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Macroeconomic implications for the Global South of a green transition in the Global North

Abstract:

This paper examines the potential macroeconomic impacts on countries and regions in the Global South arising from a reduction in the material footprint of countries in the Global North. Using environmentally extended (multi-regional) input-output analysis, we develop and compare stylised scenarios of two alternative green transition strategies: 'green growth' and 'degrowth.' The findings reveal that, on average, both scenarios lead to reductions in GDP, employment, and a worsening in the balance of trade (as a percentage of GDP) in the Global South. These outcomes highlight that, regardless of the strategy adopted, the green transition in the Global North risks exacerbating economic vulnerabilities and triggering macroeconomic crises in Global South countries under the prevailing patterns of trade and productive specialisation. The paper argues that a just and sustainable green transition requires not only reductions in material consumption in the Global North but also a fundamental restructuring of development strategies in the Global South. This entails moving away from neo-extractivism—characterised by reliance on raw material exports and the import of manufactured goods —towards diversified and equitable economic models that reduce structural dependencies and enhance resilience.

Keywords: Green growth; just transition; decoupling; degrowth; post development; sustainable development; structural dependencies.

Abbreviations: Balance of payments, BoP; Circular economy, CE; Computable General Equilibrium, CGE; Ecologically unequal exchange, EUE; Environmentally-extended input-output, EEIO; Foreign Direct Investment FDI; Gross Domestic Product, GDP; Greenhouse gas, GHG; Input-output, I-O; Integrated Assessment Model, IAM, Intergovernmental Panel on Climate Change, IPCC; Knowledge intensive business services, KIBS; Multi-regional input output, MRIO.

1. Introduction

Global efforts to meet the Paris Climate Agreement and operate within planetary boundaries highlight an urgent need to reduce material and energy consumption, particularly in high-income countries (Rockström *et al.*, 2009; Richardson *et al.*, 2023). However, the strategies pursued to achieve this often overlook the potential economic knock-on effects that such reductions could create in the Global South. Many countries in this region are highly dependent on energy and material exports, meaning that reductions in demand for such goods from the Global North could destabilise economies reliant on these activities, with far-reaching implications for development and welfare (Cosme *et al.* 2017; Dengler and Seebacher, 2019; Althouse *et al.* 2020).

This paper investigates the macroeconomic implications of a 10% reduction in the material footprint of Global North countries, focusing specifically on its impacts on the Global South. This reduction represents the approximate compound rate required over an *initial five-year period* to align material footprints with planetary boundaries by 2050, based on estimates of globally sustainable material use.

The analysis adopts a static Leontief model based on (multi-regional) environmentally-extended input-output (EEIO) tables to estimate the effects of two contrasting scenarios: (1) A degrowth scenario, in which reductions in material use declines due to a one-off reduction in final demand in high-income countries, and (2) a green growth scenario, which assumes a one-off technical change which enhances material efficiency in high-income countries, with further sub-scenarios considering different cost-pass-through mechanisms (Hickel and Hallegatte, 2021)[1]. The results of each scenario are compared to the observed values in the dataset used (EXIOBASE v.3, Stadler et al., 2018), assuming that GDP, employment, and the trade balance remain otherwise unchanged.

This dual focus allows the paper to make two key contributions to the literature. First, it investigates the macroeconomic risks for the Global South associated with the green transition in the Global North, considering two alternative strategies—green growth and degrowth—and offering insights into their respective implications for resource-dependent economies. The analysis reflects current patterns of trade specialisation, in which the Global South remains reliant on raw material exports and on imports of high-value green technologies from the Global North. This structural dependence also helps motivate the paper's second contribution: the exploration of policy options for Global South

[1] While improvements in material efficiency are a key pillar—and an ultimate goal—of a 'green growth' transition strategy, they are not the only factor. Such a strategy would also likely involve a 'Green New Deal,' in which increased public investment during the transition phase facilitates material efficiency gains and could generate positive economic effects for countries in both the Global North and South. However, these effects would be most pronounced during the transition phase, whereas our static framework compares only the 'final' outcomes between two stationary states. The limitations of this approach are further discussed in Section 6.

economies facing increasing balance of payment deficits due to the green transition in the North, with a focus on reducing import dependency in areas such as advanced technologies and knowledge-intensive business services. This approach bridges previously disjointed literatures: one on the social and economic impacts of the green transition and the other on balance-of-payment restrictions to development in the Global South.

While earlier studies have explored different aspects of transition risks, they often do so in isolation or without addressing the implications of reduced material demand on resource-dependent economies (Semieniuk et al., 2021). From an economic development perspective, this is particularly relevant, as historically countries in the Global South have mainly specialised in exporting agricultural commodities, mineral resources, or resource intensive manufacturing (Lebdioui, 2021; Weber2021; Weber et al., 2022, and Brondino et al., 2023). A few notable exceptions have examined climate and transition-related risks to the external balance of Global South countries. Löscher and Kaltenbrunner (2023, 2025), from a post-Keynesian and empirical perspective, show how climate change heightens currency and balance of payments vulnerabilities in developing countries, constraining domestic policy space. Magacho et al. (2023) highlight how large shares of employment, wages, and fiscal revenue in many developing economies depend on fossil fuel exports, leaving them exposed to falling demand during the low-carbon transition.

Our paper builds on this line of research by explicitly contrasting the economic impacts of different transition pathways, particularly for the Global South, and going beyond the focus on the transition away from fossil fuels by exploring the impacts of a reduction in overall raw material consumption in Global North countries. These pathways are not only relevant to academic debates but also critical for policymakers seeking to balance the ecological imperative of reduced material consumption with the economic imperative of sustaining livelihoods in material resource-exporting nations.

The findings reveal that reductions in demand for material resources from the Global North, regardless of strategy, can have destabilising macroeconomic effects in the Global South. In particular, lower demand for materials and energy in the Global North could ultimately lead to trade deficits and reduced foreign direct investment (FDI), which can have destabilising macroeconomic consequences such as balance-of-payment crises and currency devaluations. These effects could, in turn, exacerbate socio-economic vulnerabilities, including reduced access to foreign currency for imports, higher unemployment, and rising domestic prices for staple commodities. The degrowth scenario, for instance, primarily impacts economies through reduced final demand, while the green growth scenario redistributes effects via changes in production efficiencies and cost structures. By quantitatively modelling these scenarios, the paper responds to calls for empirical research on the structural dependencies between Global North and South in the context of green transitions (Gräbner-Radkowitsch and Strunk, 2023)[2].

The results also underscore the need for proactive industrial policy to mitigate adverse effects, echoing longstanding arguments from development economics and Latin American structuralism (Rugitsky, 2023). Such policies could promote structural transformation away from resource extraction, fostering diversification and resilience in Global South economies.

It is important to emphasise that the results in this paper are illustrative rather than predictive, providing a broad assessment of potential first-order impacts within a static input-output framework while acknowledging its limitations. As such, secondary effects—such as changes in foreign direct investment or exchange rates due to reduced demand and exports of raw materials—fall beyond the scope of this study but are likely to further amplify the impacts reported. Rather than predicting the dynamic responses of economic agents and markets to the initial shock implemented in each scenario[3], our aim is to highlight the macroeconomic pressures that may arise under different transition strategies—represented by stylised scenarios of degrowth and green growth—and to outline potential policy options for mitigating these pressures.

The remainder of the paper is structured as follows: Section 2 discusses the relevant literature on green transitions and their global economic implications. Section 3 provides an overview of the methodology and data used in the muti-regional EEIO analysis, the results of which are presented in Section 4. Section 5 contrasts the results of each scenario and discusses the economic policy implications and options for ensuring a just and green transition for Global South economies, while Section 6 addresses the study's limitations and assumptions. Section 7 concludes by reflecting on the broader implications of the findings and future research priorities.

2. Literature review

This section begins by examining two contrasting strategies for achieving the green transition—'green growth' and 'degrowth'—and their domestic and international implications. It then explores the literature on green transition risks, highlighting financial and economic challenges, as well as the social and physical risks associated with shifting to a low-carbon economy. Next, it reviews the current state of formal modelling efforts, particularly in the context of degrowth research and reductions in material

[2] In addition, Gräbner-Radkowitsch and Strunk (2023) also argue that this research should encompass formal modelling including, explicitly, environmentally extended multi-regional input-output analysis. Weiss and Cataneo (2017) and Frame (2023) echo these points.

[3] As is done in CGE, Macroeconometric I-O or Stock-Flow consistent I-O models, and obtain final socio-economic and environmental impacts which are highly dependent on the assumed parameters in each model.

consumption. Finally, this review underscores the need for a comprehensive analysis that addresses key gaps, setting the stage for the research questions and contributions that follow.

2.1. Green growth and degrowth: alternative approaches to the green transition

Green growth and degrowth represent two contrasting paradigms for reconciling economic and environmental objectives, each with distinct implications for the Global South.

> *"Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities"* (OCED, 2011).

The quote from the OECD exemplifies the concept of green growth: founded on the idea that 'sustainable development' can be achieved through human ingenuity (in the form of technical progress) in conjunction with instruments to correct market failures, it does not question the ongoing pursuit of economic growth but rather seeks to try and make this compatible with economic *and* environmental objectives (see also United Nation Environment Programme [UNEP], 2011; World Bank, 2012). Economic growth is seen as the conduit for human development: a way of avoiding recessions, creating employment and financing reductions in poverty and the cleaner production technologies that play a large part in 'decoupling' economic output from environmental and social pressures (Hallegatte *et al.*, 2012; Antal and Van Den Bergh, 2016). As a result, we are offered the prospect of 'win-win' outcomes that have the potential to square the circle between the economy and the environment wherever green growth is embraced (Herman, 2023). The potential for this harmonious relationship is thus represented by the inverted U-shaped Environmental Kuznets Curve, which argues that environmental pressures increase up to a point but decline with additional economic growth (Panayotou, 1993; Dinda, 2004). Amongst other things, this perspective has been criticised for the limited empirical evidence of *absolute* decoupling (rising growth accompanied by falling material and energy use), beyond individual countries, and isolated environmental impacts (Steinberger *et al.*, 2013; Ward *et al.*, 2016; Haberl *et al.*, 2020; Hickel and Kallis, 2020; Vogel and Hickel, 2023).

Degrowth, as identified by Beling *et al.* (2018) and Gräbner-Radkowitsch and Strunk (2023), comprises two main strands: (1) a cultural strand rooted in post-development discourses (e.g., Latouche, 2009), and (2) an ecological strand that critiques the hegemonic growth-based order, aiming to address urgent climate and environmental concerns (Lamboll *et al.*, 2023). The latter understands degrowth as "an equitable downscaling of production and consumption that increases human well-being and enhances ecological conditions at the local and global level, in the short and long term" (Schneider *et al.*, 2010).

A central theme within this ecological critique has been the examination of trade and consumption patterns in the Global North, highlighting excessive material and energy throughput and the dynamics of Ecologically Unequal Exchange (EUE), where such throughput in the Global North drives environmental degradation and social inequalities in the Global South (Dorninger et al., 2021). Degrowth emphasises the need for high-income countries to reduce their energy and resource consumption, which often far exceeds their per capita fair share under a Paris-compliant scenario aiming to limit global warming to 1.5–2°C above preindustrial levels (Vogel and Hickel, 2023). However, crucially, degrowth does not target reductions in Gross Domestic Product (GDP) *per se* but rather advocates for a planned reduction of material and energy consumption, although reductions in GDP are likely in some cases (Kallis, 2020; Hickel, 2021).

