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Imperialist appropriation in the world economy: Drain from the global South through unequal exchange, 1990–2015

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ABSTRACT

Unequal exchange theory posits that economic growth in the "advanced economies" of the global North relies on a large net appropriation of resources and labour from the global South, extracted through price differentials in international trade. Past attempts to estimate the scale and value of this drain have faced a number of conceptual and empirical limitations, and have been unable to capture the upstream resources and labour embodied in traded goods. Here we use environmental input-output data and footprint analysis to quantify the physical scale of net appropriation from the South in terms of embodied resources and labour over the period 1990 to 2015. We then represent the value of appropriated resources in terms of prevailing market prices. Our results show that in 2015 the North net appropriated from the South 12 billion tons of embodied raw material equivalents, 822 million hectares of embodied land, 21 exajoules of embodied energy, and 188 million person-years of embodied labour, worth $10.8 trillion in Northern prices – enough to end extreme poverty 70 times over. Over the whole period, drain from the South totalled $242 trillion (constant 2010 USD). This drain represents a significant windfall for the global North, equivalent to a quarter of Northern GDP. For comparison, we also report drain in global average prices. Using this method, we find that the South's losses due to unequal exchange outstrip their total aid receipts over the period by a factor of 30. Our analysis confirms that unequal exchange is a significant driver of global inequality, uneven development, and ecological breakdown.

1. Introduction

Historians have demonstrated that the rise of Western Europe depended in large part on natural resources and labour forcibly appropriated from the global South during the colonial period, on a vast scale. Spain extracted gold and silver from the Andes, Portugal extracted sugar from Brazil, France extracted fossil fuels, minerals and agricultural products from West Africa, Belgium extracted rubber from the Congo; and Britain extracted cotton, opium, grain, timber, tea and countless other commodities from its colonies around the world – all of which entailed the exploitation of Southern labour on coercive terms, including through mass enslavement and indenture. This pattern of appropriation was central to Europe's industrial growth, and to financing the expansion and industrialization of European settler colonies, including Canada, Australia, New Zealand and the United States, which went on to develop similarly imperialist orientations toward the South (e.g., Naoroji, 1902; Pomeranz, 2000; Beckert, 2015; Moore, 2015; Bhambra, 2017; Patnaik, 2018; Davis, 2002).

According to the conventional public narrative, colonial patterns of extraction ended with the withdrawal of colonial troops, flags and bureaucrats from the territories of the global South. Today, we are told, the world economy functions as a meritocracy: countries that have strong institutions, good markets, and a steadfast work ethic become rich and successful, while countries that lack these things, or which are hobbled by corruption and bad governance, remain poor. This assumption underpins dominant perspectives in the field of international development (Sachs, 2005; Collier, 2007; Rostow, 1990; Moyo, 2010; Calderisi, 2007; Acemoglu and Robinson, 2012), and is reinforced by the rhetoric,

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common among neoclassical economists, that free-trade globalization has created an "even playing field".

This narrative of post-colonial innocence has long come under critique. In the 1960s and 1970s, economists and historians associated with dependency theory and world-system theory argued that the general structure of the colonial economy remains in place, with industrial growth in the global North continuing to rely on appropriation from the South well into the post-colonial era (Rodney, 1972; Prebisch, 1950; Galeano, 1973; Wallerstein, 1974; Frank, 1967; Nkrumah, 1965). Rich countries and monopolistic corporations leverage their geopolitical and commercial dominance in the world economy to depress or cheapen the prices of resources and labour in the global South, both at the level of whole national economies as well as within global commodity chains (section 5.2). As a result, for every unit of embodied resources and labour that the South imports from the North they have to export many more units to pay for it, enabling the North to achieve a net appropriation through trade. This dynamic was theorized by Emmanuel (1972) and Amin (1978) as a process of "unequal exchange".

Emmanuel and Amin argued that unequal exchange enables a "hidden transfer of value" from the global South to the global North, or from periphery to core, which takes place subtly and almost invisibly, without the overt coercion of the colonial apparatus and therefore without provoking moral outrage. Prices are naturalized on the grounds that they represent "utility", or "value", or the outcome of "market mechanisms" such as supply and demand, obscuring the extent to which they are determined by power imbalances in the global political economy. Price differentials in international trade therefore function as an effective method of maintaining the patterns of appropriation that once overtly defined the colonial economy, allowing blame for "underdevelopment" to be shifted onto the victims.

This pattern remains entrenched despite the fact that, with the rise of neoliberal globalization in the 1980s, manufacturing has shifted overwhelmingly to the global South, to the point where Southern countries contribute the vast majority of the world's industrial labour and industrial production (Smith, 2016). Northern appropriation from the South comprises resources and labour embodied not only in primary commodities but also in manufactured goods, including high-technology products such as smartphones, computer chips, cars, designer fashion, etc., along with intermediate parts. Most of this appropriation occurs through global commodity chains, wherein Northern firms deploy monopsony and monopoly power to depress Southern suppliers' prices at every node, from extraction to manufacture, while setting final prices as high as possible (Suwandi, 2019; Clelland, 2014).

Several attempts have been made to estimate the monetary value of appropriation or drain from the global South through unequal exchange, generally by correcting the South's export revenues for North-South price distortions in order to arrive at some representation of "losses". Amin (1978: 144) focused on international wage inequalities, although doing so meant he was unable to account for other inputs that may affect overall price differentials. Köhler (1998) developed a more holistic method, using the distortion factor between market exchange rates (MER) and purchasing power parity (PPP) as a proxy for overall price inequalities. Using a modified version of Köhler's method, recent research has found that in 2015 drain from the South through unequal exchange amounted to $2.1 trillion (constant 2011 dollars), represented in Northern prices (Hickel et al., 2021). Köhler's proxy approach is limited in several respects, however. It relies on PPP figures that do not adequately account for the comparatively high prices of Northern exports; it relies on GDP figures that are affected by the low prices of imports from the South; and it compares Southern exports to prices across whole economies, rather than to those of only traded goods. All of this leads to underestimating the scale of drain (see Hickel et al., 2021).

Perhaps more importantly, existing methods are limited in that they rely on trade revenues and price differentials as proxies by which to estimate drain without any reference to actual goods, precisely because goods remain hidden behind monetary trade data. Moreover, the conventional monetary data relates only to traded goods themselves and does not capture the upstream inputs that go into producing them, the prices of which significantly affect trade prices and, in a context of globally dispersed commodity chains, may involve many different countries. For instance, if the USA exports an aircraft, it may embody parts imported from China and Bolivia, which existing methods can account for using conventional trade data (e.g., Hickel et al., 2021), but it also embodies the materials and labour deployed in China and Bolivia to produce those parts, which existing methods cannot capture.

