ZENTRUM FÜR ENTWICKLUNGSFORSCHUNG (ZEF)

Economics of consumer and business behavior related to environment

Studies in Belarus

DISSERTATION

zur Erlangung des Grades
Doktorin der Agrarwissenschaften (Dr. agr.)

der Landwirtschaftlichen Fakultät
der Rheinischen Friedrich-Wilhelms-Universität Bonn

von
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Kobrin, Belarus

Bonn 2023

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Tag der mündlichen Prüfung: 17.10.2023

Angefertigt mit Genehmigung der Landwirtschaftlichen Fakultät der Universität Bonn

Printed and/or published with the support of the German Academic Exchange Service

ABSTRACT

Environmental problems constitute a major risk to humanity. This thesis empirically analyzes the implications of consumer and business behavior related to environment on three levels: on a micro-; on a meso-; and on a macro-level.

The first study investigates how exposure to information through different media (TV, radio, newspapers, the Internet) can influence behavior. It assumes that individuals can be simultaneously exposed to climate change messages as well as information promoting unsustainable lifestyles. Using individual-level nationally representative survey data collected in Belarus in April-May, 2022 it estimates two structural equation models. The 1^{st} model assesses how exposure to climate change information can affect sustainable consumption behaviors, namely promotional, accommodating and pro-active behavior, and how exposure to information promoting consumerism can influence these behaviors. The 2^{nd} model evaluates how exposure to information promoting consumerism can impact unsustainable actions. The findings reveal that exposure to climate change information has a large positive and direct effect on promotional and accommodating actions (0.239 standard deviation change) and through them an indirect positive effect on pro-active behavior (0.075 standard deviation change). This indirect effect on pro-active behavior diminishes a bit (0.074 standard deviation change) once exposure to information promoting consumerism is taken into account.

The second study explores environmental implications of trade relationships and productivity. Using the firm-level data for manufacturing companies in Belarus, it aims to answer whether exporting enterprises are more environmentally oriented and whether application of cleaner technologies increases the productivity and export intensity of an enterprise. The study estimates a system of structural equations using three-stage least squares in which exporting, adoption of environmentally friendly measures and productivity are treated as endogenous. The findings show that when a company adopts one more environmentally friendly measure, it increases its export intensity by 4.4% to 4.6%. Adoption of cleaner technologies improves labor productivity in a company – by 20.7%, but is negatively associated with its resource productivity (a 1.9% decrease), which results in the neutral effect on the total productivity. In the manufacturing sector the mean cost of labor is 3.7 times less than the mean cost of raw materials and intermediate goods used in production.

The third study analyzes the environmental impacts of the final household consumption and their social costs across the economic development spectrum. The environmental impacts are assessed in the form of CO_2-, CH_4- and N_2O-footprints across the value chain sector-wise. The study employs an environmentally extended multiregional input-output model from the EORA26 database which uses a common 26-sector classification for all countries. The findings disclose that developing economies have lower CO_2-footprints than developed economies, but higher CH_4- and N_2O-footprints per capita. Areas of high impact consumer behaviors include housing/building, food, and mobility, clothing and agriculture. The study also identifies those sectors where the social costs of aggregated emissions make up a substantial share of the industries' output. Thus, it indicates the industries where more stringent environmental regulation should be in place.

ZUSAMMENFASSUNG

Umweltprobleme stellen eines der größten Risiken für die Menschheit dar. Diese Doktorarbeit analysiert empirisch die Auswirkungen des Verbraucher- und Unternehmensverhaltens im Zusammenhang mit der Umwelt auf drei Ebenen: auf der Mikro-, Meso- und Makroebene.

Die erste Studie untersucht, wie Informationen über verschiedene Medienkanäle (Fernsehen, Radio, Zeitungen, Internet) das Konsumverhalten beeinflussen können. Sie behauptet, dass Individuen gleichzeitig den Nachrichten über die Folgen des Klimawandels und den Informationen, die für einen nicht nachhaltigen Lebensstil werben, ausgesetzt sein können. Anhand der in Belarus von April bis Mai 2022 gesammelten landesweit repräsentativen Umfragedaten werden zwei Strukturgleichungsmodelle eingesetzt. Das erste Modell bewertet, wie Informationen über den Klimawandel nachhaltiges Konsumverhalten beeinflussen können, einschließlich förderndes, entgegenkommendes und proaktives Verhalten. Die erweitere Version des Modells zeigt hingegen, wie Informationen, die den Überkonsum fördern, nachhaltiges Konsumverhalten beeinträchtigen können. Das zweite Modell schätzt, wie sich Informationen, die Überkonsum fördern, auf nicht nachhaltiges Verhalten auswirken können. Die Ergebnisse zeigen, dass Informationen über den Klimawandel einen großen positiven und direkten Effekt auf fördernde und entgegenkommende Aktivitäten (0.239 Standardabweichungen) und durch sie einen indirekten positiven Effekt auf proaktives Verhalten haben (0.075 Standardabweichungen). Dieser indirekte positive Effekt auf proaktives Verhalten verringert sich aber minimal (0.074 Standardabweichungen), sobald Informationen, die den Überkonsum fördern, im Modell berücksichtigt werden.

Die zweite Studie untersucht die Zusammenhänge zwischen Handel, Produktivität und der Umwelt. Anhand der Daten von Produktionsfirmen in Belarus soll beantwortet werden, ob exportierende Unternehmen umweltorientierter agieren. Des Weiteren wird analysiert, ob die Anwendung umweltfreundlicher Technologien die Produktivität und die Exportintensität erhöht. Die Studie verwendet dreistufige kleinste Quadrate (3SLS), in denen der Export, die Einführung umweltfreundlicher Technologien und die Produktivität als endogen behandelt werden. Die Ergebnisse zeigen, dass ein Anstieg der Anwendung umweltfreundlicher Technologien die Exportintensität um 4,4 % bis 4,6 % und die Arbeitsproduktivität in einem Unternehmen um 20,7 % verbessert. Diese ist aber negativ mit der Ressourcenproduktivität verbunden (ein Rückgang um 1,89 %), was zu einem neutralen Effekt auf die Gesamtproduktivität führt. In Produktionsfirmen sind die durchschnittlichen Arbeitskosten 3,7-mal niedriger als die Kosten für Rohstoffe und Zwischenprodukte.

Die dritte Studie analysiert die Umweltauswirkungen des Endverbrauchs in Privathaushalten und ihre sozialen Kosten für verschiedene Länder. Die Umweltauswirkungen werden in Form von CO_2-, CH_4- und N_2O-Fußabdrücken über die Wertschöpfungskette sektorbezogen bewertet. Die Studie verwendet ein ökologisch erweitertes multiregionales Eingabe-Ausgabe-Modell aus der EORA26-Datenbank, die eine gemeinsame 26-Sektoren-Klassifikation für alle Länder benutzt. Aus den Ergebnissen geht hervor, dass die Entwicklungsländer pro Kopf zwar einen niedrigeren CO_2-Fußabdruck, jedoch einen höheren CH_4- und N_2O-Fußabdruck als die entwickelten Länder haben. Zu den wirkungsvollen Bereichen des Verbraucherverhaltens gehören Wohnen/Bauen, Lebensmittel und Mobilität, Bekleidung und Landwirtschaft. In der Studie werden auch die Sektoren ermittelt, in denen die sozialen Kosten aggregierter Emissionen einen erheblichen Anteil an der Produktion der Industrie ausmachen. Diese stellen die Industriezweige dar, in denen strengere Umweltvorschriften umgesetzt werden sollten.

ACKNOWLEDGEMENTS

"Don't do life alone", says Michelle Obama to her daughters in the book "The Light We Carry. Overcoming in Uncertain Times". A PhD is definitely not a journey one can undertake alone. Many people have contributed to its comfort and discomfort, in other words, to making the best of it.

First of all, I would like to acknowledge the trust, guidance and support of my first supervisor, Prof. Dr. Joachim von Braun. I extend my sincere gratitude for his comments, questions and suggestions that have broaden the perspectives of this dissertation and for putting a fair amount of pressure that has allowed me to finish the thesis on time. I am extremely grateful to my tutor and second supervisor PD Dr. Alisher Mirzabaev for his scientific guidance to bring each chapter to its final stage. I would also like to express my gratitude for his practical advice and encouragement during my PhD journey. Special thanks go to Prof. Dr. Monika Hartmann for reviewing this thesis and Prof. Dr. Matin Qaim for agreeing to chair the Dissertation Committee.

I gratefully acknowledge the financial support received from the German Academic Exchange Service (DAAD). Much appreciation goes to BEROC Research Center for financing the primary data collection for my thesis in Belarus and to the marketing research company "MIA Research" for conducting the survey during the very turbulent time in the country. I would like to heartily thank the ZEF administration team, in particular, Ms. Maike Retat-Amin, Max Voit, Dr. Silke Tönsjost, Ms. Alison Beck, Mr. Volker Merx, and also Ms. Parisa Asemi for all the support they have provided me.

I am immensely grateful to my colleagues and friends from the ZEF community, specifically to batch 2019 and subsequent batches. Much appreciation goes to Dr. Zaneta Kubik, Dr. Sundus Salemi, Hina Amber, Mayra Martin, Andre Castro, Daiana Castillo, Hiwot Adebo, Elizabeth Ndunda, Arif Pratama, Ahmed Abdalla, Myint Thu Thu Aung, Subash Padmaja, Hendrik Zeddies, Milena Florez for fruitful academic and non-academic discussions and for making the challenging PhD journey quite exciting and memorable. I would also like to extend my appreciation to a number of friends outside the ZEF community whose support and presence in my life played an important role during my PhD time, in particular, to Chris Butters, Benedikt Basten, Katja Girr, Franziska Geiger, Katja Brender, Madeleine Szczepanik, Oksana Koshulko, Susana Pascua, Hanna Sasinovich and many others. I express my deepest gratitude to the colleagues from BEROC Research Center, specifically to Pavel Daneyko, Irina Tochitskaya, Olga Tomashevskaya, Kateryna Bornukova for broadening my scientific outlook and updating me on the situation in Belarus relevant to my PhD topic. Last but not least, I am deeply grateful to my drum teacher, Giorgio Ranciaro, for teaching me how to stay focused, disciplined and consistent in order to gradually advance in things you would like to do and for all the inspiration, creativity and joy in my life due to drums. That has made an enormous impact on my PhD journey.

In the end, I would like to thank my family in Belarus, foremost, my mother, Larysa Shershunovich, for all their emotional support and care.

I dedicate this dissertation to the memory of my grandmother Anna (RIP) and my uncle Oleg (RIP) who left this world while I was on my PhD journey.

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LIST OF ABBREVIATIONS

AEFM	Adoption of Environmentally Friendly Measures
ABC	Attitude-Behavior-Context
AVE	Average Variance Extracted
CBAM	Carbon Border Adjustment Mechanism
CFA	Confirmatory Factor Analysis
CH_4	Methane
CIS	Commonwealth of Independent States
CO_2	Carbon Dioxide
EEMRIO	Environmentally Extended Multiregional Input-Output
EEIO	Environmentally Extended Input-Output
EPD	Environmental Product Declaration
EPI	Environmental Performance Index
ESG	Environmental, Social and Governance
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GTAP	Global Trade Analysis Project
GWP	Global Warming Potential
HIC	High Income Country
LIC	Low Income Country
LMC	Lower Middle Income Country
N_2O	Nitrous Oxide
OECD	Organization for Economic Co-operation and Development
RRC	Raykov's Reliability Coefficient
SDG	Sustainable Development Goal
SEM	Structural Equation Modeling
UMC	Upper Middle Income Country
WIOD	World Input-Output Database

CHAPTER 1: INTRODUCTION

1.1 PROBLEM STATEMENT

The world has become increasingly interconnected, not only through global trade but also through global environmental problems. According to a survey among business decision makers, out of 10 major risks to humanity over the next 10-year period six are related to environment (World Economic Forum, 2023). These are failure to mitigate climate change, failure of climate change adaptation, natural disasters and extreme weather events, biodiversity loss and ecosystem collapse, natural resource crises, large scale environmental damage incidents (World Economic Forum, 2023).

Pollution generated in the production of goods and their consumption are very often geographically separated. That can be viewed as a way for consumers to shift the pollution caused by their consumption to other territories. However, emissions of greenhouse gases (GHGs) as global pollutants make consumers bear the costs of pollution regardless of where production occurs (Peters and Hertwich, 2008). While household consumption accounts for the largest share of the global GHGs emissions worldwide (Dubois et al., 2019), both consumers and producers make decisions that affect the final environmental footprint. The concept of shared responsibility acknowledges that there are always two perspectives involved in goods produced and impacts caused: the consumer and the producer one (Lenzen et al., 2007). The importance of both consumption and production sides for choices that have environmental consequences is reflected in Sustainable Development Goal (SDG) 12 – ensuring responsible consumption and production. Moreover, the United Nations (2020) considers that failure to achieve SDG 12 jeopardizes accomplishing the majority of the other SDGs. Recognizing the high priority of responsible consumption and production for the overall development, the main policy objective of this dissertation is as follows. It aims to contribute to understanding how to shift consumer and business choices in the direction of sustainability. To do that, this thesis empirically analyzes the implications of consumer and business behavior related to environment on three levels:

- ✓ on a micro-level – how individual consumers respond through their behavior to information about climate change or sustainable lifestyles and, conversely, to information promoting consumerism in different media;
- ✓ on a meso-level – how manufacturing companies respond through their adoption/non-adoption of cleaner technologies to the conditions of the global market;
- ✓ on a macro-level – how high the environmental impacts of the final household consumption and their subsequent social costs are across the economic development spectrum; what level of technological efficiency the respective economies have and which industries should be under more stringent environmental regulation.

1.2 FRAMEWORK OF FOCUS AREAS IN THE RESEARCH

The conceptual framework of this thesis is based broadly on the ideas from *Narrative Economics* (Shiller, 2020) and more specifically on theories of responsibility, in particular, the shared consumer and producer responsibility (Gallego and Lenzen, 2005; Lenzen et al., 2007). Shiller (2020) argues that stories (the word-of-mouth contagion of ideas) carry the potential for driving people's economic decisions and major economic events, especially in the time of information technology and social media. Therefore they should be included into understanding a complex economy. According to Shiller (2020), the economic narratives usually involve scripts describing sequences of action that others take, such as, for example, investing in certain financial markets and, thus, improving one's wealth. People make their economic decisions based on hearing narratives that other people are doing these things. Shiller (2020) shows that controlled experiments in fields other than economics have proven that human behavior is affected by narratives. Very often people whose investment and consumption decisions drive aggregate economic activity are not particularly well-informed. Thus, their decisions are influenced by attention-getting narratives, often involving some celebrities or trusted persons (Shiller, 2020).

Despite its paramount importance to humanity, climate change is very often perceived as something abstract and difficult to understand by ordinary audiences (Moser, 2010). In this regard, media become the major source of information about it (Newmann et al., 2020) and play a key role in raising awareness about global warming (Carvalho, 2010). Thus, narratives prevailing in media can affect public concern regarding climate change and other environmental problems. And this concern in turn, on the one hand, can lead to consumers putting pressure on producers and politicians who will eventually pass it back to producers, resulting in more stringent environmental policies as well as improved products. On the other hand, this public concern is the precondition for people to change their consumption patterns (Le Coq and Paltseva, 2021). However, there exist differences in how much countries cover climate change and other environmental issues in news media (Schmidt et al., 2013; Grundmann and Scott, 2014; Vu et al., 2019), and in most cases differences are particularly pronounced between developed and developing countries (Schäfer and Painter, 2020). Hase et al. (2021) empirically prove that between 2006 and 2018 developing countries (the so called countries from the Global South) covered climate change in media less frequently than developed countries. This can be due to generally less importance paid to scientific issues and a lack of journalistic resources (Nguyen and Tran, 2019; Schäfer and Painter, 2020). Developed countries dominate research, policies and communication regarding climate change (Schäfer and Schlichting, 2014; Blicharska et al., 2017).

In view of all this, taking the approach of *Narrative Economics* (Shiller, 2020) lays the foundation for subsequent sections and chapters. While studying the behavior of consumers or companies it is essential to bear in mind in which narrative context it occurs. And it is important to consider how this context directly or indirectly influences consumer, business, and policy decisions.

A function of media related to environment is to create awareness about ecological risks. Based on the prevailing narratives consumers are either aware or unaware about climate change and other environmental issues. According to Shaver's model of responsibility (1985), the acceptance of ecological responsibility to oneself stems from a general awareness of ecological risks and a belief in own abilities to decrease those risks. In the concept of shared responsibility, every product or service and its environmental impact along the whole value chain is an interplay of responsibilities between consumers, producers and more broadly local and national governments.

The framework linking together all the chapters of this dissertation is presented in fig. 1.1. The concept of shared responsibility is embedded into this framework in different ways. In chapter two the thesis explores empirically how exposure to information about climate change (climate change media use) and to information promoting consumerism (consumerism media use) through different media affects individual pro-environmental behaviors. Although this chapter is devoted to consumer analysis, the shared responsibility between consumers and producers enters it as follows. Amongst all possible environmental actions only those (repair and reuse; saving energy; saving water) have been chosen for consumers where support exists on the supply side in the context of the country under analysis, i.e. by producers. Repairing and reusing things instead of throwing them away can only be exercised if there is a developed market of repair services. And there is a substantial difference in price between repairing things and buying them new. Saving energy and water at home not only means habits like switching off lights or taking shower instead of a bath but also implies access to energy-efficient and water-saving household appliances and equipment (e.g., dishwashers, gas boilers, etc.).

The third chapter of this dissertation is dedicated to producer analysis. It studies the bidirectional relationships between exporting, adoption of environmentally friendly measures and productivity at the firm-level. Among others, it aims to answer whether application of cleaner technologies brings productivity improvement and increases the export intensity of enterprises. Adoption of environmentally friendly measures is endogenous and instrumented through sales two years back and customers' requirements for the enterprise to implement environmental certifications or adhere to certain environmental standards as a condition to do business. These customers' requirements are the consumer part of the shared responsibility. Although we acknowledge that in the context of manufacturing companies some customers can be intermediate consumers and, thus, their requirements can enter the value chain still on the producer part of the shared responsibility. But as Lenzen et al. (2007, p. 36) put it, "in shared responsibility, every member of the supply chain is affected by their upstream supplier and affects their downstream recipient, hence it is in all actors' interest to enter into a dialogue about what to do to improve supply chain performance". In accordance with the transaction cost theory (Coase, 1937; Williamson, 1975; 1985), producers will adopt buyer-demanded cleaner technologies if they consider that the additional transaction costs related to this adoption help to maintain the relationship with a buyer (Tate et al., 2011). Thus, they might apply environmentally friendly measures if they expect that their exports (as a result of their relationships with their buyers) will rise. And this increase in exports should compensate for the transaction costs related to the adoption.

The fourth chapter unifies consumer and producer behavior related to environment in the manifested CO_2-, CH_4-, and N_2O-footprints of final household consumption. It employs environmentally extended multiregional input-output analysis (EEMRIO). EEMRIO analysis traditionally assumes full consumer responsibility when allocating environmental impacts generated in the entire production chain of goods to the final consumers of these goods, since via supply chains ultimately all production is linked to households (Moran et al., 2020). However, the concept of "shared responsibility" is more appropriate when deriving policy implications on the basis of this type of analysis. In addition, to bring the production side more evidently into the EEMRIO analysis, the study identifies those sectors where the social costs of aggregated CO_2, CH_4 and N_2O emissions make up a substantial share of the industries' output. That indicates the level of technological efficiency of the respective economies and the industries where environmental regulation should be strengthened.

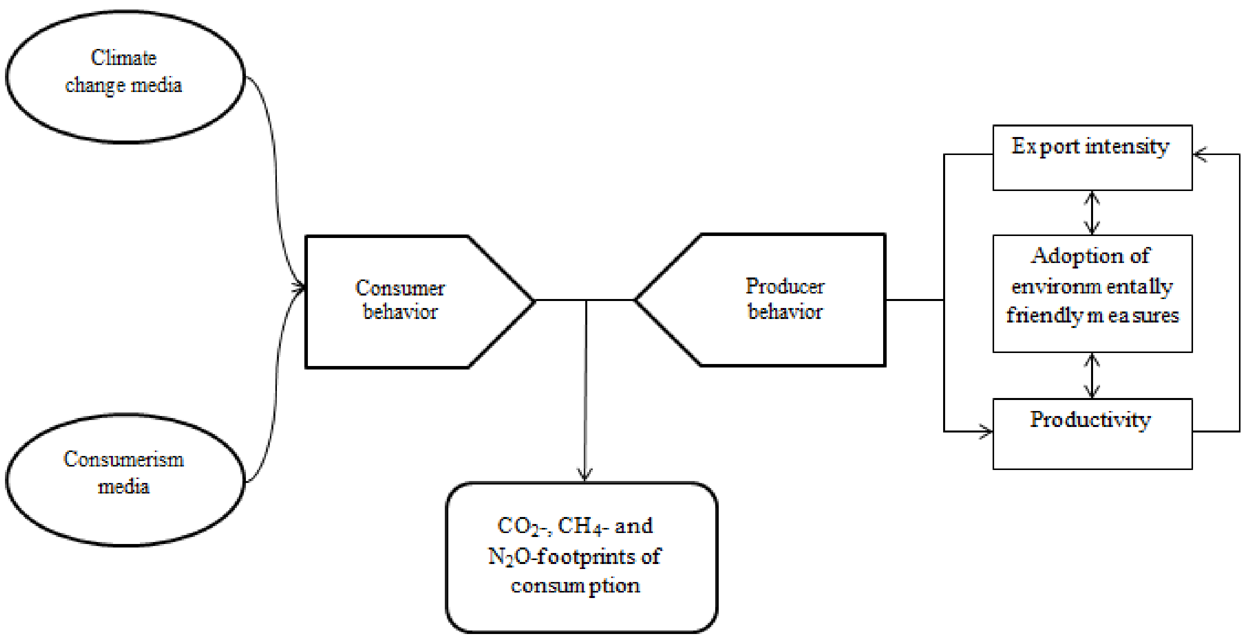

Figure 1.1: Framework of focus areas in the research
Source: the author's own elaboration.

1.3 RESEARCH QUESTIONS AND ORGANIZATION OF THE THESIS

The second chapter of this thesis employs two structural equation models (SEM) to address the research question:

RQ_1 How does exposure to different types of information through the media (TV, radio, newspapers, the Internet) affect consumer behavior related to environment?

The third chapter estimates a system of simultaneous equations using three-stage least squares to explore the research question:

RQ_2 Does adoption of environmentally friendly measures make a positive impact on the export intensity and productivity of a company?

The fourth chapter employs a EEMRIO model to fulfill the following research objective:

RO_3 To evaluate the CO_2-, CH_4-, and N_2O-footprints of household consumption across the value chain and their social costs for purposefully and carefully selected countries at different economic development levels and with various geographic settings.

The fifth chapter summarizes the main findings of this thesis as well as its policy implications.

1.4 COUNTRY CONTEXT

The second and third chapters of this dissertation are focused on Belarus. It has a population of 9.26 million people[1] (National Statistical Committee of the Republic of Belarus, 2022a). The country borders with three European Union (EU) states, namely Latvia, Lithuania, and Poland, on its north-western and western sides, with Ukraine to the south and with Russia on its north and eastern part. With gross domestic product (GDP) per capita equal to 7 302.2 current USD in 2021, Belarus belongs to the bracket of upper middle income countries, according to the World Bank classification (World Bank, 2023), and is often described as a transition economy.

Earlier Belarus could be characterized as an open export-oriented economy. For example, in 2015-2019 the share of exports in GDP amounted to about 50% (National Statistical Committee of the Republic of Belarus, 2019, 2020). In 2020-2023 the economy started to experience a number of shocks including the COVID-19 pandemic and packages of economic sanctions in response to the widely queried validity of the 2020 elections and Belarus's involvement in the Russian war with Ukraine (World Bank, 2022). In 2020-2021 the negative effect of these measures on the Belarusian economy was limited. However, the expanded packages of sanctions in 2022 restricted the exports of goods significantly leading to a loss of up to one-third of commodities export revenues, which accounted for about 18% of 2021 GDP[2] (World Bank, 2022). Decreased exports and weakened domestic demand resulted into real GDP decline equal to 4.2% y/y during the first half of 2022[3] (World Bank, 2022).

[1] As of 1st of January, 2022.
[2] As of fall, 2022.
[3] As of fall, 2022.

Not only sanctions negatively affect the economy of Belarus. Around 40% of GDP in Belarus is produced in sectors that are sensitive to weather conditions, namely in the agriculture and forestry, energy, construction, transport and communications, housing and utilities sectors (World Bank Group, 2020). According to the estimations of the World Bank Group (2020), atmospheric hazards such as localized rain, hail, wind and extreme temperatures lead to about 0.4% of GDP loss in Belarus on a yearly basis. Additionally, flooding results in around 1% of GDP loss and affects about 100 000 people on average every year (World Bank Group, 2020). Extreme weather events took place in Belarus also in the past but in recent years due to climate change they have happened more frequently and with a higher intensity (Tochitskaya, 2020).

As a result of global warming, agro-climatic zones in Belarus have been modified (Melnik et al., 2017). Before 1989 there were three agro-climatic zones in the country with regard to temperatures: northern, central and southern. During the period from 1989[4] up to 2020, the northern zone almost disappeared, the central and the southern zones shifted northwards, and a new warmer agro-climatic area formed on the south of Belarus and it continues to expand (Melnik et al., 2017; UNDP Belarus, 2020). According to the hydrometeorological data, the average annual temperature in the period 1989-2019 exceeded the climate normal by 1.3 ºC (UNDP Belarus, 2020). August, 2022 and August, 2010 have been the warmest months in Belarus since the meteorological data first started to be collected in 1881 (BELHYDROMET, 2022). Extreme heat with temperatures above 35ºC has been observed more and more often and not only in the southern regions (Brest and Gomel) (Tochitskaya, 2020).

Climate change influences not only the economy but also the health of the nation and its labor productivity. Seppanen et al. (2003) conclude that each 1ºC for temperatures above 25ºC is associated with a 2% productivity loss in different cognitive tasks. In sections 1.4.1-1.4.3 this thesis will look more closely at how the country context is reflected in the awareness of the population about climate change, business behavior and the legislative framework related to the green economy.

1.4.1 CLIMATE CONCERNS AMONG THE POPULATION IN BELARUS

The geographical position of Belarus predetermines the uniqueness of its narrative regarding climate change and other environmental issues. On the one hand, it is influenced by the EU in which the population generally tends to have higher awareness. On the other, it is affected by Russia whose abundance of fossil fuels and dependence of the economy on revenues from them can to some extent restrict the environmental discourse in the country. Le Coq and Paltseva (2021) conducted a cross-country analysis on the climate change concerns based on the Lloyd's Register Foundation (2023) World Risk Poll collected in 2019. Their analysis reveals that in the non-EU part of Eastern Europe perception of climate change as a threat among the population is lower than in the EU-part of Eastern Europe and in Western Europe (fig. 1.2). In Belarus, in particular, the climate change risk perception is close to the region average, being the third lowest after such resource-abundant countries as Russia and

[4] When the climate in Belarus started to become increasingly warmer.

Azerbaijan. Shershunovich and Gorskaya (2023) show that gender, experience of extreme weather events and exposure to the climate information through the Internet are statistically significant predictors of the climate change risk perception among the population in Belarus.

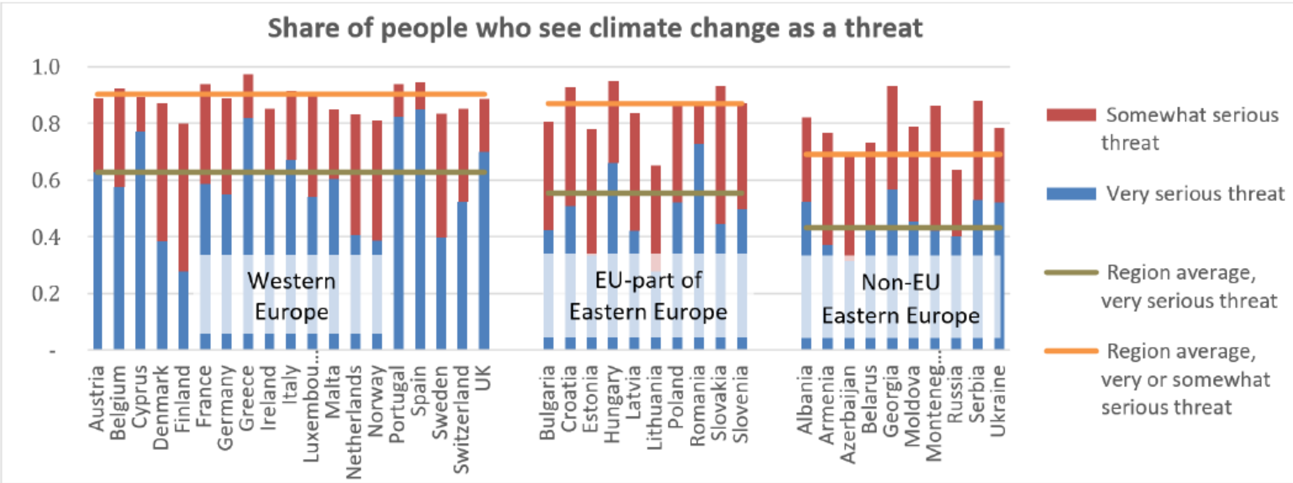

Figure 1.2: Climate concerns in Eastern and Western Europe

Source: (Le Coq and Paltseva, 2021).

Fig. 1.3 presents the percentage of the respondents in Belarus who consider climate change to be a threat to the country in 2010, 2019, and 2022. The data for 2010 come from the Life in Transition Survey II (European Bank for Reconstruction and Development, 2023) with a sample size of 1000 people. The 2019 survey data are from the Lloyd's Register Foundation (2023) World Risk Poll comprising a sample of 1128 respondents for Belarus. The 2022 data are from the survey conducted specifically for the purposes of this dissertation, in particular for its second chapter. The 2022 survey sample includes 1029 participants. For 2010 and 2019 the survey covers both urban and rural population, for 2022 – only urban citizens. Although it is not possible to draw a direct comparison between different years, one still can elicit a valid conclusion on the increase in people's awareness about climate change between 2010 and 2019.

As mentioned above, after 2019 Belarus entered a very turbulent period that resulted into a contraction of the economy. That period is characterized by a high level of uncertainty for the population and businesses. This uncertainty stems not only from the economic conditions but also from the political situation in the country, namely suppression of the democracy movement and involvement in the Russian invasion of Ukraine. When the population faces a series of crises that might *seem* more vital than environmental problems, their attention might be diverted from climate change. A high degree of uncertainty might lead to people stop caring about the environment and indulge in more careless or destructive consumption patterns to relieve the stress. According to Liu et al. (2022), self-uncertainty is associated with compulsive buying behavior. However, as illustrated in fig. 1.3, a sharp decrease in climate change risk perception among the population in Belarus in 2022 against 2019 is not observed.

That lays a solid foundation for exploring pro-environmental behaviors and factors affecting them in chapter two.

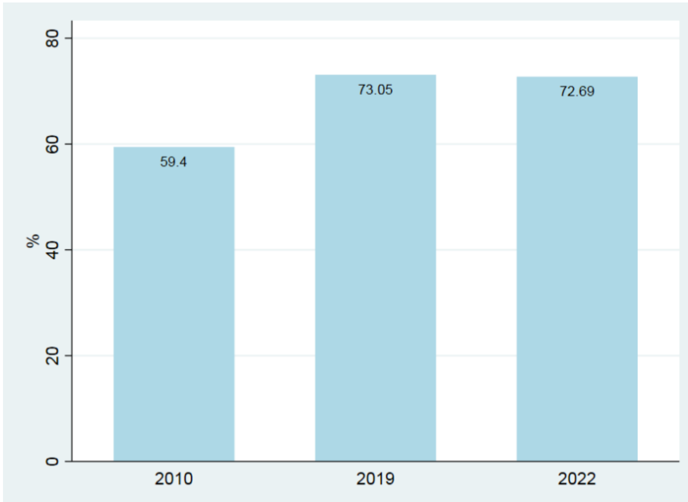

Figure 1.3: Percentage of people in Belarus who consider climate change to be a threat to the country
Source: the author's own elaboration based on the data for 2010 from (European Bank for Reconstruction and Development, 2023); for 2019 from (Lloyd's Register Foundation, 2023); the own data for 2022.

1.4.2 BUSINESS ADHERENCE TO THE GREEN AGENDA IN BELARUS

The economy of Belarus is defined by developed industrial, services and agricultural sectors. Manufacturing industries contribute about 20.2-22.9% to GDP in 2010-2021 (National Statistical Committee of the Republic of Belarus, 2022b). About 65% of the produced goods are exported (Ministry of Foreign Affairs of the Republic of Belarus, 2021). The commodity structure of exports in Belarus relies on chemical products (19.7% in 2020), food goods and agricultural raw materials (19.6% in 2020), machinery, equipment and transport vehicles (19.2% in 2020), mineral products (13.3% in 2020) (National Statistical Committee of the Republic of Belarus, 2021).

If the environmental narrative for the population could be to some extent based on extreme weather events they observe, for businesses it should be of more pronounced economic nature. This kind of narrative for enterprises in Belarus started to emerge in 2020 after the European Commission presented its Green Deal in December, 2019 (European Commission, 2023). This narrative gained momentum in 2021 as the EU announced the introduction of the carbon border adjustment mechanism (CBAM) as a preventive measure to carbon leakage (European Commission, 2021). The CBAM stimulates non-EU producers who export their goods to the EU to decrease their emissions (European Commission, 2021). As at that time (2021) the EU was the second largest trade partner for Belarus (Ministry of Foreign Affairs of the Republic of Belarus, 2021), some manufacturing industries could be substantially affected after the implementation of the CBAM. According to Tochitskaya and Shershunovich (2021), the CBAM could be considered as an equivalent to introducing an import duty by the EU. This duty can amount to 3.4-3.8% for inorganic chemical products and fertilizers, 6.7-13.7% – for metals and metal products, and 6.5-6.6% – for mineral goods from Belarus depending on the range of the GHGs covered (Tochitskaya and Shershunovich, 2021).

In Belarus there are around 100 large and medium enterprises that comprehensively estimate their environmental, social, and corporate risks (Batova and Tochitskaya, 2022). Risk assessment in these three spheres is the first step on the way to the implementation of the Environmental, Social and Governance (ESG) strategy. Adherence to ESG strategy can transform the economic relationships of businesses into more environmentally and socially responsible ones. Some of these companies, namely 31 companies as of December, 2021, take part at the United Nations Global Compact, which means that the concept of sustainable development is a centerpiece of their activity (Global Compact Network Belarus, 2022). Different elements of the ESG strategy are disproportionally implemented among the enterprises in Belarus (Batova and Tochitskaya, 2022). According to the Enterprise Survey conducted by BEROC in 2020-2021 among 403 enterprises in Belarus (Batova et al., 2021), the majority of enterprises consider themselves as environmentally responsible. Though this responsibility is limited to some environmental control measures and measures to increase the resource efficiency and does not find its way into a comprehensive strategy of environmental responsibility. The survey results (Batova et al., 2021) show that only 6.2% of the respondents have this kind of strategy.

The green agenda does not still seem to be very well incorporated into the practices of enterprises in Belarus. Nevertheless, the general development of the business environment shows that companies are slowly turning more and more into the green direction. In February, 2022 a working group was created by the Ministry of Finance of the Republic of Belarus with the aim to explore the possibilities of implementing the ESG-standards and developing the national taxonomy of green financing (Batova and Tochitskaya, 2022). In May, 2022 the rating agency BIK Ratings prepared the methodology of assigning ESG-ratings to companies, cities and regions, which was then brought to public consideration (BIK Ratings, 2022). Understanding the context in which the business environment in Belarus evolves is of importance for chapter three of this dissertation. It uses the firm level data for manufacturing companies from the World Bank Enterprise Survey collected in Belarus between October 2018 and April 2019 (World Bank Group, 2023).

1.4.3 LEGISLATIVE FRAMEWORK FOR THE GREEN ECONOMY IN BELARUS

In recent years Belarus has made some progress in achieving SDGs. In 2022 SDG Index Belarus is ranked 34th out of 163 countries having the score of 76.0, which is higher than the regional average for Eastern Europe and Central Asia (71.6) (Sachs et al., 2022). With regard to the environmental performance of Belarus in the global context, a brief overview can be drawn from the Environmental Performance Index (EPI). The 2022 EPI assesses 180 countries across 40 indicators on climate change performance, environmental health, and ecosystem vitality (Wolf et al., 2022). The 2022 EPI ranks Belarus 55th with a score of 48.5. The country takes the second place among the former Soviet States after Ukraine (Wolf et al., 2022). However, the 2023 Climate Change Performance Index which reflects how 59 countries and the EU are dealing with the climate protection rates Belarus's efforts as low. The country is ranked 46th reaching the score of 43.69 (Burck et al., 2023).

Several legal documents and commitments show that Belarus is going to foster the efforts in the green economy development. The National strategy of sustainable development for the Republic of Belarus till 2035 approved on the 4th of February, 2020 (the Ministry of Economy of the Republic of Belarus, 2020) outlines five priority areas for the country. One of them is providing ecological security and transition to responsible consumption and production. The National strategy (the Ministry of Economy of the Republic of Belarus, 2020) acknowledges that to reach this goal it is necessary to develop measures that stimulate implementation of innovative economically feasible "green" technologies that are based on energy- and resource-saving. The National action plan on the "green" economy development in the Republic of Belarus in 2021-2025 approved on the 10th of December, 2021 (the Ministry of Economy of the Republic of Belarus, 2021) defines green economy as the economic model aimed at achieving the goals of socio-economic development while decreasing ecological risks and environmental degradation. This model is resource-efficient, low-carbon, socially inclusive and grounded in innovations. The National action plan sets 11 priorities for the green economy development in Belarus. Among others there is implementation of principles for responsible consumption and production, transition to a circular economy which implies decrease in environmental consequences from production and increase in resource-efficiency, and social engagement. And these three priorities are closely connected with the research questions of this thesis outlined in section 1.3. In accordance with Article 4 of the Paris Agreement Belarus is committed to bring down its GHGs emissions by at least 35% against the level of 1990 (United Nations Climate Change, 2022). The country expresses its readiness to cut down emissions even further – by at least 40% if it can access the international financial mechanisms to apply best available technologies in order to decrease GHGs (United Nations Climate Change, 2022).

Although these documents and commitments show a positive direction, in which Belarus would like to move, so far it belongs to countries that have a large ecological footprint and consequently inflict significant damage on the environment. The ecological footprint of a consumer in Belarus equals to 4.2 global ha, which is 1.5 times higher than the world average (2.8 global ha) (the Ministry of Economy of the Republic of Belarus, 2021). That proves that more efforts should be put into transition to responsible consumption and production. Nowadays the Strategy for the long-term low-carbon development of the Republic of Belarus till 2050 and the National action plan for adaptation to climate change till 2030 are in the pipeline (the Ministry of Economy of the Republic of Belarus, 2021).

Given the importance of decreasing the ecological footprint from consumption in Belarus, the fourth chapter of this dissertation assesses the CO_2-, CH_4-, and N_2O-footprints from the final household consumption using an environmentally extended input-output model. That allows not only estimating the above mentioned footprints but also putting them into a global perspective while comparing countries at different stages of development. Moreover, the approach taken in the fourth chapter of this thesis enables to overcome several drawbacks that are inherent to the ecological footprint indicator (Giljum et al., 2007). Namely, this indicator is usually not disaggregated into economic sectors and its design does not allow it to be combined with the System of National Accounts indicators (Giljum et al., 2007). Imported goods' energy requirements and emission intensities are calculated using the world average data for this indicator and, thus, do not account for any of the exporting country's environmentally relevant characteristics (Giljum et al., 2007). And the ecological footprint does not enable evaluators to come to monetary units in the assessment (Wackernagel et al., 2005). In the fourth chapter of this dissertation environmental impacts in the form of CO_2-, CH_4-, and N_2O emissions from the final household consumption are assessed along the value chain sector-wise and are evaluated with regard to their social costs. The study employs EEMRIO model from the EORA26 database (Lenzen et al., 2015) which takes into account international trade. The analysis is based on the data from 2015 as it was the latest data available from EORA26 at the period when the study was carried out (2020-2021). As the economic structure does not change significantly from one year to another (Wang et al., 2015), the results of this research are still viable to the present time.

CHAPTER 2: BEHAVIOR AND MEDIA: DOES INFORMATION MATTER FOR SUSTAINABLE CONSUMPTION?

ABSTRACT

Consumer behavior is recognized by research as a vital component in dealing with climate change. A lot of research focuses on psychological factors such as environmental values, beliefs and efficacy that can affect sustainable behavior. But these factors have limited practical implications as they are difficult and slow to change. This study empirically investigates how exposure to information through different media channels (TV, radio, newspapers, and the Internet) can influence consumer behavior. It comes from the proposition that individuals do not live in a vacuum and can be simultaneously exposed to climate change messages as well as information promoting unsustainable lifestyles on the media. The study estimates two structural equation models to assess how exposure to climate change information can affect sustainable consumption behaviors, including promotional, accommodating and pro-active behavior (1st model, basic version). It further explores how exposure to information promoting overconsumption can influence sustainable consumption behaviors (1st model, extended version). It also aims to answer how exposure to information promoting overconsumption can impact unsustainable actions (2nd model). The study uses the nationally representative sample of Belarusian consumers. The Attitude-Behavior-Context theory in combination with the analytical framework from Identity Economics is applied as a conceptual basis of this research. The findings reveal that exposure to climate change information has a positive and direct effect on promotional and accommodating actions and through them an indirect positive effect on pro-active sustainable behavior. Exposure to information promoting overconsumption does not negatively affect pro-environmental behaviors. But it diminishes a bit the positive indirect effect of exposure to information about climate change on pro-active behavior. Besides, exposure to information promoting overconsumption exerts a stronger positive effect on unsustainable actions than climate change information does on pro-active sustainable behaviors. It highlights the important role media use can play in shaping consumer behavior, both sustainable and unsustainable ones. The research provides insights how governments, businesses and non-governmental organizations can use the media to change consumer behavior in the direction of sustainability.

Keywords: structural equation modeling, climate change media use, consumerism media use, unsustainable consumption behavior, sustainable consumption behavior, Identity Economics, Attitude-Behavior-Context theory.

2.1 INTRODUCTION

Climate change is one of the major current threats to humankind. Its impacts are aggravated by unfolding environment related global trends, such as natural resources depletion, ecosystem and land degradation, loss of biodiversity, etc. (IPCC, 2022a). Success in dealing with climate change and other environmental problems requires not only efforts from policymakers and businesses but also active engagement from consumers changing their behaviors.

Behavior change has been relatively neglected by climate policy-makers and analysts (Moran et al., 2020), although research shows that it has large potential in dealing with climate change and other environmental problems. Hertwich and Peters (2009) estimate that household or "lifestyle" consumption such as food, housing, mobility etc. is responsible for 72% of global greenhouse gas emissions. In Belarus, 66% of the CO_2-footprint is attributable to the final household consumption. According to Moran et al. (2020), changes in consumer behavior could lead to the European Union (EU) carbon footprint reduction by approximately 25%. The Intergovernmental Panel on Climate Change (IPCC) also regards behavior change as a relevant strategy for decreasing emissions (Pacala and Socolow, 2004).

The question then arises what can induce behavior change towards more sustainable consumption. A lot of studies focus on psychological factors such as environmental values, beliefs and efficacy that can affect sustainable consumption behavior of people (e.g., Tabernero and Hernandez, 2011; Vicente-Molina et al., 2013; Lee et al., 2014; Lauren et al., 2016; Jugert et al., 2016; Sharma and Jha, 2017; Hamann and Reese, 2020; Inkpen and Baily, 2020; Sadiq et al., 2022). However, it could be quite difficult for governments, enterprises and non-profit organizations to influence sustainable consumption behavior through these psychological factors as they are the internal values of individuals (Huang, 2016). For practical reasons, it's necessary to identify those factors that, on the one hand, can strengthen sustainable consumption behavior of people and, on the other hand, can be impacted by the efforts of different organizations (Huang, 2016). There is a lack of research on the potential means that can affect behavior in the direction of more sustainable consumption (Reisch et al., 2021).

The idea that consumers are independent in their decisions in the marketplace has long been discredited (Mishan, 1969). In their works Kapp (1950; 1978) and Galbraith (1958; 1979) expand on the role the institutions of market play in shaping behavior. In this regard, media can be considered as one of the tools through which institutions of market communicate with consumers. There are two conflicting streams of literature on the effects of media use on consumption behavior: (1) stating that media use exerts a positive effect on pro-environmental attitudes and behavior; (2) declaring that media use (in particular, the Internet) promotes consumerism.

This study comes from the proposition that individuals do not live in a vacuum and can be simultaneously exposed to climate change messages as well as information promoting unsustainable lifestyles on the media. In this regard the study's goal is threefold: first, it intends to test how exposure to climate change information on different media affects individuals' sustainable consumption behavior. Second, it sets a goal to explore how exposure to information promoting consumerism through various media can influence sustainable consumption behavior and whether in this case the effect of climate change information on these behaviors decreases. And, third, it aims to investigate how exposure to consumerism information on different media affects individuals' unsustainable consumption behavior. All research questions will be answered using the same sample of people. From a policy perspective, this study constitutes an interesting case. It allows discovering which means are more effective in changing behavior towards more sustainable consumption – whether exposure to climate change information on the media should be strengthened or it is more viable to limit the exposure to consumerism information in order to affect behavior.

This research makes a contribution in a number of ways. First, to the best of our knowledge, this is the first study that explores both the influence of climate change and consumerism media use on sustainable behaviors in the same model. Second, it complements these findings with investigations on the impact of consumerism media use on unsustainable behavior. That allows us to derive more insightful policy implications from the research. Third, partially following Huang (2016), we classify sustainable consumption behavior in two distinct groups, which improves the precision of the results. Fourth, for its theoretical framework the study combines theories from economics and psychology demonstrating that concepts from different disciplines can complement and enrich each other.

The remainder of the chapter is structured as follows. Section 2.2 introduces the theoretical framework of this study and develops hypotheses. Section 2.3 describes the sample and operationalization of constructs for the structural equation model applied to address the research questions. Section 2.4 presents the empirical results. Section 2.5 discusses the findings of this study while section 2.6 concludes and presents policy implications.

2.2 THEORETICAL FRAMEWORK AND HYPOTHESES

Our research is grounded in several theories from economics and psychology. The Attitude-Behavior-Context (ABC) theory (Guagnano et al., 1995) states that behavior (B) is a product of personal attitudinal variables (A) and contextual factors (C), which is in line with the economic approach to crime from G. Becker (1993). According to him (G. Becker, 1993), not only rationality and preferences of would-be criminals define the amount of crime but also economic and social environment. Stern (2000) refines the ABC theory and defines four categories of causal variables for environmentally significant behavior: attitudinal factors (norms, beliefs and values), contextual forces (e.g. interpersonal influences, media, community expectations, monetary incentives and costs), personal capabilities (eg. knowledge and skills, the availability of time) and habit or routine. Regarding a particular behavior, there is evidence that different categories of causal variables can make an influence (Gardner and Stern, 1996; Stern, 2000). In line with this perspective, our study includes three groups of variables to investigate sustainable and unsustainable consumption behaviors: attitudinal factors (environmental beliefs, materialistic values), personal capabilities (self-efficacy), contextual factors (exposure to climate change information through different media; exposure to consumerism information through different media).

Our research also relies heavily on the ideas from *Identity Economics* (Akerlof and Kranton, 2010) which states that that identity (a person's sense of self) represents a motivation for behavior and impacts economic outcomes. In this stream of economic thought social context is of primary importance. According to Akerlof and Kranton (2010, p.4), "in every social context, people have a notion of who they are, which is associated with beliefs about how they and others are supposed to behave". The cornerstones of identity economics are identity, norms, social categories and identity utility which all operate in the relevant social context. A person's identity determines their social category. Different norms on how individuals should behave are associated with different social categories. An individual experiences either a gain or loss in their identity utility depending on whether their actions conform to norms and ideals or not (Akerlof and Kranton, 2010).

