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Short-term trade dependencies of the South as an obstacle to degrowth? Quantifying the twin challenge of global dependencies

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Abstract

This paper is a first attempt to quantify the potential short-term effects on income and business profits that may occur in the Global South if the Global North were to implement policies to reduce and relocalize consumption and production. To this end, we use the EORA26 global input-output table to calculate dependency shares, which capture the share of incomes and profits in the Global South that manifests because of trade with the Global North. In the aggregate, we find that roughly a seventh of total incomes and profits in the South depends on trade in the North, although dependency varies significantly by region. We find that most of this dependency stems from trade of intermediate goods, not from exports for final demand. We also find that there is no single factor beyond trade-openness that clearly explains the differences in dependency among countries in the South, pointing to the importance of country-specific analyses. We therefore argue that a deeper understanding of the specific trade relations of any given country in the Global South with countries of the North is necessary for researchers interested in post-growth industrial policy as well as, more broadly, any type of policy-driven degrowth transitions in the Global North.

Keywords: degrowth, unequal exchange, structural dependencies, input-output analysis, Global North, Global South, trade, delinking, decolonization

1. Introduction

The starting point and motivation of this paper is the conjecture of a “twin challenge of global dependencies” (Gräbner-Radkowsch and Strunk 2023a), i.e. the apprehension that within the current institutional framework of the global economy, structural dependencies between the Global North and South are a motivation for, and a potential obstacle to degrowth at the same time. On the one hand, degrowth scholars criticize the Western development model for being based on a form of growth and global economic integration that in many places of the world erodes the grounds for sustainable and decent living conditions, threatens alternative ways of provisioning, such as subsistence-oriented lifestyles, and leaves workers exposed to global capitalism and inclusion into its wage relations as the main means of securing a livelihood – a trend only made worse by climate change. Degrowth scholars who point out these neocolonial economic relations often refer to the literature on ecologically unequal exchange between the Global North and South, to the detriment of the latter (Dorninger et al. 2021; Hickel et al. 2022). In moving away from global capitalism, degrowth is envisioned as a step toward decolonization and toward greater justice in the global economic system, with eliminating unequal trade relations between the North and South as one crucial element (Hickel 2021b, 2021a).

On the other hand, it is these very dependencies in the areas of international trade and finance, that give rise to fears of potential short-term adverse effects of implementing degrowth policies in the North on the South, especially in the absence of adequate regional policy coordination (Althouse, Guarini, and Gabriel Porcile 2020; Chiengkul 2018; Dengler and Seebacher 2019; Frame 2023). So far, degrowth scholarship has focused more on pointing out the way in which degrowth aligns with regional, bottom-up thought and action in the South (e.g. Beling et al. 2018; Escobar 2015; Gerber and Raina 2018; Kothari, Demaria, and Acosta 2014), and on highlighting that the challenges implied by potential short-term adverse effects should not be used as an argument *against* degrowth (Hickel 2021b). The flip side of the twin challenge of global dependencies, however, has not received as much attention in the degrowth literature, especially when it comes to the quantification of the relevance of these dependencies (see Fevereiro and Lowe 2025 for a recent exception that takes a different, but complementary approach to the one we outline below).

This is where the present paper aims to make a contribution. We approach the topic of dependencies through the lens of global trade.¹ Our research question is the following: How dependent are countries from the Global South from exports to the Global South, when it comes to incomes and profits? How heterogeneous is this dependency across countries? To this end, we assume a planned, democratic reduction in consumption and production in the North (Schmelzer and Hofferberth 2023) and study the implied relocation of production and consumption and thus the implied reduction of trade with the South. More precisely, we use input-output modelling to quantify the share of total value added (in various dimensions) in the Global South that can be attributed to exports into the Global North. In a hypothetical scenario where the Global North would reduce or restructure its demand in an orientation toward more regional economies, it is this share that would be affected and that potentially threatens

1 For finance, see e.g. Althouse et al. (2020); Althouse and Svartzman (2022); Svartzman and Althouse (2022); for delinking more broadly, see e.g. Ricci (2025a).

the incomes attached to it. These dependency shares are thus a core element of understanding how a degrowth transition in the Global North might have effects on the Global South. It is important, however, to point out that the actual effects in the South could be much lower, depending on how much of the exports to the North were replaced by exports to other countries in the South, and how the affected activities were relocated within domestic economies.

Our main contribution is twofold. On a methodological level, we suggest that dependency shares are a useful analytical tool to quantify the side of the twin challenge of global dependencies that has, thus far, not received adequate attention in the degrowth literature: the vulnerability of Global South economies to demand reductions in the Global North. On a substantive level, our findings show that significant trade dependencies exist, with a global average of 13.59% of value added in the South attributable to exports to the North. The largest part of these dependencies is not due to final demand in the North, but to intermediate demand, i.e. to producers in the North purchasing intermediate goods and services. Regionally, the dependencies are very heterogeneous, and dependency shares reach from almost nothing in the least dependent up to 30-40% in the most dependent countries. Using a regression model, we show that beyond the obvious factor of trade openness, there is no single, clear macroeconomic factor that explains the dependency of a given country, indicating that further research particularly on the country level is warranted.

The remainder of this paper is structured as follows: we will first provide more context and motivation through a literature review (Section 2). Section 3 presents our data and methodology, and Section 4 our results. In Section 5, we discuss our results and conclude. The code to replicate the findings in this paper is published as Gräbner-Radkowsch and Strunk (2025). More background information, methodological explanations, diagnostics and robustness checks are available through a supplementary online appendix.

2. Literature Review

Degrowth aims for a planned reduction of economic activity in the Global North that explicitly targets global justice (Schmelzer and Hofferberth 2023): it entails “an equitable downscaling of production and consumption that increases human wellbeing and enhances ecological conditions at the local and global level, in the short and long term” (Schneider, Kallis, and Martinez-Alier 2010, 512). While originally being a movement rooted in bottom-up activism and strongly inspired by Southern critiques of development (Latouche 2009; Martínez-Alier et al. 2010), it has in recent years additionally branched out into more mainstream policy spaces, bringing along questions around economic planning and policy design (Cosme, Santos, and O’Neill 2017; Fitzpatrick, Parrique, and Cosme 2022; Schmelzer and Hofferberth 2023), including industrial policy (Hauge and Hickel 2025; Bärnthaler, Mang, and Hickel 2025). Degrowth policy proposals are primarily focused on the domestic (often regional or municipal) level, consistent with degrowth’s postcolonial aspiration for the North to “set their own house in order”, rather than setting a new, neocolonial agenda for the globe (Agarwal and Narain 1991, 16; Dengler and Seebacher 2019, 248). However, a range of scholars have pointed out that in doing so, degrowth has remained too silent on the imperialist roots of global capitalism and of the wealth levels of the North (Hickel 2021a; Tyberg and Jung 2021), and the structural dependencies between countries that question the feasibility to study single countries or regions in isolation (e.g. Gräbner-Radkowsch and Strunk 2023b). According to some, degrowth therefore needs to start

paying more attention to the world-systems level of global capitalism (Frame 2023), lest it become an inward-looking and provincial project (Schmelzer and Noshwin 2023) that does not live up to its goal of enhancing global justice.

The critique of the imperialist roots of Western development and its neocolonial repercussions have indeed started to receive more attention in the degrowth literature in recent years. Degrowth literature has, for example, started to engage with the literature around ecologically unequal exchange.² These contributions provide a host of empirical work showing that rich countries benefit from a net transfer of embodied materials, energy, and labor time from the Global South to the Global North (often using the language of ‘core’ and ‘periphery’), while systematically displacing environmental costs of production processes to poorer regions (for an overview of the field, see Hornburg (2023); for recent studies, see e.g. Schaffartzik et al. (2019) or Dorninger et al. (2021)). There has recently emerged a literature that explicitly connects ecologically unequal exchange with degrowth (Hickel et al. 2022; Hickel, Hanbury Lemos, and Barbour 2024; Ricci 2025a), giving more empirical substance to the claim that degrowth aims to promote not just local but also global justice.

So far, this literature has mainly focused on using these empirical tools to strengthen the degrowth critique of global capitalism. Hickel (2021b), for instance, points out that due to global power imbalances and asymmetric dependencies between the North and South, “some worry that degrowth in the North might have a negative impact on economies in the South” [p. 5; see e.g. Chiengkul (2018) as someone who, while sympathetic to degrowth, raises this concern]. He argues that using this risk as an argument against degrowth as a whole is problematic, as it “echoes arguments that were regularly made under colonialism, namely, that extraction and exploitation by the colonizer is ultimately good for the colonized” (ibid.). In that sense, the very existence of these exploitative dependencies is a reason *for* degrowth—and thus one side of the “twin challenge of global dependencies” (Gräbner-Radkowsitch and Strunk 2023b).

However, while it is indeed problematic to use these dependencies as a fundamental argument *against* degrowth, they surely should be understood as an obstacle to implementing a purely domestically oriented degrowth policy-program in the North. The risk of short-term adverse effects in the South, if certain degrowth policies were implemented in the North, is a relevant flipside of the “twin challenge of global dependencies”. Althouse et al. (2020), for example, show that although growth in the core is indeed socially and ecologically harmful in the periphery, it nonetheless “presents a major source of economic demand and supports socioeconomic stability [in the South] under existing institutional frameworks” (p. 8). A sudden and significant demand drop in the core might indeed lead to declining welfare, greater inequality, and higher unemployment in the periphery. Althouse et al. (2020) therefore highlight the importance of regional policy coordination and argue that degrowth scholarship needs to investigate more thoroughly what effects degrowth in the center might have on the periphery. Such

² While neoclassical theory assumes that all exchange is by definition free and voluntary, the literature on unequal exchange, both in its Marxist and its ecological variant, argue that in real-world economies there are a range of structural asymmetries between economies of the core and (semi-)periphery that come with enforced and asymmetric exchange relations (e.g. [Hornburg 2023](#)). In its Marxist/structuralist variant, this research elaborates, e.g., on how differences in technology access or labor costs allow core economies to extract surplus value from peripheral economies through unequal terms of trade (for a detailed overview of dependency theory, see e.g. [Kvangraven 2023](#)).

consideration of the potential short-term effects in the South is also warranted by a postcolonial methodology, which would put special attention on the effects of the particularly disadvantaged populations (e.g., Go 2016).

Despite a range of methodological challenges, there are now a few first attempts at addressing this question (Leoni 2024; Fevereiro and Lowe 2025). It is precisely this research agenda that our paper tries to contribute to. In the following, we use input-output analysis to investigate currently-existing dependency relations between the North and the South with a focus on trade, tracing the amount of value added (income and business profits) in the South that depends on exports to — and thus demand from — the North. This allows us to provide a quantitative estimate of the risk of short-term adverse effects of Northern reductions in consumption and production on the South. Rather than using such an estimate in a theoretical debate around the desirability or necessity of degrowth, we see it as an integral part to the degrowth literature that deals with industrial policy, political strategy, and transition design.

