Some Questions Regarding Economic Growth in a Global Environment of Uneven Demands

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Abstract: The global economic environment offers extraordinary opportunities to leverage comparative and absolute advantages, leading to significant changes in labor productivity and the efficiency of economic cooperative links. Although all participants in global markets generally benefit from these processes, the distribution of benefits is uneven, provoking social resistance to globalization despite data confirming its overall contribution. The pressure to implement measures against climate change introduces a new factor that fundamentally impacts the existing economic order.

The article compares statistical data on labor productivity growth, environmental measures, and their impact on international trade. It considers the differences in wage levels, exchange rates, raw material availability, transportation costs, and regional tax policies. The research focused on identifying key factors influencing changes in the division of labor and industrial sectors among global regions.

The results show that support for renewable energy sources and the varying pace of climate measure implementation significantly disrupt the existing economic balance. There are only two possible paths: either developed countries abandon key industrial sectors with potential strategic and defensive consequences, or it will be necessary to adopt new rules for foreign trade, such as through ecological tariffs and restrictions, or to relax climate goals. This analysis highlights the need to balance environmental requirements and economic stability.

Keywords: deindustrialization, climate change, renewable resources, industry.
JEL Classification: G32, G33, C35

1 Introduction

Globalization is a process whose economic essence lies in maximizing comparative and absolute advantages. However, there are many economic, cultural, social, and societal definitions of the globalization process. A framework overview of these definitions, particularly the development of the theory of globalization as the maximization of the use of comparative and absolute advantages, which we will further explore, is provided in the studies by Kislingerová (2023) and Kislingerová et al. (2024, especially pp. 31-69).

For this work, it is sufficient to summarize that this perspective on globalization primarily draws from certain aspects of the works of Immanuel Wallerstein (2000, Wallerstein et al. 2013). It particularly references his neo-Marxist theses about the finitude of capitalism and his definition of capitalism as a system maximizing profit. Additionally, it incorporates the anti-globalist visions of Samuel Huntington (1996) regarding the clash of civilizations based on shared cultural and religious characteristics, as well as the globalization concepts of Francis Fukuyama (1992), which emphasize the superiority of liberal democracies as systems that ensure optimal competitive and market conditions.

Based on the conclusions of these otherwise contradictory theories and works, the aforementioned studies construct a thesis on economically infinite globalization, which is deepened by the creation of continually new comparative and absolute advantages, depending on changes in logistics, technology, shifts in the significance of various resources (both mineral and others, such as educational resources), and many other factors. Within the created model, the political and social risks of limiting globalization, arising from differences in cultural and social models, particularly from the divergence of political and power structures, stand in contrast to economic infinity. The potential for globalization would indeed be infinite if the process included only liberal democracies as a state power system that offers the greatest space for markets and free enterprise. However, since this is not a realistic assumption, especially not in the current state, the existence of asymmetrically empowered, individualized state entities within globalization processes continually raises

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questions about the strategic feasibility of maximizing comparative and absolute advantages. Examples of such risks include the COVID-19 pandemic and the associated logistical crisis, the energy crisis related to price manipulation of gas by the Russian Federation, and, of course, the war in Ukraine.

Beyond this fundamental framework, as outlined in the mentioned studies, we can also consider contexts such as the activities of OPEC, since this supranational cartel essentially distorts the market and, thus, the competitive environment in oil extraction, which is in stark contradiction to the maximization of comparative and absolute advantages. OPEC's decisions create an environment that, while market-driven in many respects—where prices are set based on supply and demand—results in a supply condition influenced by cartel agreements, leading to distorted price information. Other distortions arise from trade restrictions and embargoes, such as those on oil from the Russian Federation or Iran. Conversely, an anti-market element emerges from the artificial reduction of demand, driven by efforts from many primarily developed countries to limit fossil fuel consumption as much as possible. Certainly, further examples can be added over time. For instance, China's pressure against Taiwan and the security risks associated with this situation lead to various embargoes, tariffs, and other barriers to free trade.