Combining the ABC theory (Guagnano et al., 1995; Stern 2000) with the analytical framework from *Identity Economics* (Akerlof and Kranton, 2010), we build the conceptual approach of our research upon the following. Personal capabilities are part of an individual's identity. Attitudinal factors such as beliefs and values define the rules or norms how individuals should behave with regard to their identity. Both personal capabilities and attitudinal factors can influence to some extent the context in which an individual operates and, thus, their exposure to the information on different media. In the end, personal capabilities, attitudinal factors and the context lead to specific behaviors adopted by individuals with a varying degree of frequency on a spectrum from seldom exercised actions to a habit or routine. Various components of the conceptual approach for our research are further explained in the subsequent parts of this section. Fig. 2.1 illustrates the conceptual framework of this study.

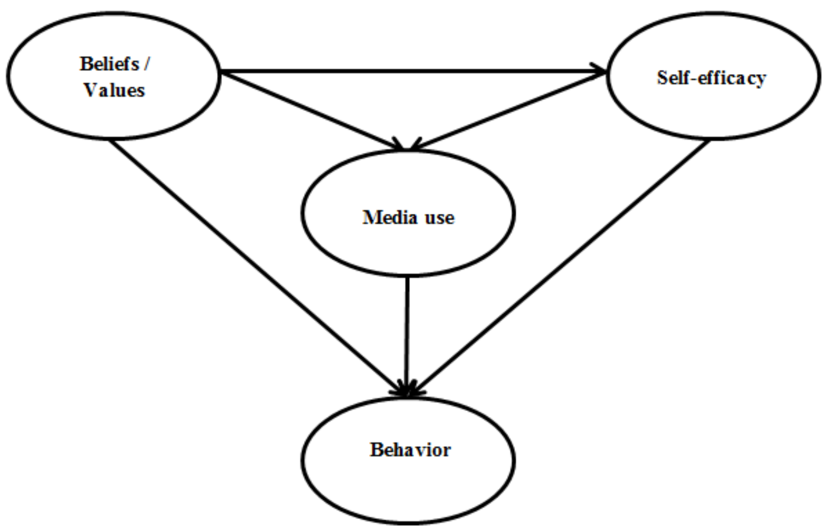

Figure 2.1: Conceptual framework for the study based on ABC theory (Guagnano et al., 1995; Stern 2000) and Identity Economics (Akerlof and Kranton, 2010).
Source: author's own elaboration.

It is important to note that in reality there could be a reverse link from behavior to beliefs / values and even to self-efficacy and from media use to beliefs / values. Explaining where norms come from, Akerlof (2009a,b) suggests that people seek confirmation of their beliefs. When actors desiring this confirmation interact with each other, identities and norms emerge (Akerlof, 2009a, b). In our case promotional and accommodating behaviors which will be described in the next section embody this interaction of people who in many cases have similar beliefs. Shehata et al. (2021) provide a conceptualization of long-term media effects on societal beliefs based on research published in major communication journals. In our study we do not explore the reverse links from behavior to beliefs / values and to self-efficacy and from media use to beliefs / values for a number of reasons. First, from a policy perspective these psychological variables are difficult to exert an influence on (Huang, 2016). Second, values represent stable structures that are slow to change and as Manfredo et al. (2016) put it, efforts to manage value shifts are likely to be ineffective. Third, the main focus of this study is the effect of the media use on behavior which will be explored with the help of structural equation models. The introduction of the reverse links will additionally complicate the models.

2.2.1 SUSTAINABLE CONSUMPTION BEHAVIOR

At the Oslo Symposium *sustainable consumption* was defined as “the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations” (Norwegian Ministry of the Environment, 1994). Unsustainable, on the contrary, denotes consumption that cannot be carried on at its current rate (Blühdorn, 2007). In this study sustainable consumption behavior is used interchangeably with pro-environmental behavior. In the literature there are two approaches to sustainable consumption behavior: an impact-oriented and an intent-oriented one (Geiger et al., 2017). When defined by its impact, this behavior is linked to the change it causes in the ecological or social environment. An intent-oriented approach focuses on intentions of a certain behavior from the actor’s standpoint (Geiger et al., 2017).

Stern (2000) classifies impact-oriented sustainable consumption behavior into two types: public-sphere and private-sphere environmentalism. Public-sphere sustainable consumption behavior includes such activities as, for example, joining environmental groups, active involvement in their campaigns, public support. Private-sphere sustainable consumption behavior encompasses purchase behavior, treatment of waste and maintenance and use of household equipment (Stern, 2000).

With regard to intent-oriented sustainable consumption behavior, there are activities with no direct impact on the environment that, nevertheless, show that an individual cares (Huang, 2016). They include, for example, searching for information about environmental problems or sustainable lifestyles on the media, discussing this kind of information with others, etc. This type of activities is classified as accommodating behavior by the media effects research (Tsfati and Cohen, 2003; Wei et al., 2010; Huang, 2016).

The current study focuses on (1) different impact-oriented private-sphere sustainable consumption activities and refer to them as *pro-active* behavior; (2) impact-oriented public-sphere sustainable consumption activities and refer to them as *promotional* behavior; (3) intent-oriented sustainable consumption activities labeled as *accommodating* behavior. For the purpose of this study promotional and accommodating behaviors will be combined in one group.

2.2.2 MEDIA USE

Media use in general means exposure or attention to both traditional media, such as newspapers, TV, and radio, and the Internet (Huang, 2016). The results of the research on the effects of media use on consumption behavior to a large extent might depend on a kind of information a person has been exposed to through the media and quite interestingly on the media itself. As mentioned above, there are two conflicting streams of literature on the effects of media use on consumption behavior: (1) stating that media use exerts a positive effect on pro-environmental behavior; (2) declaring that media use (in particular, the Internet) promotes consumerism.

As an example of the studies falling under the first stream of literature, it is worth mentioning Holbert et al. (2003) who find that nature documentaries and televised public affairs are positively associated with pro-environmental behavior of viewers. According to Ho et al. (2015), attention to pro-environmental messages on the traditional media (TV and newspapers) positively predicts green purchasing. Attention to this kind of information on the Internet is positively associated with environmental civic engagement (Ho et al., 2015). Howell (2011, 2013) shows based on the UK sample that there is a short-term increase in the audience motivation to adopt pro-environmental behavior after watching “The Age of Stupid”. This film portrays the devastation of the world by climate change in 2055. Huang (2016) finds that global warming media use (TV, newspapers and the Internet) exerts a direct positive effect on accommodating, promotional and pro-active behavior.

At the same time, the Internet with its convenient and interactive features can serve well to promote consumerism (Wang and Hao, 2018). The Global Web Index in 2020 shows that social networking sites are used to research products by 54% of its active users. According to Bush and Gilbert (2002), higher levels of materialism are shown by consumers who spend more time on social networking sites in comparison to those who spend time reading newspapers. Simeone and Scarpato (2020) find that unsustainable consumption behavior with regard to food choices is positively associated with the probability that information is acquired through social networking sites.

This study defines media use as exposure to different information on TV, radio, newspapers and the Internet. Further in the text, we apply the terms “media use” and “exposure to information” interchangeably. When it focuses on the exposure to information about climate change, environmental problems or sustainable lifestyle on the above mentioned media, it labels it as *climate change media* *use.* When it addresses the exposure to information promoting luxurious lifestyle and buying more stuff to be happy on the above mentioned media, it labels it as *consumerism media use*. For the 1st research question and respectively the basic version of our 1st model, we put forward the following **main** hypotheses about the relationship between climate change media use and sustainable consumption behaviors.

H1-1. Climate change media use positively affects pro-active sustainable consumption behavior.
H1-2. Climate change media use positively affects accommodating and promotional sustainable consumption behaviors.

For the 2nd research question we extend the 1st model by adding to it consumerism media use to check the following **main** hypotheses of this study.

H1-1e. Consumerism media use negatively impacts pro-active sustainable consumption behavior.
H1-2e. Consumerism media use negatively impacts accommodating and promotional sustainable consumption behaviors.

For the 3nd research question and respectively the 2nd model, we formulate the following **main** hypothesis regarding consumerism media use and unsustainable consumption behavior.

H2-1. Consumerism media use has a positive effect on unsustainable consumption behavior.

2.2.3 ENVIRONMENTAL BELIEFS AND ENVIRONMENTAL SELF-EFFICACY

Prior research demonstrates that environmental beliefs, values, awareness, self-efficacy, perceived environmental impact, etc. play an important role in explaining sustainable consumption behaviors (Peattie, 2010; Lee, 2011; Tabernero and Henandez, 2011; Vicente-Molina et al., 2013; Lee et al., 2014; Koning et al., 2015; Panzone et al., 2016; Sharma and Jha, 2017; Fischer et al., 2017; Jaiswal and Singh, 2018).

Environmental beliefs represent people's attitudes towards the natural environment (Huang, 2016) that determine their environmental behavior (Gray and Wiegel, 1985) and, thus, can be considered as a form of behavioral beliefs (Li et al., 2021). They are often referred to as environmental concern, values or attitudes and measured using usually items from the revised New Environmental Paradigm (NEP) (e.g. Lee et al., 2014; Huang, 2016). The revised NEP developed by Dunlap et al. (2000) is a survey-based metric containing 15 items to measure an ecological worldview of an individual.

Environmental self-efficacy, or a similar concept of perceived consumer effectiveness, refers to the belief that an individual has in their efforts to be able to make a difference (Ellen et al., 1991). Straughan and Roberts (1999) and also Afonso et al. (2012) find that environmental self-efficacy is more important in explaining sustainable consumption behaviors than other psychological characteristics and socio-demographic factors. Self-efficacy varies on three dimensions: level, generality and strength (Bandura, 1997). Level deals with degrees of task difficulty an individual think they can carry out. Generality describes the range of activities people believe they can be effective in. Strength accounts for the degree of confidence an individual has to execute specific tasks (Huang, 2016).

2.2.4 MATERIALISM

For the first time, Richins and Dawson (1992) defined materialism as a function of value given to material goods and, thus, brought materialism research into a new direction (Pellegrino and Shannon, 2021). According to Hurst et al. (2013), there are two main reasons why materialistic values should be included in research on sustainable consumption behavior. First, theoretical and empirical evidence suggests that materialistic values are negatively associated with this type of behavior. Second, as materialism is an individual difference, it can be more easily targeted and changed than personality traits which are more stable.

To measure materialism as a value some studies employ the Aspiration Index (Kasser and Ryan, 1996), the Materialistic Values Scale (Richins and Dawson, 1992) or a modification of one of these measures (e.g., the Materialistic Values Scale short version (Richins, 2004)). The original Materialistic Values Scale (Richins and Dawson, 1992) contains 18 items. The shorter versions developed later are of 15-, nine-, six- and three-items length. In their scale materialistic values are ascribed to three categories: success – possessions are used to evaluate the success of others and oneself; centrality – the central role of possessions in a person's life; and thirdly happiness – the belief that happiness and life satisfaction are achieved through possessions and their acquisition (Richins, 2004).

Materialism is considered to be a function of both intrinsic and extrinsic goals (Kasser and Ahuvia, 2002). While intrinsic objectives such as self-acceptance and physical fitness can be beneficial to attain as they are linked to intrinsic psychological need like self-acceptance and competency, extrinsic goals such as money and fame are used to cope with individual insecurities (Kasser and Ahuvia, 2002). Extrinsic purposes can often find their expression in compulsive buying, impulse buying and conspicuous buying behavior (Pellegrino and Shannon, 2021), which we believe can be referred to as unsustainable consumption behavior.

2.2.5 AUXILIARY HYPOTHESES

In structural equation modeling (SEM) which will be used for this study all the relationships between latent variables should be hypothesized. In addition to our main hypotheses mentioned above, based on the literature results and our theoretical framework, the following hypotheses are postulated for *the* *basic version of our 1st model.* They concern the influence of environmental beliefs and self-efficacy on sustainable consumption behaviors.

H1-3. Environmental beliefs positively influence pro-active sustainable consumption behavior.
H1-4. Environmental beliefs positively influence promotional and accommodating sustainable consumption behaviors.
H1-5. Environmental self-efficacy exerts a positive effect on pro-active sustainable consumption behavior.
H1-6. Environmental self-efficacy exerts a positive effect on promotional and accommodating sustainable consumption behaviors.

According to our conceptual approach, attitudinal factors (beliefs) and personal capabilities can influence the context within which an individual operates. That brings us to the next hypotheses for *the basic version of our 1st model*.

H1-7. Environmental beliefs positively affect climate change media use.
H1-8. Environmental self-efficacy positively affects climate change media use.

In line with our conceptual approach, environmental self-efficacy is part of an individual's identity and environmental beliefs define the norms how individuals should behave regarding their identity. When they behave in accordance with these rules, they experience a gain in their identity utility. With respect to this, our next hypothesis for *the basic version of our 1st model* is as follows.

H1-9. Environmental beliefs enhance environmental self-efficacy.

Since the goal of promotional and accommodating behaviors is in the end to support and promote pro-active behavior, our last hypothesis for *the basic version of our 1st model* is postulated as follows.

H1-10. Promotional and accommodating behaviors enhance pro-active sustainable consumption behavior.

The basic version of our 1st model has to be extended to incorporate consumerism media use, which necessitates two additional hypotheses about the relationships between climate change media use and consumerism media use.

H1-11. Consumerism media use negatively affects climate change media use.
H1-12. Climate change media use positively impacts consumerism media use.

Hypothesis **H1-12** is formulated in this way as we expect that while getting information about climate change or environmental issues a consumer will still be at the same time bombarded by information promoting overconsumption.

In our second model in which we focus on unsustainable consumption behavior (3rd research question), we use materialistic values instead of environmental beliefs as an attitudinal component of our model. At the same time, environmental self-efficacy is still used as personal capabilities part of the model. In addition to the main hypothesis (H2-1), the following ones are formulated for the 2nd model.

H2-2. Materialistic values make a positive influence on unsustainable consumption behavior.
H2-3. Materialistic values make a positive influence on consumerism media use.
H2-4. Materialistic values make a negative influence on environmental self-efficacy.
H2-5. Environmental self-efficacy negatively affects consumerism media use.
H2-6. Environmental self-efficacy negatively affects unsustainable consumption behavior.

2.3 METHODS

2.3.1 DATA COLLECTION AND SAMPLE CHARACTERISTICS

For the purpose of this study, primary data were collected in April-May, 2022. The data were gathered through an online survey administered to the urban population of Belarus aged 18-75 recruited via an online panel by the marketing research company "MIA Research". The sample frame comprised the online panel that included around 25 000 participants. 1029 questionnaires were completed during the survey period. The survey was done in the Russian language, which is the official and most common language of the population in Belarus. At the beginning of the survey there were filter questions about gender, age, and region to ensure the representativeness of the sample according to these criteria. Thus, the study avoids the representativeness bias associated with small convenience samples of typically university students, which is prevalent in many studies using online surveys (Pellegrino and Shannon, 2021). Out of the 1029 respondents, 48.59% are men and 51.41% are women. The average age is 41.03 years. 14.77% of the respondents live in Brest region, 12.24% – in Vitebsk region, 14.67% – in Gomel region, 10.01% – in Grodno region, 26.92% – in Minsk, the capital city, 11.37% – in Minsk region, and 10.01% – in Mogilev region. The socio-demographic characteristics of the sample that are used in the subsequent multi-group analysis are presented in table A.1 in the Appendix A.

2.3.2 OPERATIONALIZATION OF CONSTRUCTS

To measure climate change media use, this study partially adapts the approach from Huang (2016). We apply a 4-point Likert scale to ask the participants how often they come across the information about climate change, environmental problems or sustainable lifestyle on four types of media, including television, the newspapers, the radio, and the Internet (1=never, 4=very often; 0=I do not use this type of media). Respectively, to estimate consumerism media use we apply the same Likert scale to see how often the respondents come across the information promoting luxurious lifestyle and buying more stuff to be happy on television, the newspapers, the radio, and the Internet (1=never, 4=very often; 0=I do not use this type of media).

Environmental beliefs are operationalized based on the items from the revised NEP scale (Dunlap et al., 2000). The revised NEP scale contains 15 items that can be allocated to four dimensions: a tendency to conserve, recycle, be cautious about the future, and support animal rights (Shephard et al., 2009; Harraway et al., 2012). Out of 15 items, seven have been found by Harraway et al. (2012) to be co-located with the largest loadings for each dimension. Huang (2016) tests these seven items in the research on the global warming media influence on the pro-environmental behavior and proves that only three of them exhibit the acceptable level of loadings. Following him, this study adapts these three items to measure environmental beliefs. We ask the respondents to evaluate on a scale from 1 (strongly disagree) to 5 (strongly agree) how they feel about the following statements: (1) humans are severely abusing the environment; (2) plants and animals have as much a right as humans to exist; (3) if things continue on their present course, we will soon experience a major ecological catastrophe.

After analyzing the research literature that uses different scales of environmental self-efficacy (e.g. Lauren et al., 2016; Huang, 2016; Jugert et al., 2016; Wang and Hao, 2018; Moeller and Stahlmann, 2019; Hamann and Reese, 2020), we adapt the following items to measure environmental self-efficacy on both level and strength dimensions: I believe that I have the ability to take action to help the environment (strength); I can still change my behavior to be more environmentally-friendly, even when it costs more money or takes more time (level). The study applies the 5-point Likert scale (1=strongly disagree, 5=strongly agree) to measure this concept.

To estimate materialistic values of the respondent, we use the Materialistic Values Scale short version of three items developed by Richins (2004). As well as the longer versions of the Materialistic Values Scale (Richins and Dawson, 1992; Richins, 2004), the three-item version assesses the values across three domains: success, centrality, and happiness. One of the advantages of the Materialistic Values Scale short versions is that equal weight is ascribed to the three domains in the summed scale, unlike in the original scale in which each domain includes a different number of items (Richins, 2004). The participants of this study are asked to evaluate on a scale from 1 (strongly disagree) to 5 (strongly agree) how they feel about the following statements: I admire people who own expensive homes, cars, and clothes (it refers to the domain *success*); I like a lot of luxury in my life (it regards the domain *centrality*); I'd be happier if I could afford to buy more things (it belongs to the domain *happiness*).

This study investigates the impact of the attitudinal factors, personal capabilities and climate change media use on pro-active, accommodating and promotional sustainable consumption behaviors. Pro-active behavior refers to people's daily conservation practices. The study assesses on a 4-point Likert scale (1=never, 4=always) how often the respondents are engaged in the following actions for environmental reasons: choosing to reuse or repair things rather than throw them away; reducing the energy used at home; choosing to save or reuse water at home. The items used here for pro-active behavior are mostly adapted from the World Value Survey, Wave III, 1996 (WVS Database, 2023) and the Life in Transition Survey II, 2010 (European Bank for Reconstruction and Development, 2023) to allow some comparison for descriptive purposes with previous years. As mentioned earlier, accommodating and promotional behaviors will be studied as one group. Promotional behavior concerns efforts aimed at promoting solutions to combat climate change (Huang, 2016). Accommodating behavior is expressed through activities in which individuals show their interest or intent to help the environment (Huang, 2016). For estimation of promotional behavior, this study adapts the item from the World Value Survey, Wave III, 1996 (WVS Database, 2023) and Huang (2016) and assesses on a 4-point Likert scale (1=never, 4=always) how often the respondents are engaged in the following activity: participating in activities organized by environmental groups (organizations) to mitigate environmental problems. Accommodating behavior is assessed based on the items adapted from Huang (2016) using the above mentioned 4-point Likert scale (1=never, 4=always) and includes: searching for information about environmental problems or sustainable lifestyle; discussing information about environmental problems or sustainable lifestyle with others.

In our study, we define unsustainable consumption behavior as conspicuous buying, which describes acquiring expensive, and luxury goods or services in order to impress others and gather prestige through objects (Rook, 1987; Pellegrino and Shannon, 2021). This study develops three items to measure unsustainable consumption behavior and uses the 4-point Likert scale (1=never, 4=always) to assess how often the respondents perform the following actions: updating your household appliances to the best models on the market; updating your electronic devices to the newer models (your mobile phone, TV, computer) on the market; buying luxury products (for example, brand-name clothing, gold or diamond jewelry, expensive cosmetic of foreign brands). An overview of the descriptive statistics of all presented indicators and their codes are given in Table A.2 in the Appendix A.

2.3.3 DATA ANALYSIS METHOD

Following Stern's (2000) suggestion about using synthetic models that include variables from more than one broad class to explore sustainable consumption behavior, SEM will be applied for this study. SEM is a simultaneous multiple-equation technique that allows modeling the relationships between latent variables (Mehmetoglu and Jakobsen, 2017). Its advantage lies in evaluating the relationships when more than one dependent variable is present (Mehmetoglu and Jakobsen, 2017). For this study, covariance-based SEM is used. The first step of SEM is to conduct a confirmatory factor analysis (CFA). In CFA, the number of factors (latent variables) and pattern of indicator-factor relationship as well as some other parameters are specified (Brown, 2015). As part of CFA, the reliability, validity and model fit of the measurement model are assessed (Awang, 2014; Mehmetoglu and Jakobsen, 2017). When the measurement model is correctly specified, latent path analysis can be conducted to determine the hypothesized structural relationships among latent variables (Mehmetoglu and Jakobsen, 2017). As part of latent path analysis, the model fit of the structural model is estimated. All the calculations in this study are done using Stata 16.

2.4 RESULTS

2.4.1 DESCRIPTIVE RESULTS

Sustainable and unsustainable consumption behaviors of the population in Belarus in 2022

Fig. 2.2 presents the distribution of the respondents with regard to their engagement in pro-active sustainable consumption behavior in 2022. Choosing to reuse and repair things rather than throwing them away, saving energy and water at home are exercised by around 28-29% of the population in Belarus on a constant basis (this share of the respondents are *always* engaged in them). The popularity of these sustainable consumption actions could be to some extent also explained by a number of economic conditions. First, water and energy tariffs have been rising in Belarus, which might stimulate people to engage in saving for their own financial benefits and not only because they care about the environment. Second, as regards repair and reuse of things, in Belarus there are numerous repair facilities in close proximities to residential areas and there is a substantial difference in price between repairing and buying a new product.

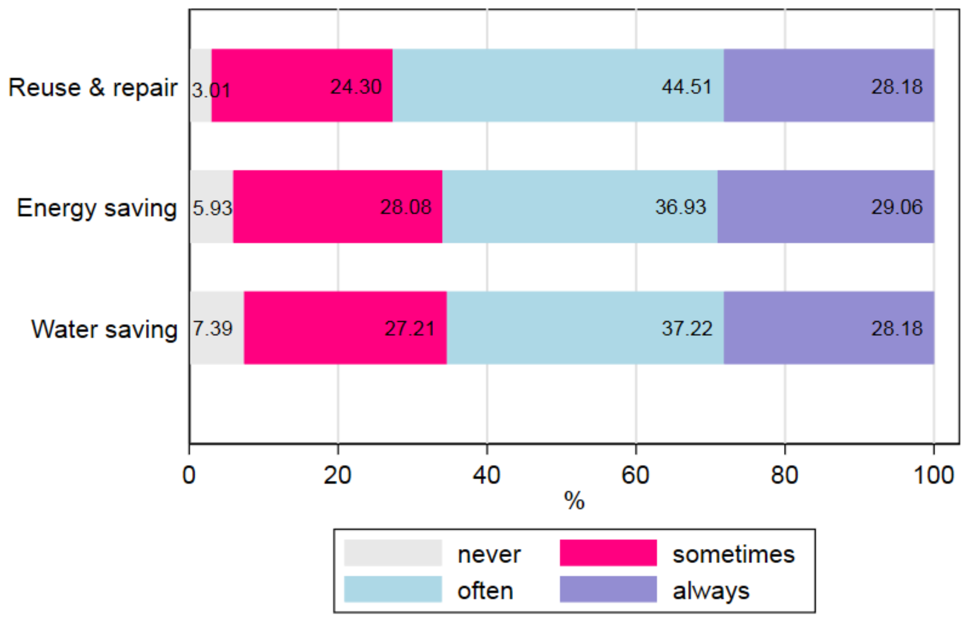

Figure 2.2: Distribution of the answers to the question “Could you please evaluate on a scale from 1 (never) to 4 (always) how often you engage in these behaviors for environmental reasons?”
Source: authors’ own construction.

Fig. 2.3 presents the distribution of respondents regarding their engagement in promotional and accommodating sustainable consumption behaviors. The results show that these actions are less practiced by the population in Belarus comparing to their pro-active behaviors. Around 63-65% of the respondents only *sometimes* search for information about environmental problems or sustainable lifestyle and discuss it with others and 56% of the participants never take part in activities organized by environmental groups (organizations) to mitigate environmental problems. On the one hand, from the supply side perspective the media in Belarus does not offer sufficient coverage of climate change problems and actions that should be practiced on a daily basis to mitigate them. On the other, from the demand side perspective the population does not have enough interest in these topics, which in its turn leads to insufficient coverage by the media. It points out that environmental awareness of the Belarusian population has not reached its potential.

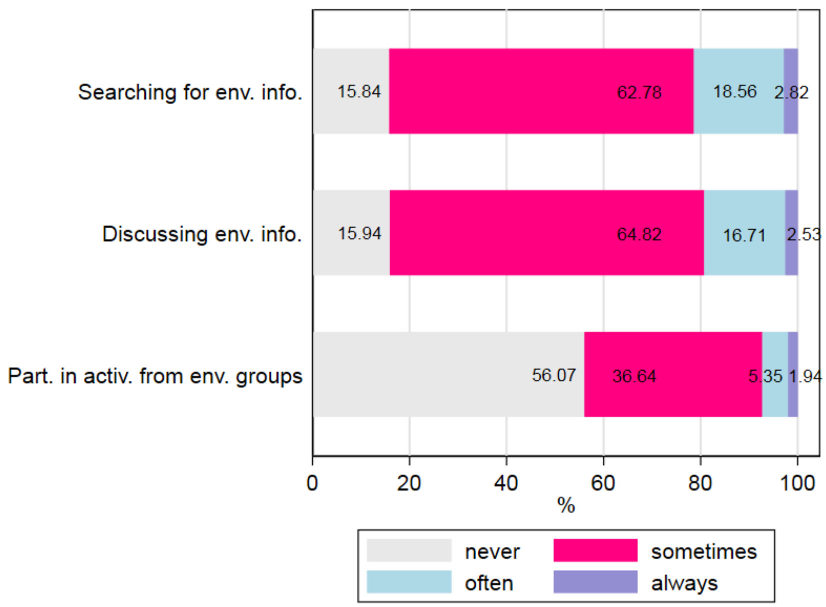

Figure 2.3: Distribution of the answers to the question "Could you please evaluate on a scale from 1 (never) to 4 (always) how often you engage in these behaviors?"
Source: authors' own construction.

Fig. 2.4 presents the distribution of participants with regard to their involvement in unsustainable consumption behavior. Around 62-67% of the respondents *sometimes* update their household appliances and their electronic devices (mobile phones, TVs, computers) to the best models on the market. About 32% of the participants *sometimes* buy luxury products (for example, brand-name clothing, gold or diamond jewelry, expensive foreign brand cosmetics). If comparing to pro-active environmental behaviors, unsustainable actions are exercised less often. Nevertheless, it does not automatically mean that the population is environmentally oriented. The involvement in unsustainable actions presented here to some extent depends on the income level of the consumers as updating household appliances and electronic devices and buying luxury products can be costly.

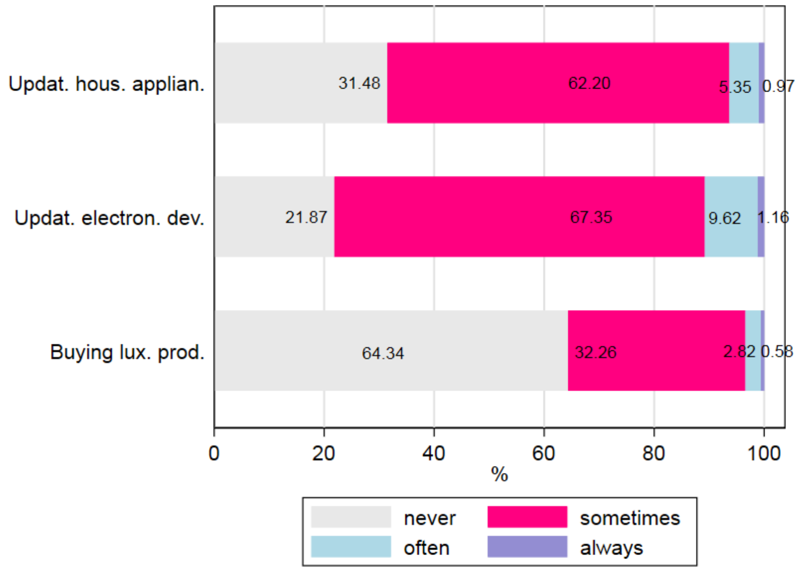

Figure 2.4: Distribution of the answers to the question "Could you please evaluate on a scale from 1 (never) to 4 (always) how often you engage in these behaviors?"
Source: author's own construction.

Comparison of some sustainable consumption behaviors between 2022, 2010 and 1996

In order to compare the descriptive results for 2022 with previous years, we use the following databases:

- the World Value Survey, Wave III, 1996 (WVS Database, 2023). The sample size for Belarus is equal to 2092 people. This survey includes questions on pro-environmental behavior.
- the Life in Transition Survey II, 2010 (European Bank for Reconstruction and Development, 2023). The sample size for Belarus amounts to 1000 persons. This survey has a section on climate change.

To enable comparison with 1996 and 2010, the answers[5] "sometimes", "often", "always" to the question "Could you please evaluate on a scale from 1 (never) to 4 (always) how often you engage in these behaviors for *environmental* reasons?" in the 2022 survey are recoded as "yes" and the answer "never" – as "no", respectively. Figs. 2.5-2.7 demonstrate the distribution of the respondents regarding their involvement into pro-active behaviors, fig. 2.8 – in terms of their engagement into promotional behavior.

[5] The same process has been repeated for the answers to the question "Could you please evaluate on a scale from 1 (never) to 4 (always) how often you engage in these behaviors?".

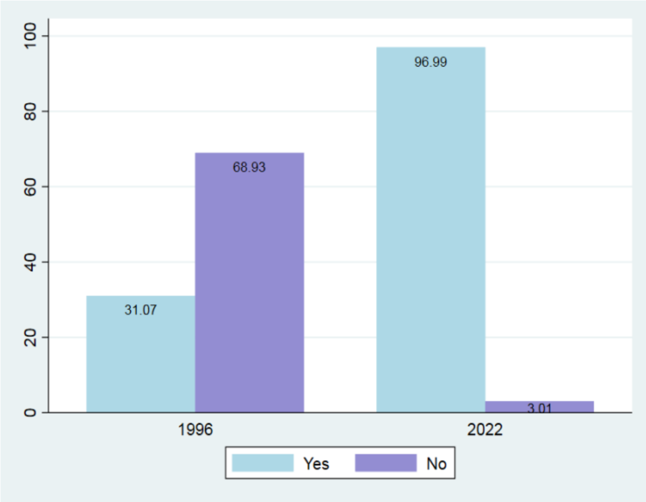

Figure 2.5: Distribution of the answers on the item "choosing to reuse or repair things rather than throw them away", %[6]

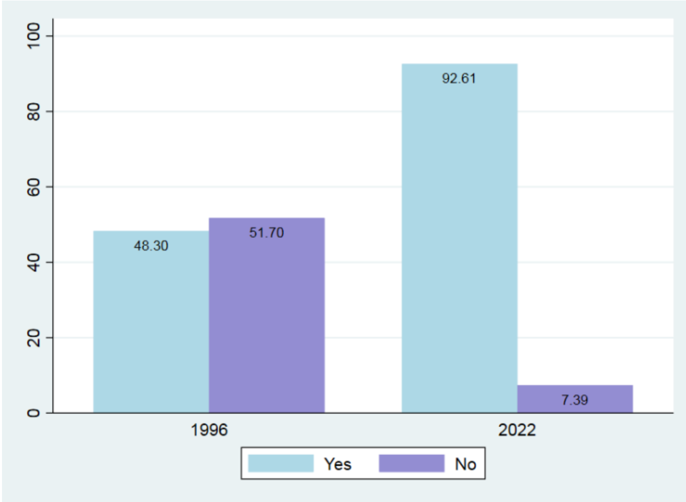

Figure 2.6: Distribution of the answers on the item "choosing to save or reuse water at home", %[7]

Source: author's construction based on the surveys data.

As follows from figs. 2.5, 2.6 and 2.7, there are positive trends in pro-active sustainable consumption behaviors of the population in 2022 against the previous years. The share of people who engage in reusing and repair of things increased from 31.07% in 1996 to 96.99% in 2022. The percentage of people who save or reuse water at home rose from 48.30% in 1996 to 92.61% in 2022. In addition, more people started saving energy at home in 2022 as compared to 2010. On the one hand, these trends show that the population in Belarus is getting more and more responsible in terms of resource using. On the other hand, from these descriptive statistics we can't infer whether these changes are happening primarily because of the increase in environmental awareness of the population or due to the external economic conditions that affect financial well-being of the people.

[6] The comparison question in the 1996 survey is "Have you decided for environmental reasons to reuse or recycle something rather than throw it away in the last 12 months, out of concern for the environment?".

[7] The comparison question in the 1996 survey is "Have you tried to reduce water consumption for environmental reasons in the last 12 months?".

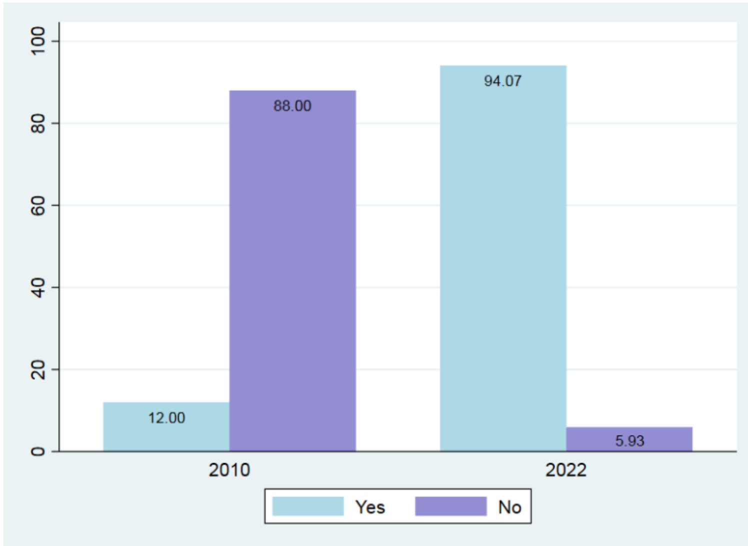

Figure 2.7: Distribution of the answers on the item “reducing the energy used at home”, %[8]
Source: authors’ construction based on the surveys data.

Next; the category of promotional sustainable consumption behavior can really reflect the environmental awareness of people as it cannot be motivated by some external conditions or factors not connected with the care about the environment. There is a tenfold increase in engagement in this kind of behavior in 2022 against 1996, as follows from fig. 2.8.

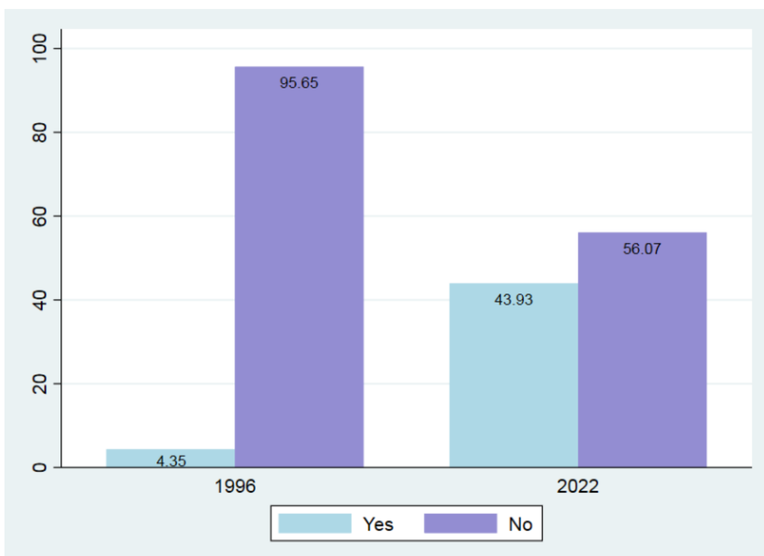

Figure 2.8: Distribution of the answers on the item “participating in activities organized by environmental groups (organizations) to mitigate environmental problems”, %[9]
Source: authors’ construction based on the surveys data.

[8] The comparison question in the 2010 survey is “Which of the following actions aimed at fighting climate change have you personally taken? **Reduced energy consumption at home** (e.g. turning down air conditioning or heating, not leaving appliances on standby, buying energy efficient products, such as low-energy light bulbs or appliances).

[9] The comparison question in the 1996 survey is “Have you attended a meeting or signed a letter or petition aimed at protecting the environment in the last 12 months?”.

2.4.2 STRUCTURAL EQUATION MODELS

2.4.2.1 SUSTAINABLE CONSUMPTION BEHAVIOR MODEL (BASIC VERSION)

Validity and reliability of constructs

As the first step, this study conducts a confirmatory factor analysis (CFA) to verify the proposed theoretical constructs. Preliminary results show that one item for environmental beliefs has loadings lower than is considered acceptable (standardized loadings should be equal to or above 0.4 (Mehmetoglu and Jakobsen, 2017)). It is eliminated from the further analysis. The final CFA demonstrates an acceptable model fit, as shown in table 2.1.

Table 2.1: Fit indices of the measurement model[10]

Fit statistic	Value	Acceptable value[a]
Minimum discrepancy per degree of freedom (x^2/df)	2.68	< 3.00
Standardized root mean squared residual (SRMR)	0.040	< 0.1
Root mean squared error of approximation (RMSEA)	0.040	< 0.08
Comparative fit index (CFI)	0.976	>= 0.9
Tucker-Lewis index (TLI)	0.965	>= 0.9

Note: [a] based on Kline (2016), Mehmetoglu and Jakobsen (2017).

The chi-squared (x^2) test for the goodness of fit of our model is significant (x^2=168.91; df=63; p=0.000). The literature agrees that the x^2 statistic is very sensitive to sample sizes, it has a tendency to be statistically significant in large samples (Bagozzi and Yi, 2012; Mehmetoglu and Jakobsen, 2017). In this regard, the x^2 statistic per degree of freedom is considered to be more informative. In our model it indicates a good fit staying below the recommended value of 3.00 (Kline, 2016). It is recommended to examine a number of other goodness-of-fit measures as the validity of the x^2 is quite disputable (Mehmetoglu and Jakobsen, 2017). The other fit indices (SRMR=0.040; RMSEA=0.040; CFI=0.976; TLI=0.965) signal a very good model fit (table 2.1).

Table 2.2 demonstrates the maximum-likelihood estimates of the fully standardized factor loadings and well-established validity and reliability measures. The squared factor loading indicates the amount of the variance in an indicator explained by a latent construct and can be considered as a measure of an indicator reliability (Mehmetoglu and Jakobsen, 2017). It is generally recommended to include indicators in CFA/SEM that have standardized factor loadings equal to or above 0.4 (Mehmetoglu and Jakobsen, 2017). In our model there is one item which has a factor loading a bit lower than 0.4 (AB_rep). As its value is very close to 0.4 (0.395) and other reliability and validity measures of the

[10] The Stata codes are presented in the Appendix A.

factor AB are good, we have decided to keep this item. Factor reliability refers to the proportion of the true variance in the latent variable formed by a set of indicators (Mehmetoglu and Jakobsen, 2017). It is usually measured by a Cronbach's alpha coefficient, which values of 0.6-0.7 are an acceptable level of reliability (Nunnaly and Bernstein, 1994; Pallant, 2001; Ursachi et al., 2015). Another measure of the factor reliability is Raykov's (1997) reliability coefficient (RRC) (composite reliability). Composite reliability values between 0.6 and 0.7 are considered to be acceptable while values higher than 0.7 are preferred (Hair et al., 2021). As table 2 shows, both Cronbach's alpha and RRC values are between 0.660 and 0.884, which indicates a good level of factor reliabilities. Moreover, it's important to examine convergent and discriminant validity of latent variables. The average variance extracted (AVE) equal to or higher than 0.5 shows that the latent variable explains at least 50% of variance in its indicators and demonstrates that convergent validity is achieved. In our model, all the factors have the average variance extracted equal to or higher than 0.5. Discriminant validity refers to the distinctiveness of latent variables. According to the Fornell-Larcker (1981) criterion, the correlation between a latent variable and its indicators expressed as the square root of AVE should be higher than its correlation with any other latent variable in the model for discriminant validity to be achieved. As follows from table 2.2, the square root of AVE (diagonal) for each latent variable is greater than the correlation for each pair of latent variables (off-diagonal). It means that all the latent variables in our model exhibit discriminant validity. As our CFA model is correctly specified, we can now proceed to the latent path analysis.

Table 2.2: Factor loadings and reliability and validity measures of the CFA to verify the measurement model

Factors	Items	Factor load.	Reliability		Conv. valid.	Discriminant validity				
			Cron-bach's α	RRC[b]	AVE	CM	EB	SE	AB	PB
CM	CM_TV	0.583	0.722	0.884	0.500	**0.707**				
	CM_new	0.840								
	CM_rad	0.679								
	CM_Int	0.704								
EB	EB1	0.705	0.660	0.668	0.503	0.089	**0.709**			
	EB3	0.713								
SE	SE1	0.717	0.708	0.710	0.550	0.251	0.446	**0.742**		
	SE2	0.765								
AB	AB_rep	0.395	0.755	0.809	0.583	0.170	0.297	0.275	**0.764**	
	AB_en	0.890								
	AB_wat	0.895								
PB	PB_part	0.591	0.778	0.741	0.555	0.351	0.285	0.513	0.392	**0.745**
	PB_sear	0.823								
	PB_disc	0.799								
Benchmark		0.4	0.6	0.6	0.5					

Note: [b] Raykov's reliability coefficient.

An overview of the descriptive statistics of all presented indicators and their codes are given in Table A.2 in the Appendix A.

CM – climate change media use; CM_TV – exposure to climate change coverage on TV; CM_new – exposure to climate change coverage on the newspapers; CM_rad – exposure to climate change coverage on the radio; CM_Int – exposure to climate change coverage on the Internet; EB – environmental beliefs; EB1 – environmental belief 1 (humans are severely abusing the environment); EB3 – environmental belief 3 (if things continue on their present course, we will soon experience a major ecological catastrophe); SE – environmental self-efficacy; SE1 – environmental self-efficacy item 1 (I believe that I have the ability to take action to help the environment); SE2 – environmental self-efficacy item 2 (I can still change my behavior to be more environmentally-friendly, even when it costs more money or takes more time); AB – pro-active sustainable consumption behavior; AB_rep – choosing to reuse or repair things rather than throwing them away; AB_en – reducing the energy or fuel used at home; AB_wat – choosing to save or reuse water; PB – promotional and accommodating sustainable consumption behavior; PB_part – participating in activities organized by environmental groups (organizations) to mitigate environmental problems; PB_sear – searching for information about environmental problems or sustainable lifestyle; PB_disc – discussing information about environmental problems or sustainable lifestyle with others.

Assessment of the proposed model and hypotheses

Now the study proceeds to the estimation of the SEM model. As in the case with the CFA model, the x^2 statistic for the SEM model is significant (x^2=168.91; df=63; p=0.000). At the same time, all the other fit indices provide evidence of a good model fit (x^2/df=2.68; SRMR=0.040; RMSEA=0.040; CFI=0.976; TLI=0.965). Fig. 2.9 shows the path diagram with maximum-likelihood estimates of fully standardized coefficients. Table 2.3 presents not only the direct effects as in fig 2.9 but also includes the indirect effects. The SEM explains 19.26% of the variance in pro-active sustainable consumption behavior and 32.06% of the variance in promotional and accommodating behaviors.

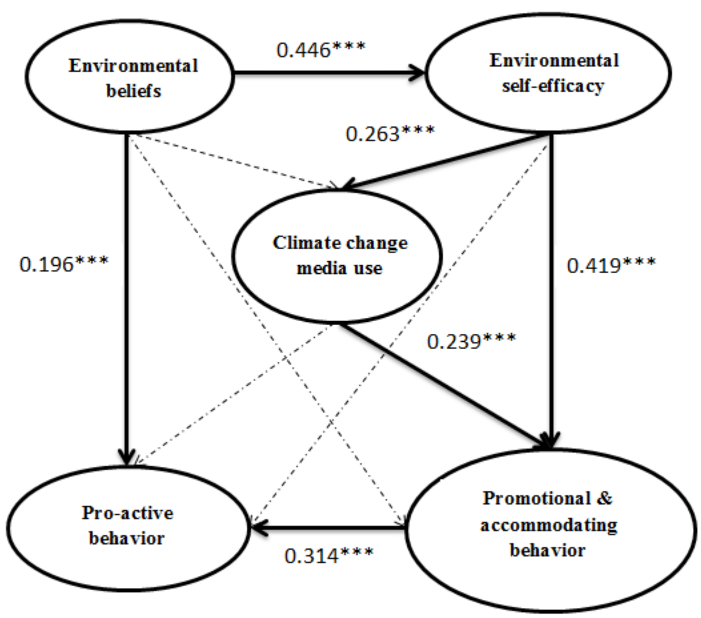

Figure 2.9: Path diagram of the structural equation model explaining sustainable consumption behavior (basic version)

Note: standardized coefficients; solid line – significant path; *** p<0.001, ** p<0.01; *p<0.05.

Table 2.3: Estimates of the structural equation model explaining sustainable consumption behavior[11]

Path	Model (standardized coefficients)	
	Direct effects	Indirect[12] effects
Environmental beliefs ⟶ Pro-active behavior	0.196*** (0.045)	0.101***
Environmental self-efficacy ⟶ Pro-active behavior	0.019 (0.055)	0.161***
Climate change media use ⟶ Pro-active behavior	0.037 (0.034)	0.075***
Promotional & accommodating behavior ⟶ Pro-active behavior	0.314*** (0.044)	
Environmental beliefs ⟶ Promotional & accommodating beh.	0.077 (0.045)	0.209***
Environmental self-efficacy ⟶ Promotional & accommodating beh.	0.419*** (0.044)	0.063***
Climate change media use ⟶ Promotional & accommodating beh.	0.239*** (0.032)	
Environmental beliefs ⟶ Climate change media use	-0.026 (0.045)	0.117***
Environmental self-efficacy ⟶ Climate change media use	0.263*** (0.042)	
Environmental beliefs ⟶ Environmental self-efficacy	0.446*** (0.040)	
Overall R^2	0.700	
Pro-active behavior	0.193	
Promotional & accommodating behavior	0.321	
Climate change media use	0.064	
Environmental self-efficacy	0.199	
Fit indices		
x^2	168.91	
df	63	
p	0.000	

[11] The Stata codes are presented in the Appendix A.
[12] The indirect effects are included only if they are statistically significant or at least the pathway along which they arise is statistically significant.

x^2/df	2.68
SRMR	0.040
RMSEA	0.040
CFI	0.976
TLI	0.965

Note: standardized coefficients; *** p<0.001, ** p<0.01; *p<0.05; standard errors in parentheses.

For the 1st research question the results (table 2.3 and Fig. 2.9) do not support our main hypothesis **H1-1** that climate change media use positively affects pro-active sustainable consumption behavior (*b*=0.037; p>0.05). However, main hypothesis **H1-2** is confirmed as climate change media use exerts a statistically significant effect on promotional and accommodating actions (*b*=0.239; p<0.001). According to Mehmetoglu and Jakobsen (2017), if standardized beta coefficients are larger than 0.2, it is an indication of a large effect. Climate change media use positively influences promotional and accommodating behavior, and this behavior positively predicts pro-active actions (*b*=0.314; p<0.001; **H1-10**). Thus, climate change media use still makes an indirect positive influence on pro-active behavior through promotional and accommodating behavior**.** The indirect effect of climate change media use on pro-active behavior is equal to 0.075 standard deviation change and is statistically significant at the 0.001 level.