3. Methodology

To answer our research question we used the EORA26 Input-Output Tables. We aggregated countries into the Global North and South and then calculated dependency shares of various factors of value added that quantify the trade dependency of the Global South on the Global North. We used these dependency shares as our main conceptual tool to run our analyses, as described below. This section elaborates on the various aspects of our methodology one by one. More details are provided in a supplementary online appendix.

3.1 Input-Output Modeling

Input-output (I-O) modeling provides a framework for analyzing the interconnected flows of goods and services within and between economies. This makes it particularly valuable for examining trade dependencies and their broader socio-economic implications. I-O tables are typically compiled by national statistical agencies using data from business surveys, administrative records, and national accounts, organized into standardized sector classifications. Using these tables, I-O analysis captures how different sectors of an economy rely on inputs from other sectors to produce their outputs by representing the economy as a matrix where each cell shows the monetary value of transactions between sectors. This systematic accounting reveals both direct inter-industry relationships (e.g., sector A uses inputs directly from sector B) and sales to final demand (households, government, exports), as well as indirect relationships that arise when intermediate goods and services are supplied via multiple rounds of production. When the underlying table includes different countries or regions (and it is, therefore, called a *multi-regional* I-O table), I-O models can trace how domestic production depends on foreign inputs and how domestic outputs serve foreign markets. We use global multiregional I-O tables when we calculate dependency shares on regionally aggregate (North versus South) and disaggregated (to countries in the South) levels.

While I-O modeling offers several analytical advantages for modelling immediate and short-term transition effects, there are also limitations that need to be taken seriously when interpreting the results of such models. These limitations arise directly from the core assumptions one must be willing to make to use such models. For example, I-O models assume constant returns to scale, fixed proportions in the use of factors of production (i.e. there is no adaptation to changes in factor prices, in contrast to what is assumed in neoclassical production functions), no

technical change that changes productive efficiency, and a short-run price elasticity of final demand of zero (i.e., within the model there are no immediate effects of price changes on the quantity demanded). Therefore, I-O modelling is limited in projecting dynamic effects over longer time periods, in which economies would undergo structural transformations in response to e.g. demand shocks. However, when carefully interpreted, I-O models are well suited to investigate contemporary trade relations and how, given these relations, any sort of transition in one region or sector can have immediate ripple effects in other regions or sectors and economies, if no further policy measures were undertaken. Therefore, this quantitative approach complements qualitative analyses of power relations and structural dependencies in global trade, providing empirical grounding for theoretical arguments about economic vulnerability, unequal exchange, and the geography of production networks. For more technical details on input-output methodology, the reader may consult the supplementary appendix.

3.2 Data source

As our data source, we use the global MRIO (multi-regional Input Output) model EORA26, which is a simplified model of the full Eora MRIO. Eora26 reduces the full table to a matrix containing only 26 sectors (from 15,909 sectors in the full table), covering 190 countries. Using the version with the simpler, harmonised classification is preferable for our analysis as we do not disaggregate our result to the sectoral level but rather conduct more detailed analyses on various regional levels.

We use the table of the year 2017, the most recently publicly available data with a free academic license. For future research, an extension of our analysis using more recent data (with the most recent data available for purchase for the year 2022) would be desirable. For now, the use of the 2017 table allows us, on the one hand, to ensure public replicability of our results, and on the other hand, to capture the state of trade relations in pre-pandemic times that is not affected by pandemic-related (and thus exceptional) supply chain disruptions. Moreover, in appendix D we show the temporal robustness of trade dependencies between 2008 and 2015.

3.3 North-South classification

We conduct our analyses both on a regionally aggregated and disaggregated level. For the aggregated analyses, we categorise the 190 countries available in EORA26 as either ‘Global North’ or ‘Global South’. To keep things simple and transparent we follow the common strategy of other studies on unequal ecological exchange, such as Dorninger et al. (2021), who start with the different income groups provided by the World Bank, and then adjust the grouping for population sizes. Table 1 provides key demographic and environmental indicators for the two groups (a full list of countries is provided in the appendix). The Global North comprises 53 countries with a combined population of 1082.6M people, representing 22.7% of the global population covered in our analysis. The Global South includes 133 countries with 3685.9M inhabitants, accounting for 77.3% of the world population.

Table 1: Descriptive Statistics by Country Group (2017)

Indicator	Global North	Global South
Number of countries	53	133
Total population (millions)	1082.6	3685.9
Average population per country (millions)	20.8	28.4
Median population per country (millions)	5.0	11.0
Share of global population (%)	22.7	77.3
Total GHG emissions (Mt CO ₂ -eq)	15479622.0	15700041.1
Per capita emissions (t CO ₂ -eq/person)	0.014	0.004
Total raw material inputs (millions)	15132.8	27409.1
Per capita material inputs	13.98	7.44

Note that we exclude China and India from our analysis due to their unique economic characteristics and substantial influence that, on the one hand, makes it ambivalent to classify them, and on the other hand, would make it difficult to capture the experience of those less prominent Global South countries which, we assume, most scholars have in mind when they call out the potentially adverse effects of Northern Degrowth on Global South economies.

Note also that there is no general consensus on North-South classifications, and the use of these categories is itself contested (Haug, Braveboy-Wagner, and Maihold 2021; Sud and Sánchez-Ancochea 2022)]. The reason we are using this framing initially is that we thereby connect directly to Degrowth debates on the question of ‘Degrowth and the Global South’. Moreover, for the intended meaning of the question what happens to ‘the South’ if ‘the North’ degrows, our classification along income brackets seems fairly reasonable. Our ‘North’ category includes most of those countries of which it is said that Degrowth is a concept by and for them, such as most (but not all) European countries, the United States, and Japan. Nonetheless, recognising the limits of such an aggregate analysis, we also add a disaggregated perspective that quantifies in greater detail the shape and size of the architecture of dependency of those countries not classified as high-income countries across various regions, such as Latin America, Sub-Saharan Africa, or Asia.

3.4 Dependency shares

Our main analytical tool is that of dependency shares. They capture what amount of value added in the form of, for example, employee compensation or business profits, in a given region can be attributed to – and thus depends on – trade with the cluster of high-income countries, i.e. the Global North. In other words, they measure the share of value added that emerges in the Global South because of activities associated with exports to the Global North.

In this context, we distinguish between dependency on final demand and total trade dependency. Final demand dependency takes into account exports of goods and services that are directly consumed in the Global North, whereby total trade dependency also includes the export of intermediate goods and services, products and services that are used in further production processes in the North. After having thereby quantified the total trade dependency of the Global South on the Global North in terms of its effect on various value added categories, we

then provide the regionally disaggregated analysis that calculates the dependency share for each country on trade with the Global North, showing the result by continent as well as by dependency cluster (ranging from countries that experience only weak or no dependency, to those who see a significant share of their country's total value added coming from trade with the North).

Lastly, we look at the main determinants of trade dependency using a linear regression model, testing for trade openness, country size, wealth and natural resources. The main motivation for this analysis was to test whether there are some clear patterns of dependency, such as 'smaller countries are more dependent' or 'richer countries are less dependent'. As we will explain below, the model clearly shows that such simple relationship do *not* explain the heterogeneity in trade dependency.

Aside from our concrete results, which will follow in the next section, we see one contribution of this paper in its methodological suggestion – namely to use dependency shares, calculated through multi-regional input-output tables, as a core analytical tool to contribute to the questions around structural dependencies in the context of the debate of 'Degrowth and the Global South'. Here our paper differs from related contributions, such as Fevereiro and Lowe (2025), who use projections over several years instead of dependency shares.

4. Results

4.1 Export dependency at the aggregate level

In the following we compute the export dependency for three different kinds of so called primary inputs to production³ in the Global South, which are all relevant to capture different aspects of socio-economic provisioning: employee compensation, net mixed income, and net operating surplus.⁴

4.1.1 *Employee compensation*

Employee compensation is defined as the total remuneration provided by enterprises to workers in exchange for their labor. It encompasses both monetary wages and salaries as well as non-monetary benefits and employer-paid social contributions. In the System of National Accounts, the term encompasses not only direct cash payments but also payments in kind, social security contributions, and other employment-related social insurance schemes funded by employers (for technical details see p. 139ff in United Nations 2009).

In the context of Global South economies, employee compensation serves as a crucial indicator of formal sector employment vulnerability, as it captures the direct income flows to workers. It is imperative to comprehend the interrelation between trade and the compensation of employees, particularly in the context of lower-income economies. A decline in Global North demand that threatens this compensation category would therefore have

³ Primary inputs to production are inputs that are not supplied by other sectors, but by actors that are outside the inter-industry relationships. These actors are usually the government, households and other countries.

⁴ The definitions of these categories are taken directly from the 2008 *System of National Accounts* (United Nations et al. 2009), i.e. the global accounting framework for any macroeconomic indicator.

ramifications for both individual workers' immediate purchasing power and their long-term economic security on commodity markets, as well as access to employment-related benefits.

We start by computing *consumption-driven dependency* of employee compensation, i.e. how much Global South employee compensation depends on Global North households, governments, and businesses purchasing final goods and services. While this includes indirect effects through Global South supply chains (via Leontief inverse) it does *not* include Global South inputs sold to Global North production processes.

Concretely, the total amount of employee compensation in the South that is dependent on exports to the North is \$179.7M, which amounts to 3.299% of total employee compensation in the South. On the one hand, this result might overestimate the effect, since input-output calculations do not take into account mitigation and adaptation effects: Employees might switch their job towards companies that are less dependent from export business, or the goods and services might be sold to other countries in the South itself. Whether such adaptation measures can actually occur, and how long they take is, however, unclear, which is why the above result is likely to be relevant at least in the short term. On the other hand, however, this result underestimates the *total* risk for the South as many exports do not go to final consumption in the North, but are used as further inputs to production by Northern firms.

Taking into account this export of intermediate goods, the amount of employee compensation that is realized because of exports from the South to the North adds up to \$646.4M, which amounts to 11.868% of total employee compensation in the South. This means that roughly 1 in 8 dollars of formal employment compensation in the Global South is tied to Northern economic activity. Notably, exports of intermediate products make up 72.2% of total trade dependencies when it comes to employee compensation, and are thus a much larger factor in considering trade dependencies for employee compensation. We now turn to the next primary input of interest, net mixed income.

4.1.2 Net mixed income

Net mixed income is defined as the sum of income generated by unincorporated enterprises owned by households, encompassing both labor and capital components. It signifies the earnings of individuals who are unable to distinctly differentiate between their returns to labor and their returns to capital ownership (United Nations et al. 2009, para. 7.9). This category primarily encompasses income from self-employment, small-scale farming, informal enterprises, and micro-businesses where owners provide both their labor and use their own capital assets.