Regarding the theories of comparative and absolute advantage, references are made to earlier authors (Smith 1776, Ricardo 1817), emphasizing the dynamics of both phenomena. This primarily concerns the continuous circulation of advantage distribution, the variability of their available mass, and the differing changes in efficiency offered. Simply put, a decrease in logistics costs can lead to the creation of new comparative and absolute advantages, and technological changes can provoke similar effects. Good examples include fracking in oil extraction or the robotics and automation of large-scale industrial production. Other standard phenomena, among many others, include the discovery of new areas for mineral extraction.

Thus, this summarizes the globalization framework as described in the aforementioned studies and briefly elaborated upon in this work. However, the studies also suggest (albeit without deeper analysis) that various circumstances, particularly multi-speed measures aimed at mitigating global climate change, may significantly influence the challenges of globalization. It is precisely this aspect of the situation that we will now focus on in more detail.

2 Methods

We will refer to the current world, in terms of individual national climate protection policies, as a world of uneven demands. We will further examine how these potentially existing uneven demands affect efficiency and productivity in individual countries and whether they can exert a similarly strong or even more significant influence compared to traditional reasons for changes in absolute and comparative advantages.

It is crucial to emphasize that we will continue to view globalization not as a one-way process but as a variable structure that continuously changes and evolves based on numerous circumstances. This also implies that it can be a reverse process.

2.1 Principle of uneven demands

The situation of uneven demands has become a relatively widely discussed topic, particularly in relation to the energy crisis, the creation of energy dependence of advanced Europe on resources from the Russian Federation, and most notably with the inflation wave from 2021 to 2023. The issue of differing dynamics in decarbonization has intersected with the other mentioned factors and has been the subject of discussions on multiple levels. It has become a political topic that has undeniably had a strong impact on the social sphere and is one of those issues that polarise European societies. Different paces of decarbonization are automatically accepted as a fact within political and social discourse without any more precise evidence being provided. Moreover, there has been no attempt to quantify the actual impacts of faster decarbonization realistically or to analyze its relationship with other causes of economic difficulties in European countries.

The working hypothesis states that:

- Firstly, (relatively) small producers of hazardous emissions implement extensive measures at an extraordinary pace, which are very demanding and costly in terms of both immediate and long-term expenses. At the same time, the largest (absolutely) polluters carry out measures at a slow pace that have a significantly smaller overall scope. Moreover, similar extensive actions are promised only in a relatively distant future (regarding economic changes).

- Secondly, this differing pace of implementing changes leads to different impacts on individual economies, thereby resulting in further redistribution of comparative and absolute advantages on a global scale.
- Thirdly, the differing paces of decarbonization and the associated costs in this area lead to a loss of competitiveness for European producers, which is the primary reason for this phenomenon.

In the initial phase, it is necessary to define what is meant by areas with differing paces of decarbonization in this context. With considerable simplification, we can say that the first group of countries represents the European Union, while the second includes China and other rapidly growing economies (typically India). Somewhere in the middle of these extremes lies the economy of the United States.

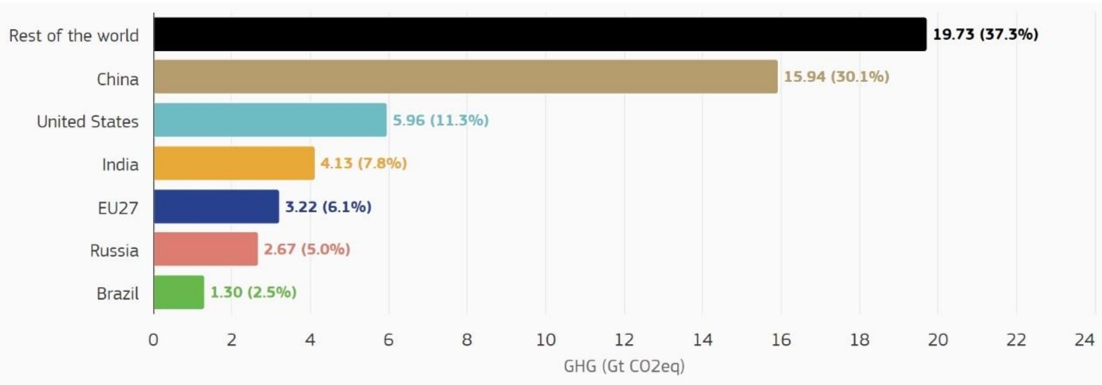
On this basis, we can then begin further investigation of the situation and, if the hypothesis is confirmed, formulate and possibly quantify certain consequences stemming from its validity and describe possible scenarios for future developments. However, it is crucial first to provide evidence of the unevenness of demands, as although this is taken as an automatic fact, it still needs to be substantiated.