Here we take a novel approach that seeks to overcome the limitations of previous work. Following Dorninger et al. (2021), we use a "footprint" analysis of input–output data to quantify the physical scale of raw materials, land, energy and labour embodied in trade between the North and South, looking not only at traded goods themselves but also the upstream resources and labour that go into producing and transporting those goods, including the machines, factories, infrastructure, etc. (Lenzen et al., 2013; Lenzen et al., 2012; Wiedmann et al., 2015). This approach builds on scholarship in ecological economics and industrial ecology. Using footprint metrics allows us to capture inputs even when they flow through complex global commodity chains: we can identify where the labour and resources are rendered and where the value is ultimately captured. This enables us to ground our analysis of unequal exchange in real resources and a more robust assessment of prices and price inequalities in trade, while maximizing the comparability of flows between the North and South.

Using environmental input–output data, we find that there has been a significant *net* flow of embodied labour and natural resources from the global South to the global North over the period 1990 to 2015 (section 3). By comparing the physical scale of net resource flows to global price differentials, we estimate the monetary dimension of the drain. This is calculated not with respect to some objectively "correct" price for labour and resources (there is no such thing), but rather by representing the drain in terms of prevailing Northern prices, as well as in terms of global average prices for comparison. For "prices" we use trade in value-added (TiVA) per unit of resources embodied in traded goods, which is the monetary counterpart of our footprint method.

Grounding our analysis in the physical dimensions of unequal exchange is important for several reasons. First, these resources – raw materials, land, labour and energy – embody the productive potential that is required for meeting human needs (use-value) and for generating economic growth (exchange-value). Physical drain is therefore ultimately what drives global inequalities in terms of access to provisions, as well as in terms of GDP or income (see Hornborg, 2020). Second, this approach allows us to maintain sight of the ecological impacts of unequal exchange. We know that excess energy and material consumption in high-income nations, facilitated by appropriation from the rest of the world, is causing ecological breakdown on a global scale. Tracing flows of resources embodied in trade allows us to determine the extent to which Northern appropriation is responsible for ecological impacts in the South; i.e., ecological debt (Roberts and Parks, 2009; Warlenius et al., 2015; Hornborg and Martinez-Alier, 2016).

2. Methodology

To assess the scale of resource flows in trade and their monetary counterpart – the trade in value added (TiVA), we use input–output methodology and an environmentally-extended multi-regional input–output (MRIO) database. The present study is based on a data set which has been sourced from the MRIO analysis of Dorninger et al. (2021). For further details on the methodology, we refer readers to that paper. In what follows here, we provide a brief overview of the input–output (IO) analysis and the MRIO database. Upper- and lower-case letters denote matrices and column-vectors respectively; prime indicates transposition; i is a column-vector of ones used for summation, hence Zi sums the row elements (outputs) of the transaction matrix and i'Z the column elements (inputs).

IO tables describe the interdependencies between different economic entities by recording transactions among industries (Z), final demand (y) and value added in production (v) which accounts for employee compensation, depreciation of fixed capital, profits plus taxes minus subsidies. The core principle of IO tables are monetary industry balances, where total output must be equal to total input. Total output (x) equals all sales for intermediate production plus final demand, that is, $x = Zi + y$, whereas total input (x') equals all inter-industry purchases plus value added, $x' = i'Z + v$. IO tables are central to the System of National Accounts (European Commission et al., 2009). Various national statistical institutions compile national IO databases on a regular basis.

Using basic matrix algebra, the demand-driven IO model can be estimated by $x = (I - A)^{-1}y$, where $A = Z\hat{x}^{-1}$ is the technology matrix of direct input coefficients, whose element $a_{ij} = z_{ij}/x_j$ expresses direct inputs from industry i required per unit of gross output of sector j . I is the identity matrix with ones on the diagonal. Hats ($\hat{}$) indicate diagonalization of vectors, and $\hat{x}^{-1}$ denotes matrix inversion. $(I - A)^{-1}$ is the so-called 'Leontief inverse' L . The element l_{ij} of L quantifies the total upstream, i.e., direct and indirect, inputs from sector i that are required to produce a unit of industry output j for final demand (Miller and Blair, 2009).

MRIO tables integrate national IO tables and bilateral trade accounts and contain data for a large number of countries (Tukker and Dietzenbacher, 2013). MRIO analysis is frequently applied for assessments of environmental pressures embodied in international trade (Wiedmann and Lenzen, 2018). A number of global MRIO databases have been developed over the last decade (Inomata and Owen, 2014). The present study uses the MRIO database Eora (Lenzen et al., 2013; Lenzen et al., 2012; version v.199.82) which includes data for 189 countries in a time series from 1990 to 2015.

MRIO tables in monetary units are complemented by satellite accounts (e), i.e., extension tables recording non-monetary flows associated with economic activities, such as raw material extraction (measured in metric tons), land use (hectares), final energy consumption (Joule), and labour requirements (working hours). Extension tables are sometimes referred to as the territorial, i.e., production-based, account. Consumption-based accounts (F) take on a complementary perspective and are often referred to as footprint indicators. MRIO-based footprint indicators are calculated by $F = \hat{q}L\hat{y}$, where $\hat{q} = \hat{e}\hat{x}^{-1}$ is a diagonalized intensity vector showing the direct use of non-monetary flows (e) per unit of industries' gross output (x). Element f_{ij} quantifies the amount of non-monetary flows (e) that are embodied in the total upstream inputs from industry i required to satisfy the final demand for industry output j (for further details about environmental IO analysis see chapter 9 in Miller and Blair, 2009). Consumption-based accounts (F), when calculated in an MRIO framework, omit double counting and hence always add up to the total production-based account (e).

Due to the growing fragmentation of international commodity chains, monetary databases on bilateral gross trade flows have been criticised for not accurately depicting the monetary interdependencies between national economies (Johnson and Noguera, 2012), i.e., the amount of a countries' value added that is induced by foreign final demand and international trade relations. Trade in Value Added (TiVA) indicators (Johnson and Noguera, 2012; Timmer et al., 2014) are designed to take into account the complexity of the global economy. The TiVA concept is motivated by the fact that, in monetary terms, trade in intermediates accounts for approximately two-thirds of international trade. Imports (of intermediates) are used to produce exports and hence bilateral gross exports may include inputs (i.e., value added) from third party countries (Stehrer, 2012). TiVA reveals where (e.g., in which country or industry) and how (e.g. by capital or labour) value is added or captured in global commodity chains (Timmer et al., 2014).

TiVA, which is sometimes referred to as the "value footprint", is the monetary counterpart of the MRIO-based environmental footprint because both indicators follow the same system boundaries, i.e., all supply chains between production and final consumption of two countries including all direct and indirect interlinkages. Moreover, in contrast to global bilateral monetary trade flows, TiVA is globally balanced, meaning that national exports and imports globally sum up to zero. This is an important feature of the TiVA indicator that facilitates more consistent and unambiguous assessments.

Using a demand-driven IO model as described before, TiVA (B) is calculated by $B = \hat{p}L\hat{y}$, where $\hat{p} = \hat{v}\hat{x}^{-1}$ is a diagonalized vector showing the amount of value added (v) per unit of industries' gross output (x). The column sum of matrix B adds up to final demand (y) and the row sum to value added (v), no double-counting involved. Because TiVA is globally balanced, global value added (v) must sum up to global final demand (y). In 2015, this was approximately 75 trillion USD. In the present work, TiVA is quantified in terms of constant international 2010 US-American dollars (USD). Element b_{ij} quantifies how much value added (v) is embodied in the upstream inputs from industry i required to satisfy the final demand for product j . We can interpret the element b_{ij} as an indicator showing how much of the expenditures for final product j is directly and indirectly captured by the production activity i . In the following we use TiVA to represent a country's compensation for its exports.