Now we proceed to examining the results regarding the set of hypotheses about the influence of environmental beliefs and self-efficacy on sustainable consumption behavior. Hypothesis **H1-3** stating that environmental beliefs positively influence pro-active sustainable consumption behavior is confirmed by our findings (*b*=0.196; p<0.001). But hypothesis **H1-4** about the positive effect of these beliefs on promotional and accommodating behavior cannot be supported (*b*=0.077; p>0.05). Nevertheless, they still influence this behavior indirectly (*b*=0.209; p<0.001). As regards environmental self-efficacy, the results are the opposite as compared to environmental beliefs. It positively affects promotional and accommodating behavior (*b*=0.419; p<0.001) but does not exert any direct influence on pro-active actions (*b*=0.019; p>0.05). The indirect effect of environmental self-efficacy on pro-active actions is equal to 0.161 standard deviation change and is statistically significant at the 0.001 level. Thus, the findings confirm hypothesis **H1-6** but do not support hypothesis **H1-5.**

The next set of hypotheses expects a positive effect of environmental beliefs and self-efficacy on climate change media use. The findings partially support these effects. Environmental self-efficacy positively impacts climate change media use (*b*=0.263; p<0.001) but there is no evidence of the influence from environmental beliefs (*b*= -0.026; p>0.05). Therefore, out of hypotheses **H1-7** and **H1-8,** only **H1-8** can be confirmed. Hypothesis **H1-9** that environmental beliefs enhance environmental self-efficacy finds strong support by the results (*b*=0.446; p<0.001). All in all, 6 out of 10 hypotheses for this model can be supported.

2.4.2.2 SUSTAINABLE CONSUMPTION BEHAVIOR MODEL (EXTENDED VERSION)

Validity and reliability of constructs

In order to answer the 2nd research question we extend our sustainable consumption model by adding consumerism media use to it and repeat the CFA and SEM analysis again. Despite the significance of the x^2 statistic (x^2=320.60; df=108; p=0.000), the fit indices prove that the measurement model is very good (table 2.4).

Table 2.4: Fit indices of the measurement model [13](extended version)

Fit statistic	Value	Acceptable value[c]
Minimum discrepancy per degree of freedom (x^2/df)	2.97	< 3.00
Standardized root mean squared residual (SRMR)	0.053	< 0.1
Root mean squared error of approximation (RMSEA)	0.044	< 0.08
Comparative fit index (CFI)	0.970	>= 0.9
Tucker-Lewis index (TLI)	0.958	>= 0.9

Note: [c] based on Kline (2016), Mehmetoglu and Jakobsen (2017).

The maximum-likelihood estimates of the fully standardized factor loadings and validity and reliability measures are shown in table 2.5. As in the case with the basic version of the sustainable consumption model, the item AB_rep has a factor loading a bit lower than recommended 0.4. Since all the other reliability and validity measures for the latent variable AB are good, we have decided to keep the item AB_rep. Table 2.5 illustrates that factor reliabilities are achieved for all constructs included in the model as both Cronbach's alpha and RRC values are above 0.6. With regard to convergent validity, all the factors except for CM (*climate change media use*) and CN (*consumerism media use*) have the AVE equal to or higher than 0.5. According to Fornell and Larcker (1981), when the AVE is less than 0.5 but the latent variable exhibits the composite reliability higher than 0.6 (as in our case), the convergent validity of the latent variable is adequate. Discriminant validity is observed for all constructs in the model. The following section proceeds with the latent path analysis.

[13] The Stata codes are presented in the Appendix A.

Table 2.5: Factor loadings and reliability and validity measures of the CFA to verify the measurement model (extended version)

Factors	Items	Factor load.	Reliability		Conv. valid.	Discriminant validity					
			Cronbach's α	RRC[d]	AVE	CM	CN	EB	SE	AB	PB
CM	CM_TV	0.685	0.722	0.620	0.442	**0.665**					
	CM_new	0.767									
	CM_rad	0.646									
	CM_Int	0.541									
CN	CN_TV	0.836	0.714	0.836	0.472	0.621	**0.687**				
	CN_new	0.769									
	CN_rad	0.646									
	CN_Int	0.424									
EB	EB1	0.711	0.660	0.667	0.503	0.084	0.000	**0.709**			
	EB3	0.707									
SE	SE1	0.706	0.708	0.751	0.548	0.164	0.000	0.455	**0.740**		
	SE2	0.772									
AB	AB_rep	0.395	0.755	0.809	0.583	0.122	0.000	0.297	0.276	**0.764**	
	AB_en	0.890									
	AB_wat	0.895									
PB	PB_part	0.577	0.778	0.705	0.547	0.303	0.114	0.290	0.500	0.386	**0.740**
	PB_sear	0.818									
	PB_disc	0.799									
Benchmark		0.4	0.6	0.6	0.5						

Note: [d] Raykov's reliability coefficient.

An overview of the descriptive statistics of all presented indicators and their codes are given in Table A.2 in the Appendix A.

CM – climate change media use; CM_TV – exposure to climate change coverage on TV; CM_new – exposure to climate change coverage on the newspapers; CM_rad – exposure to climate change coverage on the radio; CM_Int – exposure to climate change coverage on the Internet; CN – consumerism media use; CN_TV – exposure to the information promoting luxurious lifestyle on TV; CN_new – exposure to the information promoting luxurious lifestyle on the newspapers; CN_rad – exposure to the information promoting luxurious lifestyle on the radio; CN_Int – exposure to the information promoting luxurious lifestyle on the Internet; EB – environmental beliefs; EB1 – environmental belief 1 (humans are severely abusing the environment); EB3 – environmental belief 3 (if things continue on their present course, we will soon experience a major ecological catastrophe); SE – environmental self-efficacy; SE1 – environmental self-efficacy item 1 (I believe that I have the ability to take action to help the environment); SE2 – environmental self-efficacy item 2 (I can still change my behavior to be more environmentally-friendly, even when it costs more money or takes more time); AB – pro-active sustainable consumption behavior; AB_rep – choosing to reuse or repair things rather than throwing them away; AB_en – reducing the energy or fuel used at home; AB_wat – choosing to save or reuse water; PB – promotional and accommodating sustainable consumption behavior; PB_part – participating in activities organized by environmental groups (organizations) to mitigate environmental problems; PB_sear – searching for information about environmental problems or sustainable lifestyle; PB_disc – discussing information about environmental problems or sustainable lifestyle with others.

Assessment of the proposed model and hypotheses

Except for the x^2 statistic, the other fit indices signal that the model fits the data well (table 2.6). After extending the sustainable consumption behavior model by adding to it *consumerism media use*, all relationships from the basic model still hold (table 2.6). That proves that the sustainable consumption behavior model is robust. The relationships to test added to the basic version of the model are marked in bold in table 2.6. The main hypotheses (**H1-1e** and **H1-2e**) that consumerism media use negatively affects pro-active behavior (b= -0.025; p>0.05) and promotional and accommodating behavior (b= -0.044; p>0.05) cannot be supported. Although these main hypotheses cannot be confirmed, the small negative influence of consumerism media use on pro-active sustainable consumption behavior is realized through the following channel. In the basic model the indirect positive effect of climate change media on pro-active behavior equals to 0.075 standard deviation change and is statistically significant at the 0.001 level. After adding consumerism media use to the model, this positive impact of climate change media use decreases a bit from 0.075 to 0.074 standard deviation change being statistically significant at 0.01 level. The findings do not support hypothesis **H1-11** that consumerism media use exerts a negative effect on climate change media use (b=0.205; p>0.05). However, hypothesis **H1-12** stating that climate change media use positively affects consumerism media use is confirmed (b=0.491; p<0.001).

Table 2.6: Estimates of the structural equation model explaining sustainable consumption behavior[14] (extended version)

Path	Model (standardized coefficients)	
	Direct effects	Indirect[15] effects
Environmental beliefs ⟶ Pro-active behavior	0.192*** (0.045)	0.105***
Environmental self-efficacy ⟶ Pro-active behavior	0.018 (0.055)	0.162***
Climate change media use ⟶ Pro-active behavior	0.065 (0.045)	0.074**
Consumerism media use ⟶ Pro-active behavior	-0.025 (0.038)	
Promotional & accommodating behavior ⟶ Pro-active behavior	0.311*** (0.044)	
Environmental beliefs ⟶ Promotional & accommodating beh.	0.075 (0.046)	0.217***

[14] The Stata codes are presented in the Appendix A.
[15] The indirect effects are included only if they are statistically significant or at least the pathway along which they arise is statistically significant.

Environmental self-efficacy ⟶ Promotional & accommodating beh.	0.419*** (0.045)	0.059***
Climate change media use ⟶ Promotional & accommodating beh.	0.254*** (0.044)	
Consumerism media use ⟶ Promotional & accommodating beh.	-0.044 (0.039)	
Environmental beliefs ⟶ Climate change media use	-0.002 (0.045)	0.116***
Environmental self-efficacy ⟶ Climate change media use	0.230*** (0.048)	
Consumerism media use ⟶ Climate change media use	0.205 (0.139)	
Climate change media use ⟶ Consumerism media use	0.491*** (0.112)	
Environmental beliefs ⟶ Environmental self-efficacy	0.455*** (0.040)	
Overall R^2	0.758	
Pro-active behavior	0.194	
Promotional & accommodating behavior	0.316	
Climate change media use	0.270	
Consumerism media use	0.380	
Environmental self-efficacy	0.207	
Fit indices		
x^2	306.59	
df	106	
p	0.000	
x^2/df	2.89	
SRMR	0.046	
RMSEA	0.043	
CFI	0.972	
TLI	0.959	

Note: standardized coefficients; *** p<0.001, ** p<0.01; *p<0.05; standard errors in parentheses.

2.4.2.3 UNSUSTAINABLE CONSUMPTION BEHAVIOR MODEL

Validity and reliability of constructs

As in the case with the sustainable consumption model, first, CFA is conducted to verify the measurement model. Although the x^2 statistic is significant (x^2=128.49; df=44; p=0.000), all the other indices signal a very good model fit (table 2.7).

Table 2.7: Fit indices of the measurement mode[16]

Fit statistic	Value	Acceptable value[e]
Minimum discrepancy per degree of freedom (x^2/df)	2.92	< 3.00
Standardized root mean squared residual (SRMR)	0.038	< 0.1
Root mean squared error of approximation (RMSEA)	0.043	< 0.08
Comparative fit index (CFI)	0.966	>= 0.9
Tucker-Lewis index (TLI)	0.949	>= 0.9

Note: [e] based on Kline (2016), Mehmetoglu and Jakobsen (2017).

Table 2.8 shows the maximum-likelihood estimates of the fully standardized factor loadings and validity and reliability measures. All items have loadings on their expected factors higher than 0.4, which ensures indicators reliability. As follows from table 2.8, both Cronbach's alpha and RRC values are above 0.6. That signals an acceptable level of factor reliabilities. As regards convergent validity, two of our latent variables (*consumerism media use* and *materialistic values*) exhibit AVE lower than 0.5. Nevertheless, as their composite reliability (RRC) is higher than 0.6, their convergent reliability is considered to be adequate (Fornell and Larcker, 1981). The results in table 2.8 show that all the latent variables in our model exhibit discriminant validity. As our CFA model is correctly specified, we can now proceed to the latent path analysis.

Table 2.8: Factor loadings and reliability and validity measures of the CFA to verify the measurement model

Factors	Items	Factor load-ings	Reliability		Conv. valid.	Discriminant validity			
			Cron-bach's α	RRC[f]	AVE	CN	MV	SE	UB
CN	CN_TV	0.546	0.714	0.811	0.471	**0.686**			
	CN_new	0.876							

[16] The Stata codes are presented in the Appendix A.

	CN_rad	0.604							
	CN_Int	0.673							
MV	MV1	0.470	0.680	0.619	0.424	0.170	**0.651**		
	MV2	0.912							
	MV3	0.469							
SE	SE1	0.812	0.708	0.711	0.557	0.110	0.000	**0.746**	
	SE2	0.675							
UB	UB_h	0.908	0.677	0.806	0.517	0.164	0.277	0.000	**0.719**
	UB_el	0.670							
	UB_lux	0.528							
Benchmark		0.4	0.6	0.6	0.5				

Note: [f] Raykov's reliability coefficient.
An overview of the descriptive statistics of all presented indicators and their codes are given in Table A.2 in the Appendix A.
CN – consumerism media use; CN_TV – exposure to the information promoting luxurious lifestyle on TV; CN_new – exposure to the information promoting luxurious lifestyle on the newspapers; CN_rad – exposure to the information promoting luxurious lifestyle on the radio; CN_Int – exposure to the information promoting luxurious lifestyle on the Internet; MV – materialistic values; MV1 – materialistic value 1 (I admire people who own expensive homes, cars, and clothes); MV2 – materialistic value 2 (I like a lot of luxury in my life); MV3 – materialistic value 3 (I'd be happier if I could afford to buy more things); SE – environmental self-efficacy; SE1 – environmental self-efficacy item 1 (I believe that I have the ability to take action to help the environment); SE2 – environmental self-efficacy item 2 (I can still change my behavior to be more environmentally-friendly, even when it costs more money or takes more time); UB – unsustainable consumption behavior; UB_h – updating your household appliances to the best models on the market; UB_el – updating your electronic devices to the newer models (your mobile phone, TV, computer) on the market; UB_lux – buying luxury products (for example, brand-name clothing, gold or diamond jewelry, expensive cosmetic of foreign brands).

Assessment of the unsustainable consumption behavior model and the related hypotheses

This study proceeds by estimating the structural equation model for unsustainable consumption behavior. This model exhibits an adequate fit[17] (x^2/df=2.99; SRMR=0.037; RMSEA=0.044; CFI=0.967; TLI=0.947). Fig. 2.10 shows the path diagram with maximum-likelihood estimates of fully standardized coefficients. The results are also presented in table 2.9.

The results (table 2.9 and fig. 2.10) support our main hypothesis **H2-1** for the 3rd research question that consumerism media use has a positive effect on unsustainable consumption behavior (*b*=0.124; p<0.001). If standardized beta coefficients are between 0.09 and 0.2, it is an indication of a moderate effect (Mehmetoglu and Jakobsen, 2017). The evidence shows that materialistic values make a positive influence on unsustainable consumption behavior (*b*=0.249; p<0.001). As it has been expected, materialistic values also exert a positive and statistically significant effect on consumerism media use

[17] The x^2 statistic for the goodness of fit of the model is significant (x^2=125.57; df=42; p=0.000).

(*b*=0.165; p<0.001). Thus, hypotheses **H2-2** and **H2-3** are also confirmed. The results do not show any effect of materialistic values on environmental self-efficacy (*b*=0.065; p>0.05). Therefore, hypothesis **H2-4** cannot be accepted. As regards the impact of environmental self-efficacy, contrary to our expectations, it has a positive effect on consumerism media use but it is statistically significant only at the 0.05 level (*b*=0.097;p<0.05). Environmental self-efficacy negatively impacts unsustainable consumption behavior but this effect is not statistically significant (*b*= -0.004; p>0.05). Hypotheses **H2-5** and **H2-6** cannot be confirmed. All in all, 3 out 6 hypotheses for this model can be supported.

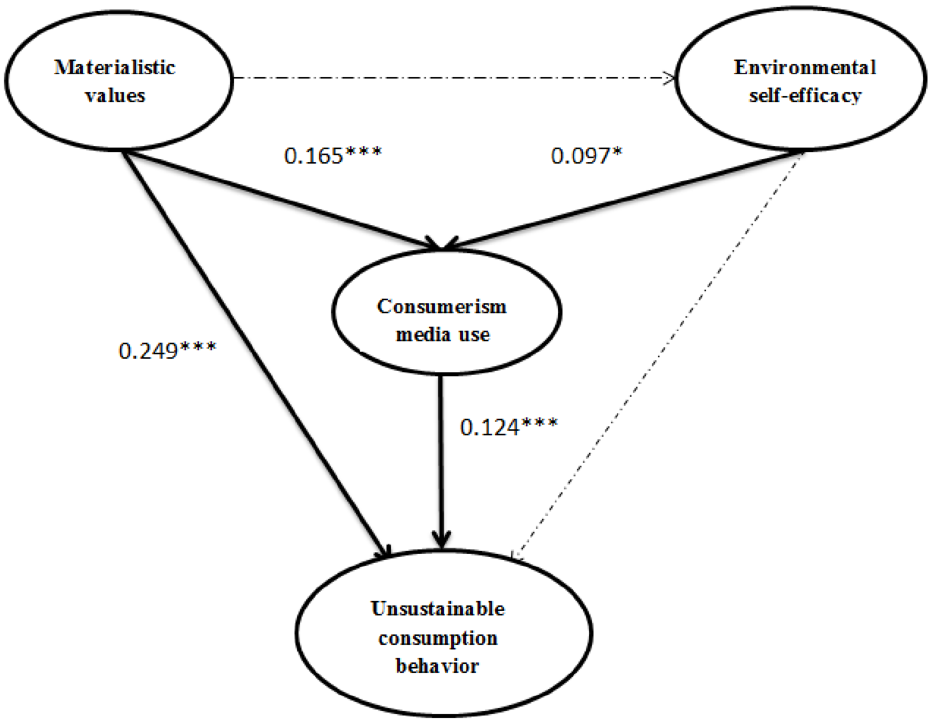

Figure 2.10: Path diagram of the structural equation model explaining unsustainable consumption behavior

Note: standardized coefficients; solid line – significant path; *** p<0.001, ** p<0.01; *p<0.05.

Table 2.9: Estimates of the structural equation model explaining unsustainable consumption behavior[18]

Path	Model (standardized coefficients)	
	Direct effects	Indirect[19] effects
Materialistic values ⟶ Unsustainable behavior	0.249*** (0.043)	0.021**
Environmental self-efficacy ⟶ Unsustainable behavior	-0.004 (0.039)	0.012

[18] The Stata codes are presented in the Appendix A.

[19] The indirect effects are included only if they are statistically significant or at least the pathway along which they arise is statistically significant.

Consumerism media use → Unsustainable behavior	0.124***
	(0.034)
Materialistic values → Consumerism media use	0.165***
	(0.036)
Environmental self-efficacy → Consumerism media use	0.097*
	(0.047)
Materialistic values → Environmental self-efficacy	0.065
	(0.036)
Overall R^2	0.883
Unsustainable consumption behavior	0.088
Consumerism media use	0.039
Environmental self-efficacy	0.004
Fit indices	
x^2	125.57
df	42
p	0.000
x^2/df	2.99
SRMR	0.037
RMSEA	0.044
CFI	0.967
TLI	0.947

Note: standardized coefficients; *** p<0.001, ** p<0.01; *p<0.05; standard errors in parentheses.

2.4.3 MULTI-GROUP ANALYSIS

The multi-group analysis is used to investigate variations of the same model between different groups (Newsom, 2020). It tests separate SEM models in two or more discrete groups (Jöreskog, 1971; Sorbörn, 1974). The objective of this analysis often referred to as invariance testing is to examine whether parameters are equivalent across groups (Newsom, 2020). For the extended version of the sustainable consumption behavior model group differences are explored by[20]:

(1) gender: group 1(male), and group 2 (female);
(2) age: group 1(18-30), group 2(31-50), and group 3 (51 and older);
(3) education: group 1 (<higher education), and group 2 (higher education);
(4) region: group 1 (all regions except Minsk region), and group 2 (Minsk region);

[20] The Stata codes are presented in the Appendix A.

(5) income: group 1 (up to 1350 BYR), group 2 (1351-1800 BYR), and group 3 (1801 BYR and more).

The groups are constructed in such a way as to ensure that the SEM model tested in each group is based on a sample size of at least 200 individuals as suggested by Kline (2016). The multi-group analysis is performed to test whether the structural coefficients of the SEM models differ across groups within each category (gender, age, education, regions, income). Wald tests are reported for the structural coefficients that are not constraint. The null hypothesis says that the constraint would be valid (i.e., parameters should be constrained to be equal across groups) (Acock, 2013).

The structural coefficients and the Wald tests results for the multi-group analysis of the extended sustainable consumption behavior model are presented in table A.3 in the Appendix A. There are no statistically significant differences between structural coefficients in gender models. However, one thing worth drawing attention to is that the effect size of climate change media use on promotional and accommodating behavior is bigger for males (*b*=0.324; p<0.001) than for females (*b*=0.198; p<0.001). According to Mehmetoglu and Jakobsen (2017), if standardized beta coefficients are less than or equal to 0.09, it is an indication of a small effect. If they are between 0.09 and 0.2, it signals a moderate effect. When they are larger than 0.2, it is an indication of a large effect (Mehmetoglu and Jakobsen, 2017). Thus, the effect of climate change media use on promotional and accommodating behavior is large for men and moderate for women.

In age models (table A.3 in the Appendix A) statistically significant differences can be found in the impacts of promotional and accommodating behavior on pro-active behavior (Wald statistics: x^2=8.616; p=0.014), environmental self-efficacy on pro-active behavior (Wald statistics: x^2=7.005; p=0.030), and consumerism media use on pro-active behavior (Wald statistics: x^2=5.490; p=0.064). Out of three age groups, the impact of promotional and accommodating behavior on pro-active behavior is the strongest among individuals aged 18-30 (*b*=0.477; p<0.001), the effect among people in the age 31-50 is also large (*b*=0.335; p<0.001). But there is no statistically significant effect of promotional and accommodating actions on pro-active behavior among people who are 51 and older (*b*=0.055; p>0.05). In the sustainable consumption behavior model not tested in different age groups environmental self-efficacy does not exert statistically significant influence on pro-active behavior. In the age models, this relationship holds for individuals aged 31-50 (*b*=0.047; p>0.05) and for people aged 51 and older (*b*=0.182; p>0.05). At the same time, there is a statistically significant negative effect among younger people (18-30 years old) (*b*= -0.256; p<0.05). In this regard, it is interesting to point out that this younger group also differs in the effect of environmental self-efficacy on climate change media use. Unlike in the models for individuals aged 31-50 (*b*=0.201; p<0.001) and for consumers in the age of 51 and older (*b*=0.297; p<0.01), environmental self-efficacy does not exert statistically significant effect on climate change media use for people 18-30 years old (*b*=0.280; p>0.05).

In education models (table A.3 in the Appendix A) statistically significant differences can be observed in the effects of promotional and accommodating actions on pro-active behavior (Wald statistics: x^2=3.174; p=0.075), consumerism media use on pro-active behavior (Wald statistics: x^2=3.008; p=0.083), and environmental self-efficacy on promotional and accommodating activities (Wald statistics: x^2=2.943; p=0.086). The impact of promotional and accommodating actions on pro-active behavior is larger by individuals without higher education (*b*=0.380; p<0.001) than by consumers with higher education (*b*=0.247; p<0.001). It is interesting to note that the positive influence of climate change media use on consumerism media use present in the general sustainable consumption behavior model holds only for people without higher education (*b*=0.625; p<0.001). For individuals with higher education the association goes into the opposite direction with consumerism media use positively affecting climate change media use (*b*=0.423; p<0.001).

In region models (table A.3 in the Appendix A) there are differences in the impacts of consumerism media use on pro-active behavior (Wald statistics: x^2=4.162; p=0.041) and environmental beliefs on self-efficacy (Wald statistics: x^2=4.678; p=0.031). Besides, climate change media use positively affects consumerism media use in all regions except for Minsk region (*b*=0.527; p<0.001). In Minsk region there are no statistically significant relationships in this case.

As for income models (table A.3 in the Appendix A), statistically significant differences can be found in the effects of environmental self-efficacy on pro-active behavior (Wald statistics: x^2=5.219; p=0.074) and consumerism media use on climate change media use (Wald statistics: x^2=6.253; p=0.044). It is worth drawing attention to the fact that consumerism media use exerts statistically significant positive influence climate change media use only among people with the highest income level (group 3) (*b*=0.757; p<0.01). For people with the income close to national average (group 2) and lower (group 1) climate change media positively affects consumerism media use (*b*=0.461; p<0.01 for group 2; *b*=0.694; p<0.001 for group 1).

For the unsustainable consumption behavior model, multi-group analysis is conducted by gender, education, and region. The groups within these categories are the same as for the sustainable consumption behavior model. Group differences are not explored by income and age because income and age models for unsustainable consumption behavior do not converge. The results of the multi-group analysis are presented in table A.4 in the Appendix A. There are no statistically significant differences in gender models. In the education models differences can be observed in the impacts of materialistic values on environmental self-efficacy (Wald statistics: x^2=11.028; p=0.001). For consumers without higher education materialistic values make a positive influence on self-efficacy (*b*=0.174; p<0.01), for individuals with higher education the influence is negative and not statistically significant (*b*= - 0.057; p>0.05). Besides, it is important to point out that consumerism media use positively affects unsustainable consumption behavior only in the sample without higher education (*b*=0.166; p<0.001). For people with higher education this effect is not statistically significant (*b*=0.084; p>0.05). According to Wald tests, region models are invariant.

2.5 DISCUSSION AND IMPLICATIONS

This study investigates how exposure to information through different media channels can influence behavior. The aim is to explore a realistic context in which the same individuals can be exposed to both climate change information as well as information promoting consumerism and to analyze how these two types of information can affect consumption behavior. From a policy perspective, the study provides a leverage point for governmental officials, businesses and non-profit organizations to change people's actions in the direction of sustainability.

The main findings from the basic version of sustainable consumption behavior model indicate that climate change media use makes a positive direct effect on promotional and accommodating actions (e.g., environmental civic engagement, searching for information about climate change, discussing it with others). Through them climate change media use exerts an indirect positive effect on pro-active behaviors (saving water, energy, repairing things). The results from the extended version of this model show that exposure to information promoting luxurious lifestyle and buying more stuff to be happy on the different media does not negatively affect pro-environmental behaviors. The positive indirect effect of exposure to information about climate change on pro-active behavior diminishes a bit when consumerism media use is accounted for in the model. The evidence from the unsustainable consumption behavior model demonstrates that exposure to information promoting overconsumption positively impacts unsustainable consumption behaviors (updating household appliances and electronic devices to the best models on the markets, buying luxury products). Moreover, if two models are compared, it becomes obvious that consumerism media use exerts a stronger positive effect on unsustainable behavior than climate change media use does on pro-active sustainable consumption activities.

The findings suggest that exposure to climate change information does not translate directly into pro-active sustainable actions but through promotional and accommodating activities. It means that first individuals need to engage with this information, i.e. discuss it with others, search for more information on similar topics, etc., and only after that they are ready to undertake some pro-environmental actions. The importance of social interactions in the form of promotional and accommodating activities is underpinned by the ideas from *Narrative Economics* (Shiller, 2020). According to Shiller (2020), in order to understand information people form it into stories and these stories are embedded in social interactions. And the contagion rate of these stories is to some extent the result of frequency of meetings among people. The results from the structural model on sustainable consumption behavior are supported by the research literature on the importance of environmental knowledge for sustainable consumption behaviors and intentions (e.g., Yadav and Pathak, 2016; Taneja and Ali, 2020; Saari et al., 2021; Kurowski et al., 2022). In some cases, for example in the context of Taiwan (Huang, 2016), global warming media use can directly affect pro-active environmental behavior. The fact that in the Belarusian context exposure to the information about climate change and environmental problems does not directly impact pro-active sustainable consumption behavior provides important insights. It indicates that, first, there is not enough information about climate change and environmental issues in the Belarusian media, second, this information might be of insufficient quality. As a result, the environmental awareness of the population is still at the beginning of its formation. According to Shaver's model of responsibility (1985), the acceptance of ecological responsibility to oneself stems from a general awareness of ecological risks and a belief in own abilities to decrease those risks. The function of the media should be to create this general awareness of important issues, including ecological risks. From a policy perspective, the results from the structural model on sustainable consumption behavior can be interpreted as follows. It is important to educate journalists on environmental topics so that they can bring these themes on the agenda more often and provide a more engaging narrative. That will eventually lead to a greater level of environmental awareness among the population and translate into pro-active sustainable consumption behaviors. For the population in Belarus, it is necessary to create opportunities to interact with climate change information more closely through, for example, activities including workshops and seminars organized by environmental non-profit entities. It follows from age models that the effect of promotional and accommodating activities on pro-active environmental behaviors is the strongest among the youngest population (18-30 years old). This evidence more broadly implies the necessity to provide education on climate change and sustainable living at university-, school, and kindergartner-levels. For younger groups in particular, more information via social media channels would also seem important.

As follows from the 2nd model, the impact of consumerism media use on unsustainable behaviors is stronger than the impact of climate change media use on pro-active sustainable behaviors. There are two channels leading to these particular findings – the emotions at play and the presentation of information. First, advertisements promoting luxurious lifestyle and buying more stuff to be happy can elicit quite strong emotions in consumers related to happiness and success in life. And these emotions can be stronger than the feelings evoked by the information about climate change which some consumers might consider quite abstract and difficult to relate personally. Around two decades ago a large body of literature in consumer research emerged on the role of emotions in decision-making (for an overview see Laros and Steenkamp, 2005). Recent experimental studies about adoption of sustainable innovations (e.g. Contzen et al., 2021 (a); Contzen et al., 2021 (b)) also proves the role emotions play in consumer behavior. Shiller (2020) argues that stories that stay longer in people's memory and can influence economic behavior are not only connected to the emotions attached but also involve social psychological factors, such as a shared identity with others. From a policy perspective, if governments really would like to promote a sustainable lifestyle among the population, they can start by downplaying the emotional appeal of these ads. For example, they can make it obligatory that advertisements include information about the negative footprint for the environment generated during the production (or the whole lifecycle) of the particular product they advertise. Second, it matters a lot how information is presented. Ideas often go unnoticed if they are not packaged well enough (Shiller, 2020). In this regard, climate change information usually loses away to information promoting overconsumption with its images of highly successful people using different goods. Good news is better accepted than bad news or moralizing; sustainable choices should be presented as positive for success and wellbeing. As has already been mentioned, information about climate change is often presented in a way that it is rather abstract and difficult to relate to personally. Machill et al. (2007) conducted an experiment about information presentation. It proves that the experimental presentation of information in the form of a story involving a protagonist (in their case – a baker suffering from health problems caused by air pollution) and antagonists (those who benefit from pollution activities) is retained better by the audience than an actual TV news report covering the dangers of air pollution. Tversky and Kahnemann (1981) and also Thaler (2015, 2016) point out the importance of framing, how a story is framed. An amusing story can get retold many times and so establish a reference point that will affect decisions (Shiller, 2020). From a policy perspective, it is useful to create engaging narratives about sustainable living taking into account the importance of framing and visual images to assist the audience with remembering a story.

Based on the evidence from the two structural models, this study finds that attitudinal factors such as values and beliefs turn out to be strong determinants of behavior. These findings are line with the ABC theory (Guagnano et al., 1995; Stern 2000) as well as the analytical framework from *Identity Economics* (Akerlof and Kranton, 2009). In the case of sustainable consumption, environmental beliefs exert a moderate positive direct effect on pro-active behavior (*b*=0.192 in the extended model; *b*=0.196 in the basic model). They also have a large indirect impact on promotional and accommodating behavior (*b*=0.217 in the extended model; *b*=0.209 in the basic model). This finding is supported by theory (Stern and Dietz, 1994; De Groot and Steg, 2010) as well as by empirical literature (van der Werff et al., 2014; Steg et al., 2014; Ruepert et al., 2017; Wang et al., 2021) on the relevance of environmental (biospheric) values/beliefs for pro-environmental behavior. For example, in Lithuania which shares a border with Belarus and is also a post-socialist country, environmental values are positively related to conservation pro-environmental behaviors (Balunde et al., 2019; Liobkiene et al., 2019). In the case of unsustainable consumption, materialistic values are a strong positive predictor of unsustainable behavior (*b*=0.249). This result is underpinned by the empirical literature on materialism and conspicuous, impulse and compulsive buying, which all are manifestations of unsustainable consumption (Chacko et al., 2018; Bhatia, 2019; Zakaria et al., 2021; Mueller et al., 2022).

An interesting finding is that environmental self-efficacy, which according to our analytical framework forms part of an individual's self-identity, exerts an indirect influence on pro-active sustainable consumption behavior through promotional and accommodating actions. This result once again points at the important role of promotional and accommodating behaviors. Through them environmental self-efficacy as well as climate change media use have an impact on pro-active behavior.

2.6. CONCLUSIONS AND SUGGESTIONS FOR FUTURE STUDIES

In the literature there are conflicting streams with regard to the effects of media use on consumption behavior. Some studies state that media use, in particular exposure to global warming information, is positively associated with pro-environmental behavior. Others show that media use, especially the

Internet, promotes overconsumption. Our study reproduces the real life conditions in which individuals can be simultaneously exposed to climate change information as well as information promoting consumerism through different media channels. The study develops and empirically tests two SEM models based on a representative sample of Belarusian consumers. To the best of our knowledge, this is the first research that assesses both the influence of climate change media use and consumerism media use on sustainable consumption behaviors in the same model. Besides, it estimates the impact of consumerism media use on unsustainable actions. In addition to that, this research makes insightful theoretical and empirical contributions that can be utilized for policy decisions. Alongside with the ABC theory (Guagnano et al., 1995; Stern 2000) the study applies the analytical framework from *Identity Economics* (Akerlof and Kranton, 2009) to develop its models showing that theories from different disciplines can complement and enrich each other. Following Huang (2016), this study shows that sustainable consumption behavior includes a variety of intent- and impact-oriented activities that can be classified into two groups of behavior (pro-active behavior and promotional and accommodating actions). Bringing these two groups of behavior into analysis improves the precision of the results.

The findings show that exposure to the climate change information in the different media has a positive and direct effect on promotional and accommodating actions and through them an indirect positive effect on pro-active sustainable behavior (1^{st} research question, 1^{st} model, basic version). Exposure to information promoting overconsumption does not affect sustainable consumption behaviors but decreases a bit the indirect positive effect of climate change media use on pro-active sustainable behavior (2^{nd} research question, 1^{st} model, extended version). Moreover, exposure to information promoting overconsumption exerts a positive and direct effect on unsustainable consumption behavior (3^{nd} research question, 2^{nd} model). If comparing the effect size from the two SEM models, it is evident that, on the one side, climate change media use makes a stronger effect on promotional and accommodating actions than consumerism media use does on unsustainable behavior. On the other side, the influence of consumerism media use on unsustainable activities is stronger than the impact of climate change media use on pro-active sustainable behaviors.

Various policy implications can be derived on the basis of the study results, aimed at changing consumer behavior in the direction of sustainability. The media is a powerful tool for promoting sustainable as well as unsustainable behaviors. To change the public discourse in the direction of sustainability, it is necessary to educate journalists and other media-based “influencers” about such topics as climate change, green economy, sustainable lifestyles, etc. It is important that they could provide more frequent content and of a higher quality regarding these themes. Information on climate change and sustainable lifestyles in different media should be presented and framed in a more engaging and memorable way so that the audience can personally relate. Non-governmental organizations and policy-makers should develop educational measures which allow the consumers to interact with climate change information more closely and on a more regular basis. Finally, advertising promoting overconsumption could be obliged to include information (accurate and visible) such as in EPDs (environmental product declarations) about the negative footprint for the environment generated by the product or service they advertise.

The findings of this study are statistically robust. At the same time, there is room for improvement. First of all, the measurements of behavior are self-reported, thus, they could be subject to error due to, for example, social desirability bias. Future studies may try to estimate the degree of social desirability to better account for the sources of this error or use more objective measures of behavior. Second, this study uses a three-item version of the Materialistic Values Scale. Although their reliability and validity levels in this research are still satisfactory, future studies may employ longer versions of the Materialistic Values Scale **(**a six-item or a nine-item one)**.** That may improve their levels of reliability and validity. Third, future studies can in addition conduct a content analysis of climate change coverage on the different media channels and compare it with a similar analysis based on a selection of ads promoting overconsumption on the same media channels. That will deepen the understanding of the media use influence on sustainable and unsustainable behaviors. Further: similar studies in other countries and contexts would provide useful comparative knowledge and understanding. Cultural and other differences may reveal different patterns and, in extension of that, different policies may be appropriate.

CHAPTER 3: CLEAN, COMPETITIVE, PRODUCTIVE? THE IMPACT OF ENVIRONMENTALLY FRIENDLY TECHNOLOGIES ON EXPORTING AND PRODUCTIVITY OF THE MANUFACTURING COMPANIES IN BELARUS

ABSTRACT

The impact of trade on environment is a big concern, with increasing focus on the role of international trade in climate change. This study explores the bidirectional relationships between exporting, adoption of environmentally friendly measures and productivity using the firm-level data from Belarus. It aims to answer whether exporting enterprises are more environmentally oriented and whether application of cleaner technologies brings productivity improvement and increases the export intensity of an enterprise. We estimate a system of structural equations using three-stage least squares in which exporting, adoption of environmentally friendly measures and productivity are by design treated as endogenous. The findings show that adoption of cleaner technologies positively affects the export intensity of a company and its labor productivity.

Keywords: exporters, international trade, productivity, adoption of environmentally friendly measures, three-stage least squares.

3.1 INTRODUCTION

The role of trade with regard to environment has always been controversial. The pollution haven hypothesis (McGuire, 1982; Pethig, 1976) has dominated the debate on trade openness and environment for an extensive period of time. It predicts that due to trade pollution-intensive industries can move to countries with not very stringent environmental regulations. One of the observed results of the pollution haven happening is carbon leakage, which is quite difficult to tackle on the international arena. For example, the European Union is now in the process of developing a carbon border adjustment mechanism (CBAM) which objective is to address “the risk of carbon leakage in order to fight climate change by reducing GHG emissions in the Union and globally” (European Commission, 2021, p. 3). The CBAM aims to guarantee that the price of imports reflects their carbon content (European Commission, 2021).

At the same time the tone of the debate on trade starts changing in the 1st decade of the 21st century. Levinson (2007) rejects the pollution haven hypothesis and concludes that trade is a sustainable way of environmental protection because it stimulates the application of cleaner technologies. Dean and Lovely (2008) and Antweiler et al. (2001) come to the similar conclusion. Theory also predicts that exporters have better environmental performance than non-exporters (see Batrakova and Davies, 2012; Cui et al., 2012).

Moreover, in high-income countries which are the main international export markets (Martín-Tapia et al., 2010) the demand for ecological products has a growth tendency (Cairncross, 1992; Lohr, 2001). According to the Eurobarometer 2008, 75% of Europeans are willing to purchase environmentally friendly products even if their price is a bit higher (European Commission, 2008). Now consumers are becoming more and more aware of climate risks and can put pressure on producers and on politicians who will eventually pass this pressure to producers. Under these circumstances the role of trade with regard to environment can change substantially.

Currently international trade is going more and more into a climate conscious mode. For example, with the CBAM[21] at place it will reflect the relationships between countries with and without carbon pricing mechanisms. As a consequence, even in countries with weaker environmental regulations companies willing to operate in the international market will be stimulated externally to use cleaner technologies in comparison to enterprises functioning domestically. In this regard, the application of firm-level data can bring new insights in the research on international trade and environment. This kind of data enables one to better consider firm heterogeneity within sectors as opposed to aggregate studies and helps to set up the appropriate policies for various types of firms. Due to the data availability, most research on these issues has been conducted on developed economies (Pei et al., 2021).

Moreover, standards both international and specific to an importing country exert an effect on international trade. From a theoretical standpoint, this effect can be either positive or negative (Shepherd, 2020). On the one hand, they can transfer information about market conditions in the importing country, thus, reducing information-gathering costs for exporters. On the other hand, exporters may have to apply changes to products and processes in order to conform to foreign standards, which can be costs-increasing. The net result depends on which effect prevails (Shepherd, 2020).

The current study builds on previous research as it employs already existing theoretical frameworks (Girma et al., 2008; Melitz, 2003; Porter and Linde, 1995) to investigate empirically the relationships between export intensity, application of environmentally friendly measures and productivity at the firm level of manufacturing industries. Total productivity will be further disaggregated into resource productivity and labor productivity to check whether the effect of environmentally friendly measures changes. The study has been done for an export-oriented developing economy – Belarus for 2018.

This study aims to explore the following research questions and hypotheses:

1. Are exporting enterprises more environmentally-oriented?

Hypothesis 1 (a): Exporting positively affects adoption of environmentally friendly measures by a company.

[21] It is going to be introduced gradually between 2023 and 2025 (European Commission, 2021).

Hypothesis 1 (b): Adoption of cleaner technologies makes a positive impact on the export intensity of a company.

2. Do more environmentally-oriented enterprises tend to be more productive?

Hypothesis 2: Application of environmentally friendly measures has a positive association with productivity improvement.

The study contributes to the existing empirical literature in a number of ways. First, it investigates the interrelationships between export intensity, application of environmentally friendly measures and different types of firm productivity in both directions by employing the system of structural equations. Thus, by the research design exporting, adoption of cleaner technologies and productivity are treated as endogenous variables and simultaneity bias is corrected. Second, the study applies the firm-level data (2018) for a developing export-oriented economy – Belarus while the existing research literature is mostly focused on developed countries. Third, unlike the majority of studies which estimate exporting activities of enterprises as a dummy variable (Batrakova and Davies, 2012; Cui et al., 2012; Forslid et al., 2018; Girma et al., 2008; Lu et al., 2020) whether a company exports or not, our study applies export intensity to measure exporting. We believe that increases the precision of the results.

The main findings can be summarized as follows. First, a positive effect of environmental performance on exporting is observed. Specifically, when a company adopts one more environmentally friendly measure, it increases its export intensity by 4.4% – 4.6%. Adoption of cleaner technologies improves labor productivity in a company – by 20.7%, but is negatively associated with its resource productivity (a 1.9% decrease), which results in the neutral effect on the total productivity.

The rest of the study proceeds as follows. Section 3.2 provides a literature review on the topic. Section 3.3 introduces a theoretical framework. Section 3.4 describes the data and the empirical model. Section 3.5 discusses the results and their implications. Section 3.6 concludes.

3.2 LITERATURE REVIEW

3.2.1 APPLICATION OF ENVIRONMENTALLY FRIENDLY MEASURES AND EXPORTING

At the aggregate level mixed evidence exists about the environmental impacts of trade. Combining scale, technique, and composition effects, Antweiler et al. (2001) come to the conclusion that for an average country further openness to international trade will be beneficial for environment. Frankel and Rose (2005) conclude that openness to trade contributes to air pollution reduction, except for CO_2, and it does not bring significant environmental degradation. Managi et al. (2009) find that the impact of trade on environment depends on the pollutant and the country, with OECD states' environment benefiting from trade and non-OECD nations having the opposite effect. At the same time, these studies do not take into account enterprises' dynamic decisions to enter and exit and their heterogeneity assuming the similar behavior of all firms within sectors (Cui et al., 2012). Bartelsman and Doms

(2000) show the drawbacks of this approach when there exists within-sector heterogeneity. In this regard, the application of firm-level data enables us to better understand enterprises' behavior taking into account their heterogeneity.

There are two strands of empirical literature regarding the relationships between environmental performance and export of enterprises: (1) research that studies the effect of exports on environmental performance of enterprises; and (2) research that explores the effect of the environmental performance on exports of enterprises. The empirical literature about the impact of exporting on environmental performance of enterprises at the firm level is more conclusive than at the aggregate level. Batrakova and Davies (2012) verify their theoretical predictions using the data on Irish manufacturing enterprises. They show that for low energy intensity companies exporting is associated with an increased energy use. However, in high energy intensity enterprises the adoption of greener technologies due to exporting at least partially offsets this effect (Batrakova and Davies, 2012). According to Girma et al. (2008), UK exporting firms are more prone to implement innovations which have a positive environmental effect. Using the manufacturing plant-level data from the USA, Holladay (2016) shows that the emissions of exporting facilities are 9% to 13% less in comparison to non-exporters. Cui et al. (2012) also find that exporting manufacturing facilities in the USA have lower emissions per value of sales than non-exporting plants in the same industry after controlling for the facility productivity and its exposure to environmental regulation. Research evidence on this topic mostly comes from developed countries while studies focused on developing economies are scarce. One example is the research by Pei et al. (2021) who apply Chinese manufacturing enterprises data to show that a lower environmental impact is associated with a higher export intensity. Another study that uses the similar data is Cui et al. (2020). In their research China's WTO accession is treated as a quasi-natural experiment to explore the relationship between pollution and trade liberalization. They come to the conclusion that trade liberalization decreases SO_2 emission intensity at the firm level. Kaiser and Schulze (2005) research Indonesian manufacturing plants and find out that exporters are significantly more likely to spend on environmental protection. Thus, empirical literature on the basis of firm-level data from different countries and with various measures of environmental performance indicates that exporters are cleaner than non-exporters.

Research on the impact of environmental performance of enterprises on their exports is not that numerous. Alpay et al. (2001) analyze the export performance of firms in the Turkish food industry and state that their environmental behavior has a significant positive effect on it. According to Martín-Tapia et al. (2010), pro-active environmental strategies positively affect the export intensity at medium, small and micro-enterprises in the Spanish food industry and this effect gets stronger with the increase of firm size. Lu et al. (2020) explore whether environmental information disclosure can affect the exports of Chinese enterprises and observe an U-shaped relationship between these two factors.

As it can be concluded from the analysis of the selected empirical literature presented here, the relationships between exporting activities and environmental performance of enterprises are bidirectional. Thus, studying only the effect of exports on environmental behavior of firms or vice versa can result in a simultaneity bias. To our best knowledge, there is only one study that looks at these relationships from both sides. Galdeano-Gómez (2010) finds that environmental component of a firm's total productivity is 41% higher for export-oriented enterprises compared to non-export-oriented ones in the Spanish food industry. Galdeano-Gómez (2010) also demonstrates that environmental productivity positively impacts a firm's export sales ratio, and this effect is statistically and economically significant. Another study worth citing here is by Al-Tuwaijri et al. (2004). Although they don't consider exporting activities of enterprises, their approach is still very relevant here as they investigate the interrelationships among economic performance, environmental performance, and environmental disclosure in the system of simultaneous equations.

Therefore, there is a research gap in exploring the relationships between exporting activities and environmental performance of enterprises in both directions at the same time. Another research gap lies in addressing this issue for developing countries since the empirical research on export-environmental relationships mostly focuses on developed nations. Developing economies may have weaker environmental regulations and, thus, offer a different research setting. In this regard, adoption of cleaner technologies and the overall environmental performance of enterprises in developing countries may reflect their motivation to compete in the international market.

3.2.2 APPLICATION OF ENVIRONMENTALLY FRIENDLY MEASURES AND PRODUCTIVITY

The environmental management literature focuses to a great extent on evaluating the relationship between application of environmentally friendly practices and enterprises' economic performance (Cohen et al., 1995). There are two perspectives on this relationship: (1) the win-win hypothesis and (2) the win-lose perspective (Galdeano-Gómez et al., 2006). According to Galdeano-Gómez et al. (2006), the first approach states that investment in environmental technology can lead to a competitive advantage in companies and an increase in their profits (Porter and Linde, 1995; Hart, 1997; Sinclair-Desgagne, 1999; Gabel and Sinclair-Desgagne, 2001). The second approach, on the contrary, argues that investment into environmentally friendly measures brings more costs, including those of opportunity, which results in profit reductions (Greer and Bruno, 1996; Walley and Whitehead, 1994). Both these perspectives have been empirically tested on different industries. For example, Gray and Shadbegian (1993, 1995) find a negative association between the total factor productivity and the pollution reduction costs using the plant-level data from 1979 to 1990 from the paper, oil, and steel industries in the USA. According to Conrad and Morrison (1989), investment in pollution abatement capital negatively impacts productivity growth for the manufacturing sectors in Canada, the USA and Germany. On the contrary, Klassen and Whybark (1999) find a positive relationship between the increase in the allocation of environmental technology portfolio to pollution prevention technologies and improvement in such areas of manufacturing performance as cost, speed and flexibility in the furniture industry of the USA. The newer literature is more in favour of the win-win perspective. For example, Cui et al. (2015) find out that there is a negative association between emissions intensity and facility productivity in the USA manufacturing industry. That means that improvement of environmental performance spurs productivity improvement. According to Galdeano-Gómez et al. (2008), investment in environmental practices is associated with productivity (measured as a value added) improvement in horticultural firms from Andalusia (Southern Spain). Studies on manufacturing companies from the field of performance management (for example, Muñoz-Villamizar et al., 2019c; Santos et al., 2019) suggest that simultaneous improvement of company's productivity and environmental performance is possible.

Analyzing the older and the newer literature on environmental practices/environmental performance and productivity, we can come to a conclusion that the relationship can depend to a large extent on how these phenomena are measured and on the context and time of the study. It is worth drawing attention to the fact that there is still no consensus in the literature.

3.3 THEORETICAL FRAMEWORK

The theoretical framework for this study is based on two sets of theories:

1) the Melitz (2003) model of heterogeneous firms and its extension in Girma et al. (2008);
2) the concept of the environment-competitiveness relationship by Porter and Linde (1995).