2.2 Path to evidence of unevenness

First, clarifying which parameters to monitor is essential to ensure the data are comparable and relevant. From the perspective of the presumed existence of unevenness and the need to halt global climate change—where we assume sufficient scientific consensus on the causes—it is not critical to consider pollution production per capita or pollution intensity. What is truly important is the absolute data, specifically the total volumes of pollution. The climate impacts of pollution do not depend on the fact that Luxembourg is the largest European polluter per capita but rather on the reality that Germany is the largest polluter in absolute terms within Europe, while globally, China and the United States lead.

Therefore, the significant data are the total figures reported for greenhouse gases in equivalents of tonnes of CO2 (CO2eq). The fact that pollution per capita is higher in one country than in another is a relatively insignificant aspect of the situation. Even if Luxembourg, which produces nearly 20 tonnes of CO2 equivalent per capita annually (by far the highest in the EU), were to reduce its total emissions from about 11 million tonnes of CO2 equivalent to zero, it would have no rational significance compared to China's production of around 18 billion tonnes of CO2 equivalent.

Figure 1 GHG emissions and contribution of the six largest emitting economies and the rest of the world in 2023 (in Gt CO2eq and percentage of the global total)



Source: European Commission, Joint Research Centre (2024). Note: A total of 150 countries have declared their readiness to participate in achieving climate goals by adopting public pledges or laws aimed at carbon neutrality; these countries account for 89 percent of global emissions.

The percentage data in the graph relate to the total volume of global annual greenhouse gas emissions, which is approximately 53 billion tonnes of CO2 equivalent (CO2eq). If we focus solely on CO2, China's contribution to pollution is around 27 to 28 percent. In scientific climate discussions, the distinction between total greenhouse gas emissions and CO2 emissions is certainly significant; however, from our perspective, it is less critical, as CO2 constitutes an overwhelmingly dominant part of the problem, barring a few exceptions. Nonetheless, we will consistently refer to greenhouse gases as a whole in terms of CO2eq.

The overall and verbally expressed commitments of countries that have signed up for climate goals are comparable. Typically, these involve reducing CO2eq emissions by half or a similar value from a chosen reference point by a specified time, followed by further reductions in subsequent periods, and achieving independence from fossil fuels by another specified deadline.

It is therefore clear that if there is a problem in this area, it lies in the differences in the chosen time frames and the relative flexibility in selecting reference points.

2.3 Problem of time horizons and reference point

Now, we will compare the commitments of key countries and regions regarding emission reductions and carbon neutrality in broad strokes. However, we will pay particular attention to the situation in China, as it is the largest polluter and primarily an economy that continues to dynamically expand its coal-fired power plants, which is fundamentally at odds with its declared climate goals.

