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ASSESSMENT OF THE ENVIRONMENTAL AND ECONOMIC COOPERATION OF THE BRICS COUNTRIES IN GLOBAL VALUE CHAINS

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ABSTRACT

Objective: This study aims to analyze the environmental performance and economic dynamics of the BRICS countries (Brazil, Russia, India, China, and South Africa) within the context of their participation in global value chains (GVCs). The focus is on the strategies employed by these nations for decarbonization and sustainable development in the face of global warming and environmental degradation.

Method: The research methodology encompasses a comprehensive review of existing literature, statistical data analysis, and case studies. Data sources include peer-reviewed scientific literature, governmental reports, industry publications, and international databases. Both qualitative and quantitative methods are employed to evaluate environmental externalities, carbon footprint, energy consumption, and greenhouse gas emissions of the BRICS countries.

Results: The findings reveal that the BRICS countries, with the exception of Russia, exhibit higher incentives for the decarbonization of GVCs due to the anticipated significant economic damage from global warming. However, these incentives are adversely affected by their relatively low levels of economic development. The study underscores the disparate contributions of BRICS countries to global emissions and their potential for increasing the adoption of renewable energy sources. Additionally, the environmental risks associated with GVCs, such as disruptions from natural disasters and heightened emissions, are examined.

Conclusions: The BRICS countries possess substantial opportunities and incentives to implement greener practices within their GVCs, thereby enhancing their negotiating positions in global climate discussions. The transition to renewable energy and low-carbon technologies is imperative for sustainable development. Collaborative efforts and the exchange of experiences among BRICS nations can lead to improved environmental and economic outcomes.

Keywords: Global Value Chains, Decarbonization, Green Economy, Environmental Performance, Sustainable Development

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INTRODUCTION

The past 50 years were marked by a sharp increase in globalization and several deglobalization trends after the 2008-2009 global financial crisis, namely growing protectionism and trade wars, primarily between the US and China. The number of new discriminatory measures that infringe on the commercial interests of other countries rose from 2,142 after the financial crisis (2009) to 2,949 in 2018 when Donald Trump began imposing sanctions against China and other countries. This figure reached 5,333 during the COVID-19 pandemic in 2020 (but reduced to 3,121 in 2022). Trade activity in the world (the sum of exports and imports as a percentage of GDP) peaked at 61% in 2008. Since then, it has fallen to 57%. However, this figure is still much higher than that in the previous decades: 40% in the 1990s, 36% in the 1980s, and 31% in the 1970s.

Increased public attention to environmental problems has played a significant role in the globalization process. Businesses moving resource-intensive and dirty industries outside their own countries look up to developing countries, especially those in Asia with high population density, cheap resources, and practically dormant environmental protection and regulation.

After the 2008-2009 global financial and economic crisis, global value chains (GVCs) faced several problems. These include the trade war between the US and China, increased protectionist sentiment, the COVID-19 pandemic, unprecedented economic sanctions against the Russian Federation, as well as increased demands for eco-friendly production. The current trends strengthening every year increase the risks associated with disruptions and gaps in the supply of resources in the production chain in one country, which leads to a reduction in the import of intermediate and export of finished products by its trading partners who are participants in a value chain.

Globalization occurs through the creation of GVCs branched around the world. However, this process is accompanied by an increase in the number of risks, especially environmental risks. Environmental risks are hazards having adverse or probable consequences for humans or the environment (Whyte and Burton 1980). GVCs are closely linked to such risks, and the impact of these risks on GVCs has increased in recent decades. Environmental risks are associated, in particular, with geophysical (earthquakes, volcanic eruptions, etc.), meteorological (extreme temperatures), hydrological (floods), and climatological (droughts, forest fires) emergency situations (UNDRR 2020). While the death toll from major natural disasters has decreased, the economic impact of such disasters has increased, as shown by data from the Emergency Events Database (emdat.be). Such events can heavily disrupt the operations of multinational corporations (MNCs) (for example, Koehl, 2021).

Environmental risks can arise due to various circumstances. Some of them are due to natural causes, and others are caused by human activities (anthropogenic), including climate change, pollution, deforestation, erosion of natural habitats, and loss of biodiversity.

Since the transportation of components for the manufacturing of complex products involves crossing the globe, their production through the GVC has a higher environmental cost than in standard trade. What is worse is that some of the most environmentally harmful components (such as batteries) may be produced in countries with the laxest environmental regulations, causing even more environmental degradation.