3. The physical scale of drain through unequal exchange

Our first step is to calculate the physical scale of the embodied resources that flow between the global North and the global South. As a proxy for the "global North," we use the IMF's "advanced economies" grouping (as of 2015), which includes the USA, Canada, Western and Northern Europe, Australia, New Zealand, Israel and Japan, plus South Korea, Taiwan, Singapore and Hong Kong, and a number of small island territories (see Appendix 1 for country classification). All other countries (i.e., the IMF's "emerging and developing economies") are classified as the "global South". Following Dorninger et al. (2021), we examine direct and indirect trade flows between these advanced economies and the rest of the world, tracking four categories:

- materials, measured in 'raw material equivalents' (RMEs): i.e., total upstream (direct and indirect) raw material requirements related to the production of goods and services (measured in Gigatons [Gt]) (Wiedmann et al., 2015);
- land: i.e., total area of land use required for the production of goods and services (measured in million hectares [mn ha]) (Bruckner et al., 2015); and
- energy: i.e., total primary energy required to produce economic goods and services (measured in Exajoules [EJ]) (Chen et al., 2018).
- labour: i.e., labour expended in the global commodity chain to produce a certain good and service (measured in million person-year equivalents [mn p-y_{eq}]) (Alsamawi et al., 2014);

A national footprint represents the domestic extraction (materials), use (energy, land) or input (labour) of resources within a given nation plus the net trade (i.e., imports minus exports, including embodied flows). For example, the domestic labour input plus the embodied labour of imports and minus the embodied labour of exports results in a country's employment footprint (Alsamawi et al., 2014). Fig. 1 shows the South's embodied resource exports and imports to and from the North. It reveals that for every unit of embodied raw material equivalent that the South imports from the North, they have to export on average five units to "pay" for it (a ratio of 5:1). For land the average ratio is also 5:1, for energy it is 3:1, and for labour it is 13:1. This pattern results in significant net flows of resources from South to North, which are represented in absolute terms in Table 1, and as shares of Northern consumption in Table 2. On a global scale, net appropriation by the North is equivalent to net drain from the South. The choice of terminology

Fig. 1. Resource drain from the South.

Table 1
Resource drain from the South.

Resource	North → South flows 2015	South → North flows 2015	Drain from South in 2015	Cumulative drain from South 1990–2015
Raw material equivalents [Gt]	3.37	15.39	12.02	254.40
Embodied land [mn ha]	527.42	1,349.01	821.59	32,987.23
Embodied energy [EJ]	21.55	43.51	21.06	650.34
Embodied labour [mn py-eq]	31.11	219.22	188.12	5,956.62

Table 2
Drain as share of Northern consumption.

Resource	Northern consumption in 2015	Drain as % of Northern consumption in 2015	Northern consumption 1990–2015	Drain as % of Northern consumption 1990–2015
Raw material equivalents [Gt]	28.06	43%	676.77	38%
Embodied land [mn ha]	3,878.80	21%	112,416.80	29%
Embodied energy [EJ]	217.43	10%	6,137.42	11%
Embodied labour [mn py-eq]	630.06	30%	17,365.49	34%

depends on which perspective we take on these transfers. In the figures and tables presented here, we refer to it as a drain.

The results show that in the year 2015 the North's *net* appropriation from the South totalled 12 billion tons of raw materials, 822 million hectares of land, 21 exajoules of energy (equivalent to 3.4 billion barrels of oil), and 188 million person-years equivalents of labour (equivalent to 392 billion hours of work). By net appropriation we mean that these resources are not compensated in equivalent terms through trade; they are effectively transferred *gratis*. And this appropriation is not insignificant in scale; on the contrary, it comprises a large share (on average about a quarter) of the North's total consumption.

This net appropriation, which is known as ecologically unequal exchange (Hornborg, 1998; 2012), has significant consequences for the global South, in terms of lost use-value. This quantity of Southern raw materials, land, energy and labour *could* be used to provision for human needs and develop sovereign industrial capacity in the South, but instead it is mobilized around servicing consumption in the global North. For instance, 21 exajoules of energy would be enough to cover the annual energy requirements of building out necessary infrastructure to ensure that all 6.5 billion people in the global South have access to decent housing, public transport, healthcare, education, sanitation, communication, etc. (Kikstra et al., 2021a). Eight hundred and twenty-two million hectares of land, which is twice the size of India, would in theory be enough to provide nutritious food for up to 6 billion people, depending on land productivity and diet composition (Poore and Nemecek, 2018).

Net resource appropriation also has significant *ecological* consequences in the regions where the extraction takes place. For instance, material use is tightly linked to environmental pressures. It accounts for more than 90% of variation in environmental damage indicators (Steinmann et al., 2017), and more than 90% of biodiversity loss and water stress (International Resource Panel, 2019). Moreover, as Van der Voet et al. (2004) demonstrate, while impacts vary by material, and vary as technologies change, there is a coupling between *aggregate* mass flows and ecological impact. Net flows of material resources from South to North mean that much of the impact of material consumption in the North (43% of it, net of trade) is suffered in the South. The damage is offshored.

Industrial ecologists hold that global extraction and use of materials should not exceed 50 billion tons per year (Bringezu, 2015). In 2015, the global economy was using 87 billion tons per year, overshooting the boundary by 74% and driving ecological breakdown. This overshoot is due almost entirely to excess resource consumption in global North countries. The North consumed 26.71 tons of materials per capita in 2015, which is roughly four times over the sustainable threshold (6.80 tons per capita in 2015). Our results indicate that most of the North's *excess* consumption (58% of it) is sustained by net appropriation from the global South; without this appropriation, material use in high-income nations would be much closer to the sustainable level.

Something similar can be said about energy. The vast majority of embodied energy appropriated from the South is supplied by fossil fuels and therefore entails greenhouse gas emissions. In consumption-based terms, the North is responsible for 92% of carbon dioxide emissions in excess of the planetary boundary (350 ppm atmospheric concentration of CO_2) (Hickel, 2020), while the consequences harm the South disproportionately, inflicting dramatic social and economic costs (Kikstra et al., 2021b; Srinivasan et al., 2008). The South suffers 82–92% of the costs of climate change, and 98–99% of the deaths associated with climate change (DARA, 2012) (note these texts rely on slightly different country groupings to the ones we use here). The North's net appropriation of energy from the South (as in Fig. 1 and Table 1) means that the benefits accrue in the former while emissions-related damages fall mostly on the latter. The same is true of the North's appropriation of embodied land, which is another major driver of emissions (IPCC, 2018).