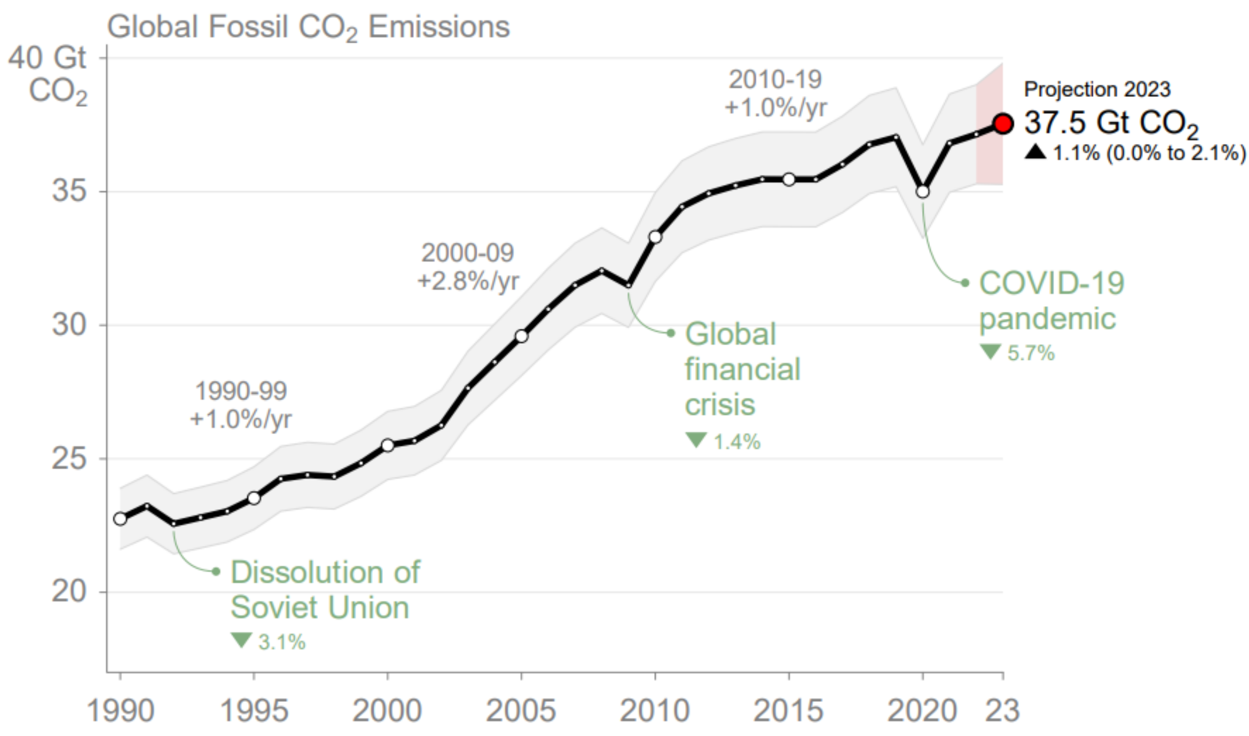
China

The European public and political representatives openly suspect the world's largest polluter is unwilling to meet commitments in the fight against climate change. The issue, in principle, lies more in how the rest of the world has accepted China's approach during the negotiations of international agreements (particularly the Paris Agreement) and its emphasis on its own pace rather than having concrete evidence of non-compliance with commitments.

Under the plan known as 30/60, China has committed to reduce emissions per unit of GDP by 65 percent from 2005 levels by 2030 and achieve carbon neutrality by 2060, meaning it will produce only as much CO2eq as it can eliminate concurrently.

The first commitment is exceptionally mild compared to other countries, as it is linked to GDP. Firstly, there is a significant transformation in the economy's structure compared to 2005, where sectors with high added value, in line with global trends, are gaining strength, while the influence of industries, particularly metallurgy, heavy engineering, and other highly polluting activities, is declining. Therefore, reducing emissions per unit of GDP is a process that occurs partially without major (targeted) investments or demanding measures, as it is a natural consequence of economic restructuring. This process is somewhat analogous to the similar transformation in the Czech Republic in the 1990s.

Figure 2 Global Fossil CO_2 Emissions



When including cement carbonation, the estimates for 2022 and 2023 amount to 36.4 ± 2 $GtCO_2$ and 36.8 ± 2 $GtCO_2$ respectively. The 2023 projection is based on preliminary data and modelling. Source: Friedlingstein et al. 2023; Global Carbon Project 2023.

