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The Effects of the Dutch Disease in Russia

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Abstract

This paper shows how the Dutch Disease has affected the Russian economy since the start of the transition in the early 1990s. Four symptoms have been detected, namely: 1) a real exchange rate appreciation, 2) a temporary improved economic situation, 3) an output decline in the non-booming-sector, 4) an export reduction in the non-booming-sector.

An extended version of the Balassa-Samuelson model has been implemented to test symptom 1. Our results suggest a positive long-run cointegration relationship between the real exchange rate and the oil price. A 7% real appreciation is caused by a 10% oil price shock. Moreover, a 10% increase in oil prices leads to a 2% GDP growth, while a 10% real appreciation is associated with a 2.1% output decline. The total effect on GDP growth, considering the Balassa-Samuelson effect, confirms symptom 2. Finally, the domestic industrial production drops and high-tech and textile exports are crowed out. This indicates that the Russian economy is also affected by symptoms 3 and 4. We conclude that Russia's government should invest the tax revenues collected from the resource sector such that the structure of the economy becomes more diversified and less vulnerable to exogenous shocks.

Kurzfassung

Dieser Beitrag zeigt, wie der „Dutch-Disease-Effekt“ in den 90er Jahren die russische Wirtschaft beeinträchtigt hat. Vier Symptome wurden entdeckt: 1) eine reale Aufwertung des Rubel Wechselkurses gegenüber dem US-Dollar; 2) eine temporär verbesserte wirtschaftliche Lage; 3) ein Ertragsrückgang im nicht florierenden Sektor und 4) eine Exportverringerung im nicht florierenden Sektor.

Eine erweiterte Version des „Balassa-Samuelson-Modells“ wurde verwendet, um Symptom 1 zu überprüfen. Unsere Resultate deuten auf ein positives langfristiges Kointegrations-Verhältnis zwischen dem realen Wechselkurs und dem Erdölpreis: Eine 7% reale Aufwertung wird durch eine 10%-ige Erhöhung der Produktion von Rohöl verursacht. Bezüglich des Symptoms 2 wurde gezeigt, dass eine Zunahme der Erdölpreise um 10% zu einem Wachstum des Bruttoinlandsprodukts (BIP) um 2% führt, während eine reale Wertsteigerung um 10% mit einer Abnahme der Bruttowertschöpfung um 2,1% verbunden ist. Unter Berücksichtigung der kumulierten Wirkungen des „Dutch-Disease-Effekts“ auf das BIP wird der „Balassa-Samuelson-Effekt“ bestätigt. Hinsichtlich der Symptome 3 und 4 wurde festgestellt, dass der „Dutch-Disease-Effekt“ zu einem Rückgang der inländischen Industrieproduktion führt und die Exporte in den Sektoren Hochtechnologie und Textilindustrie sinken. Daraus ergibt sich folgende Schlussfolgerung: Die russische Regierung sollte die Steuereinnahmen von den Energiesektoren so investieren, dass die Struktur der Volkswirtschaft diversifiziert und damit weniger anfällig für exogene „Shocks“ wird.

1 Introduction

When a country experiences a resource boom due to a tradable resource discovery and/or to an increase in a resource price, it normally undergoes a real appreciation of its exchange rate and, as a result of rising wages, a relocation of some of the labor force to the resource sector. A real appreciation reduces the international competitiveness of other tradable sectors because resource-based exports crowd out commodity exports produced by those sectors (Krugman, 1987). This phenomenon, known as the "Dutch Disease", first drew attention in the late 1950s when natural gas discoveries in the Netherlands eventually hurt the competitiveness of the Dutch manufacturing sector. Thereafter, the Dutch Disease has been used to explain economic performance of countries facing similar conditions[1].

When Russia opened up its foreign trade regime and liberalized its exchange rate in 1991, the Dutch Disease became a real threat. Note that the oil boom in Russia and other transition countries was triggered both by the "discovery[2]" of oil reserves, and by the changes in world oil prices. The literature asserts that in both cases the classical Dutch Disease effects hold, namely an appreciation of the real exchange rate and crowding out of the non-oil traded good sector. Nevertheless, an oil discovery is usually supposed to cause a stronger income effect relative to substitution effect and, thereby, a larger demand shock. This is because the impact on the price of oil-intensive intermediate goods is not immediate when an oil deposit is discovered (Rosenberg, Saavalainen, 1998).

This paper is divided into 7 sections. Section 2 presents the basic Dutch Disease model and reviews the key literature on the topic. Section 3 outlines the salient features of the Russian economy. The following sections investigate the symptoms of the Dutch Disease in the former Soviet Union. In particular, the appreciation of the real exchange rate is estimated in section 4 through an extended version of the Balassa-Samuelson model. Section 5 shows the impact of the international oil price and the real exchange rate on Russia's GDP. Section 6 deals with the

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[1] Mineral and agricultural booms in Latin America during colonial and republican times have been examined in DD terms (Prebish, 1963), as well as cases of Sub-Saharan economies (Gelb, 1988; Wheller, 1984). Also the gold discoveries in Australia during the 19th century were approached in DD terms (Forsyth, 1985). See W. Max Corden (1984), T. Gylfason (2001) for a number of further examples.

[2] The term "discovery", in the case of Russia and other countries of the Former Soviet Union mainly Azerbaijan and Kazakhstan, refers not to the detection of new oil veins but to the better exploitation of the existent oil deposits thanks to several contracts signed up with many Western oil consortia.

effects of oil price changes on the Russian industrial production. Section 7 displays the empirical evidence on manufacturing exports losses. The main findings are summed up in the concluding section.

2 The Dutch Disease

The core *Dutch Disease* model, attributed to Corden and Neary (1983), is modelled within the framework of a three-sector economy, namely a non-tradable sector (N), a manufacturing sector (M) and a resource sector (R). The model assumes that:

- labour is perfectly mobile among all the three sectors and makes sure that wages equalise across them;
- all goods are for final consumption;
- trade is always balanced as national output always equals expenditures; and
- commodity and factor prices are not distorted.

A resource boom affects the rest of the economy through two channels: the *resource movement effect* and the *spending effect.*

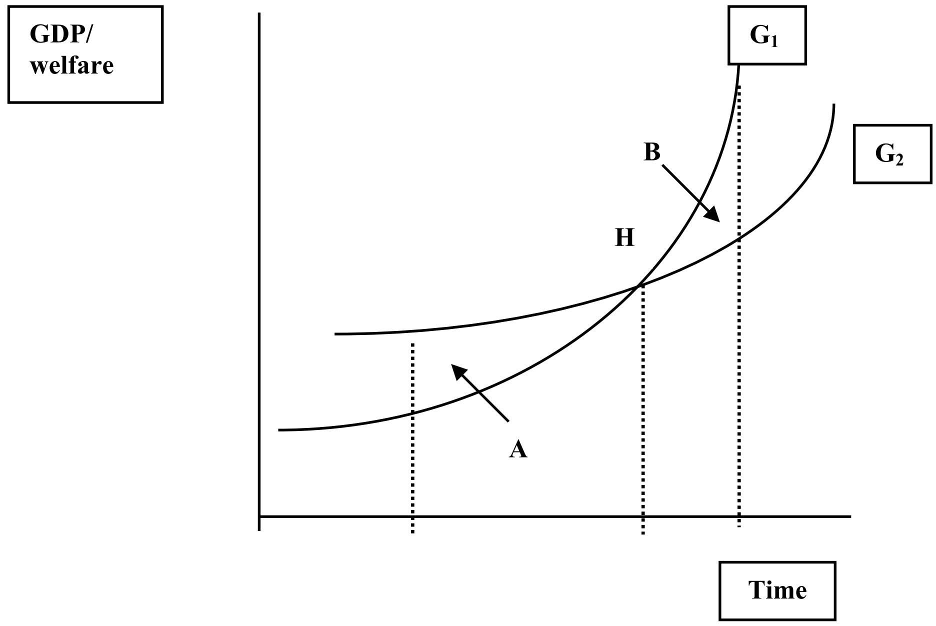
The resource movement effect. An increase in energy price raises the value of the marginal product of labour in the energy sector and pushes the equilibrium wage rate up, bringing about a movement of labour from both the manufacturing and non-tradable sectors to the energy sector. The result is a tightening of the other tradable sectors.

The spending effect. A boom in the natural resource sector, caused either by a rise in the world price of the resource or by a new deposit discovery, leads to increased income for the country which, in turn, brings about increased imports and domestic absorption for both tradables and non-tradables. Inasmuch as the prices of tradables are set internationally, this effect results in increasing prices (and wages) of non-tradables relative to tradables, i.e. a real appreciation of the exchange rate. In addition, it bids labour and capital out of the manufacturing sector.

Albeit the country experiences significant economic improvements in the short run due to a substantial upsurge in revenues from raw material exports, in the long run, it faces a risk to hold up its *"cultural, technical and intellectual development which only a strong, healthy manufacturing industry...can provide" (Kaldor, 1981)*. Hence, the long term effect may be to erode the country's competitive position in manufacturing from which it may be difficult to recover. This structural argument is particular relevant for transition countries which yet have to define their competitive position in a globalized world. Put differently, a country has to trade off the short-run advantages of owning natural resources against the costs of permanently lagging behind in terms of economic development. This idea is illustrated in Figure 1.

G_1 is the initial growth path with a dynamic manufacturing sector. A boom in raw material exports leads the country to G_2, characterized by a higher initial level of GDP than G_1 but a lower growth rate. In the short-run the country's gain is represented by area A. From point H on, the effect of crowding out the dynamic manufacturing sector starts playing its adverse impact. In the long-run the country is worse off. The loss is represented by area B.

Figure 1: The Dutch Disease Effect



The magnitude of benefits and losses in utility, in present value terms, to be on a growth path G_2 vs. G_1 depends on various factors, such as price shock and other disturbances such as domestic policies. For a given size of A and B, the net present value is influenced by the discount rate. The bigger this rate is, the more relevant are the augmented oil gains (A is wider) and less valuable is the future divide between the welfare along the two patterns of growth G_1 and G_2.