A key limitation of degrowth is that while it primarily targets high-income nations, reductions in energy and resource use in the Global North could still have unintended consequences for the Global South. However, the degrowth literature has paid relatively less attention to the broader international implications of degrowth policies, particularly their adverse effects on export-reliant economies in the Global South (Cosme *et al.*, 2017; Frame, 2023). For instance, significant reductions in demand for goods produced with low-wage labour and natural resources in the Global South could lead to declining human welfare, higher unemployment, and growing inequality in these regions (Dengler and Seebacher, 2019; Althouse *et al.*, 2020).

This dynamic underscores what Gräbner-Radkowitsch and Strunk (2023) frame as the “twin problem of structural dependency,” wherein the Global North’s reliance on EUE simultaneously drives and hinders degrowth implementation. While degrowth recognises these dependencies, it often overlooks their "flipside"—the potential socioeconomic harm to the Global South from degrowth-oriented policies in the Global North. Other authors have raised similar concerns (Jackson, 2009; Cosme *et al.*, 2017; Weiss and Cattaneo, 2017; Chiengkul, 2018).

2.2. Risks and trade-offs in the green transition for the Global South

The imperative to mitigate the environmental consequences of economic activity is gaining acceptance in the literature. However, besides the risk associated with the climate change to economic activity, an emerging literature has been highlighting different risks associated with the transition towards a more ecologically sustainable economy, refereed to as ‘transition risks’ following the terminology used by the former governor of the Bank of England, Mark Carney in 2015 (Daumas, 2024). However, within this literature, a significant amount of research has been focused on financial instability, while key transnational macroeconomic risks remain underexplored and warrant further attention.

In broad terms, financial instability would emerge from two main channels. On the one hand, physical risks of climate change, such as physical damage to infrastructure and lower agricultural productivity, would result in financial losses to investors and lead to financial instability (e.g. Battiston et al. 2017, Dafermos et. al, 2018; Monasterolo, 2020; Dafermos and Nikolaidi, 2021; Lamperti et al. 2021, Seminiuk et al., 2022). However, on the other, rapid and unorderly transitions to low-carbon economy can also lead to financial instability associated with stranded assets in the context of rapid transition to a low-carbon economy (Caldecott, 2017; Van der Ploeg and Rezai, 2020; Roncoroni, 2021; Campiglio and Van der Ploeg, 2022; Cahen-Fourot et. al., 2021; Semieniuk et al., 2022). As discussed by Semieniuk et al. (2021), the transition to a low-carbon (and to low-material-resource consumption) economy entail also large-scale structural change in the sectoral composition of the global economy, with sectors linked to fossil fuel production and raw material extraction likely to shrink ('sunset' sectors). These changes render capital goods associated with dirty technologies obsolete, resulting in stranded assets and, consequently, financial losses for investors, increasing risks of credit defaults and banking crises.

Associated with these, researchers have also explored the climate change challenges for central banks and financial regulators, in general, (Campiglio et al. 2018) and for central banks of the Global South, in particular (Loscher and Kaltenbrunner, 2023 and 2025). Through a post-Keynesian theoretical framework, Loscher and Kaltenbrunner (2023) argue that physical and transition risks of climate change, as well as mitigation measures, are expected to have negative effects on the liquidity premia of currencies of developing countries, and lead to higher volatility in the exchange rate, exacerbating prevalent international monetary hierarchies. Loscher and Kaltenbrunner (2025) triangulate econometric analysis with policy makers' interviews to demonstrate how climate risks impact the balance of payments of a Global South resource-dependent economy like Nigeria and reduces policy space of its central banks monetary policy to pursue domestic objectives. The negative impact of shocks associated with climate change on the current and financial accounts, reduces inflows of foreign exchange income, pressuring the exchange rate downwards. This would require Nigeria's Central bank to raise interest rates to avoid devaluation and spike in inflation rates, with the drawback of increasing interest payments on government debt and on bank loans to the private sector, harming the local economy.

If climate change in itself poses risks for the macroeconomic stability of Global South economies, the macroeconomic implications of a green transition are equally pressing. A 'successful' green transition may reduce global demand for goods in which many Global South economies specialise. While impacts will vary by country, energy-exporting nations are particularly vulnerable, as falling fossil fuel demand threatens exports and fiscal revenues. Conversely, resource-rich countries supplying critical minerals (e.g., lithium, cobalt, nickel) may benefit—though a broader material transition could negatively affect both groups. Declining GDP and rising unemployment in already vulnerable regions could worsen socioeconomic conditions while deteriorating trade balances increase the risk of external debt crises (Semieniuk *et al.*, 2021). Countries with structural trade deficits may struggle to secure sufficient foreign exchange, heightening the risk of balance of payments crises, especially in economies where government debt is predominantly denominated in foreign currency (Alami *et al.*, 2022).

This is particularly concerning given strong empirical evidence that balance of payments constraints has for long limited growth in developing economies (Thirlwall, 1979; Britto and McCombie, 2009; Bhering *et al.*, 2019; Spinola, 2020). To understand why the balance of payments has historically been a binding constraint to the development of Global South economies, it is important to recover the insights long developed by Latin-American structuralist school of thought, developed in the post-war decades at the ECLAC-UN (Boyanovsky and Solís, 2014).

Starting with Raul Prebisch's trilogy of "manifestos" (1949; 1950; 1951) and the works of Celso Furtado (1958, 1964) and Felipe Pazos (1948), Latin-American structuralists established an analytical difference between peripheral and central economies[4], which refers to the way in which countries were inserted into the international division of labour, based on their different productive structures. Contrary to the centre, peripheral regions are characterised by a less diversified productive structure, specialising in the production of primary goods, with strong technological heterogeneity and unlimited supply of labour with incomes close to the subsistence level (Pinkusfeld and Pereira, 2024).

Within this stratified specialisation pattern the relationship between periphery (South) and centre (North) are analysed. In this context, the balance of payment constraint would emerge as binding for the development of the Global South, because income-elasticity of primary goods (exported by Global South economies) would be lower than the income-elasticity of manufactured goods (which the Global South imports). As such, whenever the Global South income levels were to grow more rapidly and try to converge their consumption levels with that of the centre, the process would be chronically interrupted by the deterioration of the balance of payment, which would trigger an economic crisis. In analysing why Latin American countries failed to converge to GDP per capita income levels observed

[4] In a broad sense the distinction between peripheral and central regions can be related to the current usage of Global South and Global North, respectively.

in developed economies, Cimoli et al. (2010) show that the developing countries that succeeded in reducing the income gap (namely east Asian countries) were those that transformed their economic structures in favour of sectors with higher technology intensity and whose international demand grew at higher rates. In this context, the green transition, with its stated goal of reducing the material resource consumption to ensure that society operates within safe planetary boundaries, has the potential to exacerbate the chronic balance of payment constraint problem faced by Global South economies[5].

2.3. Macroeconomic modelling of green transition scenarios

The literature on the economic impacts of green transition policies is vast; however, most studies have focused on scenarios driven by technological change, primarily within the energy transition and efforts to reduce CO_2 emissions (Hardt and O'Neill, 2017). As such, three important aspects have received less attention:

- Consumption-based transition scenarios – Modelling approaches that explore shifts in consumption habits, aligning with degrowth principles.
- Broad ecological transition scenarios – Modelling efforts that extend beyond greenhouse gas (GHG) emissions to address other ecological pressures, in line with the planetary boundaries framework (Rockström *et al.*, 2009).
- Modelling of the green transition focusing on macroeconomic risks for the Global South.

This section reviews studies that have engaged with these three aspects to some extent, positioning them in relation to our own intended contribution.

The macroeconomic modelling of degrowth remains underdeveloped, particularly regarding its transnational impacts. As reviewed by Gräbner-Radkowitsch and Strunk (2023), most degrowth literature is qualitative or based on case studies. However, a few notable exceptions exist. Keyβer and Lenzen (2021) compare degrowth scenarios with conventional integrated assessment model (IAM) scenarios from the IPCC's Special Report on 1.5°C (SR1.5). They argue that degrowth scenarios present lower socio-economic risks, whereas IAMs rely on optimistic assumptions about technological change and negative emissions technologies. Similarly, Kikstra *et al.* (2024) apply an IAM (MESSAGE-IX) to assess a degrowth scenario for Australia. However, like standard IAMs, GDP is set exogenously in both studies, meaning the feedback effects of transition policies on GDP are not accounted for. However, a key limitation of these traditional IAMs is their simplified representation of the economy. As Nieto

[5] For an overview of the evolution of the ecological perspective in Latin American Structuralism see Porcile and Torres (2024).

et al. (2021, p.2) put it, they often depict the economy as a "monolithic energy-consuming machine," overlooking its complex sectoral structure and regional variations.

An alternative approach is the use of ecological macroeconomic models, which integrate biophysical insights, system dynamics, and input-output analysis. Notable examples include the EUROGREEN models for France (D'Alessandro *et al.*, 2020) and Italy (Cieplinski *et al.*, 2021), the MEDEAS model for the global economy (Nieto *et al.*, 2021), and the LowGrow model for Canada (Victor, 2012; Jackson and Victor, 2020). These dynamic models incorporate sophisticated feedback effects between the economy and the environment while providing a detailed sectoral breakdown. However, they remain single-region models, meaning they do not capture the transnational impacts of degrowth and green growth strategies.

To address this gap, we adopt a Leontief Input-Output (I-O) model (Leontief, 1944) using multi-regional environmentally extended input-output (EEIO) tables. This approach offers a more detailed picture of the transnational impacts of green transition policies aligned with degrowth principles. However, it does not fully capture dynamic feedback effects, which may be important. A relevant application of this method to comparing alternative transition scenarios is De Koning *et al.* (2016), who used a trade-linked Leontief I-O model to assess pathways to a +2°C world by 2050. They concluded that such a scenario would only be feasible with a combination of technological change, deep emissions reductions, and shifts in final demand across all regions. However, their analysis, based on an earlier version of EXIOBASE (129-sector disaggregation), aggregates the world into four broad regions—EU, high-income countries, newly developing countries, and the rest of the world. This coarse regional breakdown masks significant geographical variations. Moreover, like much of the literature, it focuses exclusively on emissions.

Macroeconomic modelling of transition policies focusing specifically at reducing material consumption has lagged behind but is gaining traction, particularly with the rise of interest in Circular Economy (CE) practices. However, most of the literature emphasises technological solutions, often presenting CE as a "win-win" strategy that decouples economic activity from environmental impacts (Aguilar-Hernandez *et al.*, 2021; Genovese and Pansera, 2021). This overlooks potential policy trade-offs, including rebound effects and uneven distributional impacts across social classes and regions (Fevereiro *et al.*, Forthcoming). Several studies highlight these uneven effects. Boer *et al.* (2021), using a multi-regional EEIO model, find that introducing CE practices in Belgium's metal and electrical sectors increases both employment and emissions domestically but reduces both at a global level. Nechifor *et al.* (2020) analyse the increased use of steel scrap in China, showing modest GDP gains domestically but negative effects for major iron ore exporters in the Global South, including Brazil, India, other developing Asian countries, and Russia. Martínez-Hernando *et al.* (2024) study secondary platinum production via supply chain interventions using an MRIO approach and find negative labour market impacts, primarily affecting Global South countries. Although not the major focus of this body of literature, these results highlight the transnational macroeconomic risks of the green transition discussed in the previous section. However, once again, these papers do not address the contrasting impacts of alternative transition strategies and focus exclusively on measures associated with the Circular Economy

Within the transition risks literature, three key contributions have attempted to measure the transition risk arising from macroeconomic imbalances, which stand closer to our own intended contribution. Using multi-regional input-output analysis, Magacho *et al.* (2023) measure the exposure of developing economies to the low-carbon transition, highlighting risks to employment, wages, and fiscal revenue from declining fossil fuel demand. Espagne *et al.* (2023), employing a dynamic macroeconometric I-O model, track cross-border risks and find that countries such as Argentina, Australia, Brazil, Canada, Russia, and the U.S. may face trade balance deteriorations exceeding 1% of GDP, with GDP losses also projected for Australia, Canada, Russia, Saudi Arabia, South Africa, the UK, and the U.S. Lastly, Gourdel et al. (2025) use the EIRIN Stock-Flow-Consistent model calibrated for Indonesia, to analyse the spillover risk of a reduction in its exports of fossil fuels, with results indicating the direct negative impact of the reduction of exports is amplified by secondary effects of fall in asset prices, investment and on fiscal revenue.