This kind of income is particularly salient in the South, where a significant portion of the workforce operate outside formal employment structures, engaging in subsistence agriculture, street vending, artisanal production, and small-scale service provision as their respective earnings are usually accounted as mixed income. Therefore, quantifying the trade dependency of mixed income is crucial for assessing the vulnerability of these economic actors, that are often marginalized in the global economy.

The results show that mixed income exhibits remarkably similar vulnerability to employee compensation regarding Global North final demand. Specifically, \$56.2M of Global South mixed income – representing 3.280% of the total – depends on Global North household, government, and business consumption. This dependency level closely

mirrors that observed for employee compensation (3.299%), suggesting that informal workers, small farmers, and micro-entrepreneurs face comparable dependency to Global North consumption patterns as formal employees.

When we extend the analysis to include goods and services supplied to Northern production processes, the dependend amount of mixed income increases substantially to \$217.0M, representing 12.653% of total Global South mixed income. This finding indicates that approximately 1 in 8 dollars of mixed income in the South is tied to Northern economic activity. Consistent with our findings for employee compensation, intermediate trade relationships dominate the dependency structure, accounting for 74.1% of total trade linkages, indicating that changes in Northern final consumption generate amplified impacts through supply chain networks.

4.1.3 Net operating surplus

Net operating surplus is defined as the operating surplus generated by corporations and quasi-corporations after the deduction of employee compensation and the consumption of fixed capital from their gross value added (United Nations et al. 2009, paras. 7.8–7.12). In contrast to net mixed income, which captures the blended labor and capital returns of unincorporated household enterprises, net operating surplus specifically measures the returns to capital in formal corporate structures where the distinction between labor compensation and capital returns can be distinguished clearly. Thereby, this category comprises business profits, dividends, retained earnings, and other forms of property income accruing to corporate entities.

For our analysis of Southern dependencies, it complements the previous two measures by explicating the vulnerability of the formal business sector returns and investment incentives. While net mixed income captures the precarious livelihoods of informal sector participants, net operating surplus reflects the exposure of established businesses and capital formation processes.

The total amount of net operating surplus being dependent on exports to the final demand in the North sums up to \$201.9M – 3.744% of total net operating surplus in the South. Taking into account intermediate goods increases the dependency of net operating surplus to \$842.5M (15.626% of total Global South net operating surplus). In other words: 1 in 6 dollars of net operating surplus in the South is dependent on exports to the North. As in the previous cases, intermediate trade relationships dominate the dependency structure, accounting for 76.0% of total trade dependency, highlighting again the crucial role of supply chain network integration.

4.1.4 Taking stock

Figure 1 and Table 2 synthesize our findings on Global South trade dependencies across all three primary input categories. Several patterns emerge from the analysis so far. First, the consumption-driven dependencies demonstrate remarkable consistency across all primary inputs, ranging narrowly from 3.28% to 3.74%. This indicates that Global North final demand directly accounts for approximately 3.4% of all forms of value added in the Global South, irrespective of whether we examine formal wages, informal sector income, or business profits. The uniformity of this relationship is particularly noteworthy given the heterogeneous economic characteristics of these income categories.

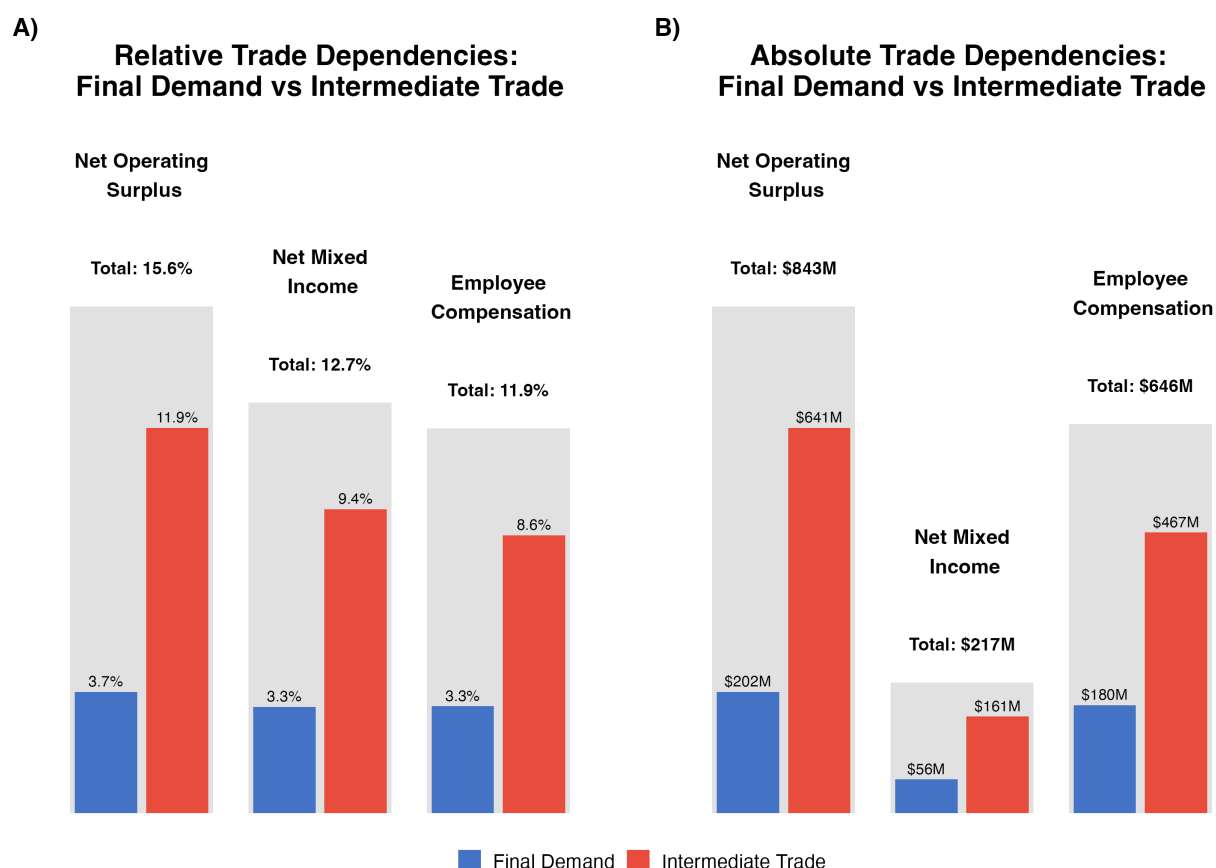


Figure 1: Global South Trade Dependencies on Global North Demand by Primary Input Category

Second, intermediate trade constitutes the predominant component of the dependency structure across all categories. As Table 2 demonstrates, between 72.2% and 76.0% of total trade dependencies originate from Southern provision of intermediate inputs to Northern production processes rather than from direct sales to Northern final consumers. Consequently, supply chain linkages generate multiplier effects ranging from 3.6 for employee compensation to 4.2 for operating surplus. Stated alternatively, for every dollar of Global South value added directly attributable to Northern consumption, an additional \$2.6 to \$3.2 is generated through intermediate trade relationships.

Third, the incorporation of intermediate trade linkages points to a certain hierarchy of vulnerability. As illustrated in Figure 1, net operating surplus exhibits the highest dependency at 15.63%, followed by net mixed income at 12.65%, and employee compensation at 11.87%. This progression reflects the differential integration of income categories into global markets: while approximately one in 8 dollars of wages depends on Northern demand, this ratio increases to one in 6 dollars for business profits. This suggests that capital-intensive sectors in Global South economies exhibit greater structural dependence on Northern-centered value chains than their labor-intensive counterparts.

Table 2: Global South Value Added Dependencies on Global North Demand (2017). The multiplier effect in the table is computed as the ratio of total trade dependency and final demand dependency. It shows how supply chain linkages amplify the impact of changes in final demand.

Primary Input Category	Total GS Value Added (\$ billions)	Final Demand Dependency (\$ billions)	Total Trade Dependency (\$ billions)	Intermediate Share (%)	Multiplier Effect
Employee Compensation	5.45	0.180 (3.30%)	0.646 (11.87%)	72.2	3.6×
Net Mixed Income	1.71	0.056 (3.28%)	0.217 (12.65%)	74.1	3.9×
Net Operating Surplus	5.39	0.202 (3.74%)	0.843 (15.63%)	76.0	4.2×
Total	12.55	0.438 (3.49%)	1.706 (13.59%)	74.3	3.9×

All in all, the aggregate statistics presented in Table 2 indicate that \$1.7 billions of Global South value added — representing 13.59% of the total value added in the South — depends on economic activity in the North. This dependency encompasses \$437.9M directly linked to final consumption and an additional \$1268.1M generated through production networks. While these aggregate results already provide some insights into the architecture of global economic interdependencies and the practical relevance of structural dependencies, they potentially obscure considerable heterogeneity across individual countries and regions within the South. We address this shortcoming in the next section.

4.2 Regional disaggregation

In the following, we consider the average dependency of each country with regard to the three primary inputs previously mentioned.⁵ Figure 2 and Table 3 provide an initial overview of the results.

The initial observation is the remarkable heterogeneity of dependency shares, ranging from nearly zero (e.g., Somalia, Nepal, and Guyana) to over one-third (e.g., Ethiopia, Libya, and Hungary). As demonstrated in panel B of Figure 2 and Table 3, there are four different groups of countries: The majority of countries exhibit dependency levels ranging from 5% to 15%. However, a considerable number of countries demonstrates an average dependency level of 15-25%. Additionally, the data reveals two smaller groups of equally sized countries: one with low dependencies of 0-5% and another with very high dependencies of 25% or more. These findings suggest that dependencies exhibit significant heterogeneity across countries in the South.

⁵ Alternatives would have included a weighted average or the share of total value added. However, we decided to examine the simple average since it was deemed inadvisable to prioritize any of the categories to a disproportionate degree.