2.1 Literature Review

There is a broad literature on the Dutch Disease. Until the mid-1990s, most of the empirical works corroborate the presence of the Dutch Disease in a host of countries. In particular, during the 1970s and 1980s the poor economic performance of Latin America and African countries, despite their abundance in natural resources, was compared to the economic success of the Asian Tigers, which are poor in terms of natural resources. In the last decades, almost all cases of poor economic growth were attributed to Dutch Disease effects. Sachs-Warner (1995) constitutes the classical and most comprehensive empirical work on the Dutch Disease. The authors prove by an extensive empirical cross country research how, on average, countries with a high value of resource-based exports to GDP have a tendency to show lower growth rates. Resource-poor economies were often more successful than resource-rich economies in terms of economic growth. In the nineteenth and twentieth century, resource-poor countries such as Japan and Switzerland outperformed most other resource-abundant economies like Russia. In the last thirty years, the strongest and most flourishing economies worldwide have been the resource-scarce Newly Industrialising Countries of East Asia, namely Hong Kong, Singapore, Taiwan and Korea, whilst several resource-abundant economies, specifically the oil-rich countries of Venezuela, Mexico and Nigeria, have experienced serious economic difficulties. Valuable earlier findings of the failures of resource-driven development encompass works by Alan Gelb (1988) and studies by Auty (1990). Based on their findings, the disappointing performance of resource-abundant economies may be ascribed to a score of economic and political factors. Auty, for example, examines the poor performance of resource abundant countries in terms of both external and internal factors. The author provides three hypotheses linked to the external impacts: (i) the non-booming tradable sector shrinks and loses in competitiveness because of the Dutch Disease effect; (ii) exports of primary products enlarge income inequality; and (iii) a primary export orientation can lead to periodic growth collapses owing to higher volatility of primary goods prices as compared to manufactured goods.

Van Wijnbergen (1984) postulates that a boom in the exports of primary goods, in addition to its detrimental effects on the manufacturing sector, can also affect economic growth through “forward and backward linkages.” If most economic growth is attributed to learning-by-doing processes, which chiefly shape and affect the manufacturing tradable sector, a temporary decline in that sector may reduce productivity and, hence, lower future national income.

An alternative explanation of linkages between a country’s resource abundance and low growth rates can be traced back to the area of political economy. Lane and Tornel (1996) demonstrates that resource-rich economies are vulnerable to more intense rent seeking activities than resource deficient economies, as national politics is prone to grabbing up the rents gained by the natural resource endowments. In their empirical model, a windfall originated by a discovery of natural resources or a terms of trade improvement can induce to a “feeding frenzy” in which rival groups struggle for the natural resource rents until they deplete the public good. Auty (1999),while supporting these political channel of influence, points out that in the case of transition economies, resource rents create a stagnant response to reforms, thereby increasing the risk of policy corruption.

In the second half of the 1990s, the general validity of the Dutch Disease was questioned by a consistent number of empirical works. The latter elucidated that the Dutch Disease hypotheses are particularly strict and hold under specific assumptions. Therefore, the economic consequences and the policy implications of the findings of Sachs-Warner (1995) are consistently reduced. Davis (1995) ranks the top 43 mineral-producing developing countries by using a modified mineral dependence index. By assessing the countries’ performance for 1970 (prior to the oil and gold price boom) and for 1991 (after the boom ended), the author concludes that the harmful consequences of the misuse of natural resources for the long term growth of resource-abundant developing countries are not widespread. Spilimbergo (1999) shows that countries with copious natural resources like Chile and South Africa, were not even slightly affected by the Dutch Disease. Altamirano (1999) refers to Corden (1984) who suggests that the Dutch Disease might not even hold for the Netherlands. According to him:

> *…"the true Dutch Disease in the Netherlands was not the adverse effects on manufacturing of real appreciation but rather the use of booming sector revenues for social service levels which are not sustainable…".*

Gylfason (2002) argues that, in the long term, natural resource-abundant countries may register slow down in their growth rates not only because of the Dutch Disease but, above all, as a result of lacking and/or ill-defined property rights, weak rule of law and imperfect, missing or moonlighting markets in many developing and emerging market economies; extensive rent-seeking which can reinforce corruption in business and government; and, low incentives for human capital accumulation. As a result many people end up stuck in low-skill intensive natural resource-based industries. This view is shared by Stijns (2000). The author demonstrates that the negative relationship between natural resource abundance and economic growth, as predicted by Sachs-Warner, does not hold when one uses actual data about energy, mineral reserves and production. The empirical findings presented by Sachs-Warner are everything but robust. Matsen and Torvik (2003) affirm that some Dutch Disease is always optimal, because lower growth in resource abundant countries might be part of an optimal growth path.

2.2 The Dutch Disease in a Transition Economy

The empirical analysis of the Dutch Disease is mostly focused on the experience in resource abundant developing countries (e.g. Venezuela, Ecuador, Nigeria, Indonesia) and in several industrial countries (e.g. the United Kingdom, the Netherlands, and Norway). There are, however, only a few analyses regarding the effects of a booming resource sector in a post-Soviet transition economy. Rosenberg and Saavalainen (1998) evaluate the economic risks correlated to the extensive use of natural resources in Azerbaijan and suggest a policy strategy to deal with such risks. The authors revise the standard three sector Dutch Disease model to take into account some peculiarities of transition economies, specifically: (i) depreciation of the national currency; (ii) weakness of the financial system; and (iii) increases in capital inflows. "Transition factors" turn out to be magnifying the speed of real appreciation. Non-oil sectors may be worse off, but mainly as a result of transition-specific structural and institutional problems than due to a real appreciation. The authors argue that Azerbaijan can avoid the Dutch Disease problem if it "promotes savings and open trade and strengthens the supply side through structural policies". The Azerbaijan case is also analysed by Singh and Laurila (1999). According to them, the Dutch Disease syndrome is supposed to become a policy concern in the medium to long term, particularly after 2005. Kuralbayeva, Kutan and Wyzan (2001) examine if Kazakhstan is vulnerable to the Dutch Disease. Using an extended version of the Balassa-Samuelson model, they find evidence that changes in the terms of trade have a significant effect on the real exchange rate after 1996, providing evidence of the Dutch Disease.

In spite of the common perception that oil is extremely important for the Russian economic dynamics, there is, unexpectedly, a dearth of research on how oil prices influence Russian macroeconomic performance. Most studies either have theoretical foundations (Moiseev, 1999), or are based on rather direct and straightforward computations. For example, Russia's exports and/or fiscal revenues are measured by a one dollar-change in oil price.

Hitherto, a crucial reason for the absence of empirical analyses regarding the effects of oil prices and the real exchange rate on Russia's economy has been data issues. In detail, fragmented time series concerning trade variables, output and fiscal figures and recurrent data adjustments have been the main obstacles to carry out research. Furthermore, the several institutional and structural adjustments that occurred in Russia during the transition process to a market economy have further complicated empirical analysis.

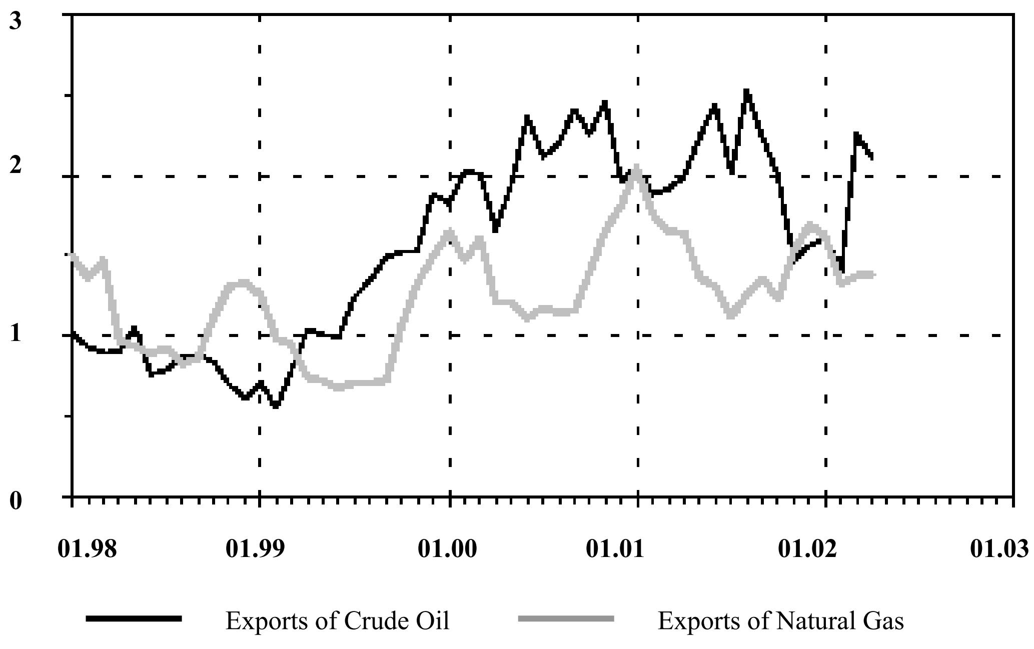
In the following sections, we will therefore try to fill this gap in economic research with the aid of a wider availability of data, taken from the *Russian Economic Trends* (RET). More specifically, after having outlined the special features of the Russian economy, four propositions derived from the Dutch Disease literature will be tested, namely:

- a real exchange rate appreciation (sec. 4),
- a temporary improved economic situation (sec. 5),
- a decline in the non-booming sector output (sec. 6),
- a reduction in the non-booming sector exports (sec. 7).

3 Relevant Features of Russia's Economy

Natural gas, electrical power and oil occupy a central place in the Russian economy. Russia possesses roughly one third of the world's natural gas reserves and currently supplies one fourth of all gas on the world market. The volume of Russian electricity production is second only to that of the United States (OECD, Russian Federation Economic Survey, 2002). The Russian Federation is the largest petroleum producer in the CIS, putting it in the top 10 among the world's 90 oil producing countries. Outside OPEC, Russia is now the world's second largest oil exporter[3] (The Economist, 19 June 2002). Moreover, Russia owns strategically significant reserves of raw materials. Average per capita reserves of coal, iron, wood, the main ferrous metals by far exceed the world average. The country holds the world's vastest reserves of copper, nickel, aluminium and pulp. The importance of natural resources to Russia's economy is illustrated by the country's export structure, as depicted in Figure 2 and Table 1 Appendix.

Figure 2: Exports of Crude Oil and Natural Gas ($ bn)



Source: Goskomstat and RET Estimates

[3] The largest non-OPEC oil exporter-country is Venezuela.

Natural resources abundance causes the Dutch Disease[4] in the sense that a natural resource boom and the associated burst in raw-material exports tend to drive up the value of domestic currency in real terms, with the result that exports from other sectors may stagnate or even fall relative to GDP, or may become biased against manufacturing.

According to President Putin's economic advisor, Andrei Illarionov, Russia is suffering from the early stages of the Dutch Disease. Easy money from natural resources is keeping the exchange rate high and inflation up, and is beginning to strangle the rest of the economy (The Economist, 2001).

A general view holds that the real exchange rate and oil price play a strong role in determining Russia's GDP dynamics. This idea relies on the fact that the 2001 exports amounted to about one third of the GDP, and that almost half of trade revenues originated from energy. Furthermore, it is supposed that the federal budget depends considerably on both energy prices and output performances. In accordance with numerous statistical sources, about 30-40% of central government total revenues[5] are due to the energy sector's returns.