There are several other impacts worth mentioning. Net appropriation of land means soil depletion, water depletion, and chemical runoff are offshored; net appropriation of energy means that the health impacts of particulate pollution are offshored; net appropriation of labour means that the negative social impacts of exploitation are offshored, etc (Wiedmann and Lenzen, 2018). In the case of non-renewable resources there is also a problem of depletion: resources appropriated from the South are no longer available for future generations to use (Costanza and Daly, 1992; World Bank, 2018), which is particularly problematic given that under conditions of net appropriation economic losses are not offset by investments in capital stock (cf. Hartwick, 1977). Finally, the extractivism that underpins resource appropriation generates social dislocations and conflicts at resource frontiers (Martinez-Alier, 2021).

In sum, our results indicate that high and unsustainable levels of resource consumption in the global North rely on patterns of net appropriation from the South. The benefits accrue to the former while the damage is borne by the latter, generating a significant ecological debt. People in the South also disproportionately suffer the social impacts of Northern growth and consumption, and are deprived of resources necessary for development and provisioning for human needs.

4. Monetary representations of unequal exchange

Once we have established the scale of physical drain from the South, the question becomes how best to represent the value of this drain in monetary terms. This is a fraught terrain, because the value of resources and labour cannot be quantified in dollars, and there is no such thing as a "correct" price. Prices under capitalism do not reflect value or utility in any objective way. Rather, they reflect, among other things, the (im) balance of power between market agents (capital and labour, core and periphery, lead firms and their suppliers, etc); in other words, they are a political artefact. In the process of production, the primary objective of capital is to depress the prices of inputs as much as possible, and, in the absence of any countervailing political force, ideally toward zero. Indeed, this is the process that enables appropriation through global commodity chains and international trade. Quantifying value transfer therefore is not a matter of measuring the use-value (much less the ecological value) of appropriated resources and labour, or defining what the South could earn under fairer conditions, or determining how existing income should be apportioned. Rather, it is a matter of representing the drain in terms of existing market prices within capitalism. While prices by definition do not reflect value, they do allow us to compare the scale of drain to prevailing monetary representations of production and income in the world economy.

4.1. Primary method: drain represented in Northern prices

Amin (1978) and Köhler (1998) argued that value transfer should be measured in terms of Northern prices. In other words, the value of the physical quantity of labour and resources that the North appropriates from the South should be represented in terms of how that quantity would be priced in the North. This approach is valid insofar as Northern prices are used as a reference point for "value" (which is the case, for instance, in calculations of purchasing power parity, and with the household consumption data that is central to development economics). In the past, scholars have used some version of this equation for quantifying value transfer:

$$T = d^*X - X \tag{1}$$

where:

T = transfers through unequal exchange
X = Southern earnings on exports to the North
d = distortion factor: ratio of Northern prices to Southern prices

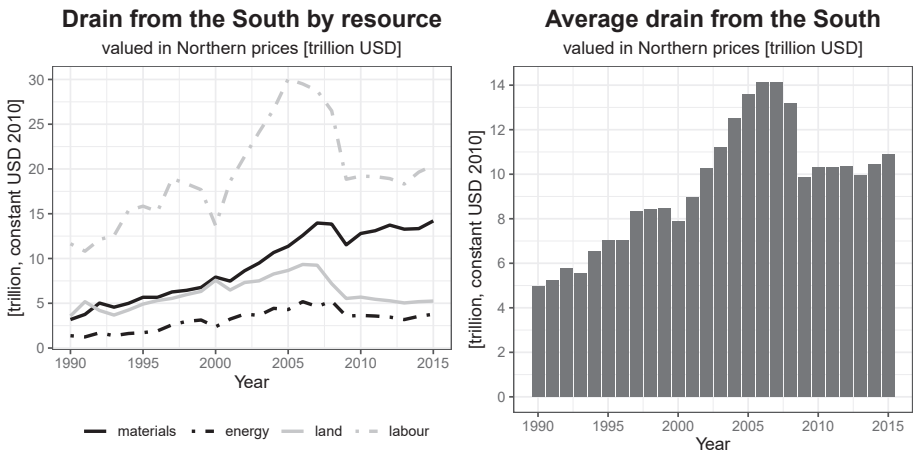

Fig. 2. Drain from the South, represented in Northern prices (constant 2010 USD).

This approach was useful at a time when data was available only for trade revenues and price proxies, such as those mentioned in section 1. It allowed analysts to estimate drain through trade that was otherwise "hidden" behind monetary trade figures. But because we can now quantify the actual resources and labour that are appropriated from the South each year, the hidden transfer is no longer hidden, and we can use a more direct approach to estimating its value. For instance, if we know that the North appropriated a net total of 12 billion tons [Gt] of embodied raw material equivalents from the South in 2015, then we can determine the value of that quantity in Northern prices, by multiplying net resource drain from the South by the Northern resource prices in that year. Then we need to correct for any net monetary trade flows that could be construed as partial payment for the resource trade deficit. We can represent this with the following equation:

$$T = R_{net} * P_N - M_{net} \quad (2)$$

where:

T = value transfers through unequal exchange
R_{net} = net resource drain from South to North
P_N = Northern export price per resource unit
M_{net} = net monetary transfers from North to South

To determine Northern prices we use TiVA, as discussed above; specifically, the average TiVA that countries in the North receive per unit of resources and labour embodied in goods exported to other countries. Here we maximize comparability of resources by excluding goods and prices related to domestic final consumption (i.e., finished goods) in order to focus only on prices for traded goods. Drain is therefore represented in terms of the exchange-value of resources and labour from the perspective of Northern workers, producers and sellers involved at any stage in the production of traded goods.

Fig. 2 shows that drain from the South in 2015 amounted to $14.1 trillion when measured in terms of raw material equivalents, $5.1 trillion when measured in terms of land, $3.6 trillion when measured in terms of energy and $20.3 trillion when measured in terms of labour. One cannot definitively attribute TiVA to specific inputs, however. The best we can say is that the value of the drain through unequal exchange in 2015 ranged between $3.6 trillion (if land represented 100% of TiVA) and $20.3 trillion (if labour represented 100% of TiVA). If we assume equal proportions for each factor in TiVA, the drain in that year amounted to $10.8 trillion in Norther prices. Drain from China alone amounted to $2.4 trillion, comprising 22% of net South-North flows (see Appendix 2 for results on China's physical trade with the North).

Table 3
Drain from the South, in Northern prices (constant 2010 USD), 1990–2015.

	Value of drain (trillions USD)	% of North's GDP
2015	$10.78	23%
1990–2015	$242.41	24%

This drain represents a significant loss for the South. For perspective, $10.8 trillion would have been enough to end extreme poverty 70 times over in 2015; i.e., with reference to the poverty gap at $1.90 per day in 2011 PPP, which is expressed in roughly the equivalent of Northern prices (World Bank 2021). It is worth noting that this result is larger than previous estimates of drain through unequal exchange (e.g., five times larger than in Hickel et al., 2021). This is because the footprint data we use here captures not only traded goods but also the upstream resources and labour embodied in the production of traded goods, which results in a larger North-South price differential (*d*). The difference can also be attributed to the fact that our method avoids the limitations of Köhler's price-proxy approach discussed in section 1, allowing for more precise and accurate results. The footprint method reveals that Northern accumulation relies on more intensive appropriation, and of a much broader share of total Southern production, than previous studies have suggested.