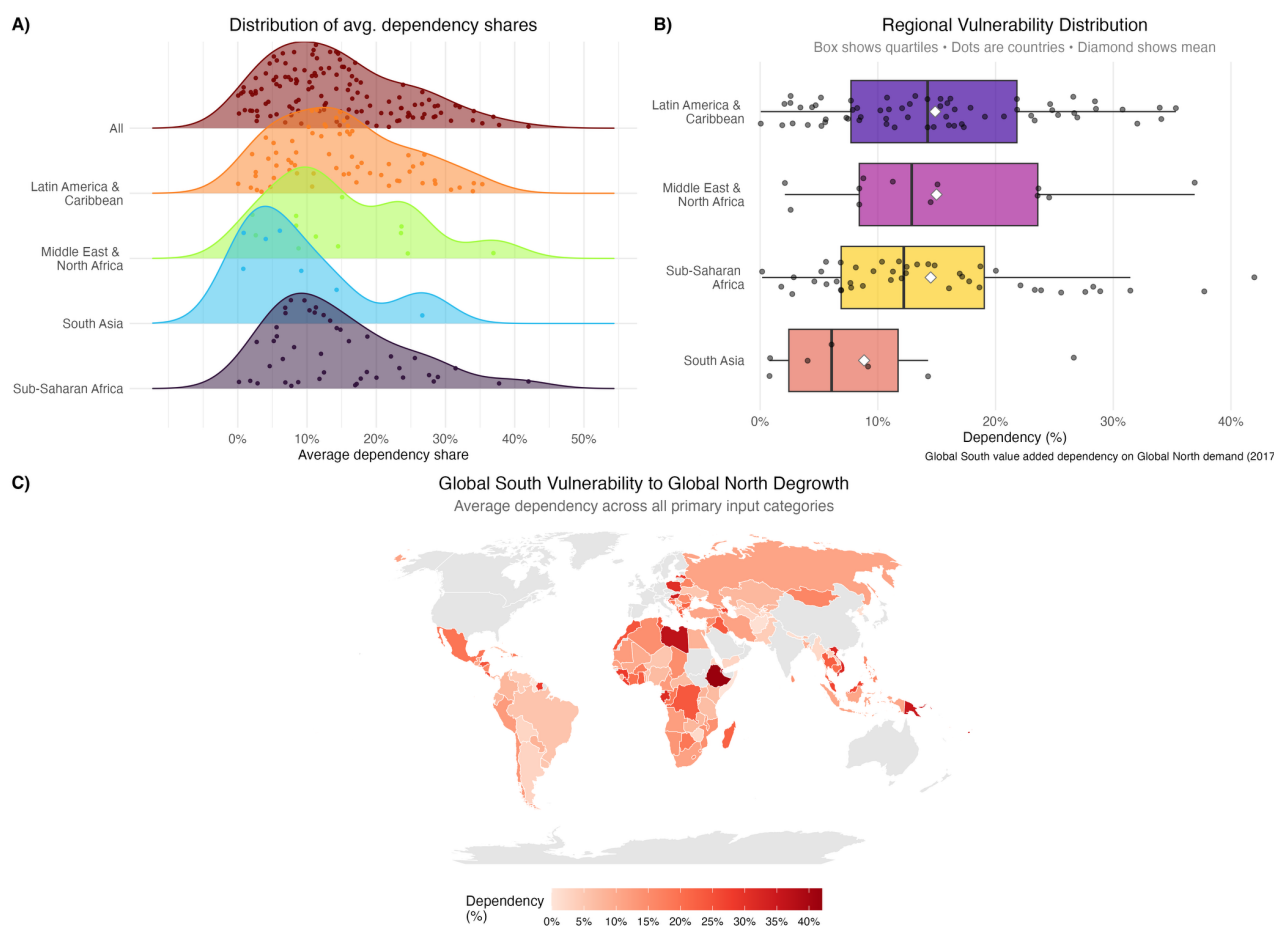


Figure 2: Global South Trade Dependencies for individual countries and regions

Panels B and C of Figure 2 show the regional distributions of dependencies; however, there is no clear regional pattern to identify: Countries in Latin America demonstrate the greatest heterogeneity, ranging from nearly zero (Guyana and Suriname) to over 30% (some Caribbean states). This results in slightly higher dependency than the global average. South Asian countries appear slightly less dependent on average. However, the Middle East and North Africa are slightly more dependent, with significant variation within the region. Finally, Sub-Saharan Africa has many countries with moderate to high dependency, as well as a significant portion of highly dependent countries with dependency shares well above 25%, on average.

This strong heterogeneity between and within regions raises the question of whether dependency is associated with common macroeconomic variables. To this end, Figure 3 visualizes correlations with some evident indicators, and Table 4 quantifies these relationships using statistical analysis. The table shows how four country characteristics predict trade dependency, with results presented using three different statistical approaches to ensure the relationships are robust: a classical OLS regression, then a MM estimation, which deflates the impact of potential outlier cases (which diagnostic tests suggests to be relevant in the OLS context, see Appendix C), and an OLS regression with potential outlier being excluded manually. This robustness check reveals that results are extremely

stable across the different estimation methods: all coefficient differences between MM-estimation and explicit exclusion are less than 3.9% of the original OLS estimates.⁶

Table 3: Countries Grouped by Dependency Levels

Dependency Group	Number of Countries	Countries
Weak dependency (<5%)	22	Serbia (5%), Burundi (5%), Uzbekistan (4%), Venezuela (4%), Pakistan (4%), Laos (3%), Gambia (3%), Argentina (3%), Eritrea (3%), Yemen (3%), Turkmenistan (3%), Bolivia (3%), PSE (2%), Myanmar (2%), Tajikistan (2%), Zimbabwe (2%), North Korea (1%), Nepal (1%), Afghanistan (1%), SUD (0%), Somalia (0%), Guyana (0%)
Moderate dependency (<15%)	55	Chad (15%), North Macedonia (15%), Moldova (15%), Algeria (14%), Mozambique (14%), Sri Lanka (14%), Georgia (14%), Antigua and Barbuda (14%), Namibia (13%), Chile (13%), Armenia (13%), Peru (13%), Cameroon (12%), Mauritania (12%), Haiti (12%), Angola (12%), Malawi (12%), Samoa (11%), South Africa (11%), Iran (11%), Senegal (11%), Russia (11%), El Salvador (11%), Turkey (11%), Indonesia (11%), Togo (10%), Guatemala (10%), Mali (10%), Bangladesh (9%), Lebanon (9%), Rwanda (9%), Panama (9%), Paraguay (8%), Jordan (8%), Egypt (8%), Montenegro (8%), Uganda (8%), Kyrgyzstan (8%), Zambia (8%), Colombia (8%), Sierra Leone (8%), Kazakhstan (7%), Ecuador (7%), Kenya (7%), Nigeria (7%), Central African Republic (7%), Tanzania (7%), Bhutan (6%), São Tomé and Príncipe (6%), Benin (6%), Cuba (6%), Brazil (6%), Ukraine (5%), Niger (5%), Uruguay (5%)
Strong dependency (<25%)	33	Croatia (25%), Honduras (25%), Morocco (25%), Democratic Republic of Congo (24%), Tunisia (24%), Iraq (24%), Ghana (23%), Greece (23%), Thailand (23%), Madagascar (22%), Jamaica (22%), Bulgaria (22%), Cambodia (21%), Côte d'Ivoire (20%), Mexico (19%), Botswana (19%), Congo (19%), Dominican Republic (18%), Burkina Faso (18%), Bahamas (17%), Eswatini (17%), Bosnia and Herzegovina (17%), Cape Verde (17%), Belarus (17%), Barbados (16%), Mongolia (16%), Lesotho (16%), Nicaragua (16%), Philippines (16%), Albania (16%), Vanuatu (15%), Romania (15%), Syria (15%)
Very strong dependency (>25%)	21	Ethiopia (42%), Djibouti (38%), Libya (37%), Papua New Guinea (35%), Fiji (34%), Hungary (34%), Vietnam (32%), Gabon (31%), Poland (31%), Aruba (29%), Seychelles (29%), Suriname (29%), Latvia (28%), Guinea (28%), Liberia (28%), Malaysia (27%), Belize (27%), Maldives (27%), Azerbaijan (27%), Mauritius (26%), Costa Rica (25%)

⁶ The diagnostic plots for the different models, as well as additional technical details, can be found in Appendix C.

Table 4: Determinants of Trade Dependency. The MM-estimator provides robust estimates with automatic outlier detection; Exclusion model removes identified outliers. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, . $p < 0.1$

	OLS Coef.	OLS SE	MM Coef.	MM SE	Excl. Coef.	Excl. SE
Constant	-21.523.	(11.458)	-24.770**	(7.851)	-24.648*	(9.543)
Trade (% of GDP)	0.134***	(0.021)	0.144***	(0.020)	0.144***	(0.017)
Log GDP per capita	1.776*	(0.820)	1.910*	(0.797)	1.866**	(0.692)
Log Population	0.520	(0.489)	0.575	(0.433)	0.596	(0.412)
Natural resources (% of GDP)	0.257*	(0.103)	0.204*	(0.094)	0.201*	(0.088)
R-squared	0.353		0.457		0.476	
Observations	113		113		110	
Method	OLS		MM-Estimator		OLS (Excluded)	
Outlier treatment	Included		Downweighted		Excluded	
Countries affected	-		ETH, LBY, FJI		ETH, LBY, FJI	

As expected, we observe a strong correlation between trade dependency and openness, as becomes evident in panel A of Figure 3: Countries with higher trade intensity tend to be more vulnerable to demand reductions in the North. Our regression models confirm this pattern across all estimation approaches, with trade openness being a highly significant and stable predictor of dependency (Table 4).

More surprising is the relationship between dependency and wealth, as measured by a country's per capita GDP (in constant PPP). Panel B of Figure 3 suggests that wealthier countries have higher trade dependencies. This counterintuitive finding is confirmed across all our estimation approaches when we control for trade openness and other structural factors (Table 4). This suggests that wealthy, trade-integrated economies (e.g., Chile or Malaysia) face particular vulnerabilities. In other words, trade with the Global North appears to be an important source of these countries' monetary wealth, but it also makes them more vulnerable to degrowth in the North.

The relationship between trade dependency and population size is intricate. One might expect larger countries to have larger internal markets and, consequently, greater resilience. This conjecture appears even more plausible given the negative correlation between dependency share and population size shown in Panel C of Figure 3. However, our robust regression results in Table 4 show that this correlation masks an important confounding effect. Large countries tend to have higher trade volumes, which could increase their dependency on trade with the Global North. When controlling for other factors, the association parameter for population and dependency

becomes positive across all estimation methods, though the magnitude varies slightly. This suggests that countries such as Brazil, Mexico, Nigeria, and Indonesia benefit from their size, but these advantages are partially obscured in simple comparisons due to their simultaneous integration into global trade networks.