Figure 3, by portraying the dynamics of the Russian real GDP, the central government real revenues, the real effective exchange rate and oil prices, reinforces the perception that tight links exist among the considered variables. Specifically, government revenues seem to keep strictly pace with GDP developments and oil price trends. The dependence of GDP on oil prices is conceivably not as plain as in the case of government revenues, although the Russian output and oil prices moved together before the August 1998 crisis, and again since 1999 on. Figure 3 shows that since 1995 the real exchange rate tended to appreciate progressively, but such a tendency fizzled out in 1998 when the rouble collapsed as a result of the August crisis. However, the graphs alone cannot clearly explain the nature of the relationship between the real exchange rate and GDP. The extent to which the August 1998 crisis affected Russian output needs to be also taken into consideration (Rautava, 2002).

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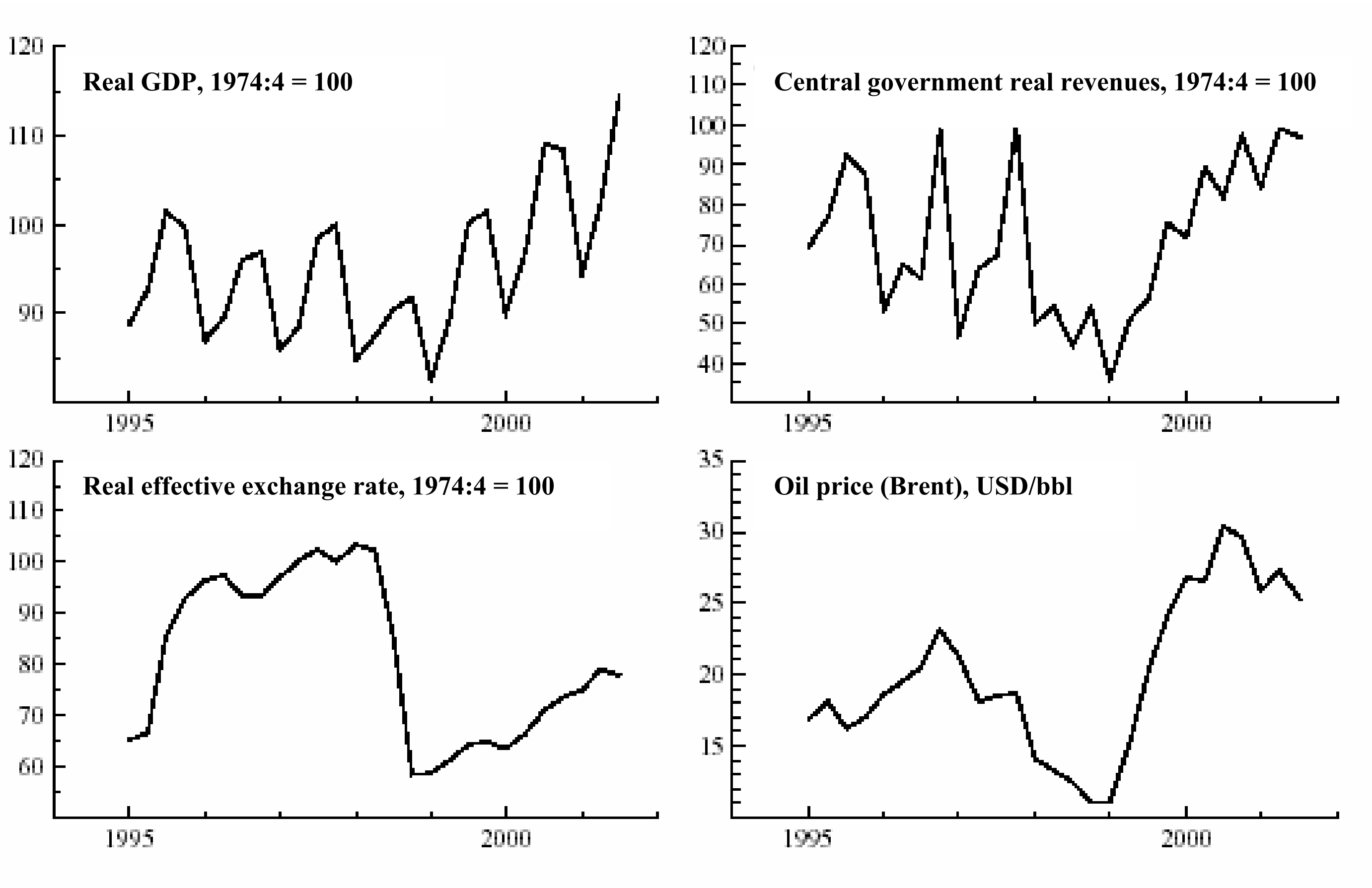
[4] See Gylfason 2001 to sum up the possible channels of transmission from natural resource abundance to sluggish economic growth.

[5] See for example OECD, Economic Survey on Russia (2002).

Figure 3: Real GDP, Real Revenues, Real Effective Exchange and Oil Movements



Source: Russian Economic Trends, Various Issues

4 The Dutch Disease in Russia Symptom 1: A Real Exchange Rate Appreciation

Studies and models on the Dutch Disease in general assume some notion of equilibrium real exchange rate (RER) at the start of a resource boom. Once the discovery of a new natural resource occurs, or a price shock materializes, the equilibrium RER shifts from its initial level to a new, appreciated one. Also, the actual RER exhibits a tendency to appreciate as a result of either one or a combination of the following factors: (i) an upsurge in domestic absorption and permanent income; (ii) an increase in the price of non-tradable goods; (iii) a change in relative prices; and (iv) a boost in foreign capital inflows. Experience from transition countries like Russia reveal that the pre-condition of initial RER equilibrium at the outset of a resource boom tends not to hold. Instead, it is more likely that the external and internal balance conditions are not satisfied, and the assumption of working market mechanisms are not met in countries of transition (Rosemberg and Saavalainen, 1998). Nevertheless recent research in this area (Halpern and Wyplosz, 1996; Krajnyak and Zettelmeyer, 1998; Rosenberg and Saavalainen, 1998; Coricelli Jazbec, 2001) has detected some stylised facts of both actual and equilibrium real exchange rate dynamics. More precisely, according to these studies, it seems that the actual RER follows a U-shape pattern, whereby the exchange rate first "undershoots" the equilibrium RER,[6] and then starts to appreciate to eventually approach the equilibrium RER. The discovery of natural resource deposits or price shocks will move the equilibrium RER towards a new path.

This section is divided into two parts. In the first part (4.1), the principal causes of real exchange movements are investigated. In the second part (4.2), an extended real effective exchange equation is estimated in order to quantify Russia's vulnerability to the Dutch Disease.

4.1 The Dutch Disease Impact on Real Exchange Rate: Theory and Methodology

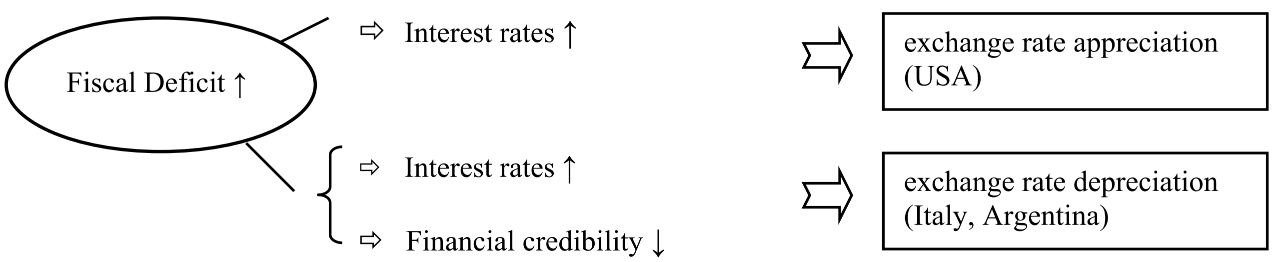
There are different theories that elucidate the dynamics of the real exchange rate during economic transition in several Central and Eastern European countries (CEEC) and in the Former Soviet Union. One explanation of such a movement is based on the Balassa-Samuelson effect (Halpern and Wyplosz, 1997; Coricelli and Jazbec, 2001; De Broeck and Sløk, 2001; Égert, 2002). Changes in relative prices between tradables and non-tradables cause changes in the real exchange rate. According to the Balassa-Samuelson effect, *productivity growth* in the tradable sector brings about a rise in real wages. If wages are the same in different sectors of the economy, then wages and thus prices would increase in the non-tradable sector, thereby affecting

[6] According to some estimates by Krajnyak and Zettelmeyer, at the beginning of transition, Russia had an actual RER equal to 188 against an equilibrium RER of 268 average dollar wage per month.

the real exchange rate. In other words, sectoral productivity differentials across countries are identified as the fundamental determinant of real exchange rate movements. Economies with a higher level of productivity in tradables will be characterized by higher wages and since international productivity differences are wider in tradables than in non-tradables, also by higher prices of non-tradables[7].

A second strand of literature considers changes in the real exchange rate as a consequence of variations in relative prices between exports and imports. In other words, relative price movements within the tradable sector, specifically movements in the relative price of exports, are a major determinant of real exchange rate movements (Dornbusch, 1983; Roldos, 1990; Frenkel and Razin, 1992). For a small open economy, an increase in the export price, which improves the terms of trade, will intensify its export revenues. This leads to a surge in spending on all goods, which raises domestic prices relative to foreign prices, causing a real exchange rate appreciation. For a large open economy, a rise in export prices will provoke either a slump in revenues, if its demand for exports is elastic, or, in the case of inelastic export demand, an increase in revenues. In the first case, the real exchange rate depreciates; in the latter, it picks up. Orlowski (1997) finds evidence that high inflation rates, growing labour costs and trends in nominal exchange rates drive real exchange rate movements in several transition economies. Dibooglu and Kutan (2001) check empirically Brada's (1998) assumption that real exchange rates dynamics in transition economies are a consequence of either real or monetary shocks. They conclude that Brada's conjecture on real exchange rates movements holds for all transition economies. De Gregorio and Wolf (1994) have extended the Balassa-Samuelson effect to include the terms of trade (TOT).

A third strand of literature stresses the importance of fiscal policy changes in determining real exchange movements. A fiscal deficit could produce two sorts of effects. On the one hand, if the fiscal deficit increases (i.e. there is an expansive fiscal policy), interest rates will rise as a consequence of a restrictive monetary policy, and the real exchange rate will appreciate. This is what the United States have experienced from 1980 to 1985. On the other hand, when a fiscal deficit increases, it can be accompanied both by a rise in interest rate and by a drop in financial credibility. This combination of factors can yield to a real exchange rate depreciation, as witnessed by Italy in 1992 and Argentina in 2001-2002.



[7] Perfect intersectoral factor mobility ensures factor price equalization across tradables and non-tradables.

