share of exports of primary products in GDP results in slower average growth rates of GDP per capita independent of the additional explanatory variables. NEUMAYER (2004) confirms that this also holds true for the period from 1970 to 1998 as well as for growth in genuine income.[37]

Since we use a longer period, 1970 to 2008, we have to replace some of the explanatory variables from these two original studies with analogous ones from a theoretical viewpoint, explained below. Table 1 in the next chapter, shows the results of six regressions in six columns. We start by mimicking the original model, then replace the endogenous with the average rate of GS and then investigate the different types of capital. In Table 2, we summarize the regressions with additional variables.

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[34] http://data.worldbank.org/data-catalog.
[35] http://www.prsgroup.com/CountryData.aspx.
[36] http://www.systemicpeace.org/polity/ polity4.htm.
[37] In NEUMAYER (2004) genuine income is GDP minus the depreciation of produced and natural capital. Since this study by NEUMAYER (2004), the World Bank publishes genuine income as adjusted net national income in its World Development Indicators: http://data.worldbank. org/data-catalog.

In our first analysis (results in Table 1, regression 1), we regress the average annual growth rate of GDP per capita between 1970 and 2008 (**GDP7008**) on the initial GDP per capita in 1970 and the average share of exports of primary products (agricultural, mineral and energy resources) in GNI between 1970 and 2008 (**SXP7008**). Contrary to SACHS and WARNER (1995/1997), we use the average share over the whole period as our proxy for resource dependence, since the single base year 1970 used in the original study loses its applicability when analyzing across forty years.

For the integration into world markets, we apply the average share of total trade (imports and exports) in GDP – the typical proxy in empirical literature (BARRO and SALA-I-MARTIN 2004) – between 1970 and 2008 (**TRADE7008**). The openness index used by SACHS and WARNER (1995/1997) cannot be expanded beyond the year 1990. As in the original analyses, the investment share of real GDP (**INV7007**) from the Penn World Tables (HESTON ET AL. 2009) provides a proxy for the handling of natural resource income: the investment in produced capital.

The rule of law index from 1982 used by SACHS and WARNER (1995/1997) is today only available from 1984 on in the International Country Risk Guide. However, instead of only a single year we use the average index value between 1984 and 2008 (**RL8408**). The average growth rate of the net barter terms of trade index between 1980 and 2008 (**TOT8008**) by the World Bank completes the first regression.

In regression 2, GDP is replaced by GS. We regress the average rate of GS between 1970 and 2008 in % of GNI (**GS7008**) on the initial GS from the individual years for which it is first available (different years depending on the country), and the same five additional explanatory variables as in column 1. In regression 3, we use NNS in % of GNI as dependent variable for the average change rate in physical capital between 1970 and 2008 (**KP7008**). The average education expenditures in % of GNI comprise the average investment in human capital between 1970 and 2008 (**KH7008**) in regression 4. In regression 5 and 6, we differentiate the consumption of natural capital in the actual average depletion of natural resources (**KN7008**), which relates the RC directly to GS, and the damages by carbon dioxide (**CARB7008**), due to the argument that CO_2 emissions are not only a direct depletion of a country's natural capital, rather a transboundary one of all capital forms. By regressing the three forms of capital on their initial values and the same explanatory variables as in regressions 1 and 2, we show the influence of these determinants on the different components of GS. To our knowledge, only DE SOYSA ET AL. (2010) have used similar dependents, regressing on another set of determinants.

In Table 2, we add variables applicable as proxies for additional theories and hypotheses behind the RC, such as DD. Dependent variables, initial values, the average share of primary exports (SXP7008), total trade (TRADE7008), and the growth rate of the terms of trade index (TOT8008) remain constant as in Table 1. However, in Table 2, we complement the share of primary exports with easily attainable exogenous source of income by remittances received from migrant workers (**REMI7008**), since most resource-abundant countries also depend on them.

In Table 1, we test the argument that GS are net investments in the total capital stock of a country and therefore the investment share of real GDP (INV7007) theoretically has a positive influence on KP and the total GS rate. In Table 2, we then test the counterpart of this argument, that a higher share of consumption should affect GS negatively and exchange investment by the average consumption share of real GDP (**CON7008**) (due to multi-collinearity we cannot use both in the same regression).

Following arguments by ATKINSON and HAMILTON (2003), who state that macroeconomic policies and public expenditures have an important impact on the distribution of investment and consumption and therefore also on the relationship between the RC and GS, we use the average real interest rate (**INT7008**) as a proxy for a country's macroeconomics and as the average price for investment or compensation for savings, respectively.

As a proxy for DD's so-called spending effect, which states that additional income from resource exports should appreciate the real exchange rate, we use its average growth rate between 1970 and 2008 (**EXCH7008**). The hypothesis of the movement effect – that workers migrate from traditional sectors either to work in the booming resource or growing service sector – is proxied by the average share of employees in the service sector to total employment (**EMSER7008**).

As DIETZ ET AL. (2007) show, there are other important institutional factors influencing the rate of GS besides the rule of law. To have a more general institutional variable, we combine the index for the rule of law from Table 1 with indices for corruption and bureaucratic quality - all surveyed in the same scale by PRS – and create averages from these three indices from 1984 to 2008 (**IQ8408**). Multi-collinearity prevents us from using the individual indices together; therefore we additionally show the results separately. However, since the other coefficients only change slightly, we report the results for **RL8408**, **COR8408** and **BQ8408** separately and not the entirely new models. In the last row of Table 2, we exchange IQ8408 with the average value of the democracy index Polity IV (**POL7008**), since we know from DE SOYSA ET AL. (2010)

that democratic development influences GS rates positively. This index includes opportunities for political expression and gaining executive power through competitive elections, as well as its transfer and constraints.

4.3.2 Results and Discussion

In regression 1, we see that the main results by SACHS and WARNER (1995/1997) and NEUMAYER (2004) also hold for this longer period and for a larger sample. Detailed conclusions for GDP growth can be found in these studies. All variables apart from terms of trade stay significant with the same signs as in the original studies. It seems that terms of trade growth loses its positive link to GDP growth in the period between 1980 and 2008 used in our regressions compared with the period from 1970 until 1990 analyzed by SACHS and WARNER (1995/1997). Beside the average growth rate of the net barter terms of trade index (**TOT8008**), we also checked for the average index values and the average volatility rate of world market commodity prices between 1970 and 2008 without significant results. In the original study by SACHS and WARNER (1995/1997), it was only slightly significant at the 10% level (and no longer significant at any level in the study by NEUMAYER (2004)). Average international commodity prices were subject to 10.5% fewer fluctuations in the longer period from 1980 to 2008 used in our analysis. Therefore, this insignificance might be simply due to a lack of variance.

Regression 2 assigns the exogenous variables to the average rate of GS between 1970 and 2008 (**GS7008**). For most variables, the same signs apply but the initial values have a positive influence since GS rates are measured in % of GNI and not as growth rates. While a higher initial GDP level results in smaller growth rates, there is an intuitive relationship between the initial GS rate and its average value over the next 39 years. By nature of its calculation, the average GS rate between 1970 and 2008 is more negatively influenced by the share of primary exports in GNI than GDP: A 10% increase in the average share of primaries (**SXP7008**) is estimated as decreasing the average GS between 1970 and 2008 by around 1.4% compared with 0.3% for GDP growth (in the original 21-year analysis this is more than 1% (SACHS and WARNER 1995/1997)). However, it has to be kept in mind that this is sound to a certain limit since the GS rate is around 8% of GNI while the growth rate of GDP per capita is averagely around 2% over the whole sample.

As expected, the share of primary exports in GNI between 1970 and 2008 (**SXP7008**) increases the depletion of natural capital (in regression 5) but shows no significant relationship to the change rates of the two other forms of capital. The difference of the SXP7008 coefficients in 2 and 5 can be interpreted as the reinvestment realized in the two other forms of capital, as δK_N is subtracted in the calculation of GS. Looking at these numbers reveals that reinvestment is small, mirroring the discussion that resource-dependent countries "[…] need to invest more of the proceeds of natural capital depletion into the formation of other forms of capital than they currently do" (DIETZ and NEUMAYER 2006).

As DE SOYSA and NEUMAYER (2005) show, the economic openness of a country, here reflected by the integration into world markets (**TRADE7008**), positively influences the rate of GS. While the share of trade in GDP shows a significant positive influence on all calculation parts of GS in DE SOYSA ET AL. (2010), we estimate only a slightly positive influence on investment in physical capital (**KP7008**) and therefore the total GS rate; the integration into world markets results in diversification away from exclusively living from natural capital and decreases the prices of imported capital goods that comprise the basis for investment in KP. A 10% higher share of total trade in GDP increases GS by around 0.4%.

The investment share of real GDP (**INV7007**) influences GDP growth positively in the original studies as well as in regression 1. However, while the growth rate of genuine income in the analysis by NEUMAYER (2004) is also positively related to increasing investments, Table 1 shows its only link besides GDP to the damages from CO_2 emissions (in regression 6). That is, higher investments increase emissions, which could be related to investments in the manufacturing sector. Interestingly, INV7007, which measures the average gross investment in physical capital is not estimated to have an influence on KP7008 – theoretically intended to show the net investment in physical capital – or on GS itself.

Higher index values for a country's rule of law (**RL8408**) decrease CO_2 emissions, increase the investment in human capital (KH7008) and are therefore related to a higher total GS rate (regressions 2, 4 and 6). The average rule of law from 1984 to 2008 influences even the growth rate of GDP per capita more than in the original study by SACHS and WARNER (1995/1997), which only uses the index value for one year in 1982. Interestingly, the period average from 1982 to 1995 applied in the analysis by NEUMAYER (2004) does not show any effect on GDP or genuine income. Clearly, for the 1980s through the mid-1990s, rule of law was not as important for economic growth and sustainable development as it was for the remaining period until 2008.

Table 1: Dependent Variables: GDP, Genuine Savings and its components 1970-2008.

	1	2	3	4	5	6
	GDP7008	**GS7008**	**KP7008**	**KH7008**	**KN7008**	**CARB7008**
Initial	-0.0004	0.28	0.23	0.63	0.31	0.39
	(-3.57)***	(4.12)***	(4.0)***	(11.1)***	(3.51)***	(6.1)***
SXP7008	-3.05	-14.38	6.2	-0.1	16.01	0.34
	(-2.66)***	(-2.21)**	(1.16)	(-0.1)	(3.13)***	(1.24)
TRADE7008	0.82	3.87	2.76	-0.1	-0.82	-0.06
	(2.4)**	(2.16)**	(1.72)*	(-0.49)	(-0.42)	(-0.71)
INV7007	3.24	13.47	5.1	1.42	-9.78	1.06
	(2.07)**	(1.59)	(0.68)	(1.42)	(-1.52)	(2.75)***
RL8408	0.52	1.49	0.58	0.22	-0.66	-0.09
	(3.49)***	(2.36)**	(1.01)	(2.95)***	(-1.29)	(-2.9)***
TOT8008	0.02	-0.75	0.1	-0.0004	0.84	0.007
	(0.56)	(-3.17)***	(0.43)	(-0.016)	(4.19)***	(0.61)
N	107	103	104	104	99	108
Adjusted R2	0.32	0.48	0.28	0.67	0.65	0.42
F-statistic	9.2	16.94	7.62	35.11	31.09	13.67

*** Significant at 0.01 level, ** at 0.05 level, * at 0.10 level (t-values in parentheses)

The only different sign compared to the original study by SACHS and WARNER (1995/1997) appears in the growth rate of terms of trade (**TOT8008**). Their analysis finds it positively influencing GDP growth. The authors assign this to the Prebisch-Singer thesis arguing that decreasing terms of trade of primary commodity exporters slow economic growth (PREBISCH 1950; SINGER 1950). This is due to the composition of GS that terms of trade influence it negatively (in regression 2): KN (in regression 5) is positively affected since an increase of terms of trade means higher prices for exports at least relative to imports. Higher resource prices result in increasing depletion, either through real increases in depleted amounts or by the calculation method through world market prices. An increase of KN decreases GS as soon as there is no sufficient reinvestment. Therefore, a higher average growth rate of a country's terms of trade results on average in smaller GS.

In the extended regressions in Table 2, we keep SXP7008, TRADE7008 and TOT8008. They show the same signs as in Table 1 with minor differences: Despite more control variables, all of which are discussed in the following, the share of resource exports in GNI (**SXP7008**) influences GDP as well as GS more negatively and significantly than in Table 1. Additionally, there is a highly significant negative influence of resource exports on investments in physical capital (KP7008) (in regression 9). Although we did not find the same result in Table 1 this was theoretically expected due to the argument that investments in the resource sector crowd out those in more productive sectors. Therefore, a higher share of income from the export of natural resources in GNI decreases investments in physical capital at least relatively to the share of additional consumption. The above argued diversification by higher openness is additionally mirrored by the negative influence of **TRADE7008** on the depletion of natural capital in regression 11. The positive link between trade and GS is higher and more significant, as in Table 1.

Moreover, we use average net incoming remittances in % of GDP between 1970 and 2008 (REMI7008) to control for other exogenous income sources besides primary exports in order to ensure that the observed effects really stem from the dependence on the exports of natural resources. We also tested foreign aid and development assistance unsuccessfully, theoretically also negatively influencing the spending behavior in resource-dependent countries. All of these exogenous factors do not prevent the export of primary goods from being significant. Choosing remittances was logical since a great deal of resource-abundant countries also depend on this other foreign income source (LÓPEZ CÓRDOVA and OLMEDO 2006). Remittances are positively linked to GS through high investments in KP. Recipient households are proven to invest in private education and in small, productive businesses. However, the mere level of investment in KP also predicts high additional investments in, for example, the manufacturing sector.

Due to the argument that consumption should decrease GS since consumed income is not invested into a country's capital stock, we replace the insignificant share of investment from Table 1 with the average total consumption share of real GDP between 1970 and 2008 (**CON7008**). Increased consumption is significantly negatively related to GDP growth as well as the rate of GS (in regressions 7 and 8). Although both coefficients for GDP7008 and GS7008 have to be interpreted carefully due to partial identity problems,[38] these results support the theories behind the RC and GS concerning the consumption of natural capital: As expected, higher consumption negatively influences reinvestment in KP (in regression 9) and therefore the total rate of GS. Since increasing consumption is also statistically related to a decrease in the depletion of KN (in regression 11), the difference between these two coefficients almost count for the negative one of total GS (regression 8).

Following ATKINSON and HAMILTON (2003), we also tested public consumption due to their findings that "countries that have primarily used resource abundance to finance current consumption have fared far less well" than the ones whose governments "have used resource abundance to finance investments". Our results show no significant difference between public or total consumption. Therefore, we keep total consumption in the regressions based on the fact that private consumption also increases as the income elasticity of demand for the consumption of manufactured goods is higher than for investment in capital goods (BARBIER 2007).

Public expenditure policies dividing the governmental budget into consumption and investment depend on macroeconomic policies as do private saving and investment decisions. Therefore, in addition to the share of consumption, we use the average real interest rate (**INT7008**) as a proxy for a country's macroeconomics. As the average compensation for savings or the market price for investments respectively, this influences GS positively. Higher interest rates cause an increase in savings but there is no significant sign that smaller interest rates result in investment in other capital forms than natural. However, the negative link between the interest rate and KN7008 could serve as an argument that higher interest rates result in investments other than mining.

The average growth rate of the official exchange rate (**EXCH7008**), following the DD hypothesis of appreciation due to the increasing income influx from natural resource exports (or

[38] In both, somewhere along the calculation path, consumption is used as content and therefore, within regressions 1-2 and 7-8, this appears on both sides of the equation.

other income sources such as remittances), influence investment in KP (in regression 9) and total GS (in regression 8) negatively. Possible reasons for this include increasing consumption shares in income when imports become cheaper as well as a decreasing governmental budget for investments from trade taxes in domestic currency. Since GYLFASON ET AL. (1999) state that not only the pure appreciation has a negative impact on economic growth, but also uncertainties resulting from exchange rate volatility, we checked for this using a volatility index without significant results.

The other DD effect, the migration of workers from the manufacturing into the resource and the service sector shows through our proxy – the share of employment in the service sector in total employment (**EMSER7008**) – the expected negative influence on KP (in regression 9). This is logical since the service sector needs less investment in KP, but we did not find the expected negative effect on KH. Following the crowding out argument in the theory of the DD – as explained in 4.2 – worker migration should also decrease KH (in regression 10). Additionally, the higher negative coefficient on total GS compared with the one on KP indicates a negative background effect not shown in this model. However, since our sample not only includes resource-dependent but also industrialized countries with sophisticated service sectors such as finance or consulting that involve higher average investments in KH, this cancels any significant effects. Nevertheless, the positive link to the depletion of KN (in regression 11) additionally supports the theory of the DD.

As the only study known so far using GS as dependent variable in combination with explanatory variables for the RC, DIETZ ET AL. (2007) show that in interaction with resource-abundance, a lack of institutional quality is a serious factor for low rates of GS. They use a panel analysis to demonstrate that corruption is one of the major determinants negatively influencing GS and that a stronger rule of law also has a positive influence on GS. All three indices for corruption, rule of law and bureaucratic quality used by this analysis are measured in the same way.[39] Therefore, we put all three together to one index of institutional quality from 1984 to 2008 (IQ8408): As expected, higher institutional quality is linked to less depletion of KN (in regression 11) and higher education expenditures (in regression 10), showing that the total GS rate (in regression 8) is positively influenced by the quality of institutions. Clearly, good institutions are related to a greater diversification of the economy beyond depleting natural resources, which entails preserving parts of this stock and investing more in human capital for sophisticated production processes and services.

[39] Data is from the International Country Risk Guide by the Political Risk Service: http://www.prsgroup.com/CountryData.aspx.

Table 2: Dependent Variables: GDP, Genuine Savings and its components 1970-2008

	7	8	9	10	11	12
	GDP7008	**GS7008**	**KP7008**	**KH7008**	**KN7008**	**CARB7008**
Initial	-0.0006	0.22	0.14	0.57	0.31	0.61
	(2.52)**	(3.39)***	(2.9)***	(9.1)***	(2.65)***	(7.26)***
SXP7008	-5.82	-35.85	-12.01	0.84	25.77	0.47
	(-4.24)***	(-4.94)***	(-2.66)***	(0.91)	(4.54)***	(1.19)
TRADE7008	0.86	5.81	1.42	0.1	-3.82	-0.003
	(2.21)**	(2.9)***	(1.16)	(0.39)	(-2.49)**	(-0.03)
TOT8008	0.005	-0.57	-0.24	-0.002	0.22	0.003
	(0.1)	(-2.44)**	(-1.53)	(-0.05)	(1.23)	(1.41)
REMI7008	14.13	92.5	102.72	5.49	3.9	3.97
	(2.64)**	(3.64)***	(6.03)***	(1.52)	(0.21)	(2.58)**
CON7008	-10.18	-40.55	-68.24	0.09	-24.64	-0.73
	(-5.36)***	(-4.57)***	(-10.95)***	(0.07)	(-3.78)***	(-1.3)
INT7008	-0.21	20.68	3.83	-1.17	-12.85	0.11
	(-0.13)	(2.74)***	(0.75)	(-1.11)	(-2.29)**	(0.25)
EXCH7008	-0.02	-0.18	-0.15	0.01	0.02	0.0004
	(-1.44)	(-2.39)**	(-2.9)***	(0.48)	(0.4)	(0.1)
EMSER7008	-0.64	-13.75	-8.0	0.28	6.41	-0.38
	(-0.72)	(-3.45)***	(-3.0)***	(0.49)	(2.22)**	(-1.57)
IQ8408	0.13	0.42	-0.22	0.14	-0.51	-0.01
	(1.97)*	(1.95)*	(-1.59)	(4.5)***	(-2.81)***	(-1.0)
RL8408	0.54	1.24	-0.31	0.3	-0.1	-0.03
	(3.4)***	(2.11)**	(-0.79)	(3.22)***	(-2.1)**	(-0.87)
COR8408	0.27	1.45	-0.9	0.39	-2.11	-0.03
	(1.39)	(2.1)**	(-1.97)*	(3.65)***	(-3.7)***	(-0.73)
BQ8408	0.22	2.39	-1.1	0.74	-2.63	-0.1
	(0.78)	(2.58)**	(-1.76)*	(5.97)***	(-3.64)***	(-1.43)
POL7008	-0.01	0.41	0.02	0.05	-0.51	-0.002
	(-0.31)	(4.02)***	(0.22)	(3.45)***	(-4.87)***	(-0.37)
N	85	84	85	84	80	85
Adjusted R2	0.45	0.63	0.7	0.72	0.73	0.51
F-statistic	7.76	14.85	20.14	22.12	21.88	9.84

*** Significant at 0.01 level, ** at 0.05 level, * at 0.10 level (t-values in parentheses)

We also examine the single indices, only reporting their results and not the entirely new models, since the remaining outcome does not change substantially. In Table 1, rule of law (RL8408) positively influences GS through a decrease in the depletion of KN and higher investments in KH. Corruption (COR8408) shows the same signs but a stronger influence and an additional positive correlation to the investment in KP (in regression 9). Neither the coefficient nor the significance is high but it seems interesting that corruption could be related to further investment. Possible explanations are so-called "white elephants", investment projects with sinecures for certain interest groups but negative social surplus (ROBINSON and TORVIK 2005). While higher corruption, especially rent-seeking behavior, is directly related to higher depletion of KN (in regression 11), it also decreases investments in KH (in regression 10) and therefore the total GS rate (in regression 8). Bureaucratic quality (BQ8408) – related to corruption through patronage structures that hand official positions to interest groups – influences GS and its components slightly more in the same direction. In total, GS rates are positively influenced by higher quality institutions, but conversely to the study by DIETZ ET AL. (2007), bureaucratic quality plays the biggest role followed by corruption. This is not entirely unexpected due to large inefficient bureaucratic apparatuses created to serve various interest groups in resource-abundant countries, which increase the ratio of consumption through more publicly paid employees.

Additionally, due to evidence by DE SOYSA ET AL. (2010) that democracy influences GS rates positively, we exchange the quality of institutions with the democracy index Polity IV (**POL7008**). DE SOYSA ET AL. (2010) also use the individual components of GS as dependent variables, showing that democracies deplete less natural capital and invest more in human capital, as we also show in regressions 10 and 11. In total, the democratic status of a country positively influences its GS rate.