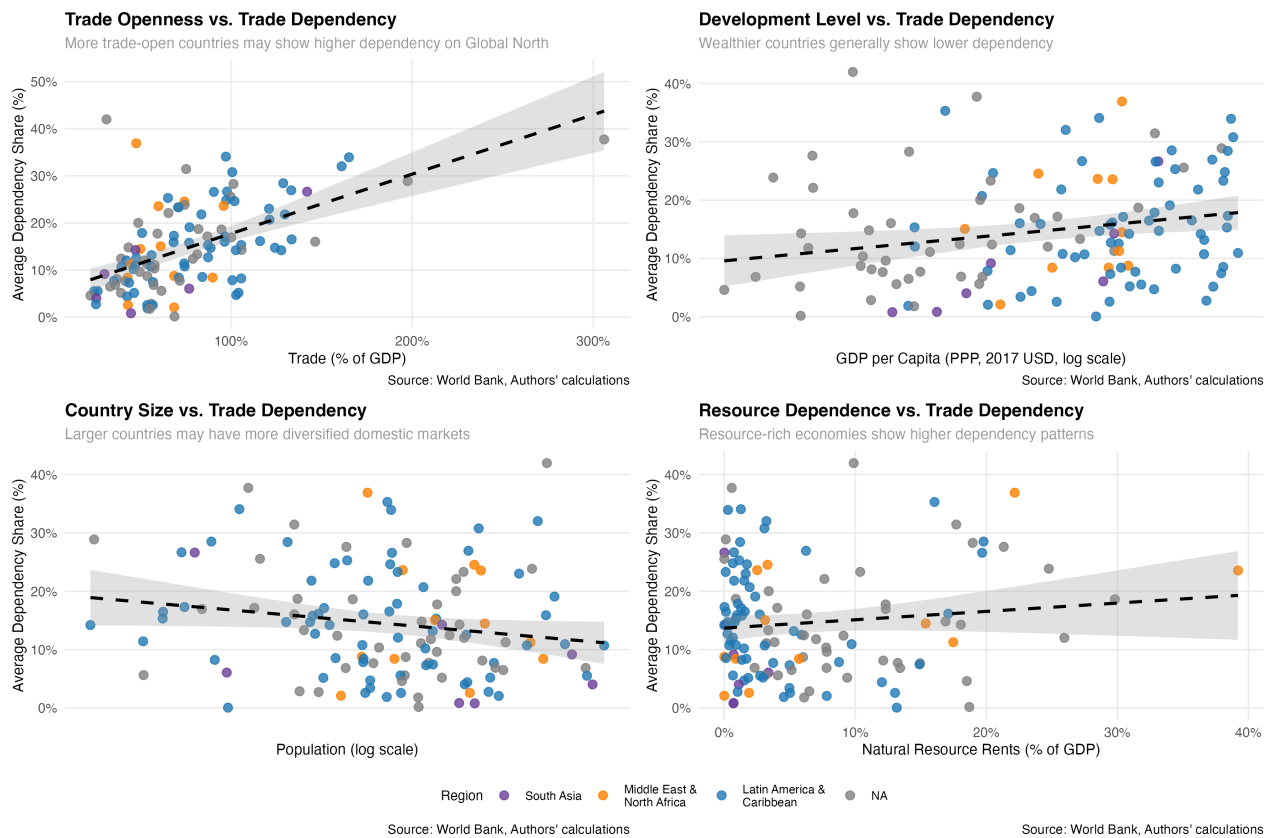


Figure 3: Global South Trade Dependencies for individual countries and regions

Finally, panel D of Figure 3 shows a positive correlation between dependence on natural resources and trade dependency. This association remains significant across all our robust estimation approaches (Table 4). This suggests that resource-dependent countries often generate significant portions of their value added through exports to Northern countries - a finding consistent with literature on resource extractivism and dependent growth.⁷

Future research could clarify the overall relationships or focus on interesting individual case studies. For example, Ethiopia shows an extremely high dependency despite its large population. In contrast, Nepal shows basically no dependency, and Malaysia shows strong dependence despite its relatively high wealth level. Nevertheless, our

⁷ To ensure our results are robust to outlying observations, we employ MM-estimation alongside explicit exclusion of identified outliers (Table 4). The MM-estimator identifies 3 countries as outliers, with Ethiopia showing the most extreme deviation (standardized residual = 5). The MM-estimator assigns Ethiopia zero weight while providing Libya partial weight (0.18), employing its automatic outlier detection capabilities. The robustness check reveals very high stability across methods. All coefficient differences between MM-estimation and explicit exclusion are less than 3.9% of the original OLS estimates. The trade openness coefficient—our key finding—shows remarkable consistency: 0.13 (OLS), 0.14 (MM-estimator), and 0.14 (exclusion), representing only 0.7% variation. This close correspondence between MM-estimation and explicit exclusion confirms that our findings are not driven by outlying observations and validates the MM-estimator’s automatic outlier handling. Overall, our regression analysis explains approximately 35% of the variation in dependency shares across countries.

results reveal systematic patterns that suggest trade dependency is not merely a function of economic development, geography, or history, but rather reflects the structural characteristics of economies' integration into global markets.

5. Discussion and Conclusion

This paper has been a first attempt to quantify the so far unerresearched side of the “twin challenge of global dependencies” (Gräbner-Radkowsch and Strunk 2023a) in the context of degrowth. The twin challenge points out that, on the one hand, global dependencies are a *reason* for degrowth, assuming that degrowth in the North could scale back neocolonial trade and financial relationships with the South. Much of the quantitative degrowth literature so far has contributed to *this* side of the twin challenge, analyzing currently existing patterns of ecologically unequal exchange and highlighting neocolonial hierarchies in the global economy (e.g. Schaffartzik, Duro, and Krausmann 2019; 2021; Hickel, Hanbury Lemos, and Barbour 2024; Ricci 2025b). Here we have complemented this research by having on the *other* side of the twin challenge: Our results show that significant dependencies do exist in some countries, with roughly a seventh of total incomes and profits in the South depending on trade with the North, with business profits being more vulnerable than incomes. Importantly, however, we found that dependency varies significantly by country, and does not follow a clear explanatory factor aside from trade openness. This suggests that more regionally specific future analyses are necessary to better understand this side of global dependency as well. It also shows that in a highly integrated global economy, policy changes in any country can have important impacts on other countries, meaning that the idea that Northern countries should focus on scaling down their economic activity alone can be problematic: policy design in the North must take serious a country's specific trade patterns with Southern economies and the corresponding implications. For the academic degrowth discourse this means that the search for strategies that take into account global dependencies of any kind is crucial.

But of course, there are certain limits to our approach that should be taken into account when interpreting our findings. Firstly, on the methodological side, input-output modelling, by its nature, is a static approach. It does not model or project structural adjustments that may happen as a response to hypothetical demand shocks. Therefore, we merely provide a snapshot of current trade relations that account for immediate economic vulnerability on part of the exporting partners *if* there was a reduction in demand. Secondly, on the substantive side, we have to caution against falling into the trap of seeing degrowth merely as a demand-reduction policy package. As Dengler and Seebacher (2019), for example, point out, most degrowth proponents do not envision degrowth to be a version of ‘less of the same,’ where degrowth is understood unidimensionally as a rapid quantitative reduction of consumption and production in the North. Degrowth aspires to be holistic and *qualitatively* different, which includes a range of interventions on various levels and dimensions, many of which are not limited to the formal policy sphere, nor merely to economic factors (D’Alisa and Kallis 2020). We therefore see our study not primarily as a predictive exercise that shows what part of incomes and profits in the South would be lost ‘if degrowth was implemented’, but rather as part and parcel of a larger research undertaking - including qualitative and quantitative studies - that aims to better understand the specific parameters of the ‘twin challenge of global dependencies’. This is a research project in its infancy, and we hope with this paper to contribute a first step toward a quantification of the obstacle side of the twin challenges.

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Short-term trade dependencies of the South as an obstacle to degrowth? Quantifying the twin challenge of global dependencies

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1. Appendix A: Country Classifications

Table 1: Country Classifications: Global North and Global South

Global North	Global South
Andorra, United Arab Emirates, Australia, Austria, Belgium, Bahrain, Bermuda, Brunei, Canada, Switzerland, Cayman Islands, Cyprus, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greenland, Hong Kong, Ireland, Iceland, Israel, Italy, Japan, South Korea, Kuwait, Liechtenstein, Lithuania, Luxembourg, Macao, Monaco, Malta, New Caledonia, Netherlands, Norway, New Zealand, Oman, Portugal, French Polynesia, Qatar, Saudi Arabia, Singapore, San Marino, Slovakia, Slovenia, Sweden, Trinidad and Tobago, Taiwan, United States, British Virgin Islands	Aruba, Afghanistan, Angola, Albania, Argentina, Armenia, Antigua and Barbuda, Azerbaijan, Burundi, Benin, Burkina Faso, Bangladesh, Bulgaria, Bahamas, Bosnia and Herzegovina, Belarus, Belize, Bolivia, Brazil, Barbados, Bhutan, Botswana, Central African Republic, Chile, Côte d'Ivoire, Cameroon, Democratic Republic of Congo, Congo, Colombia, Cape Verde, Costa Rica, Cuba, Djibouti, Dominican Republic, Algeria, Ecuador, Egypt, Eritrea, Ethiopia, Fiji, Gabon, Georgia, Ghana, Guinea, Gambia, Greece, Guatemala, Guyana, Honduras, Croatia, Haiti, Hungary, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kyrgyzstan, Cambodia, Laos, Lebanon, Liberia, Libya, Sri Lanka, Lesotho, Latvia, Morocco, Moldova, Madagascar, Maldives, Mexico, North Macedonia, Mali, Myanmar, Montenegro, Mongolia, Mozambique, Mauritania, Mauritius, Malawi, Malaysia, Namibia, Niger, Nigeria, Nicaragua, Nepal, Pakistan, Panama, Peru, Philippines, Papua New Guinea, Poland, North Korea, Paraguay, PSE, Romania, Russia, Rwanda, Sudan, Senegal, Sierra Leone, El Salvador, Somalia, Serbia, South Sudan, São Tomé and Príncipe, SUD, Suriname, Eswatini, Seychelles, Syria, Chad, Togo, Thailand, Tajikistan, Turkmenistan, Tunisia, Turkey, Tanzania, Uganda, Ukraine, Uruguay, Uzbekistan, Venezuela, Vietnam, Vanuatu, Samoa, Yemen, South Africa, Zambia, Zimbabwe

Table 2: Descriptive Statistics by Country Group (2017)

Indicator	Global North	Global South
Number of countries	53	133
Total population (millions)	1082.6	3685.9
Average population per country (millions)	20.8	28.4
Median population per country (millions)	5.0	11.0
Share of global population (%)	22.7	77.3
Total GHG emissions (Mt CO ₂ -eq)	15479622.0	15700041.1
Per capita emissions (t CO ₂ -eq/person)	0.014	0.004
Total raw material inputs (millions)	15132.8	27409.1
Per capita material inputs	13.98	7.44

The country classification we use for our analysis is summarized in [Table 1](#). It largely follows Dorninger et al. (2021), who categorize countries based on World Bank income classifications (according to a country's GNI per capita) but correct for population sizes. The Global North consists of high-income countries, while the Global

South encompasses low-income, lower-middle-income, and upper-middle-income countries. This classification excludes China and India from both groups due to their unique economic characteristics and substantial influence. Due to their sheer size they would dominate the results for their respective group completely.

Table 2 provides key demographic and environmental indicators for the two groups. The Global North comprises 53 countries with a combined population of 1082.6M people, representing 22.7% of the global population covered in our analysis. The Global South includes 133 countries with {python} format_millions(population_south_final) inhabitants, accounting for 77.3% of the world population.