However, GVCs actively promote innovations that stimulate the creation and dissemination of less harmful products and manufacturing processes to generate new eco-friendly products. Major international brands can use GVCs to encourage the global adoption of clean and efficient technologies and processes that improve both profitability and sustainability.

Environmental impacts are driven by such GVC features as task hyper-specialization, spatial distribution of production, scale effect, and bargaining power of leading companies. The overall environmental impact of GVCs can be regarded in three ways:

1. The scale effect. The emergence and development of GVCs is accompanied by an increase in economic activity, and if the structure and methods of production and consumer preferences remain unchanged (i.e., pollution per unit of output is unchanged), this leads to environmental degradation. GVCs are associated with a higher amount of waste and a higher volume of traffic in the aggregate, which causes more environmental problems.

– Greenhouse gases from transporting products: the greater the distance a product travels during transportation, the more fuel is consumed and the greater the amount of emissions. A report from the International Transport Forum (ITF Transport Outlook, 2021) estimates that logistics-related greenhouse gas emissions will increase by 16% by 2050, even if existing commitments to decarbonize transport are met. A decade ago, international transport generated about 7% of global carbon dioxide emissions (ITF, 2015). According to estimates (Cristea et al., 2013), this figure was half as much (3.5%). By 2050, greenhouse gas emissions from international freight are projected to quadruple, undermining the temperature targets of the Paris Agreement. These emissions lead to environmental pollution, climate change, and ocean acidification and adversely affect biodiversity.

– Animal habitat destruction: The development of transport, especially land transport, requires the creation of infrastructure such as roads and bridges. This infrastructure increases the likelihood of such problems as the disappearance of animal habitats and environmental pollution. The more ships are involved in maritime and river transport, the more likely are major oil spills or other leaks that undermine the fragile aquatic environment.

– Spread of invasive species: Shipping containers and ships allow living organisms to reach a new location where they can become invasive and reproduce themselves without any natural limitations.

2. The composite effect. GVCs are transforming international trade by encouraging task trade, which brings some economic activities to the international level. On the one hand, these comparative advantages allow the transfer of production from countries poor in natural resources to countries rich in them, helping to save resources (for example, land and water) at the global level. On the other hand, a redistribution of dirty and clean tasks among countries can lead to the concentration of environmental costs in some countries while reducing them in others. In other words, economic activity is clustered in different geographical areas. These may be coastal areas with a high concentration of population, whose logistics are associated with lower transport costs (Gereffi and Luo 2014). This clustering of production can lead to environmental problems such as habitat loss, deforestation, and overexploitation of natural resources. If we translate this into economic language, it means that the production of environmentally harmful products is above the optimal level, i.e., the maximum social costs (including negative externalities from environmental pollution in a given area) are higher than the maximum social benefits (mainly the benefits of producers, workers and the state in the form of tax revenues).

Here are some examples of such an impact:

- Illegal logging in Russia (mainly for export to China) and Brazil (due to increased cattle farming, which requires significant land for cattle grazing);
- Overfishing in coastal waters (especially in South East Asia), resulting in decreasing fish stocks and ocean pollution;
- Over-reliance on cash crops such as coffee, cocoa, and various fruits, which has contributed to biodiversity loss, especially in tropical climates.

In some cases, international trade can lead to lower CO_2 emissions if production and distribution through GVCs entail lower emissions than domestic production (le Moigne and Ossa, 2021).

Globalization has also made some countries specialize in the production of energy commodities such as oil, natural gas, and wood. Such countries are much more likely to undertake market interventions in the form of subsidizing the energy costs of their companies and households, which complicates the transition to renewable energy resources (RES). A by-product of such actions is an increase in greenhouse gas emissions above optimal levels. Whenever we speak of the optimal level, we refer to the level of production at which the maximum social benefit equals the maximum social cost.

It is estimated (Zhang et al., 2020) that GVCs account for about 20% of CO_2 emissions from MNCs. Adhering to the cost-benefit principle under GVCs has led to an increase in waste, plastic, and overconsumption (Kaza et al., 2018).