4.4. Summary

In using the average growth rate of GDP per capita, we show that the main results by SACHS and WARNER (1995/1997) hold true, also for the period from 1970 to 2008. By nature of its calculation, GS is intuitively more closely related to the exports of natural resources. Our analysis estimates a decrease between 1.4% (Table 1) and 3.5% (Table 2) in the average GS rate for a 10% increase in the average share of primary exports in GNI between 1970 and 2008. For most of the control variables, the same signs apply as in the original studies. However, the growth rate of terms-of-trade decreases GS due to the composition of exported K_N and imported consumption goods as well as capital goods as reinvestments in K_P. The consumption share of real GDP is highly significantly, negatively related to the rate of GS since higher consumption decreases reinvestments. Public expenditure policies dividing the governmental budget into consumption and investment as well as private saving and investment decisions depend partially on interest rates. Higher interest rates cause an increase in savings and have a positive effect on the total GS rate. The appreciation of the exchange rate influences GS negatively through decreasing investments in K_P caused by an increase in imported consumption. Migration of workers from the manufacturing sector into the service sector shows the expected negative influence on K_P since the service sector requires less investment in produced capital. The positive link to the depletion of K_N supports the theory of Dutch disease. Table 3 shows an overview of all significant coefficient signs from both tables.

As expected, better institutional quality is linked to less depletion of natural capital and higher education expenditures, showing that the total GS rate is positively influenced by the quality of institutions. Surprisingly, bureaucratic quality plays a more important role than in earlier studies. For the period investigated by our analysis, corruption-related patronage structures handing official positions to interest groups seem to influence GS and its components more than corruption itself or a functioning rule of law. Increased quality in bureaucratic services and institutions negatively influences reinvestment in K_P since most countries with high quality institutions already have large stocks in produced capital. However, countries with stable institutions and democratic structures deplete less natural capital and invest more in human capital and therefore have higher GS rates.

In summary, independent of the control variables used, the average share of primary exports in GNI between 1970 and 2008 negatively influence the average rate of GS as an indicator for sustainable development. Integration into international trade, its mere size as well as the proportion between exports and imports play an important role here, equal to the comparison between investment and consumption. Even if it is difficult to show Dutch disease effects empirically, higher ratios of consumption in additional income, an appreciation of the exchange rate as well as a higher ratio of employment in the service sector influences GS rates negatively. In contrast, democracy, a functioning rule of law, low rates of corruption and the quality of the bureaucratic apparatus influence sustainable development rather positively.

Table 3: Overview of regression results*

	GDP7008	GS7008	KP7008	KH7008	KN7008	CARB7008
Initial	-	+	+	+	+	+
SXP7008	-	-	-		+	
TRADE7008	+	+	+		-	
TOT8008		-			+	
REMI7008	+	+	+			+
INV7007	+					+
CON7008	-	-	-		-	
INT7008		+			-	
EXCH7008		-	-			
EMSER7008		-	-		+	
IQ8408	+	+		+	-	
RL8408	+	+		+	-	
COR8408		+	-	+	-	
BQ8408		+	-	+	-	
POL7008		+		+	-	

* Signs listed for coefficients that are at least significant at 10% level.

4.5. Conclusions

On the one hand, we show that the curse of natural resources does not only retard economic growth but also depreciates a country's capital stock and thereby its basis for future growth. We confirm that theories and factors behind the RC are assignable to the concept of GS. We also show how single components of a country's capital stock are influenced by the RC. Table 3 sums up possible determinants of this index concept for "weak" sustainability, suggesting further research in this direction, especially whether or not (and how) countries dependent on natural resource exports are able to realize positive GS rates. Therefore, structures for reinvestment in physical and human capital at least equalling the size of depleted natural capital have to be identified.

On the other hand, in using Genuine Savings and the changes in physical, human and natural capital as dependent variables, we additionally show that this combination of dependent variables is a more appropriate approach to explain the RC than regressions on GDP alone. We strongly recommend using a combination of GDP and GS as dependents in further studies on the RC, since not only the selection of explanatory variables is important to prove theoretical concepts.

Where our results differ from those derived from studies on GDP, the theoretical background offers an explanation. On the whole, the estimated results meet our expectations. We gain several insights into the mechanism of the RC via the division into the three capital types. However, we worked with a broad basis, testing several variables in order to confirm our theory and method. We do not dig deeper into special relationships apart from one example of Dutch disease. Therefore, we strongly recommend further investigation of GS and its components for two reasons: Shrinking GS constitute an early sign for eroding the capital stock for sustained development. Even without observable RC effects, this should be considered an economic warning for the respective country. Using the three types of capital allows learning more about the mechanisms behind the RC. Knowing these in more detail might enable us to better prevent economies from suffering. It facilitates gathering more a priori information for case studies. Overall, further research in this field supports better policy recommendations.

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5. The Zambian Resource Curse and its influence on Genuine Savings as an indicator for “weak” sustainable development

Abstract The empirical evidence that economies predominantly reliant on their natural resources are characterized by slower economic growth—the so-called Resource Curse (RC) – is in many ways confirmed by the case of Zambia. Haber and Menaldo (2011) identify Zambia’s extreme dependence on copper exports as one of the worldwide most striking examples for a country suffering from this ‘‘curse.’’ In topical literature, the RC is traced back to the generation of natural resource rents regardless of economic performance, which among other problems leads to suboptimal reinvestment. The World Banks indicator for the ‘‘weak’’ sustainable development of a country—the so-called Genuine Savings (GS)—considers exactly this reinvestment of rents from the depletion of natural capital rents into physical or human capital. Although it has been shown empirically that countries dependent on primary exports on average feature negative GS rates and that the determinants of the RC influence both present economic growth and future sustainability as measured by GS, no case studies have been conducted to confirm this. Against this background, we qualitatively survey the relationship between the most discussed determinants causing the RC in Zambia and the country’s GS rate. We show that all theoretical relationships between the GS rates of a country and RC determinants such as consumption behavior, volatile world market prices, the so-called Dutch disease as well as political and institutional structures apply to Zambia between 1964 and 2010: an extreme dependency on copper exports and insufficient reinvestments of income from the depletion of Zambia’s natural capital constitutes one of the main reasons for slow growth and negative GS until the copper price booms in the second half of the 2000s.

“We are in part to blame, but this is the curse of being born with a copper spoon in our mouths.”

Kenneth Kaunda

Former President of Zambia

5.1. Introduction[40]

SACHS and WARNER (1995/1997) show in their renowned cross-country analysis ‘‘that economies abundant in natural resources have tended to grow slower than economies without substantial natural resources.’’ This so-called Resource Curse (RC), namely that economies predominantly reliant on exports of their natural resources are characterized by slower economic growth, is in many ways confirmed by the case of Zambia. HABER and MENALDO (2011) identify Zambia’s extreme dependence on copper exports, reaching an average of 33 % of its Gross National Income (GNI) between 1964 and 2012, coupled with a decrease in real per capita income in the same period, as one of the world’s most striking examples of a country suffering from this ‘‘curse.’’ Theoretically, the RC can be traced back to the argument that natural resources generate rents regardless of economic performance, which leads among other problems to suboptimal reinvestment.

The WORLD BANK (2011a) indicator for the ‘‘weak’’ sustainable development of a country – the so-called Genuine Savings (GS) – considers exactly this reinvestment of rents from the depletion of natural capital into physical or human capital. Thereby, GS incorporates negative rents from the depletion of natural capital (K_N) and positive reinvestment in physical (K_P) and human capital (K_H) to represent investment in future development. As a result, positive GS rates theoretically forecast a sustainable development path (HAMILTON and ATKINSON 2006). However, recent studies such as ATKINSON and HAMILTON (2003) or NEUMAYER (2004) demonstrate the intuitive negative relationship between the RC and GS. Disproportionately high numbers of countries richly endowed with natural resources show negative GS rates (NEUMAYER 2010). However, only a few publications such as DIETZ ET AL. (2007) or SOYSA ET AL. (2010), but especially BOOS and HOLM-MÜLLER (2012, 2013), show a direct relation between GS rates and theories or hypotheses behind the RC.

These publications determine the relationship and use this information to analyze direct relations between determinants held responsible for the RC and the individual components in the calculation of GS. However, the relationship between the RC and GS has only been discussed theoretically and analyzed empirically in cross-country studies (BOOS and HOLM-MÜLLER 2012, 2013). None of these relationships has been discussed in detail or – as BOOS and

[40] If not noted otherwise, all data in this paper are taken from the World Development Indicators 2014 (WORLD BANK 2014a) found in the World Bank database: http://data.worldbank.org/data-catalog/worlddevelopment-indicators.

HOLM-MÜLLER (2013) use datasets of more than one hundred countries – analyzed in the isolated case of an individual country. To our knowledge, the paper at hand is the first case study investigating the development of determinants causing the RC and its relationship to the GS rate of a resource-dependent country. Contrary to cross-sectional studies, a detailed discussion within a case study provides additional opportunities to examine this relationship qualitatively without being constrained by the structures and assumptions of econometric models. For example, BOOS and HOLM-MÜLLER (2012) discuss the theoretical importance of short- and medium-term volatility of international market prices for the calculation of GS, but they are only able to prove this empirically by examining terms of trade over the long run (2013). In the case of Zambia, we are able to show that copper depletion and therefore GS rates reacted extremely volatile on copper prices, even in the short run.

Since the first extensive analysis on the RC, Zambia is a regular case study for mineral-dependent countries (AUTY 1993).[41] The most recent case studies on the Zambian RC by CALI and TE VELDE (2007) and WEEKS (2008) analyze the copper price boom in the 2000s, the resulting so-called Dutch disease.[42] More recently, the paper on upstream linkages by FESSEHAIE (2012) examines diversification in the Zambian mining industry, but addresses neither the country’s copper dependence nor the resulting RC. Since GS is not analyzed in any of these publications, we on the one hand contribute to the case study research on the Zambian RC and on the other hand provide a case study on the determinants of a country’s GS rate, to our knowledge the first case study in this area.

One could argue that existing cross-country analyses—as presented for example by DIETZ ET AL. (2007) or BOOS and HOLM-MÜLLER (2013)—already identify relationships between the RC and GS and therefore a case study of only one country could not contribute to the existing literature. However, cross-country studies only examine the research question from a broader angle using averages across the analyzed data set. And while the global average of positive GS rates lies within an acceptable area, namely 9 % of GNI for the period from 1964 to 2012, Zambia, as an extremely copper-dependent country, showed a GS rate of -3 %. With this GS rate, Zambia ranked as the seventeenth worst country over this period of more than for decades. Within the illustrious group of the bottom twenty, Zambia proved the country with the most available data for an analysis on the relationship between the RC and GS.

[41] Other case studies have been conducted by MCPHERSON (1993), SHAFER (1994), FOX and GREENBERG (2001), and the WORLD BANK (2011c).

[42] The Dutch disease model is the original and most prominent theory behind the RC presented by CORDEN and NEARY (1982) and CORDEN (1984), which we present and analyze in detail in Sect. 4.2.2.

We analyze the relationship between the RC and GS tracing the course of Zambian economic history from independence in 1964 to the most recent data in 2012, a period within which Zambia shows negative average GS rates. We analyze this entire period using the theories and hypotheses behind the RC and its relationship to the different forms of capital in the calculation of the Zambian GS rate. The hypothesis we aim to prove is that these theories and earlier empirical results could be used to explain the situation in resource-dependent countries such as Zambia better than conventional approaches, but the most important aim is to determine whether the theoretical framework and empirical model by BOOS and HOLM-MÜLLER (2012, 2013) still hold true in the individual analysis of a highly resource-dependent country affected by the Dutch disease. In contrast to the research design of cross-country analyses, this offers room for qualitative discussion that digs deeper into certain special relationships, and we show that most of the theories relating the RC to GS do in fact apply to the Zambian situation.

The methodology or research design of the paper follows this hypothesis. We begin with a short overview of Zambia and its dependence on copper exports, followed by the theoretical background and calculation method of GS. In this section, we directly present the data on Zambia's GS rate and exhibit the relation between Zambia's copper exports and mineral depletion within the GS calculation. After a short overview on the theoretical background of the RC, the main section of our case study analyzes the applicability of the theories and hypotheses behind the determinants held responsible to cause the RC on the development of Zambia's GS rate. We therefore use the theoretical framework of BOOS and HOLM-MÜLLER (2012), separating the explanations into exogenous and endogenous parts. We demonstrate that the RC determinants influence Zambia exactly as the theory would expect.

5.2. A brief overview of Zambia

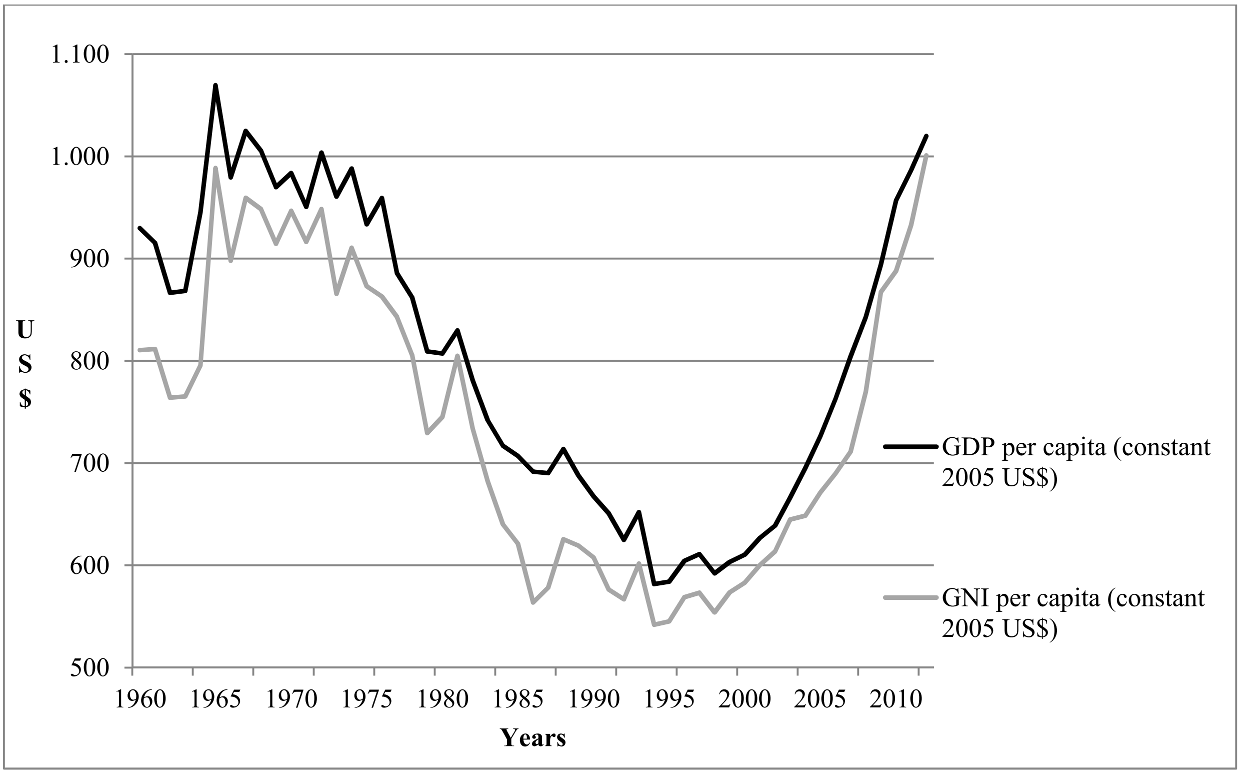
5.2.1 General considerations

Zambia is a tropical and landlocked country in Southern Africa with an area of 752,618 km^2 and a border totaling a length of 5.664 km.[43] It is mostly flat on a high plateau with few hills (the highest point is 2.301 m above sea level) and the origin of the Zambezi, Africa's fourth longest river, which also constitutes, at 329 m, the lowest point in the country (HOLMES and WONG 2008). A total of 1.3 % is covered by water, while 30 % of Zambia consists of agricultural land and more than 60 % is covered by forest. According to MCPHERSON (2004a),

[43] Zambia borders on Angola, Botswana, DR Congo, Malawi, Mozambique, Tanzania and Zimbabwe.

agricultural output did not increase in the first two decades after independence. Due to population growth, food production per capita decreased. In the period analyzed here, agricultural outputs doubled between 1964 and 2012, while the population quadrupled. Only in the years since the mid-2000s has Zambia's food security begun to improve. The total population increased by a yearly average of around 3 % from 3.4 Mio. in 1964 to 14.1 Mio. in 2012, with a life expectancy at birth of only 48 years in the 2000s due in large part to an HIV/AIDS rate of 13.5 %.

Figure 21: Zambia's GDP and GNI per capita from 1960 to 2012.



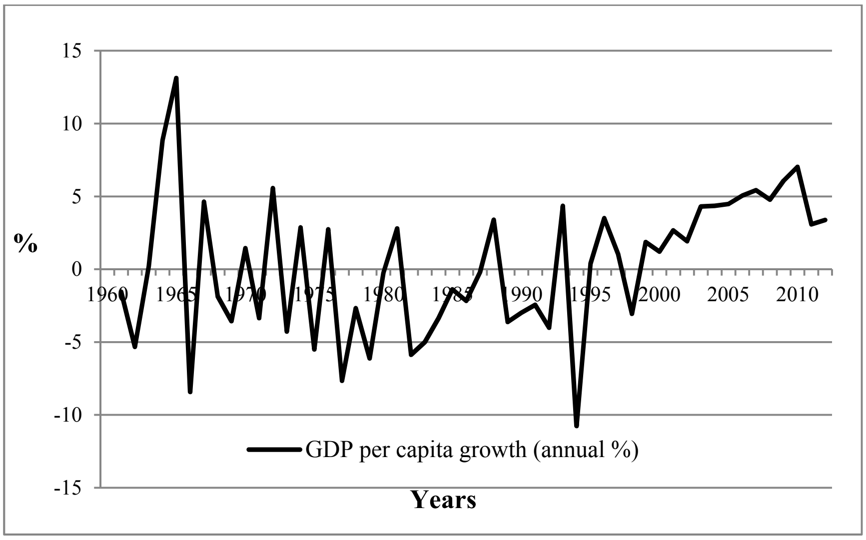
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

From World War II until the copper price shock in the mid-1970s, Zambia was one of the fastest growing economies worldwide. Permanent saving and investment rates reached more than 30 %, and in 1964 it became independent with one of the highest per capita incomes in Sub-Saharan Africa. However, today Zambia is not only one of the poorest countries worldwide, but the only country other than Iraq and North Korea that has seen its Human Development Index[44] decrease since the 1970s (HILL and MCPHERSON 2004). Over the period we examine, Zambia's real GDP per capita (in constant 2005 US$) decreased from US$ 1070 in

[44] The Human Development Index is an indicator provided by UNDP that includes life expectancy, education, and different income indices used to rank the human development of countries: In 2012 Zambia ranked 143 out of 187 countries.

1965 to US$ 1020 in 2012. Although it is difficult to compare the income of a country over four decades, Fig. 21 shows that Zambia's real GDP and GNI per capita only grew from the 1960s until the copper price shock in the mid-1970s, and again in the 2000s due to the increase in copper demand from China and India. GDP proved highly volatile and positive growth only stabilized in the 2000s, as Fig. 22 illustrates. In later sections, we show that these fluctuations relate strongly to the volatility of world copper prices. In the four decades considered in the following analysis, only the income in current US$ increased. While real income decreased, Zambia relied on copper exports at an average rate of 33 % of its GNI.

Figure 22: GDP growth from 1960 to 2012.

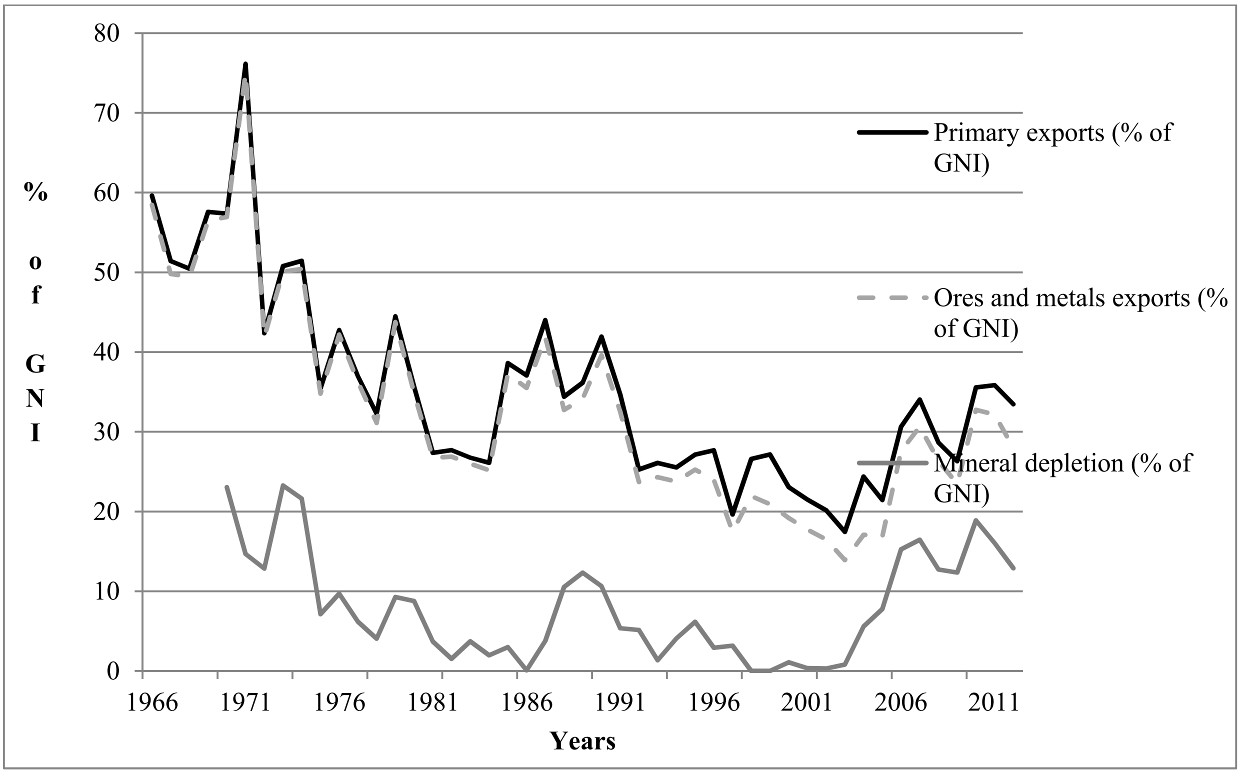


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

5.2.2 Zambia's dependence on copper

Copper production already started to decrease at the beginning of the 1970s due to mismanaged mines and a lack of investment in the period following independence. As Fig. 23 shows, ores and metals exports collapsed beginning with the copper price shock in the mid-1970s, and remained subdued in the following two decades. According to AUTY (1993), Zambia was unusually dependent on its copper reserves in the years after independence, with three-fifths of its revenues stemming from copper. In 1974, the dependence of Zambia's GNI on primary exports was still over 50 %, which decreased to 35 % in 1975 and remained below an average of 30 % until the increase in the mid-2000s (from 22 % in 2005 to 34 % in 2012), when prices again increased. As Fig. 24 shows, the real-world market prices of copper collapsed by almost 50 % between 1974 and 1975, and by another 50 % until the mid-1980s (MIKESELL 1988). This had a negative influence not only on copper exports, but also on Zambian GNI. In 1975, real income per capita decreased by 5.5 %, followed by a decade with an average decline of 3.3 % per year. Although income per capita again rose in the 2000s (by an average of 5.4 % annually), the period in between was characterized by volatile changes in income per capita, as shown in Fig. 22. Zambia's primary exports consisted mainly of ores and metals (95 % copper) for the period analyzed, which made up almost 98 % of total merchandise exports in 1966 (58 % of GNI). This increased to a peak of 99 % in 1970 (57 % of GNI), decreased to 63 % at the end of the 1990s (23 % of GNI), and grew rapidly to more than 80 % in the second half of the 2000s. The top three export commodities between 2008 and 2012 were different copper products, which accounted for more than 28 % of GNI on average over the last 5 years of our analysis.[45] Therefore, the share of primary exports in GNI – the key figure for the RC by SACHS and WARNER (1995/1997) – is extremely high in the case of Zambia and determines the depletion of the country´s natural capital (as one of the components of the calculation of GS).