4.2 A Model for Russia

In order to model the real exchange rate equation for Russia, the three strands of literature have been combined[8] and a new explanatory variable, the oil price, added, in order to isolate the Dutch disease[9]. The extended Balassa-Samuelson model, examined within an Error Correction (ECM) framework, can be specified as:

$$REX = f\ (\underset{+}{POIL},\ \underset{+}{PR},\ \underset{\pm}{TOT},\ \underset{\pm}{GOV}) \qquad (1)$$

where REX, POIL, PR, TOT, and GOV are respectively the real effective exchange rate, oil prices, productivity, terms of trade[10] and a government variable. The real effective exchange rate (REX) is a significant indicator that directly reflects Russia's international competitiveness in terms of its foreign exchange rate. It is a more suitable indicator than a bilateral exchange rate based on the US dollar because of the oil-price sensitivity of US consumption. An increase in the trade-weighted real exchange rate implies an appreciation of the domestic currency. The oil price variable (POIL) is included in the model to test for the Dutch Disease effects. The productivity variable (PR), which reflects the Balassa-Samuelson hypothesis, is constructed as index of industrial production divided by the index of employment in that sector. This practice is consistent with the evidence reported by Coricelli and Jazbec (2001) and Égert (2002) who analyze the real exchange rate dynamics in different transition economies and prove that the B-S effect plays a dominant role at the later stage of transition. Oil and natural gas exports have been taken out of the TOT in order to filter out the Russian manufacturing trade price structure. The variable GOV embodies the public deficit and has been constructed as a ratio of the total State budget expenditure and total State budget revenues. The rationale behind describing deficit as a ratio and not as difference is due to negative signs obtained from subtraction which prevent variables to be expressed in log form.

According to the literature, the first two variables are expected to have a positive sign, and the latter may have either a positive or a negative sign. The variable TOT always shows a positive sign in the case of small open economies or large countries with an inelastic export demand. TOT has a negative value in the case of large country with elastic demand for exports. The variable GOV is positive when a country enjoys a strong financial credibility and vice-versa.

Monthly data for the period from January 1994 to May 2002 are used to estimate an ECM model for the Russian economy. The real effective exchange rate data, productivity data, terms

[8] The initial idea is allotted to De Gregorio, Wolf (1994).

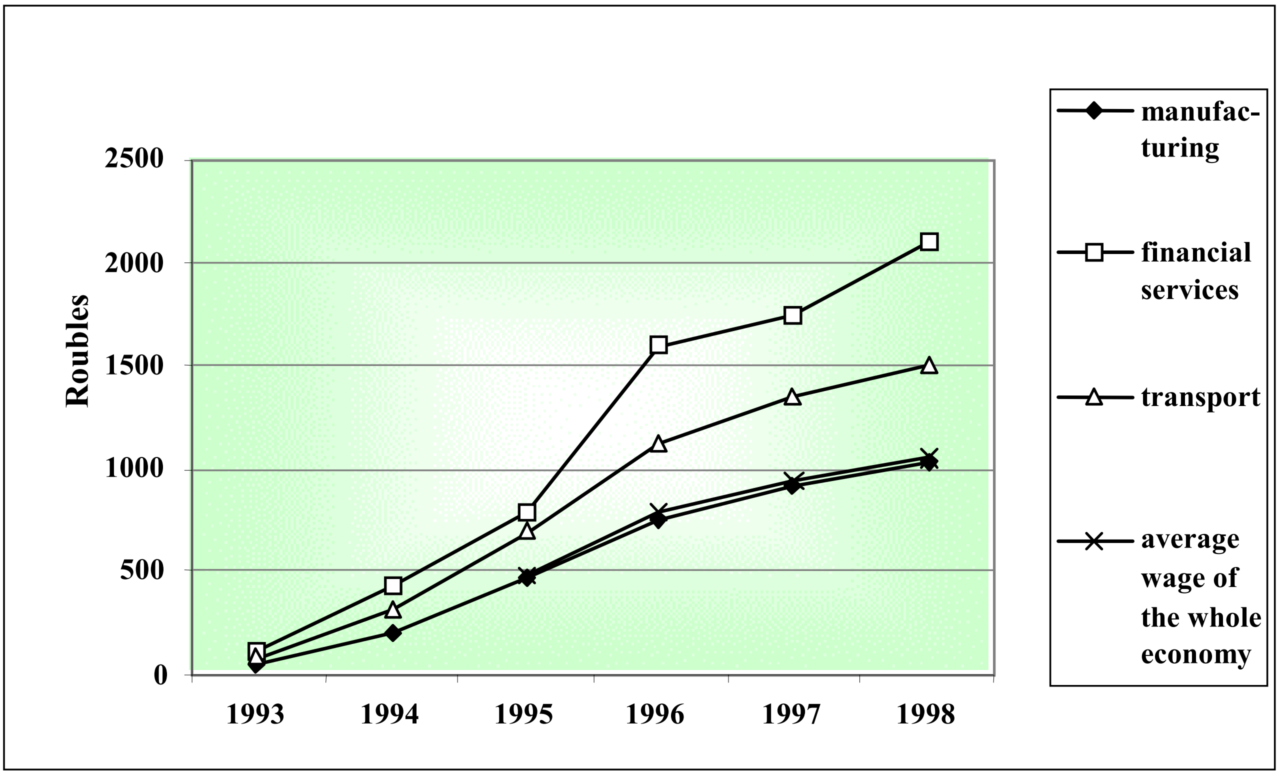
[9] The exchange rate policy in Russia has changed over time. In July 1992, the Russian government adopted a flexible exchange rate system. In June 1995, Russia shifted from the flexible exchange rate system to a target one. The Russian exchange rate was allowed to fluctuate within a range of 4,300 to 4,900 roubles per US $. In the following two years this range was modified many times. Since 1998, a constant central parity (6.2 roubles per US $ after the denomination of the rouble) with a fluctuation range (± 15%) was established (W.R. Poganietz, 2000).

[10] Indices of unit export and import values have been used as measure of Russian exports and imports prices.

of trade, total government expenditure and revenues have been collected from the Russian Economic Trends and the IMF's International Financial Statistics. Oil prices are taken from the United States Energy Information Administration.

The Balassa-Samuelson model postulates that wages between the tradable and non-tradable sectors should equalise, therefore this hypothesis has been checked before conducting the econometric analysis. Specifically, equalization requires that relative wages (non-tradable wage minus tradable wage) should be mean reverting, in the sense that, albeit a gap in the levels between nominal wages across sectors may exist, such a gap should remain stable over time (Égert, 2002). Therefore, it has been verified whether a spur in the nominal wages of non-tradable sector has been accompanied by an increase in the nominal wages of the industrial sector. Sectoral nominal wages data with annual frequency have been collected from ILO. The data set, which spans from 1991 to 1999, was enhanced to evaluate and compare the development of average nominal wages in the whole economy with that of wages in industry. To reveal the dynamics on a more disaggregated level, we have shown the respective ratio for financial services, transport and manufacturing. We have found that the ratio between the nominal wages in different sectors of the economy remains stable over time (Figure 4).

Figure 4: Wages by Economic Activity



Source: Own calculations on Laborsta, ILO, Database, 2003

A preliminary test on equation 1 expressed in logs has been carried out for the Russian Federation.

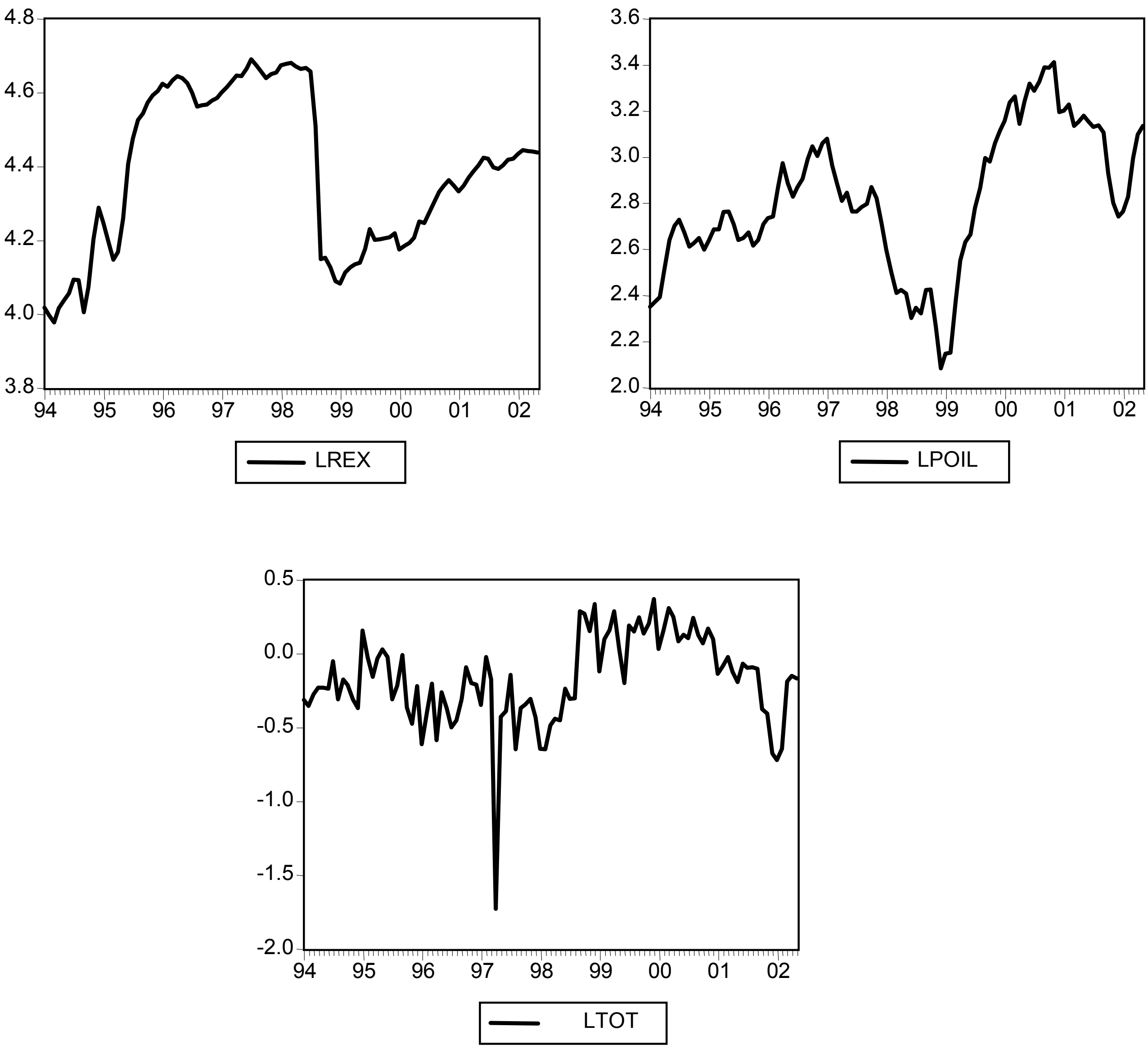
$$\log rex_t = \alpha + \Sigma\chi \log poil_t + \Sigma\beta \log (TOT)_t + \Sigma\delta \log pr_t + \Sigma\, \varepsilon \log gov_t + u_t \qquad (2)$$