3. The technological effect. GVCs improve production methods at various levels. Information flows between corporate networks contribute to the development and/or faster adoption of green technologies. Due to their scale, integrators are able to maintain high rates of innovation activity. Increasing market concentration is often negative in terms of prices and outputs, and reduces the complexities associated with exploiting shared resources such as forests and fisheries. The relationship aspect of GVCs is also of great importance as the leading companies in GVCs promote the transfer of green technologies to their suppliers and promote higher standards.

Mechanisms for the implementation of environmental risks are as follows:

Environmental risks can have both a direct impact on the private sector (through negative natural phenomena) and an indirect impact through the same natural phenomena on suppliers and consumers.

The development of GVCs implies that companies in different geographic locations included in the same production chains become more interconnected through the input-output relationship.

However, the interdependence of the companies in GVCs allows them to increase the efficiency of their functioning but also gives rise to several additional risks.

Relatively small adverse environmental events can lead to significant disruptions in supply chains, which can both directly and indirectly affect the economic strength of the state, including through supply and demand mechanisms.

The mechanism of possible cause-and-effect influence is as follows:

– Failures caused by the physical loss of production capacity. Industrial disasters result in loss of life as well as destruction of capital assets, inventories, and infrastructure. From a macro perspective, there is an aggregate supply shock, which causes a fall in real output and employment, as well as a negative impact on economic growth in the long run. Climate-related environmental changes can affect the availability and productivity of raw materials and inputs (e.g., sea level rise, the relationship between labor productivity and rising

temperatures, and levels of stress on human health (Dell, Jones, Olken, 2012). The tourism industry is heavily dependent on the climate agenda.

– Failures in companies at the earlier stages of GVCs producing complementary products can significantly affect the release of the final product. Just-in-time delivery and lean supply chain management increase the likelihood of supply chain disruption during any disruption caused by a natural disaster (Abe and Ye, 2013). Such a threat is typical of the automotive and semiconductor industries.

– Increased demand for several goods and services. After emergencies, there has been an increase in demand for food, medicines, basic necessities, equipment, and assistance services. Capital-intensive products such as telecommunications and transport are also in high demand, with domestic capacity to provide these services often drastically reduced (Xu and Kouwoaye, 2019).

– The growth in demand for final goods leads to an increase in demand for raw materials and intermediate products and consequently to an increase in prices in the respective markets. However, the falling incomes of enterprises and households as a result of cataclysms can have a downward effect on prices, including on intermediate products and resources in the extractive sectors, which can lead to an economic downturn.

– The cost of moving goods and human capital between countries. GVCs rely on sophisticated transportation and logistics to move intermediate and final products across borders. Climate change impacts can negatively affect transport infrastructure (ports and roads, shipping and flight routes) due to more frequent disasters causing disruptions in supply, transport, and distribution chains (Dellink et al., 2017; IPCC, 2014). Logistics disruptions lead to the disruption of supply chains, which amplifies the economic impact (Colon, Hallegatte, Rozenberg, 2021).

METHODS

This study used a multidimensional analytical approach to explore the complex relationship of environmental impacts, GVCs, and governance strategies in the BRICS economies. The research methodology combined both qualitative and quantitative methods.

Research sources included peer-reviewed scientific literature, government reports, industry publications, and international databases. In addition, qualitative information was obtained on the management strategies implemented by these countries to mitigate negative impacts. This included a qualitative review of policies, regulations, and initiatives aimed at sustainable development and emission reduction.

Carbon footprint data, energy consumption statistics, and greenhouse gas emission data were assessed to estimate the magnitude of environmental externalities. The quantitative analysis also included an assessment of the relative contribution of each BRICS country to global emissions, which allowed for a comparative assessment of their positions.

The qualitative insights and quantitative data were synthesized to unravel the multifaceted relationship between environmental impact, GVCs, and management strategies in the BRICS context. By amalgamating findings from diverse sources and methods, the study provided a comprehensive overview of the current status and future prospects of environmental management in the BRICS countries.

RESULTS AND DISCUSSION

This paper examines the incentives and opportunities of the BRICS countries to green the GVCs in which they participate. The BRICS account for about 1/6 of world trade, but trade

relations between the countries are not well developed. China is the main trading partner. Russia supplies valuable resources.

New trends in political and economic development open up new opportunities. The rupture of ties between the EU and Russia led to the fact that the US became the largest importer of energy resources for the EU (for example, LNG supplies increased 2.5 times in 2022). Russia's trade with China increased by 29.3% in 2022, partly due to rising energy prices.