Over the period 1990–2015, the drain sums to $242 trillion (constant 2010 USD). This represents a significant "windfall" for the North, similar to the windfall that was derived from colonial forms of appropriation; i.e., goods that did not have to be produced on the domestic landmass or with domestic labour, and did not have to be bought on the domestic market, or paid for with exports (see Pomeranz, 2000; Patnaik, 2018). While previous studies have shown that the price distortion factor increased dramatically during the structural adjustment period in the 1980's (Hickel et al., 2021), our data confirms that since the early- to mid-1990's it has tended to decline slightly. This means that the increase in drain during the period 1990–2007, prior to the global financial crisis, was driven primarily by an increase in the volume of international trade rather than by an increase in price distortion.

Because the North's windfall is represented in Northern prices, it is suitable for comparison to Northern GDP. Table 3 shows that, over the 1990–2015 period, resources appropriated from the South have been worth on average roughly a quarter of Northern GDP.

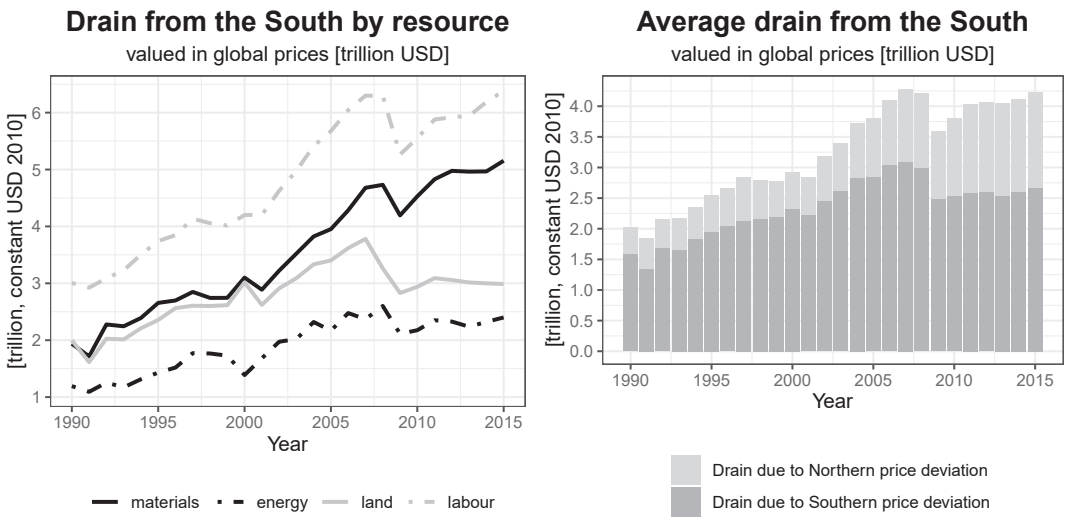

Fig. 3. Drain from the South, represented in global average prices (constant 2010 USD).

4.2. For comparison: Drain represented in global average prices

For comparison, we can also represent drain from the South in terms of global average prices. Cope (2019) developed a method for this, drawing on the notion that if labour was allowed to move freely across borders, and if bargaining power between North and South was more balanced, then aggregate prices would converge. Cope proposes using global average prices as a proxy for prices in an equal-exchange scenario. By this logic, the difference between the South's existing earnings on trade and what they would earn at global average prices represents the South's losses compared to a fairer world. Cope sums the results of two formulas: one (T1) that calculates drain due to price deviations on Southern exports, and another (T2) that calculates drain due to price deviations on Northern exports, compared to global average prices. The equations are as follows:

$$T1 = d1{*}X1 - X1 \tag{3a}$$

where:

X1 = Southern earnings on exports to the North
d1 = ratio of global average prices to Southern prices

$$T2 = X2 - d2{*}X2 \tag{3b}$$

where:

X2 = Northern earnings on exports to the South
d2 = ratio of global average prices to Northern prices
The South's total losses, $T = T1 + T2$

In reality, however, it is impossible to predict what might happen to prices under equal-exchange conditions. We can assume that, all else being equal, an improvement in the bargaining power of the South, and of labour, would likely increase the global average prices of traded goods well beyond the level of global average prices today. On the other hand, in such a scenario labour movements might also push to decommodify key sectors of the economy (healthcare, education, etc.), thus moving prices in the other direction. Furthermore, it is impossible to predict how equitable conditions might affect the total volume and composition of trade. Global average prices therefore cannot be used as a proxy for equal-exchange conditions, but they *can* be used as a metric by which to represent the monetary value of drain at the global price level under existing conditions. We can represent this with the following simplified equation:

$$T = R_{net}{*}P_G - M_{net} \tag{4}$$

where:

T = value transfers through unequal exchange
R_{net} = net resource drain from South to North
P_G = Global average price
M_{net} = net monetary transfers from North to South

In the right-side panel of Fig. 3, the light grey represents the share of drain that is due to the deviation of Northern prices above the global average, while the dark grey represents the share that is due to the deviation of Southern prices below the global average. Representing the drain in terms of global average prices allows us to compare it to the South's GDP in MER, as well as to other Southern financial stocks and flows that are measured in terms of market dollars, such as aid receipts (section 4.3). Table 4 shows that over the period from 1990 to 2015, drain from the South was equivalent to nearly a quarter of the South's GDP.

Table 4
Drain from the South, in global average prices (constant 2010 USD), 1990–2015.

	Value of drain (trillions)	% of South's GDP
2015	$4.23	15%
1990–2015	$84.55	23%

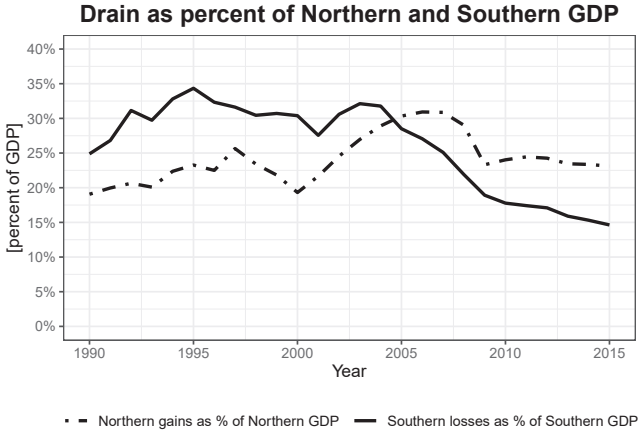

Fig. 4. Drain as percent of Northern GDP and Southern GDP.

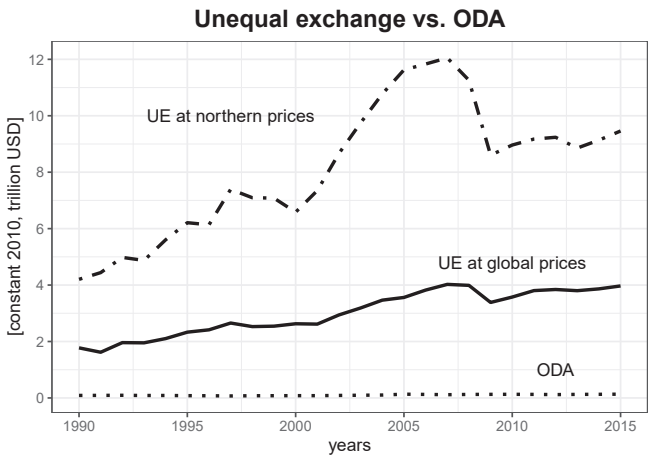

Fig. 5. Unequal exchange compared to ODA (constant 2010 USD).