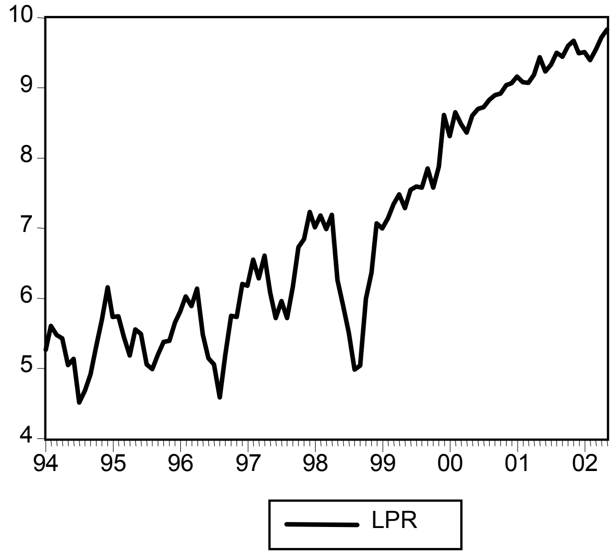
All the coefficients express elasticities. Equation (2) states that real effective exchange rate movements are driven by oil prices, productivity data, TOT change and the government variable.

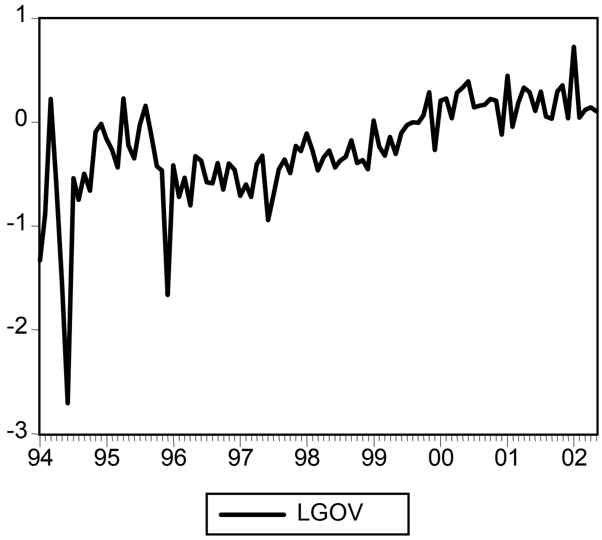
4.3 Empirical Evidence

The variables' dynamics are sketched in Figure 5.

Figure 5: Series Behavior







Note: LREX = log of the effective real exchange rate; LPOIL = log of international oil price; LTOT = log of terms of trade; LPR = log of productivity; LGOV = log of governmental deficit.

Source: own presentation, data from RET database.

The lpoil and lpr variables have been seasonally adjusted to account for their seasonal movements. Each series seems to meander in a fashion characteristic of a random walk process. To formally test for the presence of **unit roots** in the series, the Augmented Dickey-Fuller (ADF) and the Philips Perron (P-P) tests have been conducted for each variable. The number of unit roots contained in the series, which gives the order of integration, is the number of differencing operations it takes to make the series stationary. In our case, all the independent and dependent variables are integrated of order one I(1) following the ADF test. The critical values for the rejection of the hypothesis of a unit root are those computed according to the McKinnon criterion. According to the P-P test, on the other hand, the GOV variable is stationary at each critical value. Even though the two tests show different results for the GOV variable, it is acceptable to follow the ADF technique which, according to the literature, is more accurate. The outcomes of the tests are reported in appendix (Table 2a and Table 2b). The presence of non-stationarity implies that the Least Square estimates are no longer suitable and that, consequently, a cointegration analysis is required.

4.4 Cointegration Analysis

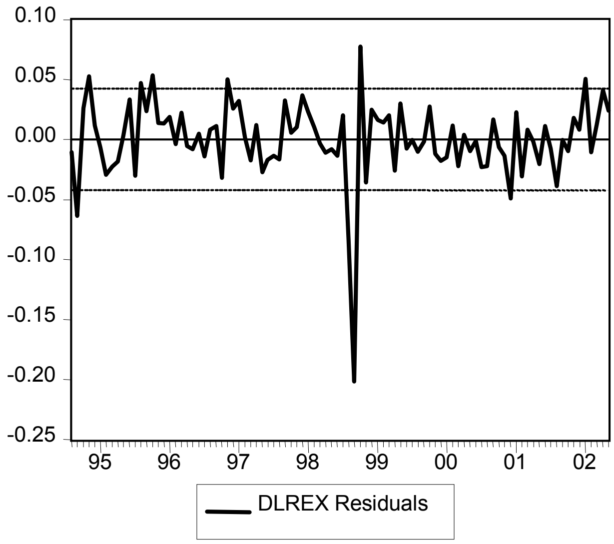
An Error Correction Model (ECM) has been adopted to determine if the non-stationary time series are cointegrated, and to identify the cointegrating (long-run equilibrium) relationships.

The first error-correction specification is used to gauge the impact of the explanatory variables against the real exchange rate. It contains differences in lags of the dependent and independent variables and lags (by one period) of explanatory variables (equation 3). Each difference in lags is the short run impact of the explanatory variables on the dependent ones, while each lag describes the long run dynamics among variables. To determine the appropriate length of the distributed lag, the Akaike Information Criterion (AIC) has been adopted, with the results supporting a lag length of twelve[11].

$\Delta lrex_t = \xi + \beta_1 lrex_{t-1} + \beta_2 lpoil_{t-1} + \beta_3 lpr_{t-1} + \beta_4 lTOT_{t-1} + \beta_5 lgov_{t-1} + \Sigma_i \chi_i \Delta lrex_{t-i} + \Sigma_i \mu_i \Delta lpoil_{t-i} + \Sigma_i \eta_i \Delta lpr_{t-i} + \Sigma_i \lambda_i \Delta lTOT_{t-i} + \Sigma_i \rho_i \Delta lgov_{t-i} + u_t$ (3)

In the equation, a dummy variable has been entered for August 1998 because in that month, the residuals (Figure 6) indicate that the series is affected by an outlier. The outlier can naturally be attributed to the financial crisis of Russia that culminated in August 1998.

Figure 6: Residual Graph



A trend, resulting significant, was included in the final ECM specification. The latter, estimated by LS technique[12] (Appendix Table 3) is formalized by:

$\Delta logrex_t = \beta_1 \log rex_{t-1} + \beta_2 \log poil_{t-1} + \beta_3 \log pr_{t-1} + \beta_4 \log tot_{t-1} + \beta_5 \log gov_{t-1} + \eta_2 \Delta \log rex_{t-2} + \eta_4 \Delta \log rex_{t-4} + \eta_8 \Delta \log rex_{t-8} + \eta_{10} \Delta \log rex_{t-10} + \eta_2 \Delta \log rex_{t-10} + \lambda_1 \Delta \log tot_{t-1} + \lambda_2 \Delta \log tot_{t-2} + \rho_3 \Delta \log gov_{t-3} + \rho_4 \Delta \log gov_{t-4} + \rho_5 \Delta \log gov_{t-5} + \rho_7 \Delta \log gov_{t-7} + \mu_4 \Delta \log poil_{t-4} + \mu_{11} \Delta \log poil_{t-11} + \eta_4 \Delta \log pr_{t-4} + \eta_8 \Delta \log rw_{t-8} + \eta_{12} \Delta \log rw_{t-12} + @trend$ (4)

The residuals are white noise, because using the LM test, the null hypothesis (exists no serial correlation) cannot be rejected [see Appendix Table 2 Obs*R_square 3.610755< 9.8 crit.].

---

[11] The selected lag specification has the lowest values of the AIC.

[12] If the variables are cointegrated, a LS regression yields a "super-consistent" estimator of the cointegrating parameters. Stock (1987) proves that the LS estimates of the cointegrated parameters converge faster than in LS models using stationary variables.

The Durbin-Watson statistics also shows the same result. Normality of the residuals have been examined by performing the Jarque-Bera multivariate test on single equation residuals. The R^2 (57.0%) reveals high goodness of fit of the model. Finally the t-statistics of lrex(-1) (-5.723114) emphasizes the existence of a long run cointegration relationship among variables, i.e. they cannot move independently of each other (Appendix Table 3). The null hypothesis that no cointegration vs. cointegration is rejected .

Ho: no cointegration vs. H1: cointegration

$$t_{ECM} = -5.723114 < t_{CRIT} -3.98$$

The long run cointegration relationship, given by the Bewley-transformation[13] (Table 4 Appendix), is:

$$\log rex_t = 0.838859 * \log poil_t + 0.776095 * \log prsa_t - 0.569032 * \log (TOT)_t + 0.484941 * \log gov_t \quad (5)$$

$$(3.307802) \qquad (4.743926) \qquad (-2.411046) \qquad (1.962289)$$

where the values in brackets are t-values.

4.5 Analysis of Results

In line with the previous literature, oil prices, terms of trade, productivity and the government variable enter as highly significant in the final equation and have the expected signs. More specifically, oil prices are positively related to the real effective exchange rate. An increase in international oil prices brings about a Russian real exchange rate appreciation. More precisely, if oil prices at time t increases by 10% with respect to time t-1, Russian consumer prices will rise by 8.4% in t. The real exchange rate is elastic to oil price changes and mirrors the latter's movements (eq. 5).

The Russian real effective exchange rate is negatively related to the terms of trade. A rise in export price will cause a real depreciation, pushing the real exchange rate down and, with a certain time lag, making Russian exports more competitive on international markets: a 10% increase in Russian relative prices of manufactures results in a real depreciation of 5.6%. This result is in compliance with the theory about large countries. De Gregorio and Wolf (1994) find always positive TOT signs for a panel of 14 countries[14]. The positive sign could be ascribed to the inclusion of both manufactures and the resource sector in TOT, which would produce inelastic demand for exports. A drawback of De Gregorio and Wolf analysis may be traced back

[13] The long run relationship estimated by the ECM is numerically identical to the one estimated by the Bewley transformation. But the latter also provides t-values for the long run coefficients.

[14] The United States, Germany, UK, Australia, Belgium, Canada, Denmark, Finland, France, Italy, Japan, the Netherlands, Norway and Sweden.

to the fact that they adapt the considerations for a small open economy model to a group of countries of different size, mainly with considerable dimensions.