The BRICS countries have different economic characteristics. Let us consider their trade relations. In 2020, the total volume of world exports was $19,237,800 million, while the total exports of the BRICS countries amounted to $3,492,098.1 million, which is 18.2% (almost 1/5) of world exports. In 2020, the total volume of world imports amounted to $17,221,104 million, while the total imports of the BRICS countries amounted to $2,738,155.7 million, which is 15.9% (about 1/6) of world imports.

These figures indicate the significant role of the BRICS in world trade. However, the dominant share of the total volume belongs to China. The role of other countries is much less significant. China is a major trading partner for the rest of the BRICS countries, while the importance of the other countries for China is lower in terms of the share of exports and imports and the total volume of trade.

As of 2020, the share of exports and imports in the total volume between Russia, India, South Africa, and Brazil is relatively small. 2020 was associated with significant restrictions in terms of international transportation and logistics due to the COVID-19 pandemic.

However, the cost criterion cannot be exhaustive. For example, the share of Russia in the total volume of the association is relatively small but Russia supplies important energy resources.

In 2022-2023 in connection with the sanctions against Russia imposed by Western countries, the role of its BRICS partners increased. In addition, trade with India is remarkable: over the past year, the share of Russian oil in India's imports has grown from 2 to 20%. According to the Kpler data and analytics firm, the share of Russian oil in the Indian market hit a record of 46% in May 2023 (https://www.rbc.ru/economics/28/06/2023/649b9aff9a79474151fed3d9?from=newsfeed).

Deliveries to China are also growing. According to Refinitiv Oil Research, China's imports of Russian oil, both by sea and through pipelines, amounted to 2 million b/d in May, if compared with 1.74 million b/d in April.

The environmental agenda of the BRICS members has several common features.

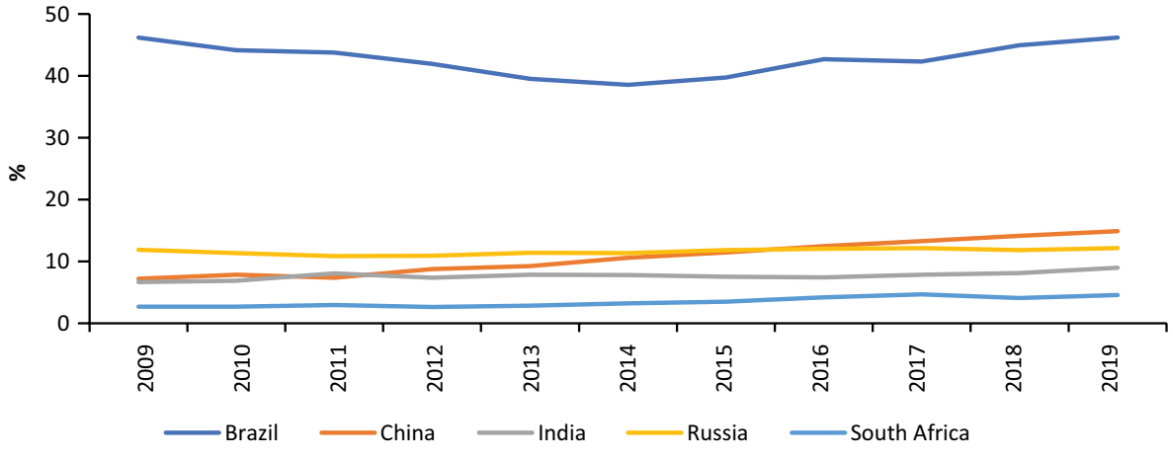
Firstly, these countries have unique ecosystems by world standards. For example, more than a third of the world's forests are located in Russia and Brazil. Russia and Brazil have such unique ecosystems around Lake Baikal and the Amazon River (more than 60% of the Amazon forests are located in Brazil, which stands for 15-20% of the world's biodiversity (https://www.unep.org/news-and-stories/story/megadiverse-brazil-giving-biodiversity-online-boost). Glaciers in the Himalayan Mountains mostly located in China and India provide water for about 2 billion people. Russia embraces most of the unique Arctic zone, which is particularly vulnerable to climate change.