When looking at environmental indicators the stark asymmetries between North and South become obvious: while both regions produce similar total greenhouse gas emissions , the Global North's per capita emissions are` {python} format_number(north_per_cap_emissions/south_per_cap_emissions) times higher than those of the Global South. For raw materials, the Global South uses significantly more in absolute terms, but the Global North consumes 2 times more per capita. These patterns reflect the substantial inequalities in resource consumption and environmental impact between developed and developing economies that has motivated our analysis of structural dependencies in the first place.

2. Appendix B: Details on methodological approach

This Section is meant to provide additional details on the formal methodology to compute dependency shares in the main paper. For a more general introduction to input-output modelling see Miller and Blair ([Miller and Blair 2009](#)). The code used for our analysis is publicly available as Gräbner-Radkowsch and Strunk ([Gräbner-Radkowsch and Strunk 2025](#)).

Input-output (I-O) analysis goes back to the contributions of Wassily Leontief in the 1930s. His key motivation was to develop a formal framework that is closely aligned with how economic data gets computed by administrative organisations (i.e. following closely the systems of national accounting), and that allows for an analysis of the interdependencies between different sectors of an economy. Correspondingly, the method of I-O analysis represents the economy as a network of interconnected sectors (or ‘industries’), where each sector uses inputs from other sectors to produce its output. Thus, it is particularly useful for understanding how economic shocks or policy changes in one sector propagate through the entire economic system.

The fact that the production of any good or service requires inputs from various other sectors, creating a web of dependencies that can be quantified through mathematical relationships, is the vantage point of I-O analysis. In its classical form, I-O analysis was concerned with a single national economy. But when extended to multiple regions or countries, I-O analysis becomes a powerful tool for examining international trade dependencies and the potential impacts of policy changes across national boundaries.

2.1 Mathematical Formulation

2.1.1 Basic Input-Output Table Structure

An input-output table is organized as a matrix that captures all monetary transactions within an economy over a specific period (typically one year).⁸ The table consists of three main components:

1. Intermediate transactions matrix (**Z**): This is an $n \times n$ square matrix that records the monetary flows between the n sectors in the economy
2. Final demand matrix (**Y**): This is an $n \times m$ matrix that captures sales to end users (households, government, exports, with m denoting the number of final demand categories); these are flows that ‘leave’ the circular economy represented by **Z**
3. Value-added matrix (**V**): This is a $k \times n$ matrix that includes wages, profits, and taxes, with k denoting the number of primary input categories; these are flows that ‘enter’ the circular economy represented by **Z** as primary inputs

The *final demand* represents the portion of each sector’s output that is consumed by end users rather than used as intermediate inputs by other sectors. It usually comprises household consumption, government spending, investment (capital formation), and net exports. Final demand is crucial because it represents the ultimate

⁸ There are also *physical* I-O tables that consider flows of physical material. Moreover, monetary I-O tables are sometimes augmented with physical tables that track, for instance, the environmental impact of production and consumption activities. EORA is one such ‘environmentally augmented’ I-O table.

destination of production in the economy - to satisfy the consumption needs of households, government requirements, capital accumulation, and export markets.

Value added or *primary inputs* constitute the complement to final demand on the input side of the economy. While final demand shows where outputs go, value added represents the primary inputs that enter the production process. Value added includes compensation of employees (wages and salaries), gross operating surplus (profits), taxes on production, and depreciation of capital. These primary inputs, along with intermediate inputs from other sectors, enable each industry to produce its total output. The sum of value added across all sectors equals the gross domestic product of the economy.

The fundamental accounting identity underlying I-O tables ensures that total inputs equal total outputs for each sector:

$$x_i = \sum_{j=1}^n z_{ij} + y_i$$

where:

- x_i = total output of sector i
- z_{ij} = intermediate sales from sector i to sector j
- y_i = final demand for sector i 's output
- n = number of sectors

Following the convention that lower-case bold letters represent vectors and upper-case bold letters represent matrices ([Miller and Blair 2009, 12](#)), the previous equation can be written for the entire economy as

$$\mathbf{x} = \mathbf{Z}\mathbf{i} + \mathbf{y}$$

where

$$\mathbf{x} = \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix}, \quad \mathbf{Z} = \begin{bmatrix} z_{11} & \cdots & z_{1n} \\ \vdots & \ddots & \vdots \\ z_{n1} & \cdots & z_{nn} \end{bmatrix} \quad \text{and} \quad \mathbf{y} = \begin{bmatrix} y_1 \\ \vdots \\ y_n \end{bmatrix}$$

$\mathbf{i}$ is a vector of ones that is needed for the above computations to satisfy the rules of linear algebra.

2.1.2 Technical Coefficients Matrix

The core of I-O analysis lies in the technical coefficients matrix $\mathbf{A}$, which captures the direct input requirements per unit of output. Each element a_{ij} represents the amount of input from sector i required to produce one unit of output in sector j :

$$a_{ij} = \frac{z_{ij}}{x_j}$$

This gives the technical coefficients matrix:

$$\mathbf{A} = \mathbf{Z} \cdot \hat{\mathbf{x}}^{-1}$$

where $\hat{\mathbf{x}}$ is a diagonal matrix of total outputs:

$$\hat{\mathbf{x}} = \begin{bmatrix} x_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & x_n \end{bmatrix}, \quad \hat{\mathbf{x}}^{-1} = \begin{bmatrix} 1/x_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 1/x_n \end{bmatrix}$$

It is a crucial and potentially problematic assumption of I-O analysis that $\mathbf{A}$ is fixed, meaning that economies of scale or technological innovations cannot be accounted for.

2.1.3 The Fundamental Input-Output Equation and the Leontief Inverse

The relationship between total output, intermediate demand, and final demand can be expressed as:

$$\mathbf{x} = \mathbf{Ax} + \mathbf{y}$$

where $\mathbf{y}$ is the vector of final demand for each sector's output.

Rearranging to solve for total output:

$$\mathbf{x} - \mathbf{Ax} = \mathbf{y}$$

$$(\mathbf{I} - \mathbf{A})\mathbf{x} = \mathbf{y}$$

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y}$$

The matrix $(\mathbf{I} - \mathbf{A})^{-1}$ is known as the *Leontief inverse* or *total requirements matrix*, denoted as $\mathbf{L}$:

$$\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$$

Each element l_{ij} of this matrix represents the total (direct plus indirect) amount of output from sector i required to satisfy one unit of final demand for sector j 's output. The diagonal elements represent direct requirements, while off-diagonal elements capture indirect requirements through the production network.

2.2 Multi-Regional Input-Output Extension

When analyzing trade dependencies between regions, the basic I-O framework can be extended to multiple regions. The biggest challenge in this context is to harmonize the data obtained for different countries, and take care of the many accounting problems that occur in practice. These challenging problems, however, are not visible when we look at the equations as such, which is why the mathematical formulation might appear trivial at first, as it looks like one is just “stacking” the I-O tables for different regions.

For a two-region system (which we might interpret as Global North and Global South), the technical coefficients matrix becomes:

$$\mathbf{A} = \begin{pmatrix} \mathbf{A}^{NN} & \mathbf{A}^{NS} \\ \mathbf{A}^{SN} & \mathbf{A}^{SS} \end{pmatrix}$$

where:

- $\mathbf{A}^{NN}$ = technical coefficients for North-North transactions
- $\mathbf{A}^{NS}$ = technical coefficients for North-South transactions

- $\mathbf{A}^{SN}$ = technical coefficients for South-North transactions
- $\mathbf{A}^{SS}$ = technical coefficients for South-South transactions

Each of these matrices contains technical coefficients for a particular subset of transactions. For instance, assume that the North consists of three sectors (e.g., agriculture, manufacturing, and services), the matrix $\mathbf{A}^{NN}$ might look like:

$$\mathbf{A}^{NN} = \begin{pmatrix} 0.15 & 0.25 & 0.05 \\ 0.20 & 0.35 & 0.10 \\ 0.10 & 0.15 & 0.30 \end{pmatrix}$$

where each element a_{ij}^{NN} represents the amount of input from Northern sector i required per unit of output in Northern sector j . For example, $a_{12}^{NN} = 0.25$ indicates that manufacturing in the North requires 0.25 units of agricultural inputs per unit of manufacturing output produced within the North.

The corresponding Leontief inverse for the two-region system is:

$$\mathbf{L} = \begin{pmatrix} \mathbf{L}^{NN} & \mathbf{L}^{NS} \\ \mathbf{L}^{SN} & \mathbf{L}^{SS} \end{pmatrix} = \begin{pmatrix} \mathbf{I} - \mathbf{A}^{NN} & -\mathbf{A}^{NS} \\ -\mathbf{A}^{SN} & \mathbf{I} - \mathbf{A}^{SS} \end{pmatrix}^{-1}$$

This matrix captures how final demand changes in one region affect production in all regions through both direct trade links and indirect effects through global supply chains.

2.3 Dependency Share Calculation

In the main paper, we have defined **dependency shares** as the proportion of value added (income and profits) in the Global South that depends on trade relationships with the Global North. This captures the economic vulnerability of Southern economies to potential demand reductions in Northern economies. In our analysis, we distinguish between *final demand dependency* and *total trade dependency*. Both concepts are defined formally below. To this end, we use the following notation:

- S = set of Global South countries
- N = set of Global North countries
- $\mathbf{v}_S$ = vector of value-added coefficients for Global South sectors
- $\mathbf{L}_{SS}$ = Global South domestic Leontief inverse matrix
- $\mathbf{y}_{S \leftarrow N}$ = vector of Global North final demand for Global South products
- $\mathbf{z}_{S \leftarrow N}$ = vector of Global North intermediate demand for Global South products
- V_S^{total} = total value added of the specified type in the Global South

A key element of our approach is that we focus on the domestic production chains within the Global South that are triggered by external (Global North) demand changes. This is why we use the Global South domestic Leontief inverse $\mathbf{L}_{SS}$ rather than the full global Leontief matrix.

2.3.1 Final Demand Dependency

The *final demand dependency* quantifies how much value added in the Global South depends on exports of goods and services to final consumers in the Global North (such as households and governments):

$$DS^{final} = \frac{\mathbf{v}_S \cdot \mathbf{L}_{SS} \cdot \mathbf{y}_{S \leftarrow N}}{V_S^{total}} \times 100$$

This calculation proceeds in three steps:

1. **External demand identification:** $\mathbf{y}_{S \leftarrow N}$ captures all final demand from Global North entities for Global South products and services
2. **Domestic production requirements:** $\mathbf{L}_{SS} \cdot \mathbf{y}_{S \leftarrow N}$ calculates the total production (direct plus indirect) required within the Global South to satisfy this external final demand, accounting for domestic supply chain linkages
3. **Value added generation:** $\mathbf{v}_S \cdot (\mathbf{L}_{SS} \cdot \mathbf{y}_{S \leftarrow N})$ applies the value-added coefficients to determine how much of the specified primary input (employee compensation, mixed income, or operating surplus) is generated through these production processes

2.3.2 Total Trade Dependency

The *total trade dependency* includes both final demand and intermediate demand from the Global North:

$$DS^{total} = \frac{\mathbf{v}_S \cdot \mathbf{L}_{SS} \cdot (\mathbf{y}_{S \leftarrow N} + \mathbf{z}_{S \leftarrow N})}{V_S^{total}} \times 100$$

where $\mathbf{z}_{S \leftarrow N}$ represents Global North purchases of Global South products for use as intermediate inputs in Northern production processes.