The productivity variable is positively linked to the real effective exchange rate. A real appreciation in fact implies that the productivity level in a certain country increases more than abroad. For the Russian economy, a boost in productivity of 10% would lead to a real appreciation of about 7.8%.

The government variable shows a positive relationship with the real exchange rate. That is, an expansive fiscal policy of 10% triggers a real appreciation of about 4.8%. This means that the increase in the Russian interest rates has been bigger than the loss in Russia's financial credibility (paragraph 3.1).

5 The Dutch Disease in Russia Symptom 2: GDP Changes

In this section the effects of oil price and real effective exchange rate changes on Russian GDP are investigated. The aim is to examine the sensitivity of Russia's output to changes in international prices and in the trade-weighted real exchange rate.

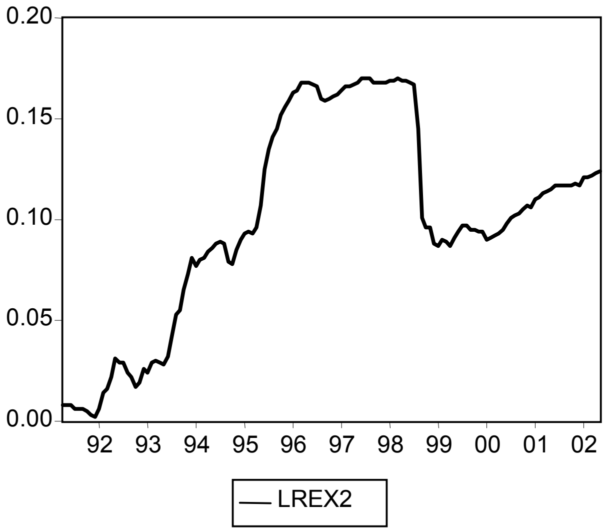
$$GDP = f\,(\underset{+}{POIL},\ \underset{-}{REX2}) \qquad (6)$$

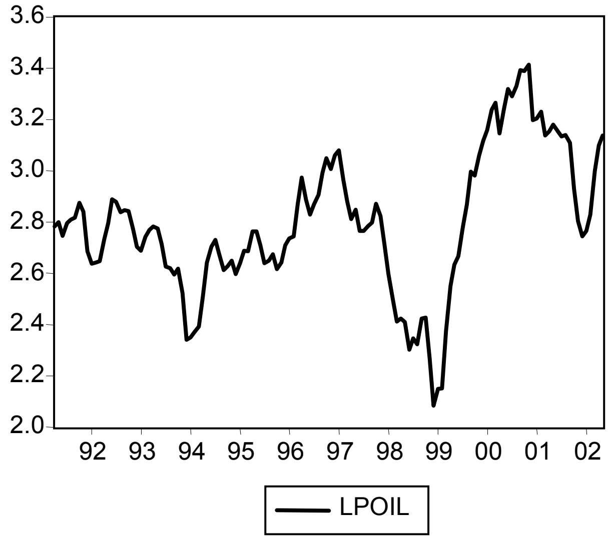
As in the previous analysis, monthly data ranging from 1991:4 to 2002:5 are used to estimate the ECM model for the Russian economy. The model includes the real effective exchange rate of Russia (rex2) and the international oil prices[15] (poil) as exogenous variables. The Russian GDP index at 1997 price (gdp) is the endogenous variable[16]. Data regarding the effective exchange rate and GDP are computed from the Russian Economic Trends, data on international oil prices are taken from the Energy Information Administration's statistics.

The behaviour of the variables over time is depicted in Figure 7.

Figure 7: Series Movements

[15] Domestic first purchase price, dollar per barrel.
[16] All variables are expressed in log form ('l').





The presence of non-stationary series is formally detected by using the Augmented Dickey Fuller (ADF) test and the Philips-Perron (P-P) ones (Table 5a and Table 5b Appendix). Our model includes a constant and a trend, since both are significant. The presence of a trend is also quite clear from the previous graphical inspection. According to the ADF and the PP tests, the variables do not exhibit stationarity. The null hypothesis H_0 of a unit root, in fact, cannot be rejected (Table 5a and Table 5b Appendix). All the variables are integrated of order one I(1) at any of the reported significance levels.

5.1 Cointegration Analysis

The first error-corrected model specified for the estimation of short and long run impact of real exchange rate changes and oil prices variations on the Russian GDP includes explanatory variables up to 12 lags.

$$\Delta lgdp_t = \alpha + \beta_1 lgdp_{t-1} + \beta_2 lrex2_{t-1} + \beta_3 lpoil_{t-1} + \Sigma_i \chi_i \Delta lgdp_{t-i} + \Sigma_i \mu_i \Delta lrex2_{t-i} + \Sigma_i \eta_i \Delta lpoil_{t-i} + u_t \qquad (7)$$

Three dummy variables relative to 1994, 1995 and 1999 have been added. Trend and seasons turned out to be not significant

The final result (Table 6 Appendix), obtained after dropping one by one all the not significant variables, is given by:

$$dlgdp = \alpha + \beta_1 lgdp_{t-1} + \beta_2 lrex2_{t-1} + \beta_3 lpoil_{t-1} + \chi_3 dlgdp_{t-3} + \mu_6\, dlrex2_{t-6} + \eta_9 dlpoil_{t-9}$$
$$+ \mu_{11} dlrex2_{t-11} + \chi_{12} dlgdp_{t-12} + D94 + D95 + D99 + u_t \qquad (8)$$

The specification of the estimated model is appropriate, since there is no autocorrelation among residuals (Table 6 Appendix).

The hypothesis test:

Ho: no cointegration vs. H1: cointegration

has rejected the null:

$$t_{ECM} = -4.680573 < t_{CRIT} -3.98$$

hence a long run meaningful cointegration relationship among variables exists and it is (Table 7 Appendix) given by:

$$\log gdp_{t-1} = -\ \underset{(-8.844219)}{0.215601}*\log rex2_{t-1} + \underset{(3.969991)}{0.206650}*\log poil_{t-1} \qquad (9)$$

Lastly, we have tested for weak exogeneity to evaluate the significance of the fitted error correction term (ECMHAT). The $H_0 : \phi_1=\phi_2=0$. The test is constructed according to the Wald principle (Table 8a and 8b Appendix). More formally, under the null hypothesis H_0, the Wald statistic has an asymptotic $\chi^2(q)$ distribution, where q is the number of restrictions.

$$\text{Wald} = 2.291770 < \chi^2(2)_{0.05} = 5.99$$
$$\text{Wald} = 2.060561 < \chi^2(2)_{0.05} = 5.99$$

The Ho of weak exogeneity was not rejected, this means that the single equation approach is valid.

5.2 Analysis of Results

The coefficients of independent variables are the elasticities of Russian GDP. Put differently, the coefficients show the sensitivity of Russian GDP to changes in international oil prices and in the real effective exchange rate. The oil price elasticity is 0.21, whilst the real effective exchange rate elasticity is –0.22. The oil price and the exchange rate signs are in conformity with those predicted by the theoretical model. The estimates point out that a boost in international oil price of 10% will have an impact on national GDP of 2.1%. In fact, an upturn in international oil price will produce more revenues for Russian oil producers, since the oil demand is relatively inelastic to price changes. On the other hand, a real exchange rate appreciation of 10% will cause a reduction of Russian GDP of 2.2% because Russian products will be less competitive in the international arena, their demand will be reduced, thereby negatively impacting on Russian domestic product. A real exchange rate appreciation can thus be considered as an increase of national labour costs, which dampen the international competitiveness of a country.

The results of this estimation indicate that the impact of oil price changes on output could be balanced by respective changes in the real effective exchange rate. However, this counterbalancing effect has to take into account also the influence of oil price changes on real effective exchange rate as estimated under equation 5. As a consequence, an increase in oil price by 10% produces two effects: a rise in GDP by 2.066% (eq.9) and an appreciation of real exchange rate by 8.38% (eq.5). An appreciation of real exchange rate of 8.38% leads to a drop in GDP growth by 1.81%. The total GDP growth is thus 0.256%.

6 The Dutch Disease in Russia Symptom 3: Output Loss in the Non-booming Sector

This section aims to isolate and estimate the effect of oil price changes on Russian production. In particular the seasonal adjusted oil price variable has been regressed against the ratio of industrial production and service production, in order to test symptom 4 of the Dutch Disease effect. The tested equation, which incorporates the oil price as the only overriding explanatory variable, is:

$$Y_{industry}/Y_{services} = f\,(\underset{-}{POIL}) \qquad (10)$$

The index of industrial and service production at price 1997 = 100 has also been seasonally adjusted.

Figure 8: Adjusted Y Industry/Y Services Series in Logs

The expected sign is negative, since the Dutch Disease hypothesis postulates a fall in manufacturing production whenever a resource boom materializes. The adopted data set ranges from April 1994 to May 2002. Data have again been taken from RET. After having tested for the presence of a unit root in the dependent variable (Table 9 a and b), and after having made the series stationary, the first error-correction specification has been computed:

$$\Delta l\ Y_{industry}/Y_{services\ t} = \alpha + \beta\ l\ Y_{industry}/Y_{services\ t-1} + \gamma\ lpoil_{t-1} + \Sigma_i\delta_i\Delta l\ Y_{industry}/Y_{services\ t-i} + \Sigma_i\phi_i\Delta lpoil_{t-i} + u_t \qquad (11)$$

The long run cointegration relationship (Table 10) estimated by the Bewley transformation (Table 11) is:

$$\log Y_{industry}/Y_{services t} = \underset{(-11.37157)}{-0.083535} * \log poil_t \qquad (12)$$

The estimated model is robust in terms of autocorrelation and normality. The oil price variable is significant in explaining output movements and it has the correct sign. An upturn in oil prices of 10% will lead to a slump in the output ratio of non booming sector by 0.84%.

7 The Dutch Disease in Russia Symptom 4: Russian Exports Loss

To complete the Dutch Disease investigation, we have analysed which Russian manufacturing sectors seem to have been hampered by changes in oil prices. Some statistical indices have been computed for the period 1996-2000 to highlight the loss in export levels, registered by some manufacturing sectors.