Our work seeks to extend these contributions in two ways. First, unlike Espagne *et al.* (2023), who analyse a single transition pathway, or Magacho *et al.* (2023), who assess fossil fuel dependence, this paper compares scenarios based on two alternative transition paradigms to identify consistent and scenario-dependent effects across countries. Second, rather than focusing solely on the low-carbon transition, we address a broader reduction in material consumption aligned with planetary boundaries. Third, unlike Gourdel (2025), who focus on a single economy, we provide a holistic multi-regional analysis. Nevertheless, unlike Espagne et al (2023) and Gourdel (2025), both of which use dynamic models which incorporate several feedback mechanisms, which can amplify the initial result, we rely on a comparative static Leontief I-O framework. The benefits and limitations of our empirical strategy are further discussed in Section 6.

2.4. Summary and research questions

Existing literature on green transition risks, while valuable, presents several key gaps. First, there is a need for explicit comparison of different transition strategies, specifically green growth and degrowth, and their respective impacts on the Global South's macroeconomic stability and existing structural dependencies within the global economy. Second, analyses often focus narrowly on energy sector transitions, neglecting the broader implications of reduced material footprints and their associated economic disruptions. Third, while some studies address balance of payments and trade imbalances, a comprehensive understanding of how distinct green transition strategies affect these vulnerabilities in the Global South remains lacking. Finally, the social and political ramifications of these macroeconomic shifts, including potential increases in inequality, social unrest, and political instability, require further investigation, particularly concerning their interaction with pre-existing vulnerabilities in the Global South. This paper seeks to address these gaps by using a multi-regional environmentally extended input-output (I-O) analysis to quantify the economic consequences of green growth and degrowth strategies. It focuses on the macroeconomic vulnerabilities of the Global South, incorporates a broader consideration of social and political risks, and explores policy options for Global South countries to adapt to a world with lower material resource consumption.

The research is guided by the following questions:

- **(RQ1)** What would the GDP, employment and balance of payments impacts be in the Global South of a reduction in material footprint in the high-income countries of the Global North?
- **(RQ2)** How do the economic impacts vary depending on the strategy used to reduce the material footprint, and what are the implications for development pathways?
- **(RQ3)** How can Global South countries mitigate the trade balance and balance of payments challenges posed by different green transition pathways?

3. Methods

3.1. Multi-regional environmentally extended Input-output analysis

As discussed by Miller and Blair (2009), Input-Output (I-O) analysis is an analytical tool – pioneered by Wassily Leontief (1936,1941) – that allows us to represent the interdependencies between different sectors (or industries) of a national economy (or different regional economies). Based on observed economic data for specific geographic areas, I-O tables are normally compiled by national statistical offices of a country in the process of producing national accounts (which are used to compute GDP and other macroeconomic variables). Transaction flows are framed into an inter-industry table, which shows the destination of sector-related output. The latter can be an input for other sectors, which utilise this for production purposes, or it can be purchased as a final demand for a product or service by households, firms, the government, and the foreign sector (in the form of consumption, investment, government spending, and exports, respectively). Of particular interest for our study is the use of *global* multiregional input-output tables, which combine the above mentioned information for multiple countries and regions of the world in a single table. Figure 1 provides a simplified illustration using two regions and three sectors.

2 x 2 regions with 3x3 industries MRIO		**Region R**			**Region S**			**Region R**	**Region S**	**Total Output (at basic prices)**
		Intermediate Demand						**Final Demand**		
Country	**Sectors**	**Agriculture**	**Manufacturing**	**Services**	**Agriculture**	**Manufacturing**	**Services**			
Region R	**Agriculture**	Intermediate inputs demanded by sectors in Region R from sectors in Region R			Imported intermediate inputs demanded by sectors in Region S from sectors in Region R			Final demand of Region R for goods produced in Region R	Final demand of Region S for imports from Region R	Total output of Region R
	Manufacturing									
	Services									
Region S	**Agriculture**	Imported intermediate inputs demanded by sectors in Region R from sectors in Country S			Intermediate inputs demanded by sectors in Region S from sectors in Region S			Final demand of Region R for imports from Region S	Final demand of Region S for goods produced in Region S	Total output of Region R
	Manufacturing									
	Services									
Value Added	**Profits**	Value added in Region R			Value added in Region S					
	Wages									
Total Outlays (at basic prices)		Total outlays per sector in Region R			Total outlays per sector in Region S			Tot final demand from R	Tot final demand from S	Total output (at basic prices)

Figure 1: An illustration of a multi-regional input-output (MRIO) table with two regions and 3 sectors.
Note: In bold are headings of the MRIO table and in italic are blockchain which the monetary flows are accounted for.
Source: Author's own elaboration.

As such, the total output produced by each sector *I* in each country can be represented as a column vector (x), which is equal to:

$$x = Z + f_d \qquad (1)$$

where f_d is a column vector with the total final demand for the output of each sector, Z is a square matrix $(n\ x\ n)$ representing inter-industry transaction flows with each element, and z_{ij}, represents the total amount of inputs purchased from sector i by sector j.

Dividing each element (z_{ij}) of Z by the total output of the respective sector j, x_j, one obtains the matrix of technical coefficients, A, in which each element is defined.

$$a_{ij} = \frac{z_{ij}}{x_j} \qquad (2)$$

Where a_{ij} are known as the technical coefficients, which represent the amount of inputs from sector i required to produce one unit of output of sector j. As such, equation (1) can be re-written as:

$$x = Ax + f \qquad (3)$$

Solving equation (3) for x yields:

$$x = (I - A)^{-1}\ f_d \qquad (4)$$

where x is the column vector of total output produced in each sector, f is the column vector of final demands for goods and services produced by each sector, and $(I - A)^{-1}$ is the so-called 'Leontief inverse matrix'.

Equation (4), coupled with some fundamental assumptions[6] gives rise to the so-called 'open' Leontief quantity I-O model, which shows the quantity of total output required to meet each level of final demand, given the relative prices and the available technology. It is therefore particularly useful to estimate the impacts of exogenous changes in final demand and technical coefficients on total output.

When I-O tables (expressed in monetary units) are linked with environmental accounts (typically expressed in physical units, such as emissions, waste, material extraction per sector), in what is known as environmentally-extended I-O tables[7] (EEIO), it is possible to analyse the impacts of changes in technology and final demand on the broad ecosystem, in what is known as EEIO analysis.

Using data from the EEIO tables EXIOBASE 3 (Stadler et al. 2018), we can obtain the obtain the total amount of material consumption (M) in an economy by pre-multiplying the Leontief inverse matrix and the final demand vector by the column vector of sector-related material extraction coefficients:

$$M = s(I - A)^{-1} f_d \qquad (5)$$

where s is the material intensity coefficient, which defines the total amount of material used (in tonnes) *per* unit of output in each sector; and M is the column vector of total material use footprint associated with final demand for each sector's output.

3.2. Scenarios

In this paper, we develop a comparison of two alternative overarching scenarios that achieve a 10% reduction in total material footprint in Global North countries, i.e. a reduction of 10% in M.

$$\Delta M = 10\%$$

As mentioned in the introduction, this reduction would roughly represent the approximate compound rate required over an *initial* five-year period to achieve the reduction in material footprint necessary

[6] The Leontief I-O model is based on some fundamental assumptions: (i) there are constant returns to scale, i.e. technical coefficients do not depend on the scale of production; (ii) there is no possibility of substitution between factors of production, i.e. the technology of production operates in fixed proportions; (iii) only one technology is used to produces only a single homogeneous product by each sector; (iv) changes in prices do not affect final demand (i.e. price-elasticity of demand is nil); (v) there are no supply constraints of labour, capital, and natural resources, and there are no financial constraints either.

[7] Such as WIOD (Timmer *et al.*, 2015), EORA (Lenzen *et al.*, 2013) or EXIOBASE (Stadler et. al. 2018).

to achieve a resource consumption level consistent with planetary boundaries in 2050.[8,9] To achieve this target, our paper simulates scenarios based on two alternative strategies (degrowth and green growth).

In the first scenario, labelled 'degrowth,' the reduction in material use footprint is achieved through a linear reduction in final demand for all agricultural, mining, manufacturing, construction, and energy inputs, but not for services (which remains constant)[10]. That is, we shock the final demand vector (f_d^*):

$$\Delta M = s(I - A)^{-1} \Delta f_d \qquad (6)$$

In many ways, this scenario could be thought of as analogous to the sufficiency-based future illustrated by Bauwens *et al.* (2020): in this scenario, primacy is given to reducing resource consumption and the extraction of raw materials rather than improving the efficiency of resource use. As such, the focus shifts to delivering societies' fundamental requirements, not generating surplus production and servicing export markets, whilst at the same time fostering democratic participation in decision-making at all levels.

In scenario 2, labelled *'green growth*', changes in the material footprint of Global North countries are achieved through technical change, where all sectors located in Global North countries reduce the quantity of inputs from agriculture, mining, manufacturing, construction and energy required to produce one unit of its output[11], i.e. a reduction in the technical coefficients (a_{ij}), leading to a new technical coefficient matrix A^*[12]:

$$\Delta M = s(I - A^*)^{-1} f_d \qquad (7)$$

[8] Specifically, the 10% reduction assumes: (1) that the "emerging consensus" referred to by Hickel and Kallis (2020, p.476) regarding the maximum material footprint compatible with the planet's ecology (50 billion tonnes p.a.) is correct, (2) that reduction to this level needs to occur by 2050 i.e. over a circa 30-year period (Bringezu, 2015), and (3) a material footprint of 95.9 billion tons in 2019 (UNSTATS, 2024).

[9] Note that the goal of a maximum material footprint of 50 billion tons per year represents the global material footprint: annual reductions in the Global North may need to be more than what is modelled here given separate questions of distributional justice (Hickel, 2020).

[10] To achieve the target of a 10% reduction in total material footprint in Global North countries, an average reduction of 11.76% in final demand for agricultural, mining, manufacturing, construction, and energy is necessary.

[11] To achieve a 10% reduction target in total material footprint in Global North countries, an average reduction of 15.76% on technical coefficients of agricultural, mining, manufacturing, construction, and energy inputs required by all sectors.

[12] Note that, as highlighted by Wood *et al.* (2017), there may be a dependency between changes in A and changes in s, as new technology of production can lead to changes in the composition and quantity of material per unit of output demanded. In line with Wiebe *et al.* (2019) and Donati *et al.* (2020), we do not implement changes in the s associated with lower technical coefficients a_{ij}. If lower a_{ij} are associated with lower material use coefficients the increase in the model than, the associated change in A to achieve the given target will be smaller.

The *green-growth* scenario could be thought of as akin to the modernist future illustrated by Bauwens *et al.* (2020): imbued with techno-optimism, this scenario reflects an eco-modernist perspective in that human ingenuity is sufficient to deliver 'climate compatible growth', which is successfully decoupled from environmental impacts. Consequently, this scenario is aligned with the consumption and growth orientation of many Western capitalist nations and associated business models.