According to Melitz (2003), international trade acts as a catalyst for firms reallocations within an industry. The exposure to trade will cause only the firms with the higher productivity levels to enter the export market. At the same time the enterprises with the lower productivity levels will have to continue to operate only in the domestic market while the least productive firms will be induced to exit. As a result, market shares and profits are redistributed towards more productive enterprises (Melitz, 2003). Girma et al. (2008) build on Melitz (2003) approach and show that competitive price strategies different for the export and domestic markets and a larger sales base allow exporters to better amortize the fixed costs of abatement technology. Thus, even if there could be equal access to cleaner technologies, more productive exporting enterprises are better positioned to absorb their fixed costs as they have lower variable costs per unit and higher output. The introduction of cleaner more advanced technologies often requires the replacement of obsolete equipment and, as a consequence, can result in not only improved environmental performance of exporters but also productivity enhancement (Girma et al., 2008). Thus, the theory predicts (Girma et al., 2008) higher efforts to abate pollution will be demonstrated by exporters as opposed to enterprises working exclusively in the domestic market.

Other theoretical models that go in the direction similar to Girma et al. (2008) and also rely on Melitz (2003) include Batrakova and Davies (2012), Cui et al. (2012), Forslid et al. (2018). Batrakova and Davies (2012) apply energy use as a measure of environmental performance and show that the effect of exports on energy use differs in accordance with energy intensity of firms. When starting to export, low energy intensity enterprises raise their energy use, whilst on the contrary, high energy intensity companies decrease their energy use (Batrakova and Davies, 2012). In the model of Cui et al. (2012) which incorporates a pollution externality firms have the choice between an emission-saving technology and a normal ("dirty") technology. The model predicts that heterogeneous enterprises are divided by a technology choice and an export status and that only exporters with the highest productivity levels choose the upgraded technology. Thus, Cui et al. (2012) assume that emissions intensity is negatively correlated with an export status and facility productivity. Forslid et al. (2018) develop a mechanism involving abatement investments to explain a lower emission intensity of exporting firms, which are subject to an environmental tax. According to Forslid et al. (2018), exporting results in higher production volumes and, thus, leads to a lower emission intensity.

Regarding the concept of Porter and Linde (1995), they argue that stricter environmental standards can stimulate innovation and hence well-designed environmental regulation can raise international competitiveness of enterprises. The costs of complying with environmental regulation may partially or more than fully be offset by the innovation triggered. According to Porter and Linde (1995), the way of thinking about the relationship between environment and industrial competitiveness as involving an inevitable tradeoff relies on a static view. In this static view technology, processes, products and customer preferences are fixed. In the real, dynamic world competitive advantage rests on the capability to innovate and, in this regard, strict environmental regulation can raise exports by spurring innovation. Porter and Linde (1995) propose that environmental improvement for firms should be framed in terms of resource productivity, which goes beyond just pollution elimination and leads to decreasing true economic costs and enhancing true economic value of goods. In this respect, resource productivity is based on private costs that arise in enterprises due to pollution, not on mitigating the social costs of pollution (Porter and Linde, 1995).

Based on our theoretical framework and the review of empirical literature, we developed the conceptual framework for the present study (fig. 3.1). The conceptual framework reflects the interrelationships to be investigated and also the instruments to be used for the main variables of interest. We expect that adoption of environmentally friendly measures will exert a positive impact on the export intensity of an enterprise. This is due to the fact that application of cleaner technologies spurred by customers' requirements to adhere to certain environmental standards often boosts a company's capacity to innovate. That as a result can make an enterprise more competitive in the international market. Moreover, companies can better market their goods to environmentally conscious customers if they apply environmentally friendly measures. At the same time we consider that exporting will positively affect the firm's environmental performance. Exporting is instrumented through the number of days to clear customs and the international market being the main market of operation. On the one hand, thanks to a larger sales base, exporting companies are better positioned to amortize the fixed costs of cleaner technologies. On the other hand, being exposed to international trade which gradually incorporates a climate dimension, exporters might have a better understanding of the value of cleaner technologies for their operations than domestic producers. That, of course, depends to a large extent on the markets in which exporters are operating. If an exporting company sells to developed countries which have stringent environmental regulations, we suppose that this increases the probability that this company will apply more environmentally friendly measures to its production. But if an exporting enterprise interacts on the international market mostly with developing countries that have weak environmental standards, it might bring no positive influence on its application of environmentally friendly technologies. As, according to Melitz (2003), only the most productive companies self-select into exporting, we also expect that in line with the theory exporters will have higher productivity levels than non-exporters. And vice versa productivity will exert a positive influence on the export intensity of an enterprise. As regards adoption of environmentally friendly measures and productivity, we expect that they can depend on the type of productivity under analysis. On the one hand, application of cleaner technologies might lead to an upgrade of equipment, which in the short-term might increase costs and result in decreasing resource productivity levels. On the other hand, an upgrade of equipment can lead to automation of processes and bring labor productivity increments.

The other direction of this relationship could be that companies with higher productivity levels have more resources to invest in adoption of environmentally friendly measures. But it can to a larger extent be determined by intrinsic motivation of enterprises and factors other than productivity. Although our conceptual framework reflects this relationship, we do not expect it to be strong. As productivity is under some control of enterprises it will be instrumented through mean productivity of an industry a company belongs to.

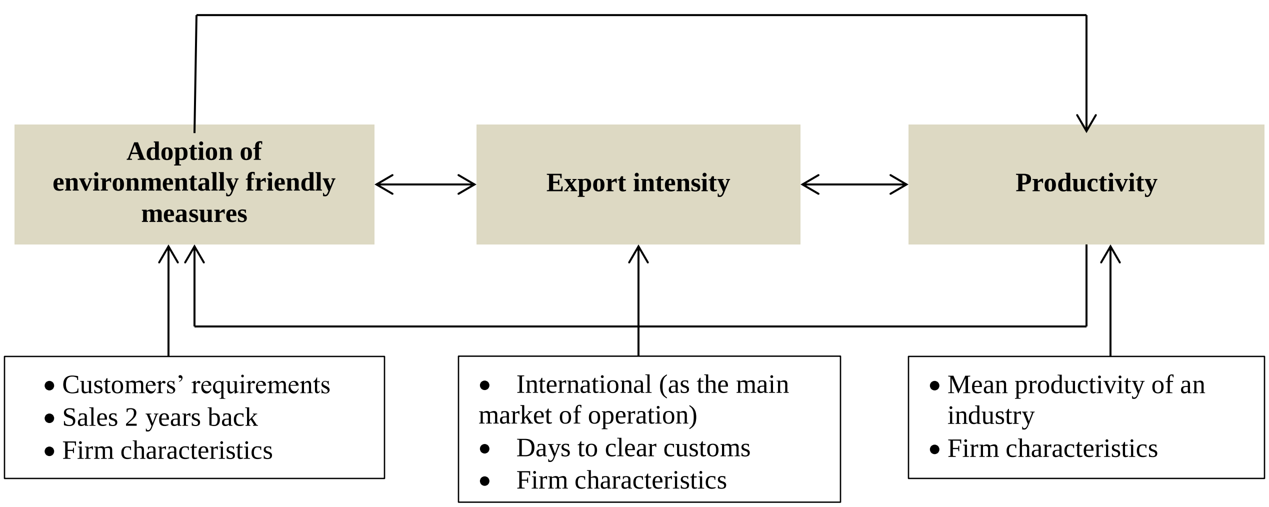

Figure 3.1: Conceptual framework

The interrelationships explored in this study can also be viewed through the lenses of the transaction cost theory (Coase, 1937; Williamson, 1975; 1985). According to Ouchi (1980, p.180), "a transaction cost is any activity which is engaged in to satisfy each party to an exchange that the value given and received is in accord with his or her expectations". Companies conduct transactions with other firms with the help of contracts and, based on this perspective, they can be described as a nexus of contracts (Coase, 1937). The way the relationships between the agents are organized influences the transaction costs (Campos and Mello, 2017). Transaction costs emerge in two fundamental ways: the transaction characteristics and the governance mechanism of the organization (Williamson, 1975). The transaction characteristics generating transaction costs embrace frequency of transactions, uncertainty and asset specificity (uniqueness and peculiarity of an asset) (Williamson, 1975, 1985).

Exporting enterprises are generally involved in longer supply chains than companies operating exclusively on a domestic market. Therefore they represent a broader nexus of contracts mediated by transaction characteristics than non-exporters. Amelung (1991) shows that transaction costs should be considered as a barrier to international trade that can be reduced by technical and institutional innovations. Applying the transaction cost theory to our case enables us to examine the situation when a producer (a supplier) considers whether to do business with a consumer (a buyer) when they want a producer to engage in environmental practices. Asset specificity is a major component of transaction costs. As international standards regarding environmental practices increase, assets associated with environmentally friendly measures become more multipurpose rather than specific (Tate et al., 2011). The transaction cost theory postulates that there is a higher likelihood for a supplier to decide to adopt buyer-demanded environmentally friendly measures when this adoption does not lead to investment in specific assets (Heide and Stump, 1995). Transaction costs associated with transaction frequency and managing uncertainty include information-seeking costs (search costs), bargaining-related and enforcement-related costs (monitoring costs) (Tate et al., 2011). Tate et al. (2011) argue that there exists an inverse relationship between a supplier's likelihood to adopt an environmentally friendly measure and the perceived information-seeking, bargaining-related and enforcement-related costs. An important factor that can decrease the impact of the transaction costs for a supplier is the expectation of the relationships continuity with a buyer (Dyer, 1997; Heide and Stump, 1995; Tate et al., 2011). Therefore, it is more likely that a supplier adopts an environmentally friendly measure if they consider that the additional transaction costs related to this adoption help to maintain the relationship with a buyer (Tate et al., 2011). Research on small and medium enterprises shows that when the buyers push the suppliers' adoption of environmental practices, the suppliers reckon on support from their buyers (Simpson and Power, 2005; Lee and Klassen, 2008). With respect to this, in the case of our study manufacturing companies might adopt environmentally friendly measures if they expect that their exports (as a result of their relationships with their buyers) will rise. And this increase in exports should compensate for the transaction costs related to the adoption. If exports increase by the amount close to the transaction costs related to the adoption, the effect of environmentally friendly measures on productivity (measured as total annual sales divided by total costs) in a given period could be neutral. If exports increase faster, the effect of adoption on productivity could be positive. And if exports rise slower than the transaction costs, the effect from implementation of environmental practices on productivity could be negative.

3.4 DATA AND METHODOLOGY

3.4.1 EMPIRICAL MODEL

Using the firm level data for 2018-2019 we set out to investigate the bidirectional relationships between export intensity, adoption of environmentally friendly measures and productivity. For that we employ a system of structural equations. The choice of estimator is defined by the key assumption about the error terms in the structural equations. As there are endogenous variables among the explanatory variables, they are assumed to be correlated with the disturbances in the system's equations. This implies that OLS will result in inconsistent estimates of the coefficients. Thus, estimation is performed via three-stage-least-squares (3SLS) (Zellner and Theil, 1962) in which endogenous variables are instrumented and the precision of the estimates is improved as the covariance across equation disturbances is accounted for. We specify three structural equations:

$$AEFM_i = \beta_0 + \beta_1 export\_int_i + \beta_2 productivity_i + \beta_3 customers\_req_i + \beta_4 sales\_2\_years\_back_i + \sum \beta_n firm\_characteristics_i + u_1 \quad (1)$$

$$export\_int_i = \alpha_0 + \alpha_1 AEFM_i + \alpha_2 productivity_i + \alpha_3 days\_to\_clear\_customs_i + \alpha_4 international_i + \sum \alpha_n firm\_characteristics_i + u_2 \quad (2)$$

$$productivity_i = c_0 + c_1 AEFM_i + c_2 export\_int_i + c_3 mean\_productivity\_of\_ind_i + \sum c_n firm\_characteristics_i + u_3 \quad (3)$$

The main variables of interest are $AEFM_i$, $export\_int_i$, and $productivity_i$. $AEFM_i$ represents the number of environmentally friendly measures adopted by a firm over the last three years. $export\_int_i$ constitutes direct exports as a percentage of total sales. $productivity_i$ corresponds to total output divided by total input (table 3.1). We further disaggregate $productivity_i$ into $resource\_productivity_i$ measured as the total output per cost of raw materials and intermediate goods used in production and $labor\_productivity_i$ calculated as the total output per cost of labor (table 1). After that, we run the system of structural equations again. The majority of the variables used in the current study are measured over the last fiscal year for a company. This cross-sectional data design constitutes the limitation of our study while we are addressing a complex dynamic trade issue.

In a 3SLS estimation endogenous variables are allowed to be instrumented on all exogenous variables anywhere in the system of structural equations. Nevertheless, to understand the validity of instruments (their relevance, exogeneity and exclusion restriction) it would be useful to relate each excluded instrument with a respective endogenous variable. $AEFM_i$ is instrumented with the variables $customers\_req_i$ and $sales\_2\_years\_back_i$ (in natural log) (table 3.1). Customers' requirements for environmental certifications or adherence to certain environmental standards as a condition to do business are expected to be correlated with decisions on adoption of cleaner technologies. Total annual sales for all products and services two years back influence to a great extent the investment decisions whether to apply certain environmentally friendly measures or not. $days\_to\_clear\_customs_i$ and $international_i$ provide instruments for $export\_int_i$ (table 3.1). Average number of days to clear customs from the time the goods of an enterprise arrived at their main point of exit distinctly divides companies into exporters and non-exporters. This indicator could not be applied to companies operating exclusively in the domestic market. At the same time enterprises have a different degree of exposure to the international market with some companies considering it as their main market while others having a small share of exports in their sales. The variable $international_i$ divides companies into those that sell their main product mostly in the international market and enterprises that mainly operate in the domestic market although also possibly having some share of exports in their sales. It is important to use both of these instruments as they complement each other. Our $productivity_i$ variables (total, resource and labor productivities) are instrumented through the mean productivities of industries enterprises belong to (table 3.1). The overview of the industries is presented in table B.8 in the Appendix B. The mean productivity of an industry has a strong correlation with the productivity of a company belonging to that industry. If an enterprise cannot keep up with the mean productivity of an industry, it will have to exit the market.

To control for other aspects relevant for an international activity of an enterprise as an exporter, adoption of environmentally friendly measures (AEFM) and productivity, a set of variables $firm\_characteristics_i$ is included in the equations (table 3.2). As size is directly related to labor and, thus, can affect an enterprise's productivity, we control for this factor in the productivity equation. We also include it in the AEFM equation as in research on corporate environmental strategies size has proven to exert a statistically significant effect (Buysse and Verbeke, 2003; Sharma, 2000). We do not control for size in the exporting equation as we believe it can only affect exporting through productivity. All the other variables from $firm\_characteristics_i$ are controlled for in all of the three equations. Skills (Dean and Lovely, 2008; Girma et al., 2008) is considered to be a proxy for human capital and can influence productivity, environmental performance of companies and their export activities. As regards introduction of innovations related to products or processes, it can be of particular importance for technology changes and a company's productivity as it can contribute to saving resources. According to Girma et al. (2008), innovations introduced by exporting companies are more likely to be more environmentally friendly and energy-efficient. Besides, innovations are used by many enterprises to get price premiums for cleaner products and enter new market segments (Porter and Linde, 1995). In the literature on international standards and trade the basic approach is to include in models the count of total number of standards (Shepherd, 2020). We follow this approach, although the compliance costs for various standards can substantially differ (Shepherd, 2020), which is not captured by this variable. As standards can require redesigning of product and processes, they can have an impact on application of environmentally friendly measures within a company. Their positive or negative effect on company's productivity will depend on whether costs connected with product and processes redesign and conformity assessment will outweigh the reduction of information gathering costs in foreign markets and expansion of sales base due to the reduced information asymmetries faced by clients. As foreign firms can use cleaner and more efficient technologies (Batrakova and Davies, 2012; Dean and Lovely, 2008; Eskeland and Harrison, 2003), usage of technology licensed from a foreign-owned company is also accounted for. The focus of our study is on manufacturing enterprises, in this regard it is important to control for capacity utilization of a company and also its CO_2 emissions. There is no information in our data on the volume of CO_2 emissions that's why we can only include a dummy variable whether a company emits or not. According to the National Statistical Committee of the Republic of Belarus (2019b), only enterprises which volume of pollutant emissions constitutes 25 tons per year and more are obliged to report them. This is the reason why in the summary statistics (table B.1 in the Appendix B), about 30% of enterprises are CO_2-emitters. Additionally, we control for age (Galdeano-Gómez, 2010), years of work experience in the sector that the top manager has and a number of competitors in the main market where a company sells its main product. Lastly, we include industry classification dummies for the most prevalent industries in the manufacturing sector. The overview of industries is presented in table B.8 in the Appendix B.

Table 3.1: Construction and definition of dependent variables

Variable	Definition/ Construction	Instrumental variables
Adoption of environmentally friendly measures (AEFM)	Number of measures adopted by a firm over the last three years from the following list: (a) Heating and cooling improvements (b) More climate-friendly energy generation on site (c) Machinery and equipment upgrades (d) Energy management (e) Waste minimization, recycling and waste management (f) Air pollution control measures (g) Water management (h) Upgrades of vehicles (i) Improvements to lighting systems (j) Other pollution control measures	• Customers' requirements - Dummy variable equal to 1 if in the last fiscal year any of the firm's customers required environmental certifications or adherence to certain environmental standards as a condition to do business • Sales 2 years back - Total annual sales for all products and services 2 years back in BYR in prices of 2017, in natural log
Export intensity	Direct exports as a percentage of total sales	• International - Dummy variable equal to 1 if in the last fiscal year the main market in which the firm sold its main product was international

		• Days to clear customs - Average number of days to clear customs (from the time the goods of a firm arrived at their main point of exit (e.g., port, airport) until the time these goods cleared customs
Total productivity	Total annual sales for all products and services divided by total costs of sale (incl. cost of raw materials and intermediate goods used in production, cost of labor, electricity, fuel, etc.), in BYR	• Total mean productivity - Total mean productivity of an industry an enterprise belongs to (see table B.8 in the Appendix B for an overview of industries in the manufacturing sector), in BYR
Resource productivity	Total annual sales for all products and services divided by annual cost of raw materials and intermediate goods used in production, in BYR	• Mean resource productivity - Mean resource productivity of an industry an enterprise belongs to (see table B.8 in the Appendix B for an overview of industries in the manufacturing sector), in BYR
Labor productivity	Total annual sales for all products and services divided by annual cost of labor incl. wages, salaries, bonuses, social security payments, in BYR, in natural log	• Mean labor productivity - Mean labor productivity of an industry an enterprise belongs to (see table B.8 in the Appendix B for an overview of industries in the manufacturing sector), in BYR, in natural log

Table 3.2: Construction and definition of independent variables

Variable	Definition/ Construction
Size	Number of permanent full-time workers and full-time seasonal or temporary workers employed in the last fiscal year
Skills	Percentage of permanent full-time employees with a university degree in the total number of permanent full-time employees
Product innovation	Dummy variable equal to 1 if during the last three years a firm introduced new or improved products or services
Process innovation	Dummy variable equal to 1 if during the last three years a firm introduced any new or improved process

Number of standards	Number of internationally-recognized quality certificates that an enterprise has
Age	Year in which a firm began operations subtracted from the year of the survey
Experience	Number of experience working in the sector the top manager has
CO_2	Dummy variable equal to 1 if a firm emitted CO_2 over the last three years
Capacity utilization	Last fiscal year output produced as a percentage of the maximum output possible if using all the resources available
Foreign technology	Dummy variable equal to 1 if a firm at present use technology licensed from a foreign-owned company, excluding office software
Number of competitors	Number of competitors a firm's main product faced in the main market
Industry	Five dummies for industry classification: furniture; plastics; food; garments; metal.

We also perform the weak instruments tests after the 3SLS estimation for each set of instruments for our endogenous variables and prove that each set of instruments is jointly significant (table B.2, B.4 and B.6 in the Appendix B). Additionally, we run the K-P LM test (Kleibergen and Paap) of under-identification and the Sargan test of over-identification where applicable using single equation two-stage least squares (2SLS) estimations for each endogenous variable (table B.3, B.5 and B.7 in the Appendix B). In the K-P LM test we reject under-identification for all the instruments and conclude that our instruments are relevant. In the cases where we have two instruments for one endogenous variable (for $AEFM_i$, $export\_int_i$) we accept the null hypothesis in the Sargan test of over-identification that instruments are appropriately independent of the error process for all the equations except for the labor productivity equation. In that equation we have to reject the null hypothesis in the Sargan test for the instruments of the variable $AEFM_i$. But as the instruments for this variable performs well in all the other tests we believe they are still valid to use.

3.4.2 STUDY AREA

The geographical position of Belarus between Russia and the European Union predetermines its large transit and foreign trade potential. The share of exports in Belarusian GDP amounted to about 50% in 2015-2019 (table 3.3), which shows the exports oriented focus of the Belarusian economy. However, the qualitative structure of the country's foreign trade relationships is characterized by the real exports intensity of GDP which is measured as a share of exports of goods in the manufacturing output (Abramchuk, 2016). In 2015-2019 the real exports intensity of GDP for Belarus varied between 57.33-62.60%[22]. That demonstrates the high level of exports orientation in the manufacturing sector in Belarus.

[22] Author's own calculations based on the data from the National Statistical Committee of the Republic of Belarus (2021).

Table 3.3: Share of exports in Belarusian GDP in 2015-2019, %

	2015	2016	2017	2018	2019
Exports in GDP, %	47	49	53	57	52

Source: (National Statistical Committee of the Republic of Belarus, 2020, 2019a).

The exports of goods in 2019 increased by 23.61% against 2015 while the imports increased by 30.32% for the same period (fig. 3.2). Despite the exports oriented focus of the Belarusian economy, the balance of foreign trade of goods was negative for 2015-2019.

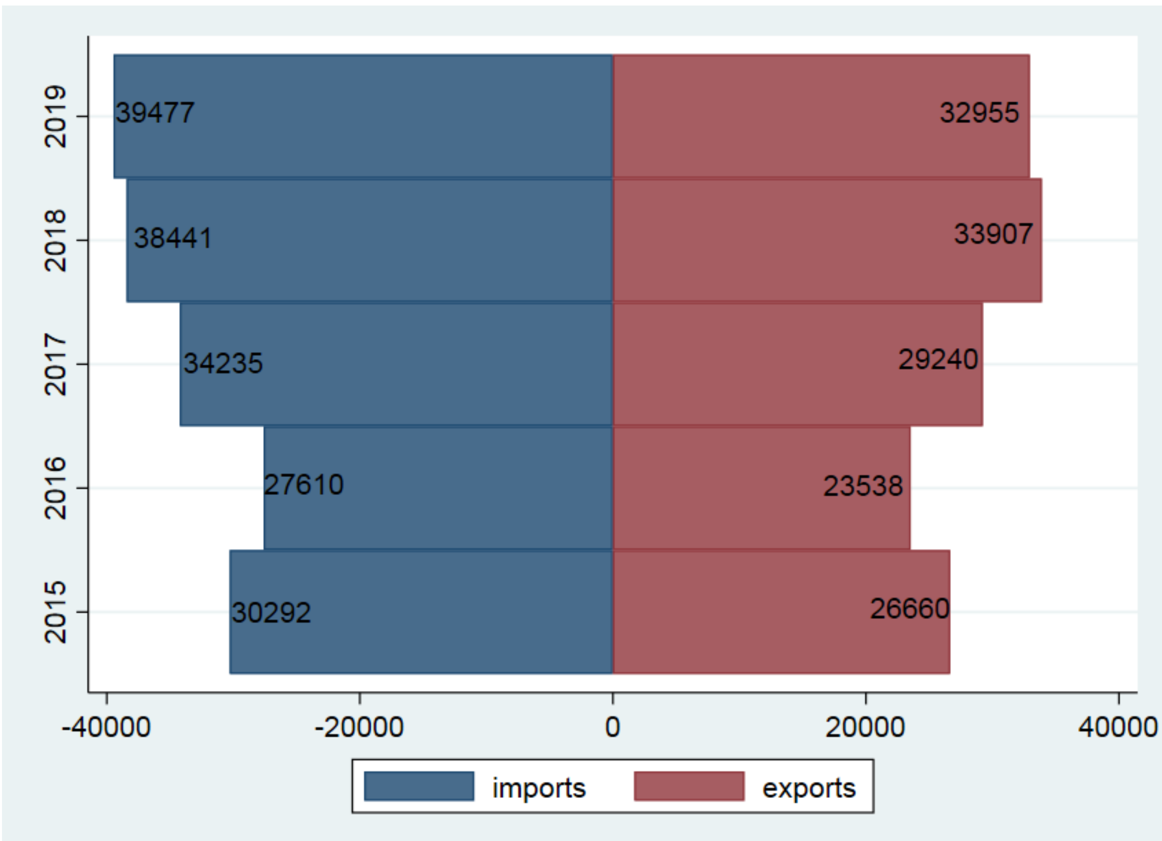

Figure 3.2: Dynamics of foreign trade of goods for 2015-2019 in Belarus, millions of USD
Source: calculations based on the data from National Statistical Committee of the Republic of Belarus (2021).

Russia can be considered the main export market for Belarus with the share of 38.30-46.51% in the structure of exports of goods by regions of destination for 2015-2019 (fig. 3.3). In this period the exports of goods to Russia increased by 31.62%. Although the other Commonwealth of Independent States (CIS) countries excluding Russia accounted for only 13.80-17.27% in the exports of goods, in 2015-2019 it was the fastest growing exports market for Belarus (with the growth rate of 54.70%). The share of other countries including developed and developing ones in the structure of exports of goods by regions of destination accounted to 37.77-47.20% and grew only by 7.91% in the time under consideration. In 2019 it was equal to the share of the main export market (Russia).

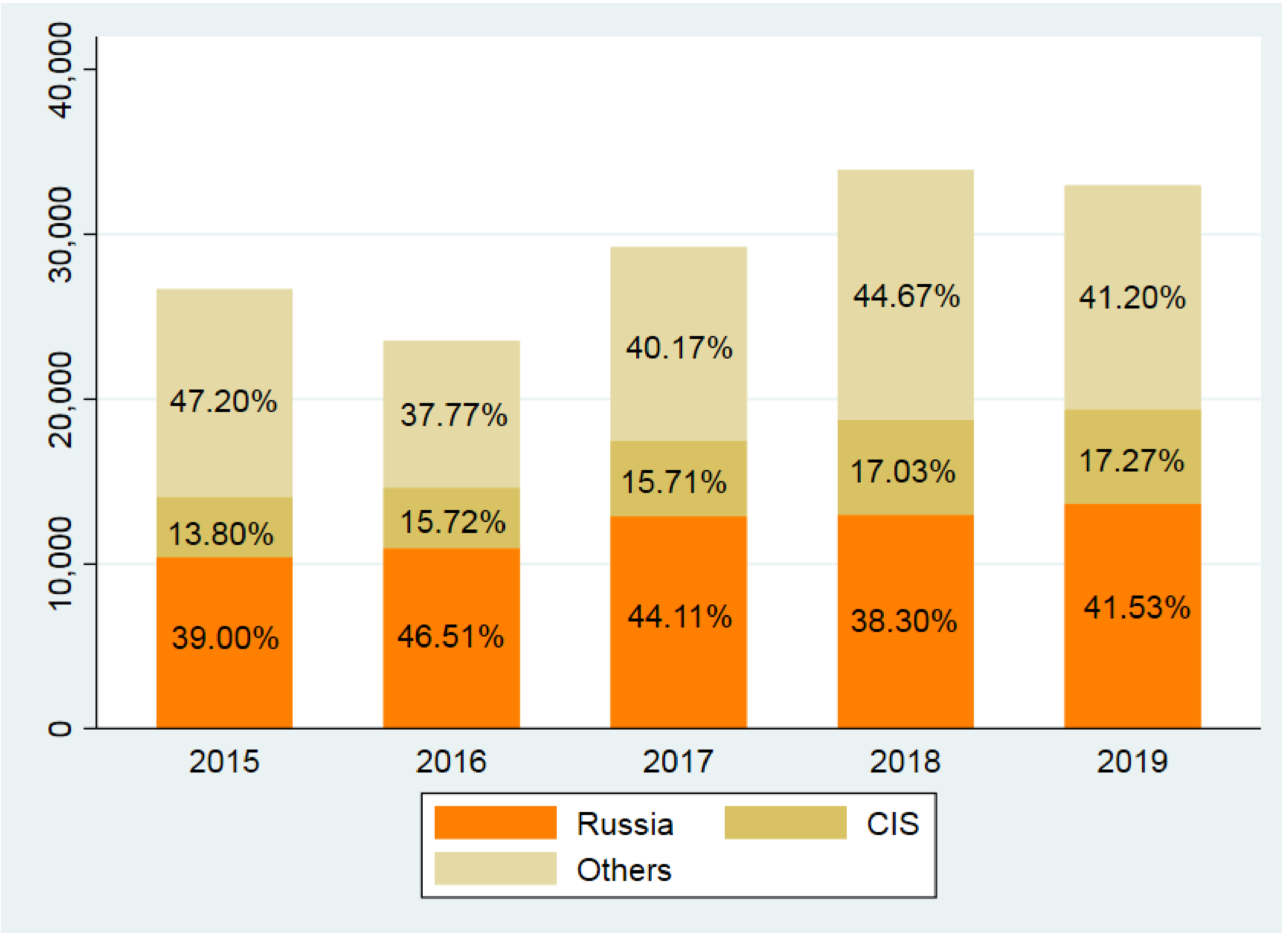

Figure 3.3: Structure of exports of goods from Belarus by regions of destination for 2015-2019, millions of USD

Source: calculations based on the data from National Statistical Committee of the Republic of Belarus (2021).

Note: CIS - the Commonwealth of Independent States (CIS) countries.

The most exported goods for Belarus in 2019 included mineral products, chemical products, machinery, equipment and vehicles and food and agricultural products (fig. 3.4). Among those goods mineral products fall under the category to which the Carbon Border Adjustment Mechanism will be applied in the first place, according to the European Commission (European Commission, 2021).

As regards the environmental performance of Belarus in the global context, the brief overview can be drawn from the Environmental Performance Index (Wendling et al., 2020). The 2020 EPI assesses 180 countries across 32 performance indicators on environmental health and ecosystem vitality. In 2020 Belarus was ranked 49th with a score of 53 taking the first place among the CIS countries (Wendling et al., 2020).

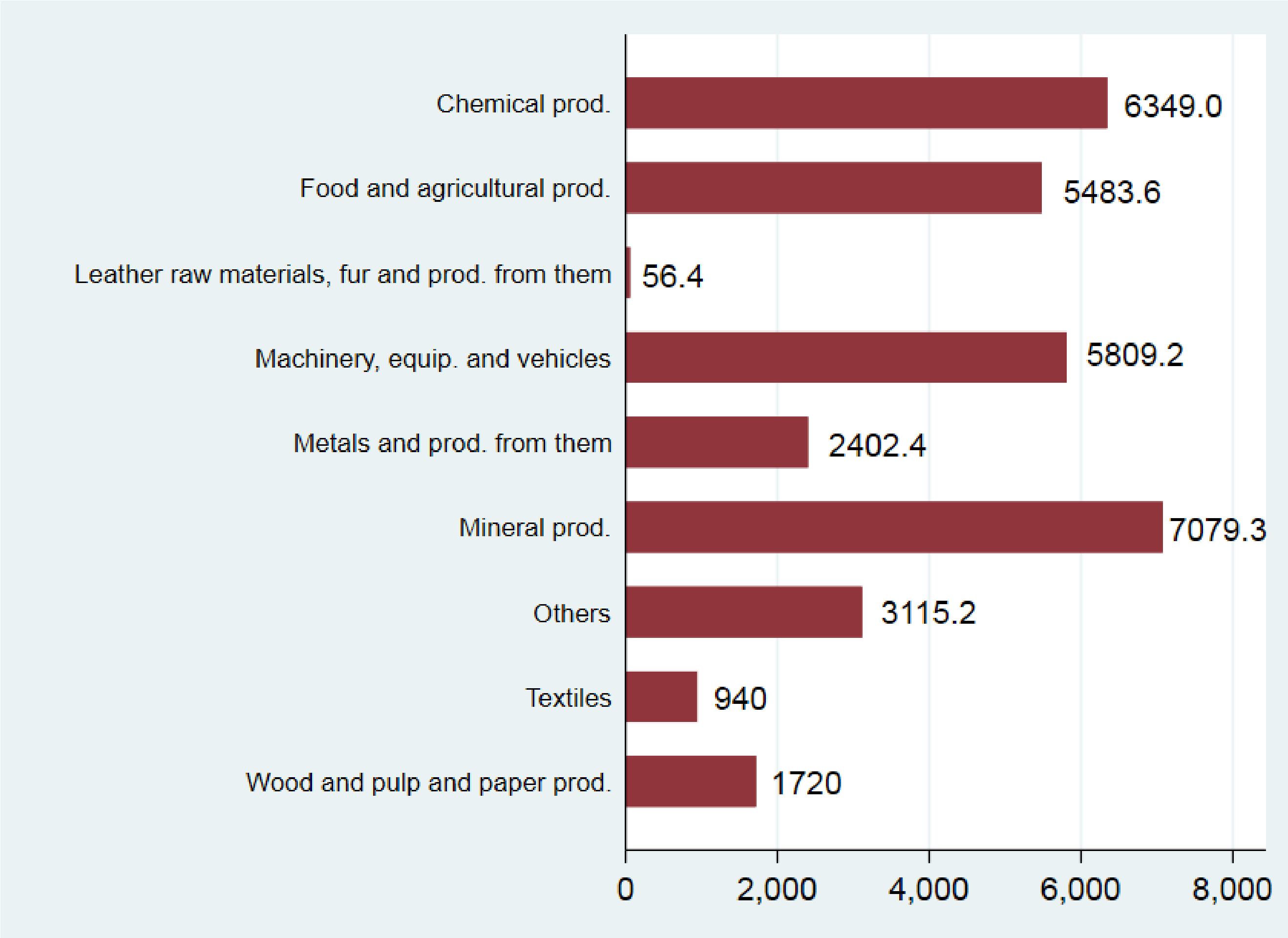

Figure 3.4: Exports structure of Belarus by goods for 2019, millions of USD
Source: calculations based on the data from National Statistical Committee of the Republic of Belarus (2021).
Note: prod. – products.

3.4.3 DATA

The study uses the firm level data from the Enterprise Survey of the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB) and the World Bank Group (WBG). The survey was conducted in Belarus between October 2018 and April 2019 (World Bank Group, 2023).

For 2018 Belarus Enterprise Survey stratified random sampling was applied. The whole population comprises the non-agricultural economy in Belarus: all manufacturing sectors according to the group classification of the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3.1 (group D), construction sector (group F), services sector (groups G and H), and transport, storage and communications sector (group I). Stratification was done at three levels: industry, establishment size, and region. At the industry level the population was stratified into three manufacturing industries (Food and Beverages (ISIC Rev. 3.1 code 15), Garments (ISIC code 18), Other Manufacturing (ISIC codes 16-17 and 19-37)) and two services industries (Retail (ISIC code 52), Other Services (ISIC codes 45, 50, 51, 55, 60-64, and 72)). Size stratification was designed to include small (5 to 19 employees), medium (20 to 99 employees), and large (100 or more employees) enterprises. Regional stratification was conducted on the basis of seven zones: Minsk, Minskaya, Gomelskaya, Mogilevskaya, Brestskaya, Grodnenskaya, and Vitebskaya (The World Bank Group, 2023).

As a result, the total sample included 600 enterprises with 328 companies belonging to the manufacturing sector. This study focuses on this sub-sample as manufacturing enterprises are much more polluting than services companies and, thus, the application of cleaner measures and technologies is much more demandable there. The Enterprise Surveys conducted for Belarus in the previous years are not possible to use for the current research as the "Green Economy Module" whose data play the core role in this study was introduced only in the 2018 Enterprise Survey.

3.4.4 DESCRIPTIVE STATISTICS

As exporting in our models is not a dummy but a continuous variable, we present the descriptive statistics based on the instrumental variable $international_i$. Table 3.4 demonstrates a brief overview of the distribution of enterprises whose main market is international vs. companies mostly operating in the domestic market in the manufacturing sector. The share of firms operating mainly in the international market amounts to 22.32% of the sample, 77.68% of the surveyed enterprises work in the domestic market as their main market of operation. The highest share of exporters falls on garments (38.36%) and other manufacturing (27.39%), the lowest one - on metal (2.74%). For all enterprises that define their main market as international the average share of exports in sales is 67.51%.

Table 3.4: Distribution of enterprises in manufacturing sectors by the type of their main market

	% Total	% Plastics	% Furniture	% Food	% Garments	% Metal	% Other manufacturing
International market	22.32	5.48	5.48	20.55	38.36	2.74	27.39
Domestic market	77.68	5.51	5.51	34.65	31.89	5.12	17.32

Table 3.5 compares the mean values of some characteristics between enterprises working mainly in the international or domestic markets. Exporting firms are slightly more innovation oriented than their domestic counterparts. Moreover, they comply with a higher number of standards than their domestic counterparts. Generally exporting enterprises are 7 years older than companies working in the domestic market. The top managers of firms operating in the international market on the whole have more experience in the industry as their counterparts from non-export oriented companies. Exporters have also around 10% higher levels of capacity utilization than other companies. Surprisingly, enterprises operating in the domestic market retain higher human capital (the variable 'skills') than companies

whose main market is international. Other summary statistics are presented in table B.1 in the Appendix B.

Table 3.5: Characteristics of enterprises working mainly in the international and domestic markets

Characteristics	Observations	International		Domestic	
		Mean	Std. Err.	Mean	Std. Err.
Skills	322	29.916	2.543	31.305	1.339
Product innovation	327	0.575	0.058	0.512	0.031
Process innovation	326	0.301	0.054	0.241	0.027
Number of standards	321	0.778	0.093	0.486	0.048
Age	327	29.918	3.018	22.402	1.239
Experience	324	18.930	1.380	16.202	0.601
CO_2	322	0.356	0.056	0.317	0.030
Capacity utilization	316	85.479	1.983	74.996	1.444
Foreign technology	326	0.153	0.043	0.063	0.015
Number of competitors	295	4.678	0.619	4.640	0.305

3.5 RESULTS AND DISCUSSION

3.5.1 APPLICATION OF ENVIRONMENTALLY FRIENDLY MEASURES AND EXPORTING (EQUATIONS 1 AND 2)

In table 3.6 we show the results of the 3SLS estimation for export intensity, application of environmentally friendly measures (AEFM) and total productivity. In table 3.7 the results for export intensity, AEFM and resource productivity are presented. In table 3.8 we demonstrate the results for export intensity, AEFM and labor productivity.

The results of the 3SLS estimation (table 3.6-3.8) show that there is no statistically significant evidence that with an increase in export intensity Belarusian enterprises are going to be more environmentally oriented. The coefficient of the respective variable (‘*export intensity’* in the AEFM equation in all the models) is statistically insignificant. Although exporting enterprises can be better positioned to adopt environmentally friendly technologies, these results point at the lack of understanding within enterprises whether they can actually benefit from adoption or not.

As expected, the improvement in productivity does not stimulate enterprises to invest more in cleaner technologies as the coefficient of the respected variables (‘*productivity’, ‘labor productivity’, ‘resource productivity’* in the AEFM equations in all the models) is statistically insignificant. This result can imply that in developing countries like Belarus if enterprises are not stimulated externally by the government or by their customers to improve their environmental performance, they do not have an intrinsic motivation to do so. One of the reasons why companies are not environmentally pro-active is that their managers lack the evidence that benefits can be larger than costs (Miras-Rodríguez et al., 2015; Montabon et al., 2007; Muñoz-Villamizar et al., 2018a). Interesting results in this regard were obtained in the study by Batova and Tochitskaya (2020) in which they interviewed the top-management of the Belarusian enterprises. According to their results, on the one hand, the top-management understands that circular economy is an unavoidable global trend and it is connected with innovations, resource efficiency and new market opportunities. On the other hand, they don't associate Belarus with circular economy and believe that enterprises there will still be developing under the linear economy model.

At the same time adoption of one more environmentally friendly measure within a company brings a 4.441% – 4.613% increase in the enterprise's export intensity (the variable '*AEFM*' in the Export intensity equation). This effect is statistically significant at a 1% level in all the models. This result can be attributable to the fact that better environmental performance can help to improve an enterprise's competitiveness in the international market, which is in line with the theory (Porter and Linde, 1995).

Table 3.6: 3SLS results on the relationships among environmental performance, exporting and total productivity

	(1) AEFM	(2) Export intensity	(3) Productivity
AEFM		4.441***	0.035
		(1.602)	(0.050)
Export intensity	- 0.008		0.002
	(0.007)		(0.002)
Productivity	-0.195	7.399	
	(0.644)	(5.434)	
Customers' requirements	0.903 **		
	(0.377)		
Sales 2 years ago	0.530***		
	(0.129)		
International		54.155***	
		(3.912)	
Days to clear customs		2.471***	
		(0.668)	
Mean productivity			1.009***
			(0.160)
Size	0.001		-0.0003**
	(0.0005)		(0.0001)
Skills	-0.006	0.157**	-0.003
	(0.008)	(0.077)	(0.002)
Product innovation	1.049***	-8.530**	-0.072
	(0.343)	(3.668)	(0.102)

Process innovation	0.672	-13.861***	0.057
	(0.425)	(4.202)	(0.115)
Number of standards	-0.135	3.171	0.170**
	(0.317)	(2.865)	(0.073)
Age	-0.001	-0.154*	0.001
	(0.009)	(0.084)	(0.002)
Experience	-0.006	0.081	0.001
	(0.016)	(0.150)	(0.004)
CO_2	1.054***	-6.153	-0.0002
	(0.391)	(4.459)	(0.121)
Capacity utilization	-0.005	0.075	0.001
	(0.008)	(0.071)	(0.002)
Foreign technology	0.647	-12.546**	0.175
	(0.628)	(6.238)	(0.161)
	-0.002	-0.289	-0.001
Number of competitors	(0.034)	(0.323)	(0.009)
Furniture	-0.181	5.663	-0.223
	(0.760)	(7.085)	(0.181)
Plastics	-0.291	4.516	0.099
	(0.742)	(7.009)	(0.185)
Food	-0.520	5.004	-0.151
	(0.566)	(4.904)	(0.121)
Garments	-0.106	12.544***	-0.081
	(0.489)	(4.445)	(0.117)
	-0.773	3.034	-0.042
Metal	(0.738)	(6.987)	(0.183)
Constant	-3.855**	-22.381*	-0.172
	(1.927)	(13.050)	(0.376)
Observations	223	223	223

Note: Standard errors in parentheses.
**** p<0.01, ** p<0.05, * p<0.1*

Thus, for the first research question we cannot accept hypothesis 1 (a) that exporting positively affects adoption of environmentally friendly measures by a company but we can confirm hypothesis 1 (b) that adoption of cleaner technologies makes a positive impact on the export intensity of an enterprise. As to our best knowledge, this is the first empirical study on the relationships between exporting and application of environmentally friendly measures using the firm-level data for Belarus, we can't compare the results with other studies for this country. As has been discussed in part '2.2 Empirical literature review' the majority of evidence on this topic comes from developed countries. Nonacceptance of hypothesis 1 is in opposition to studies on UK (Girma et al., 2008), the USA (Holladay, 2016), Sweden (Forslid et al., 2018), Indonesia (Kaiser and Schulze, 2005) and China (Pei et al., 2021), although these studies use other measures of environmental performance than the number of adopted environmentally friendly measures over the last three years.

The confirmation of hypothesis 1 (b) is in line with the research results on Turkish food industry companies (Alpay et al., 2001) and Spanish food industry enterprises (Martín-Tapia et al., 2010). In accordance with the findings of Batrakova and Davies (2012), Wagner and Van Biesebroeck (2008), McCann (2009) who all use Irish firm-level data, we also do not find evidence that productivity affects exporting. That is contradictory to some other research results (see Bernard and Bradford Jensen, 1999).

Several other factors also influence application of environmentally friendly measures by enterprises in Belarus which are worth drawing attention to. If a firm introduced new or improved products or services during the last three years it increases the application of environmentally friendly measures within a company by 0.996-1.049%. These results are statistically significant at a 1% level in all the models. There are at least two ways how introduction of new or improved products or services can influence adoption of environmentally friendly technologies by an enterprise. One is that product innovations themselves can have improved environmental characteristics. The other is that their launch can require an upgrade of equipment, which can lead to an application of more environmentally friendly measures. Companies that emit CO_2 tend to care more about adoption of environmentally friendly measures than enterprises that don't.

Table 3.7: 3SLS results on the relationships among environmental performance, exporting and resource productivity

	(1) AEFM	(2) Export intensity	(3) Resource productivity
AEFM		4.591***	-1.864**
		(1.769)	(0.874)
Export intensity	-0.008		0.015
	(0.008)		(0.032)
Resource productivity	-0.033	0.169	
	(0.049)	(0.468)	
Customers' requirements	0.853**		
	(0.363)		
Sales 2 years ago	0.470***		
	(0.123)		
International		49.665***	
		(3.944)	
Days to clear customs		2.746***	

		(0.682)	
Mean resource productivity			1.076***
			(0.237)
Size	0.001*		0.002
	(0.0004)		(0.002)
Skills	-0.007	0.153*	-0.068*
	(0.008)	(0.080)	(0.035)
Product innovation	1.001***	-6.929*	2.789*
	(0.355)	(3.856)	(1.681)
Process innovation	0.661	-13.064***	1.201
	(0.419)	(4.105)	(1.884)
Number of standards	-0.221	7.458***	-0.277
	(0.293)	(2.512)	(1.174)
Age	-0.0001	-0.196**	0.017
	(0.009)	(0.082)	(0.035)
Experience	-0.010	0.006	-0.069
	(0.016)	(0.153)	(0.067)
CO_2	1.163***	-6.268	3.339
	(0.384)	(4.617)	(2.052)
Capacity utilization	-0.003	0.046	0.015
	(0.008)	(0.071)	(0.031)
Foreign technology	0.662	-11.645*	-0.246
	(0.612)	(6.051)	(2.666)
	-0.014	-0.190	-0.080
Number of competitors	(0.034)	(0.322)	(0.142)
Furniture	-0.249	2.533	-0.769
	(0.709)	(6.636)	(2.902)
Plastics	-0.326	4.415	-0.612
	(0.754)	(7.052)	(3.097)
Food	-0.452	1.388	-1.639
	(0.489)	(4.537)	(1.915)
Garments	-0.026	6.499	-3.040*
	(0.459)	(4.196)	(1.748)
	-0.814	0.453	-1.264
Metal	(0.730)	(7.037)	(3.091)
Constant	-3.113	-8.882	6.875
	(1.948)	(10.506)	(4.651)
Observations	227	227	227

Note: Standard errors in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

3.5.2 PRODUCTIVITY (EQUATION 3)

Muñoz-Villamizaret al. (2018b) suggest that in companies' decision-making environmental performance should not be considered separately from productive performance as the ultimate goal of an enterprise is to maximize its productivity (Neugebauer, 2011). Investment in environmental measures leads to the development of such capabilities as innovation, stakeholder integration and organizational learning, which in their turn contribute to achieving better financial performance by an enterprise (Galdeano-Gómez et al., 2008; Sharma and Vredenburg, 1998).

What we observe in our models is that application of environmentally friendly measures positively affects the labor productivity of an enterprise. Adoption of one more environmentally friendly technology (the variable '*AEFM*' in the Labor productivity equation in table 3.8) leads to 20.7% increase in labor productivity. We can actually underpin these results by the explanation from Myers and Nakamura (1980) who used a putty-clay approach to examine energy and pollution effects on productivity. According to them, productivity can be influenced by diverting investment from productivity-enhancing capital additions to uses the effect of which on productivity is neutral or even negative. Their examples of these uses are investments in heat loss reduction or decrease in discharge of pollutants among others, which in our case are environmentally friendly measures. They come to the conclusion that if new production technology is entitled by these measures, it can lead to capital turnover acceleration and the net result can be a productivity growth. In our case adoption of different environmentally friendly measures can lead to the improvement of production processes through their automation (for example, machinery and equipment upgrades, waste minimization), and thus, reduce the demand for labor.

At the same time, application of environmentally friendly measures exerts a negative effect on resource productivity. Adoption of one more environmentally friendly technology (the variable '*AEFM*' in the Resource productivity equation) leads to 1.864% decrease in resource productivity. First, adoption of cleaner technologies can be implemented before these technologies are developed enough from the production efficiency point of view (Ayerbe and Gorriz, 2001). Second, investment in measures to protect the environment can shift capital from other investments that are directly productive (Jaffe et al., 1995). Although according to Rose (1983), the ratio of the reduction of the investments in other types of capital due to environmental investment is less than one.

As we see in our results (table 3.6), application of environmentally friendly measures does not exert a statistically significant effect on total productivity (the variable '*AEFM*' in the Productivity equation).

In this regard, we can conclude that the positive influence of adoption of cleaner technologies on labor productivity is neutralized by the negative influence on resource productivity[23].