This can be decomposed into two components:

$$DS^{total} = DS^{final} + DS^{intermediate}$$

where:

$$DS^{intermediate} = \frac{\mathbf{v}_S \cdot \mathbf{L}_{SS} \cdot \mathbf{z}_{S \leftarrow N}}{V_S^{total}} \times 100$$

2.3.3 Implementation Details

The computational implementation of these equations can be seen in the code that we publish alongside this paper as Gräbner-Radkowsch and Strunk (2025). When you align the code to the equations above it might be useful to keep the following aspects in mind:

- Sectors are organized by country-sector pairs (e.g., “Brazil-Agriculture”, “Brazil-Manufacturing”)
- The Global South domestic Leontief inverse $\mathbf{L}_{SS}$ includes all within-South linkages while excluding North-South production dependencies
- Value-added coefficients $\mathbf{v}_S$ are calculated as ratios of primary inputs to total sectoral output
- Final and intermediate demands are extracted from the appropriate sub-matrices of the full global input-output table

These specificities are due to the way the data is organized in the EORA tables we use.

2.4 Limitations and Interpretative Caveats

It is important to keep in mind that the static nature of I-O analysis imposes several important limitations on interpretation. The analysis assumes fixed technical coefficients, meaning that the input requirements per unit of output remain constant regardless of changes in relative prices or technological conditions. Additionally, the analysis assumes zero price elasticity of final demand in the short run, implying that quantity demanded does not respond immediately to price changes. These assumptions make I-O analysis most suitable for examining short-term impacts and immediate structural dependencies, while longer-term dynamic adjustments requiring behavioral responses fall outside the scope of this methodology.

For the present context this means that the computed dependency shares should be considered a rough indication for the short-term vulnerability of a country, rather than a precise estimate. It is likely that some countries are more capable of adapting their productive structure to the new demand conditions, meaning the actual medium-term impact on their value added might be much smaller than suggested by the dependency shares. At the same time, other countries might face particular challenges when transforming their economies. Such differences are crucial to understand, but I-O analysis is not the right tool to study them.

3. Appendix C: Regression Details and Diagnostics

In our regressions we use the following control variables:

Variable	Definition	Source	Unit
Trade dependency	Average dependency across three primary inputs	Authors' calculations from EORA26	Percentage
Trade openness	(Exports + Imports) / GDP	World Bank WDI	Percentage
GDP per capita	GDP per capita, PPP (constant 2017 USD)	World Bank WDI	USD
Population	Total population	World Bank WDI	Persons
Natural resources	Total natural resources rents (% of GDP)	World Bank WDI	Percentage

3.1 Details on the OLS Baseline Regression

Diagnostic Plots: Baseline OLS Model

DEP = TradeOpen+log(GDPpc)+log(Population)+ResourceRents



Figure 1: OLS Regression Diagnostics

Figure 1 presents the standard diagnostic plots for the baseline OLS regression. The *residuals vs fitted* plot (top left), the most common diagnostic plot when it comes to linear regression, shows residuals – the difference between observed and fitted values – on the y-axis and the fitted values (or ‘model predictions’) on the x-axis. In the best

case, these plot does not exhibit any obvious structure. In the present case, this plot shows the point being scattered roughly evenly around zero with no clear pattern, yet it also points to several observations with high residuals, particularly Ethiopia, Libya, and Papua New Guinea. While this indicates that the linear model assumptions are reasonably met, it also suggests caution with regard to the influence of these outliers for the overall result.

The *normal Q-Q* plot (top right) compares the distribution of the residuals of our model (y-axis) against what we would expect from a normal distribution (x-axis). In the ideal case of perfectly normally distributed residuals, the points would appear on the 45 degree line. In our case, the plot suggests that in most areas the residuals follow approximately a normal distribution, as most points lie close to the diagonal line. Yet, it also reveals deviations from normality in the tails, suggesting, again, the presence of outliers.

The *scale-location* plot (bottom left) displays the square root of standardized residuals against fitted values. This plot is used to assess whether the variance of residuals is constant across all prediction levels. For our case, the plot shows relatively constant variance across all values, suggesting the homoscedasticity (equal variance) assumption is met.

Finally, the *residuals vs leverage* plot (bottom right) helps identify influential observations by plotting standardized residuals against leverage, which is a measure of how far a country's characteristics deviate from the average. In the present case, the plot identifies several influential observations including Ethiopia, Libya, and Papua New Guinea. While none of them exceeds conventional thresholds for problematic leverage (Cook's distance $> 4/n$), their presence suggests to also use more robust estimation methods to solidify our results.

3.2 Robust MM Estimation

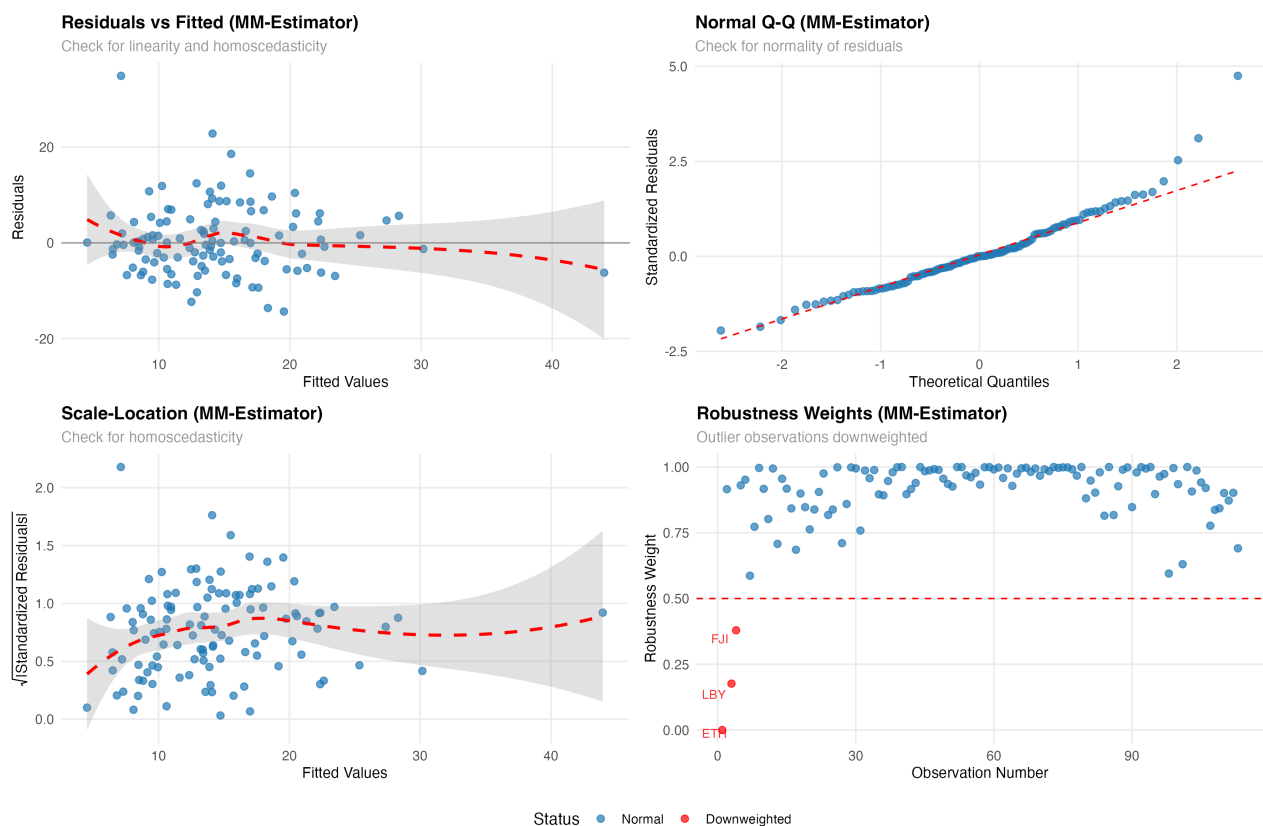


Figure 2: MM-Estimator Diagnostics

To this end, we use an MM-estimator, which employs a two-step process. First, it computes an initial robust estimate using an S-estimator. The S-estimator finds the parameter values that minimize a robust measure of scale, rather than the sum of squared residuals used in ordinary least squares (OLS). Then, it improves efficiency through M-estimation by re-estimating the parameters and minimizing a robust loss function that down-weights large residuals. The “M” stands for “maximum likelihood-type.” A breakdown point is a theoretical measure indicating how many outliers an estimator can tolerate before failing completely. It represents the worst-case scenario in which outliers are positioned to cause maximum disruption to the estimation process. A breakdown point of 50% means the method can handle up to half of the observations being outliers while still producing meaningful results—theoretically the maximum for any estimator. In practice, the MM-estimator’s high breakdown point allows it to identify core relationships even when a substantial minority of countries exhibit highly unusual patterns. This approach offers automatic outlier detection and handling, which differs from ordinary least squares (OLS) regression in that it is less sensitive to extreme values. While OLS treats all observations equally and is substantially influenced by outliers (essentially having a breakdown point of zero), the MM-estimator assigns weights to each observation based on how well it conforms to the overall pattern. Countries with unusual dependency patterns receive reduced weights, which can prevent them from influencing the observed relationships across the majority of countries disproportionately. This is particularly useful in cross-country analyses, where some nations may have unique economic structures that do not represent broader global patterns. Thus, the MM-estimator aims to preserve genuine relationships while maintaining statistical reliability without requiring manual exclusion of specific countries.

Figure 2 shows the diagnostic plots for the MM-estimator, which automatically downweights influential, but uncommon observations. It is used if one suspects outliers to have a problematic influence on the results. The Figure 2 suggests that this robust method indeed performs better than standard OLS: The residuals vs fitted plot shows even better scatter around zero, the Q-Q plot indicates more normal residual distribution with only three observations that act as outliers, which are also clearly visible in the weights plot (bottom right): Ethiopia (given a weight of zero), Libya (with a weight of about 0.18), and Fiji (with a weight of about 0.93).

3.3 OLS regression with manual outlier removal

The third estimation we did was not to use the weighting approach for handling outliers characteristic for the MM-estimation, but to manually remove the outliers that were detected by the MM-estimator (Ethiopia, Libya, and Fiji) and then to rely on OLS.