In the *green-growth* scenario, the reduction in the technical coefficients influences the costs of production (and, potentially) prices. As such, a subsequent question is whether these cost-efficiency gains are passed through to prices or appropriated by firms (and distributed as profits and/or increased wages). This leads to the results of the *green-growth* scenario being split into two sub-scenarios corresponding to different institutional settings:

a) the *pro-business* scenario where cost efficiencies are not passed through to prices.
b) the *pro-consumer* scenario where cost efficiencies are fully passed through to prices.

Prices are defined following the Leontief price model (Miller and Blair, 2009):

$$p = v'(I - A)^{-1} \qquad (8)$$

Where p is the price column vector representing the price level of the output of each sector, while v' is the transposed into a row vector, with each element representing sector j value added coefficient:

$$v_j = \frac{va_j}{x_j} \qquad (9)$$

In the pro-business scenario, changes in the technical coefficient matrix ($A \rightarrow A^*$) are compensated by an increase in the value-added coefficients vector ($v \rightarrow v^*$), therefore cost efficiencies are not passed on to prices and prices remain constant. This entails higher gross profit margins for firms and, possibly, higher nominal wages for workers located in the Global North countries, although we do not make assumptions about how these gains are split between both. In the pro-consumer scenario. cost efficiency gains are fully passed through to prices, value-added coefficients remain constant and prices to final consumers fall.

Changes in GDP are assessed from an income perspective, through changes in value-added, which can be calculated as:

$$VA = v'(I - A)^{-1} f_d \qquad (10)$$

Where VA is a column vector with the value added of each sector j. In the pro-consumer sub-scenario, where there is a change in prices, changes in *real* GDP are obtained by dividing the new values for the value-added vector by the new price vector calculated with A* matrix, in equations (10) and (7), respectively.

Employment impacts are calculated by pre-multiplying the Leontief inverse matrix and final demand vector by the transposed employment coefficient vector $\left(n_j = \frac{N_j}{X_j}\right)$:

$$N = n'(I - A)^{-1} f_d \qquad (11)$$

Lastly, to calculate the balance of trade (and the changes in it), we need to compute the exports and imports of each country. For each country-region (r) exports (imports) by the sum of exports (imports) demanded in other regions ($s \neq r$ (domestically) as intermediate inputs (given in Z) and demanded abroad for final use (given in Y):

$$Exports\ from\ Region\ r = \sum_{s \neq r} Z_{rs} + \sum_{s \neq r} Y_{rs} \qquad (12)$$

$$Imports\ into\ Region\ r = \sum_{s \neq r} Z_{sr} + \sum_{s \neq r} Y_{sr} \qquad (13)$$

In terms of the MRIO table in Figure 1 the trade flows correspond to shaded areas of the MRIO table, with imports given by the column sums of the shaded areas (intermediate inputs and final demand) for each region and exports given by the row sums of the shaded areas . Finally the trade balance in region r (TB_r) is given by:

$$TB_r = Exports_r - Imports_r \quad (14)$$

In our results, we present the trade balance impacts as the change (in percentage points) in the ratio of the trade balance relative to value added (GDP) in each scenario, under the assumption of fixed exchange rates. Rather than considering this as a plausible forecast of what would happen, the idea is to indicate that, *ceteris paribus*, the worsening of the balance of trade indicates an underlying devaluation pressure for the country's currency, which in itself could bring further repercussions such as inflation or balance of payment crisis.

The results of each scenario are reported relative to the values observed in the dataset used (i.e. EXIOBASE v.3 in 2011). As such, GDP, employment and the trade balance do not change in the baseline no-green transition 'scenario'. Of course, it is important to highlight that under current trends of CO2 emissions and material resource consumption, climate change and the depletion of natural resources are expected to increasingly lead to negative economic shocks. However, trying to predict the geographical distribution of the economic damage associated with climate change (Diaz and Moore, 2017) to develop a no-green transition baseline scenario is beyond the scope of the paper.

It is important to note that this study simplifies the complex reality of green transitions by employing dichotomous green growth and degrowth scenarios, focusing solely on reductions in final demand or technical coefficients. In practice, combined strategies are more likely, blurring the lines between Global North and South. Moreover, in practice different sectors have different material efficiency gains potentials. However, these potentials are still subject to controversy. As we seek to compare results between a scenario based on changes in final demand with other based on technical efficiency, if we applied different sectoral specific changes, our results in favour of one or the other scenario be attributed to differences in sectoral composition of the shock, which despite best efforts to anchor ir in existing literature would still be controversial. Addressing the limitations, discussed further in Section 6, should be the object of further research to gain further insights on the socio-economic outcomes of the green transition strategies. However, the multi-regional granularity provided by the EEIO approach adopted here should not be overlooked.

3.3. Data

The analysis utilises environmentally extended, multi-region input-output (I-O) tables sourced from EXIOBASE 3 version 3.8.2 [13](Stadler et al. 2018). This dataset comprises I-O tables for 44 individual countries[14] and five "rest of the world" (RoW) regions, where each RoW region represents a grouping of the remaining countries not explicitly modelled. The specific data used are for 2011, which is the last year for which official national I-O tables were available[15]. EXIOBASE provides I-O tables, as well as environmental impacts and socio-economic variables, disaggregated for 164 sectors per country/region. However, for the purpose of our work, tables were aggregated into 12 sectors[16]. Despite its wide use in the literature, the concepts of Global North and Global South do not have an agreed definition of specific countries which are allocated to one or another group. For this work, countries were classified as being part of the Global South and Global North based on the World Bank income *per capita* (2022), with high-income economies being classified as the Global North[17] [18]. The five rest of the world regions in EXIOBASE were classified as being part of the Global South.

4. Results

4.1. Degrowth scenario

Table 1 provides an overview of the average results of the Degrowth scenario in each region and of the distribution of these results across countries within each group. The results of each scenario are

[13] Available at: https://zenodo.org/records/5589597

[14] EU-28 and their 16 most important trading partners (representing about 95% of global GDP).

[15] I-O tables after 2011 are estimates based on a range of auxiliary data (mainly trade and macro-economic data) and, thus, less reliable.

[16] A correspondence table is provided in Appendix A.1.

[17] A correspondence table is provided in Appendix A.2.

[18] This classification results in some countries, such as Russia, which might typically be considered part of the Global North, being categorised as part of the Global South—a distinction that may be seen as controversial. However, given Russia's reliance on fossil fuel and mineral resource exports, we believe it is more appropriate to exclude it from the group of countries reducing their material footprint by 10% (i.e., the Global North).

contrasted with the current values observed (i.e. assuming no change in employment, GDP or trade flows). Overall, in the degrowth scenario changes in employment and GDP would be similar in both regions. On average, employment and GDP would fall by 3.8% in countries in the Global North, while GDP and employment would fall by 1.1% in Global South economies relative to baseline.[19] In general the severity of the impact on Global South countries occurs because employment (and GDP) impacts are negatively affected by: (i) the degree of exposure of countries' exports to countries where final demand and output are falling more steeply, and (ii) the countries' employment share of the most impacted sectors. That is, the higher the share of exports destined for the Global North and the larger the employment (and GDP) share of material-intensive sectors in the economy, the worse will be the impact on the country. As such, Global South countries with larger populations, whose non-tradable sector represents a larger share of their economies, such as Brazil (-0.3% GDP and employment) and India (-0.5% in GDP and -0.6% in employment) would experience lower negative impacts. Regions where countries’ exports of fossil fuels and other natural resources represent a larger share of GDP, such as middle-east countries (RoW Middle-east) and other Asian countries (RoW Asia), would see a larger fall in GDP (-1.8% and -1.7%, respectively) and in employment (-1.4% and -2.2%). China, with its large population but at the same time high share of exported manufactured goods to Global North countries, would experience an in-between impact of -1% in GDP and in employment.

In the Global North, smaller EU countries with a low share of manufacturing in GDP—such as Cyprus, Malta, Luxembourg, Greece, and Portugal—would generally experience a smaller decline in GDP and employment. Those countries more heavily associated with manufacturing in the EU, such as Germany, Czechia, Poland, Hungary, Slovakia and Lithuania would suffer steeper falls in GDP and employment. Countries like Romania and Norway, which have a high share of exports in raw materials would be severely impacted as well, with Norway’s GDP falling -4.6% and Romania experiencing a 6.2% fall. The US (-2.9% and -3.1%) and the UK (-2.8% and -2.6%) would have a below average fall in GDP and employment, respectively.

[19] Reductions in employment do not factor in possible working time reductions.

Table 1: Macroeconomic impacts in the degrowth scenario

% change in Employment						
	Average	**Std. Dev**	**MIN**	**MAX**	**Weighted average**	**Employment improve in # of regions**
Global North	-3.8%	+/- 0.9%	-6.8%	-2.4%	-3.6%	0 out of 35
Global South	-1.1%	+/- 0.5%	-8.1%	-0.3%	-1.3%	0 out of 14
% change in GDP						
	Average	**Std. Dev**	**MIN**	**MAX**	**Weighted average**	**GDP improve in # of regions**
Global North	-3.8%	+/- 0.8%	-6.3%	-2.3%	-3.5%	0 out of 35
Global South	-1.1%	+/- 0.4%	-1.8%	-0.3%	-1.1%	0 out of 14
Change (in p.p.) in the balance of trade (BoT) (surplus/deficit) as % of GDP						
	Average	**Std. Dev**	**MIN**	**MAX**	**Weighted average**	**BoT improve in # of regions**
Global North	0.7 p.p.	+/- 0.7 p.p.	-1.1 p.p.	3.0 p.p.	0.6 p.p.	33 out of 35
Global South	-0.9 p.p.	+/- 0.4 p.p.	-1.7 p.p.	-0.3 p.p.	-1.0 p.p.	0 out of 14

Source: Author's elaboration based on EXIOBASE v 3.8.2 data (Stadler *et al.*, 2018). Note: BoT = Balance of Trade, GDP= Gross Domestic Product, p.p. = percentage points.

Regarding the balance of trade, the changes are more nuanced (see Figure 2). The steeper fall in GDP, on average, also implies that Global North countries imports from the Global South fall more than their exports to the Global South. This, in turn, leads to an average improvement in the balance of trade to GDP ratio of +0.7 percentage points (p.p.) in Global North countries and a worsening of -0.9 p.p. in Global South countries, with the balance of trade to GDP ratio worsening in all 14 countries (regions) of the Global South. As expected, Middle East countries (RoW M-East) would face the steepest deterioration of its trade balance to GDP ratio (-1.7 p.p.). Large manufacturing exporters such as Mexico (-1.5 p.p.) and China (-0.9 p.p.), also see a more significant deterioration of its balance of trade. On the other side, the least impacted country would be Brazil (-0.3 p.p.) and India (-0.4 p.p.) in line reflecting the lower share of trade flows in the functioning of their economies.

Despite the impact on the balance of trade to GDP ratio of most countries of the Global North (33 out of 35) being positive, this comes as consequence of: (i) the decline in GDP would lead to a larger reduction in its imports than the decrease observed in their exports, and (ii) the sectoral specialisation in the trade of different countries in the region, with those specialising in exporting (importing) knowledge intensive business services being least (worst) affected. To illustrate this point: (i) it is useful to consider the case of the UK: in the degrowth scenario its exports would fall by 3.6%, however with a fall in GDP (income) of -2.8% and imports composition centred heavily on primary and manufacturing products, its imports would be projected to fall by -5.7%, improving its trade balance to GDP ratio by 0.6 p.p. The exceptions would be Switzerland (-0.1 p.p.) and Norway, whose exports would be the worst hit (6.9%) among global north countries, due to its export-dependency on fossil fuel, leading to a deterioration in its balance of trade to GDP ratio of -1.1 p.p.