Secondly, it is possible to achieve targets even without a real reduction in CO_2 and other greenhouse gas emissions simply by significantly transforming the country's energy mix. This is undoubtedly occurring, as evidenced by China's substantial increase in its commitments regarding the installed capacity of photovoltaic and wind power plants. In this regard, it is clearly a global leader, and its future plans are undeniably ambitious. Nevertheless, massive construction of thermal power plants continues, which the Chinese leadership justifies by the need for a robust energy security framework amidst the dynamically growing share of renewable resources. China currently operates nearly 3,200 facilities of various sizes and capacities, with new sources of 48 GW installed capacity coming online in 2023, and various reports indicate that further constructions have been approved, potentially at least at a similar level, if not higher. However, it is a fact that in 2023, solar power plants with an installed capacity of around 100 GW, wind power plants with 65 GW, and hydropower plants with 10 GW were also launched.

For these and other reasons, China remains the driving force behind the growth of greenhouse gas emissions. However, Figure 2 reflects only the status of CO_2, which is why the total figure differs from what we see in Figure 1. On the other hand, China is also among the countries most severely affected by climate change, with rising temperature extremes in the central provinces being particularly concerning. Climate change has also impacted the power generation sector in recent years, with hydropower production significantly declining due to drought. It is also important to note that the quality of the local environment still lags far behind hygiene standards in many regions and has serious repercussions on the population's health. This situation is leading to growing discontent in the increasingly affluent Chinese society. Thus, the country's leadership must contend with broad measures and numerous local crises.

Regarding the term "carbon neutrality," the year 2060 is set a decade later than for developed countries, which currently refer to the United States, the European Union, and Japan. Despite frequent reports about accelerating the development of renewable resources, specialized institutions monitor China's progress with skepticism, often deeming its plans insufficient in final assessments. Nevertheless, in the latest updates to relevant documents, China has committed to reaching peak greenhouse gas emissions before 2030, whereas previous versions cited a date shortly after 2030. There have also been significant increases in commitments regarding reforestation.

In summary, China's pace and the demands of broad measures to support remedial actions are roughly ten to fifteen years, and in many respects more than twenty years, behind those of developed countries. Therefore, the state and businesses bear significantly lower costs to mitigate climate change. The ostentatious reliance on coal-fired power plants, combined with extremely low coal prices (the country has some of the largest reserves in the world), results in an overall low level of energy raw material prices.

In comparison to developed countries, two significant differences are evident. The first is the substantially lower costs for the state, but especially for the business sector, in reducing emissions. Because of how China has framed its targets and chosen advantageous reference points and criteria, it is not currently compelled (and the same applies to business entities) to implement extensive measures to support decarbonization. In particular, it is not obliged to undertake "low outcomes in many areas" measures, which are very capital-intensive. Thanks to the dynamic construction of modern coal-fired power sources, it will be possible in the coming years to decommission the oldest coal plants with the highest environmental impacts as the capacity of renewable sources increases.

The second is the maintenance of low electricity prices, as the dynamic construction of coal-fired power plants (easily permitted and even supported by the state) creates (likely intentionally) a certain oversupply of energy. The promotion of renewable resource development further supports this. As a result, prices remain quite low, essentially representing a method of state management of the entire energy sector through incentives for resource construction and other levers to control the energy market.

This creates a significant cost difference for European businesses, as they bear the burden of investments necessary to meet ecological limits and overall environmental legislation and additional costs in the form of substantially higher energy prices. Expressing this difference in financial terms is a very challenging task and would require a considerably more extensive study. Nonetheless, we will attempt to explore this difference.

A potentially important factor in the postponement of targets and the subsequent implementation of individual steps could be that Chinese enterprises and the state are, due to this delay, taking measures to reduce emissions when technological readiness is higher. It can be assumed that this likely means higher efficiency at lower costs.