Figure 23: Primary exports & mineral depletion from 1966 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

[45] In 2010, of a total of US$ 7.2 billion in commodity exports, the top ten primary exports account for US$ 6.4 billion; refined copper alone amounting to US$ 4.6 billion. Source: UNITED NATIONS COMTRADE INTERNATIONAL MERCHANDISE TRADE STATISTICS: http://comtrade.un.org/pb/CountryPagesNew.aspx?y=2010.

As the first to analyze the RC empirically in detail, Sachs and Warner (1995/1997) show in their renowned cross-country analysis that an increase in these share of primary exports in GNI results in a decline of per capita GDP growth.[46] As a general rule, the negative relationship between resource dependence and economic development is the key point of the RC that academics have sought to explain since. Figure 23 shows Zambia's high level of dependence on ores and metals exports and therefore mineral depletion, amounting to an average of 33 % and almost 8 % of GNI over the period from 1970 to 2012. Dependence to this extent can become a handicap for a country's own development, as industrial progress is not necessary to continue generating national income. Or as SACHS and WARNER (2001, p. 833) put it most precisely: ''Natural Resources crowd out activity x. Activity x drives growth. Therefore Natural Resources harm growth.'' In a classic model – dubbed the Dutch disease – CORDEN and NEARY (1982) and CORDEN (1984) show that a boom in the depletion of natural resources and thereby export revenues crowd out activities and development in non-primary sectors and therefore harm growth.[47] To simplify, the income from natural resources prevents engagement in other sectors and attracts investment and human capital needed to develop these sectors. In 2012, the income from primary exports amounted to more than US$ 8 billion, or 34 % of the Zambian GNI. However, with a GINI index of more than 57 in 2010, clearly this income does not disperse and benefit of the greater population, rather it flows to a small dominant clique with access to Zambia's copper mines.[48]

The case of Zambia is one of the most prominent RC examples in literature; nearly every general text on the topic lists the copper-dependent country as one of those affected by the RC. The general literature agrees on the importance of natural capital as a principal source of income for developing countries such as Zambia. A large number of publications, which we consider partially in our analysis later on, show general evidence that economic performance has frequently been inversely related to natural resource endowment. Regardless of country-specific reasons (or determinants) that result in the RC, consensus on one crucial point has been

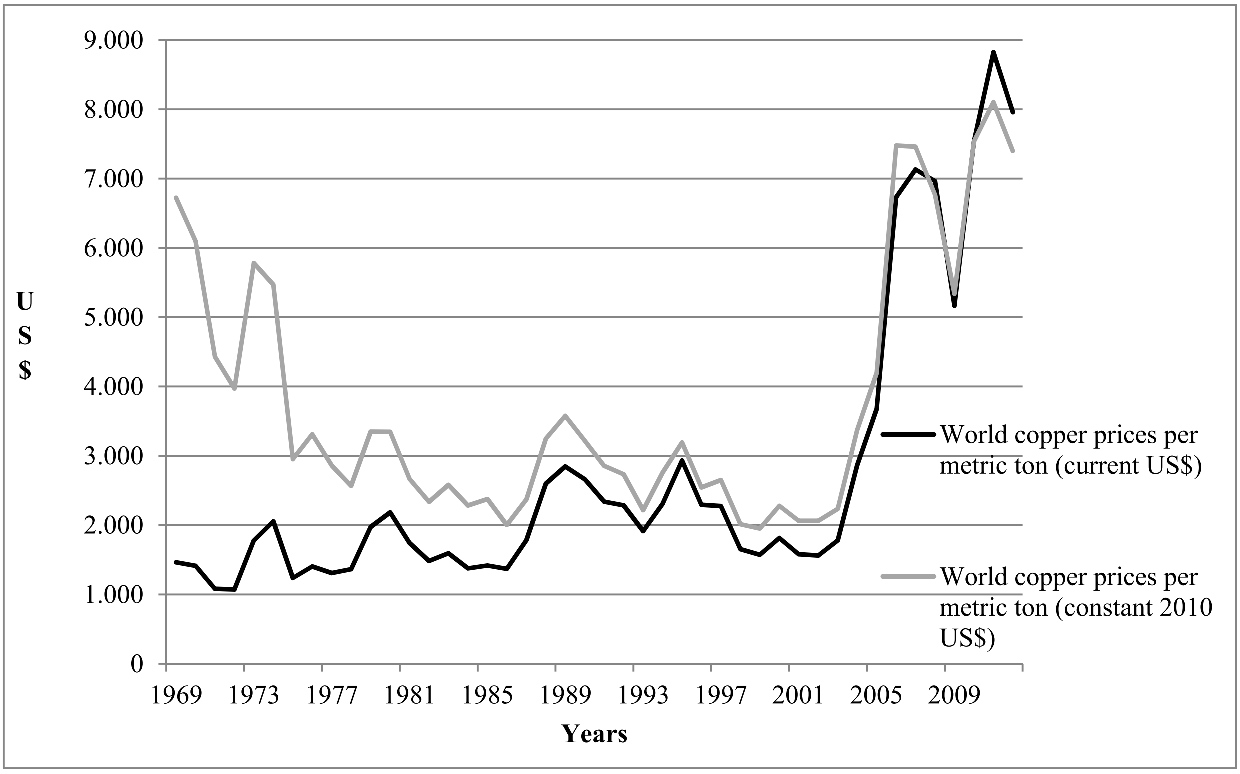
[46] SACHS and WARNER (1995/1997) show a consistent decrease of more than 1 % of GDP growth with a 10 % increase in the average share of primary exports in GNI, regardless of which additional explanatory variables are used in the model. This correlation is not as high in the study by BOOS and HOLM-MÜLLER (2013), who show only a 0.3 % decrease for a larger sample and longer time series. However, they demonstrate the additional relationship between primary exports and GS rates. With samples featuring between 84 and 103 countries in models with up to eleven explanatory variables, BOOS and HOLM-MÜLLER (2013) estimate an average decrease in GS rates by 1.4 % if primary exports increase by 10 %.

[47] The rather famous name of this model (described in detail in CORDEN 1984) – Dutch disease – originates from the decline in the Dutch manufacturing sector after the discovery of new sources of natural gas in the North Sea (THE ECONOMIST 1977).

[48] The GINI index measures the extent to which the distribution of income among households within an economy deviates from a perfectly equal distribution; a GINI index of 0 represents perfect equality, while an index of 100 implies perfect inequality.

reached: ''for sustainable economic development, income from nonrenewable resources must be reinvested, not used to fund consumption'' (WORLD BANK 2011a, p. 15). In principle, Zambia should transform its natural capital, namely the income from copper, into other forms of more sustainable capital so that other sources of income exist once the copper supply is exhausted. The depletion of copper is not sustainable, but the income from it can be invested in other forms of capital (WORLD BANK 2011a).

Figure 24: Primary exports & mineral depletion from 1966 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

5.3. Genuine Savings in Zambia

5.3.1 Theory

GS is a concept that follows exactly this line of thought and attempts to make the idea of ''weak'' sustainability (WS) more concrete and measurable. The theory of WS assumes that different forms of capital are in principle substitutable and only the maintenance of the total capital stock – consisting of physical, human and natural capital – is important to provide future utility. The so-called ''HARTWICK rule'' (1977) provides a ''rule of thumb'' for WS: A country's total capital stock should be held at least at a constant level by investing as much or more into all forms of capital as consumption or depletion of all forms of capital, which in turn allows for sustained consumption over time (NEUMAYER 2010, p. 127). The WORLD BANK (2006, 2011a) estimated total capital stocks for more than 120 countries in 2005. Zambia was one of the poorest countries surveyed with a total capital stock of US$ 113 billion (US$ 9678 per capita). Its per capita wealth is comprised of US$ 1482 physical, US$ 2142 natural and US$ 6961 intangible capital (human, institutional, etc.).[49]

GS shows the reinvestment of depleted natural capital into other forms of capital (DIETZ ET AL. 2007) and is considered by the World Bank to show the annual changes in countries' total capital stock, or the ''wealth of nations'' (WORLD BANK 2006). Therefore, GS as calculated by the World Bank also provides information on the potential for future sustainable development in RC affected countries (BOOS and HOLM-MÜLLER 2012).

The first ''intuitive rule for determining whether a country is on or off a sustainable development path'' came from PEARCE and ATKINSON (1993, p. 104), who ''adopt a neoclassical stance and assume the possibility of substitution between 'natural' (K_N) and 'manmade' (K_P) capital,'' so that if ''the combined depreciation on the two forms of capital'' is lower than a country's savings (S), the condition for ''weak'' sustainability (WS) is fulfilled:

$$WS \geq 0 \;\; iff \;\; S \geq (\delta K_N + \delta K_P) \qquad (24)$$

Hamilton (1994), Pearce et al. (1996) and Hamilton and Clemens (1999) expand Equation (24) by investment in human capital and abatement costs for pollution damages. Based on Gross National Income (GNI), GS – based on the World Bank definition – theoretically includes the rates of change for the three forms of capital, physical (K_P), human (K_H) and natural (K_N) (Bolt et al. 2002; World Bank 2006, 2011a, 2014a). GNI minus private (C_P) and public (governmental) consumption (C_G) plus net current transfers (NCT)[50] results in Gross National Savings (GNS). The subtraction from GNS of the depreciation of K_P, such as buildings, machines or infrastructure, leads to a country's Net National Savings (NNS) (Hamilton and Clemens 1999). Investment in K_H is measured by current operating expenditures in education, including teachers' wages and salaries, but excluding capital investments in buildings and equipment. Together with NNS, investment in K_H must compensate for natural resource depletion to provide GS.

[49] The global average lies at a total of US$ 115,484 (physical: US$ 20,329; natural: US$ 7119; intangible: US$ 88,361) per capita (WORLD BANK 2011a).

[50] NCT comprise all exchanges with foreign countries of goods and services as well as income and financial items without a quid pro quo (WORLD BANK 2014a).

To deduct the depletion of natural resources (δK_N), GS uses the rents (R_N) from the disposal of energy,[51] mineral[52] and forest[53] resources. R_N is calculated by multiplying the actual world market prices (P) minus region-specific average production costs (AC) to demonstrate the decrease in the natural capital stock:

$$R_N = ((P - AC) * Production\ Volume) \qquad (25)$$

To adapt these current rents to the remaining natural resource stock, the present value (PV) of R_N (discounted at 4 %) is put in relation to the remaining resource stock:

$$\delta K_N = PV\ \frac{R_N}{exhaustion\ time\ of\ the\ resource\ stock}(reserves/\ production, capped\ at\ 25\ years) \qquad (26)$$

In total, GS is calculated as follows:

$$GS = (GNI - C_P - C_G + NCT) - depreciation\ of\ K_P + education\ expenditures\ (\delta K_H) - \delta K_N \qquad (27)$$

With:

$$WS\ \geq 0\ \ iff\ \ GS\ \geq\ 0 \qquad (28)$$

The direct relationship between determinants of a possible RC and the GS rates of a resource-dependent country is intuitive. Higher depletion of δK_N affects GS negatively. In the following, we show the development of the individual components of Zambia's GS rate.

5.3.2 Empirical information

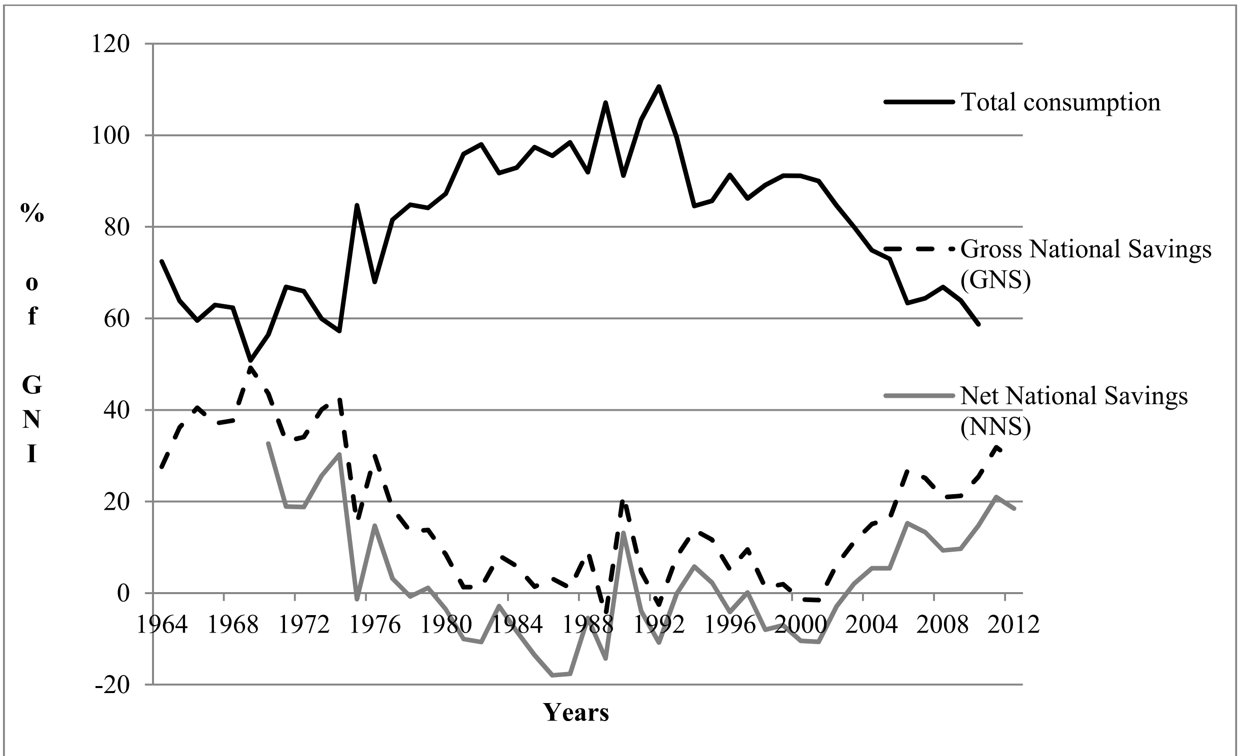
Gross National Savings (GNS), which decreased in the final years before independence as British capital left the country, was still at a high positive share of almost 28 % of GNI in 1964 and grew until the end of the decade. However, according to the calculation by the WORLD BANK (2014a), Zambia's GNS and NNS (available since 1970) both shrank in the 1970s, as shown in Fig. 25. According to MCPHERSON (2004a), domestic investment remained above 30 % of GNI until the mid-1970s, when GNS and NNS also collapsed. Total consumption expenditures, which initiated at an average of 65 % (50 % private and 15 % public) in the

[51] To date, this covers coal, crude oil, and natural gas.
[52] This covers bauxite, copper, iron, lead, nickel, phosphate, tin, zinc, gold and silver.
[53] Roundwood harvest minus natural growth; this is set to zero if growth exceeds depletion (WORLD BANK 2014a).

1960s, increased until partly even higher consumption than total GNI and declined again after 2002, as we show in Fig. 25.

As a result, GNS decreased until reaching negative values in 2000/2001.[54] A rather constant depreciation of K_P by an average of 11 % therefore resulted in a negative NNS rate over almost the entire analyzed period until 2002. Due to high demand by China and India, copper prices have risen since 2003 and – since higher income corresponds with increased spending – consumption almost quadrupled, but as a share of GNI it declined from an average of more than 95 % in the 1980s and 1990s to 74 % (63 % private and 11 % public) in the 2000s.[55] Therefore, GNS and NNS have been increasing since 2002: NNS was not only positive for nearly the first time since the end of the 1970s, it also increased immensely to an annual average of 11 % of GNI between 2003 and 2012. This could be interpreted as a sign that Zambia invested more in its K_P than it depreciated. However, until the start of the new millennium, consumption was extremely high relative to GNI, which came at the expense of investments.

Figure 25: Zambia’s consumptions, GNS & NNS from 1964 to 2012.



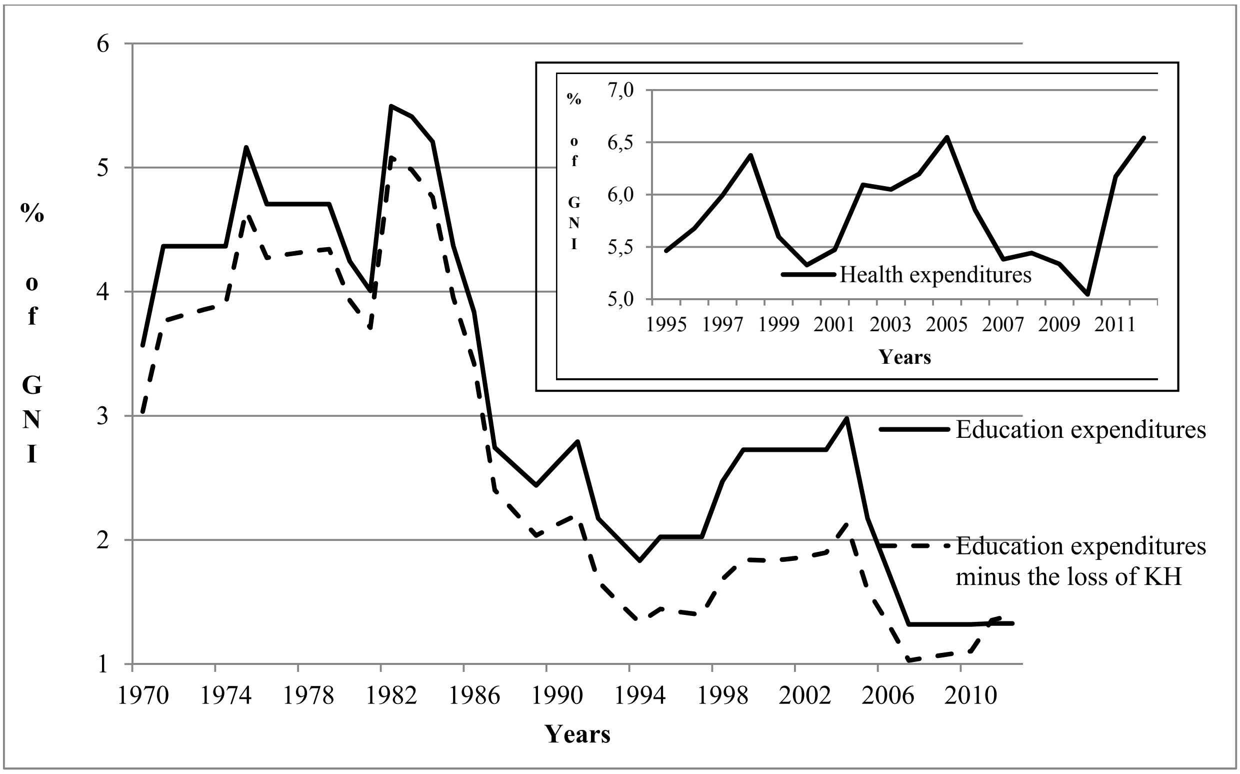
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

[54] The total average for the period between 1964 and 2012 was around 11 % of GNI, far below the world average of 23 %.

[55] The total average was approximately 80 %, below the world average of 85 % and only slightly above the 78 % average of the high-income OECD countries. Compared to other African countries such as neighboring Mozambique with an average of 110 %, this is rather low.

As the opposing trends of consumption and GNS in Figure 24 show, until the 1990s consumption increased while savings decreased. Directly after independence, the Zambian government invested in economic diversification and social development such as the education and healthcare system (TAYLOR 2006). Additionally, a mineral revenue stabilization fund was launched to save one-third of the income from copper to hedge against economic downturns (AUTY 2008). However, the mineral price shock arrived too soon after independence, so that revenues from mining decreased quickly without proper alternatives and the mineral revenue stabilization fund was rapidly consumed (AUTY 1993). In the mid-1980s, Zambia's president Kaunda apologized in the ''Times of Zambia'' (May 19, 1986), stating that the government subsidized consumption for too long at the expense of investment and economic diversification; conversely, he assured the population 3 years later that he would stop investments to fight the more urgent hunger problems (MCPHERSON 2004a). As we will see later on, Zambia's government mostly reacted to the development of copper prices, but lacked a vision to invest larger amounts in other sectors during periods of increasing prices.