Secondly, the BRICS countries are environmentally unfavorable. In the environmental performance index regularly compiled by Yale University and covering the entire range of environmental problems for 180 countries, the BRICS countries hold relatively low positions (as of 2022) (yale.edu). Brazil ranked 81st (down from 69th), Russia 112th (down from 52nd),

South Africa 116th (up from 142nd), China 160th (down from 120th), and India 180th or last in the list (down from 177th). In all BRICS countries, except for South Africa, the environmental situation has deteriorated over four years, if compared to the world average indices.

All BRICS countries are characterized by high levels of air, soil, and water pollution (especially China and India), problems with waste disposal (all countries), deforestation and forest fires (especially Russia and Brazil), loss of biodiversity (especially Brazil and South Africa), lack of water resources (especially India, China, and South Africa), etc. This has a huge negative impact on human health, increasing morbidity and mortality, and the economies of the BRICS countries.

Thirdly, the BRICS countries currently use an extensive model of economic growth which is based on the involvement of non-renewable natural resources in economic turnover and environmental degradation. This is clearly characterized by the situation with the energy balance of these countries. Coal as the most unsustainable fossil fuel plays a major role in the energy mix of China, India, and South Africa. The BRICS countries, with the exception of Brazil, hardly rely on RES in their energy mix (Figure 1).



Source: BRICS Energy Report 2021 (brics2021.gov.in)

Figure 1. The share of RES in the energy balance of the BRICS countries

Table 1 presents data on electricity generation from RES in the BRICS countries in absolute terms. Table 2 showcases the same data in relative terms. In 2020 (the latest year with data available), most energy was generated from renewable energy in China, which is about seven times higher than those indicators in India which has a similar population. This is explained both by the higher share of RES in China's energy mix (Figure 1) and by China's much higher GDP per capita. In Brazil, the volume of electricity generation from RES is about 2.5 times higher than in Russia, despite a much lower GDP per capita. However, Figure 1 demonstrates that the share of RES in the country's energy balance is about four times higher than that in Russia, which explains the above-mentioned result.

Table 1. Power generation from RES

Year	Primary solid biofuel	Biogas	Liquid biofuel	Industrial waste	Hydroelectric power station	Solar energy	Wind energy	Total
Brazil								
2000	7,844	0	0	0	304,403	Not available	2	312,249
2010	31,325	138	0	0	403,289	Not available	2,177	436,929
2020	56,231	1,956	555	2,269	396,327	10,750	57,051	525,139
Russia								
2000	22			2,516	165,375	Not available	2	167,915
2010	36			2,738	168,397	Not available	4	171,175
2020	73			3,573	214,388	2,022	1,241	221,297
India								
2000	215	0		0	74,462	2	1,684	76,363
2010	15,560	771		378	124,921	126	19,657	161,413
2020	31,660	1,145		1,163	160,909	6,1291	67,418	323,586
China								
2000	2,421	0		0	222,414	22	615	225,472
2010	24,800	39		9,063	722,172	700	44,623	801,397
2020	132,600	67		8,498	1,355,209	260,518	466,475	2,223,367
South Africa								
2000	307				3,934	0	0	4,241
2010	203				5,067	0	34	5,304
2020	350				6,239	3,603	5,937	16,129

Source: Compiled according to the International Energy Agency.

Table 2 shows that the decreased share of hydropower in Brazil's electricity generation was offset by an increase in the use of wind energy, primary solid biofuel and solar energy.

In Russia, electricity generation from RES is almost completely provided by hydropower. The share of other RES has grown neglectfully small. Therefore, adopting the experience of the BRICS countries will be valuable for Russia.

Table 2. Power generation from RES in the BRICS countries, %

Year	Primary solid biofuel	Biogas	Liquid biofuel	Industrial waste	Hydroelectric power station	Solar energy	Wind energy	Total
Brazil								
2000	2.5%	0.0%	0.0%	0.0%	97.5%		0.0%	100.0%
2010	7.2%	0.0%	0.0%	0.0%	92.3%		0.5%	100.0%
2020	10.7%	0.4%	0.1%	0.4%	75.5%	2.0%	10.9%	100.0%
Russia								
2000	0.0%	0.0%	0.0%	1.5%	98.5%		0.0%	100.0%
2010	0.0%	0.0%	0.0%	1.6%	98.4%		0.0%	100.0%
2020	0.0%	0.0%	0.0%	1.6%	96.9%	0.9%	0.6%	100.0%
India								
2000	0.3%	0.0%	0.0%	0.0%	97.5%	0.0%	2.2%	100.0%