Table 3.8: 3SLS results on the relationships among environmental performance, exporting and labor productivity

	(1) AEFM	(2) Export intensity	(3) Labor productivity, in nat. log
AEFM		4.613*** (1.664)	0.207*** (0.064)
Export intensity	-0.011 (0.007)		0.002 (0.002)
Labor productivity	-1.351 (1.116)	0.356 (5.041)	
Customers' requirements	0.252 (0.362)		
Sales 2 years ago	0.945*** (0.276)		
International		53.704*** (3.766)	
Days to clear customs		2.679*** (0.691)	
Mean labor productivity, in nat. log			0.529*** (0.155)
Size	0.0001 (0.001)		-0.0004** (0.0002)
Skills	0.0004 (0.009)	0.138* (0.078)	0.005** (0.003)
Product innovation	0.996*** (0.354)	-7.342** (3.454)	-0.077 (0.121)
Process innovation	0.985** (0.416)	-13.853*** (4.124)	-0.117 (0.142)
Number of standards	-0.206 (0.293)	6.978*** (2.503)	0.132 (0.085)
Age	-0.006 (0.010)	-0.226*** (0.082)	-0.002 (0.003)
Experience	-0.016 (0.016)	0.038 (0.144)	-0.002 (0.005)

[23] In our sample of enterprises the mean cost of labor is 3.73 times less than the mean cost of raw materials and intermediate goods used in production.

CO_2	1.018***	-6.605	-0.303**
	(0.386)	(4.376)	(0.152)
Capacity utilization	-0.004	0.069	0.002
	(0.008)	(0.069)	(0.002)
Foreign technology	0.339	-11.887**	-0.153
	(0.606)	(5.804)	(0.190)
	-0.006	-0.213	-0.003
Number of competitors	(0.034)	(0.310)	(0.010)
Furniture	-0.101	1.582	0.005
	(0.697)	(6.482)	(0.215)
Plastics	-0.020	4.376	0.099
	(0.746)	(6.891)	(0.230)
Food	-0.573	1.170	-0.329
	(0.452)	(4.181)	(0.217)
Garments	-0.508	8.008*	-0.137
	(0.638)	(4.576)	(0.162)
	-1.222*	0.651	0.183
Metal	(0.721)	(6.535)	(0.219)
Constant	-7.536***	-9.242	-0.253
	(2.483)	(10.329)	(0.420)
Observations	237	237	237

Note: Standard errors in parentheses.
*** *p<0.01, ** p<0.05, * p<0.1*

Thus, for the second research question we cannot accept our hypothesis that adoption of environmentally friendly measures is positively associated with productivity improvement, at least not in the short-term. These results could be in opposition with other research findings but we have to distinguish whether productivity has been studied in the long- or in the short-term. For example, Galdeano-Gómez et al. (2008) study horticultural firms from Andalusia (Southern Spain) over 1994-2005 and find out that investment in environmental practices translates into productivity improvement (measured as a value added).

3.6 CONCLUSIONS

The debate about the impact of international trade on the environment is quite long-standing. This paper contributes to this discussion by investigating the relationships between exporting, application of environmentally friendly measures and productivity at the firm level, which are all by design treated as endogenous. The study also brings the context of a developing country (Belarus) into this area of research that is to a larger extent focused on developed economies.

Our core results show that adoption of environmentally friendly measures by an enterprise positively affects its export intensity, thus, helping an enterprise to compete successfully in the international market. This happens because application of cleaner technologies can stimulate the demand for the company's products from more environmentally conscious customers abroad and strengthening their competitive advantage in the international arena. At the same time application of environmentally friendly measures can be costly for enterprises and can shift investments from other productive activities. Our results confirm that adoption of environmentally friendly technologies leads to labor productivity increment, which is at the same time neutralized by resource productivity decrease.

The management of enterprises quite often does not have a clear understanding whether the adoption of environmentally friendly technologies will eventually benefit an enterprise or will lead only to cost increases. In this regard, two important policy implications arise. First, companies should be stimulated externally either by the governments in their own countries or by the governmental regulations in the countries of their goods destination to become cleaner. One potentially prominent example of such regulations is a carbon border adjustment mechanism (CBAM), which is planned to be applied by the EU in the near future to the importers from the third countries. Second, more collaboration between science and business is desirable. More outreach activities are necessary to help the business community in developing countries understand the potential of environmentally friendly measures as a channel to improve company performance in the international market.

CHAPTER 4: SOCIAL COST OF HOUSEHOLD EMISSIONS: CROSS-COUNTRY COMPARISON ACROSS THE ECONOMIC DEVELOPMENT SPECTRUM[24]

ABSTRACT

Household consumption accounts for the largest share of the global anthropogenic greenhouse gases (GHG) emissions. The literature assessing the environmental impacts of household consumption is mostly focused on developed economies, thus, leaving a critical gap when it comes to assessing the impacts of household consumption and of related environmental policies in developing countries. Therefore, in order to fill this gap, this study analyzes household consumption-based emissions for high income, upper middle income, lower middle income, and low-income countries from six different geographical regions. It assesses the sector-wise CO_2-, CH_4- and N_2O-footprints and evaluates their social costs. The study methodology employs an environmentally extended multiregional input-output model from the EORA26 database which uses a common 26-sector classification for all countries. The findings show that household consumption accounts for 48%–85% of the national CO_2-footprints (the values are similar for CH_4 and N_2O). Developing economies have lower CO_2-footprints of household final consumption than developed economies, but exert a higher pressure on the environment with respect to CH_4- and N_2O-footprints per capita. That highlights the necessity to focus environmental policies in developing countries on tackling CH_4 and N_2O emissions as a higher priority. The study also identifies those sectors where the social costs of aggregated CO_2, CH_4 and N_2O emissions make up a substantial share of the industries' output. Thus, it indicates the level of technological efficiency of the respective economies and the industries where more stringent environmental regulation should be implemented.

Keywords: environmentally extended multiregional input-output analysis, social costs of emissions, environmental impact of household consumption, developing countries.

4.1 INTRODUCTION

The effects of human-induced climate change are being experienced worldwide (IPCC, 2022a). Climate change has already caused a shift in geographical ranges and seasonal activities for many species. On the whole, the positive effects of climate change on crop yields, such as through carbon fertilization, have been outweighed by negative effects across different regions and crops (Pachauri and Meyer, 2014). Anthropogenic greenhouse gas (GHG) emissions are considered to be the main cause of the current observed climate change (Pachauri and Meyer, 2014).

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[24] Shershunovich, Y., & Mirzabaev, A. (2023). Social cost of household emissions: cross-country comparison across the economic development spectrum. *Environment, Development and Sustainability*, 1-21. https://doi.org/10.1007/s10668-023-03248-3

According to the input-output framework, household consumption accounts for the largest share of the global anthropogenic GHG emissions worldwide (Ivanova et al., 2016; Dubois et al., 2019). Recently, the consequences on the environment due to society's consumption behaviors have attracted policy attention to sustainable consumption and production (Cox et al., 2013). The focus of Sustainable Development Goal (SDG) 12 is to ensure responsible consumption and production (United Nations, 2020). Failure to achieve this SDG jeopardizes accomplishing the majority of the other SDGs (United Nations, 2020). At the same time, out of all of the SDGs, SDG 12 includes the largest number of indicators that cannot currently be monitored globally (Ritchie and Mispy, 2018), highlighting the need for researchers, policymakers, and practitioners to contribute more to fill this critical gap. In this regard, without consumers' engagement, policymakers and industry leaders can only be partially successful in combating environmental problems (United Nations Division for Sustainable Development, 2013). Sustainable consumption has as its main task decreasing the depletion of natural resources and reduction of damage (Bilharz et al., 2008).

Consumers are not able to or cannot be motivated to act sustainably in all of the spheres. Therefore, identifying the options with the most significant environmental impact through which consumers can make a difference is highly important. Doing so will help avoid spreading consumers' limited resources across many options that make only a marginal contribution to sustainable consumption (Bilharz et al., 2008).

Given the importance of identifying priority fields of action with major environmental relevance to consumers, assessing the environmental footprint of final household consumption and estimating its social costs are necessary. This kind of analysis is particularly valuable for developing countries with their catching up and rapid adoption of the lifestyles of developed countries, since the majority of research on assessing the environmental impact of household consumption are conducted for developed economies (e.g. Tukker and Jansen, 2006; Ivanova et al., 2016; Mach et al., 2018; Steinegger, 2019; Castellani et al., 2019; Moran et al., 2020; He et al. 2020; Feng et al., 2021; Zsuzsa Levay et al., 2021; Hassan et al., 2022) or China (e.g. Mi et al., 2020; Liu et al., 2021; Sun et al., 2021; Lei et al., 2022)

Today, the primary approaches in the environmental impact assessment of households are macroeconomic accounting and home economics (Spangenberg and Lorek, 2002). Macroeconomic accounting allocates all of the production inputs to producing consumption goods, including the usage of resources and the release of pollution to households as final users. Home economics assesses households' environmental impact on the basis of daily consumption activities with no regard for upstream impact generation (Spangenberg and Lorek, 2002). Spangenberg and Lorek (2002, p. 132) state that "any meaningful impact assessment must be based on a life cycle approach," which is why macroeconomic accounting that measures the economy's physical throughput is preferable.

Life Cycle Assessment (LCA) was first applied in the 1970s (Klöpffer and Grahl, 2014) as an instrument for quantitatively estimating the environmental impacts of goods and services that occur during their lifetimes (Steinegger, 2019). In subsequent years, many different types of LCAs were developed. However, the LCA approach still includes two drawbacks. First, LCA does not account for the emissions embodied in international trade; second, it does not show the environmental impact of one household per year (Steinegger, 2019). Environmentally extended input-output (EEIO) tables were created that relate environmental data to economic input-output tables to produce consumption-based indicators and to overcome the second disadvantage (Steinegger, 2019). The first EEIO analysis framework was developed in Isard et al. (1968), Leontief (1970) and Herendeen (1973). At the same time, when EEIO is applied, the simplified assumption is used that imported goods are manufactured using the same production technology as domestic goods (Hertwich, 2011; Lenzen et al., 2006; Tukker and Jansen, 2006). This approach causes incorrect results, as demonstrated by Peters and Hertwich (2006) and Weber and Matthews (2008). EEIO needs to be extended to multiregional EEIO (EEMRIO), which takes into account international trade (Davis and Caldeira, 2010; Hertwich and Peters, 2009; Ivanova et al., 2016; Steinegger, 2019), to overcome this drawback.

EEMRIO analysis allows for interrelationships among the sectors in the global economy to be captured and the emissions embodied across products' value chains to be related to their final consumers (Wiedmann, 2009; Kitzes, 2013). EEIO (and EEMRIO) analysis traditionally assumes full consumer responsibility when allocating environmental impacts generated in the entire production chain of goods to the final consumers of these goods. A consumer makes the ultimate decision to buy these products (Lenzen et al., 2007) as via supply chains in the end all production is linked to households (Moran et al., 2020). However, the concept of "shared responsibility" is more appropriate when deriving policy implications on the basis of this type of analysis because both consumers and producers make decisions that affect the final consumption environmental footprint.

When estimating the environmental impact associated with GHG emissions, the common practice is to convert the emissions to CO_2-equivalent values using the Global Warming Potential (GWP) metric (e.g., Hertwich and Peters, 2009; Tukker et al., 2013; Ivanova et al., 2016; Song et al., 2019; Ivanova and Wood, 2020). This aggregation approach applies the same treatment to GHGs generated in different processes with various atmospheric residence times and potential for mitigation (Fernández-Amador et al., 2020). Moreover, aggregating GHGs using the GWP metric includes choosing a time horizon for aggregation, most commonly 100 years, although no scientific evidence exists to support the preference for this period over others (Myhre et al., 2014; Fesenfeld et al., 2018; Fernández-Amador et al., 2020). The results vary significantly depending on the time horizon. For example, in Fernández-Amador et al. (2020), the anthropogenic methane emissions during 1997–2014 were equal to either 30% or 95% of the GWP of CO_2 emissions depending on whether a 100- or 20-year period was used for computing. In addition, such an aggregation using the GWP metric results in inconsistencies in the economic evaluation of GHGs. These inconsistencies occur because the economic estimate of climate damages associated with CO_2 includes both a damage function with a power-law response to warming that increases over time and economic discounting with a diminishing value over time (Shindell et al., 2017). Because the impacts of non-CO_2 GHGs differ from those of carbon dioxide, an appropriate economic evaluation of the damages attributable to them needs consistency across time and impacts (Shindell et al., 2017).

Thus, a research gap exists in separately assessing the environmental impacts of household consumption with regard to different GHGs and performing the economic evaluation of these impacts. Using the EEMRIO analysis enables these impacts to be estimated with respect to different industries/commodities, allowing for the identification of not only priority fields of action for consumers but also sectors with the largest mitigation potential for which a difference could be made from the production side. Another research gap lies in performing the aforementioned analysis for countries at different development levels, with a special focus on the least and medium developed countries because they are underrepresented in the EEMRIO analysis research.

In this study, the notion "footprint" is used in the meaning of "embodied emissions", that is emissions "produced by a product or service throughout its whole production process" (Zhang et al., 2020). This study addresses the research gaps previously discussed by fulfilling the following objectives:

1. To evaluate the CO_2-, CH_4-, and N_2O-footprints of household consumption for purposefully and carefully selected countries at different economic development levels and with different geographic settings;
2. To estimate the social costs of the corresponding footprints;
3. To identify key actionable policy lessons from such a comparative analysis.

Our study makes a contribution in a number of ways. First, it estimates the GHGs footprints of household consumption and their social costs separately for CO_2, CH_4, and N_2O emissions. This analysis improves the precision of the social costs evaluation and can result in a more targeted environmental policy based on the composition of the GHGs footprints. Second, to our best knowledge it is the first research of environmental impact assessment using the EEMRIO framework in which a large number of developing countries are presented and compared. Third, in addition to defining the areas of high impact behavior for consumers, the chapter also identifies those sectors where the social costs of aggregated CO_2, CH_4 and N_2O emissions across the value chain make up a substantial share of the industries' output. Thus, it indicates the level of technological efficiency of the respective economies and the spheres where more stringent environmental regulation in relation to industries should be in place.

The study aims to provide a snapshot cross-country analysis and does not set as an objective to track the changes in time for a number of reasons. First, the input-output analysis relies on the assumption that there are no dramatic changes in the economic structure from the prior year to the target year (Wang et al., 2015). Second, although the concept of the Social Cost of Carbon dates back to 1980s, studies estimating them surged at the beginning of the 21st century (for example, Clarkson and Deyes, 2002; Etchart et al., 2012; Hope, 2011; Nordhaus, 2017; Stern, 2007; Tol, 2011) but were focused only on CO_2 emissions. Estimations of the social costs of non-CO_2 emissions have followed quite recently and are very moderate in number (for example, Marten and Newbold, 2012; Shindell, 2015; Shindell et al., 2017). As our study focuses on separate analysis of GHGs, using the social costs of non-CO_2 emissions together with the EEMRIO results based on 2015 data seems to be the most reasonable decision.

The remainder of this chapter is structured as follows. Section 4.2 presents the methodology, section 4.3 summarizes and discusses the main results, and section 4.4 outlines the conclusions. Section 4.5 describes the limitations and future research frontiers.

4.2 MATERIAL AND METHODS

4.2.1 ENVIRONMENTALLY EXTENDED MULTIREGIONAL INPUT-OUTPUT ANALYSIS

A number of global databases allow EEMRIO analysis: EXIOBASE, full EORA and EORA26, Global Trade Analysis Project (GTAP), World Input-Output Database (WIOD), and the Organization for Economic Co-operation and Development Input-Output Tables (OECD). The major trade-off in these databases is between covering many countries and including a high level of harmonized sector details. EORA and GTAP are most suitable for analyses focusing on developing economies because they provide data on a larger set of countries than do all other databases (table 4.1).

Table 4.1: Characteristics of existing databases for EEMRIO analysis

	Full EORA	EORA26	GTAP	EXIOBASE (version 3)	WIOD (release 2016)	OECD
Time coverage	1990–2021	1990–2021	2004, 2007, 2011, 2014	1995–2011	2000–2014	2005–2015
Countries	190	190	121	44	43	64
Sectors	National detail	26	65	163	56	36

Source: https://worldmrio.com/; https://www.gtap.agecon.purdue.edu/databases/v9/; https://www.oecd.org/sti/ind/input-outputtables.htm#IOTFig1; http://www.wiod.org/home; https://www.exiobase.eu/index.php/about-exiobase.

Although these global databases aim to achieve the same goal, various implementation details account for a significant divergence among the results obtained by researchers using different datasets (Moran and Wood, 2014). The main sources of divergence include differences in environmental production accounts and their allocation across sectors, estimations of sectoral inventories when empirical data are unavailable, and differences in economic structures and final demand. High sensitivity of the GHG-footprint in relation to perturbations in the final demand has been observed (Moran and Wood, 2014).

Even after harmonizing environmental production accounts for CO_2 emissions from fossil fuel burning among different models (EXIOBASE, WIOD, the OpenEU MRIO based on the GTAP, full EORA, and EORA26), Moran and Wood (2014) show that the difference between the model results still lies in the range 5–30% per country.

This study employs EORA26 (Lenzen et al., 2015) because it includes data for many developing countries and, in contrast to the full EORA, allows for a comparison among the same sectors of different countries. The analysis is based on the data from 2015 as it was the latest data available from EORA26 at the period when the study was carried out (2020-2021). As the economic structure does not change significantly from one year to another (Wang et al., 2015), the results of this research are still viable to the present time. To ensure the credibility of our estimates and to address the issue of EEIO results divergence among different datasets, the study applies the scenario method (see 4.2.2 Economic estimate of EEIO results).

Acquiring the following two types of raw data for the EEIO analysis is necessary: a sector-wise balanced input-output table in which the total outputs of each sector are equal to the total inputs to that sector and a measurement of direct environmental impacts attributable to each sector (Kitzes, 2013). The key assumptions of the EEMRIO analysis are homogeneity and a fixed input structure. Homogeneity means that each 1 USD sold from a given sector to any other sector in the global economy and to final consumers represents the same product (or service) and bears an identical embodied environmental impact. As EEMRIO analyses are linear models, constant, fixed input proportions are required to produce a sector's output, thus, a fixed input structure is assumed (Kitzes, 2013). EORA26 EEMRIO also uses the industry technology assumption, that is, an industry employs the same technology to produce each of its products.

The general EEMRIO model used to estimate the emissions' intensities embodied in consumption per monetary unit is as follows:

$$F_i = f_i * (I - A)^{-1} \tag{1}$$

where:

- $\boldsymbol{F_i}$: the total intensity vector of emissions *i* embodied in the consumption across sectors, which contains information on the total amount of emissions *i* (in tons) generated anywhere in the global economy, in any sector, to eventually produce 1 USD of output to final consumers from a given sector.
- $\boldsymbol{f_i}$: the transposed direct intensity vector of sectoral emissions *i* released per monetary unit of output. The EORA26 EEMRIO model has 26 sectors.
- $\boldsymbol{I}$: the identity matrix.

$\boldsymbol{A}$: the matrix of technical coefficients that represent a sector's intermediate inputs per unit of sectoral output; $(I - A)^{-1}$ is also known as the Leontief inverse, the elements of which report the information on both direct and indirect inputs requirements to produce one unit of final demand.

The total embodied emissions *i* derived by consumption per sector are obtained as follows:

$$E_{ik} = F_i * y_k \quad (2)$$

where:

$\boldsymbol{E_{ik}}$: the vector of sector-wise emissions *i* footprints caused each year by all of the sales to final demand category *k* in tons.

$\boldsymbol{y_k}$: the vector of final demand category *k* in units of monetary value. The EORA26 EEMRIO model has six categories of final demand: (1) household final consumption, (2) non-profit institutions serving households (NPISH), (3) government final consumption, (4) gross fixed capital formation, (5) changes in inventories, and (6) acquisitions less disposals of valuables.

Then, the total emissions *i* footprint of household consumption per capita in a country is calculated as follows:

$$E_{i1}^{t} = \frac{\sum E_{i1}}{p} \quad (3)$$

where:

$\boldsymbol{p}$: the total population of a country in 2015. The data were obtained from the United Nations, Department of Economic and Social Affairs (United Nations, 2019).

Here, the EEIO analysis is performed using the statistical program R version 4.0.2 (2020-06-22) (Bates et al., 2020).

4.2.2 ECONOMIC ESTIMATE OF EEIO RESULTS

Social costs represent all direct and indirect losses incurred by third persons or the general public as a consequence of unrestricted economic activities (Kapp, 1963). The U.S. government defines the social cost of carbon as being "intended to include (but not limited to) changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change" (Interagency Working Group on Social Cost of Carbon, 2013, p. 2). As regards the social costs of non-CO_2 emissions, they encompass the impacts on the same spheres (e.g., health, agriculture) even if their effects are exercised through processes different than those for CO_2 (Shindell, 2015).

The choice of a discount rate plays an important role in evaluating future damages. Significant discussions have been generated about selecting the appropriate discount rate in analyses of climate change. Stern (2007) placed most of the importance on strong action now to combat climate change and used a discount rate of 1.4%. Nordhaus (2007) argued that selecting the discount rate should be consistent with the behavior reflected in market interest rates and preferred higher discount rates (3%; 4.3%).

To make the transition from analyzing the respective footprints in physical units to estimating them in monetary values, this study uses the results of the evaluation of the CO_2 and CH_4 social costs from Shindell et al. (2017) and the N_2O social costs from Shindell (2015). The scenarios with the two discount rates 1.4% and 3% are employed (table 4.2), which apply the DICE 2007 IAM damage function (Nordhaus, 2008). The social costs are modeled over 350 years, but the results exhibit minimum sensitivity to variations beyond 150 years because of the warming limit (Shindell, 2015).[25]

Table 4.2: Social costs of CO2, CH4, and N2O (USD per ton)[c]

Discount rate	CO_2	CH_4	N_2O
3%	81.16	4109.52	42295.48
1.4%	301.78	7487.44	70873.50

Source: (Shindell et al., 2017; Shindell, 2015).
[c] Original values were converted to USD 2015.

Attaching the monetary value to the total emissions *i* footprint of a country's household consumption per capita and to the embodied emissions *i* derived from consumption per sector enables us not only to perform their economic evaluation separately, but also to come to the aggregation of the respective emissions (CO_2, CH_4, N_2O). This aggregation is performed without incurring any aggregation bias in contrast to the common practice of using CO_2-equivalent values based on the GWP metric:

$$E_1^{tm} = \frac{\sum_{i=1}^{3} \sum E_{i1} * S_i}{p} \quad (4)$$

where:

$\boldsymbol{E_1^{tm}}$: the aggregated footprint of CO_2, CH_4, and N_2O emissions of a country's household consumption per capita in monetary values.

$\boldsymbol{S_i}$: is the social costs of emissions *i*.

$$E_1^{m} = \sum_{i=1}^{3} F_i * y_1 * S_i \quad (5)$$

[25] Health-related effects are also included in social costs: (1) climate-health impacts from the altering climate for CO_2, CH_4, and N_2O, and (2) composition-health impacts from degrading air quality (via ozone) for CH_4.

where:

$\boldsymbol{E_1^m}$: the vector of aggregated CO_2-, CH_4-, and N_2O-footprints sector-wise caused each year by all of the sales to final demand category 1 (household final consumption).

$$F^m = \sum_{i=1}^{3} \; f_i * (I - A)^{-1} * S_i \qquad (6)$$

where:

$\boldsymbol{F^m}$: the aggregated intensity vector of CO_2, CH_4, and N_2O emissions embodied in consumption across sectors, which shows the total social costs of these emissions (in monetary values) occurring anywhere in the economy, in any sector, to produce 1 USD of output to final consumers from a given sector. In this regard, emissions costs that amount to 40 cents and more for the production of 1 USD of output for a given sector show that more stringent environmental regulations should be considered across the value chain. As according to Nordhaus (2007), the social costs resulting from carbon emissions could equal the carbon tax in an optimal regime.

4.2.3 SELECTION OF COUNTRIES FOR THE ANALYSIS

Three criteria were applied for selecting the relevant countries:

1) Data availability;
2) Geographical diversity;
3) Level of development.

According to the first criteria from the EORA26 EEMRIO table for 2015, only those countries were selected for which a sector-wise balance (a sector's input ≈ a sector's output) is observed. 139 countries fulfilled this criterion. As a second criterion, the World Bank classification of geographical regions was used: (1) East Asia and Pacific, (2) Europe and Central Asia, (3) Latin America and Caribbean, (4) Middle East and North Africa, (5) North America, (6) South Asia, and (7) Sub-Saharan Africa. For the third criterion, the current World Bank classification of countries by income level was applied: (1) high income (HIC), (2) upper middle income (UMC), and (3) lower middle income (LMC) and low income (LIC).

As this study demonstrates a special focus on developing economies, from each geographical region, one UMC and one LMC (or LIC) country were selected for the analysis. In North America, only HIC nations were found, which is why no country fulfilled the selection criteria for this region. In South Asia, the only UMC country was the Maldives, but it was considered not quite representative of the region. Instead, Sri-Lanka was selected. Sri-Lanka exhibited the second largest gross national income per capita in the region, although it was in the LMC category. As a result (fig. 4.1), the countries selected in each region, on the one hand, fit the global pattern of UMC or LMC (or LIC) development (the blue vertical line in fig. 4.1 separates the two groups of countries) and, on the other hand, exhibit at least a 30% difference between their GDP per capita at a regional level.

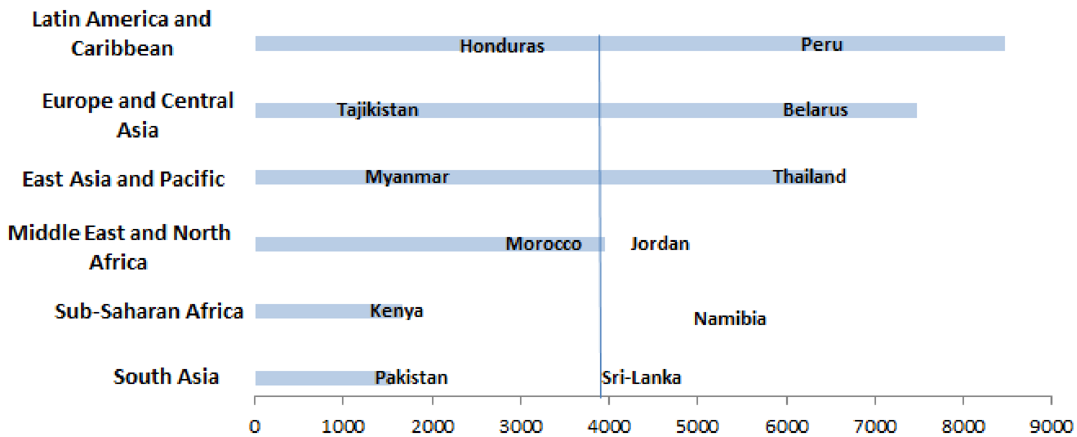

Figure 4.1: Regional GDP per capita (excluding high income) and country GDP per capita for 2015 in current USD for selected economies

Note: author's construction based on World Bank (2020).

The only HIC country selected for the analysis was Germany, for two reasons. First, Germany exhibited one of the strictest permissible emissions levels for air pollutants on the continent. Second, in the European context, Germany played the leading role in the use of emission-reducing technologies (Weidner, 1995). Between 2007 and 2013, Germany tripled its number of clean technology patents (Smith, 2015), which is why benchmarking the results of developing economies using such a country is worthwhile.

4.3 RESULTS AND DISCUSSION

Table 4.3 presents the structure of the CO_2-footprint by the final demand category in the countries under analysis. The structures of the CH_4- and N_2O-footprints do not differ much from the CO_2-footprint (tables C.2 and C.3 in Appendix C). The share of the footprint attributable to the final household consumption varies between 48.37% and 84.56%. The share of household consumption takes the first place among all the other demand categories. Ivanova et al. (2016), who analyzed the GHG-footprint structure for a sample of mostly HIC and UMC countries using the EXIOBASE database for 2007, found that the share of households in the GHG-footprint amounted to 65±7%. The share of household consumption in the carbon footprint of the United States reached 70% in 2012 and in the United Kingdom – 69% for the same year (Mi et al, 2020). In contrast to these findings, in some LMC economies (Myanmar and Pakistan), this share is definitely higher (approximately 84%). On the whole, except for Jordan and Kenya, in the sample of countries being analyzed, LIC and LMC economies tend to exhibit a higher share of household consumption in the CO_2-footprint (67.63–84.56%) than HIC and UMC nations (48.37–65.69%). One possible reason is that the share of gross fixed capital formation is generally larger in UMC and HIC countries because they have much more construction and infrastructure development.

Table 4.3: Structure of CO2-footprint by final demand category in 2015, %

Development level	Countries	Households	NPISH	Governments	Gross fixed capital formation	Changes in inventories	Acquisitions less disposals of valuables
HIC	Germany	57.11	1.22	15.38	26.48	-0.38[d]	0.19
UMC	Belarus[e]	65.69	1.01	12.28	20.97	0.05	-[f]
LIC	Tajikistan	73.02	9.11	7.61	6.07	0.68	3.51
LMC	Myanmar	84.31	1.35	7.15	6.80	0.35	0.04
UMC	Thailand	48.37	2.77	9.85	22.95	12.41	3.64
LMC	Honduras	70.29	4.79	6.85	15.37	0.97	1.73
UMC	Peru	57.50	3.84	10.01	23.48	1.30	3.86
LMC	Morocco	67.63	3.07	9.66	17.81	-0.21	2.05
UMC	Jordan	70.72	6.41	9.10	10.97	0.41	2.40
LMC	Sri-Lanka	70.01	5.29	5.89	15.17	0.44	3.19
LMC	Pakistan	84.56	1.03	4.92	8.11	0.79	0.59
LMC	Kenya	56.49	11.83	11.85	17.37	0.27	2.18
UMC	Namibia	52.92	11.61	13.91	15.65	0.23	5.67

Source: author's own calculation using the EORA26 model (Lenzen et al., 2015).

[d] The negative values in the "Changes in inventories" category indicate that part of the gross output "was supplied by a drawdown of existing inventory" (Lenzen et al., 2015); that is, emissions from the production of this part of the gross output were saved.

[e] Table C.1 in the Appendix C presents supplementary material on the EEIO model for Belarus.

[f] The EEIO model based on the input-output table from the National Statistical Committee of the Republic of Belarus includes the same categories as the EORA26 EEMRIO model, except for the "acquisitions less disposals of valuables."

The CO_2-, CH_4-, and N_2O-footprints attributable to household final consumption in physical units per capita reveal important differences among countries and the respective gases (table 4.4). For illustrative purposes, the aggregated footprint in tons of CO_2-equivalents is also presented. Table C.4 in the Appendix C provides the CO_2-, CH_4-, and N_2O-footprints in physical units per capita and tons of CO_2-equivalents of all demand categories (the national footprints). The CO_2-footprints of household final consumption and all demand categories together (table C.4 in the Appendix C) in developing countries (UMC and LMC/LIC) are much lower than in developed countries—in this example, Germany. That also finds its reflection in the amount of GHGs-footprints when all gases are converted to CO_2-equivalents (table C.4 in the Appendix C). At the same time, developing countries from different geographical regions (Europe and Central Asia, East Asia and Pacific, Sub-Saharan Africa, Middle East, and North Africa) outperform the developed countries regarding their CH_4- and N_2O-footprints per capita. This is a clear indication that more attention should be given to these gases when designing an environmental policy in non-HIC countries. The data from the World Bank's Carbon Pricing Dashboard (World Bank, 2020b) show that only four developing countries in 2015 (Bulgaria (UMC), Kazakhstan (UMC), Mexico (UMC), and Ukraine (LMC)) had some sort of GHG emissions legislation. From the aforementioned countries, only Bulgaria as a member of the European Union implemented regulations for CO_2 and N_2O emissions; the legislation for all other economies concerned only CO_2 emissions.

Our findings about the importance of bringing CH_4 emissions into a policy discourse are in line with the United Nations Environment Programme and Climate and Clean Air Coalition (2021). It suggests that climate change could be mitigated at decadal time scales by methane emissions reductions. Fernández-Amador et al. (2020) as well point out that although being important for global warming, methane has been to a large extent absent from economic and political debates and not targeted by environmental policies.

Table 4.4: CO2-, CH4-, and N2O-footprints of household final consumption in physical units per capita and tons of CO2-equivalents in 2015[26]

Countries	CO_2-footprint (tons per capita)	CH_4-footprint (tons per capita)	N_2O-footprint (tons per capita)	Aggregate footprint of CO_2, CH_4, and N_2O emissions (in tons of CO_2-equivalents per capita)
Germany	5.81	0.0319	0.0013	7.04
Belarus	3.05	0.0335	0.0023	4.59
Tajikistan	0.50	0.0213	0.0011	1.38
Myanmar	0.35	0.0474	0.0011	1.97
Thailand	2.05	0.0221	0.0005	2.81
Honduras	0.86	0.0192	0.0007	1.58
Peru	1.45	0.0220	0.0009	2.31
Morocco	1.11	0.0158	0.0017	2.00
Jordan	2.12	0.0147	0.0004	2.65
Sri-Lanka	0.96	0.0122	0.0004	1.41
Pakistan	0.71	0.0257	0.0007	1.63
Kenya	0.31	0.0172	0.0006	0.94
Namibia	2.04	0.0693	0.0025	4.65

Source: author's own calculation using the EORA26 model (Lenzen et al., 2015).

Figs. 4.2 and 4.3 present the aggregated footprint for CO_2, CH_4, and N_2O of household consumption per capita in monetary values at 3% and 1.4% discount rates, respectively. At a 3% discount rate, Tajikistan, Myanmar, Honduras, Pakistan, Kenya, and Namibia exhibit a higher share of CH_4 than CO_2 in the aggregated footprint of household consumption. In this scenario, the contribution of CH_4 to the

[26] As it has been mentioned in our definition of 'footprint', these results include embodied emissions and do not include direct emissions from household consumption.

footprint in Myanmar is the largest, at 72.22%. In contrast, it is the lowest in Germany, at 19.95%. It is difficult to compare our results with other research findings directly, as the majority of research does not disaggregate the GHG emissions footprint into separate gases. Nevertheless, literature on spatial distribution of CH_4 emissions can be used to back up our findings. According to Stavert et al. (2021), a steady decline is observed in CH_4 emissions in Europe between 2000 and 2017 but Southeast Asia and South Asia are among the top emitting regions. Reductions in European CH_4 emissions could be linked to decreases in emissions from livestock driven by the EU common agricultural policy (CAP) reforms (EUROSTAT, 2017) and in emissions from solid waste due to the EU Landfill Directive 1999/31/EC (EUROSTAT, 2014).

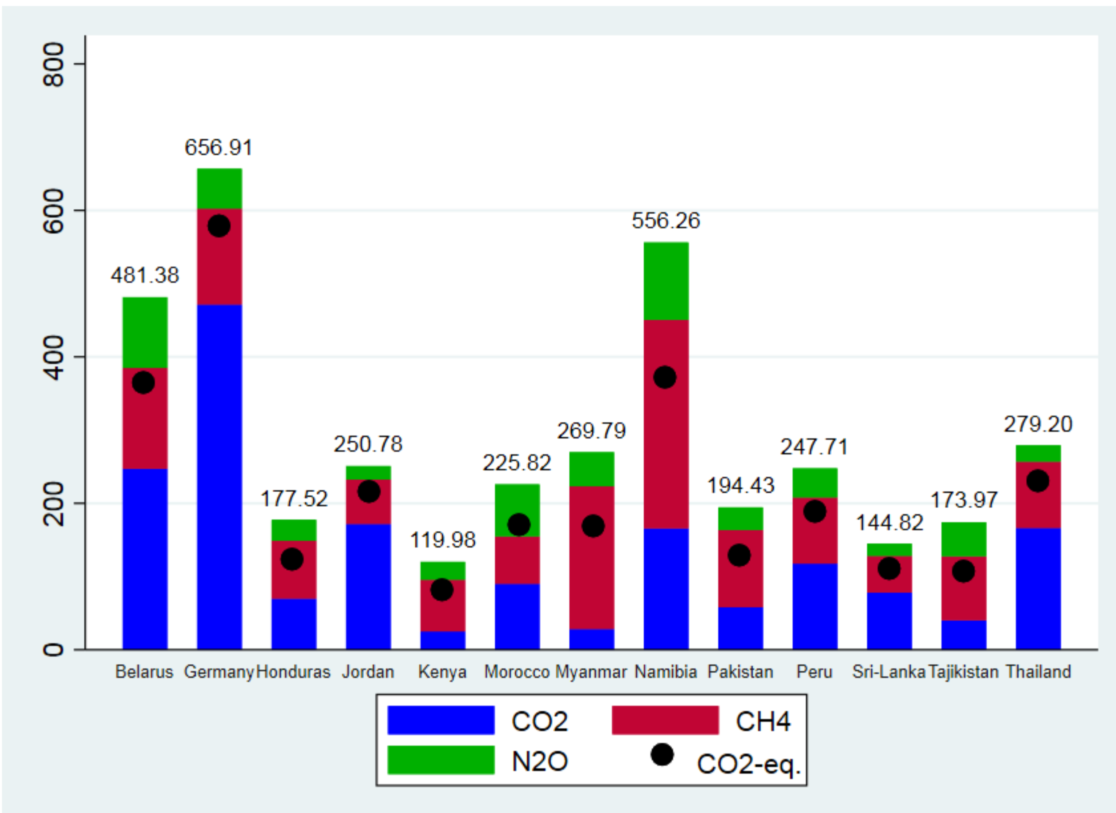

Figure 4.2: Aggregated footprint of household consumption per capita in 2015 valued at 3% discount rate in USD per capita

Source: author's own calculation using the EORA26 model (Lenzen et al., 2015).

Among the countries being analyzed at a 3% discount rate, the share of N_2O is the highest in Morocco (31.37%) and Tajikistan (26.53%). The relative contribution of CH_4 and N_2O to the aggregated footprint is observed to also diminish as the discount rate decreases. Nevertheless, even at a 1.4% discount rate in Tajikistan (41.24%), Myanmar (65.92%), and Kenya (49.01%), the share of CH_4 is still larger than that of CO_2. Germany, Namibia, and Belarus are the leaders in the aggregated footprint for CO_2, CH_4, and N_2O of household consumption per capita in all scenarios. At the 3% discount rate, Germany takes first place, followed by Namibia and Belarus. At the 1.4% discount rate, Belarus surpasses Namibia, but Germany remains in the lead. At the 3% discount rate, Kenya and Sri-Lanka demonstrate the lowest aggregated footprint, but it is Kenya and Tajikistan at the 1.4% discount rate. Depending on the scenario, the footprint in Kenya is from 5.48 (at 3%) to 7.93 (at 1.4%) times lower than the largest footprint in the given scenario.

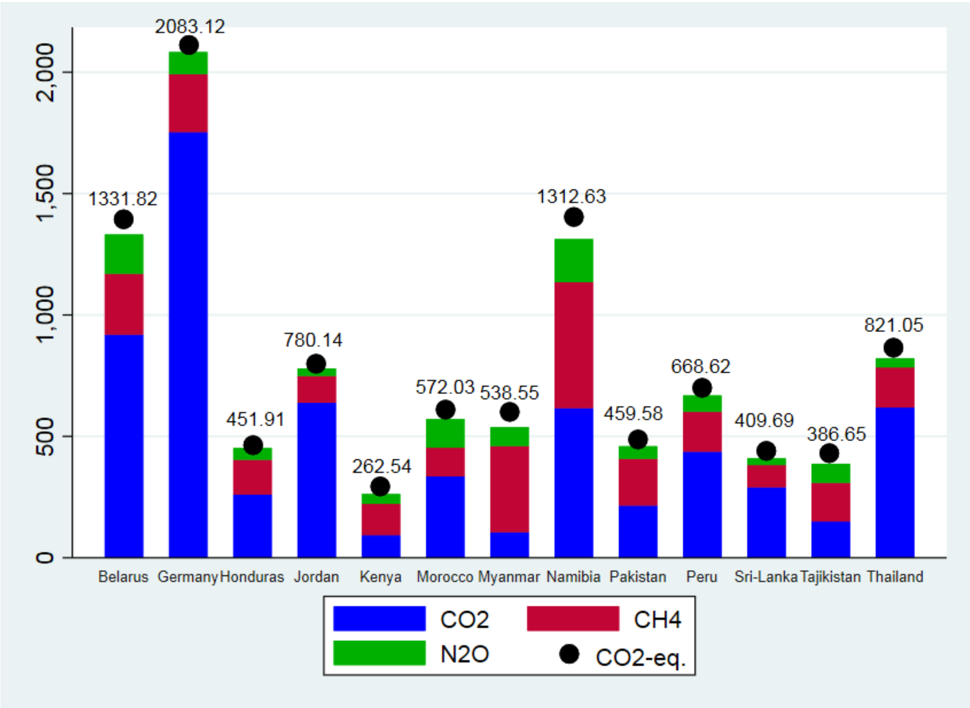

Figure 4.3: Aggregated footprint of household consumption per capita in 2015 valued at 1.4% discount rate in USD per capita

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Attention should be paid to the fact that the footprint of household consumption converted to CO_2-equivalents and estimated at the CO_2 rate either underestimates or overestimates the true value of social costs calculated on the basis of the separate rates for CO_2, CH_4, and N_2O. At the 3% discount rate, the CO_2-equivalent footprint underestimates the impact from 1.15 (in Germany) to 1.69 (in Myanmar) times. The 1.4% discount rate represents the scenario in which the difference between two estimations is at its minimum and for which the true impact is lower (1.99–9.37%) than that estimated with the help of CO_2-equivalents. When estimating the social costs of emissions embodied in household consumption and other final demand categories, separately valuing different GHGs is important.

The research findings from the developed countries (Spangenberg and Lorek, 2002; Tukker and Jansen, 2006) show that building/housing, mobility, and food are the most resource-intensive areas of household consumption. Table 4.5 provides the aggregated footprint for CO_2, CH_4, and N_2O of the household consumption per capita in monetary values (at the 1.4% discount rate) in the aforementioned areas and in the "Textiles and Wearing Apparel", "Agriculture" and "Construction" sectors. Tables C.5-C.29 in the Appendix C contain more detailed information on the embodied emissions of household consumption in different sectors at the 1.4% and 3% discount rates for each country being analyzed. The results show that not only building/housing (which can be connected to the "Electricity, Gas and Water" category) and food and mobility (which can be represented by the "Transport" category) but also clothing (which can be represented by the "Textiles and Wearing Apparel" category) and agriculture belong to the sectors with a substantial household consumption impact. In this regard, clothing and agriculture should also be added to the spheres in which consumers can make a difference and could be stimulated to act more sustainably. It is especially important for developing countries, in which agriculture is one of the key sectors. According to Stavert et al. (2021), CH_4 emissions in East Asia and Pacific and in Latin America come mostly from agriculture and waste sectors and wetlands, in South Asia the majority of these emissions are of agriculture and waste origin. At the same time, the "Construction" category (which can be connected to building/housing) does not seem to be the major contributor to environmental impacts exerted by household consumption in developing countries. It is important to keep in mind here that the footprints in the "Construction" for household consumption (table 4.5) do not include infrastructural projects as they are attributed to gross fixed capital formation demand category.

The highest variation in the aggregated footprints is observed in the "Electricity, Gas and Water" category, from 2.44 USD per capita in Kenya to 533.82 USD per capita in Belarus at the 1.4% discount rate. The reason for this variation is that the electricity mix options among the countries under analysis are very diverse. Belarus and Namibia exhibit the largest aggregated footprint in this category. Except for Germany, Thailand, Peru, and Kenya, the impact from "Electricity, Gas and Water" outperforms all other categories. The significant diversity in the aggregated footprint values for "Electricity, Gas and Water" among the countries and the fact that the footprint is relatively small for Germany point out the existence of possibilities to bring it down substantially. These findings also imply the importance of moving energy systems away from fossil fuels.

In the "Textiles and Wearing Apparel" category, the largest share of the imported footprint is observed. In HIC and UMC nations, the aggregated footprint for this sector is larger than in LMC/LIC countries across all geographical regions (except for Sri-Lanka). The situation is similar for "Food and Beverages" but within each separate geographical region; every presented UMC country exhibits a larger aggregated footprint in the "Food and Beverages" sector than an LMC (or LIC) nation in the same region (except for South Asia). This finding indicates that countries tend to exert a stronger environmental impact in the clothing and food sectors as their development levels increase. From a policy perspective, this moment should not be missed to promote more sustainable consumption in these two areas.

At the 3% discount rate in Myanmar, Pakistan, and Kenya in all of the represented sectors, in Tajikistan and Honduras in "Electricity, Gas and Water," "Food and Beverages," and "Agriculture," and in Namibia in "Electricity, Gas and Water" and "Food and Beverages" (tables C.5-C.29 in the Appendix C), the CH_4 content in the aggregated footprint for CO_2, CH_4, and N_2O of the household consumption is larger than CO_2. This finding again implies that, with respect to policies, much more attention should be given to the CH_4-footprint and its reduction in LMC and LIC countries.

Table 4.5: Aggregated CO2, CH4, and N2O footprint of household consumption valued at the 1.4% discount rate in various sectors (in USD per capita) in 2015

1.4%	Electricity, Gas and Water		Food and Beverages		Transport		Textiles and Wearing Apparel		Agriculture	
	Total	% of Import	Total	% of Import	Total	% of Import	Total	% of Import	Total	% of Import
Germany	**53.85**	0.59	**233.53**	32.57	**79.93**	21.05	**214.71**	88.23	**45.05**	62.78
Belarus[g]	**533.82**	-	**147.33**	-	**30.34**	-	**24.51**	-	**41.33**	-
Tajikistan	**184.02**	1.68	**14.96**	21.41	**9.82**	59.34	**9.84**	76.40	**1.06**	43.88
Myanmar	**404.65**	0.00	**19.26**	0.00	**3.98**	0.01	**2.87**	0.06	**1.93**	0.02
Thailand	**22.34**	0.21	**125.04**	5.85	**59.58**	13.97	**96.18**	11.35	**17.58**	5.31
Honduras	**225.31**	0.09	**27.68**	14.88	**9.37**	40.26	**10.46**	70.75	**3.00**	21.12
Peru	**9.14**	0.19	**129.59**	3.45	**44.19**	7.99	**46.76**	7.38	**29.96**	2.72
Morocco	**325.29**	0.01	**30.73**	5.18	**8.02**	19.11	**14.01**	61.60	**3.52**	9.42
Jordan	**426.33**	0.03	**48.75**	16.60	**15.53**	42.22	**44.47**	88.90	**6.16**	22.68
Sri-Lanka	**241.09**	0.02	**20.20**	19.10	**7.28**	35.36	**13.06**	76.81	**3.24**	12.69
Pakistan	**240.18**	0.00	**21.51**	1.22	**6.11**	7.25	**5.47**	18.89	**1.66**	4.63
Kenya	**2.44**	0.83	**47.64**	3.10	**48.20**	15.71	**8.03**	25.77	**47.65**	1.92
Namibia	**527.31**	0.08	**75.48**	26.86	**38.60**	42.94	**45.97**	80.66	**9.48**	46.63

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

[g] As for Belarus, using EEMRIO model was not possible, and the footprints do not include the emissions embodied in imports; see Appendix C. The values for the "Textiles and Wearing Apparel" category for Belarus include the footprints from "Textiles and Wearing Apparel" and "Leather and Footwear."

Table 4.5: Continuation

1.4%	Construction	
	Total	% of Import
Germany	**7.63**	0.00
Belarus	**4.19**	-
Tajikistan	**0.10**	17.96
Myanmar	**0.09**	0.17
Thailand	**0.27**	0.19
Honduras	**0.14**	2.82
Peru	**0.83**	0.18
Morocco	**0.17**	0.91
Jordan	**0.27**	1.59
Sri-Lanka	**0.10**	1.55

Pakistan	**0.12**	0.19
Kenya	**0.0015**	84.38
Namibia	**0.48**	3.42

The results presented in table 4.5 can be implicitly confirmed by the conclusions reached by the IPCC (2022b). They cannot be directly compared to the IPCC calculations as they represent only the footprints coming from household consumption and not all demand categories. But the distribution of major sectors that contribute to emissions is quite similar in both findings. According to the IPCC (2022b), 34[27]% of global GHG emissions are attributed to the energy sector, 24% – to industry, 22% – to agriculture, forestry and other land use, 15% – to transport, 5.6% – to buildings.