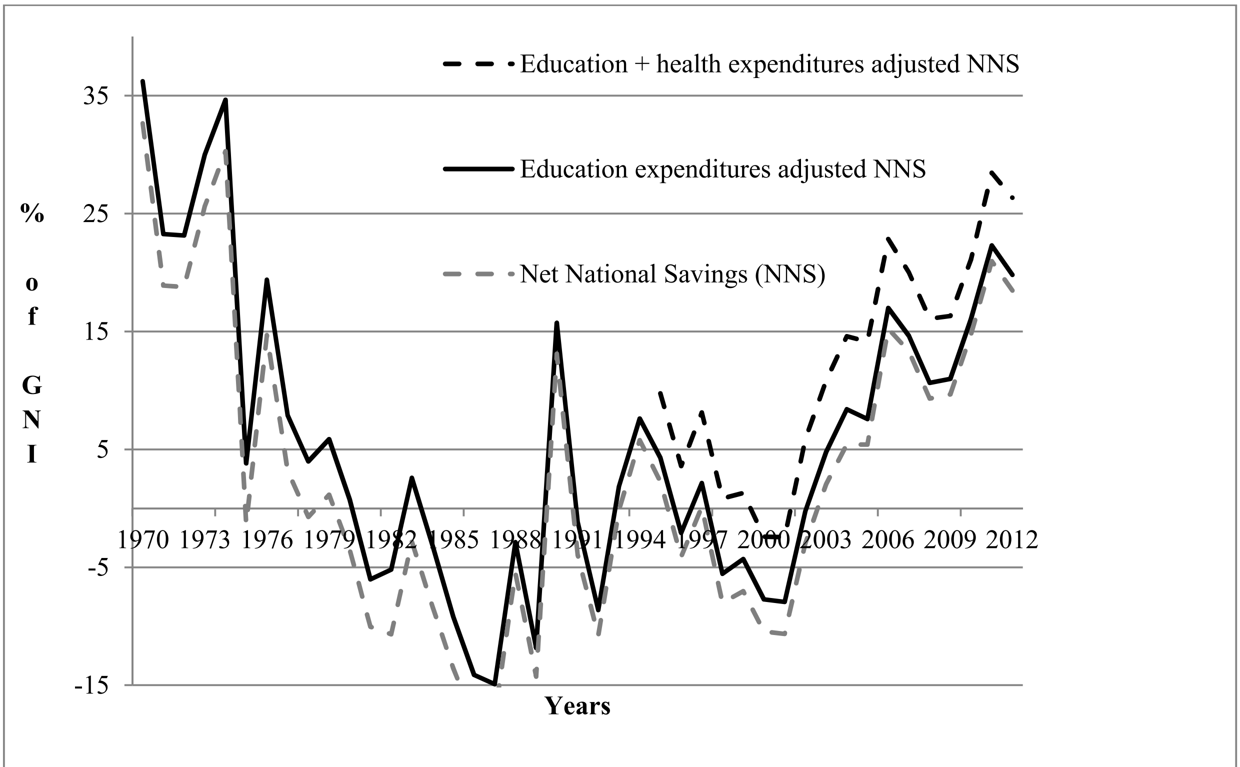
Figure 26: Education & health expenditures from 1970 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

It is clear that not only NNS will be negative if the depreciation of K_P is higher than the amount of investment in physical capital, but also that GS can only be positive if the Zambian government were to spend enough on human capital (K_H) to offset negative NNS and natural resource depletion. GS tallies current operating expenditures on education as a rather crude approximation for investment in K_H, as shown in the education expenditure-adjusted NNS (ANNS) in Fig. 27.[56] Figure 26 shows education expenditures used by the World Bank as well as our own version, which subtracts the loss of K_H due to low life expectancy rates. Figure 26 shows that the 3.1 % average investment in K_H between 1970 and 2012 would be consistently around 0.5 % lower if we deduct 2.5 %[57] of education expenditures for every year Zambia's life expectancy at birth is below the retirement age of 55. Life expectancy reached approximately 48 years in the 2000s. It increased slightly in the 1970s and 1980s and dropped again in the following decade, partly caused by the HIV/AIDS rate of 13.5 %, but also due to a rather desolate healthcare system with a child mortality rate of 11 % until the age of 5. On the whole, the average Zambian does not work until the retirement age of 55.

Figure 27: Human capital adjusted NNS from 1970 to 2012.



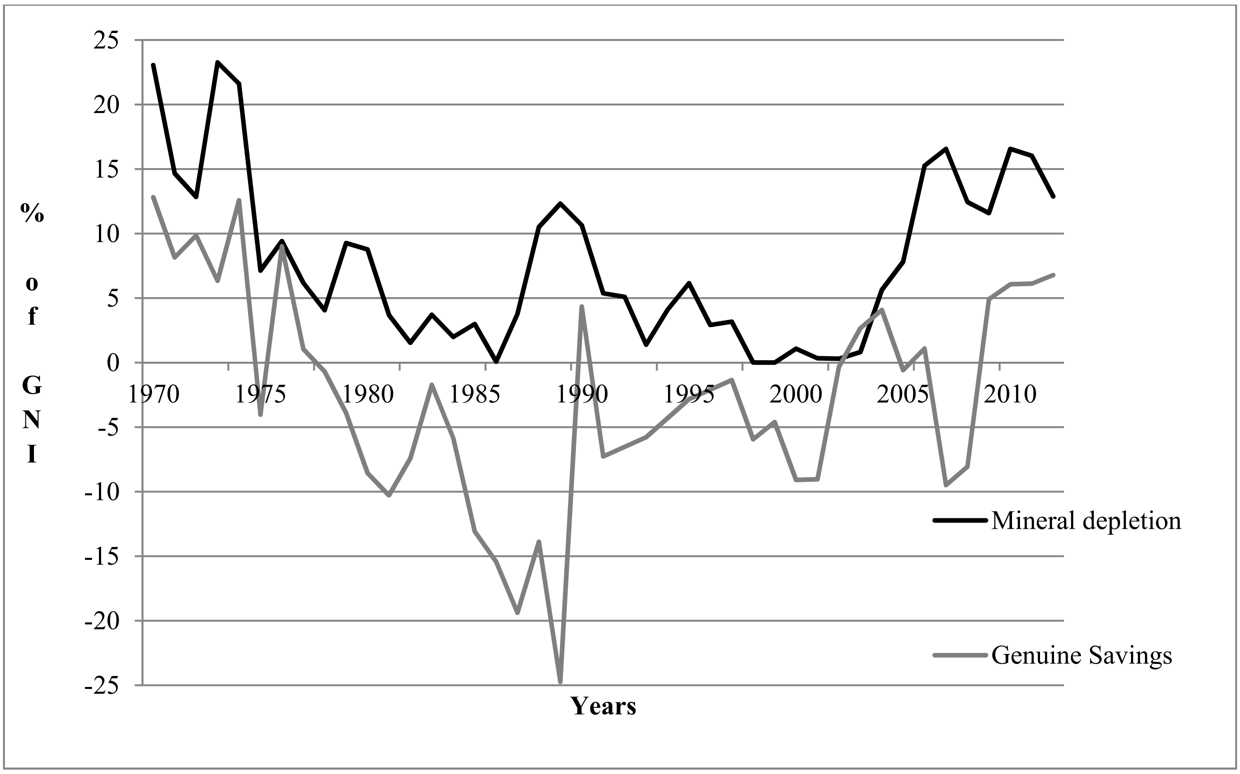
Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

[56] We do not discuss the contents of GS in general, for a critique of the calculation method see BOOS (2015). However, it is disputable whether investment in K_H should only be defined by education expenditures and if this only counts for a working life or not (DASGUPTA 2004; O'SULLIVAN and SHEFFRIN 2007). We argue with BAIRD ET AL. (2011) that health and income are strongly related and in a situation like Zambia's, health expenditures also comprise investment in K_H. We also show in Figs. 26 and 27 not only the adjusted NNS (ANNS) with education, but also including health expenditures, which results in an average difference of 6.7 % of GNI (available since 1995).

[57] Dividing 100 % of expenditures by the average 40 years of a Zambian's working life (the Zambian retirement age of 55 minus the UNESCO definition of the beginning of a working life at 15) ascribes 2.5 % of education expenditures to every working year.

While Zambian health expenditures were neither extremely volatile nor below the world average (5.8 % of GNI from 1995 to 2012), education expenditures declined beginning in the 1980s. Due to strong efforts by the Zambian government to invest sufficiently in education to secure sustainable growth in the first two decades after independence, education expenditures, at an average of 4.5 % of GNI, remained only slightly below the world average of 5.2 % in this timeframe. In the following two decades this decreased to an average of 2.2 % and as far as 1.3 % in the last 5 years of our analysis.

Figure 28: Natural capital depletion and GS from 1970 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

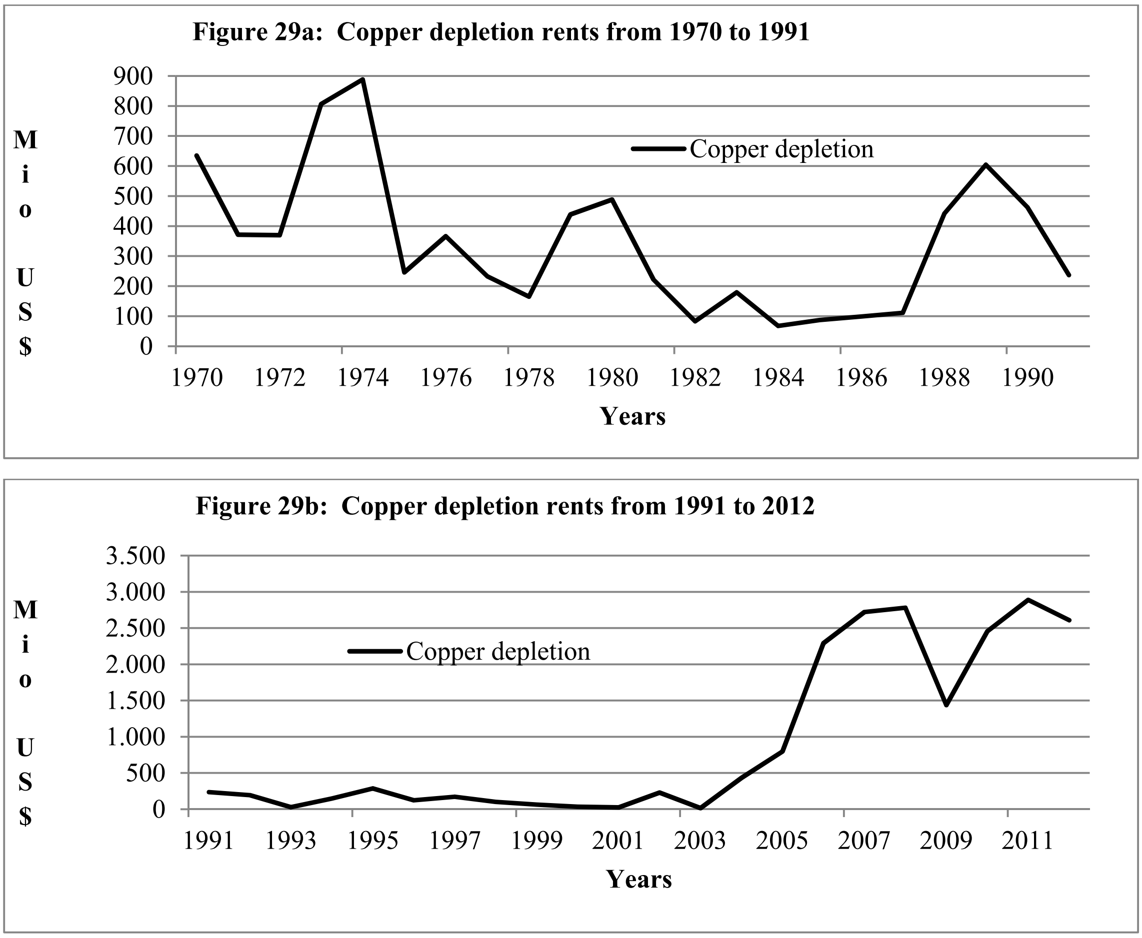
Figure 27 shows that the difference between NNS with and without education expenditures is rather small, especially in the last decade. Since copper prices in this timeframe increase, total consumption expenditures rise, while education expenditures remain almost constant and thereby decline in percentage terms since 2002. Education expenditures per pupil as % of GDP per capita even decreased from 7 % in 2000 to < 1 % in 2012.[58] This inadequate reinvestment of income from resource exports is reflected in the education status of Zambia's population: Though in the 2000s around 84 % of the total population completed primary education (still

[58] The difference between education expenditures and investment in K_H is explained by the exclusion of investment in K_P, such as school buildings, since it is already included in NNS.

low compared to 98 % in the OECD countries), the literacy rate was only around 80 % for Zambia's male population and 61 % for females.

After adding K_H, the GS calculation in (27) subtracts the depletion of K_N, considering the rents from (25) and (26) of energy and mineral resources and that of net forest depletion, as well as the damages from CO_2 emissions[59] (HAMILTON and CLEMENS 1999; WORLD BANK 2006, 2014a). Zambia's energy depletion and CO_2 emissions are both below an average of 1 %, rendering them negligible. Net forest depletion is at zero, since forest growth exceeds harvesting in official data and is therefore not shown.

Figure 29: Copper depletion rents from 1970 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

However, in Zambia's case, the rents and therefore income from mineral depletion are more important than anything else when assessing natural capital depletion. In the concept of GS, these rents are used to calculate the changes in the natural capital stock of a country. In the case of Zambia, this is represented by its stock of copper reserves (ATKINSON and HAMILTON 2007).

[59] Social costs from CO_2 emissions are assumed to be US$ 20 (in 1990 US$) per emitted metric ton (FANKHAUSER 1994).

Zambia's mineral rents started at a high level of 22 % in 1970, meaning that after subtracting production costs, minerals worth almost a quarter of the total income of the Zambian economy were consumed and an equivalent would have had to be invested in K_P or K_H to keep the total capital stock constant and fulfill the sustainability rule of GS.

A look at Figs. 23, 24, 25, 26, 27 and 28 shows that Zambia consumes more than it invests, at least over most of the period analyzed. As Fig. 28 shows, there were only a few periods in which Zambia realized sufficient reinvestments to attain positive GS rates. Zambia's GS rate had a negative average of around -2.6 % if we consider the whole period from 1970 to 2012; GS only started to increase in the beginning of the 2000s, reaching a positive average of 3 % in the last 5 years from 2008 to 2012. However, due to a high level of fluctuation, the average GS rate remained negative, amounting to -0.4 % from 2000 to 2012. To a large extent, the fluctuations of Zambia's GS rate result from volatile copper prices, which influence the value of mineral depletion subtracted in (27). Figure 29 shows that in total, copper depletion decreased from the mid-1970s until the price boom in the mid-2000s, with a short peak at the end of the 1980s and the beginning of the 1990s. This corresponds with the same peak in copper world market prices, as seen in Fig. 24. Copper depletion, which makes up an average of around 95 % of total depletion, increased to reach rents of nearly US$ 900 million at the beginning of the 1970s. Thereafter, it decreased until 2002 with the same peaks and, since 2003, rose again to US$ 2.5 billion at the end of the 2000s. In 2011 and 2012, it approached US$ 3 billion.

5.4. The RC and its influence on Zambian GS

5.4.1 Overview

Since CORDEN and NEARY (1982) and CORDEN (1984) developed a model of the implications of resource dependency on economic growth, the so-called Dutch disease,[60] the phenomenon that countries with rich natural resource endowment often show slower economic growth than resource-poor countries has been dubbed the RC. In their well-known cross-country analysis, SACHS and WARNER (1995/1997) show that an increase in the ratio of primary exports to GNI results in a decline of per capita income growth. Even after controlling for several other variables identified to be important for economic growth, this negative relationship remains significant. BOOS and HOLM-MÜLLER (2013) expand on this original study with a longer period

[60] This originated from an article by ''The Economist'' analyzing the decline in the Dutch manufacturing sector after the discovery of natural gas sources due to a crowding out of investments (THE ECONOMIST 1977).

of analysis and larger sample size as well as additional control variables, showing that not only the influence of primary exports on per capita income is similarly negative, but also that the negative impact on GS is high.

The first detailed RC case studies by GELB (1988) and AUTY (1993) show, on the one hand, the political difficulties for governments of natural resource-exporting countries such as Zambia in saving (and not spending) their rents and, on the other hand, the lack of capacity and resources to reinvest this income efficiently. The core problem is that natural resources do not need to be produced. Their depletion results in income without advanced development and requires large-scale investments in mining without further economic diversification.

The Zambian economy mainly centers on its income from copper. Between 2008 and 2012, the rents from copper depletion amounted to an annual average of 14 % of its GNI, whereby 28.5 % of GNI came from copper exports. However, a dependency such as that of Zambia does not automatically result in slower growth or negative GS, but AUTY (1993) shows that one of the biggest problems in Zambia is the inefficient handling of the easily attainable income from copper. Caused by overly optimistic expectations and failed state interventions, physical (K_P) and human (K_H) capital is transferred into sectors without foreign competitors, resulting in decreasing reinvestment.

There are, however, different explanations for the fact that resource-dependent countries reinvest inadequate amounts of their income from resources into other forms of capital. SACHS and WARNER (1995/1997) cite decreasing terms of trade and an instable rule of law as important reasons, but mainly show that the ratio of primary exports to GNI is one of the most robust determinants for slower economic growth. A multitude of studies such as SALA-I-MARTIN (1997) or DOPPELHOFER ET AL. (2000) confirm this and analyze the RC from various points of view, identifying multiple determinants as well as transmission channels (PAPYRAKIS and GERLAGH 2004), and constructing numerous theories and hypotheses concerning the ways in which resource dependence may hamper economic development (ROSS 1999; ROSSER 2006).[61] Overviews by VAN DER PLOEG (2011) or FRANKEL (2012) divide these theories in different exogenous and endogenous explanations, which BOOS and HOLM-MÜLLER (2012, 2013) relate to the individual calculation components of GS rates. We use these in the following to understand the relationship between volatile world market prices (Sect. 5.4.2.1) and the so-

[61] See for example GYLFASON ET AL. (1999), GYLFASON (2000, 2001a, b, 2006), AUTY (2001, 2007), MEHLUM ET AL. (2006), ROBINSON ET AL. (2006), VAN DER PLOEG and POELHEKKE (2009), HUMPHREYS ET AL. (2007), LEDERMAN and MALONEY (2007) or FRANKEL (2012) for a comprehensive overview of the discussion.

called Dutch disease (Sect. 5.4.2.2) as exogenous explanations[62] as well as the status of the political system (Sect. 5.4.3.1) and the quality of institutions (Sect. 5.4.3.2) as endogenous explanations[63] and Zambia's GS rate with its calculation components, namely the different forms of capital.

In summary, the elements of GS are affected by determinants of the RC; especially negative GS rates point to a possible ''curse'' in resource-dependent countries. GS rates provide an early warning system and if we assume that low or negative GS rates result in lower sustainable development in Zambia's future, it follows that its RC problematic will result in lower expected sustainability.

5.4.2 Exogenous explanations

5.4.2.1 Volatility of world market prices

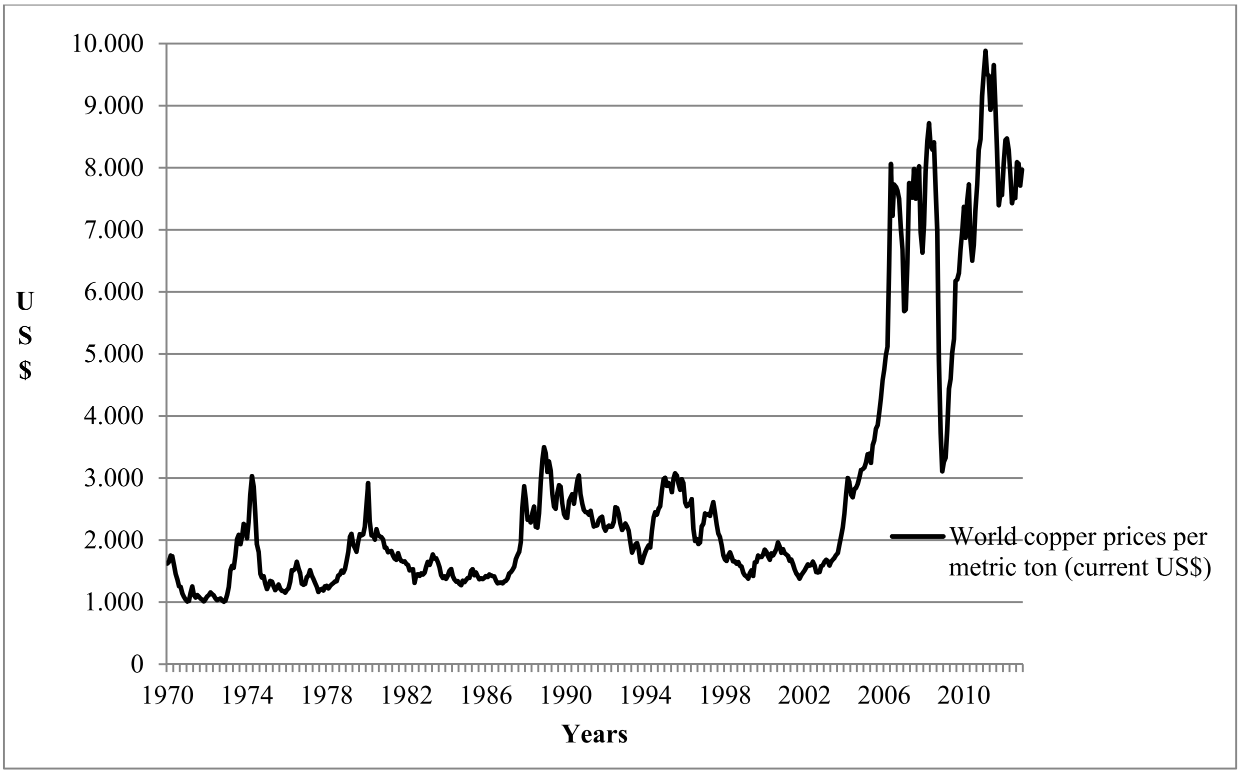
The first and foremost factor, as we have seen above, is the fluctuation of world market prices of copper. As seen in (25), the depletion of copper is calculated based on actual world market prices and therefore price volatility influences the rents that comprise natural resource depletion (δK_N) within the GS calculation in (27) (VAN DER PLOEG and POELHEKKE 2009; BOOS and HOLM-MÜLLER 2012, 2013). Starting with NURKSE (1958), a number of cross-country analyses reveal the adverse effects that the volatility of international commodity prices has on economic growth in resource-dependent countries (RAMEY and RAMEY 1995; BLATTMAN ET AL. 2007). HAUSMANN and RIGOBON (2003) or BARBIER (2007) show that the GDP of resource-dependent countries fluctuates by several percentage points each year. As Figs. 21 and 22 have already demonstrated, income growth fluctuates drastically in Zambia (by an average of 4.9 % per year), GDP per capita decreased as a result over our analyzed period. According to VAN DER PLOEG (2011) ''[v]olatility is bad for growth, but also for investment […] and educational attainment,'' as the theoretical discussion behind the relationship between the RC and GS

[62] The theoretical framework by BOOS and HOLM-MÜLLER (2012) divides exogenous explanations for the effects of the RC on GS into short- and medium-term volatility of international commodity markets as well as long-run terms of trade (ToT) effects, both of which we examine in the section on volatile world market prices (Sect. 5.4.2.1), and the Dutch disease with all its effects in Sect. 5.4.2.2.