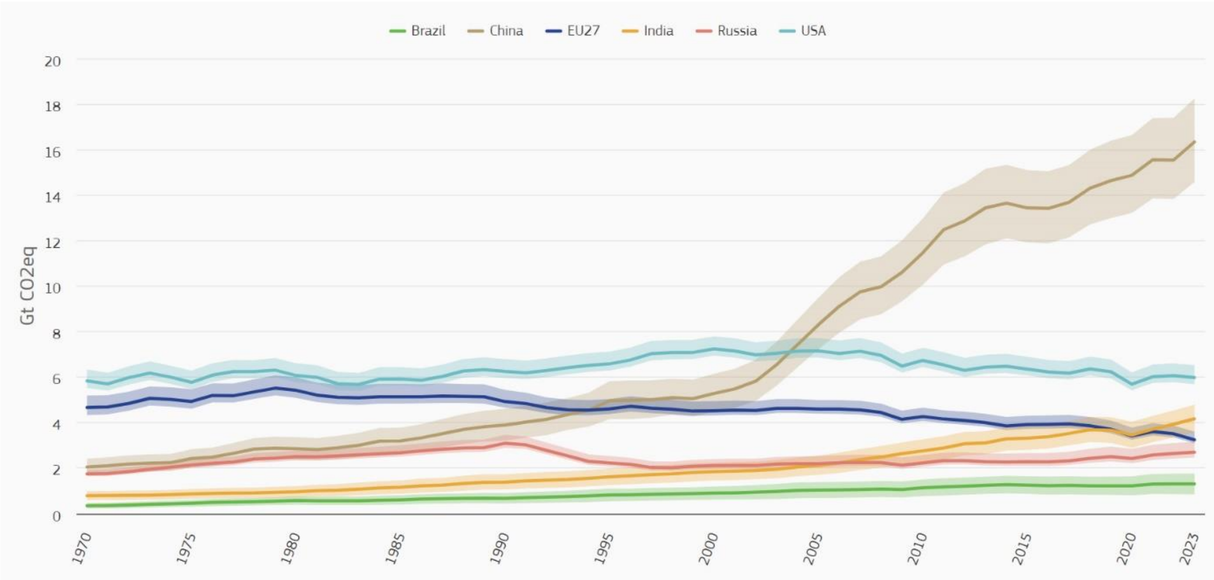
United States

Regarding the largest world economy and the second-largest polluter, the approach to the Paris Agreements and climate commitments in general is changing with the current administration. However, the existing commitments are framed as a 50% reduction in greenhouse gas emissions compared to 2005, the year when the country produced a record volume of CO2eq, and achieving net-zero carbon neutrality by 2050. This represents a very similar approach to that promised by the European Union and some other developed countries. One could say that the USA has adopted a certain standard for the speed and depth of change.

The following graph vividly illustrates China's extraordinary position in terms of environmental pollution and its contribution to greenhouse gas emissions. The gap from other countries is striking. In particular, the curve of absolute emissions growth for China is entirely unmatched by any comparison.

However, it is also worth noting developments in India. It is important to highlight how the absolute emissions values produced in the European Union and the United States significantly converged around 1973 before diverging again. The Union evidently demonstrates a higher capability for emission reductions than the American economy, but this should not be regarded as a clear and indisputable success.

Figure 3 GHG emissions in top emitting economies and estimated uncertainty (coloured bands), 1970-2023 (in Gt CO_2eq)



Source: European Commission, Joint Research Centre (2024).

European Union

The commitment of the European Union is structured similarly to that of the United States, yet in some respects, it is stricter. For 2030, the Union has promised a reduction of as much as 55% compared to the peak emissions levels recorded in 1990. This distant reference point is, however, advantageous. In the 1990s, emissions declined, likely due to improvements in power plant technologies and possibly a reduction in demand.