2010	9.6%	0.5%	0.0%	0.2%	77.4%	0.1%	12.2%	100.0%
2020	9.8%	0.4%	0.0%	0.4%	49.7%	18.9%	20.8%	100.0%
South Africa								
2000	7.2%	0.0%	0.0%	0.0%	92.8%	0.0%	0.0%	100.0%
2010	3.8%	0.0%	0.0%	0.0%	95.5%	0.0%	0.6%	100.0%
2020	2.2%	0.0%	0.0%	0.0%	38.7%	22.3%	36.8%	100.0%

In India, the share of hydroelectric power plants has decreased by two times in 20 years, which was compensated by wind energy, solar energy, and primary solid biofuel. In China, the share of hydroelectric energy has also drastically decreased (from 99 to 61%). This has been offset by growth in wind and solar energy (almost from zero), as well as primary solid biofuel. Finally, the share of hydropower has declined even more drastically in South Africa (from 93 to 39%), largely offset by the incredible growth of wind (from 0 to 37% in 20 years) and solar (from 0 to 22%) energy. Within the BRICS association, Russia has a significant potential to utilize the experience of developing RES. Fourthly, the BRICS countries can play a key role in solving global environmental problems due to the size and structure of their economies. First of all, this refers to climate change. In 2021, China ranked 1st, India 4th, and Russia 5th in terms of carbon dioxide emissions (europa.eu). Russia played a major positive role in the global reduction of such emissions in the period after 1990 due to the transformational economic downturn in the 1990s (in 1990-2018, its emissions from fossil fuel consumption decreased by about 40%) (BP Statistical Review on World Energy, 2019).

Among the possible environmental and climate policies in Russia and other BRICS countries, we can highlight the following measures:

– The development of a common position at the regular negotiations of the United National Framework Convention on Climate Change (UNFCCC);

– Acting as leaders and role models in the climate agenda for developing countries;

– The exchange of experience in the development of tools and the application of green industrial policy, as well as the use of green financing.

In the BRICS countries, national systems for regulating greenhouse gas emissions are being formed (although at different rates). However, this raises a controversial question: Which regulation would be more effective (a carbon tax, a system of cap and trade (trading emissions permits), or other possible options?

When introducing a system of regulation, it is important to understand how it will be recognized by other countries, i.e., trade and economic partners. In the near future, the EU is going to introduce the Carbon Border Adjustment Mechanism (CBAM), which will affect almost the entire list of products previously exported from Russia to the EU (currently, due to geopolitical problems, this export has practically ceased, but later the parties will still have to think about resuming trade). Indeed, a similar regulation will be introduced in some other countries, including in the Asian region, where Russian exports are now largely redirected. After all, many Asian countries, including China, are facing severe environmental problems.

In 2021, the Chinese national carbon trading scheme was launched after an 8-year experiment in eight regions of the country (the most economically developed). In addition to improving the environmental situation in China, this system aims to release Chinese companies partially or completely from the regulations of other countries where they supply products (for example, to the EU).

The Chinese system is unconventional. It differs both from the carbon tax and from the cap-and-trade system. On the one hand, this system issues emission permits that can then be

traded on a special exchange. On the other hand, the Chinese system is built on the ranking of emitting companies (https://www.dropbox.com/s/8gmlakkerip1puw/China's%20Unconventional%20Nationwide%20CO2%20Emissions%20Trading%20System%20-%2020%20Aug%20'20.pdf?dl=0). The number of permits issued depends on the ratio of emissions to output of each regulated company (currently more than 2,000 energy companies are regulated, mainly coal-fired power plants; companies from other sectors are planned to be included later). Government incentives are designed in such a way that companies are required to limit not the total amount of emissions, but the percentage of emissions relative to the output of finished products.

A recent joint study by scientists from Stanford University and Yale University (https://www.dropbox.com/s/8gmlakkerip1puw/China's%20Unconventional%20Nationwide%20CO2%20Emissions%20Trading%20System%20-%2020%20Aug%2020.pdf?dl=0) claims that some of the emission reductions that the Chinese system can achieve (by 4.9%) can be 67% more cost-effective with the cap-and-trade system. In addition, the Chinese system uses different incentives for different capacity categories. This also raises the costs for companies aimed at reducing emissions.