[63] We follow the same framework (BOOS and HOLM-MÜLLER 2012) in dividing the endogenous explanations into the political system (Sect. 5.4.3.1) and the quality of institutions (Sect. 5.4.3.2), but one could argue that the distinction between politics and institutions is overly meticulous since the political system is a part of the institutions. However, we explicitly use this division since indeed both affect each other but simultaneously cause different rather independent effects from each other. Institutions can be instable and corrupt in democracies and vice versa. Even if both can only develop in the same direction, they have different effects on GS since the transmission channel through which the RC functions is different in the case of the quality of the political system itself or its bureaucratic apparatus.

would lead us to expect (BOOS and HOLM-MÜLLER 2012). As Fig. 28 shows, Zambia's GS rate fluctuated by an extremely high average of more than 100 %, due especially to periods such as the 2000s in which GS fluctuated by an annual average of 250 % and increased from -9.1 % of GNI in 2000 to 6.1 % in 2010 (6.8 % in 2012).

Figure 30: Monthly world copper prices per metric ton from 1970 to 2012.

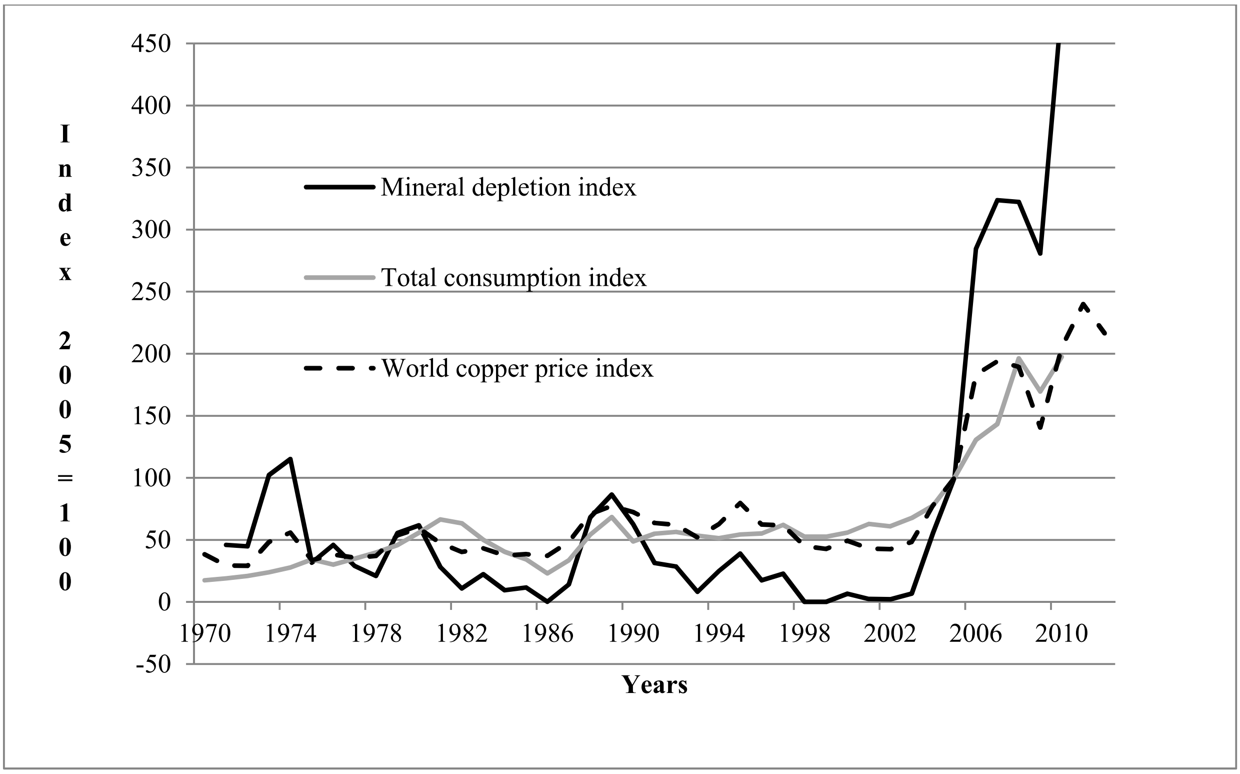


Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

As shown in Fig. 30, world copper prices are volatile and vary from 1 month to the next by an average of almost 6 % in the years between 1970 and 2012. In 1974, the price per metric ton decreased by more than 60 % in the timeframe of only a few months; while from the beginning of 1980 until the summer of 1982, another drop of 55 % was recorded. Over the next 30 years, copper prices fluctuated enormously. Since the end of the 1990s, the broader trend has shown an increase, but even in this timeframe a sharp drop between the middle of 2008 and the end of 2009 was recorded. After three decades of relatively low copper prices, Figs. 29 and 30 illustrate the boom of more than 300 % from the lowest point in 2002, an average of US$ 1560 per metric ton, to a peak of US$ 8700 in April 2008, reaching more than US$ 9000 from the end of 2010 until mid-2011. Although the demand from China and India continues to rise, the upward price trend is not a long-term certainty; prices decreased again from US$ 9650 in July 2011 to US$ 7966 in December 2012. Since Zambian copper depletion (δK_N) varies with world market prices through copper rents, price volatility is one of the most important factors impacting Zambia's GS rate. Traditional indicators such as the GDP and GNI react not only in a delayed manner but also with less volatility than can be found in GS rates.

Copper depletion within Zambia's GS as well as primary exports followed the path of copper prices and increased in the last decade together with Zambian GDP. All three – world copper prices, copper depletion and exports – are positively correlated with coefficients of more than 0.9.[64] Figure 31 shows that, along with the prices for copper and therefore Zambia's mineral depletion, total consumption also increased. The correlation between the three is very strong. Since mineral depletion depends on copper prices, this relationship is intuitive, but the positive correlation to consumption is more striking.

Figure 31: Copper prices, mineral depletion and total consumption from 1970 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Consumption is a negative term in (27) along with mineral depletion; therefore, this positive correlation doubles the negative influence on GS. Rents from mineral depletion are used for consumption rather than investment in K_P or K_H. Volatility of natural resource income has two

[64] We use a simple Pearson correlation coefficient: This is defined as the covariance of two variables divided by the product of their standard deviations, showing a value in the range of -1 for a complete negative correlation to 1 for total positive correlation (GRIFFITHS ET AL. 2008). We only use these correlation coefficients through the rest of our analysis to emphasize our qualitative arguments without applying them within the discussion due to the possibility of error between only two variables. However, we have attempted different models with multiple variables without significant results to benefit our analysis.

effects that are relevant in the case of Zambia's GS, but also in comparing GS to the traditional indicators. On the one hand, the anticipation of better times, as VAN DER PLOEG (2010, 2011) puts it, results in consumption expenditures in times with decreasing copper prices that approach levels that correspond to better times. Consumption increases quickly with higher copper prices but decreases slower than rents as prices fall. Therefore, traditional GNI as an initial calculation point reacts in a delayed manner. On the other hand, the GS calculation depends on GNI, but reacts much more directly to the volatile development of income from natural resource rents and their conversion into consumption or investment (BOOS and HOLM-MÜLLER 2012). Therefore, GS cannot function solely as an early warning system, but serves as an additional indicator to explain the development of a country, as demonstrated by the Zambian example. Zambia's GS rate predicts unsustainable future development even if the traditional indicators GDP/GNI continue to grow, driven upward by a consumption-based use of rents from mineral depletion.

Shortly after independence at the end of the 1960s, the Zambian government nationalized the mining sector and concentrated public investment on the social sector and especially the education system, as Fig. 26 shows, but not in K_P. However, the government was faced with the decision of using foreign earnings to finance the social sector and fight food shortages in the 1970s and 1980s or reinvesting a portion of rents in its income-guaranteeing mining sector (LUNGU 2008).[65] GS rates and consumption in Figs. 25 and 28 show that Zambia consumed rents instead of investing in K_P and therefore not only weakened the mining sector during the resource price crisis, but the whole economy also suffered from low investments beginning with the copper price shock (FESSEHAIE 2012). In 1974, revenues from copper depletion, as shown in Fig. 29, collapsed to below US$ 100 million and stayed at this level until the 2000s. The government expected the price shock to be a short-term anomaly, but while copper prices stayed more or less constant over the long run, it chose to face ''the largest external shock the economy had experienced since the Great Depression'' (MCPHERSON 2004a) by financing the imbalances with additional debt, followed by an extreme downward spiral (FESSEHAIE 2012).

In general, governments of resource-dependent countries not only tend to consume rather than invest, but they also have little incentive to save during phases with higher resource prices (BOOS and HOLM-MÜLLER 2012). Particularly in a situation such as Zambia's, in which a single-party regime makes its case with larger, long-term visions, these additional expenditures also find justifications in phases with low copper prices. The various Zambian governments

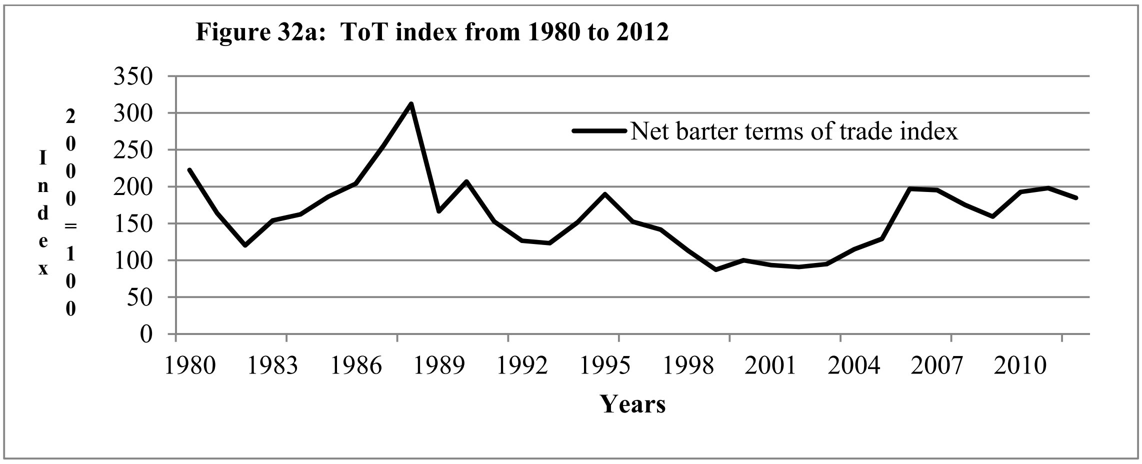
[65] The Zambian copper mines were nationalized into the Zambia Consolidated Copper Mines (ZCCM).

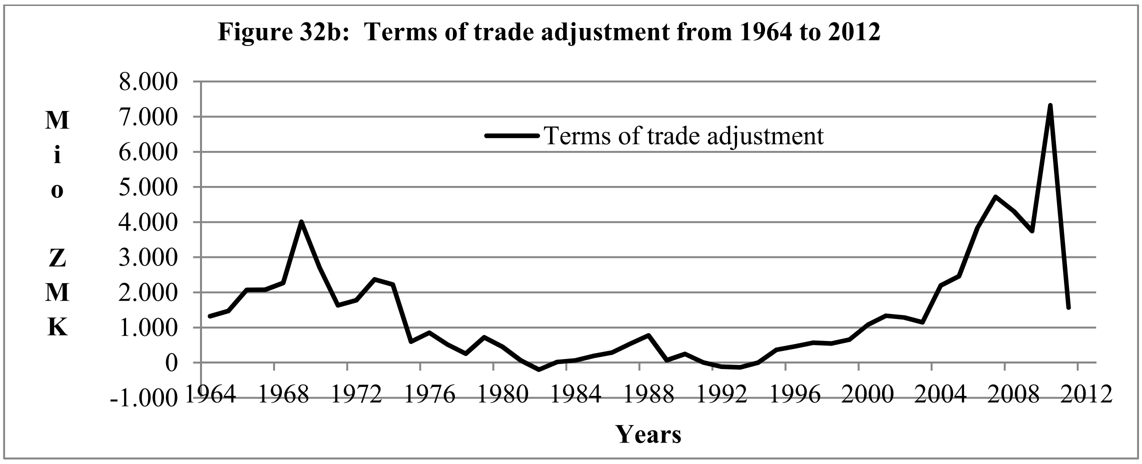
generally aligned their public expenditures with higher income phases, even in the face of decreasing prices, as they expected prices to rebound and increase over the long run. VAN DER PLOEG (2011) summarizes panel data estimations suggesting that the problems of many resource-dependent countries including Zambia originated from incorrect expectations, which during the 1970s and 1980s resulted in a debt crisis.

Zambia's public consumption also increased by an annual average of 6 % in a longer period from US$ 278 million in 1970 to US$ 683 million in 1997. Since its total GNI only increased by 4 %, the ratio of public consumption to GNI grew continuously. As Fig. 25 shows, Zambia's total consumption began at around 65 % of GNI after independence and increased to an extraordinary 95 % average in the 1990s. In nine of the 40 years between independence and the 2000s, Zambia's society consumed more than its available income. Thereby it seems difficult to follow a rule of a constant share of consumption in GNI, which is one of the typical recommendations within topical literature (AUTY 1993; HILL and MCPHERSON 2004; PAPYRAKIS ET AL. 2006). Indeed, the Zambian government could define a constant proportion of consumption and investment within GNI, which changes US$ expenses at a consistent ratio, but if Zambia requires its total GNI to finance consumption, investment in K_P is neglected. In particular the period at the end of the 1990s and the beginning of the 2000s, in which consumption accounted for almost the entirety of GNI, Zambia was one of the poorest countries worldwide and had greater societal problems than long-lasting investments.

The so-called Prebisch–Singer thesis predicts that the terms of trade (ToT) of resource exporters decrease in the long run due to a relative decline in world market prices of primary commodities in relation to imported manufactured products and, as a result, the GDP of these countries also declines (PREBISCH 1950; SINGER 1950; SACHS and WARNER 1995/1997). According to this thesis, this is due in part to decreasing income from resource depletion compared to the expenses for imports (ZANIAS 2005; BARBIER 2007). This relationship is important in the case of Zambia for two reasons: On the one hand, copper prices only decrease for the first three decades of our analysis and increase on the whole for the complete period between 1964 and 2012. The rising prices since 2003 demonstrate a rather short trend, but according to Fessehaie (2012), ''copper prices will remain high for some years to come.'' On the other hand, since ToT are calculated as the ratio between the price indices for exports and imports, these relationships are especially important for a resource-dependent country. In Zambia, copper and therefore the depletion of natural capital δK_N is primarily directed into exports while a large part of investment in K_P is determined by the demand for imported consumption and capital goods. Therefore Zambia's ToT develop on the same path as the ratio between δK_N and changes in physical capital δK_P. Due to the calculation method shown in (27), δK_N is subtracted, thus impacting GS negatively, while δK_P is added and influences GS positively. In total, this means that increasing ToT should affect GS negatively, in contrast to the positive influence on GDP growth noted in SACHS and WARNER (1995/1997) (BOOS and HOLM-MÜLLER 2012, 2013).

Figure 32: ToT index from 1980 to 2012 & ToT adjustment from 1964 to 2012.





Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

Figure 32 shows that, except for a short increase in the mid-1980s, Zambia's ToT[66] decreased in total until 2002. Due to the copper price increase it has since risen. From 1964 to the end of the 1990s ToT adjustment[67] in constant Zambian Kwacha (ZMK)[68] decreased from 1.3 billion to 650 million. The price increase since 2002 not only positively influences GNI as an initial

[66] Net barter terms of trade index: percentage ratio of the export unit value indexes to the import unit value indexes measured relative to the base year 2000 and available since 1980 (WORLD BANK 2014a).

[67] Terms of trade adjustment: capacity to import less exports of goods and services in constant ZMK (WORLD BANK 2014b).

[68] The ZMK consists of 100 ngwee. Due to the extremely high inflation in the last two decades the government revalued the currency in 2013 and dropped three zeros.

calculation point of GS in (4) but also results in increasing ToT.[69] At the beginning of the price boom, GNI increased enough to also influence GS positively, but in the second half of the decade higher copper prices and therefore increasing δK_N (correlated to the ToT index with a high coefficient of 0.95) again result in a temporary drop of GS rates. Growth rates of imports and exports were equal in the 2000s (at an average of almost 13 %) and Zambia's external trade balance stayed in a small negative range, with an average of -2.2 % between 2000 and 2012. However, while prices for copper exports grew, the import price index decreased since 1999 and Zambia's ToT therefore increased even while import quantities rose faster than exports (BRAUTIGAM 2011). In the last decade of our period of analysis, the additional income (both Zambian GDP and GNI increased by an annual average of more than 7 %, 4.5 % in per capita terms, between 2002 and 2012) was not only large enough to increase GS rates even with higher copper prices and therefore δK_N, but also enough to move Zambia's investment strategy slightly away from only investing in the primary sector. However, a boost in the income from natural resource revenues, namely the rents from copper depletion, often results in a crowding out of investment in K_P and K_H.

Only with the progressive development of productive structures in less volatile sectors does the vulnerability to fluctuations decrease (KOREN and TENREYRO 2007). According to VAN DER PLOEG and POELHEKKE (2009), price and therefore income volatility is the key channel for the RC: They show in their regressions that higher dependence on natural resources increases the vulnerability to volatile market prices, development of productive structures stabilizes a country's economy against volatility. Therefore, the GDP and investments in resource-exporting OECD countries such as Norway are much less volatile, even though they also export natural resources with volatile world market prices. These countries grow more consistently and attract more investment while landlocked Africa and especially Zambia (emphasized by PLOEG and POELHEKKE 2009) is extremely vulnerable to price changes. In the view of VAN DER PLOEG and POELHEKKE (2009), ‘‘[f]or resourcerich Africa the positive direct effect of resource dependence is more or less canceled out by the indirect effect through volatility.’’

[69] As the theory would indicate (SACHS and WARNER 1995/1997; BOOS and HOLM-MÜLLER 2012), the correlation coefficients between ToT and GDP (independently of which measure is used) are all positive (by more than 0.5), while ToT is negatively correlated to GS rates (by more than -0.3).

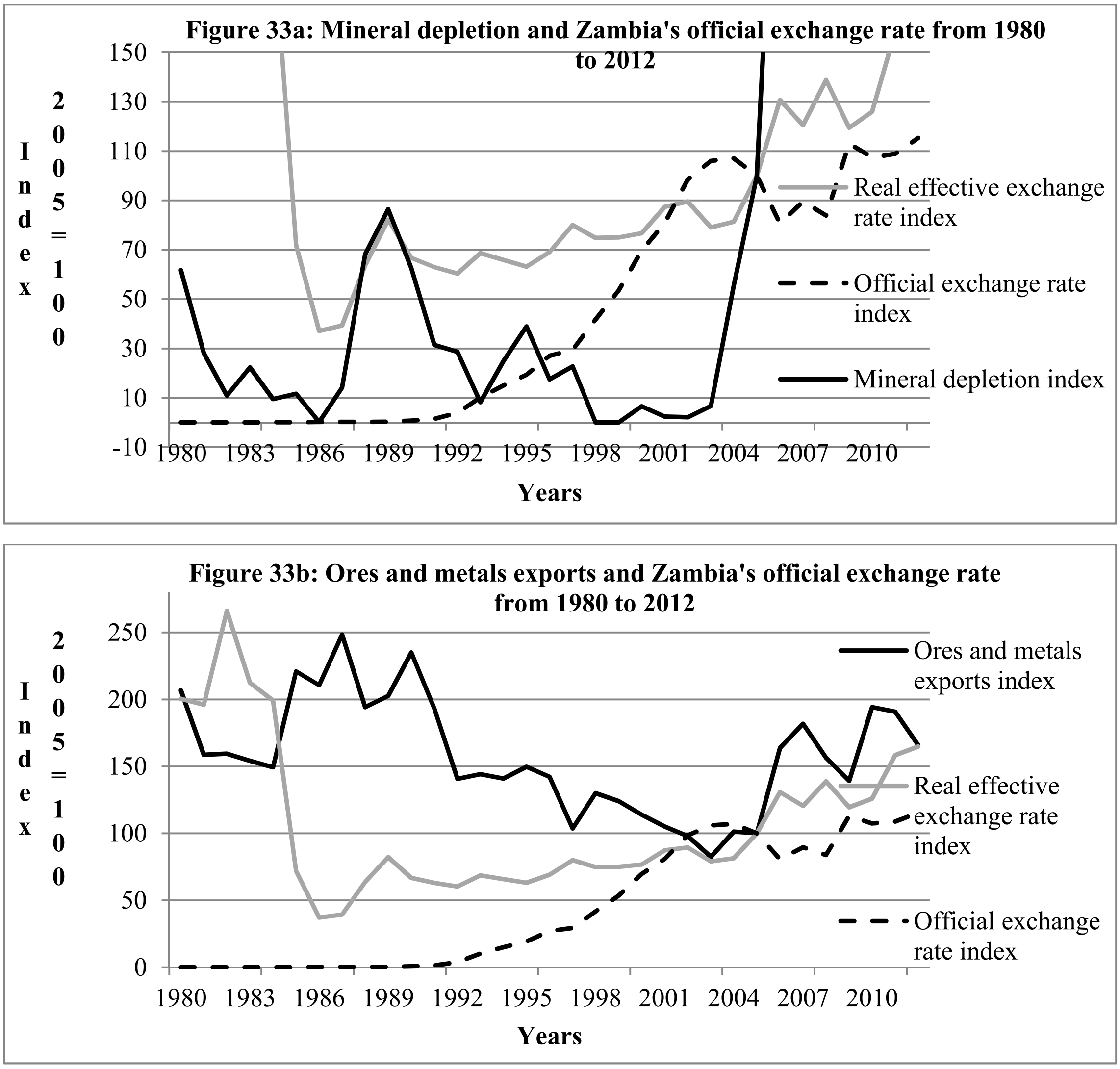
5.4.2.2 Dutch disease and crowding out effects

Structures for stable development independent of volatile copper prices have not yet been realized in Zambia, but in the 2000s the prices were rising, as shown in Figs. 30 and 31. From such a boom in world market prices and therefore increasing quantities of exported copper, effects of the so-called Dutch disease (DD) could arise. This represents the original and most prominent theory behind a possible natural RC. In this classic model presented by CORDEN and NEARY (1982) and CORDEN (1984), a boom in the natural resource sector – induced either by the discovery of new reserves, exogenous technological progress or simply by increasing resource prices (as Zambia experienced in the 2000s) – results in higher export revenues and thus increasing rents for δK_N.