Fig. 4.4 represents the sectors (five for each country being analyzed) with the highest social cost of aggregated CO_2, CH_4, and N_2O emissions across the value chain to produce 1 USD of output to final consumers at the 1.4% discount rate. Fig. C.1 in the Appendix C presents the values for the 3% discount rate. The analysis of these sectors indicates the level of technological efficiency of the respective economies.

In Belarus, Tajikistan, Myanmar, Honduras, Morocco, Jordan, Sri-Lanka, Pakistan, and Namibia, the social costs of the emissions from the “Electricity, Gas and Water” sector exceed its output already at the 3% discount rate. Moreover, “Electricity, Gas and Water” is the only sector for which the social costs of the aggregated emissions surpass the outcome at the 1.4% discount rate in all of the aforementioned countries (ranging from 5.03 USD in Sri-Lanka to 37.03 USD per 1 USD of output in Myanmar). Therefore, this sector should be given central importance when developing GHG emissions reduction industrial policies in the given countries. In this regard, there is a lot of potential in applying renewable energy on a large scale (Le et al., 2021). It is worth emphasizing that in Tajikistan, Myanmar, Honduras, Pakistan, and Namibia, the share of CH_4 in the social costs of the aggregated emissions from “Electricity, Gas and Water” is higher than the share of CO_2 at the 3% discount rate. In Tajikistan, Myanmar, and Namibia, this share continues to be higher even at the 1.4% discount rate, implying that developing countries’ energy policies should be much more oriented to decreasing CH_4 emissions. Germany, Thailand, Peru, and Kenya do not exhibit problems with the technological efficiency of the “Electricity, Gas and Water” sector.

[27] The calculations are for the year 2019.

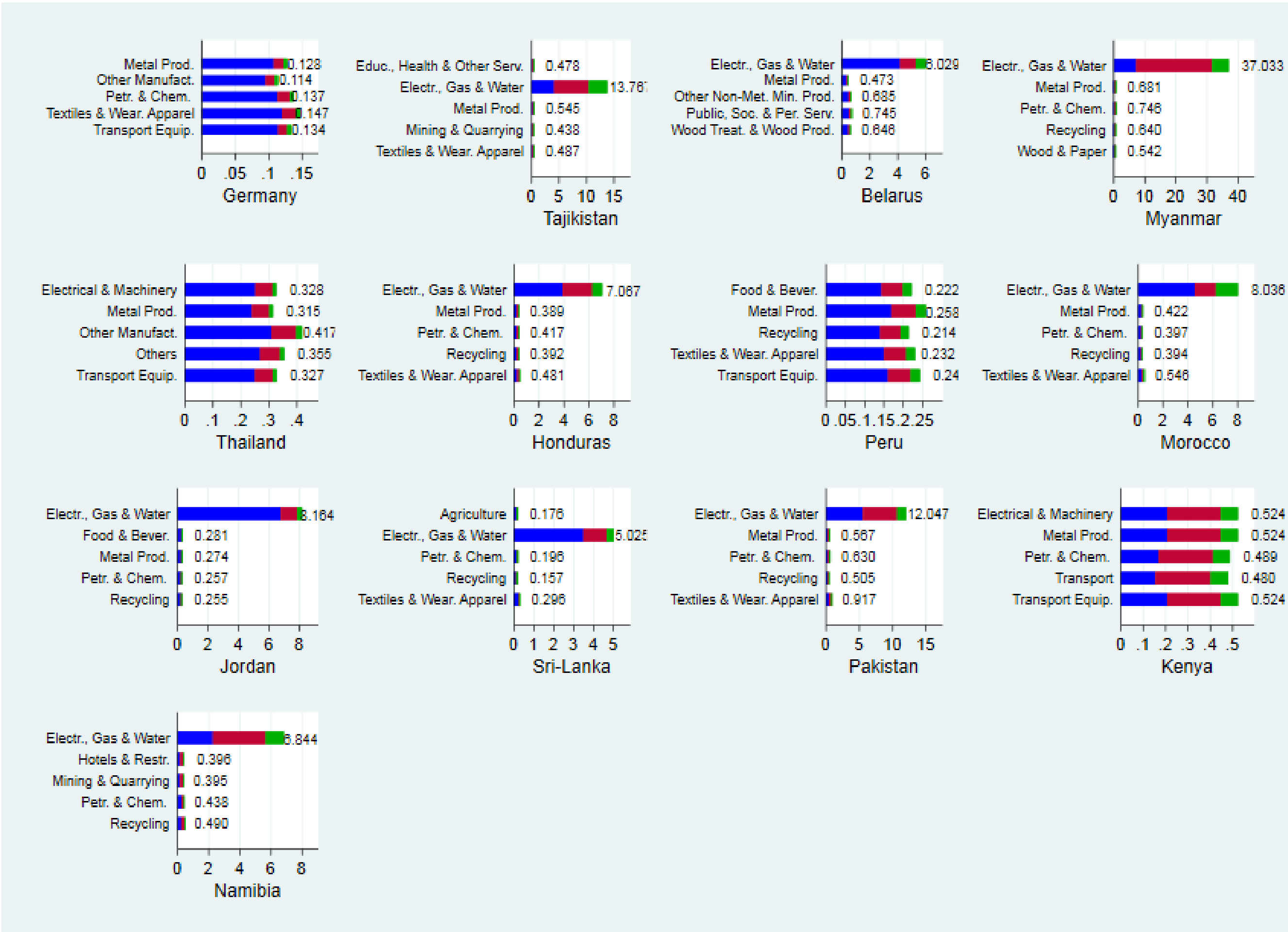

Figure 4.4: Sectors with the highest social costs of aggregated emissions per 1 USD of output (in USD per 1 USD of output) at the 1.4% discount rate in 2015

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015) and the data from National Statistical Committee of the Republic of Belarus (2020).

Note: blue represents CO_2, red – CH_4, green – N_2O.

Metal Prod. – Metal Products; Other Manufact. – Other Manufacturing; Petr. & Chem. – Petroleum, Chemical and Non-Metallic Mineral Products; Textiles & Wear. Apparel – Textiles and Wearing Apparel; Transport Equip. – Transport Equipment; Educ., Health & Other Serv. – Education, Health and Other Services; Electr., Gas & Water – Electricity, Gas and Water; Other Non-Met. Min. Prod. – Other Non-Metallic Mineral Products; Public, Soc. & Per. Serv. – Public, Social & Personal Services; Wood Treat. & Wood Prod. – Wood Treatment & Wood Products; Food & Bever. – Food & Beverages; Hotels & Restr. – Hotels & Restaurants.

Other sectors should also be considered when designing the environmental policy; however, because the social costs of their emissions exceed 40 cents at the 1.4% discount rate (i.e., 40% of their output value), the measures are not that urgent in comparison to "Electricity, Gas and Water." The most common of these sectors for the countries being analyzed are "Recycling"[28] (the social costs of its emissions surpass or are close to 40 cents per 1 USD of the output in Belarus, Myanmar, Honduras, Morocco, Pakistan, and Namibia), "Metal Products" (the social costs of its emissions surpass or are

[28] In Belarus, this sector is represented under the "Public, social and personal services" category.

close to 40 cents per 1 USD of the output in Belarus, Tajikistan, Myanmar, Honduras, Morocco, Pakistan, and Kenya), "Petroleum, Chemical and Non-Metallic Mineral Products" (the social costs of its emissions surpass or are close to 40 cents per 1 USD of the output in Myanmar, Honduras, Morocco, Pakistan, Kenya, and Namibia). In the "Metal Products" sector at the 1.4% discount rate in Tajikistan, Myanmar, and Kenya (out of all of the countries with social costs of emissions that surpass or are close to 40 cents per 1 USD of the output), the social costs of CH_4 emissions per 1 USD of output are higher than of CO_2.

Among all of the countries under analysis, Germany demonstrates the highest technological efficiency regarding GHG emissions. At the 1.4% discount rate, the social costs of the GHG emissions from the sectors with the highest social cost of aggregated CO_2, CH_4, and N_2O emissions across the value chain do not exceed 0.15 USD per 1 USD of output. Germany is followed by Peru for which the costs do not exceed 0.26 USD per 1 USD of output, Jordan—with the highest costs of 0.28 USD (except for the "Electricity, Gas and Water" sector), and Sri-Lanka—with the highest costs of 0.30 USD (except for the "Electricity, Gas and Water" sector) at the 1.4% discount rate.

Germany is ahead of the other countries in terms of technological efficiency. Its environmental regulations for air pollutants are also some of the strictest on the continent. At the same time, its aggregated footprint for CO_2, CH_4, and N_2O of household consumption per capita in monetary values at the 3% and 1.4% discount rates is the largest among all countries under analysis. This finding brings us to the most important conclusion of this study: technological efficiency and environmental regulations alone are not sufficient for sustainable consumption, and more focus should be placed on the change in consumers' behavior needed to achieve it. Greenford et al. (2020) has also arrived to the similar conclusion in their research showing that technological efficiency and shifting economic activity to services will not be of great help to reduce environmental impacts. For that prevailing patterns of consumption should be addressed.

4.4 CONCLUSIONS

This paper provides insights into the environmental impact of CO_2, CH_4, and N_2O embodied emissions of household consumption and their social costs from 12 UMC and LMC/LIC countries in six different geographical regions benchmarked with Germany. Its main contribution is the analysis of GHGs separately rather than aggregated across the economic development spectrum. The GHGs specific analysis allows for the consideration of their peculiarities and, thus, more precisely estimating their social costs and as a result developing a more targeted and multidirectional environmental policy. This policy in the short term should tackle emissions such as CH_4 with a near-term impact and should be oriented in the long term on emissions with larger effects over long periods (such as CO_2 and N_2O). In addition, the study also identifies those sectors where the social costs of aggregated CO_2, CH_4 and N_2O emissions across the value chain make up a substantial share of the industries' output. Thus, it indicates the level of technological efficiency of the respective economies and the spheres where more stringent environmental regulation in relation to industries should be in place. The overall conclusion of the study suggests that to reach sustainable development not only technological efficiency and environment regulation but also behavior change in the population should be addressed.

LIC/LMC economies tend to have a higher share of household consumption in the national CO_2-footprint structure (67.63–84.56%) than HIC and UMC nations (48.37–65.69%). This comparison is also applicable for the national CH_4-footprint and N_2O-footprint structure. In this regard, environmental policies in LIC/LMC economies should be, first of all, oriented toward the population's behavioral change. This finding also implies the possibility that when more infrastructure starts to be developed in LIC/LMC countries, it could be from the very beginning done with the application of sustainable technologies.

Developing economies in contrast to the developed ones have much lower CO_2-footprints of household final consumption but exert a higher pressure on the environment with respect to CH_4- and N_2O-footprints per capita. That highlights the necessity to focus environmental policies in developing countries on tackling CH_4 and N_2O as a high priority.

In developing countries, areas of high impact consumer behaviors, in addition to housing/building, food, and mobility (these areas were defined on the basis of the research on developed countries), also include clothing and agriculture. Effective GHGs emission reduction policies should stimulate consumers to act sustainably in these areas, which will contribute to achieving SDG 12. The findings also show that the aggregated footprint of the CO_2, CH_4, and N_2O emissions of household consumption per capita in UMC countries is higher for the "Textiles and Wearing Apparel" and "Food and Beverages" sectors than in LMC/LIC countries of the same geographical region (except for South Asia). Therefore, when these LMC/LIC countries increase their development levels, their environmental impact in the clothing and food sectors will possibly grow. From a policy perspective, this moment should not be missed to promote more sustainable consumption in these two areas.

The "Electricity, Gas and Water" sector exhibits social costs of the CO_2, CH_4, and N_2O emissions that surpass its output already at the 3% discount rate in nine out of 13 countries being analyzed. That brings attention to the urgent necessity to increase this sector's technological efficiency regarding GHGs in the respective economies. The other sectors that have problems with the level of technological efficiency and that should be under more stringent environmental regulations across the value chain include "Recycling", "Metal Products", "Petroleum, Chemical and Non-Metallic Mineral Products".

4.5 LIMITATIONS AND FUTURE RESEARCH FRONTIERS

The limitations of this study mostly stem from those inherent to the EEIO analysis. One of the biggest limitations of the EEIO approach is based on its homogeneity assumption, i.e. that each sector in the economy produces a single, homogenous item of goods or service (Kitzes, 2013). Thus, a product sold from a given industry to another industry or to its final consumers is assumed to be the same and carry an identical environmental impact (Kitzes, 2013). An EEIO table with a larger degree of sectors' disaggregation can contribute to improving the precision of the results regarding this assumption.

Greater effort should be made to achieve a sector-wise balance (a sector's input ≈ a sector's output) for countries in global EEMRIO models and to improve the convergence of the results among different models. Better allocation of territorial emissions among the sectors will help raise the precision of the footprints of all final demand categories.

CHAPTER 5: CONCLUSIONS

This dissertation contributes to understanding the economics of consumer and business behavior related to environment on three levels. In chapter two on a micro-level it investigates how exposure to information through different media channels (TV, radio, newspapers, and the Internet) can influence consumer sustainable and unsustainable behavior. In chapter three on a meso-level it explores whether application of cleaner technologies brings productivity improvement and increases the export intensity of an enterprise. In chapter four on a macro-level it analyzes the environmental impacts in the form of CO_2-, CH_4-, and N_2O-footprints from the final household consumption and their subsequent social costs in 13 countries at different level of development.

In the second chapter, applying SEM we attempt to reproduce the real life conditions in which individuals can be exposed to both climate change information and information promoting overconsumption through different media channels. Combining the ABC theory (Guagnano et al., 1995; Stern 2000) with the analytical framework from *Identity Economics* (Akerlof and Kranton, 2009) to develop the models we show that theories from different disciplines can complement each other when the economic behavior of individuals is studied as suggested by Shiller (2020). To improve the precision of our results we classify sustainable consumption behavior into two groups (pro-active behavior and promotional and accommodating actions) which include intent- and impact-oriented activities. We find that climate change media use can positively affect promotional and accommodating actions and through them positively indirectly influence pro-active behavior. It implies that individuals first need some form of engagement with this kind of information, for example, through discussing it with others, before they are ready to undertake pro-environmental actions. It also points out the importance of social interaction as two out of three behaviors included into promotional and accommodating group are actions exercised with other people. The findings also suggest that consumerism media use does not impact any group of sustainable consumption behavior. But once consumerism media use is taken into account, the indirect positive effect from exposure to climate change information on pro-active behavior diminishes a bit. Besides, exposure to information promoting overconsumption positively affects unsustainable consumption behavior. The positive effect of consumerism media use on unsustainable consumption behavior is stronger than the effect of climate change media use on pro-active sustainable behavior. These results point at the importance of emotions at play and the presentation of information when dealing with two distinct groups of information. Advertisements promoting luxurious lifestyle and buying more stuff to be happy with images of highly successful people using the goods advertised can elicit quite strong emotions in consumers related to happiness and success in life. On the contrary, information about climate change and other environmental issues is quite often perceived as abstract and difficult for individuals to relate personally.

From a policy perspective, the results of chapter two suggest that it is important to create positive and engaging narratives about climate change and sustainable living taking into account framing and visual images in order to promote more interactions of people with these topics. That in the end can translate into more often exercised pro-active sustainable consumption behavior. This can be achieved at least through three channels: (1) by providing education on climate change and sustainable living at kindergarten-, school-, and university-levels; (2) by educating journalists on environmental topics; (3) by engaging the general public into workshops and seminars on these topics organized by non-profit environmental entities and others. In addition, the government can attempt to downplay the emotional appeal of advertising promoting consumerism. It can make it obligatory that advertisements include information about the negative footprint for the environment generated during the production (or the whole lifecycle) of the particular product they advertise.

In chapter three, we explore environmental implications of trade relationships and productivity (total productivity, resource productivity, and labor productivity) at the firm-level for a developing export-oriented economy. The contribution of this chapter lies in its research design by which bidirectional relationships between application of cleaner technologies and exporting are investigated. This is unlike in the majority of the empirical literature which focuses either on whether exporting affects environmental performance of enterprises or whether environmental performance exerts an effect on exporting, although the latter case is not very numerous. The results point at several important things to consider in business behavior related to environment. First, there is no statistically significant evidence that with an increase in export intensity enterprises in Belarus are going to adopt environmentally friendly measures more. The same relates to productivity. The improvement in productivity does not stimulate enterprises to invest more in cleaner technologies. These findings imply that in developing countries like Belarus enterprises tend to not have an intrinsic motivation to be environmentally pro-active, even if they are better positioned to absorb the costs of environmentally friendly measures (like more productive exporting enterprises). This is to some extent attributed to the fact that enterprises lack the understanding whether they can benefit from the adoption of cleaner technologies.

Second, in line with the theory (Porter and Linde, 1995), application of one more environmentally friendly measure within a company is associated with a 4.441% – 4.613% increase in the enterprise's export intensity. This effect is statistically significant at a 1% level in the models with different productivity variables. This result suggests that improving the environmental performance of an enterprise by applying cleaner technologies can broaden its sales base by attracting more environmentally conscious customers abroad. Third, the effect of adopting environmentally friendly measures on productivity varies depending on a type of productivity being examined. Adoption of one more environmentally friendly measure brings a 20.7% improvement in labor productivity. Adoption of different cleaner technologies can lead to the improvement of production processes through their automation (for example, machinery and equipment upgrades, waste minimization) and, thus, result in reducing the demand for labor. At the same time, the effect of applying cleaner technologies within an enterprise on its resource productivity is negative. Adoption of one more environmentally friendly measure is associated with a 1.864% decrease in resource productivity. Application of environmentally friendly measures can be costly for enterprises and can shift investments from other productive activities. As Ayerbe and Gorriz (2001) put it, adoption of cleaner technologies can be implemented before these technologies are developed enough from the production efficiency point of view. Many enterprises in Belarus also point at that direction. According to the results of the enterprise survey conducted among 403 companies in 2020-2021 in Belarus (Batova et al., 2021), the second most important barrier for the transition from a linear to a circular economy is lack of suitable technologies (60.2% of enterprises agree on that). In the end, the positive influence from adoption of cleaner technologies on labor productivity is neutralized by the negative influence on resource productivity, which translates in no effect on total productivity.

From a policy perspective, the results of chapter three suggest that enterprises should be stimulated externally either by the governments and consumers in their own countries or by the governmental regulations and their customers in the countries of their goods destination to become cleaner. They lack the intrinsic motivation to take care of the environment. It is important to promote collaboration between science and business community to accelerate the creation of cost-effective cleaner technologies. This collaboration can shift companies' view of environmentally friendly measures from being a burden to being a channel helping to improve company's performance in the international market.

In chapter four, we analyze household consumption-based emissions (CO_2, CH_4, N_2O) across the value chain of goods and services for upper middle income, lower middle income, and low income countries from six different geographical regions benchmarking the results with Germany. Employing an environmentally extended input-output model, we track sector-wise CO_2, CH_4 and N_2O-footprints separately and assess their social costs at 3% and 1.4% discount rates. This sector-wise and GHG specific analysis across the economic development spectrum is our novel contribution to the literature. Analysis of the GHG separately rather than aggregated based on GWP metrics allows taking into consideration their peculiarities (e.g., time of residence in the atmosphere) and, thus, more precisely estimating their social costs. As a result a more targeted and multidirectional environmental policy can be developed. In particular, the merit of this GHG specific analysis consists in bringing CH_4 and N_2O to the agenda which are not given proper attention in the climate policy debates despite their important role in tackling climate change. According to United Nations Environment Programme and Climate and Clean Air Coalition (2021), reductions in CH_4 emissions could mitigate climate change at decadal time scales. The findings suggest several major things related to environment to consider at the macro-level. First, in LIC/LMC economies final household consumption has a higher share in the national CO_2-footprint structure (67.63–84.56%) than in HIC and UMC nations (48.37–65.69%), which is also attributable to the national CH_4-footprint and N_2O-footprint structures. That points at the fact that the share of gross fixed capital formation in the footprints is generally larger in UMC and HIC countries because they have much more construction and infrastructure development. Second, developing countries tend to have lower CO_2-footprints than developed economies but outperform them with respect to CH_4- and N_2O-footprints per capita. The areas with a substantial household consumption impact in developing countries include building/housing, food, mobility, clothing and agriculture. As regards Belarus in this analysis, its CH_4- and N_2O-footprints attributable to household final consumption in physical units per capita is bigger than in Germany. In terms of the aggregated footprint for these emissions from household consumption valued at 3% and 1.4% discount rates Belarus is among three leading countries (together with Germany and Namibia) under analysis. Moreover, the footprints in Belarus do not include the embodied emissions from import, i.e. the calculated values represent the lower boundaries of the true amount. In Belarus the environmental impact of embodied emissions in agriculture outperforms mobility and clothing sectors.

One can derive a number of policy implications from the results of chapter four. The most important ones are the following. When more projects related to infrastructure start to be launched in in LIC/LMC economies, they could be from the very beginning done on the basis of sustainable technologies. Environmental policies in developing countries should be to a larger degree focused on tackling CH_4 emissions in the short-term with their near-term impact and should be oriented in the long term on emissions with larger effects over long periods (N_2O and CO_2). Behavior change might have a significant potential in bringing down the environmental impacts of household consumption particularly in the areas of housing, mobility, food, agriculture and clothing.

On the whole, a general conclusion of this dissertation is that technological innovations in industries, environmental regulations in trade policy, and behavior change at the individual level can complement each other. None of these three elements alone is suffice for that purpose, which is of paramount importance to accomplishing the majority of the SDGs. Policy can identify coherent instruments to foster change working in the same direction in order to achieve responsible consumption and production.

There are several challenges that we have encountered due to the data availability that should be made explicit. In chapter two in which we investigate how exposure to information can influence behavior, the measurements of behavior are self-reported. It means that to some extent they could be subject to social desirability bias. Future studies may try to estimate the degree of social desirability and also complement the self-reported measures with other more objective measures of behavior. Besides, the online-survey conducted for the purposes of this chapter excludes the rural population of Belarus. Chapter two uses a three-item version of the Materialistic Values Scale. Although their reliability and validity levels in this research are still satisfactory, future studies may employ longer versions of the Materialistic Values Scale **(**a six-item or a nine-item one)**,** which may improve their levels of reliability and validity.

In chapter three in which we explore the bidirectional relationships between application of environmentally friendly measures, export intensity and productivity at the firm-level, we use the data from the Enterprise Survey (World Bank Group, 2023) collected between October 2018 and April 2019. To employ the Enterprise Surveys (World Bank Group, 2023) conducted for Belarus in the previous years is not possible as the "Green Economy Module" which data play the core role in this study was added to the survey only in 2018. As we are addressing a complex dynamic trade issue in chapter three, ideally panel data should have been used. That would also have helped to account for unobserved heterogeneity.

In chapter four in which we analyze the environmental impacts from final household consumption for 13 countries and apply an EEMRIO model that uses a common 26-sector classification for all countries, the limitations are mostly those inherent to the EEMRIO analysis. The homogeneity assumption, i.e. that each sector in the economy produces a single, homogenous item of goods or service, is considered one of the biggest limitations of the EEMRIO approach. It could be improved if EEMRIO tables with a larger degree of sectors' disaggregation are available. In addition, greater effort should be made to achieve a sector-wise balance (a sector's input ≈ a sector's output) for countries in global EEMRIO models and to improve the convergence of the results among different models. As the EEMRIO table for Belarus in 2015 from the EORA26 database is highly imbalanced sector-wise, for this country we use the national input-output table merged with the GHG emissions inventory satellite accounts from EORA26. The footprints calculated on the basis of that for Belarus do not include the emissions embodied in import and, thus, represent the lower boundaries of the true amount. Finally, the EEMRIO tables could be updated more often.

BIBLIOGRAPHY

Abramchuk, N. (2016). Foreign Trade Assessment in Belarus: the Aspect of Goods. *Bank Bulletin, 2,* 46–53.

Acock, A. C. (2013). Discovering Structural Equation Modeling Using Stata. Rev. ed. College Station, TX: Stata Press.

Akerlof, G.A. & Kranton, N.E. (2010). *Identity Economics: How Our Identities Shape Our Work, Wages, and Well-Being.* Princeton University Press.

Akerlof, R. J. (2009a). A Theory of Social Motivation. Chapter 1 in "*Essays in Organizational Economics*". PhD thesis, Harvard University, Cambridge, MA.

Akerlof, R. J. (2009b). A Theory of Authority. Chapter 2 in "*Essays in Organizational Economics*". PhD thesis, Harvard University, Cambridge, MA.

Afonso, C., Akehurst, G., & Martins Gonçalves, H. (2012). Re-examining green purchase behaviour and the green consumer profile: new evidences. *Management Decision*, *50*(5), 972–988. https://doi.org/10.1108/00251741211227726.

Alpay, S., Yalcin, I., Dolekoglu, T. (2001). Export Performance of Firms in Developing Countries and Food Quality and Safety Standards in Developed Countries. *American Agricultural Economics Association Conference*, 17.

Al-Tuwaijri, S.A., Christensen, T.E., & Hughes, K. (2004). The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach. *Accounting, Organ. Soc. 29*, 447–471. https://doi.org/10.1016/S0361-3682(03)00032-1.

Amelung, T. (1991). The impact of transaction costs on the direction of trade: empirical evidence for Asia Pacific. *Journal of Institutional and Theoretical Economics (JITE)/Zeitschrift für die gesamte Staatswissenschaft*, 716-732.

Antweiler, W., Copeland, B.R., Taylor, M.S. (2001). Is Free Trade Good for the Environment? *American Econonomic Review*, *91*, 877–908. https://doi.org/10.1257/aer.91.4.877.

Awang, Z. (2014). Validating the measurement model : Cfa. *Structural Equation Modelling Using Amos Grafic*, 54–73.

Ayerbe, C. G., & Górriz, C. G. (2001). The effects of environmental regulations on the productivity of large companies: an empirical analysis of the Spanish case. *Journal of Management and Governance*, *5(2)*, 129-152.

Bagozzi, R.P. & Yi, Y. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the Academy of Marketing Science* 40, 8–34.

Balundė, A., Perlaviciute, G., & Steg, L. (2019). The relationship between people's environmental considerations and pro-environmental behavior in Lithuania. *Frontiers in psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.02319.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: W. H. Freeman and Company.

Bartelsman, E. J., & Doms, M. (2000). Understanding productivity: Lessons from longitudinal microdata. *Journal of Economic literature*, *38*(3), 569-594. https://doi.org/10.1257/jel.38.3.569.

Bates, D., Chambers, J., Dalgaard, P., Gentleman, R., Hornik, K., Ihaka, R., Kalibera, T., Lawrence, M., Leisch, F., Ligges, U., Lumley, T., Maechler, M., Morgan, M., Murrel, P., Plummer, M., Ripley, B. (2020). R: A language and environment for statistical computing.

Batrakova, S., & Davies, R. B. (2012). Is there an environmental benefit to being an exporter? Evidence from firm-level data. *Review of World Economics*, *148*, 449-474. https://doi.org/10.1007/s10290-012-0125-2.

Batova, N. & Tochitskaya, I. (2020). How Belarusian Business Understands Circular Economy: Research Using REP:GRID. *BEROC Green Economy Policy Paper Series No. 13.*

Batova, N., Tochitskaya, I., & Shershunovich, Y. (2021). Potential of Circular Economy Development in Belarus: Enterprise Survey Results. *BEROC Green Economy Policy Paper Series No. 26.*

Batova, N. & Tochitskaya, I. (2022). Green Economy Monitoring: ESG-Agenda. *BEROC Green Economy Policy Paper Series No. 30.*

BELHYDROMET (2022). Climatic characteristics of the summer in 2022. Retrived February 17, 2023 from https://belgidromet.by/ru/climatolog-ru/view/klimaticheskaja-xarakteristika-leta-2022-goda-5962-2022/.

Bernard, A. B., & Jensen, J. B. (1999). Exceptional exporter performance: cause, effect, or both?. *Journal of international economics*, *47*(1), 1-25. https://doi.org/10.1016/S0022-1996(98)00027-0.

Becker, G. S. (1993). Nobel lecture: The economic way of looking at behavior. *Journal of political economy*, *101*(3), 385-409.

Bhatia, V. (2019). Impact of fashion interest, materialism and internet addiction on e-compulsive buying behaviour of apparel. *Journal of Global Fashion Marketing*, *10*(1), 66-80. https://doi.org/10.1080/20932685.2018.1544502.

BIK Ratings (2022). *Methodology of Assigning ESG-Ratings to Companies, Cities and Regions*.

Bilharz, M., Lorek, S., Schmitt, K. (2008). Key points of sustainable consumption: focusing sustainability communication on aspects which matter and appeal, in: Geer Ken, Theo;Tukker, Arnold; Vezzoli, C., Ceschin, F. (Eds.), Sustainable Consumption and Production: Framework for Action: 2nd Conference of the Sustainable Consumption Research Exchange (SCORE!) Network, 287–307.

Blicharska, M., Smithers, R. J., Kuchler, M., Agrawal, G. K., Gutiérrez, J. M., Hassanali, A., ... & Mikusiński, G. (2017). Steps to overcome the North–South divide in research relevant to climate change policy and practice. *Nature Climate Change*, *7*(1), 21-27.

Blühdorn, I. (2007). Sustaining the unsustainable: Symbolic politics and the politics of simulation. *Environmental politics*, *16*(2), 251-275. https://doi.org/10.1080/09644010701211759.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research*. Guilford publications.

Burck, J., Uhlich, T., Bals, C., Höhne, N., Nascimento, L., Tavares, M., Strietzel, E. (2023). *2023 Climate Change Performance Index.* Germany: Germanwatch, NewClimate Institute & Climate Action Network.

Bush, V. D., & Gilbert, F. W. (2002). The web as a medium: an exploratory comparison of internet users versus newspaper readers. *Journal of Marketing Theory and Practice*, *10*(1), 1-10. https://doi.org/10.1080/10696679.2002.11501905.

Buysse, K., & Verbeke, A. (2003). Proactive environmental strategies: A stakeholder management perspective. *Strategic management journal*, *24*(5), 453-470. https://doi.org/10.1002/smj.299.

Cairncross, F. (1992). *Costing the earth* (Vol. 242). Boston: Harvard Business School Press.

Campos, J. G. F. D., & Mello, A. M. D. (2017). Transaction costs in environmental purchasing: analysis through two case studies. *Journal of Operations and Supply Chain Management (JOSCM)*, *10*(1), 87-102.

Carvalho, A. (2010). Media (ted) discourses and climate change: a focus on political subjectivity and (dis) engagement. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(2), 172-179.

Catellani, V., Beylot, A., Sala, S. (2019). Environmental impacts of household consumption in Europe: Comparing process-based LCA and environmentally extended input-output analysis. *Journal of Cleaner Production*, *240*. https://doi.org/10.1016/j.jclepro.2019.117966.

Chacko, P. S., Prashar, S., & Ramanathan, H. N. (2018). Assessing the relationship between materialism and conspicuous consumption: Validation in the Indian context. *Asian Academy of Management Journal*, *23*(2), 143-159. https://doi.org/10.21315/aamj2018.23.2.7.

Clarkson, R., Deyes, K. (2002). *Estimating the Social Cost of Carbon Emissions*. London.

Coase, R. H. (1937). The Nature of the Firm. *Economica*, *4*, 386–405. Reprinted in Oliver E. Williamson and Sidney Winter (eds) (1991), The Nature of the Firm: Origins, Evolution, Development. New York: Oxford University Press, pp. 18–33.

Cohen, M. A., Fenn, S., & Naimon, J. S. (1995). *Environmental and financial performance: are they related?*. Washington, DC: Investor Responsibility Research Center, Environmental Information Service.

Conrad, K., & Morrison, C. J. (1985). The Impact of Pollution Abatement Investment on Productivity Change: An Empirical Comparison of the US, Germany, and Canada. *Southern Economic Journal*, *55(3)*, 684–698.

Contzen, N., Handreke, A. V., Perlaviciute, G., & Steg, L. (2021) (a). Emotions towards a mandatory adoption of renewable energy innovations: the role of psychological reactance and egoistic and biospheric values. *Energy Research & Social Science*, *80*, 102232. https://doi.org/10.1016/j.erss.2021.102232.

Contzen, N., Perlaviciute, G., Sadat-Razavi, P., & Steg, L. (2021) (b). Emotions toward sustainable innovations: A matter of value congruence. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.661314.

Cox, J., Griffith, S., Giorgi, S., King, G. (2013). Consumer understanding of product lifetimes. *Resources, Conservation and Recycling*, *79*, 21–29. https://doi.org/10.1016/j.resconrec.2013.05.003.

Cui, J., Lapan, H., Moschini, G. (2012). Are Exporters More Environmentally Friendly than Non-Exporters? Theory and Evidence. *Iowa State University Working Paper No. 12022*.

Cui, J., Tam, O. K., Wang, B., & Zhang, Y. (2020). The environmental effect of trade liberalization: Evidence from China's manufacturing firms. *The World Economy*, *43*(12), 3357-3383. https://doi.org/10.1111/twec.13005.

Davis, S.J., Caldeira, K. (2010). Consumption-based accounting of CO2 emissions. *Proceedings of the national academy of sciences*, *107*(12), 5687–5692. https://doi.org/10.1073/pnas.0906974107.

Dean, J. & Lovely, M. (2008). Trade Growth, Production Fragmentation, and China's Environment. *NBER Working Paper No. 13860.*

Dubois, G., Sovacool, B., Aall, C., Nilsson, M., Barbier, C., Herrmann, A., ... & Sauerborn, R. (2019). It starts at home? Climate policies targeting household consumption and behavioral decisions are key to low-carbon futures. *Energy Research & Social Science*, *52*, 144-158.

Dunlap, R., Liere, K. V., Mertig, A., & Jones, R. E. (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of social issues*, *56*(3), 425-442.

Dyer, J. H. (1997). Effective interim collaboration: how firms minimize transaction costs and maximize transaction value. *Strategic management journal*, *18*(7), 535-556.

Ellen, P. S., Wiener, J. L., & Cobb-Walgren, C. (1991). The role of perceived consumer effectiveness in motivating environmentally conscious behaviors. *Journal of public policy & marketing*, *10*(2), 102-117. https://doi.org/10.1177/074391569101000206.

Eskeland, G. S., & Harrison, A. E. (2003). Moving to greener pastures? Multinationals and the pollution haven hypothesis. *Journal of development economics*, *70*(1), 1-23. https://doi.org/10.1016/S0304-3878(02)00084-6.

Etchart, A., Sertyesilisik, B., Mill, G. (2012). Environmental effects of shipping imports from China and their economic valuation: the case of metallic valve components. *Journal of Cleaner Production, 21*, 51–61. https://doi.org/10.1016/j.jclepro.2011.08.015.

European Bank for Reconstruction and Development (2023). Life in Transition Survey II. Retrieved from https://www.ebrd.com/what-we-do/economic-research-and-data/data/lits.html.

European Commission (2021). Proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism.

European Commission (2023). A European Green Deal. Retrived February 17, 2023 from https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.

European Commission (2008). Eurobarometer 2008.

EUROSTAT. (2014). Greenhouse gas emissions from waste disposal. Retrived Sep 27, 2022 from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:Greenhouse_gas_emissions_from_waste_disposal&oldid=180915.

EUROSTAT. (2017). Agri-enviromental indicator - greenhouse gas emissions. Retrived Sep 27, 2022 from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:Agri-environmental_indicator_-_greenhouse_gas_emissions&oldid=374989.

Feng, K., Hubacek, K., Song, K. (2021). Household carbon inequality in the U.S. *Journal of Cleaner Production*, *278*. https://doi.org/10.1016/j.jclepro.2020.123994.

Fernández-Amador, O., Francois, J.F., Oberdabernig, D.A., Tomberger, P. (2020). The methane footprint of nations: Stylized facts from a global panel dataset. *Ecological Economics, 170.* https://doi.org/10.1016/j.ecolecon.2019.106528.

Fesenfeld, L.P., Schmidt, T.S., Schrode, A. (2018). Climate policy for short- and long-lived pollutants. *Nature Climate Change, 8*, 933–936. https://doi.org/10.1038/s41558-018-0328-1.

Fischer, D., Stanszus, L., Geiger, S., Grossman, P., & Schrader, U. (2017). Mindfulness and sustainable consumption: A systematic literature review of research approaches and findings. *Journal of Cleaner Production*, *162*, 544-558. https://doi.org/10.1016/j.jclepro.2017.06.007.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, *18*(1), 39-50.

Forslid, R., Okubo, T., & Ulltveit-Moe, K. H. (2018). Why are firms that export cleaner? International trade, abatement and environmental emissions. *Journal of Environmental Economics and Management*, *91*, 166-183. https://doi.org/10.1016/j.jeem.2018.07.006.

Frankel, J. A., & Rose, A. K. (2005). Is trade good or bad for the environment? Sorting out the causality. *Review of economics and statistics*, *87*(1), 85-91. https://doi.org/10.1162/0034653053327577.

Gabel, H. L., & Sinclair-Desgagné, B. (2001). The firm, its procedures and win-win environmental regulations. *Frontiers of environmental economics*, 148-175. Cheltenham, UK: Edward Elgar.

Galbraith, J.K. (1958). *The Affluent Society*. Boston: Houghton Mifflin.

Galbraith, J.K. (1979). *The New Industrial State*. Middlesex, England: Penguin.

Galdeano-Gómez, E. (2010). Exporting and environmental performance: a firm-level productivity analysis. *World Economy*, *33*(1), 60-88. https://doi.org/10.1111/j.1467-9701.2009.01188.x.

Galdeano-Gómez, E., Céspedes-Lorente, J., & Martinez-del-Rio, J. (2008). Environmental performance and spillover effects on productivity: evidence from horticultural firms. *Journal of environmental management*, *88*(4), 1552-1561. https://doi.org/10.1016/j.jenvman.2007.07.028.

Galdeano-Gómez, E., Céspedes-Lorente, J., & Rodríguez-Rodríguez, M. (2006). Productivity and environmental performance in marketing cooperatives: An analysis of the Spanish horticultural sector. *Journal of Agricultural Economics*, *57*(3), 479-500.

Gallego, B., Lenzen, M., 2005. A consistent input–output formulation of shared consumer and producer responsibility. *Economic Systems Research, 17(4)*, 365–391.

Gardner, G. T., & Stern, P. C. (1996). *Environmental problems and human behavior*. Allyn & Bacon.

Geiger, S. M., Fischer, D., & Schrader, U. (2018). Measuring what matters in sustainable consumption: an integrative framework for the selection of relevant behaviors. *Sustainable Development*, *26*(1), 18-33. https://doi.org/10.1002/sd.1688.

Global Compact Network Belarus (2022). *Report about the activity of the UN Global Compact Network in Belarus in 2022.*

Giljum, S., Hammer, M., Stocker, A., Lackner, M., Best, A., Blobel, D., Ingwersen, W., Naumann, S., Neubauer, A., Simmons, C., Lewis, K., Shmelev, S. (2007). *Scientific assessment and evaluation of the indicator "Ecological Footprint".* Dessau-Rossblau.

Girma, S., Hanley, A., & Tintelnot, F. (2008). Exporting and the environment: A new look with micro-data. *Kiel Working Paper No. 1423.*

Gray, D. B., Borden, R. J., & Weigel, R. H. (1985). Ecological beliefs and behaviors: Assessment and *change*. Westport, CN: Greenwood Press.

Gray, W.B. & Shadbegian, R.J. (1993). Environmental Regulation and Manufacturing Productivity at the Plant Level. *Center for Economic Studies Discussion Paper No. 93-6*, U.S. Department of Commerce, Washington.

Gray, W.B. & Shadbegian, R.J. (1995). Pollution Abatement Costs, Regulation, and Plant-Level Productivity. *National Bureau of Economic Research Working Paper Series No. 4994*, Massachusetts.

Greer, J., & Bruno, K. (1996). *Greenwash: The reality behind corporate environmentalism*. Third World Network.

De Groot, J. I., & Steg, L. (2010). Relationships between value orientations, self-determined motivational types and pro-environmental behavioural intentions. *Journal of Environmental Psychology*, *30*(4), 368-378. https://doi.org/10.1016/j.jenvp.2010.04.002.

Grundmann, R., & Scott, M. (2014). Disputed climate science in the media: Do countries matter?. *Public Understanding of Science*, *23*(2), 220-235.

Guagnano, G. A., Stern, P. C., & Dietz, T. (1995). Influences on attitude-behavior relationships: A natural experiment with curbside recycling. *Environment and behavior*, *27*(5), 699-718. https://doi.org/10.1177/0013916595275005.

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Hamann, K. R., & Reese, G. (2020). My influence on the world (of others): Goal efficacy beliefs and efficacy affect predict private, public, and activist pro-environmental behavior. *Journal of Social Issues*, *76*(1), 35-53. https://doi.org/10.1111/josi.12369.

Harraway, J., Broughton-Ansin, F., Deaker, L., Jowett, T., & Shephard, K. (2012). Exploring the use of the revised new ecological paradigm scale (NEP) to monitor the development of students' ecological orldviews. *The Journal of Environmental Education*, *43*(3), 177-191. https://doi.org/10.1080/00958964.2011.634450.

Hart, S. L. (1997). Beyond greening: strategies for a sustainable world. *Harvard business review*, *75*(1), 66-77.

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of management review*, *20*(4), 986-1014. https://doi.org/10.5465/amr.1995.9512280033.

Hase, V., Mahl, D., Schäfer, M. S., & Keller, T. R. (2021). Climate change in news media across the globe: An automated analysis of issue attention and themes in climate change coverage in 10 countries (2006–2018). *Global Environmental Change*, *70*, 102353.

Hassan, T., Khan, Y., He, C., Chen, J., Alsagr, N., Song, H., Khan, N. (2022). Environmental regulations, political risk and consumption-based carbon emissions: Evidence from OECD economies. *Journal of Environmental Management*, *320*. https://doi.org/10.1016/j.jenvman.2022.115893.

He, H., Reynolds, C., Hadjikakou, M., Holyoak, N., Boland, J. (2020). quantification of indirect waste generation and treatment arising from Australian household consumption: A waste input-output analysis. *Journal of Cleaner Production*, *258*. https://doi.org/10.1016/j.jclepro.2020.120935.

Heide, J. B., & Stump, R. L. (1995). Performance implications of buyer-supplier relationships in industrial markets: a transaction cost explanation. *Journal of Business Research*, *32*(1), 57-66.

Herendeen, R. A. (1973). *Energy cost of goods and services* (No. ORNL-NSF-EP-58). Oak Ridge National Lab., Tenn.(USA).

Hertwich, E.G. (2011). The Life Cycle Environmental Impacts of Consumption. *Economic Systems Research*, *23*, 27–47. https://doi.org/10.1080/09535314.2010.536905.

Hertwich, E. G., & Peters, G. P. (2009). Carbon footprint of nations: a global, trade-linked analysis. *Environmental science & technology*, *43*(16), 6414-6420. https://doi.org/10.1021/es803496a.

Ho, S. S., Liao, Y., & Rosenthal, S. (2015). Applying the theory of planned behavior and media dependency theory: Predictors of public pro-environmental behavioral intentions in Singapore. *Environmental Communication*, *9*(1), 77-99. https://doi.org/10.1080/17524032.2014.932819.

Holbert, R. L., Kwak, N., & Shah, D. V. (2003). Environmental concern, patterns of television viewing, and pro-environmental behaviors: Integrating models of media consumption and effects. *Journal of Broadcasting & Electronic Media*, *47*(2), 177-196. https://doi.org/10.1207/s15506878jobem4702_2.

Holladay, J. S. (2016). Exporters and the environment. *Canadian Journal of Economics/Revue canadienne d'économique*, *49*(1), 147-172. https://doi.org/10.1111/caje.12193.

Hope, C. (2011). The Social Cost of Co2 from the Page09 Model. *SSRN Electron. J.* https://doi.org/10.2139/ssrn.1973863.

Howell, R. A. (2011). Lights, camera… action? Altered attitudes and behaviour in response to the climate change film The Age of Stupid. *Global Environmental Change*, *21*(1), 177-187. https://doi.org/10.1016/j.gloenvcha.2010.09.004.

Howell, R. A. (2013). It's not (just) "the environment, stupid!" Values, motivations, and routes to engagement of people adopting lower-carbon lifestyles. *Global Environmental Change*, *23*(1), 281-290. https://doi.org/10.1016/j.gloenvcha.2012.10.015.

Huang, H. (2016). Media use, environmental beliefs, self-efficacy, and pro-environmental behavior. *Journal of Business Research*, *69*(6), 2206-2212. https://doi.org/10.1016/j.jbusres.2015.12.031.

Hurst, M., Dittmar, H., Bond, R., & Kasser, T. (2013). The relationship between materialistic values and environmental attitudes and behaviors: A meta-analysis. *Journal of Environmental Psychology*, *36*, 257-269. https://doi.org/10.1016/j.jenvp.2013.09.003.

Inkpen, R., & Baily, B. (2020). Environmental beliefs and their role in environmental behaviours of undergraduate students. *Journal of Environmental Studies and Sciences*, *10*(1), 57-67. https://doi.org/10.1007/s13412-019-00570-z.

Interagency Working Group on Social Cost of Carbon, U.S.G. (2013). *Technical Support Document: -Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis -Under Executive Order 12866.*

IPCC (2022a). Summary for Policymakers. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Poertner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegria, M. Craig, S. Langsdorf, S. Loeschke, V. Moeller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3–33. https://doi.org/10.1017/9781009325844.001.

IPCC (2022b). Technical Summary. In*: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S.

Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. https://doi.org/10.1017/9781009157926.002.

Isard, W., Bassett, K., Choguill, C., Furtado, J., Izumita, R., Kissin, J., Romanoff, E., Seyfarth, R., Tatlock, R., (1968). On the likage of socio-economic and ecologic systems. *Papers of the Regional Science Association*, *21*, 79–99. https://doi.org/10.1007/BF01952722.

Ivanova, D., Wood, R. (2020). The unequal distribution of household carbon footprints in Europe and its link to sustainability. *Global Sustainability, 3*, 1-12. https://doi.org/10.1017/sus.2020.12.

Ivanova, D., Stadler, K., Steen-Olsen, K., Wood, R., Vita, G., Tukker, A., Hertwich, E.G. (2016). Environmental Impact Assessment of Household Consumption. *Journal of Industrial Ecol*ogy, *20(3)*, 526-536. https://doi.org/10.1111/jiec.12371.

Jaffe, A. B., Peterson, S. R., Portney, P. R., & Stavins, R. N. (1995). Environmental regulation and the competitiveness of US manufacturing: what does the evidence tell us?. *Journal of Economic literature*, *33*(1), 132-163.

Jaiswal, D., & Singh, B. (2018). Toward sustainable consumption: Investigating the determinants of green buying behaviour of Indian consumers. *Business Strategy & Development*, *1*(1), 64–73. https://doi.org/10.1002/bsd2.12.

Jöreskog, K. G. (1971). Simultaneous factor analysis in several populations. *Psychometrika*, *36*(4), 409-426.

Jugert, P., Greenaway, K. H., Barth, M., Büchner, R., Eisentraut, S., & Fritsche, I. (2016). Collective efficacy increases pro-environmental intentions through increasing self-efficacy. *Journal of Environmental Psychology*, *48*, 12-23. https://doi.org/10.1016/j.jenvp.2016.08.003.

Kaiser, K., & Schulze, G. G. (2003). International competition and environmental expenditures: empirical evidence from Indonesian manufacturing plants. *SSRN Electron. J., 395780*. https://doi.org/10.2139/ssrn.395780.

Kapp, K.W. (1950). *The Social Costs of Private Enterprise*. New York: Shocken.

Kapp, W.K. (1963). *The Social Costs of Business Enterprise*. 2nd ed. Spokesman, Nottingham.

Kapp, K.W. (1978). *The Social Costs of Business Enterprise*, 3rd edition. Nottingham:

Spokesman.

Kasser, T., & Ahuvia, A. (2002). Materialistic values and well-being in business students. *European Journal of Social Psychology*, *32*, 137-146. http://dx.doi.org/10.1002/ejsp.85.

Kasser, T., & Ryan, R. M. (1996). Further examining the American dream: Differential correlates of intrinsic and extrinsic goals. *Personality and Social Psychology Bulletin*, *22*(3), 280-287. http://dx.doi.org/10.1177/0146167296223006.

Kitzes, J. (2013). An Introduction to Environmentally-Extended Input-Output Analysis. *Resources*, *2*, 489–503. https://doi.org/10.3390/resources2040502.

Klassen, R. D., & Whybark, D. C. (1999). The impact of environmental technologies on manufacturing performance. *Academy of Management journal*, *42*(6), 599-615. https://doi.org/10.5465/256982.