The Chinese system has its advantages. For example, it is less likely to allow carbon leakage, when consumers can switch to other energy sources in response to an increase in the price of electricity. This system is better adapted to fluctuations in the economy. For example, during an economic recovery, it allows for increased emissions; during a recession, it reduces them more than the cap-and-trade system can. This facilitates the functioning of the energy sector.

Studying the pros and cons of the Chinese system is of great importance for the Russian economy as well. Firstly, the Russian economy is also energy-intensive. Secondly, it is important to understand how to build an emission regulation system recognized by trading partners and allowing the country to avoid the CBAM on their part (at least partially).

The BRICS countries (like the rest of the world) face environmental challenges that are largely generated by their participation in GVCs.

Since the elimination of various types of environmental damage is a global public good, countries might exploit the role of free rider to varying degrees, hoping that other countries will bear the main costs. However, such countries might still benefit from more active participation in international climate agreements if they bear a disproportionately high cost of global warming. For the BRICS countries, different estimates show that Russia is likely not to lose but to gain from global warming. According to Kompas, Pham, Che, 2018, using the computable general equilibrium (CGE) model under the business-as-usual (inertial) scenario, the expected annual change in GDP (in %) in 2027, 2037, and 2047 due to global warming is as follows:

China: -0.205; -0.438; -0.692;
India: -1.023, -2.099; 3.222;
Brazil: -0.319; -0.658; -1.018;
South Africa: -0.130; -0.278; 0.443;
Russia: -0.011; -0.016; -0.027.

It can be seen that India is likely to face the most severe consequences.

According to estimates (Burke, Hsiang, Miguel, 2015), the change in GDP per capita (if compared to no climate change) with a median forecast of climate change for the BRICS countries by 2100 will be as follows: -83% for Brazil; +419% for Russia; -92% for India; -42% for

China; -66% for South Africa. Along with Mongolia and Iceland, Russia is in the top three beneficiaries of global warming according to this model.

Due to a radically different balance of benefits and costs for Russia and other BRICS countries, it is difficult for them to create a sustainable climate coalition. However, there are several touch points between Russia and other BRICS countries on the environmental agenda. The Beijing Declaration adopted at the 14th BRICS summit states, "call on all parties to adhere to the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances and in accordance with the institutional arrangement of nationally determined contributions, […] peaking of Green House Gas (GHG) emissions will take longer for developing countries. We underline that the developed countries have historical responsibilities for global climate change, and should take the lead in scaling up mitigation actions and scale up indispensable support to developing countries on finance, technology and capacity-building. […] We oppose green trade barriers and reiterate our commitment to enhancing coordination on these issues. […] We express our concern at any discriminatory measure that will distort international trade, risk new trade frictions and shift burden of addressing climate change to other trading partners, developing countries and BRICS members" (Beijing Declaration, 2022). Possessing a significant aggregate economic power, the BRICS countries have the appropriate negotiating power when discussing the global climate agenda and related economic issues.

One of the most important issues is the introduction of the CBAM by the EU from October 1, 2023 (https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en#latest-developments). Initially, the CBAM will cover commodities such as cement, iron and steel, aluminum, fertilizers, electricity, and hydrogen, whose production is accompanied by significant carbon dioxide emissions. According to its application, the CBAM is analogous to a customs duty calculated "on the volume of direct GHG emissions generated in the course of production during the release of products (the so-called Scope 1) and the price for emissions equal to the price in the EU-ETS mandatory carbon certificate market" (The European Union's new Carbon Border Adjustment Mechanism, 2021). Since the CBAM is essentially a customs tariff, its application will affect the existing networks of GVCs in which the BRICS countries participate. Due to the sanctions imposed by the EU against Russia, which prohibit the import of almost all goods regulated by the CBAM from Russia, the introduction of the CBAM will not have a direct impact on Russian trade flows for an undetermined time horizon. Russia's trade flows have already been redirected from the EU to other countries.

Just a few years ago, it seemed that the decarbonization trend that swept many countries around the world was nothing more than a fleeting fad. However, heated discussions have turned into practical actions, including public policy in several countries. The most striking example is the introduction of the CBAM by the EU on October 1, 2023. This mechanism (tax) will directly affect all countries that export goods affected by this regulation to the EU.