Table 1 Commitments of major greenhouse gas polluters

	Share of global emissions	Net-zero	Commitment 2030	Other commitments
China	29.95 %	2060	−65 % emissions on one unit of GDP compared to 2005	
USA	13.69 %	2050	−50 % of annual emissions compared to 2005 (peak production)	
EU 27	8.15 %	2050	−55 % of annual emissions compared to (peak production)	
India	6.67 %	2070	−45 % emissions on one unit of GDP compared to 2005	50 % electricity from non-fossil sources by 2030
Russia	4.75 %	2060	−30 % of annual emissions compared to (peak production)	
Japan	3.12 %	2050	−46 % of annual emissions compared to 2013 (peak production)	
South Korea	1.81 %	2050	−40 % of annual emissions compared to 2018	
Iran	1.76 %	—	Not ratified; −4 % of annual emissions compared to current state	
Indonesia	1.61 %	2060	−31.89 % of annual emissions compared to current state, end of illegal logging	Conditional target : −43.20 % annual emissions compared to current state
Saudi Arabia	1.57 %	2060	−278 Mt CO_2eq compared to current state; it corresponds to change of −19% to +24% of annual emissions compared 2019	
C**anada**	1.67 %	2050	−40 % to −45 % of annual emissions compared to 2005	
Mexico	1.33 %	—	−35 % of annual emissions compared to current state	Conditional target : −40 % annual emissions compared to current state
Brazil	1.27 %	2050	−50 % of annual emissions compared to 2005 (peak production)	
JAR	1.22 %	2050	350 to 420 Mt CO_2eq annually in 2030; ; it corresponds to emission change of −18% to −31% compared to r. 2010	
Turkey	1.12 %	2053	−41 % of annual emissions compared to 2012	
Australia	1.08 %	2050	−43 % of annual emissions compared to 2005	
Great Britain	1.0 %	2050	−68 % of annual emissions compared to 1990 (peak production)	

Source: https://faktaoklimatu.cz/studie/2021-reserse-zavazky-statu

India, Russia, Japan

For illustrative purposes, we will also mention the commitments of three other countries in ranking the largest emissions producers. India has promised carbon neutrality by 2070, Russia by 2060, and Japan by 2050. By 2030, India has committed to reducing greenhouse gas emissions per unit of GDP by 45% compared to 2005. This is a rather soft promise that may not necessarily imply a reduction in the absolute volume of emissions; in this regard, India's approach is somewhat similar to that of China. Russia has committed to a 30% reduction in greenhouse gas emissions compared to the peak in 1990, with significant methane leaks during natural gas extraction presenting a major issue for the Russian Federation. Additionally, the threat of extremely large methane leaks due to permafrost thawing in Siberian and Far Eastern regions has become a further complication, likely linked to global warming. Japan's commitment entails a reduction in annual greenhouse gas emissions by 46% compared to the levels from 2013 when production peaked.

2.4 Outline of the decarbonization cost model

A comparison of the described climate commitments of the largest polluters, as captured in Table 1, clearly indicates that, in terms of actual (absolute) volumes of greenhouse gases and the speed of their reduction, there is a significant disparity between developed economies, primarily between the European Union and the United States, and other economies. The examples of two rapidly growing economic systems, China and India, are also illustrative for other nations.

It is evident, however, that it would be possible to address this issue within a theoretical cost model at least broadly. Given the considerable difficulty in quantifying the real costs of decarbonization, it would have to be a unit model, thus not directly linked to specific monetary amounts. Moreover, due to the fundamental differences between the economies being compared, it is clear that we must work with ratios relative to the respective GDP rather than some general value.

A brief note on the issue of defining the costs of decarbonization: this is an extremely complex problem that best emerges when at least roughly describing the circumstances that need to be considered. For our purposes, we will categorize costs based on who bears them at any given moment (noting that ultimately, consumers always bear the final burden).

Costs for the state and municipalities include:

Direct investment subsidies for the construction of renewable sources, subsidies for the operation of renewable sources, subsidies for the introduction of circular, zero-emission, or low-emission technologies, subsidies to households and producers for mandated investments (typically boilers), reduction in tax revenues from non-subsidised (phased-out) sources, costs of developing distribution networks (according to an agreed division with other participants), expenditures to support research, development, and innovation in the area of a zero-emission economy, potential costs associated with addressing unemployment and retraining workers linked to the carbon economy.

Costs for private business entities include:

Higher energy prices, costs for the development of the transmission system (passed on), mandated expenditures for investments and modernisations that do not increase production or reduce costs, costs for obtaining services to secure subsidies, environmental taxes, overall increase or inability to reduce tax burdens, mandated investments in mobility, costs for strategic research, retraining of workers, recruitment of workers with higher qualifications.

Costs for consumers include:

Prices of products influenced by higher energy prices, environmental taxes, overall increase or inability to reduce tax burdens, unavailability of certain preferred products, mandated investments in real estate (heating, insulation), mandated investments in mobility, costs for retraining to remain in the job market.