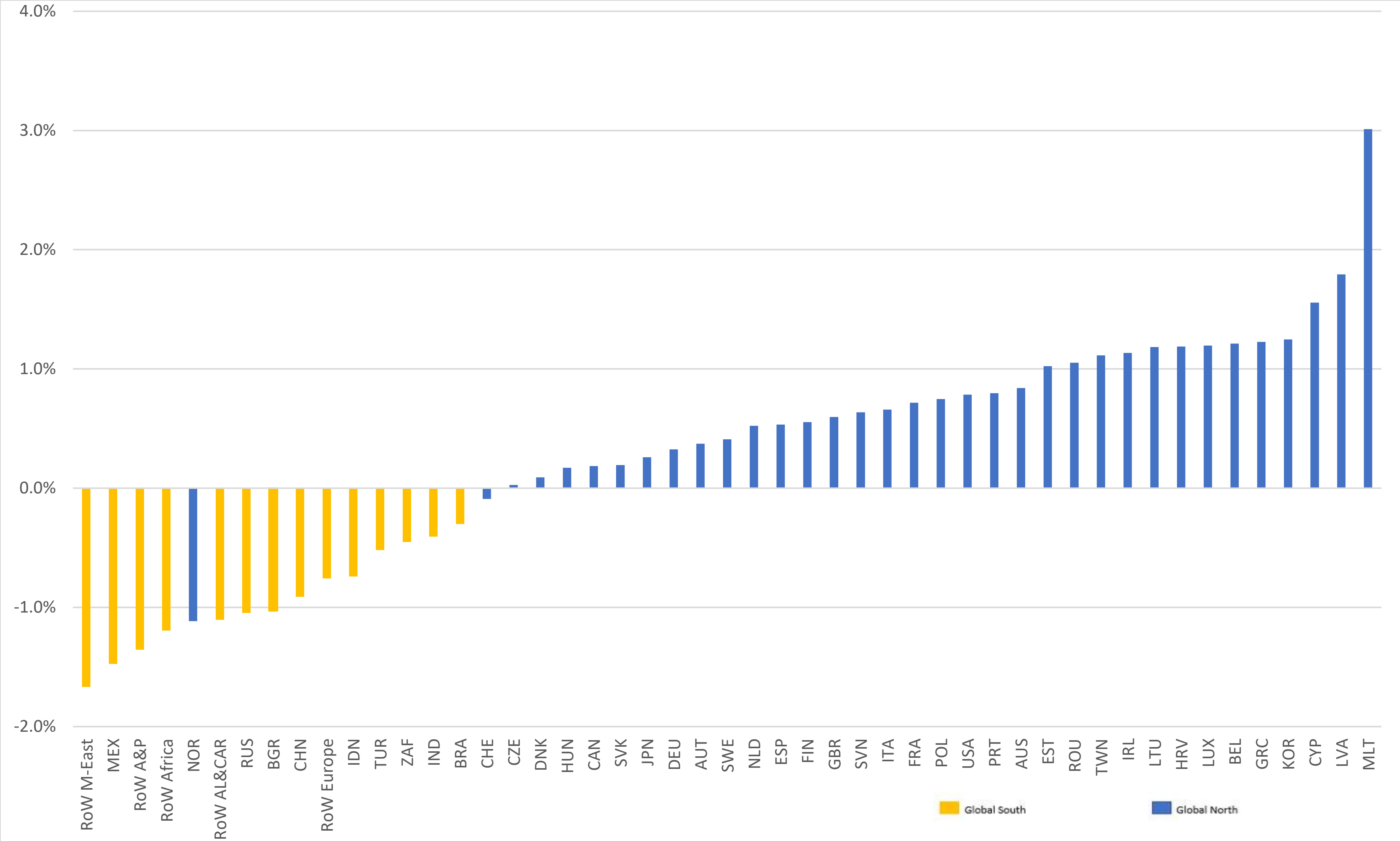

Figure 2: Degrowth scenario change (p.p.) in the Balance of Trade/GDP ratio relative to the baseline

Source: Author's elaboration based on EXIOBASE data (Stadler *et al.*, 2018).

4.2. Green growth scenario

Table 2 provides the overview of the average results of the green-growth scenario in each region and of the distribution of these results in countries within each group. In the Global North, the average fall in employment levels of (-4.2%) is higher than in the degrowth scenario (-3.2%). Employment in Global South countries would also decline (-1.5% on average), though to a lesser extent than in the degrowth scenario (-2.4%).

Table 2: Employment impacts - green-growth scenario

% change in Employment

	Average	**Std. Dev**	**MIN**	**MAX**	**Employment improve in # of regions**
Global North	-4.2%	1.3%	-7.1%	-2.2%	0 out of 35
Global South	-1.5%	0.8%	-3.6%	-0.5%	0 out of 14

Source: Author's elaboration based on EXIOBASE data (Stadler *et al.*, 2018).

As discussed in the Methods section, in the *green-growth* scenario the impact on GDP and the balance of trade depends on what happens with the reduction in costs, associated with the lower amount of inputs required per unit of output. The question of whether these cost efficiency gains are passed through to prices or appropriated by firms (and distributed as profits and/or increased wages) leads to the *green growth* scenario being split into two sub-scenarios (*pro-business*) and (*pro-consumer*) when we assess the impact on GDP and the balance of trade.

Results for the pro-business scenario, in which prices remain fixed, are summarised in Table 3. GDP, in this case, has an average increase of 1.5% in Global North countries, with 31 out of 35 regions observing positive impacts on GDP. Countries who are more specialise in manufacturing see the larger gains, such Taiwan (+7.6%), Korea (+5.5%), Hungary (3.8%), Slovakia (3.3%) and Czechia (2.9%), while it is Norway (-2.7%.), who specialises in exporting fossil fuels, the most negatively affected. In the Global South, the average impact on GDP is -1.7%, where all countries and regions observe a fall in GDP in this scenario. Brazil and Türkiye are the least affected countries (-0.6%), while the rest of the Middle East region (-3.8%), Rest of Asia and Pacific (-2.7%) and Russia (-2.6%) are the worst affected, reflecting once again the negative impacts on fossil fuel exporters in this scenario.

The balance of trade (as a % of GDP), on average, improves in Global North countries by 1.4 p.p., and falls -1.7 p.p. in countries in the Global South. As can be seen in Figure 2, in all Global South countries the balance of trade deteriorates, with fossil fuel exporters like Middle East countries (RoW M-East) (-3.5 p.p.), Rest of Asia and Oceania (RoW A&P) (-2.9 p.p.) and Russia (-2.4 p.p) being the regions most severely affected. In turn, in Global North it would be precisely Norway (-2.4 p.p.) the country worst affected in this scenario. Another three regions of the Global North also would see a deterioration of its balance of trade, Denmark (-0.3 p.p.), Ireland (-0.2 p.p.) and Canada (-0.1 p.p.). In opposition to the degrowth scenario, it is central European countries specialising in manufacturing like Hungary (3.4p.p.), Slovakia (3.2 p.p.) and Czechia (2.7 p.p.) who would see larger improvements in their balance of trade, as would Taiwan (+6.6 p.p.) and South Korea (+5.2 p.p.). This is somewhat expected considering that the sectors these countries specialise in would be among those who benefit the most.

Results for the pro-consumer scenario, in which cost savings from increased material efficiency are completely passed through to consumers as lower prices, are summarised in Table 4. In this case, gains would be more evenly distributed between North and South, as the price of imported goods in Global South countries falls. On average, the change in GDP would still be negative in the Global South (-0.7%), but some minor positive impacts would emerge, like Türkiye (0.4%), the rest of Europe (RoW Europe) (0.1%), Brazil (0.1%) and India (0.1%). The change in the balance of trade (as % of GDP) would also be, on average, still negative (-0.5 p.p.) but, as can be seen in Figure 3, the balance of trade to GDP ratio would improve more pronouncedly for Türkiye (+0.5 p.p.) and India (+0.1p.p.), countries whose export profile is not as intensively dependent of primary commodities. In turn, fossil fuel exporters like the Middle East countries (RoW M-East) and Russia are the ones who would see the steepest fall in GDP (-2.8% and -1.4%) and deterioration in their balance of trade (-2 p.p. and -1.5 p.p.).

In the Global North, the gains in GDP would be, on average, lower than in the pro-business scenario (+0.4%), and less disseminated with GDP improving in 24 out of 35 countries. A pattern which is also observed in the trade balance, with the trade balance to GDP ratio improving in 28 countries. Again, Norway would be the worst impacted, with a worsening of the balance of trade of -2.5% and reductions in GDP of -2.6%. The countries specialising in manufacturing would no longer stand to gain as the efficiency gains would be passed on to prices, with much smaller increases in GDP for most countries, and for some the change in GDP would become negative and coupled with a worsening of the trade balance, like Taiwan (-0.9% in GDP and -0.4 p.p. in the BoT to GDP ratio) and Germany (-0.1% and -0.2p.p.). As in the case of degrowth, smaller European countries in the mediterranean with a small manufacturing sector would see larger benefits in their GDP and Balance of Trade to GDP ratios, like Cyprus (+2.3 % in GDP and +1.6p.p. in the BoT to GDP ratio), Malta (+1.9% and +1.5 p.p.), Portugal (+1.9% and +1.4p.p.) and Greece (+1.3% and 1.1 p.p.).

Table 3. Pro-business sub-scenario

% change in real GDP						
	Average	**Std. Dev**	**MIN**	**MAX**	**Weighted Average**	**GDP improve in # of regions**
Global North	1.5%	+/-1.7%	-2.7%	7.6%	1.0%	31 out of 35
Global South	-1.7%	+/-0.9%	-3.8%	-0.6%	-1.7%	0 out of 14
Change (in p.p.) in the balance of trade (BoT) (surplus/deficit) as % of GDP						
	Average	**Std. Dev**	**MIN**	**MAX**	**Weighted Average**	**BoT improve in # of regions**
Global North	1.4 p.p.	+/- 1.5p.p.	-2.4p.p.	6.6p.p.	-1.0%	31 out of 35
Global South	-1.7 p.p.	+/- 1.1p.p.	-3.5p.p.	-0.6p.p.	-1.8%	0 out of 14

Table 4. Pro-consumer sub-scenario

% change in real GDP						
	Averag e	**Std. Dev**	**MIN**	**MAX**	**Weighted Average**	**GDP improve in # of regions**
Global North	0.4%	+/-1.0%	-2.6%	2.3%	0.4%	24 out of 35
Global South	-0.7%	+/-0.8%	-2.8%	0.4%	-0.8%	4 out of 14
Change (in p.p.) in the balance of trade (BoT) (surplus/deficit) as % of GDP						
	Averag e	**Std. Dev**	**MIN**	**MAX**	**Weighted Average**	**BoT improve in # of regions**
Global North	0.4 p.p.	+/- 0.7p.p.	-2.5p.p.	1.6p.p.	0.3 p.p.	28 out of 35
Global South	-0.5 p.p.	+/- 0.7p.p.	-3.5p.p.	0.5p.p.	-0.5 p.p.	3 out of 14

Source: Author's elaboration based on EXIOBASE data (Stadler *et al.*, 2018). Note: GDP= Gross Domestic Product. BoT = Balance of Trade.