The results of many studies show that a significant part of greenhouse gas emissions is associated with globalization processes. The BRICS countries represent a large part of world production and world trade. Countries within this group are still developing economies, although with large differences in GDP per capita. On the one hand, these countries are interested in high rates of economic growth, especially the poorest of them (i.e., India). On the other hand, they (except for Russia) are more affected by the negative economic consequences of global warming than developed countries. The environmental Kuznets curve is a hypothesis that at first, with the growth of GDP per capita, GHG emissions in the country

increase but after reaching a certain threshold level of GDP per capita emissions begin to decrease. The problem is that if we simply follow this pattern, the goals of decarbonization as set out in the Paris Agreement will not come close to being achievable. Therefore, the BRICS countries are required to have much more ambitious strategies to decarbonize their economies.

The fight against global warming is an example of a market failure at the world level associated with a negative externality from GHG emissions in the production (including transportation) and consumption of goods and services. Each GVC consists of industries located in at least two and often many more countries. The negative environmental externalities (NEEs) created by this chain always represent a bundle. Moreover, some of them are global, i.e., they lead to GHG emissions. The other part is local NEEs (LNEEs). The latter include the pollution of water bodies, especially with fresh water, in the country, a decrease in the population of commercial fish species, the destruction of recreational areas, the accumulation of unprocessed garbage, etc. In such cases, the state and/or local authorities have more incentives to neutralize/internalize LNEEs. They can use both administrative and economic methods to attain the end. Since this raises the cost of the resources that generate these externalities, it can also affect the configuration of GVCs. MNCs, which are leaders in GVCs, may start looking for other international locations to replace this location. The BRICS countries are mostly suppliers of resources to the global market. Since LNEEs are not sufficiently neutralized, they are subsidized by the state. If this subsidy disappears or decreases, then the comparative advantage of the BRICS countries will shift towards greater use of labor and, in general, towards resources whose use generates fewer LNEEs.

In some cases, the BRICS countries have shared resources. For example, the Amur River runs along the border between Russia and China. If one bank is polluted, then the other one will inevitably suffer from LNEEs, i.e., deterioration in the quality of the water used, a decrease in biodiversity, and the lack of commercial resources and recreational opportunities for the Amur and its delta.

A much more complex case is the global negative environmental externalities (GNEEs). In this regard, a country may not incur too much of the environmental societal cost of being included in GVCs. Then it may not have sufficient incentives to neutralize the GNEEs. However, participation in GVCs can lead to a decrease in the GNEEs through a technological effect (discussed above), where leading companies in GVCs, to maintain their reputation, may have incentives to spread advanced green technologies within GVCs. Unfortunately, studies show that this is not enough, even when such transfer occurs.

An important element in greening the existing GVCs is the increased use of green goods. At the global level, the key component of this process is the transition to RES.

CONCLUSION

Today the BRICS is more a political than an economic association. However, in connection with the anti-Russian sanctions imposed by Western countries (since February 2022), trade relations between Russia and the two largest BRICS countries (China and India) began to grow, primarily due to a sharp increase in the supply of oil and oil products from Russia.

Despite many differences, the BRICS countries have several similarities in their environmental and economic characteristics:

– Unique ecosystems by world standards, which implies significant NEEs for the rest of the world during the degradation of these ecosystems (to a lesser extent this applies to South Africa due to its smaller size);

– Unfavorable environmental conditions which are largely due to participation in GVCs as suppliers of products manufactured using dirty technologies;

– A mostly extensive model of economic growth based on the active use of non-renewable natural resources.

Global warming already has a very negative impact on the economies and public health in some of the BRICS countries. For example, India is facing record-breaking heat waves for the second year in a row, drastically undermining productivity, increasing death rates and health care and energy costs. The BRICS countries are largely not responsible for the processes leading to global warming (which are the accumulated result of economic activity of developed countries in 150 years). However, these countries (except for Russia which is so far a beneficiary of global warming) are most interested in stopping global warming and, consequently, the growth of greenhouse gas emissions. On the contrary, Russia's interest is to keep up with the ongoing technological race to introduce low-carbon technologies and materials, which will inevitably lead to a decrease in demand for hydrocarbons, i.e., the main part of Russian exports.

The BRICS countries have many incentives and opportunities for greening the links in the GVCs located in their territories. The combined economic and political potential of the BRICS allows it to improve its negotiating position when discussing transboundary carbon regulation introduced by developed countries. The BRICS countries also have significant opportunities for the exchange of experience in the implementation of RESs and low-carbon resources.

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