Diagnostic Plots: OLS with Outliers Excluded

Standard regression diagnostics after removing MM-identified outliers

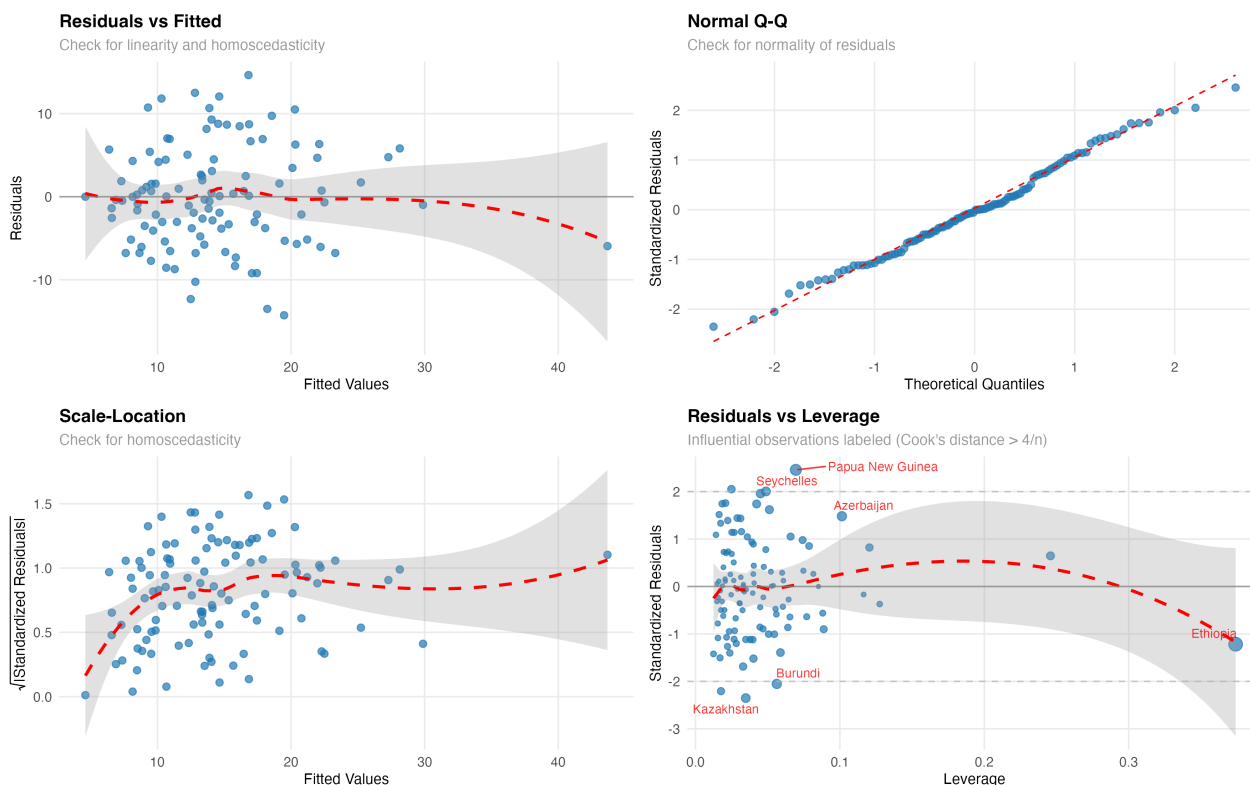


Figure 3: MM-Estimator Diagnostics

The corresponding diagnostics are shown in [Figure 3](#), which presents the diagnostic plots for the OLS model after explicitly excluding the outliers. The residuals vs fitted plot (top left) shows substantially improved behavior compared to the original OLS model, with residuals more evenly scattered around zero and no apparent systematic patterns. The normal Q-Q plot (top right) demonstrates that the residuals follow approximately normal distribution, with most points lying close to the diagonal line and fewer extreme deviations than in the full sample. The scale-location plot (bottom left) indicates more stable variance across fitted values after outlier removal, suggesting that the homoscedasticity assumption is (even) better met. The residuals vs leverage plot (bottom right) still identifies some influential observations (Papua New Guinea, Seychelles, Azerbaijan) but none exceed conventional problematic leverage thresholds (Cook's distance $> 4/n$). Notably, the removal of the three extreme outliers has substantially improved all model diagnostics while preserving the core relationships.

3.4 Model comparison

The comparison across estimation methods suggests that our findings are very consistent, regardless of how outliers are treated ([Table 3](#)). The trade openness coefficient—our central result—remains highly stable across all approaches (0.134, 0.144, and 0.144 respectively), confirming that countries with higher trade intensity tend to be more vulnerable to Global North demand reductions. The GDP per capita and natural resource coefficients show similar patterns across methods, while the population coefficient exhibits some variation but preserves the same directional relationship.

Both robust approaches produce smaller standard errors than OLS and achieve higher R-squared values (0.457 and 0.476 versus 0.353), indicating improved model fit when the three identified outliers (Ethiopia, Libya, and Fiji) are dealt with.

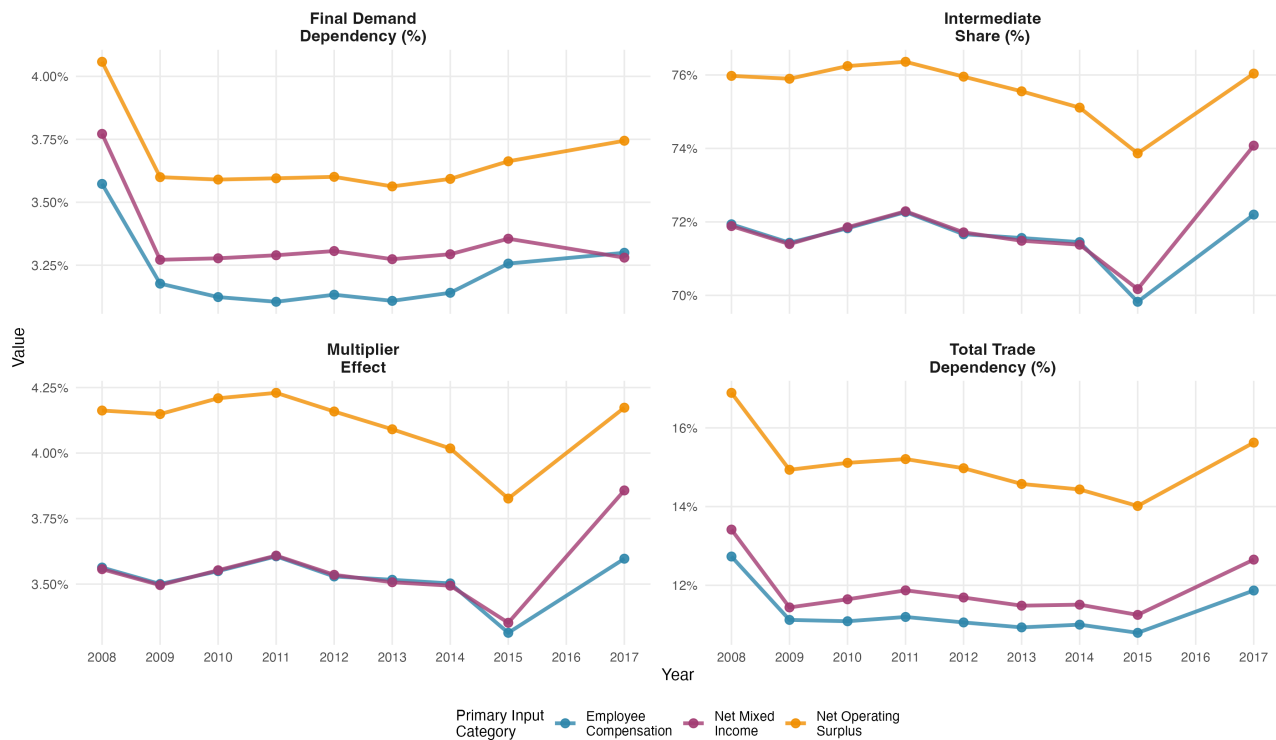
Table 3: Comprehensive Coefficient Comparison Across Estimation Methods. MM-estimator and explicit exclusion both provide robust estimates with improved precision compared to OLS.

Variable	OLS Coef.	OLS SE	MM Coef.	MM SE	Excl. Coef.	Excl. SE
Constant	-21.523.	(11.458)	-24.770**	(7.851)	-24.648*	(9.543)
Trade (% of GDP)	0.134***	(0.021)	0.144***	(0.020)	0.144***	(0.017)
Log GDP per capita	1.776*	(0.820)	1.910*	(0.797)	1.866**	(0.692)
Log Population	0.520	(0.489)	0.575	(0.433)	0.596	(0.412)
Natural resources (% of GDP)	0.257*	(0.103)	0.204*	(0.094)	0.201*	(0.088)
R-squared	0.353		0.457		0.476	
Observations	113		113		110	
Outlier treatment	Included		Downweighted		Excluded	
Countries affected	-		ETH, LBY, FJI		ETH, LBY, FJI	

4. Appendix D: Remarks on the temporal stability of the results

Temporal Robustness of Global South Trade Dependencies

Dependency measures across primary input categories over time



Source: EORA26 multi-regional input-output database

Figure 4: Temporal Robustness of Global South Trade Dependencies

The main analysis of the paper used data for the most recent year available. Here we wish to provide some remarks on the stability of our key results over time. To this end, [Figure 4](#) gives a first visual impression of the stability of the total dependency shares we have computed, and [Table 4](#) complements this with information about the mean, the standard deviation and minimum and maximum values for the . The coefficient of variation in the last column is computed as the ratio between the standard deviation and the mean, and its very low values indicate a strong temporal stability of our results.

Table 4: Temporal Robustness Summary Statistics: Trade Dependencies (2008-2015). CV = Coefficient of Variation. Lower CV values indicate more stable relationships over time.

Primary Input Category	Mean (%)	Std Dev	Min (%)	Max (%)	CV	Years Available
Employee Compensation	11.3	0.6	10.8	12.7	0.054	9
Net Mixed Income	11.9	0.7	11.2	13.4	0.059	9
Net Operating Surplus	15.1	0.8	14.0	16.9	0.055	9
Total	13.0	0.7	12.2	14.6	0.055	9

Finally, [Table 5](#) provides further evidence for this assessment through formal trend testing. The fact that all p-values are well beyond the conventional threshold of **0.05** suggests that there is no underlying trend in the dynamics of the dependency shares, meaning that our results represent rather persistent features rather than temporary phenomena.

Table 5: Temporal Stability Test Results: Trend Analysis of Trade Dependencies (2008-2015). Tests whether dependency shares show significant trends over time. Stability Assessment: ‘Stable’ indicates no significant temporal trend ($p > 0.05$).

Primary Input Category	Trend Coefficient	p-value	R ²
Employee Compensation	-0.063	0.432	0.090
Net Mixed Income	-0.051	0.582	0.046
Net Operating Surplus	-0.134	0.192	0.229
Total	-0.094	0.307	0.148

5. References

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