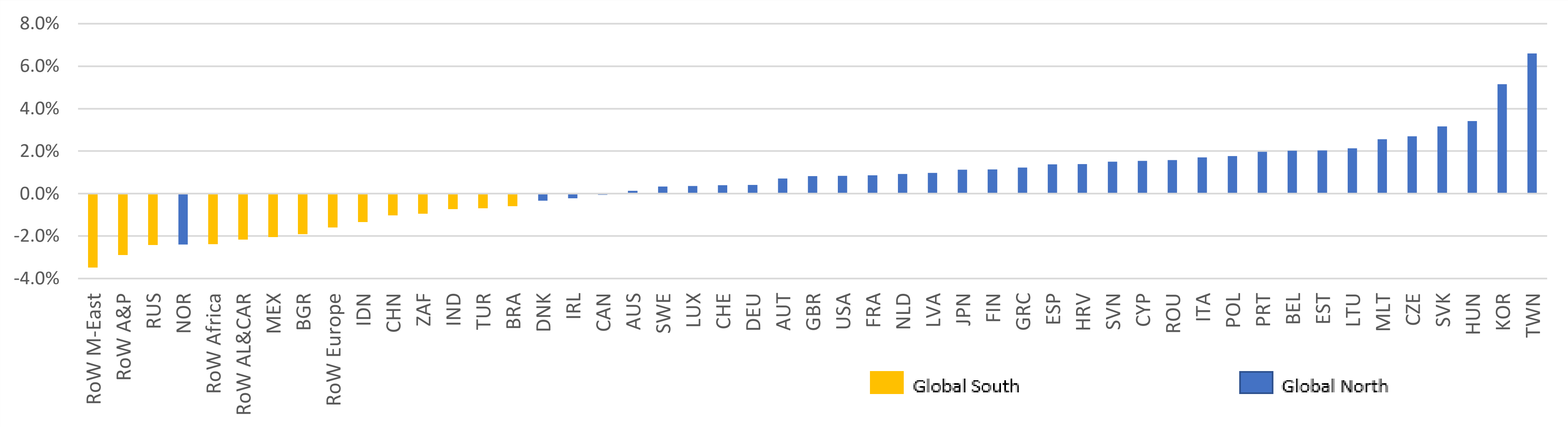

Figure 3: Pro-business scenario: Change in the balance of trade/GDP ratio relative to the baseline

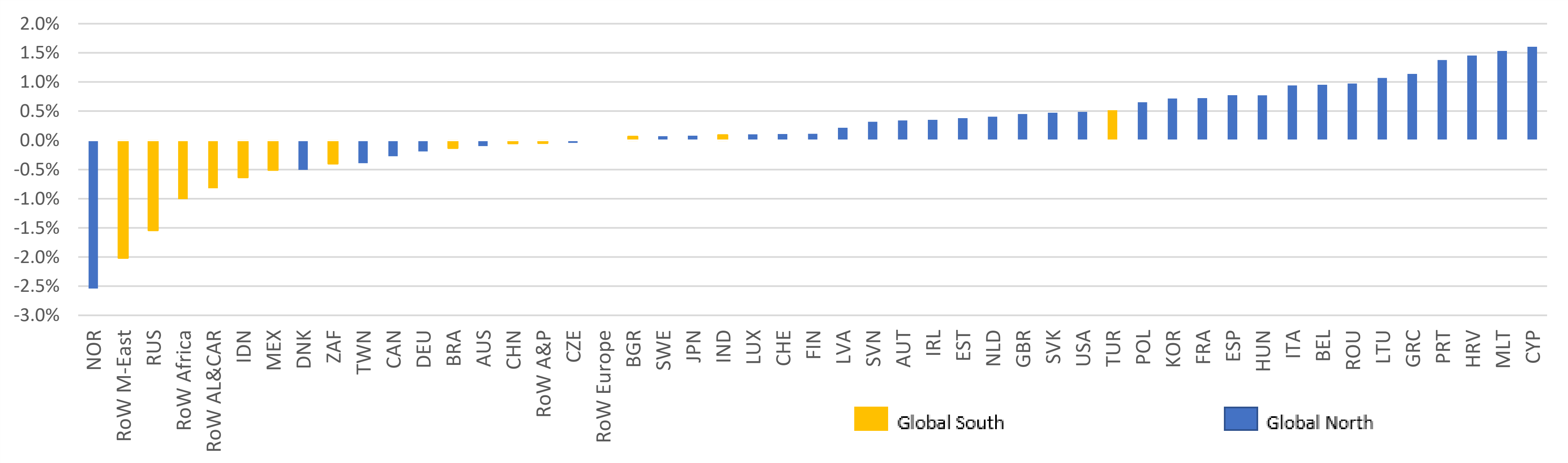

Figure 4: Pro-consumer scenario: Change in the balance of trade/GDP ratio relative to the baseline
Source: Author's elaboration based on EXIOBASE data (Stadler *et al.*, 2018)

5. Discussion

The results of the three scenarios (degrowth and the two green-growth sub-scenarios) are summarised in figures 5–7. Key findings include: (i) negative employment impacts across both regions in all scenarios, with the potential to exacerbate social inequalities; (ii) negative GDP impacts for the Global South, which can lead to reduced public revenues, constrained government spending, and increased economic precarity; and (iii) worsening trade balances for the Global South, which can result in current account deficits, increased external debt burdens, and limited fiscal policy space.

These findings provide novel insights into the spillover effects of green growth and degrowth strategies in the Global North on economies in the Global South. While much debate surrounds the merits of these two approaches, our results indicate that, irrespective of the strategy adopted, the diminished demand from Global North countries for resource-intensive exports exposes the fragility of the existing international division of labour. Global South economies, specialising in raw materials, resource-intensive manufactured goods, and agricultural commodities, remain structurally vulnerable to shifts in global demand, while Global North countries focus on high-tech manufacturing and knowledge-intensive business services (Lebdioui, 2021; Weber, 2022). This disruption has profound socio-economic implications, potentially deepening poverty, inequality, and financial instability, particularly in Global South countries heavily reliant on external trade and foreign-denominated debt (Alami et al., 2022). These challenges extend beyond the green growth vs. degrowth debate, highlighting the urgent need for economic restructuring that moves beyond neo-extractivist specialisation.

Among the three scenarios, the ‘pro-business’ green growth scenario has the most severe impact on Global South economies. In this techno-optimist scenario, the benefits of innovation are primarily captured by firms in the Global North, while the prices of goods produced in the Global North and imported by the Global South do not decline in line with material efficiency gains. In contrast, the ‘pro-consumer’ green growth scenario leads to better outcomes, as efficiency gains translate into lower import prices, allowing the Global South to benefit more directly. The degrowth scenario falls in between, resulting in intermediate economic impacts.

Regarding regional variation, as expected, countries heavily reliant on resource-intensive industries—such as Norway, Russia, Middle East nations, and the aggregated regions of the rest of Africa, Asia and the Pacific, Latin America & Caribbean—experience significant reductions in GDP and employment across all scenarios. In contrast, larger Global South economies with larger populations and with non-tradable sectors (such as services), like Brazil and India, are more insulated from the trade shock triggered by the green transition in the Global North. China and Mexico fall in between these two groups; while their exports of manufactured goods are severely impacted in all three scenarios, the overall size of their economies and their non-tradable sectors helps mitigate the shock.

Within the Global North, there are also notable contrasts across scenarios. Manufacturing-intensive economies, such as Taiwan, Japan, Germany, and Central European countries like Hungary, Czechia, and Slovakia, benefit more under the pro-business green growth scenario. Conversely, smaller Mediterranean European nations, including Portugal, Greece, Cyprus, and Malta, fare relatively worse. However, this pattern is reversed under both the degrowth and pro-consumer green growth scenarios. As with the Global South, larger economies with substantial non-tradable sectors, such as the US, UK, France, Italy, and Spain, tend to experience more moderate impacts across all scenarios.