Through the so-called spending effect, additional rents increase the demand for goods from sectors other than the primary sector. In the DD model, the non-primary sectors offer tradable goods that come almost completely from manufacturers and non-tradable goods mostly produced in the service sector. Via a process called resource movement or the crowding out effect, investment and employment move from this tradable sector into the resource and service sectors (CORDEN and NEARY 1982; AUTY 2007). This crowds out investments in K_P, since the service sector is more labor intensive, and K_H, since production processes are more unskilled in the resource sector compared to manufacturing (GYLFASON 2001a; BOOS and HOLM-MÜLLER 2012).

As shown above, the copper price boom resulted in higher income for Zambia; the correlation coefficients between GDP per capita (regardless of the calculation method) and world copper prices were always higher than 0.85 between the 1960s and 2012. Since 2003, a 40 % average annual growth of copper prices resulted in growth of GDP per capita of 4.5 %. Copper depletion (at an average of almost 8 % for the whole period) increased from values of < 1 % of GNI at the beginning to more than 16 % at the end of the 2000s. While Zambian copper rents were only slightly above US$ 30 million in 2000 (with a production volume of 250,000 metric tons at a price of US$ 1813), rents rose to almost US$ 2.5 billion at the end of the decade (560,000 metric tons at US$ 6956 in 2008). Therefore, Zambia increased its income from copper over a hundredfold within 8 years while only slightly more than doubling production. In other words, copper depletion and GS rates fluctuate without changing the depletion in metric tons. While the dependency rate on copper exports decreased from around 60 % of GNI to 32 % in 1978, and exports of ores and metals sank from US$ 1.2 billion in 1971 to US$ 820 million in 1978, these exports stayed constant in metric tons, even increasing from around 600 to 700 thousand metric tons after the hardest price shock in 1974 (MCPHERSON 2004a). This is one of the disadvantages of portraying ''weak'' sustainability by measuring GS: The amount a country has to reinvest in US$ can decline while the actual amount of depleted natural resources increase in metric tons (BOOS and HOLM-MÜLLER 2012). However, this paper does not seek to discuss the GS calculation. In our case study, higher prices decrease the metric tons Zambia's mining industry has to deplete for the same output in US$, while revenues flowing into the Zambian economy increase at constant quantities.

Figure 33: Mineral depletion & ores and metals exports and Zambia's official exchange rate from 1980 to 2012.



Source: Own calculation and illustration with data from WORLD BANK (2012, 2014).

This additional income increases the demand for goods from other sectors than the resource sector – called the spending effect – and thus changes the relationship between consumption and investment in K_P and K_H (GYLFASON ET AL. 1999). A part of the additional demand for manufactured goods must be met by imports, increasing competition in this sector (KRUGMAN 1987; DAVIS 1995) and blocking further investments (BOOS and HOLM-MÜLLER 2012). Additionally, while the manufacturing sector relies on world market prices, relative prices of non-traded goods increase to achieve home market equilibrium (BRUNO and SACHS 1982). This results in an appreciation of the real exchange rate, which on the one hand further fosters competition from imports, the prices of which decrease in ZMK (AUTY 2007; FRANKEL 2012), and on the other hand decreases the governmental budget for investments in K_P and K_H from trade taxes (WEEKS 2008).

First, Fig. 33 shows the extremely high growth of the official exchange rate from the end of the 1980s onwards. Between 1964 and 2012, the ZMK depreciated by a yearly average of 26 % from 70 Ngewee per US$ in 1964 to 5147 ZMK in 2012. Particularly in the decade between 2000 and 2010, the official exchange rate appreciated by a yearly average of almost 8 %, with a period of high volatility in the mid-2000s. As expected, Fig. 33b shows that this is negatively correlated to the amount of copper exports (with a coefficient of -0.75) and decreases with rising exports.

Second, as the theory behind DD predicts in such a price boom, the real effective exchange rate[70] is positively influenced by higher copper exports (correlation coefficient of 0.67 between 1980 (first available year) and 2012). In the 2000s, this real effective exchange rate developed parallel to copper exports (with a correlation coefficient of 0.86) and more than doubled from 2005 to 2012. Using monthly values by the Bank of Zambia, CALI and TE VELDE (2007) show the relationship between copper prices and the real effective exchange rate with coefficients of 0.5 for the period from 1985 to 2006 and higher ones of more than 0.9 from 2003 to 2006. Figure 33b shows that after 2003, exports of ores and metals and the real effective exchange rate grew together, resulting from the copper price increases shown in earlier figures. In addition to the small positive influence on investment in imported K_P, WEEKS (2008) shows a significant negative impact on public income and thereby affecting public investment in K_P and K_H.

Zambia increased its imports by a yearly average of 15 % since the mid-1990s. Therefore, net trade was negative until the mid-2000s and even in the last years of the decade it only fluctuated between positive values of US$ 500 million and US$ 2 billion, while Zambia's

[70] The World Bank's ''real effective exchange rate is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs'' (WORLD BANK 2014a).

copper exports ranged from US$ 3 billion to US$ 7 billion from the mid-2000s until 2012. However, this only served to increase investment options and wages in the resource as well as the service sector, while the tradable sector decreased due to competition from imported consumption goods (BOVA 2012). Therefore, investments as well as employees move to these two growing sectors – called the resource movement or crowding out effect (CORDEN and NEARY 1982) – crowding out investments in K_P since the service sector is more labor intensive, and partially also K_H since production processes are mostly unskilled in the resource sector (GYLFASON 2001a; BOOS and HOLM-MÜLLER 2012). Figure 26 shows that the portion of education expenditures decreased in particular, but also the necessary investment in the development and diversification of the Zambian economy failed. This resulted in a creeping de-industrialization of already existing sectors such as the clothing industry (HILL and MCPHERSON 2004).

Additionally, in a special case such as Zambia's in which the service sector mainly consists of basic unskilled services, movement to the service sector also results in decreasing investments in K_H (ARNOLD and MATTOO 2007). While the service sector share of total GDP grew by a yearly average of 5 % in the 2000s, from an average of 39.7 % of GDP (value added) in the 1990s to 47.4 % in the following decade,[71] the share of Zambian official employment remained constant at around only 20 %. According to ARNOLD and MATTOO (2007), official employment data do not show any significant movement of employees from manufacturing to services. However, at least the portion of official employment in industry decreased from 11 to 7 % between 1990 and 2005, although the mining industry grew in this period. It is nevertheless rather difficult to show changes within the employment structure of a country with a large informal sector, as is the case in Zambia. Some authors, such as ARNOLD and MATTOO (2007) or DE LUNA MARTINEZ (2007), assume that around 90 % of the Zambian workforce is employed in the informal economy.

However, if it is true that the movement of employees from the tradable to the resource and service sector serves to decrease investment in human capital – due to less skilled production processes in these two latter sectors – it follows that in the last decade education expenditures should exhibit a contraction: Regardless of the index used, education expenditures and therefore investment in K_H decreased since 2000. Average expenditures per primary-school pupil (in % of GDP per capita) decreased by more than 3 percentage points (from 8.9 to 5.4 %) within 1

[71] Official data by the ''Central Statistical Office Zambia'' show US$ 5.4 billion (46.5 %) in 2007 and US$ 6.9 billion (46.5 %) in 2008: http://www.zamstats.gov.zm/real.php. ARNOLD and MATTOO (2007) even cite a 64 % service sector share of Zambian GDP.

year between 2004 and 2005. Education expenditures (in % of GNI), which is deduced from NNS by the World Bank, decreased from 2.7 % in 2000 to a constant average of 1.3 % from 2007 to 2012.

While δK_H as a positive calculation component in (27) decreased relative to GNI, δK_N increased by a yearly average of 85 %from around 1 %of GNI in 2000 to an annual average of 14 % between 2005 and 2012. Thus, higher rents from mineral depletion are subtracted. Since GNI increased rapidly in current US$, education expenditures more than doubled in this decade, increasing from US$ 84 million in 2000 to US$ 188.5 million in 2010 and surpassing US$ 200 million in 2012. However, in the same decade, mineral depletion increased from US$ 33.6 million in 2000 to US$ 2.5 billion in 2010 (US$ 2.6 billion in 2012). Therefore, the reinvestment ratio between δK_N and δK_H decreased from 2004 on, the year in which δK_N was higher than investment in human capital δK_H for the first time. As a result, in 2012 only 7.8 % of δK_N were reinvested in δK_H (1.3 %in education, 6.5 %in health expenditures), an obvious sign of the crowding out of human capital.

Furthermore, the service sector is more labor intensive and requires relatively little investment in K_P (GYLFASON 2001a; DIETZ ET AL. 2007). The capital-intensive mining sector attracts greater investments in K_P, but crowds out investment in other parts of the manufacturing sector. In total, DD effects result in decreasing GS rates: Although copper prices rose exponentially, and thus GNI as an initial calculation point of GS in (27) increased by a yearly average of 7 % in the 2000s (4.5 % in per capita terms), the subtracted rents of δK_N also rise and have a negative impact on total GS. The Zambian GS rate reacts mainly as the theory would expect, but shows positive GS in parts of the 2000s despite extreme rises in copper prices. We could explain this with two factors: first, it could be caused by time-delayed reactions, especially since this explanation would apply to almost the entire analyzed time series. Second, at the beginning of a price boom the increasing GNI results in higher GS rates before the lack of investments reduces GS.

However, literature on the RC agrees on the importance of endogenous political and institutional explanations in addition to these exogenous ones (ROSS 1999; MEHLUM ET AL. 2006; BARBIER 2011; BOOS and HOLM-MÜLLER 2012). Neither the RC itself nor its link to the GS rates of resource-dependent countries can be completely explained by exogenous factors. It is equally important that, for example, easily attainable resource rents increase the power of interest groups, cause myopia within the political class, and thus weaken political structures and institutions.

5.4.3 Endogenous explanations

5.4.3.1 The political system

Literature proves that democracy supports economic growth (BARRO 1996; HEO and TAN 2001; BARRO and SALA-I-MARTIN 2004; JAMALI ET AL. 2007). DE SOYSA ET AL. (2010) and BOOS and HOLM-MÜLLER (2013) show empirically that democratic structures also increase GS rates. The older the democracy, the more stable a country's institutions and public investments prove to be. Newly democratizing countries are more often plagued by corruption and target their investments to satisfy interest groups (KEEFER 2007; KEEFER and VLAICU 2008). Studies such as BULTE and DAMANIA (2008) demonstrate that resource-dependent countries in general are less democratic, due, for example, to averted modernization and repression, which are enabled by resource wealth and preferential access to it by the political class (BOOS and HOLM-MÜLLER 2012).

Concerning Zambia, this causes two issues: the question to what extent the dependence on copper influenced democratic development, and to what degree it is still negatively affected (AUTY 1993). Furthermore, the results by DE SOYSA ET AL. (2010) and BOOS and HOLM-MÜLLER (2013) – stating that a higher democratic status influences GS positively – are a contentious point with respect to Zambia's history, as its political system shows rather low values in existing indices for democratic development combined with similarly low GS rates, at least as periodic averages. Figure 34 brings together two of the most accepted political indices, the ''Polity IV'' (PIV) index[72] (available from 1964 on) and the ''Freedom in the World'' (FitW) index[73] (available from 1972 on). PIV began at low but positive values at independence, decreasing over the period of the so-called First Republic (1964–1972) and turning sharply negative for the Second Republic (1972–1990). During the Third Republic (1991–present), the PIV index increased, reaching positive to high values at the end of the 2000s. Over the whole period, PIV is correlated to GS with a coefficient of 0.5. The FitW index by Freedom House began as ''partly free'' for both the political rights (PR)[74] and civil liberties (CL)[75] indices,

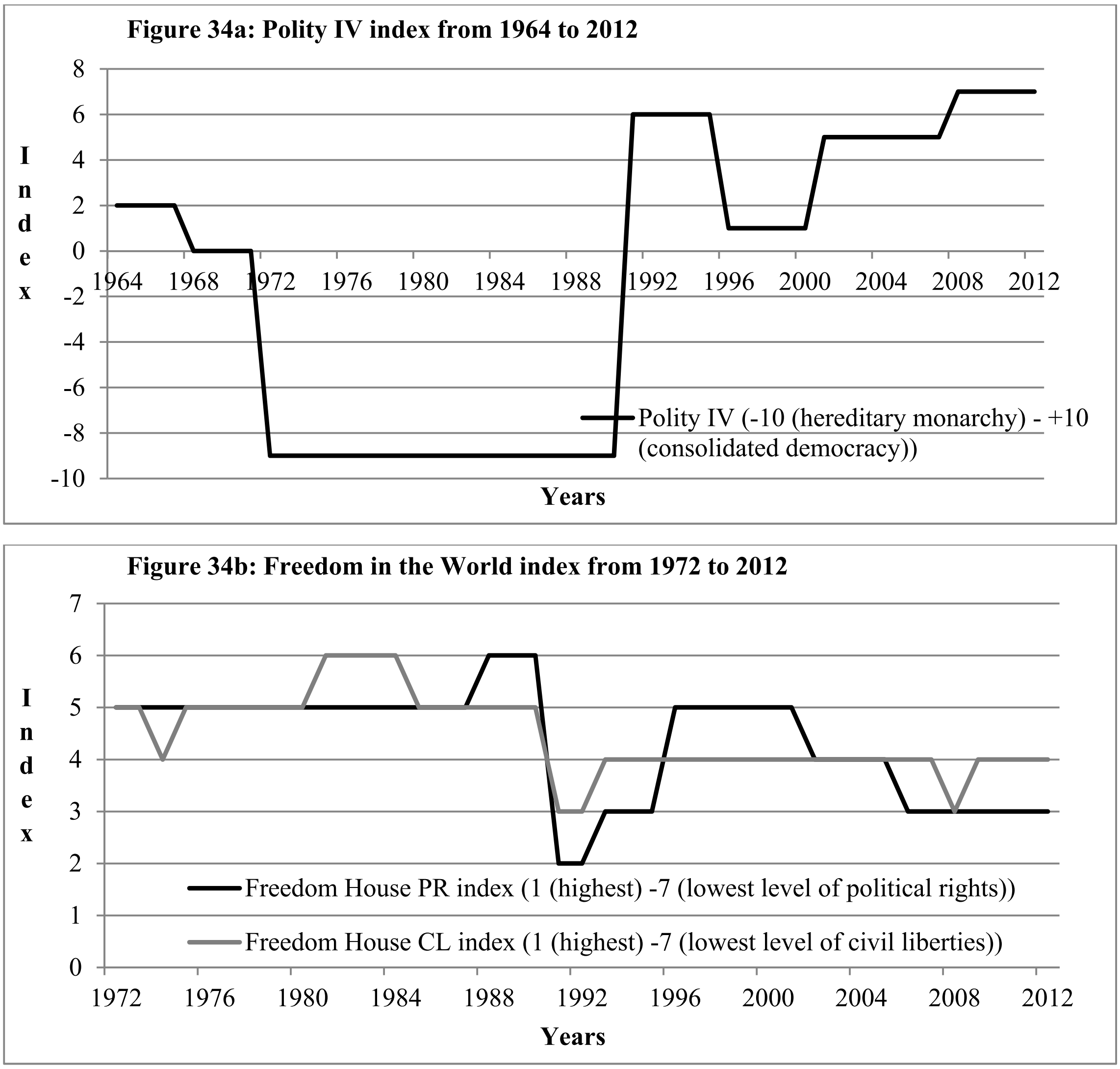
[72] PIV shows the quality of ''democratic and autocratic authority in governing institutions […] from fully institutionalized autocracies through mixed, or incoherent, authority regimes […] to fully institutionalized democracies. The 'Polity Score' captures this […] spectrum […] from -10 (hereditary monarchy) to +10 (consolidated democracy)'': http://www.systemicpeace.org/polity/polity4.htm.

[73] Freedom House rates political rights and civil liberties individually from 1 (highest) to 7 (lowest level of freedom) and values the status of free (1.0–2.5), partly free (3.0–5.5), or not free (5.5–7.0) from 1972 on: http://www.freedomhouse.org/report/freedom-world-2012/methodology.

[74] ''Political rights […] are based on an evaluation of three subcategories: electoral process, political pluralism and participation, and functioning of government'' (PUDDINGTON 2013).

remained more or less constant with minor fluctuations until 1990, and improved through the mid-1990s. However, shortly after the first democratic election, FitW worsened again; the average between PR and CL is correlated to GS with a coefficient of 0.4.

Figure 34: Polity IV index from 1964 to 2012 & Freedom in the World index from 1972 to 2012.



Source: Own illustration with data from POLITY IV (2010, 2014); FREEDOM HOUSE (2011, 2012).

In the cross-country model by BOOS and HOLM-MÜLLER (2013), PIV demonstrates a highly significant positive relationship to investments in K_P and total GS rates, whereas the depletion of K_N decreases with more stable democratic structures. Figure 34a shows that this developed similarly in Zambia. In 1964, Kenneth Kaunda and his United National Independence Party

[75] ''Civil liberties […] are based on an evaluation of four subcategories: freedom of expression and belief, associational and organizational rights, rule of law, and personal autonomy and individual rights'' (PUDDINGTON 2013).

(UNIP) were the first to form a democratic government within the so-called First Republic (1964–1972) (TORDOFF 1974). However, literature agrees upon the wide-reaching powers of Kaunda, who was the dominant leader in an only nominal multiparty system (TAYLOR 2006). From 1964 to 1967, the PIV stood at a rather high positive value for a newly independent colony, but this quickly dropped to zero for the regime Kaunda developed slowly in the years from 1968 to 1971. FREEDOM HOUSE (2011, 2012) calls the democratic structure until 1972 a de facto one-party rule by UNIP, which was controlled tightly by Kaunda. However, the government invested income from high copper prices in K_H. The ENCYCLOPEDIA OF THE NATIONS (2012) speaks of an increase in the availability of education services and an expansion of hospitals by 50 % and of health clinics by 100 %, as at least partially shown by the consumption expenditures in Fig. 25 together with the expenditures for K_H in Fig. 26. Investment in K_H was rather high until the beginning of the 1980s, which was certainly an achievement of the Kaunda regime.

To organize the growing public sector, civil service expanded and acted as a mechanism for the UNIP to offer sinecures to interest groups. Civil servants became the nation's highest earning income group regardless of overemployment in the public sector and the shortage of professional manpower (TORDOFF 1974). And while GDP per capita increased in the initial period after independence, the diversification of the economy away from copper was not significant enough to create a balance to the public sector. The UNIP indeed based a development strategy of the other sectors on the income from copper exports, but neither quickly nor resolutely enough (BONNICK 1997). When Kaunda in 1972 banned all other parties and declared a so-called ''one-party participatory democracy,'' the imbalance between the public and private sectors was already a large problem, since virtually all mid- to high-income salaries were paid out of the national budget (TORDOFF 1974). The Second Republic (1972–1990) began with a copper price crash while these public expenses already overburdened the national budget (ENCYCLOPEDIA OF THE NATIONS 2012). BAYLIES and SZEFTEL (1992) depict the UNIP government in the Second Republic as a powerful presidency within a centralized autocracy with an obtrusive security apparatus, which nonetheless refrained from brutality against its opponents. The UNIP was rapidly overburdened by its own standards and did not realize investments in K_P at a level sufficient enough to compensate consumption expenditures, at least in relation to GNI (as seen in Fig. 25). Zambian GS was only positive until 1977, but decreased to -0.7 % in 1978 and remained negative for the rest of the Second Republic.

In 1990, Kaunda was forced to agree to democratic elections by political pressure from a continuously strengthening opposition and an economic crisis that featured a serious collapse of all indicators. Figure 21 shows the decrease in the traditional GDP/GNI indicators in the mid-1980s, and Fig. 28 shows the counterpart of negative GS rates. Although copper prices increased, economic development and GS rates only recovered for a brief moment in 1990 due to positive expectations surrounding the regime change. In 1991, free presidential and parliamentary elections brought Frederick Chiluba and his MMD into power, a broad-based opposition formed by trade unions, business interests, intellectuals and students (RAKNER 2003). While the new government rushed to fulfill its campaign pledge of economic ''liberalization,'' democratic development was limited. The economic program began quickly with a number of measures, including the removal of consumer and agricultural subsidies, the increase in import tariffs and the privatization of a number of public entities, which resulted in a 24 % decrease in official employment.

The MMD initiated a Structural Adjustment Program with the help of the IMF and the World Bank to return to a free market economy, which included the privatization of the copper mines (LOXLEY 1990; SAASA 1996; SIMUTANYI 1996; INTERNATIONAL MONETARY FUND (IMF) 1999).[76] But after decades of mismanagement, not only in the mining sector but across the entire economy, the MMD faced so many challenges that selling the mines was not the first priority, especially at a time with comparatively high copper prices accompanying the political changes at the end of the 1980s and early 1990s (HILL and MCPHERSON 2004). The MMD needed the income from copper mines to finance its other reforms and hesitated to sell Zambia's ''crown jewels'' before consolidation of their power base (MCPHERSON 2004b). However, during this adjustment phase, copper prices decreased rapidly while the new and unprepared government hesitated and pursued a delay tactic.[77]

Chiluba, using existing structures from the Second Republic, formed his own personalized patrimony shortly after elections, initially within the MMD and later throughout the whole

[76] Structural Adjustment Programs in general are not without their critics and especially in Zambia's case – where where all five formal programs with the IMF between 1976 and 1991 collapsed (MCPHERSON 2004c; WHITE and EDSTRAND 1994) – the nature of the country's economic structure and the weakness of world commodity markets made short-term gains impossible (LOXLEY 1990; CALLAGHY 1990). The abandonment of the program in favor of a ''growth from own resources'' program also failed (KAYIZZI-MUGERWA 1990). The economic performance after this last Structural Adjustment Program at the beginning of the 1990s was especially alarming. Following World Bank/IMF standards much progress in liberalization was accomplished, but the manufacturing output decreased by 10 % and GDP per capita shrank by a yearly average of 2.8 % from the end of the 1980s to the mid-1990s (SAASA 1996).