Fig. 4 compares drain in Northern prices as a share of Northern GDP, and drain in global average prices as a share of Southern GDP. We see that the North's reliance on appropriation from the South has generally increased over the period (despite a significant drop after the global financial crisis), whereas the South's losses as a share of total economic activity have generally decreased, particularly since 2003, due to an increase in South-South trading and higher domestic GDP creation or capture within the South, both driven largely by China (Meng et al., 2018).Fig. 5.

4.3. Drain compared to aid flows (official development assistance, ODA)

One of the main strategies of international development is to call for overseas development assistance, and to encourage the governments of the Development Assistance Committee (DAC) to meet their commitment to spend 0.7% of GDP on aid. Aid flows create the powerful impression that rich countries give benevolently to poorer countries. But the data on drain through unequal exchange raises significant questions about this narrative. Here we compare aid flows from DAC countries to ODA (Official Development Assistance) recipients with the scale of net transfers between these groups (see the Appendix 1 for the country classifications). We use Northern prices to compare DAC aid disbursements to DAC gains through unequal exchange, and we use global average prices to compare ODA recipients' aid receipts to their losses through unequal exchange.

Our results show that net appropriation by DAC countries through unequal exchange from 1990 to 2015 outstripped their aid disbursements over the same period by a factor of almost 80 (Table 5, fourth column). In other words, for every dollar of aid that donors give, they appropriate resources worth 80 dollars through unequal exchange. From the perspective of aid recipients, for every dollar they receive in aid they lose resources worth 30 dollars through drain (Table 5, final column).

The dominant narrative of international development holds that poor countries are poor because of their own internal failings and are therefore in need of assistance. But the empirical evidence on unequal exchange demonstrates that poor countries are poor in large part because they are exploited within the global economy and are therefore in need of justice. These results indicate that combating the deleterious effects of unequal exchange by making the global economy fairer and more equitable would be much more effective, in terms of development, than charity.

5. Discussion

These results demonstrate that the general pattern of appropriation that characterized the colonial period has been maintained and indeed expanded into the postcolonial era through the mechanism of unequal exchange, despite significant changes in the structure of the world economy. In an equitable world, the resource trade deficit that the North sustains in relation to the South would be financed with a parallel *monetary* trade deficit. But in reality, the monetary trade deficit is very small, equivalent to only about 1% of global trade revenues, and fluctuates between North and South. In effect, this means that the North achieves its large net appropriation of resources and labour from the South *gratis*.

5.1. On price inequalities

In the past, unequal exchange theorists confronted questions about the comparability of goods traded between North and South. It is commonly assumed that price inequalities are due to sectoral disparities, with Northern exports consisting predominantly of manufactured goods (which embody more upstream labour, energy and machine processing), while Southern exports comprise predominantly primary commodities. Emmanuel (1972) pointed out this was not strictly true, even in the 1970s, while noting moreover that Northern prices are higher than Southern prices even when comparing like for like. He argued that, when it comes to prices, the main determining factor is bargaining power.

The question of sectoral disparities has been moot since the 1980s, however, as industrial production has shifted overwhelmingly to the South. The majority of Southern exports (70%) consist of manufactured goods (data from UNCTAD; see Smith, 2016). Of all the manufactured goods that the USA imports, 60% are produced in developing countries. For Japan it is 70%. We can see this pattern reflected also in the industrial workforce. As of 2010, at least 79% of the world's industrial workers live in the South (data from the ILO; see Smith, 2016). This shift is due in large part to the rise of global commodity chains, which now constitute 70% of international trade. Between 1995 and 2013, there has been an increase of 157 million jobs related to global commodity chains, and an estimated 116 million of them are concentrated in the South, predominantly in the export manufacturing sector (ILO, 2015). In other words, during the period we analyse in this paper (1990–2015), the South has contributed the majority of the world's industrial production, including high-technology production such as computers and cars. And yet price inequalities remain entrenched.

Are there significant qualitative differences between the labour performed in the North versus the South, within global commodity chains, that might explain wage inequalities? This seems unlikely. Southern production within global commodity chains involves labour ranging from manual work to managerial, engineering, logistics, and IT roles, with technology provided by international capital, while the end-of-chain steps performed in the global North (including design, advertising, retail and delivery) involve a similar range of labour. And yet wage disparities are nonetheless so extreme that highly skilled labour performed in the South may even receive lower pay than "unskilled" labour performed in the North.

Table 5
Value transfer compared to aid flows (monetary values are given in constant 2010 USD)

Years	Official Development Assistance (trillions)	UE at Northern prices (trillions)	DAC gains as multiple of ODA disbursements	UE at global average prices (trillions)	ODA recipients' losses as multiple of ODA receipts
2015	$0.13	$9.46	71.11	$4.00	29.84
1990–2015	$2.66	$211.33	79.46	$78.36	29.46

The dominant explanation for wage inequalities hinges on productivity differences: Northern exports have higher "value-added" because they embody higher labour productivity, the argument goes (e.g., Subasat, 2013). But this argument is tautological, and there is no evidence for the underlying claim. The conventional metric of productivity (GDP per unit of labour) is determined by *prices*, not by workers' actual productivity (Fischer, 2011; Fix, 2018). For instance, if Northern states or firms leverage monopoly power within global commodity chains to depress the prices of imports and increase the prices of final products, their labour "productivity" appears to improve, and that of their counterparts declines, even if the underlying production process remains unchanged. Indeed, empirical evidence indicates that real productivity differences between workers are minimal, and cannot explain wage inequalities (Hunter et al., 1990).

The disjuncture between wages and productivity is revealed by data on unit labour costs. The gap between unit labour costs in Northern and Southern economies demonstrates that the difference in wages is greater than the difference in productivity. In other words, wage inequalities exist not because Southern workers are less productive but because they are more intensively exploited, and often subject to rigid systems of labour control and discipline designed to maximize extraction (Suwandi et al., 2019). Indeed, this is a major reason why Northern firms offshore production to the South in the first place: because labour is cheaper per unit of physical output (Goldman, 2012).

In other words, the terminology of "value-added" is a misnomer. In international trade, TiVA does not tell us who adds more value but rather who has more power to command prices. And in the case of global commodity chains, TiVA does not indicate where value is produced but rather where it is *captured* (Smith, 2016). The power of the input–output-based footprint metric we have used here is that it maximizes the comparability of North-South exchanges by including upstream inputs embodied in traded goods, and allows us to trace the ultimate sources of the inputs that are mobilized within global commodity chains. To the extent that these inputs contribute to value added, our analysis reveals that value in global commodity chains is disproportionately produced by the South, but disproportionately captured by the North (as GDP). Value captured in this manner is misleadingly attributed to Northern economic activities (Suwandi et al., 2019:4-5).