Table 1: Loosing Export Sectors 1996-2000 (Values in U.S. $) ($x_t$-$x_{t-1}$/$x_{t-1}$)

	% change 97-96	% change 98-96	% change 99-96	% change 00-96
112 - ALCOHOLIC BEVERAGES	-50,12	-81,47	-79,76	-70,19
121 - TOBACCO, RAW AND WASTES	51,23	-32,62	-61,87	-91,77
122 - TOBACCO, MANUFACTURED	-44,91	-82,68	-83,79	21,47
211 - HIDE/SKIN (EX FUR) RAW	25,33	17,04	-48,79	-51,56
268 - WOOL/ANIMAL HAIR	29,09	-52,46	-92,38	-92,68
541 - PHARMACEUT EXC MEDICAMNT	-10,71	-18,53	-24,03	-43,52
612 - LEATHER MANUFACTURES	-19,12	-9,16	-62,45	-70,92
629 - ARTICLES OF RUBBER NES	-9,94	-15,12	-47,42	-40,98
652 - COTTON FABRICS, WOVEN	-4,97	-26,94	-40,30	-13,27
656 - TULLE/LACE/EMBR/TRIM ETC	-64,70	-80,31	-80,52	-85,76
658 - MADE-UP TEXTILE ARTICLES	-13,19	-23,56	-24,25	-15,19
663 - MINERAL MANUFACTURES NES	-1,84	-55,97	-55,20	-21,30
676 - IRON/STEEL BARS/RODS/ETC	-14,58	-46,88	-63,12	-53,46
685 - LEAD	1,43	-59,87	-39,75	-83,55
713 - INTERNAL COMBUST ENGINES	-7,29	-24,12	-44,27	-28,49
725 - PAPER INDUSTRY MACHINERY	-37,58	-63,46	-56,56	-40,46
751 - OFFICE MACHINES	-17,79	-54,82	-59,40	-66,98
752 - COMPUTER EQUIPMENT	-34,83	-29,84	3,83	-40,34
759 - OFFICE EQUIP PARTS/ACCS.	-37,85	-57,18	-62,92	-39,43
761 - TELEVISION RECEIVERS	121,87	-67,74	-87,94	-96,24
762 - RADIO BROADCAST RECEIVER	582,65	-6,37	-77,79	-61,74
763 - SOUND/TV RECORDERS ETC	112,98	-67,48	-91,97	-92,85
764 - TELECOMMS EQUIPMENT NES	14,36	-42,28	-27,93	-56,77
775 - DOMESTIC EQUIPMENT	30,97	-66,03	-43,09	-56,98
781 - PASSENGER CARS ETC	-35,75	-50,11	-67,38	-44,82
782 - GOODS/SERVICE VEHICLES	-35,26	-42,28	-56,42	-47,01
785 - MOTORCYCLES/CYCLES/ETC	-12,32	-30,02	-25,78	-29,61
843 - MEN/BOY WEAR KNIT/CROCH	-71,28	-71,32	-64,76	-76,08
846 - CLOTHING ACCESSORIES	-29,53	-57,90	-63,14	-61,04
851 - FOOTWEAR	9,36	-26,69	-53,42	-66,56
872 - MEDICAL/ETC INSTRUMENTS	-36,68	-42,64	-37,14	-32,53
881 - PHOTOGRAPHIC EQUIPMENT	54,27	-23,86	-48,40	-70,41
885 - WATCHES AND CLOCKS	-38,13	-53,44	-44,54	-56,12

Source: Own calculations on International Trade Center Statistics on Russia

It is evident from these figures (Table 1) that losses have been recorded in the high-tech sectors (e.g. television receivers, sounds TV recorder, office machines) and in the textile industry (e.g. tulle, lace, leather, wool hair). Naturally, not all negative results can be ascribed to the oil price and its exports burst. To show the exact values of the oil effect on each manufacturing industry we should carry out a more comprehensive analysis which takes into consideration other explanatory variables

8 Concluding Remarks

In this paper we have examined Russia's vulnerability to the Dutch Disease and found evidence for its four characteristic symptoms, namely: a real exchange rate appreciation; a temporary improved economic situation; a decline of output of the non-booming sector; a reduction in the non-booming sector exports. The first symptom has been detected through the estimation of a real effective exchange rate equation that merges three strands of empirical literature, that is, the linkage between relative price movements on the one hand, and the differences in sectoral productivity dynamics, terms of trade shocks and the fiscal component, on the other hand. We have found that terms of trade, oil prices (which mirror the Dutch disease), productivity changes (which reflect the Balassa-Samuelson effect), and government deficit are highly significant determinants of real effective exchange rate movements. In particular, a 10% rise of the international oil price brings about a real effective exchange rate appreciation of about 8%, an upturn in Russian productivity leads to a real appreciation of 7.8%, and an increase in budget deficit produces a real appreciation of 4.8%. Terms of trade improvements, on the other hand, cause real depreciations. All variables have the expected signs. Symptom 2 has been evaluated by an analysis of the impact of oil prices and real effective exchange rate on Russian GDP. The empirical evidence suggests that an increase in international oil prices of 10% implies a GDP growth of 2.1%, while a real appreciation of 10% will reduce the national GDP by 2.2%. The total effect, taking into account also the Balassa-Samuelson model, results in a temporary GDP growth. Symptom 3 has been investigated by regressing the oil price variable against the ratio between the Russian industrial production and service production. The results suggest a drop by 0.84% in the output ratio of the non-booming sector when oil prices increase by 10%.

In conclusion, our empirical analysis suggests that Russia is suffering from the Dutch Disease. Even though the economy has picked up, easy money from oil and other natural resources is keeping wages artificially high and inflation up. This process is beginning to strangle some sectors of the economy, namely the high-tech and textile industries. Therefore it is crucial that policy makers design appropriate macroeconomic policies to successfully deal with such issues. More specifically, revenues from the booming-sector should be used to stimulate productivity improvements in non-booming sectors and to upscale general infrastructures that are relevant for the broad economic development. Additionally, improvements of the institutional framework would be essential for the development of a market-based economy that does not rely on the natural resource sector only. Generally, this would help to diversify the production structure of the Russian economy and make it less vulnerable against exogenous shocks, such as significant declines in international oil prices.

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Appendix

Table A.1: Basic Exports from Russia

	2000	2001	2001 percentage of 2000
Fresh and frozen fish, thou. tons	916	864	94.3
Iron ore, mln. tons	19.2	23.6	122.9
Coal, mln. tons	44.2	47.6	107.6
Crude oil, mln. tons	145	160	110.5
Oil products, mln. tons	62.7	70.8	112.9
Natural gas, bln.cu.m	194	181	93.3
Electric power, bln. kW.h	15.1	19.6	129.3
Ammonia, thou. tons	2943	2813	95.6
Round wood, mln. cu.m	30.8	37.5	121.8
Sawn wood, thou. tons	4535	4593	101.3
Pulp, thou. tons	1677	1778	106.0
Ferrous metals, mln. US dollars	6733	6093	90.5
Copper, thou. tons	646	597	92.5
Nickel, thou. tons	197	189	95.7
Aluminium, thou. tons	3203	3082	96.2
Machinery and equipment, mln. US dollars	9071	10354	114.1

Source: Goskomstat, Year Book, 2002

Table A.2a: ADF Test Results

	*ADF-Test on levels**	*ADF-Test on first differences***
lrex	-2,199264	-3,864617
lpoilsa	-1,622895	-3,94451
ltot	-2,130685	-5,271449
lprsa	-0,033906	-5,835475
lgov	-2,206805	-7,614007

*MacKinnon critical values for rejection of hypothesis of a unit root.

* 1%	Critical Value	-3,4993	** 1%	Critical Value	-3.5000
5%	Critical Value	-2,8915	5%	Critical Value	-2,8918
10%	Critical Value	-2,5826	10%	Critical Value	-2,5827

Table A.2b: P-P Test Results

	*P-P Test on level**	*P-P Test on first differences***
lrex	-1,989557	-6,316846
lpoilsa	-1,822861	-6,948134
ltot	-2,534418	-12,19101
lprsa	-0,168262	-10,83683
lgov	-5,318075	

*MacKinnon critical values for rejection of hypothesis of a unit root.

* 1%	Critical Value	-3,4965	** 1%	Critical Value	-3.4972
5%	Critical Value	-2,8903	5%	Critical Value	-2,8906
10%	Critical Value	-2,5819	10%	Critical Value	-2,5821

Table A.3: Estimation Results for the ECM

REX = f (POIL,TOT, PR,GOV)

Dependent Variable: DLRER
Method: Least Squares
Sample(adjusted): 1995:02 2002:05
Included observations: 88 after adjusting endpoints

Variable	Coeff.	Std. Error	t-Statistic	Prob.
LRER(-1)	-0.081334	0.014211	**-5.723114**	0.0000
LPOILSA(-1)	0.068138	0.024800	2.747483	0.0077
LPRSA(-1)	0.063418	0.013503	4.696607	0.0000
LGOV(-1)	0.040221	0.020547	1.957557	0.0544
LTOT(-1)	-0.046219	0.021438	-2.155939	0.0347
DLTOT(-1)	0.041634	0.021843	1.906089	0.0609
DLRER(-2)	-0.170198	0.092626	-1.837470	0.0706
DLTOT(-2)	0.048186	0.019738	2.441252	0.0173
DLGOV(-3)	-0.040597	0.017429	-2.329241	0.0229
DLRER(-4)	-0.422949	0.100507	-4.208131	0.0001
DLPOILSA(-4)	-0.248433	0.071470	-3.476046	0.0009
DLPRSA(-4)	0.037611	0.019927	1.887449	0.0634
DLGOV(-4)	-0.073137	0.020826	-3.511870	0.0008
DLGOV(-5)	-0.038050	0.016658	-2.284174	0.0255
DLGOV(-7)	-0.019882	0.011325	-1.755631	0.0837
DLRER(-8)	-0.247948	0.088640	-2.797260	0.0067
DLPRSA(-8)	0.054847	0.021685	2.529245	0.0138
DLRER(-10)	-0.214622	0.086506	-2.481007	0.0156
DLPOILSA(-11)	-0.176515	0.065223	-2.706330	0.0086
DLPRSA(-12)	0.037450	0.019639	1.906907	0.0608
@TREND	-0.004998	0.000726	-6.885226	0.0000

R-squared	0.570562	Mean dependent var	0.002156
Adjusted R-squar.	0.442372	S.D. dependent var	0.050573
S.E. of regression	0.037765	Akaike info criterion	-3.510217
Sum squar. resid	0.095557	Schwarz criterion	-2.919034
Log likelihood	175.4495	Durbin-Watson stat	2.129798

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.673926	Probability	0.612534
Obs*R-squared	3.610755	Probability	0.461239

Table A.4: Estimation Results for the Bewley Transformation

REX = f (POIL, TOT, PR, GOV)

Dependent Variable: LRER
Method: Two-Stage Least Squares
Sample(adjusted): 1995:02 2002:05
Included observations: 88 after adjusting endpoints
Instrument list: LRER(-1) LPOILSA(-1) LPRSA(-1) LGOV(-1) LTOTOG(-1) DLTOTOG(-1) DLRER(-2) DLTOTOG(-2) DLGOV(-3) DLRER(-4) DLPOILSA(-4) DLPRSA(-4) DLGOV(-4) DLGOV(-5) DLGOV(-7) DLRER(-8) DLPRSA(-8) DLRER(-10) DLPOILSA(-11) DLPRSA(-12) @TREND