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (Fourth Edi).

Klöpffer, W., Grahl, B. (2014). *Life Cycle Assessment (LCA)*. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany. https://doi.org/10.1002/9783527655625.

De Koning, J. I. J. C., Crul, M. R. M., Wever, R., & Brezet, J. C. (2015). Sustainable consumption in Vietnam: an explorative study among the urban middle class. *International journal of consumer studies*, *39*(6), 608-618. https://doi.org/10.1111/ijcs.12235.

Kurowski, Ł., Rutecka-Góra, J., & Smaga, P. (2022). Is knowledge on climate change a driver of consumer purchase decisions in Poland? The case of grocery goods and green banking. *Journal of Cleaner Production*, *369*, 133444. https://doi.org/10.1016/j.jclepro.2022.133444.

Laros, F. J., & Steenkamp, J. B. E. (2005). Emotions in consumer behavior: a hierarchical approach. *Journal of business Research*, *58*(10), 1437-1445. https://doi.org/10.1016/j.jbusres.2003.09.013.

Lauren, N., Fielding, K. S., Smith, L., & Louis, W. R. (2016). You did, so you can and you will: Self-efficacy as a mediator of spillover from easy to more difficult pro-environmental behaviour. *Journal of Environmental Psychology*, *48*, 191-199. https://doi.org/10.1016/j.jenvp.2016.10.004.

Le Coq, C., & Paltseva, E. (2021). Green Concerns and Salience of Environmental Issues in Eastern Europe. *FREE Network Policy Brief*. https://freepolicybriefs.org/wpcontent/uploads/2021/06/freepolicybriefs20210607.pdf.

Lee, K. (2011). The role of media exposure, social exposure and biospheric value orientation in the environmental attitude-intention-behavior model in adolescents. *Journal of environmental psychology*, *31*(4), 301-308. https://doi.org/10.1016/j.jenvp.2011.08.004.

Lee, S. Y., & Klassen, R. D. (2008). Drivers and enablers that foster environmental management capabilities in small-and medium-sized suppliers in supply chains. *Production and Operations management*, *17*(6), 573-586.

Lee, Y. K., Kim, S., Kim, M. S., & Choi, J. G. (2014). Antecedents and interrelationships of three types of pro-environmental behavior. *Journal of Business Research*, *67*(10), 2097-2105. https://doi.org/10.1016/j.jbusres.2014.04.018.

Lei, M., Ding, Q., Cai, W., Wang, C. (2022). The exploration of joint carbon mitigation actions between demand- and supply-side for specific household consumption behaviors - A case study in China. *Applied Energy*, *324*. https://doi.org/10.1016/j.apenergy.2022.119740.

Lenzen, M., Kanemoto, K., Moran, D., Geschke, A. (2015). Eora26. Retrieved August 8, 2020 from https://worldmrio.com/eora26/.

Lenzen, M., Murray, J., Sack, F., Wiedmann, T. (2007). Shared producer and consumer responsibility — Theory and practice. *Ecological Economics*, *61*, 27–42. https://doi.org/10.1016/j.ecolecon.2006.05.018.

Lenzen, M., Wier, M., Cohen, C., Hayami, H., Pachauri, S., Schaeffer, R. (2006). A comparative multivariate analysis of household energy requirements in Australia, Brazil, Denmark, India and Japan. *Energy*, *31*, 181–207. https://doi.org/10.1016/j.energy.2005.01.009.

Leontief, W. (1970). Environmental Repercussions and the Economic Structure: An Input-Output Approach. *The Review of Economics and Statistics*, *52*, 262. https://doi.org/10.2307/1926294.

Levinson, A. (2009). Technology, international trade, and pollution from US manufacturing. *American economic review*, *99*(5), 2177-2192. https://doi.org/10.3386/w13616.

Li, N., Pei, X., Huang, Y., Qiao, J., Zhang, Y., Jamali, R.H. (2022). Impact of financial inclusion and green bond financing for renewable energy mix: implications for financial development in OECD economies. *Environmental Science and Pollution Research, 29*, 25544-25555. https://doi.org/10.1007/s11356-021-17561-9.

Li, X., Yu, R., & Su, X. (2021). Environmental Beliefs and Pro-Environmental Behavioral Intention of an Environmentally Themed Exhibition Audience: The Mediation Role of Exhibition Attachment. *SAGE Open*, *11*(2). https://doi.org/10.1177/21582440211027966.

Liobikienė, G., Liobikas, J., Brizga, J., & Juknys, R. (2020). Materialistic values impact on pro-environmental behavior: The case of transition country as Lithuania. *Journal of Cleaner Production*, *244*, 118859. https://doi.org/10.1016/j.jclepro.2019.118859.

Liu, J., Murshed, M., Chen, F., Shahbaz, M., Kirikkaleli, D., Khan, Z. (2021). An empirical analysis of the household consumption-induced carbon emissions in China. *Sustainable Production and Consumption, 26*, 943-957. https://doi.org/10.1016/j.spc.2021.01.006.

Liu, Y., Unger, A., Bi, C., Papastamatelou, J., & Raab, G. (2022). Online compulsive buying as a coping strategy for self-uncertainty: the moderating role of gender in China. *Journal of Internet Commerce*, *21*(4), 418-437. https://doi.org/10.1080/15332861.2021.1988242

Lloyd's Register Foundation (2023). World Risk Poll 2019. https://wrp.lrfoundation.org.uk/.

Lohr, L. (2001). Factors affecting international demand and trade in organic food products. *Changing structure of global food consumption and trade*, 67-79.

Lu, J., Li, B., Li, H., & Zhang, Y. (2020). Sustainability of enterprise export expansion from the perspective of environmental information disclosure. *Journal of Cleaner Production*, *252*, 119839. https://doi.org/10.1016/j.jclepro.2019.119839.

Mach, R., Weinzettel, J., Ščasný, M. (2018). Environmental Impact of Consumption by Czech Households: Hybrid Input–Output Analysis Linked to Household Consumption Data. *Ecological Economics*, *149*, 62–73. https://doi.org/10.1016/j.ecolecon.2018.02.015.

Machill, M., Köhler, S., & Waldhauser, M. (2007). The use of narrative structures in television news: An experiment in innovative forms of journalistic presentation. *European Journal of Communication*, *22*(2), 185-205.

Managi, S., Hibiki, A., & Tsurumi, T. (2009). Does trade openness improve environmental quality?. *Journal of environmental economics and management*, *58*(3), 346-363. https://doi.org/10.1016/j.jeem.2009.04.008.

Manfredo, M. J., Bruskotter, J. T., Teel, T. L., Fulton, D., Schwartz, S. H., Arlinghaus, R., ... & Sullivan, L. (2017). Why social values cannot be changed for the sake of conservation. *Conservation Biology*, *31*(4), 772-780. https://doi.org/10.1111/cobi.12855

Marten, A.L., Newbold, S.C. (2012). Estimating the social cost of non-CO2 GHG emissions: Methane and nitrous oxide. *Energy Policy, 51*, 957–972. https://doi.org/10.1016/j.enpol.2012.09.073.

Martín-Tapia, I., Aragón-Correa, J. A., & Rueda-Manzanares, A. (2010). Environmental strategy and exports in medium, small and micro-enterprises. *Journal of World Business*, *45*(3), 266-275. https://doi.org/10.1016/j.jwb.2009.09.009.

McCann, F. (2009). Importing, exporting and productivity in Irish manufacturing. *UCD Centre for Economic Research Working Paper Series No. WP09/22.*

McGuire, M. C. (1982). Regulation, factor rewards, and international trade. *Journal of public economics*, *17*(3), 335-354.

Mehmetoglu, M., & Jakobsen, T. G. (2017). *Applied Statistics Using STATA: A Guide for the Social Sciences.* London: SAGE Publications Ltd.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, *71*(6), 1695-1725. https://doi.org/10.1111/1468-0262.00467.

Melnik, V., Yacuhno, V., Denisov, N., Nikolaeva, L., Faloleeva, M. (2017). *Agroclimatic zoning of the territory of Belarus with respect to climate change as part of the development of a national strategy for adapting agriculture to climate change in the Republic of Belarus*.

Mi, Z., Zheng, J., Meng, J., Ou, J., Hubacek, K., Liu, Z., Coffman D., Stern, N., Liang, S., Wei, Y.-M. (2020). Economic development and converging household carbon footprints in China. *Nature Sustainability, 3(7),* 529-537. https://doi.org/10.1038/s41893-020-0504-y.

Mishan, E.J. (1969). The Myth of Consumers' Sovereignty. In *Growth: The Price We Pay*. E. J. Mishan. London: Staples Press, 89-96.

Ministry of Foreign Affairs of the Republic of Belarus (2021). Foreign Trade of Belarus: Trends, Goals, and Results. Retrived February 17, 2023 from https://mfa.gov.by/trade/.

Ministry of Economy of the Republic of Belarus (2020). The National strategy of sustainable development for the Republic of Belarus till 2035.

Ministry of Economy of the Republic of Belarus (2021). The National action plan on the “green” economy development in the Republic of Belarus in 2021-2025.

Miras Rodríguez, M. D. M., & Domínguez Machuca, J. A. (2015). Sustainability drivers, barriers and outcomes: Evidence from European High Performance Manufacturing Industries. In *Industrial Engineering and System Management Conference (2015. Sevilla)*.

Moeller, B. L., & Stahlmann, A. G. (2019). Which character strengths are focused on the well-being of others? Development and initial validation of the environmental self-efficacy scale: assessing confidence in overcoming barriers to pro-environmental behavior. *Journal of Well-Being Assessment*, *3*(2), 123-135.

Montabon, F., Sroufe, R., & Narasimhan, R. (2007). An examination of corporate reporting, environmental management practices and firm performance. *Journal of operations management*, *25*(5), 998-1014. https://doi.org/10.1016/j.jom.2006.10.003.

Moran, D., Wood, R. (2014). Convergence between the EORA, WIOD, EXIOBASE, and OPENEU’S Consumption-Based Carbon Accounts. *Economic Systems Research, 26*, 245–261. https://doi.org/10.1080/09535314.2014.935298.

Moran, D., Wood, R., Hertwich, E., Mattson, K., Rodriguez, J. F., Schanes, K., & Barrett, J. (2020). Quantifying the potential for consumer-oriented policy to reduce European and foreign carbon emissions. *Climate Policy*, *20*(sup1), S28-S38. https://doi.org/10.1080/14693062.2018.1551186.

Moser, S. C. (2010). Communicating climate change: history, challenges, process and future directions. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(1), 31-53.

Müller, A., Georgiadou, E., Birlin, A., Laskowski, N. M., Jiménez-Murcia, S., Fernández-Aranda, F., ... & Steins-Loeber, S. (2022). The Relationship of Shopping-Related Decisions with Materialistic Values Endorsement, Compulsive Buying-Shopping Disorder Symptoms and Everyday Moral Decision Making. *International Journal of Environmental Research and Public Health*, *19*(7). https://doi.org/10.3390/ijerph19074376.

Muñoz-Villamizar, A., Santos, J., Montoya-Torres., J. (2018). Environmental Assessment Using a

Lean Based Tool Service Orientation. *Stud. Comput. Intell. 762*, 41–50.

Muñoz-Villamizar, A., Santos, J., Viles, E., & Ormazábal, M. (2018). Manufacturing and environmental practices in the Spanish context. *Journal of Cleaner Production*, *178*, 268-275. https://doi.org/10.1016/j.jclepro.2018.01.026.

Myers, J. G., & Nakamura, L. (1980). Energy and pollution effects on productivity: A Putty-Clay approach. In *New Developments in Productivity Measurement and Analysis*, 463-506. University of Chicago Press.

Myhre, G., Shindell, D., Breon, F. -M., Collins, W., Fuglestvedt, J., Huang, J., Koch, D., Lamarque, J. -F., Lee, D., Mendoza, B., Nakajima, T., Robock, A., Stephens, G.,Takemura, T., Zhang, H. (2014). Anthropogenic and Natural Radiative Forcing. In: *Intergovernmental Panel on Climate Change (Ed.), Climate Change 2013 - The Physical Science Basis*. Cambridge University Press, Cambridge, 659–740. https://doi.org/10.1017/CBO9781107415324.

National Statistical Committee of the Republic of Belarus (2023). Input-Output Tables 2012-2020. https://www.belstat.gov.by/ofitsialnaya-statistika/realny-sector-ekonomiki/natsionalnye-scheta/sistema-tablits-zatraty-vypusk/.

National Statistical Committee of the Republic of Belarus (2022a). *Population size as of 1st January, 2022 and mid-year population for 2021 in the Republic of Belarus with a breakdown of regions, areas, cities, towns.*

National Statistical Committee of the Republic of Belarus (2022b). *Statistical Yearbook of the Republic of Belarus, 2022.*

National Statistical Committee of the Republic of Belarus (2021). *Foreign Trade of the Republic of Belarus.*

National Statistical Committee of the Republic of Belarus (2020). *Foreign Trade of the Republic of Belarus.*

National Statistical Committee of the Republic of Belarus (2019b). *Foreign Trade of the Republic of Belarus.*

National Statistical Committee of the Republic of Belarus (2019a). *Statement of the National Statistical Committee of the Republic of Belarus from 10th December, 2019 № 122.*

Neugebauer, R. (2011). Energy-efficient product and process innovations in production engineering. *CIRP Journal of Manufacturing Science and Technology*, *2*(4), 127-128. https://doi.org/10.1016/j.cirpj.2011.08.001.

Newman, N., Fletcher, R., Schulz, A., Andi, S., & Nielsen, R. K. (2020). *Reuters Institute Digital News Report 2020.*

Newsom, J. T. (2020). Psy 523/623 structural equation modelling.

Nguyen, A., & Tran, M. (2019). Science journalism for development in the Global South: A systematic literature review of issues and challenges. *Public Understanding of Science*, *28*(8), 973-990.

Nordhaus, W.D. (2017). Revisiting the social cost of carbon. *Proceedings of the National Academy of Sciences*, *114*, 1518–1523. https://doi.org/10.1073/pnas.1609244114.

Nordhaus, W.D. (2008). *A question of balance*. Yale University Press, New Haven.

Nordhaus, W.D. (2007). A Review of the Stern Review on the Economics of Climate Change. *Journal of Economic Literature*, *45*, 686–702. https://doi.org/10.1257/jel.45.3.686.

Norwegian Ministry of the Environment. (1994). *Oslo Roundtable on Sustainable Production and Consumption*.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychological theory*. New York, NY: MacGraw Hill.

Ouchi, W. G. (1980). Markets, bureaucracies, and clans. *Administrative science quarterly*, 129-141.

Pallant, J. (2001). *SPSS survival manual, a step by step guide to data analysis using SPSS for windows (version 10 and 11)*. London, UK: Open University Press.

Panzone, L., Hilton, D., Sale, L., & Cohen, D. (2016). Socio-demographics, implicit attitudes, explicit attitudes, and sustainable consumption in supermarket shopping. *Journal of Economic Psychology*, *55*, 77-95. https://doi.org/10.1016/j.joep.2016.02.004.

Pacala, S., & Socolow, R. (2004). Stabilization wedges: Solving the climate problem for the next 50 years with current technologies. *Science*, *305*, 968–972. Retrieved from http://www.sciencemag.org/content/305/5686/968.abstract. https://doi.org/10.1126/science.1100103.

Pachauri, R., Meyer, L. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Geneva, Switzerland.

Peattie, K. (2010). Green Consumption: Behavior and Norms. *Annual Review of Environment and Resources*, *35*(1), 195–228. https://doi.org/10.1146/annurev-environ-032609-094328.

Pei, J., Sturm, B., & Yu, A. (2021). Are exporters more environmentally friendly? A re-appraisal that uses China's micro-data. *The World Economy*, *44*(5), 1402-1427. https://doi.org/10.1111/twec.13024.

Pellegrino, A., & Shannon, R. (2021). Materialism's Influence on Unsustainable Consumption Across Social Networking Sites: A Systematic Review. *International Journal of Business and Economics Research*, *10*(4), 125. https://doi.org/10.11648/j.ijber.20211004.13.

Peters, G.P., Hertwich, E.G. (2008). CO2 Embodied in International Trade with Implications for Global Climate Policy. *Environmental Science & Technology*, *42*, 1401–1407. https://doi.org/10.1021/es072023k.

Peters, G.P., Hertwich, E.G. (2006). The Importance of Imports for Household Environmental Impacts. *Journal of Industrial Ecology*, *10*, 89–109. https://doi.org/10.1162/jiec.2006.10.3.89.

Pethig, R. (1976). Pollution, welfare, and environmental policy in the theory of comparative advantage. *Journal of environmental economics and management*, *2*(3), 160-169. https://doi.org/10.1016/0095-0696(76)90031-0.

Porter, M. E., & Linde, C. V. D. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of economic perspectives*, *9*(4), 97-118. https://doi.org/10.1257/jep.9.4.97.

Ramírez, S., Gallego, J., & Tamayo, M. (2020). Human capital, innovation and productivity in Colombian enterprises: a structural approach using instrumental variables. *Economics of Innovation and New Technology*, *29*(6), 625-642. https://doi.org/10.1080/10438599.2019.1664700.

Reisch, L., Spash, C. L., & Bietz, S. (2021). Sustainable consumption and mass communication: A German experiment.

Richins, M. L. (2004). The material values scale: Measurement properties and development of a short form. Journal of Consumer Research, 31, 209e219. http://dx.doi.org/10.1086/383436.

Richins, Marsha L. and Scott Dawson (1992). "A Consumer Values Orientation for Materialism and Its Measurement: Scale Development and Validation," *Journal of Consumer Research*,19 (December), 303–16. https://doi.org/10.1086/209304.

Ritchie, R., Mispy, O.-O. (2018). Measuring progress towards the Sustainable Development Goals. Retrieved September 20, 2020 from https://sdg-tracker.org/.

Rook, D. W. (1987). The buying impulse. *Journal of Consumer Research*, 14, 189-199.

Rose, A. (1983). Modeling the macroeconomic impact of air pollution abatement. *Journal of Regional Science*, *23*(4), 441-459.

Ruepert, A. M., Keizer, K., & Steg, L. (2017). The relationship between Corporate Environmental Responsibility, employees' biospheric values and pro-environmental behaviour at work. *Journal of Environmental Psychology*, *54*, 65-78. https://doi.org/10.1016/j.jenvp.2017.10.006

Saari, U. A., Damberg, S., Frömbling, L., & Ringle, C. M. (2021). Sustainable consumption behavior of Europeans: The influence of environmental knowledge and risk perception on environmental concern and behavioral intention. *Ecological Economics*, *189*, 107155. https://doi.org/10.1016/j.ecolecon.2021.107155.

Sachs, J., Lafortune, G., Kroll, C., Fuller, G., Woelm, F. (2022). SUSTAINABLE DEVELOPMENT REPORT 2022. From Crisis to Sustainable Development: the SDGs as Roadmap to 2030 and Beyond. https://doi.org/10.1017/9781009210058.

Sadiq, M., Adil, M., & Paul, J. (2022). Eco-friendly hotel stay and environmental attitude: A value-attitude-behaviour perspective. *International Journal of Hospitality Management*, *100*, 103094. https://doi.org/10.1016/j.ijhm.2021.103094.

Santos, J., Muñoz-Villamizar, A., Ormazábal, M., & Viles, E. (2019). Using problem-oriented monitoring to simultaneously improve productivity and environmental performance in manufacturing companies. *International Journal of Computer Integrated Manufacturing*, *32*(2), 183-193. https://doi.org/10.1080/0951192X.2018.1552796.

Schäfer, M. S., & Painter, J. (2020). Climate journalism in a changing media ecosystem: Assessing the production of climate change-related news around the world. *Wiley Interdisciplinary Reviews: Climate Change*, *12*(1). https://doi.org/10.1002/wcc.675.

Schäfer, M. S., & Schlichting, I. (2014). Media representations of climate change: A meta-analysis of the research field. *Environmental communication*, *8*(2), 142-160.

Schmidt, A., Ivanova, A., & Schäfer, M. S. (2013). Media attention for climate change around the world: A comparative analysis of newspaper coverage in 27 countries. *Global Environmental Change*, *23*(5), 1233-1248.

Seppanen, O., Fisk, W. J., & Faulkner, D. (2003). Cost benefit analysis of the night-time ventilative cooling in office building. Lawrence Berkeley National Laboratory. https://escholarship.org/content/qt3j82f642/qt3j82f642.pdf.

Sharma, S. (2000). Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy. *Academy of Management journal*, *43*(4), 681-697. https://doi.org/10.2307/1556361.

Sharma, R., & Jha, M. (2017). Values influencing sustainable consumption behaviour: Exploring the contextual relationship. *Journal of Business Research, 76,* 77–88. https://doi.org/10.1016/j.jbusres.2017.03.010.

Sharma, S., & Vredenburg, H. (1998). Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities. *Strategic management journal*, *19*(8), 729-753.

Shaver, K.G. (1985). *The attribution of blame. Causality, responsibility, and blameworthiness*. New York: Springer.

Shehata, A., Andersson, D., Glogger, I., Hopmann, D. N., Andersen, K., Kruikemeier, S., & Johansson, J. (2021). Conceptualizing long-term media effects on societal beliefs. *Annals of the International Communication Association*, *45*(1), 75-93.

Shepherd, B. (2020). International standards and trade. What does the research say? *International Organization for Standartization.*

Shephard, K., Mann, S., Smith, N., & Deaker, L. (2009). Benchmarking the environmental values and attitudes of students in New Zealand's post-compulsory education. *Environmental Education Research*, *15*(5), 571-587. https://doi.org/10.1080/13504620903050523.

Shershunovich, Y. & Gorskaya, M. (2023). Climate Risk Perception and Green Behavior in Belarus. *FREE Network Policy Brief.* https://freepolicybriefs.org/2023/01/23/climate-risk-perception-green-behavior/.

Shiller, R. J. (2020). *Narrative economics: How stories go viral and drive major economic events*. Princeton University Press.

Shindell, D.T. (2015). The social cost of atmospheric release. *Climate Change, 130*, 313–326. https://doi.org/10.1007/s10584-015-1343-0.

Shindell, D.T., Fuglestvedt, J.S., Collins, W.J. (2017). The social cost of methane: theory and applications. *Faraday Discussions, 200*, 429–451. https://doi.org/10.1039/C7FD00009J.

Shrivastava, P. (1995). Environmental technologies and competitive advantage. *Strategic management journal*, *16*(S1), 183-200. https://doi.org/10.1002/smj.4250160923.

Simeone, M., & Scarpato, D. (2020). Sustainable consumption: How does social media affect food choices?. *Journal of Cleaner Production*, *277*, 124036. https://doi.org/10.1016/j.jclepro.2020.124036.

Simpson, D. F., & Power, D. J. (2005). Use the supply relationship to develop lean and green suppliers. *Supply chain management: An international Journal*.

Sinclair-Desgagné, B. (1999). Remarks on environmental regulation, firm behavior and innovation.

Smith, B. (2015). Germany: Environmental Issues, Policies and Clean Technology. Retrieved August 8, 2020 from https://www.azocleantech.com/article.aspx?ArticleID=549.

Song, K., Qu, S., Taiebat, M., Liang, S., Xu, M. (2019). Scale, distribution and variations of global greenhouse gas emissions driven by U.S. households. *Environment international*, *133*. https://doi.org/10.1016/j.envint.2019.105137.

Sorbom, D. (1974). A general method for studying differences in factor means and factor structures between groups. *British Journal of Mathematical and Statistical Psychology, 27,* 229-239.

Spangenberg, J.H., Lorek, S. (2002). Environmentally sustainable household consumption: from aggregate environmental pressures to priority fields of action. *Ecological Economics, 43*, 127–140. https://doi.org/10.1016/S0921-8009(02)00212-4.

Stavert, A., Saunois, M., Canadell, J., Poulter, B., Jackson, R., Regnier, P., Lauerwald, R., Raymond, P., Allen, G., Patra, P., Bergamaschi, P., Bousquet, P. … et al. (2021). Regional trends and drivers of the global methane budget. *Global Change Biology, 28*, 182-200. https://doi.org/10.1111/gcb.15901.

Steg, L., Perlaviciute, G., Van der Werff, E., & Lurvink, J. (2014). The significance of hedonic values for environmentally relevant attitudes, preferences, and actions. *Environment and behavior*, *46*(2), 163-192. https://doi.org/10.1177/0013916512454730.

Steinegger, T. (2019). *Investigating the Environmental Footprint of Swedish Household Consumption*. KTH Royal Institute of Technology.

Stern, N. (2007). *The Economics of Climate Change*. Cambridge University Press, Cambridge. https://doi.org/10.1017/CBO9780511817434.

Stern, P. C. (2000). New environmental theories: toward a coherent theory of environmentally significant behavior. *Journal of social issues*, *56*(3), 407-424.

Stern, P. C., & Dietz, T. (1994). The value basis of environmental concern. *Journal of social issues*, *50*(3), 65-84.

Straughan, R. D., & Roberts, J. A. (1999). Environmental segmentation alternatives: a look at green consumer behavior in the new millennium. *Journal of Consumer Marketing*, *16*(6), 558–575. https://doi.org/10.1108/07363769910297506.

Sun, M., Chen, G., Xu, X., Zhang, L., Hubacek, K., Wang, Y. (2021). Reducing Carbon Footprint Inequality of Household Consumption in Rural Areas: Analysis from Five Representative Provinces in China. *Environmental Science and Technology, 55*, 17, 11511-11520. https://doi.org/10.1021/acs.est.1c01374

Tabernero, C., & Hernández, B. (2011). Self-efficacy and intrinsic motivation guiding environmental behavior. *Environment and Behavior*, *43*(5), 658-675. https://doi.org/10.1177/0013916510379759.

Taneja, S., & Ali, L. (2021). Determinants of customers' intentions towards environmentally sustainable banking: Testing the structural model. *Journal of Retailing and Consumer Services*, *59*, 102418. https://doi.org/10.1016/j.jretconser.2020.102418.

Tate, W. L., Dooley, K. J., & Ellram, L. M. (2011). Transaction cost and institutional drivers of supplier adoption of environmental practices. *Journal of Business Logistics*, *32*(1), 6-16.

Thaler, R.H. (2015). *Misbehaving: The Making of Behavioral Economics*. New York: W.W. Norton.

Thaler, R. H. (2016). Behavioral economics: Past, present, and future. *American economic review*, *106*(7), 1577-1600.

The State Committee for Standardization of the Republic of Belarus (2018). Energy saving. www.gosstandard.gov.by/saving.

The State Committee for Standardization of the Republic of Belarus (2014). Energy Efficiency Department. www.energoeffekt.gov.by/about.

Tol, R. (2011). *The Social Cost of Carbon*.

Tochitskaya, I. (2020). Exposure of Financial Sector to Climate-Related Risks: Assessments of Central

Banks. *BEROC Green Economy Policy Paper Series No. 20.*

Tochitskaya, I. & Shershunovich, Y. (2021). Assessment of the Carbon Intensity of the Belarusian Economy and Payments Under CBAM. *BEROC Green Economy Policy Paper Series No. 26.*

Tsfati, Y., & Cohen, J. (2003). On the effect of the "third-person effect": Perceived influence of media coverage and residential mobility intentions. *Journal of Communication*, *53*(4), 711-727. https://doi.org/10.1111/j.1460-2466.2003.tb02919.x.

Tukker, A., de Koning, A., Wood, R., Hawkins, T., Lutter, S., Acosta, J., Rueda Cantuche, J.M., Bouwmeester, M., Oosterhaven, J., Drosdowski, T., Kuenen, J. (2013). EXIOPOL – Development and Illustrative Analyses of a Detailed Global MR EE SUT/IOT. *Economic Systems Research, 25*, 50–70. https://doi.org/10.1080/09535314.2012.761952.

Tukker, A., Jansen, B. (2006). Environmental Impacts of Products: A Detailed Review of Studies. *Journal of Industrial Ecology*, *10*, 159–182. https://doi.org/10.1162/jiec.2006.10.3.159.

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, *211*(4481), 453-458.

Ursachi, G., Horodnic, I. A., & Zait, A. (2015). How reliable are measurement scales? External factors with indirect influence on reliability estimators. *Procedia Economics and Finance*, *20*, 679-686.

United Nations (2020). SUSTAINABLE DEVELOPMENT KNOWLEDGE PLATFORM. Retrived September 7, 2020 from https://sustainabledevelopment.un.org/.

United Nations (2019). World Population Prospects 2019. Retrived September 7, 2020 from https://www.un.org/development/desa/pd/.

UNDP Belarus (2020). What happens in Belarus due to climate change? Retrived February 17, 2023 from https://www.undp.org/ru/belarus/chto-proiskhodit-s-izmeneniem-klimata-v-belarusi.

United Nations Climate Change (2022). *Nationally Determined Contributions of Belarus till 2030*.

United Nations Division for Sustainable Development, U.N. (2013). *Agenda 21: Earth Summit: The United Nations Programme of Action from Rio*. CreateSpace Independent Publishing Platform, 2013.

United Nations Environment Programme, and Climate and Clean Air Coalition (2021). *Global methane assessment: Benefits and costs of mitigating methane emissions.*

Van der Werff, E., Steg, L., & Keizer, K. (2014). I am what I am, by looking past the present: the influence of biospheric values and past behavior on environmental self-identity. *Environment and behavior*, *46*(5), 626-657. https://doi.org/10.1177/0013916512475209.

Vicente-Molina, M. A., Fernández-Sáinz, A., & Izagirre-Olaizola, J. (2013). Environmental knowledge and other variables affecting pro-environmental behaviour: comparison of university students from emerging and advanced countries. *Journal of Cleaner Production*, *61*, 130-138. https://doi.org/10.1016/j.jclepro.2013.05.015.

Vu, H. T., Liu, Y., & Tran, D. V. (2019). Nationalizing a global phenomenon: A study of how the press in 45 countries and territories portrays climate change. *Global Environmental Change*, *58*, 101942.

Wackernagel, Mathis; Rees, W. (1998). *Our Ecological Footprint: Reducing Human Impact on the Earth*. New Society Publishers.

Wackernagel, M., Monfreda, C., Moran, D., Wermer, P., Goldfinger, S., Deumling, D., Murray, M.

(2005). National Footprint and Biocapacity Accounts 2005 : The underlying calculation method. *Land use policy*, *21*, 231–246.

Wagner, J., & Van Biesebroeck, J. (2008). Understanding cross-country differences in export premia-Comparable evidence for 14 countries. *Review of world economics*, *144*(4), 596-635.

Walley, N., & Whitehead, B. (1994). It's not easy being green. *Reader in Business and the Environment*, *36*(81), 4.

Wang, H., Wang, C., Zheng, H., Feng, H., Guan, R., Long, W. (2015). Updating Input–Output Tables with Benchmark Table Series. *Economic Systems Research, 27*, 287–305. https://doi.org/10.1080/09535314.2015.1053846.

Wang, Y., & Hao, F. (2018). Does internet penetration encourage sustainable consumption? A cross-national analysis. *Sustainable Production and Consumption*, *16*, 237-248. https://doi.org/10.1016/j.spc.2018.08.011.

Wang, X., Van der Werff, E., Bouman, T., Harder, M. K., & Steg, L. (2021). I am vs. We are: how biospheric values and environmental identity of individuals and groups can influence pro-environmental behaviour. *Frontiers in psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.618956.

Weber, C.L., Matthews, H.S. (2008). Quantifying the global and distributional aspects of American household carbon footprint. *Ecological Economics, 66*, 379–391. https://doi.org/10.1016/j.ecolecon.2007.09.021.

Weidner, H. (1995). 25 Years of Modern Environmental Policy in Germany: Treading a Well-Worn Path to the Top of the International Field. *WZB Discussion Paper No. FS II 95-301*.

Wei, R., Lo, V. H., & Lu, H. Y. (2010). The third-person effect of tainted food product recall news: Examining the role of credibility, attention, and elaboration for college students in Taiwan. *Journalism & Mass Communication Quarterly*, *87*(3-4), 598-614. https://doi.org/10.1177/107769901008700310.

Wendling, Z. A., Emerson, J.W., de Sherbinin, A., Esty, D.C., et al. (2020). 2020 Environmental Performance Index.

Wiedmann, T. (2009). A review of recent multi-region input–output models used for consumption-based emission and resource accounting. *Ecological Economics, 69*, 211–222. https://doi.org/10.1016/j.ecolecon.2009.08.026.

Williamson, O. E. (1975). *Markets and Hierarchies*. New York: Free Press.

Williamson, O. E. (1985). *The Economic Institutions of Capitalism*. New York: Free Press.

Wolf, M. J, Emerson, J. W., Esty, D. C., de Sherbinin, A., Wendling, Z. A., *et al*. (2022). *2022 Environmental Performance Index*. New Haven, CT: Yale Center for Environmental Law & Policy.

World Bank (2020a). World Development Indicators. Retrived September 7, 2020 from https://databank.worldbank.org/source/world-development-indicators#.

World Bank (2020b). Carbon Pricing Dashboard. Retrived September 7, 2020 from https://carbonpricingdashboard.worldbank.org/map_data.

World Bank. 2022. Social Protection for Recovery. *Europe and Central Asia Economic Update* (Fall). Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1928-5.

World Bank Group (2020). Strengthening Hydromet and Early Warning Services In Belarus – a Road Map.

World Bank Group (2023). Enterprise Surveys. https://www.enterprisesurveys.org/en/enterprisesurveys.

World Economic Forum (2023). *The Global Risks Report 2023, 18th Edition*.

WVS Database. (2023). World Value Survey, Wave III. Retrieved from https://www.worldvaluessurvey.org/wvs.jsp.

Yadav, R., & Pathak, G. S. (2016). Young consumers' intention towards buying green products in a developing nation: Extending the theory of planned behavior. *Journal of Cleaner Production*, *135*, 732-739. https://doi.org/10.1016/j.jclepro.2016.06.120.

Zakaria, N., Wan-Ismail, W. N. A., & Abdul-Talib, A. N. (2020). Seriously, conspicuous consumption? The impact of culture, materialism and religiosity on Malaysian Generation Y consumers' purchasing of foreign brands. *Asia Pacific Journal of Marketing and Logistics*, *33*(2), 526-560. https://doi.org/10.1108/APJML-07-2018-0283.

Zellner, A. & Theil, H. (1962). Three-Stage Least Squares: Simultaneous Estiomation of Simultaneous Equations. *Econometrica, Vol. 30 (1),* 54-78. https://doi.org/10.2307/1911287.

Zhang, B., Bai, S., Ning, Y., Ding, T., Zhang, Y. (2020). Emission Embodied in International Trade and Its Responsibility from the Perspective of Global Value Chain: Progress, Trends, and Challenges. *Sustainability*, *12*, 3097. https://doi.org/10.3390/su12083097.

Zsuzsa Levay, P., Vanhille, J., Goedeme, T., Verbist, G. (2021). The association between the carbon footprint and the socio-economic characteristics of Belgian households. *Ecological Economics, 186*. https://doi.org/10.1016/j.ecolecon.2021.107065.

APPENDIX A: APPENDIX TO CHAPTER 2

Table A1: Socio-demographic composition of the sample

Socio-demographic consumer characteristics	Sample	
	n	%
	1029	100
Gender		
Male	500	48.59
Female	529	51.41
Age		
18-30 years old	238	23.13
31-50 years old	536	52.09
51 years and older	255	24.78
Education		
< Higher education	470	45.68
= Higher education	559	54.32
Household income		
Up to 1350 BYR	518	50.34
1351-1800 BYR	233	22.64
1801 BYR and more	278	27.02
Regions		
Other regions	635	61.75
Minsk city and Minsk region	394	38.29

Table A2: Descriptive statistics of each construct's indicators

Code	Indicator	Sample (n=1029)	
		Mean	SD
CM	Climate change media use[a]		
CM_TV	Exposure to climate change coverage on TV	1.790	1.234
CM_new	Exposure to climate change coverage on the newspapers	0.948	1.063
CM_rad	Exposure to climate change coverage on the radio	1.150	1.067
CM_Int	Exposure to climate change coverage on the Internet	2.713	0.903
CN	Consumerism media use[a]		
CN_TV	Exposure to the information promoting luxurious lifestyle on TV	1.729	1.283
CN_new	Exposure to the to the information promoting luxurious lifestyle on the newspapers	0.889	0.982
CN_rad	Exposure to the to the information promoting luxurious lifestyle on the radio	1.080	1.048
CN_Int	Exposure to the to the information promoting luxurious lifestyle on the Internet	2.914	0.988
EB	Environmental beliefs[b]		
EB1	Humans are severely abusing the environment	4.195	0.804
EB2	Plants and animals have as much a right as humans to exist	4.132	0.938
EB3	If things continue on their present course, we will soon experience a major ecological catastrophe	3.986	0.988
SE	Environmental self-efficacy[b]		
SE1	I believe that I have the ability to take action to help the environment	3.539	0.854
SE2	I can still change my behavior to be more environmentally-friendly, even when it costs more money or takes more time	3.467	0.892
MV	Materialistic values[b]		
	I admire people who own expensive	2.666	0.998

MV1	homes, cars, and clothes		
MV2	I like a lot of luxury in my life	2.871	1.043
MV3	I'd be happier if I could afford to buy more things	3.405	1.020
AB	Pro-active sustainable consumption behavior[c]		
AB_rep	Choosing to reuse or repair things rather than throwing them away	2.979	0.803
AB_en	Reducing the energy or fuel used at home	2.891	0.893
AB_wat	Choosing to save or reuse water	2.862	0.912
PB	Promotional and accommodating sustainable consumption behavior[c]		
PB_part	Participating in activities organized by environmental groups (organizations) to mitigate environmental problems	1.532	0.688
PB_sear	Searching for information about environmental problems or sustainable lifestyle	2.058	0.652
PB_disc	Discussing information about environmental problems or sustainable lifestyle with others	2.084	0.671
UB	Unsustainable consumption behavior[c]		
UB_h	Updating your household appliances to the best models on the market	1.758	0.591
UB_el	Updating your electronic devices to the newer models (your mobile phone, TV, computer) on the market	1.901	0.593
UB_lux	Buying luxury products (for example, brand-name clothing, gold or diamond jewelry, expensive cosmetic of foreign brands)	1.397	0.575

[a] Four-point Likert scale (1=never; 4=very often; 0=I do not use this type of media).
[b] Five-point Likert scale (1=strongly disagree, 5=strongly agree).
[c] Four-point Likert scale (1=never, 4=always).

Stata commands for SEM

The abbreviations for variables are explained in table A2 above.

*****Sustainable consumption behavior model (basic version)*****

**Confirmatory factor analysis
sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,), covstruct(_lexogenous, diagonal) standardized latent (AB EB PB SE CM) cov(PB*SE) cov(EB*SE) cov(AB*PB) cov(AB*SE) cov(AB*EB) cov(EB*PB) cov(PB*CM) cov(SE*CM) cov(AB*CM) cov(EB*CM) cov(e.PB_part*e.CM_new) cov(e.CM_new*e.CM_Int) cov(e.CM_rad*e.CM_Int) cov(e.PB_sear*e.CM_Int)

*Fit indices of the measurement model
estat gof, stats(all)

* Cronbach's α
alpha CM_TV CM_new CM_rad CM_Int
alpha EB1 EB3
alpha SE1 SE2
alpha AB_rep AB_en AB_wat
alpha PB_sear PB_disc PB_part

*Raykov's reliability coefficients
relicoef

*Convergent and discriminant validity assessment
condisc

**Structural part
sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,) (CM<-EB) (CM<-SE) (AB<-CM) (PB<-CM) (AB<-SE) (PB<-SE) (AB<-EB) (PB<-EB) (AB<-PB) (SE<-EB), covstruct(_lexogenous, diagonal) standardized latent(AB EB PB SE CM) cov(e.PB_part*e.CM_new) cov(e.CM_new*e.CM_Int) cov(e.CM_rad*e.CM_Int) cov(e.PB_sear *e.CM_Int)

*Fit indices of the structural model
estat gof, stats(all)

*R-squared values
estat eqgof

*Indirect effects
estat teffects, stand nodirect nototal compact

*****Sustainable consumption behavior model (extended version) *****

**Confirmatory factor analysis
sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) , covstruct(_lexogenous, diagonal) standardized latent(AB EB PB SE CM CN) cov(PB*SE) cov(EB*SE) cov(AB*PB) cov(AB*SE) cov(AB*EB) cov(EB*PB) cov(CM*CN) cov(PB*CM) cov(SE*CM) cov(AB*CM) cov(PB*CN) cov (EB*CM) cov(e.CM_new*e.CM_Int) cov(e.PB_part*e.CM_new) cov(e.CM_rad*e.CM_Int) cov(e.CM_rad*e.CN_rad) cov(e.CM_TV*e.CN_TV) cov(e.CM_Int*e.CN_Int) cov(e.CM_new*e.CN_new) cov(e.PB_part*e.CN_new) cov(e.CN_rad*e.CN_Int) cov(e.CN_TV*e.CN_new) cov(e.CN_TV*e.CN_rad) cov(e. PB_disc*e.CM_TV) cov(e.CM_new*e.CN_Int) cov(e.PB_sear *e.CM_Int) cov(e.SE2*e.CM_TV)

*Fit indices of the measurement model
estat gof, stats(all)

* Cronbach's α
alpha CN_TV CN_new CN_rad CN_Int
alpha CM_TV CM_new CM_rad CM_Int
alpha EB1 EB3
alpha SE1 SE2
alpha AB_rep AB_en AB_wat
alpha PB_sear PB_disc PB_part

*Raykov's reliability coefficients
relicoef

*Convergent and discriminant validity assessment
condisc

**Structural part

sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (CM <- EB) (CN <- CM) (CM <-SE) (CM <- CN) (AB <- CM) (AB <- CN) (PB <-CM) (PB <- CN) (AB <- SE) (PB <- SE) (AB <- EB) (PB <- EB) (AB <- PB) (SE <- EB), covstruct(_lexogenous, diagonal) standardized latent(AB EB PB SE CM CN) cov(e.PB_part *e.CM_new) cov(e.CM_new*e.CM_Int) cov(e.CM_rad*e.CM_Int) cov(e.CM_rad*e.CN_rad) cov(e.CM_TV*e.CN_TV) cov(e.CM_Int*e.CN_Int) cov(e.CM_new*e.CN_new) cov(e.PB_part *e.CN_new) cov(e.CN_rad*e.CN_Int) cov(e.CN_TV*e.CN_new) cov(e.CN_TV*e.CN_rad) cov(e. PB_disc *e.CM_TV) cov(e.CM_new*e.CN_Int) cov(PB_sear *e.CM_Int) cov(e.SE2*e.CM_TV)

*Fit indices of the structural model
estat gof, stats(all)

*R-squared values
estat eqgof

*Indirect effects
estat teffects, stand nodirect nototal compact

*****Unsustainable consumption behavior model*****

**Confirmatory factor analysis
sem (UB -> UB_h,) (UB -> UB_el,) (UB -> UB_lux,) (MV -> MV1,) (MV -> MV2,) (MV -> MV3,) (SE -> SE1,) (SE -> SE2,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,), covstruct(_lexogenous, diagonal) standardized latent(UB MV CN SE) cov(MV*UB) cov(MV*CN) cov(SE*CN) cov(UB*CN) cov(e.CN_TV*e.CN_rad) cov(e.CN_new*e.CN_Int) cov(e.CN_rad*e.CN_Int) cov(e.UB_h*e.UB_lux) cov(e.MV1*e.MV3) cov(e.MV1*e.SE1)

*Fit indices of the measurement model
estat gof, stats(all)

* Cronbach’s α
alpha CN_TV CN_new CN_rad CN_Int
alpha UB_h UB_el UB_lux
alpha MV1 MV2 MV3
alpha SE1 SE2

*Raykov’s reliability coefficients
relicoef

*Convergent and discriminant validity assessment
condisc

**Structural part
sem (UB -> UB_h,) (UB -> UB_el,) (UB -> UB_lux,) (MV -> MV1,) (MV -> MV2,) (MV -> MV3,) (SE -> SE1,) (SE -> SE2,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (UB <- CN,) (UB <- SE,) (UB <- MV,) (CN <- MV,) (CN <- SE,) (SE <- MV,), covstruct(_lexogenous, diagonal) standardized latent(UB MV CN SE) cov(e.CN_TV*e.CN_rad) cov(e.CN_new*e.CN_Int) cov(e.CN_rad*e.CN_Int) cov(e.UB_h*e.UB_lux) cov(e.MV1*e.MV3) cov(e.MV1*e.SE1)

*Fit indices of the structural model
estat gof, stats(all)

*R-squared values
estat eqgof

*Indirect effects
estat teffects, stand nodirect nototal compact

Multi-group analysis

*** Multi-group analysis for the sustainable consumption behavior model (extended version)***

**By gender: group 1(male), and group 2 (female)
sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (CM <- EB) (CN <- CM) (CM <-SE) (CM <- CN) (AB <- CM) (AB <- CN) (PB <-CM) (PB <- CN) (AB <- SE) (PB <- SE) (AB <- EB) (PB <- EB) (AB <- PB) (SE <- EB), covstruct(_lexogenous, diagonal) standardized latent(AB EB PB SE CM CN) cov(e.PB_part *e.CM_new) cov(e.CM_new*e.CM_Int) cov(e.CM_rad*e.CM_Int) cov(e.CM_rad*e.CN_rad) cov(e.CM_TV*e.CN_TV) cov(e.CM_Int*e.CN_Int) cov(e.CM_new*e.CN_new) cov(e.PB_part *e.CN_new) cov(e.CN_rad*e.CN_Int) cov(e.CN_TV*e.CN_new) cov(e.CN_TV*e.CN_rad) cov(e. PB_disc*e.CM_TV) cov(e.CM_new*e.CN_Int) cov(PB_sear*e.CM_Int) cov(e.SE2*e.CM_TV) group(gender) ginvariant (mcoef mcons)

*Tests for invariance of parameters across groups (Wald tests)
estat ginvariant

**By age: group 1(18-30), group 2(31-50), and group 3 (51 and older)
sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (CM <- EB) (CN <- CM) (CM <-SE) (CM <- CN) (AB <- CM) (AB <- CN) (PB <-CM) (PB <- CN) (AB <- SE) (PB <- SE) (AB <- EB) (PB <- EB) (AB <- PB) (SE <- EB), covstruct(_lexogenous, diagonal) standardized latent(AB EB PB SE CM CN) cov(e.PB_part*e.CM_new) cov(e.CM_new*e.CM_Int) cov(e.CM_rad*e.CM_Int) cov(e.CM_rad*e.CN_rad) cov(e.CM_TV*e.CN_TV) cov(e.CM_Int*e.CN_Int) cov(e.CM_new*e.CN_new) cov(e.PB_part*e.CN_new) cov(e.CN_rad*e.CN_Int) cov(e.CN_TV*e.CN_new) cov(e.CN_TV*e.CN_rad) cov(e.PB_disc*e.CM_TV) cov(e.CM_new*e.CN_Int) cov(PB_sear*e.CM_Int) cov(e.SE2*e.CM_TV) group(age) ginvariant (mcoef mcons)

*****Tests for invariance of parameters across groups (Wald tests)
estat ginvariant

**By education: group 1 (<higher education), and group 2 (higher education)
sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (CM <- EB) (CN <- CM) (CM <-SE) (CM <- CN) (AB <- CM) (AB <- CN) (PB <-CM) (PB <- CN) (AB <- SE) (PB <- SE) (AB <- EB) (PB <- EB) (AB <- PB) (SE <- EB), covstruct(_lexogenous, diagonal) standardized latent(AB EB PB SE CM CN) cov(e.PB_part*e.CM_new) cov(e.CM_new*e.CM_Int) cov(e.CM_rad*e.CM_Int) cov(e.CM_rad*e.CN_rad) cov(e.CM_TV*e.CN_TV) cov(e.CM_Int*e.CN_Int) cov(e.CM_new*e.CN_new) cov(e.PB_part*e.CN_new) cov(e.CN_rad*e.CN_Int) cov(e.CN_TV*e.CN_new) cov(e.CN_TV*e.CN_rad) cov(e.PB_disc*e.CM_TV) cov(e.CM_new*e.CN_Int) cov(PB_sear*e.CM_Int) cov(e.SE2*e.CM_TV) group(education) ginvariant (mcoef mcons)