5.2. On power

In previous research, Dorninger et al. (2021) found that the main predictor of high export prices (and therefore the capacity for net appropriation) was economic power, as measured by GDP. In other words, rich countries are able to maintain price inequalities simply by virtue of being rich. This finding supports longstanding claims by political economists that, all else being equal, price inequalities are an artefact of power. Just as in a national economy wage rates are an artefact of the relative bargaining power of labour vis-à-vis capital, so too in international trade prices are an artefact of the relative bargaining power of national economies and corporate actors vis-à-vis their trading partners and suppliers. Countries that grew rich during the colonial period are now able to leverage their economic dominance to depress the costs of labour and resources extracted from the South. In other words, the North "finances" net appropriation from the South not with money, but rather by maintaining the prices of Southern resources and labour below the global average level.

There are a number of mechanisms that enable this pattern. In section 1 we mentioned that Northern firms leverage monopsony and monopoly power to depress Southern suppliers' prices while setting final prices artificially high. Patents play a key role here: 97% of all patents are held by corporations in high-income countries (Chang, 2008:141). We can see how this plays out in the case of major products like iPhones. The iPhone is produced almost entirely in the global South, by arms-length suppliers. Apple, headquartered in the North, forces its suppliers to compete to drive prices down to cost, with wages depressed to the level of subsistence. This allows Apple to obtain the iPhone for cheap, and then, leveraging its patent monopoly (a privilege granted and enforced not by the market but by the state), mark up the final price by over 100% (see Smith, 2016). In some cases, patents involve forcing people in the South to pay for access to resources they might otherwise have obtained much more affordably, or even for free (Shiva, 2001; 2016).

Unequal exchange is also enabled by geopolitical power imbalances in the world economy. For instance, high-income nations exercise monopoly power in the institutions of international economic governance (Chang, 2008). In the World Bank and the IMF, Northern states hold a majority of votes (and the US holds a veto), thus giving them control over key economic policy decisions. In the World Trade Organization (which controls tariffs, subsidies, and patents), bargaining power is determined by market size, enabling high-income nations to set trade rules in their own interests. Subsidized agricultural exports from the North undermine subsistence economies in the South and contribute to dispossession and unemployment, placing downward pressure on wages. Militarized borders preclude easy migration from South to North, thus preventing wage convergence. Moreover, structural adjustment programs (SAPs) imposed by the World Bank and IMF since the 1980s have cut public sector salaries and employment, rolled back labour rights, curtailed unions, and gutted environmental regulations (Khor, 1995; Petras and Veltmeyer, 2002).

On top of this, there are several forces that work to prevent the South from developing sovereign industrial capacity (i.e., outside of subordinate positions in global commodity chains). SAPs, bilateral free trade agreements, and the World Trade Organization have forced global South governments to remove tariffs, subsidies and other protections for infant industries. This prevents governments from attempting import substitution, which would improve their export prices and drive Northern prices down. Tax evasion and illicit financial flows out of the South (which total more than $1 trillion per year) drain resources that might otherwise be reinvested domestically, or which governments might otherwise use to build national industries. This problem is compounded by external debt service obligations, which drain government revenue and require obeisance to economic policies dictated by creditors (Hickel, 2017). In addition, structural dependence on foreign investors and access to Northern markets forces Southern governments and firms to compete with one another by cutting wages and resource prices in a race to the bottom.

In other words, structural power imbalances in the world economy ensure that labour and resources in the South remain cheap and accessible to international capital, while Northern exports enjoy comparatively higher prices. These price differentials enable a significant drain of labour and resources from the South. While during the colonial period the prices of labour and resources in the colonies were determined by coercion, something similar can be said of the prices Southern exporters receive in contemporary international trade. Cheap labour and raw materials in the global South are not "naturally" cheap, as if their cheapness was written in the stars. They are actively cheapened (see Moore, 2015; Patel and Moore, 2017).

5.3. Limitations

This study faces several limitations that are worth noting. One problem is that focusing on aggregate flows between North and South may obscure important regional differences, particularly within the South. We isolated China in our analysis for comparison (see Appendix), but it may be useful in future research to explore a more extensive regional breakdown. Another problem is that the North-South analysis obscures patterns of sub-imperialism. For instance, China may suffer a net drain to the North but it may also benefit from exploiting economically weaker Southern countries, such as in Africa (Li, 2021). Further research might be able to quantify this dynamic by looking at each country's trade position against all other countries. The difficulty with

these finer-grained approaches is that data uncertainty increases in the process of disaggregation, and the results are likely to be less robust.

Another limitation of our method is that the analysis obscures class and geographic inequalities *within* countries and regions, which are significant when it comes to labour prices as well as resource consumption. The high levels of resource consumption that characterize Northern economies are driven disproportionately by rich individuals and affluent areas, as well as by corporations that control supply chains, and enabled by internal patterns of exploitation and unequal exchange in addition to drain through trade (Harvey, 2005). For example, there are marginalized regions of the United States that serve as an "internal periphery" (Wishart, 2014). It would also be useful to explore the gender dynamics of unequal exchange within countries. These questions cannot be answered with our data, however.

Finally, our ability to accurately estimate the monetary value of unequal exchange faces several limits. First, we have not assessed the relative contributions of raw materials, land, energy and labour to overall TiVA, which would allow us to estimate the prices of embodied resources more precisely. Future research might analyse drain on a more detailed industry or supply chain level in order to decompose the role of each factor. This would be possible by means of structural path analysis (SPA) (Defourny and Thorbecke, 1984). However, applying SPA is a non-trivial task, which demands additional computational resources and time. Deriving overall conclusions from such a detailed data set would be challenging, and is beyond the scope of the present work. Second, we have not detailed the material composition of raw material equivalents (i.e., the relative share of biomass, metals and minerals in the footprints of traded goods), which may compromise comparability to some extent. However, it must be noted that performing MRIO analyses on a more detailed industry and material group level, as with disaggregating the results into different regions and countries, could introduce additional uncertainties that may compromise the robustness of the results.

6. Conclusion

This research confirms that the "advanced economies" of the global North rely on a large net appropriation of resources and labour from the global South, extracted through induced price differentials in international trade. By combining insights from the classical literature on unequal exchange with contemporary insights about global commodity chains and new methods for quantifying the physical scale of embodied resource transfers, we are able to develop a novel approach to estimating the scale and value of resource drain from the global South. Our results show that, when measured in Northern prices, the drain amounted to $10.8 trillion in 2015, and $242 trillion over the period from 1990 to 2015 – a significant windfall for the North, equivalent to a quarter of Northern GDP. Meanwhile, the South's losses through unequal exchange outstrip their total aid receipts over the period by a factor of 30.