This represents a diverse mix of both large and small costs, one-off and long-term, and in some cases, costs that are forcibly shared (for example, through energy prices). Additionally, this list is undoubtedly not exhaustive. It would also be appropriate to offset the results by the undeniable benefits that the transition from carbon-based energy brings. These benefits certainly include improved health and increased life expectancy, which generally leads to lower costs for health systems. Individual countries sometimes publish certain (partial) estimates of the costs of achieving the goals of the Paris Agreement; however, these figures are often incompatible with one another, typically derived through entirely different methodological approaches, and it is generally unclear what scope of total costs they actually cover. It is essential to note that comparisons cannot be made based on these figures.

The intended model therefore resigns from detailed tracking of these expenditures and potential benefits and will be conceived on a completely different basis. This work only informs about the ongoing state of model preparation rather than its final form, and should be understood as a discussion document regarding the model's conceptual framework.

The basic thesis is as follows: It is appropriate to use the state of the European Union and the relevant commitments in the form of emissions reductions and achieving carbon neutrality as the basis for conceptualizing relationships between individual countries.

It is assumed that the EU's plan for reducing emissions by 2030 will serve as a value (theoretical expenditure) of 100. The key question is what value to assign to the goal of achieving carbon neutrality by 2050. Using a value of one hundred again seems inappropriate, not least because part of the second commitment will be realised within the framework of the first. To determine this number, it will be necessary to assess the potential of the relevant area (in this case, the EU) concerning CO2 capture and potentially CO2eq. This is one of the tasks that will need to be resolved in the next phase of model preparation. For the EU, we are currently working with a value around 50, which is based on the relationship between the 2030 target and the 2050 target, the potential for afforestation, and other values.

Next, it is necessary to create a temporal model for each area. This means capturing the current state (how much of the task is currently fulfilled), appropriately reducing the initial value (100), and then determining costs in subsequent periods up to the end of the timeframes, with 2030 being a common point, while the goals for carbon neutrality are framed differently in terms of timing.

This will establish a basic framework for comparing the different areas, specifically for the European Union. A similar procedure will follow for each country or area thereafter. In this task, determining the value for the 2030 target and for the carbon neutrality target is again seen as the most challenging aspect. It will be necessary to assess and calculate these parameters: the volume of emissions reductions by 2030 and their comparison with the volume of emissions reductions in the EU. This will be particularly complex for countries that do not have an absolute emissions target but aim for a ratio of emissions to GDP (primarily China and India). Pricing and other circumstances must also be considered. Nevertheless, it appears that in the case of China, the costs required to achieve the 2030 target will be roughly at a level of around 20, which is merely one-fifth of the costs of the European Union. However, this is a very preliminary calculation, mentioned here primarily for informational purposes. A similar approach will also be applied to the carbon neutrality target, where it will again be necessary to reconsider the relationship to the potentially fulfilled 2030 target, the possibilities for capture and support for capture, and the time frame the examined country or area has set for meeting the goal. In the case of China, preliminary calculations suggest a figure higher than that of the European Union, as the 2030 target is dramatically less demanding. This is estimated to be around 70 points. However, this is very significant; this value is spread over a period of ten years, meaning the annual costs will be calculated over 30 years rather than 20 years, as with the EU. It is therefore highly probable that due to this dilution, the cost unit for the Chinese economy will fall below the cost unit for the European economy.

3 Conclusions

Previous work on the model suggests that if current climate targets are maintained, China's actual costs will remain at around twenty percent of those of the European Union over the coming decades. The primary burden of this unevenness will fall on the European industrial sector. The outcome could only be further deindustrialization of the European Union rather than just in individual countries. An alternative would be to reassess climate targets, or one could discuss changing the methods for achieving them, as is suggested in the context of the so-called Draghi report.

The issue requires further examination, particularly in refining the roughly outlined model for calculating cost disparities. However, the fact that Europe bears what appears to be an unmanageable burden of costs compared to other parts of the world (including the United States, which has not been addressed in this study) is evident even without the model itself. The model is intended solely to quantify the problem.

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