*****Tests for invariance of parameters across groups (Wald tests)
estat ginvariant

**By region: group 1 (all regions except Minsk region), and group 2 (Minsk region)
sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (CM <- EB) (CN <- CM) (CM <-SE) (CM <- CN) (AB <- CM) (AB <- CN) (PB <-CM) (PB <- CN) (AB <- SE) (PB <- SE) (AB <- EB) (PB <- EB) (AB <- PB) (SE <- EB),

covstruct(_lexogenous, diagonal) standardized latent(AB EB PB SE CM CN) cov(e.PB_part*e.CM_new) cov(e.CM_new*e.CM_Int) cov(e.CM_rad*e.CM_Int) cov(e.CM_rad*e.CN_rad) cov(e.CM_TV*e.CN_TV) cov(e.CM_Int*e.CN_Int) cov(e.CM_new*e.CN_new) cov(e.PB_part*e.CN_new) cov(e.CN_rad*e.CN_Int) cov(e.CN_TV*e.CN_new) cov(e.CN_TV*e.CN_rad) cov(e.PB_disc*e.CM_TV) cov(e.CM_new*e.CN_Int) cov(PB_sear*e.CM_Int) cov(e.SE2*e.CM_TV) group(region) ginvariant (mcoef mcons)

*Tests for invariance of parameters across groups (Wald tests)
estat ginvariant

**By income: income: group 1 (up to 1350 BYR), group 2 (1351-1800 BYR), and group 3 (1801 BYR and more)
sem (AB -> AB_rep,) (AB -> AB_en,) (AB -> AB_wat,) (EB -> EB1,) (EB -> EB3,) (PB -> PB_sear,) (PB -> PB_disc,) (PB -> PB_part,) (SE -> SE1,) (SE -> SE2,) (CM -> CM_TV,) (CM -> CM_new,) (CM -> CM_rad,) (CM -> CM_Int,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (CM <- EB) (CN <- CM) (CM <-SE) (CM <- CN) (AB <- CM) (AB <- CN) (PB <-CM) (PB <- CN) (AB <- SE) (PB <- SE) (AB <- EB) (PB <- EB) (AB <- PB) (SE <- EB), covstruct(_lexogenous, diagonal) standardized latent(AB EB PB SE CM CN) cov(e.PB_part*e.CM_new) cov(e.CM_new*e.CM_Int) cov(e.CM_rad*e.CM_Int) cov(e.CM_rad*e.CN_rad) cov(e.CM_TV*e.CN_TV) cov(e.CM_Int*e.CN_Int) cov(e.CM_new*e.CN_new) cov(e.PB_part*e.CN_new) cov(e.CN_rad*e.CN_Int) cov(e.CN_TV*e.CN_new) cov(e.CN_TV*e.CN_rad) cov(e.PB_disc*e.CM_TV) cov(e.CM_new*e.CN_Int) cov(PB_sear*e.CM_Int) cov(e.SE2*e.CM_TV) group(income) ginvariant (mcoef mcons)

*Tests for invariance of parameters across groups (Wald tests)
estat ginvariant

*** Multi-group analysis for the unsustainable consumption behavior model***

**By gender: group 1(male), and group 2 (female)
sem (UB -> UB_h,) (UB -> UB_el,) (UB -> UB_lux,) (MV -> MV1,) (MV -> MV2,) (MV -> MV3,) (SE -> SE1,) (SE -> SE2,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (UB <- CN,) (UB <- SE,) (UB <- MV,) (CN <- MV,) (CN <- SE,) (SE <- MV,), covstruct(_lexogenous, diagonal) standardized latent(UB MV CN SE) cov(e.CN_TV*e.CN_rad) cov(e.CN_new*e.CN_Int) cov(e.CN_rad*e.CN_Int) cov(e.UB_h*e.UB_lux) cov(e.MV1*e.MV3) cov(e.MV1*e.SE1) group(gender) ginvariant (mcoef mcons)

*Tests for invariance of parameters across groups (Wald tests) estat ginvariant

**By education: group 1 (<higher education), and group 2 (higher education)
sem (UB -> UB_h,) (UB -> UB_el,) (UB -> UB_lux,) (MV -> MV1,) (MV -> MV2,) (MV -> MV3,) (SE -> SE1,) (SE -> SE2,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (UB <- CN,) (UB <- SE,) (UB <- MV,) (CN <- MV,) (CN <- SE,) (SE <- MV,), covstruct(_lexogenous, diagonal) standardized latent(UB MV CN SE) cov(e.CN_TV*e.CN_rad) cov(e.CN_new*e.CN_Int) cov(e.CN_rad*e.CN_Int) cov(e.UB_h*e.UB_lux) cov(e.MV1*e.MV3) cov(e.MV1*e.SE1) group(education) ginvariant (mcoef mcons)

*Tests for invariance of parameters across groups (Wald tests)
estat ginvariant

**By region: group 1 (all regions except Minsk region), and group 2 (Minsk region)
sem (UB -> UB_h,) (UB -> UB_el,) (UB -> UB_lux,) (MV -> MV1,) (MV -> MV2,) (MV -> MV3,) (SE -> SE1,) (SE -> SE2,) (CN -> CN_TV,) (CN -> CN_new,) (CN -> CN_rad,) (CN -> CN_Int,) (UB <- CN,) (UB <- SE,) (UB <- MV,) (CN <- MV,) (CN <- SE,) (SE <- MV,), covstruct(_lexogenous, diagonal) standardized latent(UB MV CN SE) cov(e.CN_TV*e.CN_rad) cov(e.CN_new*e.CN_Int) cov(e.CN_rad*e.CN_Int) cov(e.UB_h*e.UB_lux) cov(e.MV1*e.MV3) cov(e.MV1*e.SE1) group(region) ginvariant (mcoef mcons)

*Tests for invariance of parameters across groups (Wald tests)
estat ginvariant

Table A3: Multi-group analysis for the sustainable consumption behavior model (extended version)

		PB→AB	SE→AB	CM→AB	CN→AB	EB→AB	SE→PB	CM→PB	CN→PB	EB→PB	EB→SE	SE→CM	EB→CM	CN→CM	CM→CN
Gender	Group 1 (male)	0.261***	0.030	0.125	-0.070	0.194**	0.435***	0.324***	-0.045	0.003	0.429***	0.231***	0.067	0.257	0.500***
	Group 2 (female)	0.351***	0.006	0.026	0.011	0.177**	0.388***	0.198***	-0.045	0.132*	0.493***	0.264***	-0.112	0.079	0.547**
	Wald stat: x^2	0.568	0.044	1.206	1.110	0.002	0.004	1.556	0.000	2.195	0.533	0.283	0.330	3.421	0.023
	p	0.451	0.834	0.272	0.292	0.964	0.950	0.212	0.984	0.139	0.466	0.595	0.565	0.064	0.878
Age	Group 1 (18-30)	0.477***	-0.256*	0.013	0.134	0.313***	0.536***	0.250**	-0.012	0.036	0.537***	0.280	-0.080	-0.310	0.803**
	Group 2 (31-50)	0.335***	0.047	0.017	-0.104	0.134*	0.380***	0.276***	-0.056	0.035	0.413***	0.201***	0.076	0.169	0.550***
	Group 3 (51+)	0.055	0.182	0.160	0.020	0.309***	0.398***	0.245**	-0.058	0.161	0.439***	0.297**	-0.009	0.358*	0.285
	Wald stat: x^2	8.616	7.005	1.911	5.490	4.264	1.369	0.149	0.196	1.772	1.604	1.416	1.397	1.002	2.266
	p	**0.014**	**0.030**	0.385	**0.064**	0.119	0.504	0.928	0.907	0.412	0.449	0.493	0.497	0.606	0.322
Education	Group 1 (<higher education)	0.380***	0.001	0.064	-0.089	0.215***	0.371***	0.296***	-0.066	0.106	0.507***	0.254**	0.008	-0.023	0.625***
	Group 2 (=higher education)	0.247***	0.043	0.048	0.047	0.155*	0.458***	0.210***	-0.010	0.067	0.393***	0.211***	0.004	**0.423****	0.316
	Wald stat: x^2	3.174	0.178	0.048	3.008	0.110	2.943	0.733	0.436	0.032	0.863	0.003	0.001	2.405	2.031
	p	**0.075**	0.674	0.826	**0.083**	0.740	**0.086**	0.392	0.509	0.858	0.353	0.954	0.979	0.121	0.154
Region	Group 1 (other regions)	0.310***	0.041	0.080	-0.094	0.145*	0.405***	0.260***	-0.051	0.122*	0.506***	0.248***	-0.009	0.137	0.527***
	Group 2 (Minsk region)	0.325***	-0.008	0.036	0.073	0.270***	0.423***	0.245***	-0.020	0.014	0.348***	0.201**	0.026	0.367	0.381
	Wald stat: x^2	0.054	0.183	0.193	4.162	2.049	0.613	0.008	0.166	1.260	4.678	0.039	0.160	0.551	0.160
	p	0.817	0.669	0.660	**0.041**	0.152	0.434	0.929	0.683	0.262	**0.031**	0.843	0.689	0.458	0.690
	Group 1	0.382***	-0.066	0.059	-0.024	0.250***	0.421***	0.256***	-0.061	0.073	0.461***	0.271**	-0.021	-0.081	0.694***
	Group 2	0.289**	0.237*	0.026	-0.044	0.032	0.410***	0.225*	0.062	0.092	0.392***	0.359***	0.033	0.104	0.461**

Income	Group 3	0.178*	-0.0002	0.097	-0.018	0.216*	0.408***	0.303***	-0.117	0.080	0.494***	0.180*	-0.001	0.757**	-0.201
	Wald stat: x^2 p	 3.258 0.196	 5.219 **0.074**	 0.287 0.867	 0.061 0.970	 3.659 0.161	 0.126 0.939	 0.629 0.730	 3.246 0.197	 0.034 0.983	 1.001 0.606	 1.903 0.386	 0.196 0.907	 6.253 **0.044**	 2.452 0.293

Note: standardized coefficients; *** p<0.001, ** p<0.01; *p<0.05.

Table A4: Multi-group analysis for the unsustainable consumption behavior model

		SE→UB	CN→UB	MV→UB	MV→SE	SE→CN	MV→CN
Gender	Group 1 (male)	0.011	0.129**	0.217***	0.096	0.112	0.142**
	Group 2 (female)	-0.015	0.110*	0.298***	0.032	0.093	0.195***
	Wald stat: x^2 p	 0.125 0.724	 0.116 0.733	 0.704 0.401	 0.870 0.351	 0.019 0.890	 0.430 0.512
Education	Group 1 (<higher education)	0.014	0.166***	0.268***	0.174**	0.108*	0.187***
	Group 2 (=higher education)	-0.041	0.084	0.247***	-0.057	0.057	0.149**
	Wald stat: x^2 p	 0.704 0.402	 1.217 0.270	 0.046 0.831	 11.028 **0.001**	 0.371 0.542	 0.417 0.519
Region	Group 1 (other regions)	0.005	0.119**	0.252***	0.074	0.122*	0.149***
	Group 2 (Minsk region)	-0.009	0.117*	0.240***	0.049	0.058	0.180**
	Wald stat: x^2 p	 0.039 0.844	 0.001 0.978	 0.027 0.870	 0.134 0.714	 0.438 0.508	 0.343 0.558

Note: standardized coefficients; *** p<0.001, ** p<0.01; *p<0.05.

APPENDIX B: APPENDIX TO CHAPTER 3

Table B1: Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
AEFM	328	3.561	2.965	0	10
Export intensity	326	23.175	31.881	0	100
Total productivity	284	1.43	0.661	.088	5
Resource productivity	288	4.519	9.655	1.1	136.25
Labor productivity, in nat. log	303	1.559	0.805	-1.304	6.982
Customers' requirements	326	0.206	0.405	0	1
Sales 2 years ago, in nat. log	284	14.59	2.062	10.668	19.724
International	327	0.223	0.417	0	1
Days to clear customs	328	1.015	3.808	0	60
Mean total productivity	328	1.429	0.27	1.177	2.586
Mean resource productivity	328	4.433	2.673	2.416	19.791
Mean labor productivity	328	2.003	0.788	1.104	3.012
Size	328	230.518	561.362	4	5556
Skills	323	30.942	21.226	0	100
Product innovation	328	0.527	0.5	0	1
Process innovation	327	0.254	0.436	0	1
Number of standards	322	0.553	0.777	0	4
Age	328	24.277	21.702	1	140
Experience	325	16.751	10.121	1	50
CO_2	323	0.325	0.469	0	1
Capacity utilization	317	77.344	21.804	5	100
Foreign technology	327	0.086	0.28	0	1
Number of competitors	295	4.647	4.691	1	11
Furniture	328	0.055	0.228	0	1
Plastics	328	0.055	0.228	0	1
Food	328	0.314	0.465	0	1
Garments	328	0.335	0.473	0	1
Metal	328	0.046	0.209	0	1

Table B2: Weak instrument tests for the 1st set of equations (table 3.6)

AEFM	Export intensity	Productivity
(1) customers' requirements=0	(1) days to clear customs=0	(1) Mean productivity=0
(2) sales 2 years back =0	(2) international=0	
chi2(2)=23.75	chi2(2)=219.40	chi2(1)=39.72
Prob > chi2 = 0.0000	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000

Table B3: Over-identification and under-identification tests the 1st set of equations (table 3.6)

Test	'export intensity' in the AEFM equation	'productivity' in the AEFM equation	'AEFM' in the Export intensity equation	'productivity' in the Export intensity equation	'AEFM' in the Productivity equation	'Export intensity' in the Productivity equation
Sargan statistic (overidentification test of all instruments):	1.266		3.483		2.373	0.027
Chi-sq(1) P-val:	0.261		0.062		0.124	0.870
Under-identification test (Anderson canon. corr. LM statistic):	129.925	32.823	28.159	35.558	21.742	138.912
Chi-sq(2) P-val:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table B4: Weak instrument tests for the 2nd set of equations (table 3.7)

AEFM	Export intensity	Resource productivity
(1) customers' requirements=0 (2) sales 2 years back =0 chi2(2)=17.52 Prob > chi2 = 0.0002	(1) days to clear customs=0 (2) international=0 chi2(2)=191.39 Prob > chi2 = 0.0000	(1) Mean resource productivity=0 chi2(1)=20.68 Prob > chi2 = 0.0000

Table B5: Over-identification and under-identification tests the 2nd set of equations (table 3.7)

Test	'export intensity' in the AEFM equation	'resource productivity' in the AEFM equation	'AEFM' in the Export intensity equation	'resource productivity' in the Export intensity equation	'AEFM' in the Resource productivity equation	'Export intensity' in the Resource productivity equation
Sargan statistic (overidentification test of all instruments):	0.965		3.403		0.402	0.171
Chi-sq(1) P-val:	0.326		0.0651		0.526	0.679
Under-identification test (Anderson canon. corr. LM statistic):	118.338	25.471	25.699	27.786	19.153	126.038
Chi-sq(2) P-val:	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000

Table B6: Weak instrument tests for the 3nd set of equations (table 3.8)

AEFM	Export intensity	Labor productivity
(1) customers' requirements=0	(1) days to clear customs=0	(1) Mean labor productivity=0
(2) sales 2 years back =0	(2) international=0	
chi2(2)=14.00	chi2(2)=239.12	chi2(1)=11.60
Prob > chi2 = 0.0009	Prob > chi2 = 0.0000	Prob > chi2 = 0.0007

Table B7: Over-identification and under-identification tests the 3nd set of equations (table 3.8)

Test	'export intensity' in the AEFM equation	'labor productivity' in the AEFM equation	'AEFM' in the Export intensity equation	'labor productivity' in the Export intensity equation	'AEFM' in the Labor productivity equation	'Export intensity' in the Labor productivity equation
Sargan statistic (overidentification test of all instruments):	1.472		3.589		17.877	0.393
Chi-sq(1) P-val:	0.225		0.058		0.000	0.531
Under-identification test (Anderson canon. corr. LM statistic):	131.791	12.061	26.795	19.130	19.966	140.477
Chi-sq(2) P-val:	0.0000	0.0005	0.0000	0.0000	0.0000	0.0000

Table B8: Overview of industries in the manufacturing sector

Industry	Number of enterprises	%
Food	105	32.01
Textiles	19	5.79
Garments	87	26.52
Leather	4	1.22
Wood	7	2.13
Paper	7	2.13
Publishing, printing, & recorded media	4	1.22
Chemicals	8	2.44
Plastics & rubber	18	5.49
Non-metallic mineral products	7	2.13
Fabricated metal products	15	4.57
Machinery & equipment (29-30)	9	2.74
Electronics (31-32)	8	2.44
Precision instruments	7	2.13
Furniture	18	5.49

Recycling	5	1.52
Total	328	100.00

APPENDIX C: APPENDIX TO CHAPTER 4

The EEMRIO table for Belarus in 2015 from the EORA26 database is highly imbalanced sector-wise. To overcome that problem, for the EEIO analysis for Belarus the national input-output table without environmental extensions provided by the National Statistical Committee of the Republic of Belarus (perfectly balanced sector-wise) was combined with GHG emissions inventory satellite accounts from the EORA database. The environmental satellite accounts in the EORA26 database (values were GHG emissions (Gg) from PRIMAPHIST for CO_2, CH_4 and N_2O / TOTAL excluding LULUCF) were allocated to the 26-sector input-output model whereas the input-output table from the National Statistical Committee of the Republic of Belarus included 31 sectors. The disaggregation of the 26-sector environmental satellite accounts to match the 31-sector input-output table was performed with respect to the share of the corresponding sectors in the output.

As for Belarus the national input-output table merged with the GHG emissions inventory satellite accounts from EORA26 is used, the footprints calculated on the basis of that do not include the emissions embodied in import. For all the other countries under analysis EEMRIO model from EORA26 is used with full linkages. In this regard, the results from Belarus can be interpreted as representing the lower boundary of the true value.

Table C1: Concordance table for GHG emissions inventory satellite accounts between EORA26 and the national input-out table for Belarus for 2015

EORA26	National input-output table from the National Statistical Committee of the Republic of Belarus	Comments
Agriculture	Agriculture, hunting and service delivery in these areas	
	Forestry and forestry services provision	No emissions attributable to this sector
Fishing	Fisheries, fish farming and services provision in these areas	
Mining and quarrying	Mining of fossil fuels	Emissions from EORA26 multiplied by 0.95489
	Mining of other materials than fossil fuels	Emissions from EORA26 multiplied by 0.04511
Food & beverages	Food, including beverages, and tobacco	
Textiles and wearing apparel	Textiles and wearing apparel	Emissions from EORA26 multiplied by 0.75447

	Leather and footwear	Emissions from EORA26 multiplied by 0.24553
Wood and paper	Wood treatment and wood products	Emissions from EORA26 multiplied by 0.47098
	Pulp and paper, publisher activities	Emissions from EORA26 multiplied by 0.52902
Petroleum, chemical and non-metallic mineral products	Coke, petroleum and nuclear materials	Emissions from EORA26 multiplied by 0.39104
	Chemical industry	Emissions from EORA26 multiplied by 0.38876
	Rubber and plastic products	Emissions from EORA26 multiplied by 0.10917
	Other non-metallic mineral products	Emissions from EORA26 multiplied by 0.11103
Metal products	Metal Products	
Electrical and machinery	Machinery and equipment	Emissions from EORA26 multiplied by 0.58238
	Electrical, electronic and optical equipment	Emissions from EORA26 multiplied by 0.41762
Transport equipment	Vehicles and equipment	
Other manufacturing	Other manufacturing	
Recycling	Public, social and personal services	
Electricity, gas and water	Electricity, gas and water	
Construction	Construction	
Maintenance and repair	Trade and repair	
Wholesale trade	Trade and repair	
Retail trade	Trade and repair	
Hotels and restaurants	Hotels and restaurants	
Transport	Transport	
Post and telecommunications	Information and communication	
Financial intermediation and business activities	Financial activities	Emissions from EORA26 multiplied by 0.26271
	Real estate transactions, leases and services to consumers	Emissions from EORA26 multiplied by 0.73729
Public administration	Public administration	
Education, health and other services	Education	Emissions from EORA26 multiplied by 0.50275
	Health and social services	Emissions from EORA26

		multiplied by 0.49725
Private households	Public, social and personal services	
Others	Public, social and personal services	
Re-export & re-import		No emissions attributable to this sector

Source: Lenzen et al., 2015; National Statistical Committee of the Republic of Belarus, 2023; author's own contribution.

Table C2: Structure of the CH_4-footprint by the final demand category in 2015, %

Level of Development	Countries	Households	NPISH	Governments	Gross fixed capital formation	Changes in inventories	Acquisitions less disposals of valuables
HIC	Germany	59.31	0.91	12.28	27.67	-0.46[a]	0.29
UMC	Belarus	65.69	1.01	12.28	20.97	0.05	-[b]
LIC	Tajikistan	83.81	3.57	7.66	3.32	0.53	1.11
LMC	Myanmar	85.13	1.35	6.69	6.48	0.33	0.03
UMC	Thailand	50.44	2.41	10.57	22.95	11.17	2.46
LMC	Honduras	74.70	2.61	6.85	14.18	0.98	0.68
UMC	Peru	59.34	3.58	10.65	22.72	1.39	2.32
LMC	Morocco	70.45	1.71	9.97	17.02	-0.20	1.05
UMC	Jordan	70.08	7.27	9.01	10.86	0.44	2.33
LMC	Sri-Lanka	73.81	3.82	5.98	13.71	0.43	2.25
LMC	Pakistan	86.69	0.22	4.87	7.35	0.76	0.11
LMC	Kenya	59.82	10.56	12.25	16.25	0.30	0.83
UMC	Namibia	64.76	6.17	17.16	10.24	0.20	1.46

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

[a] The negative values in the category 'Changes in inventories' mean that part of the gross output "was supplied by a drawdown of existing inventory" (Lenzen et al., 2015), i.e. the emissions from production of this part of the gross output were saved.

[b] The EEIO model based on the input-output table from the National Statistical Committee of the Republic of Belarus includes the same categories as the EORA26 EEMRIO model, except for the "acquisitions less disposals of valuables."

Table C3: Structure of the N_2O-footprint by the final demand category in 2015, %

Level of Development	Countries	Households	NPISH	Governments	Gross fixed capital formation	Changes in inventories	Acquisitions less disposals of valuables
HIC	Germany	58.70	1.08	13.80	26.59	-0.38[c]	0.21
UMC	Belarus	65.69	1.01	12.28	20.97	0.05	-[d]
LIC	Tajikistan	86.71	1.66	7.74	2.78	0.48	0.63
LMC	Myanmar	85.06	1.35	6.73	6.51	0.33	0.03
UMC	Thailand	49.42	2.71	10.05	23.07	11.58	3.16
LMC	Honduras	74.61	2.71	6.83	14.17	0.97	0.70
UMC	Peru	59.82	3.37	10.83	22.63	1.43	1.92
LMC	Morocco	72.64	0.57	10.18	16.46	-0.24	0.38
UMC	Jordan	69.16	7.77	8.87	11.12	0.44	2.64
LMC	Sri-Lanka	75.44	3.12	6.03	13.13	0.42	1.86
LMC	Pakistan	86.60	0.24	4.87	7.38	0.76	0.13
LMC	Kenya	59.91	10.52	12.21	16.26	0.30	0.81
UMC	Namibia	64.79	6.17	17.14	10.24	0.20	1.47

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

[c] The negative values in the category 'Changes in inventories' mean that part of the gross output "was supplied by a drawdown of existing inventory" (EORA, 2020), i.e. the emissions from production of this part of the gross output were saved.

[d] The EEIO model based on the input-output table from the National Statistical Committee of the Republic of Belarus includes the same categories as the EORA26 EEMRIO model, except for the "acquisitions less disposals of valuables."

Table C4: CO_2-, CH_4- and N_2O-footprints of all the final demand categories (the national footprint) in physical units per capita and in tons of CO_2-equivalents in 2015

Countries	CO_2-footprint (tons per capita)	CH_4-footprint (tons per capita)	N_2O-footprint (tons per capita)	Aggregate footprint of CO_2, CH_4 and N_2O emissions (in tons of CO_2-equivalents per capita)
Germany	10.17	0.0538	0.0022	12.26
Belarus	4.64	0.0510	0.0035	6.99
Tajikistan	0.68	0.0254	0.0013	1.72
Myanmar	0.41	0.0557	0.0013	2.32
Thailand	4.24	0.0438	0.0011	5.74
Honduras	1.23	0.0257	0.0009	2.19
Peru	2.52	0.0371	0.0016	3.97
Morocco	1.64	0.0224	0.0023	2.88
Jordan	2.99	0.0210	0.0006	3.75

Sri-Lanka	1.38	0.0165	0.0005	1.98
Pakistan	0.84	0.0297	0.0008	1.90
Kenya	0.55	0.0287	0.0010	1.60
Namibia	3.86	0.1070	0.0039	7.88

Source: Author's own calculation based on the EORA26 model (Lenzen et al., 2015).

Table C5: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Germany in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	12.43	0.06	12.49	2.86	0.03	2.89	1.26	0.01	1.27	16.65
Food and Beverages	35.64	15.63	51.27	9.80	7.41	17.21	4.23	2.66	6.89	75.37
Transport	14.61	3.62	18.23	3.41	1.42	4.82	1.53	0.48	2.01	25.06
Textiles and Wearing Apparel	5.52	39.15	44.67	1.93	18.29	20.22	0.73	6.29	7.02	71.91
Agriculture	3.86	5.60	9.46	0.94	3.09	4.03	0.42	1.10	1.52	15.00
Construction	1.75	0.00	1.75	0.44	0.00	0.44	0.19	0.00	0.19	2.38

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C6: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Germany in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	46.22	0.24	46.46	5.20	0.06	5.26	2.11	0.02	2.13	53.85
Food and Beverages	132.52	58.12	190.64	17.85	13.50	31.35	7.09	4.45	11.55	233.53
Transport	54.33	13.45	67.78	6.20	2.58	8.78	2.56	0.80	3.37	79.93
Textiles and Wearing Apparel	20.53	145.57	166.10	3.51	33.33	36.83	1.22	10.54	11.77	214.71
Agriculture	14.35	20.81	35.16	1.71	5.62	7.33	0.70	1.85	2.55	45.05
Construction	6.51	0.00	6.51	0.81	0.00	0.81	0.32	0.00	0.32	7.63

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C7: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Belarus in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	99.10	-[e]	99.10	55.17	-	55.17	38.67	-	38.67	192.95
Food and Beverages	27.35	-	27.35	15.23	-	15.23	10.67	-	10.67	53.25
Transport	5.63	-	5.63	3.14	-	3.14	2.20	-	2.20	10.96
Textiles and Wearing Apparel	4.55	-	4.55	2.53	-	2.53	1.78	-	1.78	8.86
Agriculture	7.67	-	7.67	4.27	-	4.27	2.99	-	2.99	14.94
Construction	0.78	-	0.78	0.43	-	0.43	0.30	-	0.30	1.51

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015) and the data from National Statistical Committee of the Republic of Belarus (2020).

[e] As for Belarus it was not possible to use EEMRIO model, the footprints do not include the emissions embodied in import, see Appendix C. The values for the category 'Textiles and Wearing Apparel' for Belarus includes the footprints from 'Textiles and Wearing Apparel' and 'Leather and Footwear'.

Table C8: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Belarus in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	368.49	-[f]	368.49	100.52	-	100.52	64.80	-	64.80	533.82
Food and Beverages	101.70	-	101.70	27.74	-	27.74	17.89	-	17.89	147.33
Transport	20.94	-	20.94	5.71	-	5.71	3.68	-	3.68	30.34
Textiles and Wearing Apparel	16.92	-	16.92	4.62	-	4.62	2.98	-	2.98	24.51
Agriculture	28.53	-	28.53	7.78	-	7.78	5.02	-	5.02	41.33
Construction	2.89	-	2.89	0.79	-	0.79	0.51	-	0.51	4.19

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015) and the data from National Statistical Committee of the Republic of Belarus (2020).

[f] As for Belarus it was not possible to use EEMRIO model, the footprints do not include the emissions embodied in import, see Appendix C. The values for the category 'Textiles and Wearing Apparel' for Belarus includes the footprints from 'Textiles and Wearing Apparel' and 'Leather and Footwear'.

Table C9: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Tajikistan in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	14.52	0.47	14.99	45.66	0.70	46.36	26.10	0.04	26.14	87.49
Food and Beverages	1.30	0.67	1.97	2.57	0.32	2.89	1.34	0.08	1.42	6.28
Transport	0.49	1.14	1.63	0.82	0.75	1.57	0.40	0.13	0.53	3.73
Textiles and Wearing Apparel	0.24	1.55	1.80	0.52	0.81	1.33	0.28	0.16	0.44	3.56
Agriculture	0.06	0.09	0.15	0.14	0.05	0.19	0.07	0.01	0.09	0.43
Construction	0.01	0.00	0.01	0.014	0.003	0.02	0.01	0.00	0.01	0.04

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C10: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Tajikistan in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	54.00	1.75	55.75	83.20	1.28	84.47	43.73	0.07	43.80	184.02
Food and Beverages	4.83	2.49	7.31	4.68	0.59	5.27	2.25	0.13	2.38	14.96
Transport	1.83	4.24	6.07	1.49	1.37	2.86	0.68	0.21	0.89	9.82
Textiles and Wearing Apparel	0.91	5.77	6.68	0.95	1.47	2.42	0.46	0.27	0.73	9.84
Agriculture	0.23	0.34	0.57	0.25	0.10	0.35	0.12	0.02	0.14	1.06
Construction	0.03	0.01	0.04	0.03	0.01	0.04	0.01	0.00	0.01	0.10

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C11: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Myanmar in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	21.06	0.00	21.06	146.86	0.00	146.86	35.06	0.00	35.06	202.98
Food and Beverages	1.03	0.00	1.03	6.94	0.00	6.94	1.66	0.00	1.66	9.63
Transport	0.22	0.00	0.22	1.42	0.00	1.42	0.34	0.00	0.34	1.98
Textiles and Wearing Apparel	0.15	0.00	0.15	1.04	0.00	1.04	0.25	0.00	0.25	1.44
Agriculture	0.10	0.00	0.10	0.70	0.00	0.70	0.17	0.00	0.17	0.97
Construction	0.00	0.00	0.00	0.03	0.00	0.03	0.01	0.00	0.01	0.04

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015)

Table C12: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Myanmar in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	78.32	0.00	78.32	267.58	0.00	267.58	58.75	0.00	58.75	404.65
Food and Beverages	3.83	0.00	3.83	12.65	0.00	12.65	2.78	0.00	2.78	19.26
Transport	0.81	0.00	0.81	2.59	0.00	2.59	0.57	0.00	0.57	3.98
Textiles and Wearing Apparel	0.57	0.00	0.57	1.89	0.00	1.89	0.42	0.00	0.42	2.87
Agriculture	0.38	0.00	0.38	1.27	0.00	1.27	0.28	0.00	0.28	1.93
Construction	0.02	0.0001	0.02	0.06	0.00	0.06	0.01	0.00	0.01	0.09

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C13: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Thailand in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	4.47	0.01	4.48	2.56	0.01	2.56	0.60	0.00	0.60	7.64
Food and Beverages	23.74	1.50	25.23	13.27	0.75	14.02	3.15	0.23	3.38	42.63
Transport	10.30	1.77	12.08	5.85	0.75	6.60	1.37	0.21	1.58	20.26
Textiles and Wearing Apparel	17.27	2.38	19.66	9.43	0.86	10.29	2.30	0.29	2.59	32.54
Agriculture	3.36	0.20	3.56	1.87	0.08	1.95	0.44	0.03	0.47	5.98
Construction	0.05	0.0001	0.05	0.03	0.0001	0.03	0.01	0.00	0.01	0.09

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C14: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Thailand in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	16.64	0.03	16.67	4.66	0.01	4.67	1.00	0.00	1.00	22.34
Food and Beverages	88.26	5.57	93.83	24.18	1.37	25.54	5.28	0.38	5.66	125.04
Transport	38.30	6.60	44.90	10.66	1.37	12.03	2.29	0.35	2.65	59.58
Textiles and Wearing Apparel	64.22	8.87	73.09	17.18	1.56	18.74	3.86	0.49	4.35	96.18
Agriculture	12.49	0.74	13.23	3.41	0.15	3.56	0.74	0.05	0.79	17.58
Construction	0.20	0.0003	0.20	0.06	0.0002	0.06	0.01	0.0001	0.01	0.27

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C15: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Honduras in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	33.14	0.01	33.16	42.00	0.02	42.01	15.20	0.01	15.20	90.37
Food and Beverages	3.63	0.79	4.42	4.13	0.47	4.60	1.51	0.20	1.70	10.73
Transport	0.90	0.80	1.70	0.93	0.33	1.25	0.34	0.12	0.46	3.41
Textiles and Wearing Apparel	0.46	1.45	1.91	0.55	0.81	1.37	0.20	0.32	0.52	3.79
Agriculture	0.36	0.12	0.48	0.42	0.08	0.50	0.15	0.03	0.19	1.17
Construction	0.02	0.001	0.02	0.02	0.001	0.02	0.01	0.000	0.01	0.05

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C16: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Honduras in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	123.24	0.05	123.29	76.52	0.03	76.55	25.46	0.01	25.47	225.31
Food and Beverages	13.50	2.93	16.43	7.53	0.86	8.39	2.53	0.33	2.86	27.68
Transport	3.35	2.97	6.32	1.69	0.60	2.28	0.56	0.20	0.77	9.37
Textiles and Wearing Apparel	1.72	5.38	7.10	1.00	1.48	2.49	0.33	0.53	0.87	10.46
Agriculture	1.34	0.43	1.77	0.77	0.15	0.92	0.26	0.06	0.31	3.00
Construction	0.08	0.002	0.08	0.04	0.001	0.04	0.02	0.00	0.02	0.14

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C17: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Peru in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	1.59	0.00	1.59	1.25	0.00	1.25	0.56	0.00	0.56	3.40
Food and Beverages	21.83	0.82	22.65	17.15	0.61	17.76	7.57	0.19	7.76	48.17
Transport	7.14	0.71	7.84	5.52	0.39	5.90	2.43	0.12	2.55	16.29
Textiles and Wearing Apparel	7.61	0.70	8.31	5.88	0.36	6.24	2.57	0.11	2.69	17.23
Agriculture	5.07	0.16	5.23	4.00	0.10	4.10	1.78	0.03	1.81	11.14
Construction	0.15	0.0002	0.15	0.11	0.00	0.11	0.05	0.0001	0.05	0.31

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C18: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Peru in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	5.92	0.01	5.93	2.27	0.01	2.28	0.93	0.00	0.93	9.14
Food and Beverages	81.18	3.05	84.23	31.25	1.11	32.36	12.69	0.32	13.01	129.59
Transport	26.54	2.62	29.16	10.05	0.70	10.76	4.06	0.21	4.27	44.19
Textiles and Wearing Apparel	28.28	2.61	30.89	10.72	0.65	11.36	4.31	0.19	4.50	46.76
Agriculture	18.86	0.59	19.45	7.29	0.18	7.47	2.99	0.05	3.04	29.96
Construction	0.54	0.001	0.54	0.21	0.001	0.21	0.08	0.00	0.08	0.83

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C19: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Morocco in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	49.61	0.01	49.62	37.68	0.01	37.69	43.03	0.00	43.03	130.34
Food and Beverages	4.55	0.33	4.88	3.33	0.15	3.49	3.67	0.06	3.73	12.09
Transport	1.04	0.33	1.37	0.73	0.13	0.85	0.78	0.05	0.82	3.04
Textiles and Wearing Apparel	0.84	1.87	2.70	0.62	0.69	1.31	0.68	0.25	0.93	4.95
Agriculture	0.50	0.07	0.56	0.37	0.03	0.40	0.40	0.01	0.42	1.38
Construction	0.03	0.0002	0.03	0.02	0.0003	0.02	0.02	0.0001	0.02	0.07

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C20: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Morocco in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	184.47	0.03	184.51	68.66	0.01	68.67	72.11	0.00	72.11	325.29
Food and Beverages	16.91	1.22	18.13	6.08	0.27	6.35	6.15	0.09	6.25	30.73
Transport	3.85	1.22	5.08	1.33	0.23	1.56	1.30	0.08	1.38	8.02
Textiles and Wearing Apparel	3.11	6.95	10.06	1.12	1.26	2.38	1.15	0.42	1.57	14.01
Agriculture	1.85	0.25	2.10	0.67	0.06	0.73	0.68	0.02	0.70	3.52
Construction	0.10	0.001	0.10	0.04	0.001	0.04	0.03	0.0002	0.03	0.17

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C21: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Jordan in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	94.87	0.02	94.89	31.65	0.02	31.68	9.41	0.01	9.41	135.98
Food and Beverages	8.91	1.67	10.57	3.23	0.81	4.04	0.98	0.25	1.24	15.85
Transport	1.97	1.40	3.37	0.71	0.58	1.28	0.21	0.18	0.39	5.05
Textiles and Wearing Apparel	1.07	8.22	9.30	0.40	3.72	4.13	0.13	1.30	1.43	14.85
Agriculture	1.05	0.28	1.33	0.37	0.14	0.51	0.11	0.05	0.16	2.00
Construction	0.06	0.001	0.06	0.02	0.001	0.02	0.01	0.0003	0.01	0.09

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C22: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Jordan in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	352.75	0.09	352.84	57.67	0.04	57.71	15.76	0.01	15.77	426.33
Food and Beverages	33.12	6.20	39.32	5.89	1.47	7.36	1.65	0.42	2.07	48.75
Transport	7.33	5.20	12.53	1.29	1.05	2.34	0.36	0.30	0.66	15.53
Textiles and Wearing Apparel	3.99	30.57	34.56	0.74	6.78	7.52	0.21	2.18	2.39	44.47
Agriculture	3.90	1.05	4.95	0.67	0.26	0.93	0.19	0.08	0.27	6.16
Construction	0.22	0.002	0.22	0.04	0.002	0.04	0.01	0.001	0.01	0.27

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C23: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Sri-Lanka in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	44.85	0.01	44.86	31.04	0.01	31.05	10.58	0.00	10.58	86.48
Food and Beverages	3.13	0.80	3.93	1.99	0.39	2.38	0.65	0.10	0.74	7.05
Transport	0.91	0.56	1.47	0.55	0.22	0.78	0.18	0.06	0.24	2.49
Textiles and Wearing Apparel	0.57	2.12	2.69	0.38	0.95	1.33	0.13	0.26	0.38	4.40
Agriculture	0.53	0.08	0.62	0.36	0.04	0.40	0.12	0.01	0.13	1.14
Construction	0.02	0.0002	0.02	0.01	0.0003	0.01	0.003	0.0001	0.00	0.033

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C24: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Sri-Lanka in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	166.77	0.03	166.80	56.55	0.01	56.56	17.72	0.00	17.73	241.09
Food and Beverages	11.64	2.98	14.62	3.62	0.71	4.33	1.08	0.16	1.25	20.20
Transport	3.40	2.07	5.46	1.01	0.41	1.42	0.30	0.10	0.40	7.28
Textiles and Wearing Apparel	2.13	7.88	10.01	0.69	1.72	2.42	0.21	0.43	0.64	13.06
Agriculture	1.98	0.32	2.29	0.65	0.08	0.72	0.20	0.02	0.22	3.24
Construction	0.07	0.001	0.07	0.02	0.001	0.02	0.01	0.0002	0.01	0.10

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C25: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Pakistan in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	29.69	0.00	29.70	56.14	0.00	56.15	16.39	0.00	16.39	102.23
Food and Beverages	2.69	0.05	2.74	4.87	0.03	4.90	1.42	0.01	1.43	9.07
Transport	0.73	0.09	0.82	1.28	0.04	1.32	0.37	0.01	0.39	2.53
Textiles and Wearing Apparel	0.55	0.22	0.78	1.03	0.08	1.11	0.30	0.03	0.33	2.22
Agriculture	0.20	0.01	0.22	0.36	0.01	0.37	0.11	0.00	0.11	0.70
Construction	0.02	0.00	0.02	0.03	0.00	0.03	0.01	0.00	0.01	0.06

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C26: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Pakistan in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	110.41	0.01	110.42	102.29	0.00	102.30	27.46	0.00	27.46	240.18
Food and Beverages	9.99	0.20	10.18	8.87	0.05	8.92	2.38	0.01	2.40	21.51
Transport	2.70	0.35	3.05	2.33	0.08	2.41	0.63	0.02	0.65	6.11
Textiles and Wearing Apparel	2.06	0.83	2.89	1.87	0.15	2.02	0.50	0.05	0.55	5.47
Agriculture	0.75	0.06	0.80	0.66	0.02	0.68	0.18	0.00	0.18	1.66
Construction	0.06	0.0001	0.06	0.05	0.0001	0.05	0.01	0.00	0.01	0.12

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C27: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Kenya in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	0.20	0.00	0.21	0.69	0.00	0.70	0.24	0.00	0.24	1.15
Food and Beverages	4.08	0.28	4.36	12.91	0.18	13.09	4.46	0.06	4.52	21.98
Transport	3.53	1.61	5.14	11.45	0.69	12.15	3.96	0.19	4.15	21.44
Textiles and Wearing Apparel	0.54	0.43	0.97	1.64	0.21	1.85	0.57	0.06	0.63	3.45
Agriculture	3.88	0.10	3.98	13.53	0.22	13.75	4.68	0.09	4.77	22.50
Construction	0.00	0.0002	0.0002	0.00	0.0002	0.0002	0.00	0.0001	0.0001	0.001

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C28: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Kenya in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	0.76	0.01	0.76	1.26	0.01	1.27	0.40	0.00	0.41	2.44
Food and Beverages	15.16	1.04	16.21	23.52	0.33	23.86	7.48	0.10	7.58	47.64
Transport	13.12	5.99	19.11	20.87	1.26	22.13	6.63	0.32	6.95	48.20
Textiles and Wearing Apparel	2.02	1.60	3.61	2.99	0.37	3.37	0.95	0.10	1.05	8.03
Agriculture	14.43	0.38	14.81	24.65	0.39	25.05	7.85	0.14	7.99	47.85
Construction	0.00	0.001	0.001	0.00	0.0004	0.0004	0.00	0.0001	0.0001	0.0015

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C29: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 3% discount rate in various sectors (in USD per capita) for Namibia in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	46.81	0.07	46.89	144.34	0.06	144.40	53.61	0.02	53.63	244.92
Food and Beverages	7.05	4.51	11.55	11.87	1.44	13.31	4.40	0.54	4.94	29.80
Transport	3.10	3.72	6.82	4.30	1.12	5.42	1.59	0.42	2.01	14.25
Textiles and Wearing Apparel	1.21	8.27	9.48	1.79	2.60	4.39	0.66	0.95	1.61	15.49
Agriculture	0.62	0.99	1.61	1.12	0.30	1.42	0.41	0.11	0.53	3.56
Construction	0.07	0.002	0.07	0.09	0.003	0.09	0.03	0.001	0.03	0.20

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

Table C30: The footprint for CO_2, CH_4 and N_2O of the household consumption valued at 1.4% discount rate in various sectors (in USD per capita) for Namibia in 2015

Sectors	CO_2			CH_4			N_2O			Total
	Domestic	Import	Total	Domestic	Import	Total	Domestic	Import	Total	
Electricity, Gas and Water	174.07	0.27	174.34	262.99	0.11	263.10	89.84	0.04	89.87	527.31
Food and Beverages	26.20	16.75	42.95	21.63	2.62	24.25	7.38	0.90	8.28	75.48
Transport	11.52	13.83	25.35	7.84	2.05	9.88	2.67	0.70	3.37	38.60
Textiles and Wearing Apparel	4.51	30.76	35.27	3.27	4.73	8.00	1.11	1.59	2.70	45.97
Agriculture	2.32	3.68	6.00	2.04	0.55	2.59	0.70	0.19	0.88	9.48
Construction	0.25	0.01	0.26	0.16	0.01	0.17	0.05	0.002	0.05	0.48

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015).

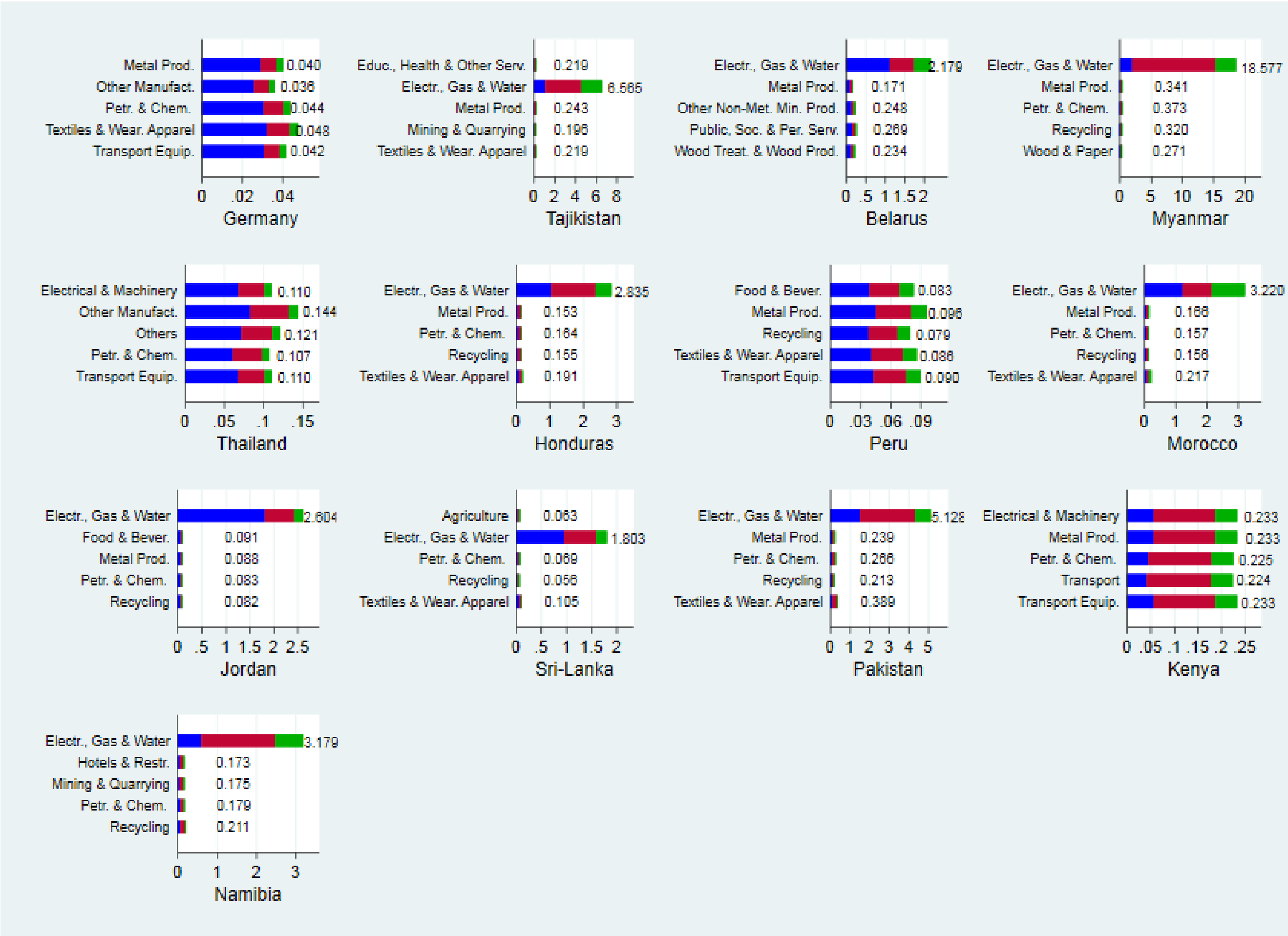

Figure C1: Sectors with the highest social costs of aggregated emissions per 1 USD of output (in USD per 1 USD of output) at the 3% discount rate in 2015

Source: Author's own calculation using the EORA26 model (Lenzen et al., 2015) and the data from National Statistical Committee of the Republic of Belarus (2023).

Note: blue represents CO_2, red – CH_4, green – N_2O.

Metal Prod. – Metal Products; Other Manufact. – Other Manufacturing; Petr. & Chem. – Petroleum, Chemical and Non-Metallic Mineral Products; Textiles & Wear. Apparel – Textiles and Wearing Apparel; Transport Equip. – Transport Equipment; Educ., Health & Other Serv. – Education, Health and Other Services; Electr., Gas & Water – Electricity, Gas and Water; Other Non-Met. Min. Prod. – Other Non-Metallic Mineral Products; Public, Soc. & Per. Serv. – Public, Social & Personal Services; Wood Treat. & Wood Prod. – Wood Treatment & Wood Products; Food & Bever. – Food & Beverages; Hotels & Restr. – Hotels & Restaurants.