Variable	Coeff.	Std. Error	t-Statistic	Prob.
DLRER	-11.17910	2.118048	-5.278018	0.0000
LPOILSA(-1)	**0.838859**	0.253600	3.307802	0.0015
LPRSA(-1)	**0.776095**	0.163598	4.743926	0.0000
LGOV(-1)	**0.484941**	0.247130	1.962289	0.0531
LTOT(-1)	**-0.569032**	0.236011	-2.411046	0.0187
DLTOT(-1)	0.509958	0.263082	1.938404	0.0568
DLRER(-2)	-2.088260	1.094949	-1.907175	0.0608
DLTOT(-2)	0.587982	0.252986	2.324167	0.0232
DLGOV(-3)	-0.495158	0.224038	-2.210148	0.0305
DLRER(-4)	-5.165281	1.355371	-3.810973	0.0003
DLPOILSA(-4)	-3.036329	0.910860	-3.333474	0.0014
DLPRSA(-4)	0.456664	0.263290	1.734451	0.0874
DLGOV(-4)	-0.891684	0.288038	-3.095713	0.0029
DLGOV(-5)	-0.463466	0.217967	-2.126317	0.0372
DLGOV(-7)	-0.242370	0.143017	-1.694696	0.0948
DLRER(-8)	-3.032428	1.094545	-2.770491	0.0072
DLPRSA(-8)	0.666213	0.301255	2.211456	0.0304
DLRER(-10)	-2.618258	1.115413	-2.347343	0.0219
DLPOILSA(-11)	-2.163047	0.767532	-2.818186	0.0063
DLPRSA(-12)	0.456579	0.249234	1.831930	0.0714
@TREND	-0.061079	0.010375	-5.886919	0.0000

R-squared	-0.561082	Mean depen var	4.425481
Adjusted R-squ	-0.532098	S.D. depend var	0.194181
S.E. of regression	0.459959	Sum squar resid	14.17467
Durbin-Wat stat	2.132978		

Breusch-Godfrey Serial Correlation LM Test:

Obs*R-squared	3.662191	Probability	0.453649

Table A.5a: ADF Test Results

	*ADF-Test on level**	*ADF-Test on first differences***
lgdp	-2,121112	-6,67596
lpoil	-2,290323	-5,106924
lrex2	-2,246735	-5,894479

*MacKinnon critical values for rejection of hypothesis of a unit root.

* 1%	Critical Value	-4,0314	** 1%	Critical Value	-4,0320
5%	Critical Value	-3,4450	5%	Critical Value	-3,4452
10%	Critical Value	-3,1471	10%	Critical Value	-3,1473

Table A.5b: P-P Test Results

	*P-P-Test on level**	*P-P-Test on first differences***
lgdp	-1,115723	-10,768
lpoil	-2,264481	-7,662675
lrex2	-1,817518	-7,625204

*MacKinnon critical values for rejection of hypothesis of a unit root.

* 1%	Critical Value	-4,0293	** 1%	Critical Value	-4,0298
5%	Critical Value	-3,4440	5%	Critical Value	-3,4442
10%	Critical Value	-3,1465	10%	Critical Value	-3,1467

Table A.6: Estimation Results for the ECM

GDP = f (POIL, RER)

Dependent Variable: DLGDP
Method: Least Squares
Sample(adjusted): 1992:05 2002:05
Included observations: 121 after adjusting endpoints

Variable	Coeff.	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.134194	0.028670	**-4.680573**	0.0000
LPOIL(-1)	0.027731	0.008107	3.420582	0.0009
LREX2(-1)	-0.028932	0.006643	-4.355055	0.0000
C	0.440121	0.112180	3.923350	0.0002
DLGDP(-3)	0.178903	0.063860	2.801498	0.0060
D94=0	0.075494	0.020737	3.640519	0.0004
DLPOIL(-9)	0.065836	0.026193	2.513450	0.0134
D95=0	-0.067895	0.020471	-3.316568	0.0012
DLGDP(-12)	0.292942	0.060242	4.862774	0.0000
D99=0	0.039765	0.014411	2.759278	0.0068
DLREX2(-6)	-0.047693	0.011622	-4.103699	0.0001
DLREX2(-11)	-0.028048	0.011406	-2.459103	0.0155

R-squared	0.588373	Mean dep. var	-0.002111
Adj. R-squared	0.546832	S.D. depen. var	0.029363
S.E. of regression	0.019767	Akaike inf.crit.	-4.915739
Sum squared resid	0.042588	Schwarz crit.	-4.638471
Log likelihood	309.4022	F-statistic	14.16387
Durbin-Wats. stat	2.124701	Prob(F-statistic)	0 .000000

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.593131	Probability	0.181584
Obs*R-squared	6.923389	Probability	0.139993

Table A.7: Estimation Results for the Bewley Transformation

GDP = f (POIL, RER)

Dependent Variable: LGDP
Method: Two-Stage Least Squares
Sample(adjusted): 1992:05 2002:05
Included observations: 121 after adjusting endpoints
Instrument list: LGDP(-1) LPOIL(-1) LREX2(-1) C DLGDP(-3) D94=0 DLPOIL(-9) D95=0 DLGDP(-12) D99=0 DLREX2(-6) DLREX2(-11)

Variable	Coeff.	Std. Error	t-Statistic	Prob.
C	3.279750	0.291136	11.26537	0.0000
DLGDP	-6.451923	1.592096	-4.052470	0.0001
LPOIL(-1)	**0.206650**	0.052053	3.969991	0.0001
LREX2(-1)	**-0.215601**	0.024378	-8.844219	0.0000
DLGDP(-3)	1.333175	0.543327	2.453722	0.0157
D94=0	0.562574	0.208749	2.694972	0.0082
DLPOIL(-9)	0.490602	0.208870	2.348837	0.0206
D95=0	-0.505948	0.205161	-2.466101	0.0152
DLGDP(-12)	2.182979	0.636824	3.427915	0.0009
D99=0	0.296327	0.118441	2.501894	0.0138
DLREX2(-6)	-0.355404	0.123360	-2.881043	0.0048
DLREX2(-11)	-0.209012	0.093366	-2.238619	0.0272

R-squared	-0.575110	Mean depend. var	4.698673
Adj. R-squared	-0.523607	S.D. depend. var	0.135393
S.E. of regress	0.147299	Sum squared res.	2.364985
F-statistic	9.038373	Durbin-Wats.stat	2.124701
Prob(F-stat.)	0.000000		

Table A.8a: Estimation Results for Weak Exogeneity

Dependent Variable: DLPOIL
Method: Least Squares
Sample(adjusted): 1992:05 2002:05
Included observations: 121 after adjusting endpoints

Variable	Coeff.	Std. Error	t-Statistic	Prob.
ECMHAT(-1)	0.002795	0.001219	**2.291770**	0.0173
DLGDP(-3)	0.005817	0.003050	1.907213	0.0692
DLPOIL(-9)	0.087527	0.036791	2.379032	0.0137
DLGDP(-12)	0.100438	0.041279	2.433116	0.0117
DLREX2(-6)	-0.078039	0.043702	-1.785709	0.0768
DLREX2(-11)	-0.041151	0.018211	-2.259678	0.0189

Table A.8b: Estimation Results for Weak Exogeneity

Dependent Variable: DLREX2
Method: Least Squares
Sample(adjusted): 1992:05 2002:05
Included observations: 121 after adjusting endpoints

Variable	Coeff.	Std. Error	t-Statistic	Prob.
ECMHAT(-1)	0.002892	0.001404	**2.060561**	0.0416
DLGDP(-3)	0.232816	0.088583	2.628224	0.0099
DLPOIL(-9)	0.155757	0.077787	2.002352	0.0439
DLGDP(-12)	-0.526469	0.234283	-2.247149	0.0190
DLREX2(-6)	-0.099931	0.044152	-2.263336	0.0155
DLREX2(-11)	0.057521	0.024666	2.331995	0.0149

Table A.9a: ADF Test Results

	ADF level	**ADF 1st differences***
lindser	-2,66725	-6,251726

1%	Critical Value	-3.4993
5%	Critical Value	-2.8915
10%	Critical Value	-2.5826
1%	Critical Value*	-3.5000
5%	Critical Value*	-2.8918
10%	Critical Value*	-2.5827

Table A.9b: PP Test Results

	PP level	**PP 1st differences***
lindser	-2,78083	-6,251726

1%	Critical Value	-3.4965
5%	Critical Value	-2.8903
10%	Critical Value	-2.5819
1%	Critical Value*	-3.4972
5%	Critical Value*	-2.8906
10%	Critical Value*	-2.5821

Table A.10: Estimation Results for the ECM

Yind/Yser = f (POIL)

Dependent Variable: DLINDSER
Method: Least Squares
Sample(adjusted): 1995:02 2002:05
Included observations: 88 after adjusting endpoints

Variable	Coeff	Std. Error	t-Statistic	Prob.
LINDSER(-1)	-0.168156	0.058207	-2.888952	0.0049
LPOILSA(-1)	-0.014579	0.006337	-2.300571	0.0239
DLINDSER(-12)	0.554933	0.070149	7.910790	0.0000
DLPOILSA(-2)	0.111808	0.059576	1.876748	0.0641
@TREND	0.000513	0.000254	2.021895	0.0464

R-squared	0.515867	Mean dep var	0.002646
Adjusted R-squared	0.492535	S.D. dep var	0.058145
S.E. of regression	0.041421	Akaike info crit	-3.474941
Sum squared resid	0.142400	Schwarz crit	-3.334183
Log likelihood	157.8974	Durbin-Wat stat	2.141487

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.909673	Probability	0.462545
Obs*R-squared	3.874757	Probability	0.423221

Table A.11: Estimation Results for the Bewley Transformation

Yind/Yser = f (POIL)

Dependent Variable: LINDSER
Method: Least Squares
Sample(adjusted): 1995:02 2002:05
Included observations: 88 after adjusting endpoints

Variable	Coeff	Std. Error	t-Statistic	Prob.
DLINDSER	0.456653	0.188078	2.428002	0.0173
LPOILSA(-1)	**-0.083535**	0.007346	-11.37157	0.0000
DLINDSER(-12)	0.131209	0.059997	2.186923	0.0252
DLPOILSA(-2)	0.019028	0.008215	2.316236	0.0210
@TREND	0.002944	0.000338	8.714008	0.0000

R-squared	0.494870	Mean depe var	-0.070829
Adjusted R-squared	0.470527	S.D. depe var	0.102323
S.E. of regression	0.074456	Akaike info crit	-2.302087
Sum squared resid	0.460122	Schwarz crit	-2.161330
Log likelihood	106.2918	Durbin-Wat sta	0.244112

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