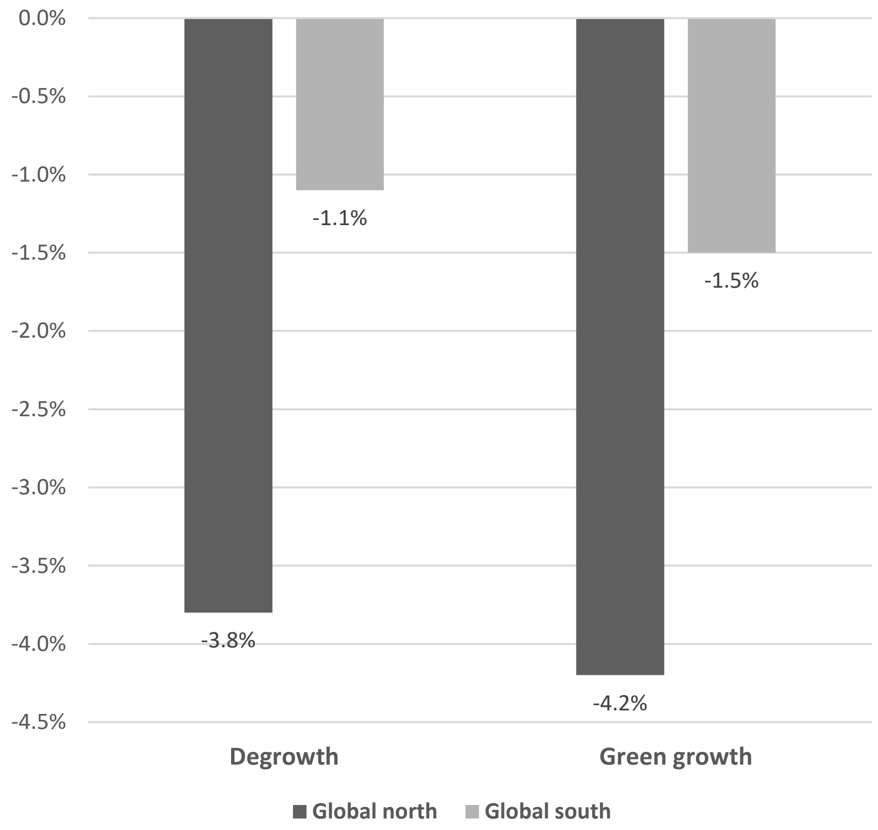

Figure 5: Change in employment by scenario

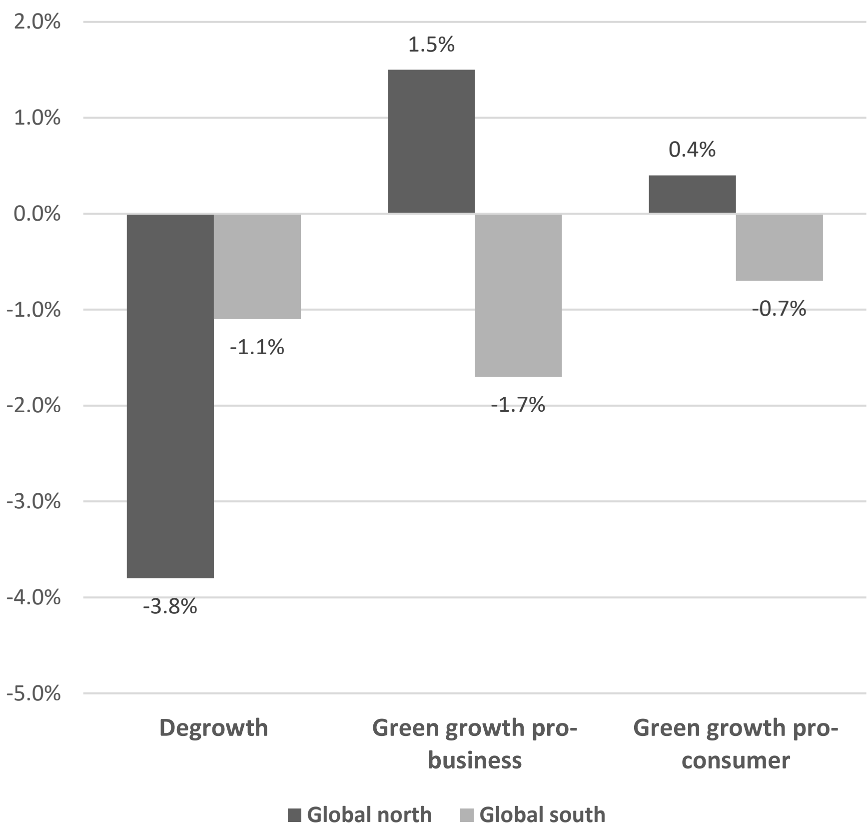

Figure 6: Change in GDP by scenario

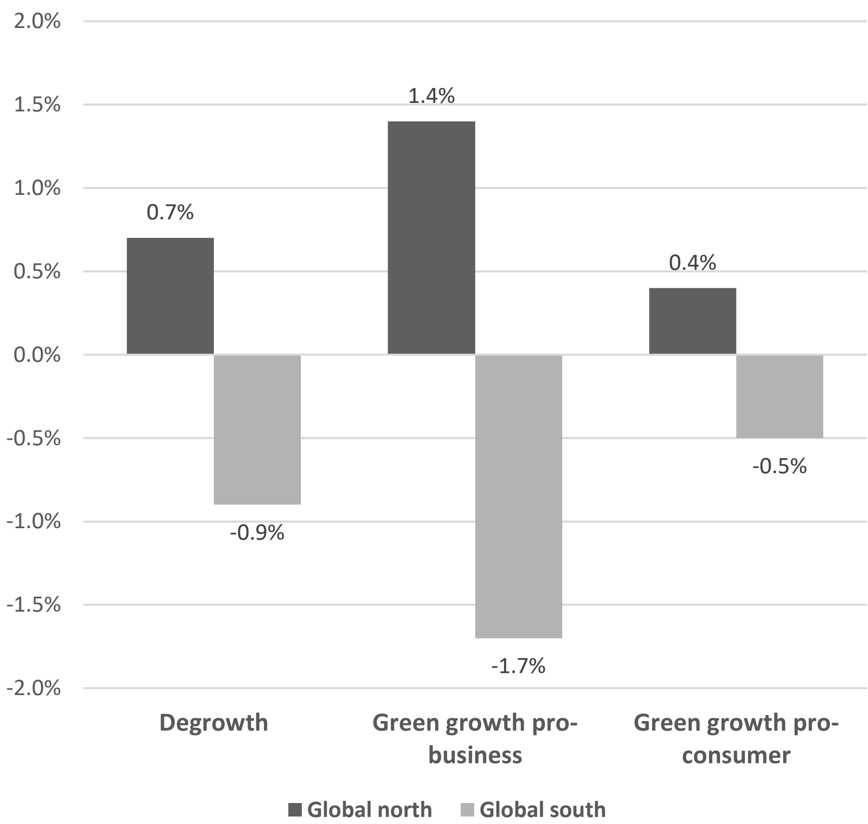

Figure 7: Change in balance of trade as a percentage of GDP by scenario

5.1- Policy implications for the Global South

The economic disruptions highlighted by our results pose significant risks for Global South economies, particularly those highly dependent on exports of agricultural and mineral commodities and fossil fuels, as well as foreign direct investment. In the absence of proactive policy interventions, these shifts could lead to severe macroeconomic instability, including balance of payments crises. While market-driven adjustments such as exchange rate devaluation (Edwards, 1989) and reduction in government deficits are often proposed as solutions (Laskaridis, 2021), empirical evidence suggests that they are unviable and, in some cases, counterproductive from a just transition perspective.

For instance, exchange rate devaluation can improve the balance of payments only if exports and imports are highly sensitive to changes in the exchange rate[20]. However, empirical evidence does not robustly support this assumption (Bahmani et al., 2013). This issue is particularly concerning for Global South economies, which, due to technological dependency or geographical constraints, may be unable to substitute key imports (Crespo et al., 2021). As a result, exchange rate devaluation may exacerbate trade deficits unless it also triggers contractionary effects on GDP and employment (Krugman and Taylor, 1978; Ribeiro et al., 2017).

Moreover, for resource-exporting economies, devaluation makes exported raw materials cheaper, reinforcing potential material rebound effects (Pfaff and Sartorius, 2015), compromising the green transition objectives. Lastly, for a nominal exchange rate devaluation to possibly adjust the balance of payments, it need not lead to inflation (i.e. to obtain real exchange rate devaluation). In a world of free mobility of capital, this requires the adjustment costs to fall on the less mobile factor of production, i.e. labour, through a reduction in real wages and worsening of the functional income distribution (Dvoskin and Feldman, 2018; Dvoskin *et al.*, 2020). As such, this approach to deal with the emergence of balance of payment deficits in Global South countries can hardly be seen to promote a just transition to an ecologically sustainable economy, even if this is effective in addressing the balance of trade deficits.

These dynamics indicate a necessity for Global South countries to move away from a neo-extractivist development model. This need is reinforced by the current structure of global trade, in which the Global South remains largely specialised in primary commodity exports while relying on the Global North for high-value green technologies. Our conclusion here is in line with those put forward by Valdecantos et al. (2023) and Porcile and Gramkow (2022), both of which highlight that the trade-off

[20] In particular, it has been demonstrated that it is necessary that the sum of the price elasticities of exports and imports, both taken as absolute values, are greater than one (Lerner 1944).

between socio-economic prosperity and environmental sustainability faced by Latin American countries can only be overcome with a 'green' structural change, which reduces the centre-periphery technological gap. The advocacy in favour of structural change towards manufacturing and knowledge intensive business services sectors in the Global South as a development strategy has a long tradition within several schools of thought in the development economics literature, such as Latin-American structuralism (Bielschowsky, 2009; Cimoli and Porcile, 2014) and dependency theorists (see Vernengo, 2006; Antunes de Oliveira and Kvangraven, 2023). To promote structural change in the Global South these traditions advocated for the use of industrial policy to substitute imports and expand exports. The green transition in the Global North and the escalating ecological crisis add urgency to the need for structural change and industrialisation through ecologically sustainable import substitution (Anzolin and Lebdioui, 2021).

Industrial policies have historically played a crucial role in fostering economic diversification and reducing dependency on primary commodities, especially in East Asia (Amsden, 2001; Chang, 2002). However, the history of industrial policies has plenty of examples where industrial promotion efforts resulted in low-productivity and uncompetitive enterprises, which were never able to reach levels of efficiency that allowed them to survive in free competitive environments. Nevertheless, recent empirical literature has provided a positive re-assessment of the effectiveness of industrial policy in promoting structural transformation and economic development (Lane, 2020), providing rigorous quantitative evidence on when and where industrial policies worked. As such, this new strand of quantitative analysis of industrial policies, complemented with qualitative cross-country case studies of successful and failed policies (Andreoni and Tregenna, 2020), can provide an important avenue for future research. Therefore, we argue in favour of a research and policy agenda that focuses not on *why* but on *how* to do industrial policy to address the challenges posed by the required green transition in the 21st century (Rodrik, 2009; Andreoni and Chang, 2019).

5.2. Policy considerations – Global North

Ultimately, the findings suggest that the success of the green transition in achieving environmental and economic sustainability also depends on the Global North adopting policies that minimise the externalities imposed on the Global South. Crucially, while both transition scenarios modelled—degrowth and green growth—generate significant macroeconomic impacts for the Global South, they do so through distinct transmission channels. The degrowth scenario primarily affects economies via reduced final demand for exports, while the green growth scenario alters competitiveness through changes in production efficiencies and cost structures. Recognising these different mechanisms is vital for designing policy responses in the Global North that mitigate structural dependencies rather than reinforce them. While degrowth in the Global North offers the potential for long-term sustainability—beyond the initial five-year shock modelled here — a prospect that remains uncertain for green growth given the evidence against absolute decoupling outlined in Section 2 — it also requires policies that address structural inequalities and promote equity in the Global South. Degrowth's emphasis on prioritising well-being over GDP and reducing material throughput calls for complementary measures, such as debt relief, fairer trade agreements, and direct financial support for sustainable development in the Global South (D'Alisa *et al.*, 2014).

All of this is necessary and welcomed from a Global South perspective. On the one hand, these measures help to mitigate the short-term impacts on the balance of payments and reduce the stock of liabilities in foreign currency these economies have accumulated. As such, as discussed by Bortz and Toftum (2023) these can be seen as important sources of funding for the Global South own transition efforts. Nevertheless, it is important to keep in mind that without a transformation in the productive structure of Global South economies, in the long-run, if these countries' populations are to be able to increase their consumption levels, imports of manufactured goods and services will increase (even if its consumption patterns are not to evolve in a wasteful and unsustainable fashion as have done in the Global North). In turn, this rise will sooner or later achieve incompatible levels in relation to the level of their exports and, thus, lead to balance of payment deficits and the build-up of new stocks of foreign debt.

In turn, while green growth integrates technological innovation with economic expansion, it nonetheless also necessitates proactive interventions to prevent worsening trade imbalances and to ensure that the Global South equitably benefits from the transition. Policies such as technology transfer, capacity-building initiatives, and targeted industrial policies may be able to facilitate structural change, particularly by reducing Global South dependence on imported green technologies and enabling greater participation in higher-value segments of the global economy. In both cases, proactive government intervention—whether through industrial policy, regional cooperation, or financial reforms—will be necessary to create a just transition that does not entrench existing inequalities.

By centring the analysis on the spillover effects of Global North policies, this study contributes a critical perspective to the green transition literature. It underscores the importance of embedding global equity into policy design and highlights the need for international cooperation to ensure that the Global North's environmental objectives do not exacerbate vulnerabilities in the Global South. These findings provide a foundation for future research on how cross-regional dynamics shape the pathways and prospects of a just and sustainable global transition.

6. Limitations of the research

Some limitations regarding the methods and scenarios should be highlighted here. As mentioned, the dichotomous nature of the green-growth and degrowth scenarios—focusing exclusively on either reductions in final demand or technical coefficients—represents a simplification of the complex reality of a green transition. In practice, a combination of these strategies is likely and transcend the rigid distinctions between Global North and Global South. We consider, however, that these extreme scenarios allow us to establish upper and lower bounds for potential macroeconomic outcomes, but it is important to note that the actual transition is expected to involve a mix of green growth and degrowth elements. The same logic applies to the differences between the pro-business and pro-consumer green-growth scenarios: in reality, these may show that firms can absorb part of the material-efficiency gains as increased profit margins (or real wages), but market competition should force a degree of pass-through of the reduction in costs to prices, benefiting consumers.

Future research could explore how integrating elements of both paradigms—alongside more dynamic modelling approaches—might offer innovative solutions to the challenges posed by the green transition. While we focused on static assumptions, more complex modelling techniques, such as Computable General Equilibrium (CGE) models, Macroeconometric Input-Output (I-O) models, or I-O Stock-Flow-Consistent models, could better capture feedback effects and provide a more nuanced understanding of the dynamic nature of the transition. These alternative approaches would allow for a more comprehensive inclusion of secondary impacts associated with income and price changes, as well as adjustments to the composition of demand and feedback effect between the financial and non-financial side of the economy, as is captured in the work by Gourdel et al. (2025) for Indonesia. However, the computational complexity of these models often requires a higher degree of aggregation of sectors and regions, which so far have limited the granularity of analysis. This granularity is precisely one of the strengths of the multi-regional EEIO approach adopted in this work.