[77] For example, the so-called Keinbaum Report was neglected, which provided a detailed analysis of privatization options and recommended the rapid unbundling and selling of the mines, while a World Bank report by twelve mining specialists, which called for an immediate revival of the mines, was never released (MCPHERSON 2004b).

country (LARMER 2011). A weak opposition was unable to offer a reasonable alternative and Chiluba was supported by Western donors, which praised ''Zambia as an exemplary model of economic reform, rhetorically critici[zing] deviations from democratic practice but not pressure[ing] […] the MMD to bring about improvements'' (LARMER 2011). The Third Republic (1991–present; under Chiluba 1991–2001) began with high scores in the political indices, but decreased as early as the mid-1990s. Coefficients show a high negative correlation of more than -0.7 between the quality of Zambian democracy and its GS rate (average of -5.3 % between 1991 and 2001) in the first period of MMD government. Although such correlations are not clear enough to prove causality, the level supports our theoretical reasoning that decreasing democratic strength is negatively related to the ''weak'' sustainable development of Zambia.

In 1996, the MMD won the second legislative period in a landslide victory, but international observers reported misbehavior by ''the Chiluba government [who] was willing to compromise the rule of law, was intolerant to criticism and willing to exploit its majority position and control of government resources to undermine its opponents'' (RAKNER 2003). By the late 1990s, in light of improvements in civil society and the independent media, protests arose and forced Chiluba to resign. In the third consecutive elections, Levy Mwanawasa (Chiluba's vice-president between 1991 and 1994) achieved a close victory with only 29 % of the votes (BURNELL 2002; POLITY IV 2010; LARMER 2011). Although none of the eleven opposition parties presented a reasonable alternative to the MMD (RAKNER 2003), their sheer number, relative size, differences in political direction and interactions demonstrated an ongoing movement from a dominant to a competitive party system with a more balanced and fragmented parliament (RAKNER and SVASAND 2004). In the first term of Mwanawasa, the government was forced to cooperate with the opposition, increasing the democratic status of the Zambian political system in the indices shown in Fig. 34. Democratic status and political rights increased in the 2000s, but civil liberties remained constant from the early 1990s onwards. BRATTON ET AL. (1999), BURNELL (2001) or RAKNER and SVASAND (2004) show clearly that the status of Zambian democracy and political freedom of its population increased while civil liberties showed no improvements. However, compared to the critique of Zambian democracy in the 1990s, the Zambian democracy index values increased beginning with the election in 2001. Mwanawasa initiated reforms, dissociated himself from Chiluba and dismissed supporters of the former president (SEDDON and SEDDON-DAINES 2005).

In 2006, Mwanawasa continued with an election victory of 44 %, although serious opposition parties such as the Patriotic Front ran against MMD (KELLY ET AL. 2008). In the beginning of his second term, Mwanawasa continued to increase governmental integrity and democratic rights (FREEDOM HOUSE 2011). As Fig. 34 shows, both indices increased around the 2006 elections due to the introduction of more serious election rules, such as transparent ballot boxes and voter identification cards with photos. Still, loyalties were more important than service to the voter, shown, for example, in the lacking professionalism and access to official representatives (FREEDOM HOUSE 2007). However, in total under the presidency of Mwanawasa, democracy and GS increased together.

In October 2008, Vice President Rupiah Banda won the next election for the MMD after Mwanawasa suddenly died from a stroke. Banda was elected with 40 % of the votes over 38 % for Sata of the Patriotic Front, although MMD used state resources for campaigns and some observers noted electoral inconsistencies. Banda's government – which only lasted to the next election in September 2011,[78] the official end of Mwanawasa's legislative period – backpedaled on several reforms of the previous government. Among other things, corruption charges against former president Chiluba were abandoned, allowing mistrust of the judicial system to return. Additionally, pressure on civil society and the independent media increased, while the constitutional reform process stagnated (FREEDOM HOUSE 2011, 2012). However, especially the country's PIV increased in the years after 2008 from values consistent with an anocracy in the period of Mwanawasa's government, to values representing a democracy under Banda (MARSHALL and COLE 2011). Most interestingly, these can be attributed to an increase in institutional quality, which we discuss in the following section. Political rights increased, while civil liberties remain constant, mainly due to human rights abuses by the police and prison employees (PUDDINGTON 2013).

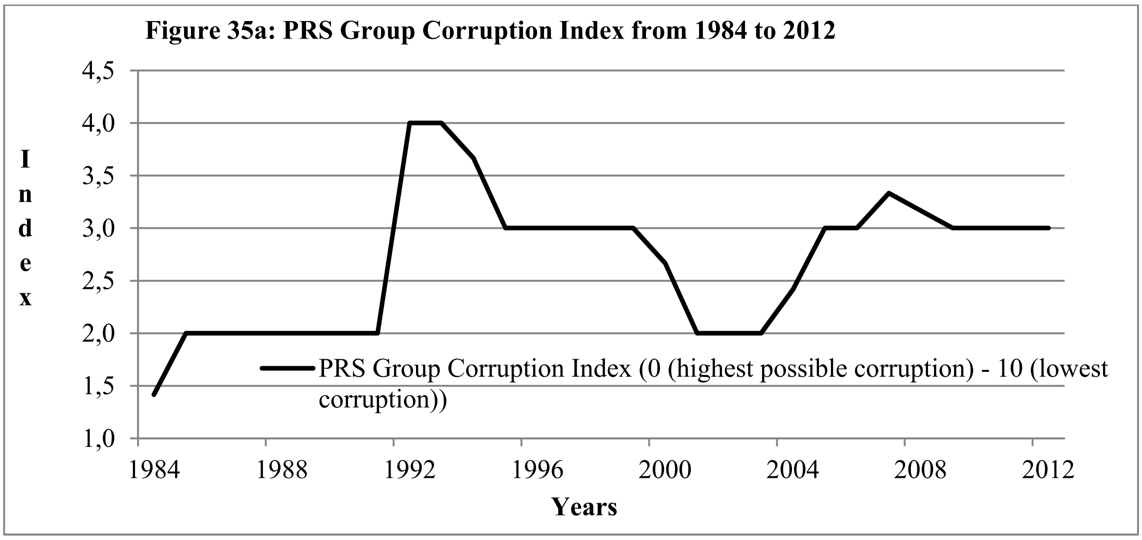
5.4.3.2 Institutional quality

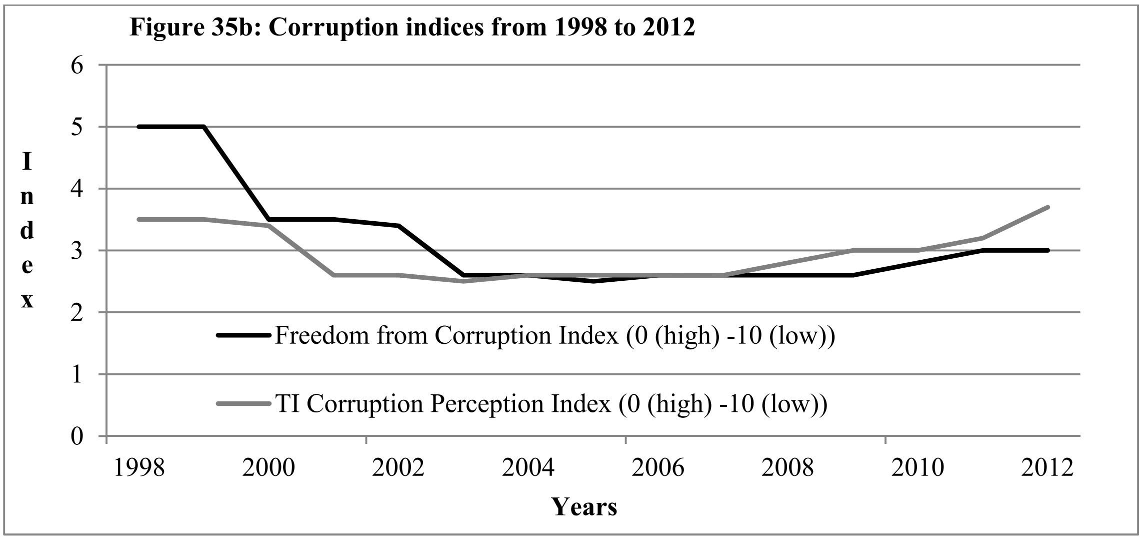
In addition to Zambia's level of democracy, its institutional quality plays an important role in its copper curse as well as the development of its GS rate. The quality of a country's institutions is the foundation for political decisions and the general handling of natural capital (ROSS 1999). The rents from natural resources cause perverse incentives for the ''wrong'' behavior of

[78] In September 2011, Michael Sata was elected as the fifth Zambian president. Since none of the decisive indicators changed and Sata's reforms did not properly start by the end of our analysis in 2012, we chose to leave out this last year in the political discussion. Additionally, none of Sata's plans to develop the economy were ever quite realized since he died in office in October 2014.

politicians and other stakeholders, which then result in policy and institutional failures. PAPYRAKIS and GERLAGH (2004) or ROBINSON ET AL. (2006) demonstrate that on the one hand, resource dependence negatively influences institutions and that on the other hand, the RC is more likely to affect countries with weak institutions. Furthermore, a complete line of literature agrees on the importance of institutions for economic growth (ACEMOGLU ET AL. 2002b; EASTERLY and LEVINE 2003; RODRIK ET AL. 2004; MEHLUM ET AL. 2006). DIETZ ET AL. (2007), SOYSA ET AL. (2010) and BOOS and HOLM-MÜLLER (2013) show the same positive influence of institutional quality on GS.

Figure 35: Corruption indices from 1984 to 2012.





Source: Own illustration with data from THE HERITAGE FOUNDATION (2015); TRANSPARENCY INTERNATIONAL (2012); THE POLITICAL RISK GROUP (2013).

In particular the analysis by DIETZ ET AL. (2007), which shows a direct negative influence of corruption on GS, highlights one of the most important and in Zambia traditionally dominant determinants of institutional quality. The relatively easy access to resource rents gives rise to the misuse of authority in order to use this income for personal gain (KOLSTAD and SOREIDE 2009). SZEFTEL (2000) characterizes Zambia as an interesting case study for the relationship between constitutional change and corruption, since corrupt structures have accompanied all three republics. As Fig. 35 shows, the corruption index published by ''The Political Risk Group''[79] increased at the end of Kaunda's Second Republic and reached its highest level around the time of the system change. However, only during the decade of Chiluba's rule from 1991 onwards did corruption become entrenched and murkily intertwined with the political class. The close link between political engagement, access to natural capital and other privileges connected to the easily attainable income from the country's resources has changed the loyalty and ideals of many politicians and shaped Zambia's development (MOMBA 2007).

Particularly patronage – a particular, generally non-financial form of corruption consisting of providing supporters and interest groups with lucrative and secure positions in public administration and private businesses – has undermined positive development (SZEFTEL 2000). The negative relationship to GS is intuitive: Higher consumption expenditures for unnecessary salaries negatively influence GNS in (27). At the beginning of the Third Republic corruption decreased shortly for a few years, but rose again until the end of Chiluba's presidency. The positive correlation between the ''Freedom from Corruption Index''[80] and Zambia's GS rate shows a high coefficient of more than 0.8 in the second term of Chiluba's government from 1996 to 2001; in this period, increased levels of corruption were related to negative GS rates. Mwanawasa began to fight these corrupt structures, which during his rule had already permeated public services in all areas, especially activities related to the copper sector. The efforts to privatize the financially pressed Zambia Consolidated Copper Mines (ZCCM) were used by insiders to receive side-payments and extract capital assets. Rising prices resulted directly in rising opportunities for abuse, which were exploited by several agents involved (MCPHERSON 2004b).[81] Mwanawasa ''set up a Task Force to investigate and prosecute plunderers of national resources'' (MWENDA 2007), following his disillusionment with the work of the Zambian Anti-Corruption Commission. This Task Force performed ''well below

[79] The ''International Country Risk Guide'' by ''The Political Risk Group'' (PRS) monitors 22 variables based on expert assessments in more than 140 countries. The index of corruption is part of its ''Political Risk Rating'' and uses a scale from 0 (highest possible corruption) to 10 (lowest corruption) (DIETZ ET AL. 2007; THE POLITICAL RISK GROUP 2013).

[80] ''Freedom from Corruption'' is part of the ''Index of Economic Freedom'' by THE HERITAGE FOUNDATION (2015), which monitors 10 variables from property rights to entrepreneurship from 0 (highest possible corruption) to 10 (lowest corruption).

[81] The correlation coefficient between international copper prices and the ''Corruption Perceptions Index'' by ''Transparency International'' was at 0.78 from the end of the 1990s to 2012: http://archive.transparency.org/policy_research/surveys_indices/cpi.

expectations […] and struggled without much success'' (NORAD (Norwegian Agency for Development Cooperation) 2011).

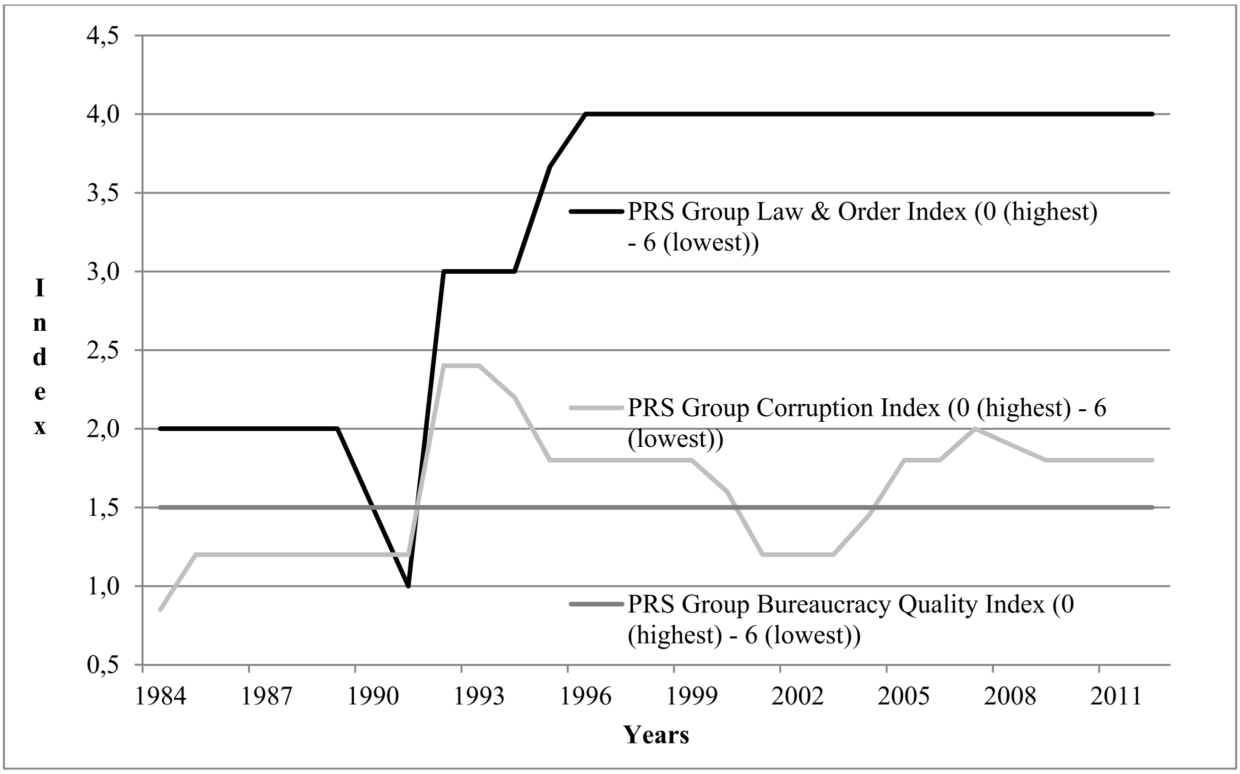
Figure 35b shows that the most renowned indicator, the ''Corruption Perception Index''[82] (CPI) published by Transparency International (TI) and available from 1998 onwards, rated Zambia initially at 3.5, which decreased to 2.5 in the mid-2000s. By 2012 the value had again increased to 3.7, which confirms that even the governments after Chiluba did not change the corrupt structures to any great extent. The ANTI-CORRUPTION RESOURCE CENTRE (2008) of TI points out, however, that certain ''Governance Indicators'' by the WORLD BANK (2013) – among others the index for the ''Control of Corruption'' – increased from 2002 onwards. Between two surveys conducted by the Bank in 2002 and 2007, the share of firms expecting to pay informal payments to public officials decreased from 45 % to 15 %, and the view of corruption as a major constraint for business dropped from 46 to 12.5 %. This corresponds with the overall increasing income per capita in the second half of the 2000s and the development of Zambia's GS rate. However, it is difficult to draw a direct connection between Zambia's corruption ratings and its GS rate, as the correlation coefficient between the CPI and GS is only slightly negative at -0.25, among other constraints.

Patronage in the public sector was discernibly high at the end of the 1990s during the country's privatization efforts (SZEFTEL 2000) and increased during the 2000s to support the power base at the local level (LEIDERER 2011). According to KOLSTAD and SOREIDE (2009), ''natural resource rents offer governments both more opportunities and greater incentives to pay off political supporters to stay in power [and] since being in power tomorrow means having access to greater resource rents, politicians are willing to spend more today to stay in power. ''From Chiluba to Mwanawasa the budget expenditures on public sector salaries increased from an already high portion of 35 % of total public expenses to almost 40 %. In the 2000s, Zambia ranked in the top third of public salary spending worldwide (average of 25 %), which increased to more than 43 % by the end of the decade. These figures support the theory that a large proportion of resource-dependent countries, especially those affected by patronage, maintain a large inefficient bureaucratic apparatus to serve various interest groups (DIETZ ET AL. 2007; BOOS and HOLM-MÜLLER 2012). Rents from copper depletion are simpler to disperse among supporters by paying salaries; especially local elites and their apparatus are appreciative receivers of public support, providing voters to the national government (BALDWIN 2013). By

[82] The ''Corruption Perception Index'' (CPI) by ''Transparency International'' (TI) captures the ''perceptions of corruption of those in a position to offer assessments of public sector corruption'' drawn ''from independent institutions specializing in governance and business climate analysis'' from 0 to 10 (TRANSPARENCY INTERNATIONAL 2012).

taking this detour, rents from δK_N find their way into consumption, thereby negatively influencing GS rates in (27).

Figure 36: Institutional quality from 1984 to 2012.



Source: Own illustration with data from THE POLITICAL RISK GROUP (2013).

The POLITICAL RISK GROUP (2013) describes bureaucratic quality as a shock absorber in countries where it ‘‘tends to be somewhat autonomous from political pressure. ’’In contrast, patronage in Zambia is a vehicle to transfer rents from the mining industry to the supporters within public services. Therefore, high transaction costs and an unreliable business environment result from an inflated apparatus, which on the one hand consumes the national budget for investments and on the other hand creates an environment in which poorly paid public officials offer low services and increase corruption (MCSHANE and NILSSON 2010). The thereby arising uncertainties and slow processes hinder investment and consume significant resources in terms of time and costs. While topical literature agrees on the negative impact of low-quality bureaucratic services on economic growth (EVANS and RAUCH 1999; OTO-PERALÍAS and ROMERO-ÁVILA 2013) and GS rates of a country (DIETZ ET AL. 2007; BOOS and HOLM-MÜLLER 2012, 2013), GS is also indirectly determined by stalled investment decisions and publicly paid wages (ATKINSON and HAMILTON 2003).

Zambia's large inefficient bureaucracy serves various interest groups, which increase the ratio of consumption through an increased number of publicly paid employees. BOOS and HOLM-MÜLLER (2013) show in cross-country regressions that higher bureaucratic quality influences GS positively. However, in the case of Zambia, the index for bureaucratic quality remained consistently low, at a constant level of 1.5 for the entire available period from 1984 onwards. There is therefore no recognizable development, and as LEVY (2012) expresses: ''Zambia's bureaucracy […] remains chronically weak and has been impervious to repeated efforts at reform.''

However, while public services are of poor quality and bureaucratic processes eroded by corruption, Zambia's rule of law remains secure. The rule of law, which implies that checks and balances are in place – and comprises among others the reliability of the judiciary system, political accountability and civil rights, property rights, and the security of contracts – is the traditional proxy for institutional quality used in various studies. NORMAN (2009) shows that the rule of law – here presented by the ''Law & Order Index'' of the Political Risk Group – is not directly influenced by higher resource exports, but rather functions as a transmission channel; countries with a weak rule of law suffer more from resource dependency. DIETZ ET AL. (2007) observe a decline in GS by 0.19 % for 1 % of additional resource exports if the rule of law is not present (worst index value).

Figure 36 shows that the period of the Third Republic from 1991 until 2012 was characterized by a consistently weak bureaucracy and corruption that fluctuated but increased overall, while the rule of law increased from low values in 1991 to a fair level in 1996, which remained stable through 2012. As we have seen, Zambia's political system and democratization status is secure and has consistently ranked in the middle of the pack globally since the 2000s. ABDI ET AL. (2005) see the functioning rule of law in Zambia as one of the most important variables for good governance. Elected governments are therefore legitimated while law and order are in place, therefore Zambian civil society is able to grow (DIAMOND 1994). BRATTON (2007) not only shows that young democracies such as Zambia only develop with a strong rule of law, but also that the Zambian population trusts the laws and the legal framework in place since the Third Republic. BAUER and TAYLOR (2005) see Zambia as much more stable and advanced in the democratization process and implementation of the rule of law compared to its neighbors.

In the last decade, the stable rule of law did not translate to similarly stable GS rates. Highly volatile changes characterized the 2000s. On the whole, as we summarize and discuss again in the following section, Zambia's GS rate recovered in the mid-2000s and was only slightly negative in the second half of the decade, featuring an average of -1 % (0.9 % from 2005 to 2012).

5.5. Conclusions

Zambia is highly copper dependent and one of the world's last examples of a country suffering from the so-called RC. In the analyzed period between 1964 and 2012, an average of more than a third of Zambia's income depended on copper exports, while its real per capita income decreased. However, after posting negative values in the 1990s, Zambia's GDP per capita growth recovered to an average of more than 4 % in the 2000s due to higher copper prices (4.1 % from 2000 to 2012). As a result of these latter years, economic growth is present. Following the concept of GS, ''weak'' sustainable development does not only depend on economic growth but also on the total capital stock of a country, which should remain (at least) constant. As we have shown, Zambia's copper depletion rents amounted to an average proportion of 8 % of Zambian GNI and even increased to 13 % in the second half of the 2000s (14 % in the last 5 years from 2008 to 2012). To ensure ''weak'' sustainable development Zambia would have had to reinvest the equivalent of its natural capital depletion (δK_N) in the increase of physical (δK_P) or human (δK_H) capital, such as infrastructure or education. Zambia rarely realized reinvestments sufficient to achieve positive GS, as Fig. 28 shows. Zambian GS proved highly volatile and completely dependent on world copper prices and to a lesser extent on political developments. In the paper at hand, we show that the theoretical framework and empirical model by BOOS and HOLM-MÜLLER (2012, 2013) still hold true in the individual case of copper-dependent Zambia. Most of the theories relating the RC to GS also apply to the Zambian situation.

Due to extreme copper price fluctuation, Zambia's terms of trade (ToT) became highly variable and therefore hardly predictable. Zambia's copper exports and thus its depletion values evolved in line with world copper prices. The depletion rents reflecting this development within the GS calculation resulted in volatile GS rates with the greatest fluctuation between the years 1999 and 2010. However, a more long-term look reveals that copper prices more or less remained constant until the end of the 1990s and only rose in the new millennium due to additional demand from China and India. We have shown that the ratio between δK_N and δK_P moves on the same path as Zambia's ToT and therefore higher ToT results in lower GS due to an also increasing $\delta K_N/\delta K_P$. Therefore, the rising prices in the 2000s not only positively influenced GNI but also led to increasing $\delta K_N/\delta K_P$ and ToT, which resulted in decreasing GS rates in the middle of the decade, as depletion of K_N was higher than investment. To achieve constant GS Zambia should therefore have invested more of its rents from natural resources into the formation of K_P and K_H. However, while investment in infrastructure or the education system is in large part a sphere of activity for public organs, copper rents are not incorporated directly into the national budget other than through taxes. Therefore, one common recommendation repeated emphatically in the literature on the RC in Zambia is to utilize the tax system to invest income from natural resources in favor of K_P or K_H and to save a share of the copper rents for worse times (HILL and MCPHERSON 2004).

As we have shown, Zambia rapidly increased its income from copper in the 2000s. This additional income from copper rents increased the demand for goods and services from other sectors and resulted in a shift of investment and employment from the manufacturing into the resource and service sectors. This crowded out investments in K_P – since the service sector is more labor intensive – and K_H – since production processes are more unskilled in the resource sector compared with manufacturing. On the one hand, the capital-intensive mining sector attracts investment in K_P, but on the other hand it crowds out investment in the K_P of more productive sectors. Since the service sector mainly consists of basic informal services using more unskilled work, investment in K_H additionally decreased after 2000. While the share of δK_N increased from around 1 % of GNI in 2000 to 12.8 % in 2012, education expenditures decreased from 2.7 to 1.3 % of GNI.

Basic problems for the Zambian GS rate still lie within the political and institutional system, which though showing improvements, which remains alarmingly problematic in comparison with other countries. Almost half a century after independence, Zambia is in the lowest thirty of 165 countries covered in the ''State Fragility Index 2010'' by Polity IV (MARSHALL and COLE 2011). Peaceful and with moderately functioning democratic structures and polls, Zambia is still politically fragile enough to find itself in the company of countries such as Kyrgyzstan or Pakistan. The continuous demand for more democracy from almost all stakeholders, but especially the growing civil society, has to be reinforced and backed by international partners. However, currently Zambia's political system is not stable enough to develop its economy past copper dependence and divert the income from K_N into industrialization and diversification. On the one hand, Zambia is stable and is improving its democratic values. On the other hand, there is still a great deal to be achieved to reach higher levels of democracy and – even though the relationship is not bulletproof – to higher and especially more stable GS rates.

Despite slow but promising democratic developments, corruption is still a major problem that casts a shadow over all three republics and most of our analyzed period. Particularly patronage inflates consumption expenditures and decreases GS rates. Corruption index values varied but in total deteriorated until 2001 and were highly correlated to Zambia's GS rate. In the 2000s, the situation improved, but the governments after Chiluba did not extensively change the corrupt structures. Patronage in the public sector was high during privatization efforts and even increased in the 2000s. At the end of the decade Zambia ranked in the top third globally in terms of spending on public salaries. However, in the 2000s, Zambia's functioning rule of law resulted in a fairly secure political system and democratization status, but it is ''generally agreed on by all stakeholders that the judicial system needs reform to make it more accountable, independent and able to deliver justice efficiently'' (NDULO 2013). Different studies show a positive relationship between a country's rule of law and its GS rates, since most investments require a secure legal framework. Since the quality of Zambia's judiciary and bureaucracy is deeply related to the corruption problematic, one potential solution could be a fixed portion of investment from δK_N into anti-corruption activities, for example, through education expenditures.

In total, Zambia's GS rates are influenced by the dependence on copper through multiple transmission channels. Development, either sustainable or not, is only possible through diversification and a reduction of dependence on an exhaustible income source such as copper. Therefore, all discussed explanations as well as a variety of further structural problems have to be dealt with. The key recommendation is that Zambia should use all possible applicable income from copper and should invest reasonably in K_P and K_H, including investments in infrastructure and education or similar development projects to the best knowledge of all decision-makers. However, since positive GS rates at least forecast future well-being, all interest groups should work together to decouple the Zambian GS from copper and the effects of the RC to increase GS permanently.

Research on the RC and GS did not require any further proof for the negative relationship of resource dependency and GS rates. However, where the paper on one hand goes further is the research design of a case study, since to our knowledge none has been conducted so far to examine this relationship. Typical case studies on the RC have used the same or similar theories and hypotheses to explain the RC, but have applied standard indicators such as GDP to analyze the influence on a country's development. This case study is the first detailed analysis of the relationship between the RC and GS in a resource-dependent country. The determinants causing the RC in Zambia influence the country's GS rate exactly as the theory behind this relationship would expect. Zambia's dependency on copper exports and insufficient reinvestments of income from the depletion of Zambia's natural capital constitute one of the main causes of slow growth and negative trends in GS. Zambia's GS rate depends on copper prices and the handling of rents within the economy, but all other theories behind the relationship between the RC and GS, as well as the determinants BOOS and HOLM-MÜLLER (2012, 2013) identify as influencing GS, also hold true in the detailed analysis of Zambia.

The bottom line is that we recommend the World Bank to further investigate this relationship since GS seems to function as a useful indicator for countries dependent on the rents from natural capital, such as Zambia, in order to analyze their situation in more detail. For countries in other situations it is, however, not particularly applicable.[83] GS and its individual calculation components could be used to illustrate the resource dependency of a country. SACHS and WARNER (1995/1997) use primary exports, but these are gross values while the resource depletion figures provided by the WORLD BANK (2014a) are adjusted for production costs. Also, GS demonstrates the handling of resource rents and especially their distribution between consumption and investment. Leaving aside possible extensions of the GS calculation (for example, presented in BOOS 2015), the data for the separate components of GS highlight the exposure of a resource-dependent country with its abundance and is therefore most interesting in the case of countries depleting natural resources. Future research on GS could further examine this relationship and use, for example, the research design we present in this paper to explain the situation in other resource-dependent countries.

[83] Most industrialized countries have positive GS rates (in 2012, only 6 % of the high and upper middle income countries had negative GS rates) while developing countries more frequently suffer from low or negative GS, in which resource-dependent play a particular role. In 2012, of a total of 45 countries with more than 10 % natural resources depletion (12.9 % in Zambia) only ten countries had positive GS rates higher than 10 % of GNI (6.8 % in Zambia) (WORLD BANK 2014a).

6. CONCLUSIONS

6.1. Summary

The dissertation at hand has conducted a detailed analysis of the relationship between the so-called Resource Curse (RC), the paradox that resource abundant countries often show slower economic growth, and the World Bank's indicator for "weak" sustainability, the so-called Genuine Savings (GS). In four logically successive parts, all peer-reviewed and published papers, GS is critically surveyed and its relationship to the RC is theoretically discussed, empirically analyzed and qualitatively investigated in the case study of Zambia, a highly resource-dependent country with negative GS rates.

As highlighted in the introductory chapter, the RC developed mainly from an empirical study by SACHS and WARNER (1995/1997) in which they prove a significant relationship between the resource dependency of countries (measured in terms of the ratio of primary exports to Gross National Income (GNI)) and their low growth rates. Together with authors such as GELB (1988) and AUTY (1993) and the models by CORDEN and NEARY (1982) and CORDEN (1984) this forms the basis of the theory behind a phenomenon which THE ECONOMIST (1977) first called "The Dutch Disease" and AUTY (1993) later relabeled "The Recourse Curse Thesis".

Building on this, a vast amount of literature concentrates on the background of the RC. One of the consistently most important explanations is the fact that natural resources generate rents that are independent of a country's economic performance. Therefore, this work relates the RC to GS as the most developed indicator for "weak" sustainability, which includes exactly these rents from the depletion of natural capital alongside the typically indicated man-made capital.

The first part of this work critically surveys the theoretical reasoning behind this GS and discusses possible extensions either not yet discussed or underrepresented in current research. It presents additional items that could be included in GS and shows that both the global average and individual country levels of GS would change immensely by including these recommendations. It serves as an introduction to GS and starts with the theoretical background and especially the calculation method, continuing with critique derived from literature and my own extensions. It examines the problematic calculation of GS per capita, the handling of volatile terms-of-trade (ToT), the differentiation between durable consumption and investment goods, defensive investments, the calculation of human capital and much more. In a nutshell, this part emphasizes the need to further develop GS to realize a more complete indicator for "weak" sustainability. One conclusion that emerges from the discussion is to analyze the determinants influencing GS, a method to develop this indicator that has been rarely used so far. And while publications discussing a possible development of GS are scarce, literature especially lacks a structured analysis of determinants influencing GS.

Therefore, part two theoretically derives and discusses possible determinants which come from the theories and explanations behind the RC. It builds on the assumption that GS as an indicator which is verifiably lower in RC-effected countries should also be negatively affected by the factors responsible for the RC. Part two surveys both areas of research, emphasizing the influence of the exogenous and endogenous determinants of economic growth that are usually used to theoretically and empirically explain the RC on the three different forms of capital considered by GS.

It discusses whether the RC hampers possibilities for resource-abundant countries to obtain sufficiently high rates of GS and finds many reasons why resource-dependent countries have problems achieving positive GS rates. The complete model (or picture) of exogenous and endogenous explanations is used to explain in detail where the linkages are. On the one hand this model builds a framework to analyze GS in a resource-driven context or in research relations in which the effects behind the indicator are important. On the other hand it presents a handy tool to use in empirical studies either on the RC or GS, or – as in this dissertation – the relationship between both.

As a result, in part three these explanations are used for an extensive empirical analysis. In a total of twelve regression models this part builds two different cross-country analyses to examine the influence of exogenous and endogenous explanations identified to cause the RC on GS and its components. The results show that the determinants leading to the RC, theoretically derived and discussed in part two, are useful explanatory variables for GS. A clear influence of the share of primary exports in GNI as well as of trade, consumption, quality of institutions and the migration of employees is found. Part three also shows that models using this combination of dependent variables (the different calculation exponents of GS) can explain the RC more comprehensively than the typically cited GDP growth.

In total, part three verifies the theoretical relationships between the RC and GS from part two in a large cross-country analysis and shows that the discussed framework can be used for extensive models with multiple dependent variables. It shows complete conformity between the theoretical model in part two and the empirical results. However, the cross-country analysis examines the research question at hand from a broader angle using averages across the analyzed data set. And while these global averages also include all resource-poor countries and those with positive GS rates, it lacks a differentiated analysis of resource-dependent countries with negative GS rates.

Therefore, part four examines the case of Zambia, an extremely copper-dependent country. It analyzes the relationship between the RC and GS tracing the course of Zambian economic history from independence in 1964 to the most recent data in 2012, a period within which Zambia shows negative average GS rates. It uses the theories and hypotheses behind the RC from part two and three and its relationship to the different forms of capital in the calculation of the Zambian GS rate. This case study is used to explain the theories and earlier empirical results in more detail in the situation of a resource-dependent country. Part four shows that the theoretical framework and empirical models from parts two and three still hold true in the individual analysis of a resource-dependent country. It shows that most of the theories relating the RC to GS do in fact apply to the Zambian situation.

However, what additional value do all these findings imply? On balance, the whole work follows two intentions: On the one hand to support the development of GS by investigating its determinants rather than only the mere calculation method and on the other hand to show and prove the deep relationship between the RC and GS. A relationship which is rather intuitive, but not analyzed in detail in topical literature, for which the dissertation at hand offers an extensive research and explanation model with multiple dependent variables.

6.2. Discussion

Part (and paper) one discusses the calculation of the different capital forms that comprise GS, but neither with the claim of an exhaustive discussion nor the intention to present a sophisticated way to develop GS. It rather shows that in all parts of its calculation there are topics still up to discussion and that the approach to deliberate part by part and consider new possible contents is often not academically objective but rather dependent on data availability and the preferences of the involved researchers. If one follows the main findings from this part, the conclusion would be that there is need for a more structured way to extend GS.

However, I formulate some extensions, such as the separation of exhaustible and renewable natural capital as well as natural capital depletion and pollution damages or the inclusion of the depreciation of human capital, without bringing up all discussions from literature but presenting a couple of new ideas. The discussion about the inclusion of natural resources such as peat, uranium or especially diamonds shows the data gaps in the GS calculation, distorting GS values in countries such as Botswana. The various renewable resources contain the same problematic, though their development should be included into the GS calculation in addition to the provided net forest depletion. The example of net fish depletion would make a real difference for several coastal countries or, for example, the developing region around Lake Victoria.

GS is by far the most developed and discussed indicator to measure sustainability in monetary terms and could in the future serve as a complement to GDP. The image that newscasts worldwide present GS alongside GDP growth as a development indicator is not completely far-fetched. However, it therefore needs a methodically structured way to properly develop its calculation method. In a subsequent paper after their commission on “The Measurement of Economic Performances and Social Progress”, FITOUSSI and STIGLITZ (2011) hold the view that a “lack of an indicator of sustainability may lead us to an unsustainable path, but a partial measure may lead us to wrong policies which would eventually jeopardize the sustainability of an economy”. Therefore a much more detailed advancement of the leading indicator GS is necessary, as it is thus far not used in a standardized manner by politicians or their advisors.

The typical discussion on the extension of GS is rather mathematically driven or depends on the data availability of natural resources or pollution damages. A good example is the discussion on the calculation of GS per capita, which is drifted to a pure discussion of the model, with a maximum of ten participants worldwide. To date, the World Bank only presents total values of GS, even though all discussion participants agree that this implies a danger for misinterpretation of positive GS rates. Researchers who are not experts in this field are excluded from this discussion and cannot understand why the World Bank does not use easy solutions such as those suggested in equations (17) and (18) in part one, at least until the discussion finds a better solution.

Complex detailed discussions such as this example are carried out about all calculation parts of GS, but there is no actual discussion on the whole indicator and its components such as in part one. Part one is therefore a proposal to step back and consider the issues from a broader angle, discussing for example the components and calculation of human capital besides forms of natural capital or whether or not pollution damages should be part of an indicator measuring the total capital of a country. And while the research on GS focuses its energy on, for example, the search for more pollution damage data to include, a simple basic discussion is missing, which would address whether or not it is reasonable to include these datasets. Or, to address the most important point of this dissertation: Why is it intuitively clear that GS is affected by resource dependency, but the World Bank and the entire research behind GS has not been able yet to analyze this relationship in detail?

We know that GS is negatively correlated to resource abundance and research discusses possible adjustment mechanisms. However, the discussion lacks a structured approach to analyzing the relationship between the negative effects of resource abundance and the calculation of GS, thereby also missing arguments that warrant inclusion. One possible path to solving some open questions is the structured analysis of factors determining GS. And one possible way to structure the search for determinants of GS is the analysis of factors leading to the RC. This is the selected approach of this dissertation.

In principle, parts two and three support the same findings, with part three empirically proving the theories from part two: a few reasons that inhibit resource-dependent countries from achieving positive GS rates are the same factors that slow GDP growth. However, some reasons are more influential on GS than on GDP and some also affect GS inversely. The most prominent example are the terms-of-trade, which so far are treated in literature as if they would affect GS in the same way they affect GDP, though the results in part two show otherwise. Positive long-term trends of increasing prices for resource exports, usually positively related to economic growth, influence GS negatively since the rents are subtracted in its calculation. Additionally, short-term volatility of resource prices causes planning uncertainty and therefore a higher ratio of consumption compared to investment.

The directly related theory of Dutch disease affects the composition of consumption and investment in physical and human capital through the appreciation of the real exchange rate and the movement of financial (physical capital) and workforce (human capital) resources from manufacturing to the resource and service sectors. The discussion as to whether resource-abundant countries benefit from increasing world market prices is already carried out in the literature. However, in this dissertation an additional discussion is carried out regarding whether GS rates benefit from increasing resource prices.

In most studies on the RC – as in this dissertation – and in the calculation of GS, Gross National Income (GNI) is used since the rents from domestically depleted natural capital earned by foreign companies outside the country is excluded. Therefore, the GNI of resource-abundant countries is in the majority of cases lower than GDP. However, economic growth is usually measured in GDP per capita, therefore often leads to a distortion of the overall picture. Countries earning much of their income through the export of resources and therefore the sale of depleted domestic natural capital abroad are always confronted with not only the problematic of re-investing enough of the generated rents but also of maintaining a fair amount within the country's own borders. Naturally, there are resource-abundant countries such as Kuwait whose GNI is higher than their GDP since they deliberately invest their rents abroad. However, most countries in Sub-Sahara Africa, especially Zambia and its neighboring countries, suffer from a drain of their natural capital.

Therefore, the political system and its institutional quality play a further important role. For example, democratic governments tend to deplete less natural capital and invest more in human capital. This depends in part on the quality of the participating institutions in terms of the level of corruption, bureaucratic services or the rule of law. As expected, better institutional quality based on these indicators is linked in part three to less depletion of natural capital and higher education expenditures, showing that the total GS rate is positively influenced by the quality of institutions. However, politicians must deal with an interdependent system of factors influencing each other. Broadly speaking, strengthening political and institutional structures may be the most important prerequisite for resource-dependent countries to reinvest their rents from natural resources.

Part four shows this in the example of Zambia, a country which uses the lion’s share of its resource rents for consumption. The country's economy eroded for example by patronage and ranked in the top third globally in terms of spending on public salaries. However, this has developed historically since colonialism and has proven difficult to repeal in a country in which public employees make up almost the complete middle class of the population. The intuitive recommendation that countries such as Zambia “need to invest more of the proceeds of natural capital depletion into the formation of other forms of capital than they currently do” (HAMILTON and CLEMENS 1999) would detract public salaries and resulting consumption in favor of investments in infrastructure and education or similar development projects. This would create a power risk for the country’s elite, wherefore they always look out for cost neutral solutions. For example, resource-rich developing countries such as Zambia could obligate foreign mining companies to invest a fixed percentage of their profit within the country alongside paying taxes.

However, all affected countries deal with a complicated combination of problems and possible solutions. Therefore, an extended investigation of GS and its components could satisfy multiple requirements: Shrinking GS constitute an early sign for the erosion of the capital stock required for sustained development. Even without observable RC effects, this should be considered an economic warning for the respective country. Using the three types of capital allows one to learn more about the mechanisms behind the RC. This approach facilitates gathering more a priori information for case studies. Overall, further research in this field supports better policy recommendations since governments can function as the balancing actors that invest rents into education, health or other sectors that support development. Contrarily, using RC determinants allows one to learn more about the problems behind the GS calculation. If GS as an indicator for "weak" sustainability should be taken seriously, it needs further development in a structured manner. The analysis of factors which determine its calculation parts is the first helpful instrument for this structure.

6.3. Outlook

The first words of this dissertation were written in the middle of 2009 and by this time it initiated with the rather famous citation of the abstract by SACHS and WARNER (1995/1997):

"One of the surprising features of modern economic growth is that economies with abundant natural resources have tended to grow less rapidly than natural-resource-scarce economies."

In 2015, just as I concluded the last words of this work, Jeffrey Sachs published his highly respected book "The Age of Sustainable Development" (SACHS 2015) accompanying his globally successful lecture series under the same name. It ends with an equally suitable quote:

"Now it's our turn to see if we can move the world toward sustainable development."

He does not use GS to show sustainable development (SD), but other indicators such as the "Human Development Index" and discusses that SD must be more clearly measurable. However, in the six years that my work continued I had the suspicion that the development of indicators stagnated. Only around fifteen qualified and recognizable articles which contain GS in their title were published between 2009 and 2015. This could simply be a sign for the concentration of research on other possible indicators to measure sustainability, but overall publications on the measurement of sustainability in general decreased. Although this is admittedly more difficult to detect, all interesting keyword combinations used in "Google Scholar" such as "sustainability indicator" or "sustainability measure" dropped by more than half from the period 2004-2009 to 2009-2015. And as far as I am aware, there has been no noticeable development to one of the other indicators such as the "Human Development Index" or the "Ecological Footprint". This is by far not a breakthrough discovery, but a small disturbing sign for a world driven by the desire to develop sustainably, and to have control over its development. To know whether the world moves in the direction of SD or not, it needs a more complete indicator than available to date.

However, the re-investment of rents from natural resource depletion in physical and human capital in adequate amounts and at a level of quality that supports development is one of the most important drivers of welfare growth and sustainable development. To conclude and summarize the line of argumentation from SACHS and WARNER (1995/1997) to SACHS (2015): Those countries which export their natural capital could turn to SD if they use their rents for investments in diversification, infrastructure, education, health and all the other possible sectors which are proven to support development. And an indicator that should measure sustainable re-investment in the total capital stock of countries should include these possible sectors.

Independently of the nature and composition of a country’s total capital stock, GS is a helpful instrument to forecast and interpret possible future development trends and the exposure with a country’s own capital stock. Therefore, the next steps should use the results from this dissertation to further develop GS. One way would be to make GS more publicized in a first step - not necessarily directly to the general public but at least more familiar to researchers around the world. The research on SD has fallen behind on developing GS, what has to be compensated by more dissertations and research projects. And after the structured extension of GS, the next step could include the following image: In a couple of years news anchors present the growth in GDP per capita as the indicator of economic development and the trend of GS rates as the achievement of “weak” sustainable development.

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