Another limitation lies in the assumed linear reductions in final demand and technical coefficients across sectors, which do not account for the potential redirection of savings or demand shifts in response to the green transition. Specifically, in the degrowth scenario, the fall in demand for goods was not diverted to services, nor was the impact of increased savings modelled. In appendix A.3 we report results for a 'degrowth' scenario where the final demand reduction for agricultural, extractive industries, manufacturing, construction and energy is shifted to services (e.g., reflecting increased demand for healthcare, education, and other post-growth services). The main difference is that impacts on employment and GDP would become positive in the Global North (given that services are more labour intensive and have lower imported content). Impacts on the Global South, however, would remain negative, with worsening of the trade balance to GDP ratio and fall in employment and GDP, on average.

Similarly, in the green-growth scenario, we did not account for increased investment in more efficient capital goods or research and development (R&D) that would be necessary to bring about the technological innovations required for material efficiency. While this assumption of costless technological change is a simplification, it has been widely used in previous literature on green transition policies (e.g., Ross *et al.*, 2023; Donati *et al.*, 2020). Further research could incorporate these factors to better simulate the long-term impacts of green growth policies on the Global South. However, it is important to stress out that even if the investment in 'green' technology has lower environmental impacts, any increase in investment in the transition phase would lead to some degree of rebound effect in material consumption. Thus, to achieve the set target in the scenario, it would need to be balanced by a larger decrease in the technical coefficients. Therefore, we argue that these effects would largely cancel each other out, leaving the qualitative implications of our results unchanged. Although we do believe that testing alternative scenarios assumptions and methodologies should be the subject of further research. Specially, considering that a comparison of results between different transitions pathway can offer insights to which pathways may be socially just and offer macroeconomic stability for Global South economies, which is of our ultimate interest.

A further limitation concerns the composition of material demand. Our scenarios assume a uniform reduction in overall material use rather than accounting for potential substitution between material types. In reality, some materials—such as rare earth elements and critical minerals—may see increased demand under green growth pathways, particularly in renewable energy and battery technologies. As many of these resources are concentrated in the Global South, such a shift could partially offset the negative balance of payments impacts we report. However, capturing these effects would require more detailed modelling of specific material flows and supply chains, which is beyond the scope of this analysis. We hope future research will build on our work to explore these sector- and material-specific trade-offs.

Lastly, in our results of the green transition scenarios, we assumed that the changes in technology operated in the technical coefficient matrix (A), while keeping the material intensity coefficient (s) constant, in line with have been done with other EEIO papers simulating CE practices, such as Wiebe et al. (2019) and Donati et al. (2020). To gauge whether our qualitative results would differ in case we were to reduce material intensity coefficient in line with the reduction of the technical coefficients in matrix (A) we report the results in appendix A.3. The consequence is that the average reduction in GDP and employment in the Global South is lower, but still negative, while the trade balance to GDP ratio would still be worsening (although to a lower degree as well). In the pro-consumer scenario, however, some countries of the Global South see, on the margin, minor positive results on GDP and on the trade balance, such as Turkey (+0.5% in GDP and 0.4 p.p. in the Balance of Trade to GDP ratio), and India (+0.2% and +0.1p.p., respectively).

Despite these limitations, we believe that the results presented in this paper provide valuable insights into the macroeconomic impacts of a green transition. While more sophisticated methodologies and alternative scenario assumptions could refine these results, we do not expect them to change the overall qualitative conclusions, particularly with regard to the consistent negative effects on the Global South's trade balance and socio-economic stability. The reduction of material footprints in high-income countries of the Global North is likely to exacerbate existing vulnerabilities in Global South economies, which are heavily reliant on raw material extraction and exports.

7. Concluding remarks

This paper conducted a multi-regional I-O analysis exploring the macroeconomic impact of alternative scenarios for the green transition, focusing on a reduction in the material footprint in the Global North.[21] This reduction was achieved either via a reduction in final demand (degrowth scenario) or a reduction in technical coefficients (green-growth scenario). The consistent negative trade, employment and GDP impacts for Global South countries that emerge in all scenarios highlight the potential negative macroeconomic effects of a transition towards a more environmentally sustainable economy in the Global North. In societies already marked by increasingly poor living conditions, increasing unemployment and falling GDP will likely exacerbate many other socio-economic problems. But beyond this, the worsening of the balance of trade for countries in the Global South can also lead to persistent trade deficits, which, *ceteris paribus*, can lead to exchange rate devaluation. This in itself can lead to higher inflation in the basic consumption goods affected, which tend to be based on agricultural and energy commodities (which are priced internationally in US$). Ultimately, this can lead to balance of payment crises, where the exchange rate and, consequently, domestic inflation spiral out of control.

In sum, regardless of the strategy adopted - whether relying on techno-optimism and green growth or changes in habits of consumption - reducing energy and resource use in the Global North will have significant negative impacts on several countries in the Global South. As such, a just transition towards an environmentally sustainable economy needs to consider a necessary restructuring of the Global South development model. A future with lower resource consumption requires countries in the Global

[21] Defined as high-income economies by the World Bank classification (2022).

South to move away from a development strategy based on neo-extractivism towards strategies more aligned with a post-growth environment. To cope with the lower exports of resources, countries in the Global South need to develop new specialisations and mitigate their dependency on imports of manufactured goods and services. In our discussion, we indicate that industrial policy can be a potential way out of this conundrum for Global South countries. To tackle ecological sustainability challenges of the 21st century in a just manner, the call for import substitution industrialisation of the Global South, long advocated by Latin American structuralism in the 20th century, becomes more essential. However, it must be achieved in an updated fashion in terms of policy instruments and environmental concerns.

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Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

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Appendices:

Table A1: Sectoral classification used to aggregate sector listed in EXIOBASE

Sectors:	EXIOBASE v. 3 sectors number
Agriculture	1 to 15, 18 and 19
Manure Treatment	16 and 17
Mining and Quarrying	20 to 34
Manufacturing	35 to91 (except 51, 53, 60, 66, 70, 73, 75, 77, 79, 81, 83)
Re-processing of secondary manufacturing materials	51, 53, 60, 66, 70, 73, 75, 77, 79, 81, 83
Recycling	94 and 95
Energy Supply and Distribution	96 to 110
Water Supply and Distribution	111 and 112
Construction	113
Re-processing of secondary construction materials	114
Service	115 to163 (except 139 to 158)
Waste Management Services	139 to 158

Source: Author’s own elaboration based on EXIOBASE data (Stadler *et al.*, 2018). Note: EXIOBASE v. 3 sectors number can be found in Stadler et al. (2018) supplementary information.

Table A2: Countries and rest of the world regions in EXIOBASE

Code	Region	Country	Code	Region	Country
AUT	Global North	Austria	JPN	Global North	Japan
BEL	Global North	Belgium	CHN	Global South	China
BGR	Global South	Bulgaria	CAN	Global North	Canada
CYP	Global North	Cyprus	KOR	Global North	South Korea
CZE	Global North	Czechia	BRA	Global South	Brazil
DEU	Global North	Germany	IND	Global South	India
DNK	Global North	Denmark	MEX	Global South	Mexico
EST	Global North	Estonia	RUS	Global South	Russia
ESP	Global North	Spain	AUS	Global North	Australia
FIN	Global North	Finland	CHE	Global North	Switzerland
FRA	Global North	France	TUR	Global South	Türkiye
GRC	Global North	Greece	TWN	Global North	Taiwan
HRV	Global North	Croatia	NOR	Global North	Norway
HUN	Global North	Hungary	IDN	Global South	Indonesia
IRL	Global North	Ireland	ZAF	Global South	South Africa
ITA	Global North	Italy	RoW A&P	Global South	RoW Asia and Pacific
LTU	Global North	Lithuania	RoW AL&CAR	Global South	RoW America
LUX	Global North	Luxembourg	RoW Europe	Global South	RoW Europe
LVA	Global North	Latvia	RoW Africa	Global South	RoW Africa
MLT	Global North	Malta	RoW M-East	Global South	RoW Middle East

Source: Author's own elaboration based on EXIOBASE data (Stadler *et al.*, 2018)

Appendix A.3 – Main results with alternative scenario assumptions

a) Degrowth with transition to services

In this scenario rather than reducing final demand in absolute values the reduction in final demand for all agricultural, mining, manufacturing, construction, and energy inputs, but not for services (which remains constant). To achieve the 10% reduction target in material consumption, however, the fall in demand for material intensive goods needs to fall more than in the original Degrowth scenario.

Table A.3.1. Degrowth with transition to services

% change in Employment					
	Average	**Std. Dev**	**MIN**	**MAX**	**Employment improve in # of regions**
Global North	0.7%	+/- 0.9%	-1.4%	2.6%	24 out of 35
Global South	-0.9%	+/- 0.5%	-2.1%	-0.3%	0 out of 14
% change in GDP					
	Average	**Std. Dev**	**MIN**	**MAX**	**GDP improve in # of regions**
Global North	0.6%	+/- 0.7%	-1.2%	2.6%	29 out of 35
Global South	-0.8%	+/- 0.4%	-1.5%	-0.3%	0 out of 14
Change (in p.p.) in the balance of trade (BoT) (surplus/deficit) as % of GDP					
	Average	**Std. Dev**	**MIN**	**MAX**	**BoT improve in # of regions**
Global North	0.6 p.p.	+/- 0.6 p.p.	-1.1 p.p.	2.4 p.p.	27 out of 35
Global South	-0.8 p.p.	+/- 0.4 p.p.	-1.3 p.p.	-0.3 p.p.	0 out of 14

b) **Green growth with falling material intensity coefficients**

In this scenario the fall in the technical coefficients in the A matrix occurs concomitantly with a proportional fall in the material intensity coefficients (s). The leads to the size of the reduction in the technical coefficients necessary to meet the 10% reduction in the material consumption footprint to be halved.

Table A.3.2. Employment impacts green growth with falling material intensity coefficients

% change in Employment					
	Average	**Std. Dev**	**MIN**	**MAX**	**TB improve in % of regions**
Global North	-3.0%	1.0%	-5.1%	-1.6%	0 out of 35
Global South	-1.1%	0.6%	-2.6%	-0.4%	0 out of 14

Table A.3.3. Pro-business green growth with falling material intensity coefficients

% change in real GDP					
	Average	**Std. Dev**	**MIN**	**MAX**	**GDP improve in # of regions**
Global North	1.1%	+/-1.3%	-2.0%	5.6%	31 out of 35
Global South	-1.2%	+/-0.7%	-2.8%	-0.4%	0 out of 14
	Average	**Std. Dev**	**MIN**	**MAX**	**BoT improve in # of regions**
Global North	1.0 p.p.	+/- 1.5p.p.	-1.7 p.p.	5.0 p.p.	31 out of 35
Global South	-1.2 p.p.	+/- 1.1p.p.	-2.5p.p.	-0.4 p.p.	0 out of 14

Table A.3.4. Pro-consumer green growth with falling material intensity coefficients

% change in real GDP					
	Average	**Std. Dev**	**MIN**	**MAX**	**GDP improve in # of regions**
Global North	1.7%	+/-0.8%	-0.6%	2.9%	32 out of 35
Global South	-0.2%	+/-0.6%	-1.8%	0.5%	5 out 14
	Average	**Std. Dev**	**MIN**	**MAX**	**BoT improve in # of regions**
Global North	0.3 p.p.	+/- 0.5p.p.	-1.8 p.p.	1.2 p.p.	31 out of 35
Global South	-0.3 p.p.	+/- 0.8 p.p.	-1.5p.p.	0.4 p.p.	3 out of 14