Our findings on net resource appropriation support contemporary demands for reparations for ecological debt, as articulated by environmental justice movements and by the G77 (Roberts and Parks, 2009; Warlenius et al., 2015; Hornborg and Martinez-Alier, 2016). At minimum, the social, economic and ecological damages associated with resource appropriation from the South – including damages from emissions – should be paid for by the appropriators, according to the polluter pays principle that operates in the European Union, United Kingdom, United States and other OECD countries. Reparations could also be paid according to the monetary value of appropriated resources, which could be used by the South to claim back resources from the North equivalent to what was drained, thus meeting Southern needs while reducing excess Northern consumption. Ultimately, however, the scale of ecological debt, like the value of resources themselves, cannot be quantified in monetary terms alone. Ecology is the basis of life itself and money cannot compensate for its loss. True repair requires permanently ending the unequal distribution of environmental goods and burdens between the global North and global South, restoring damaged ecosystems, and shifting to a regenerative economic system.

Our findings also have significant implications for international development theory and practice. It is clear that official development assistance is not a meaningful solution to global poverty and inequality; nor is the claim that global South countries need more economic liberalisation and export-oriented market integration. The core problem is that low- and middle-income countries are integrated into the global economy on fundamentally unequal terms. Rectifying this problem is critical to ensuring that global South countries have the financial, physical and human resources they need to improve social outcomes.

There are a number of steps that could be taken toward this end. One would be to democratize the institutions of global economic governance, such as the World Bank, IMF and WTO, so that global South countries have more control over trade and finance policy. Another would be to end the North's use of unfair subsidies for agricultural exports, and remove structural adjustment conditions on international finance, which would help mitigate downward pressure on wages and resource prices in the South while at the same time enabling Southern countries to build sovereign industrial capacity. Alternatively, and perhaps more directly, implementing a global living wage system, and a global system of environmental regulations, would effectively put a floor on labour and resource prices.

Interventions along these lines would allow the South to capture a fairer level of income from international trade. This would be more effective at improving development outcomes than the existing prescriptions based on aid, liberalisation, and market integration; and it would enable the South to mobilize domestic resources and labour for meeting domestic needs, rather than for servicing Northern consumption. But it would also have significant implications in terms of ecology. Reducing North-South price differentials would in turn reduce the scale of the North's net resource appropriation from the South (in other words, it would reduce ecologically unequal exchange), thus reducing excess consumption in the North and the ecological impacts that it inflicts on the South.

Such reforms are unlikely to be handed down from above, however, as they would run against the interests of geopolitical factions that benefit prodigiously from the present structure of the global economy. Structural transformation will only be achieved through political struggle from below, including by the anti-colonial and environmental justice movements that continue to fight against imperialism today (WPCCC, 2010; Scheidel et al., 2020; Red Nation, 2021). It will also require Southern states to use industrial and fiscal policy to pursue economic sovereignty, food and energy self-sufficiency, progressive import substitution, and regional solidarities (Amin, 1990; Kaboub, 2008; Ajl, 2021).

CRediT authorship contribution statement

Jason Hickel: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Christian Dorninger:** Conceptualization, Methodology, Writing – review & editing. **Hanspeter Wieland:** Methodology. **Intan Suwandi:** Conceptualization, Writing – review & editing.

Declaration of Competing Interest

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.

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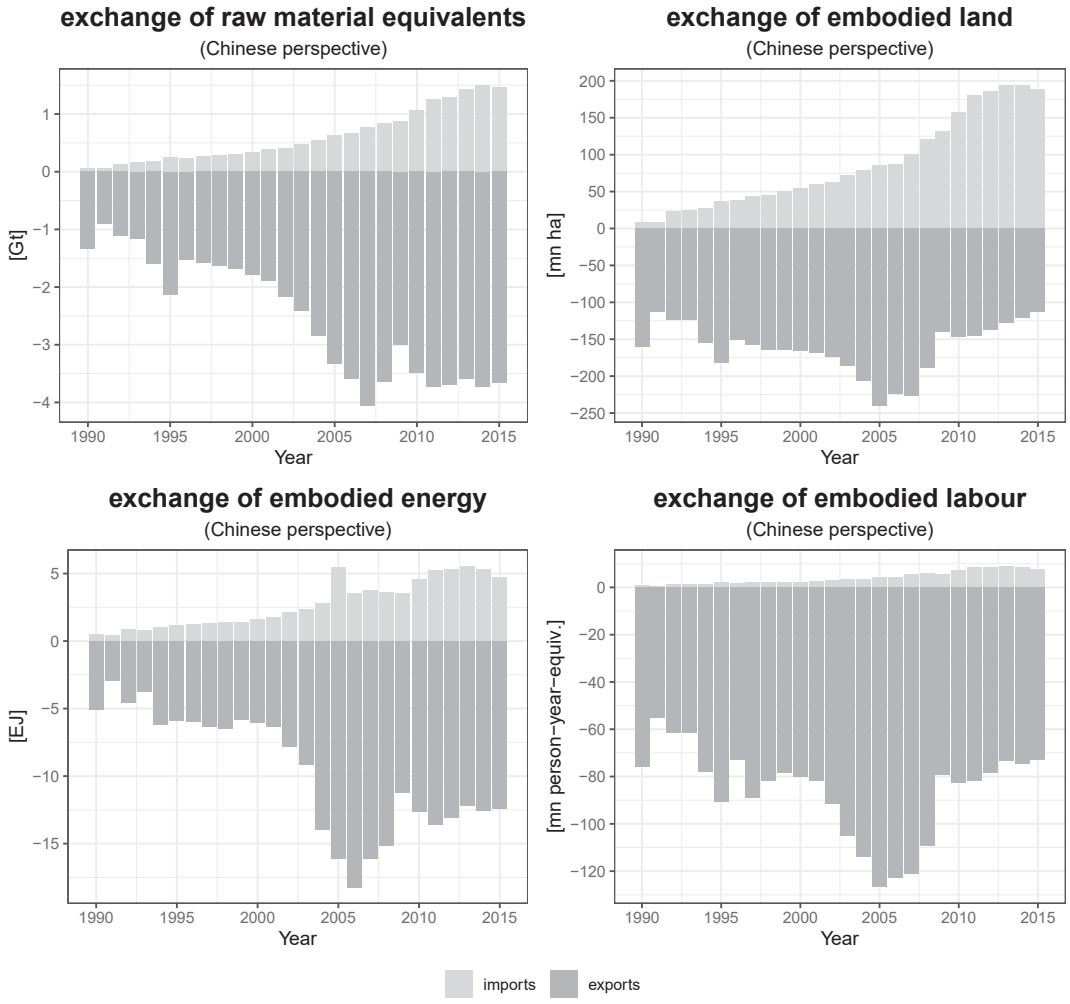
Appendix 1

List and classification of countries.

Country name	ODA list	IMF list	Country	ODA list	IMF list	Country	ODA list	IMF list
Afghanistan	recipient	not-advanced	Gabon	recipient	not-advanced	Niger	recipient	not-advanced
Albania	recipient	not-advanced	Gambia	recipient	not-advanced	Nigeria	recipient	not-advanced
Algeria	recipient	not-advanced	Gaza Strip	recipient	not-advanced	North Korea	recipient	not-advanced
Andorra	donor	advanced	Georgia	recipient	not-advanced	Norway	donor	advanced
Angola	recipient	not-advanced	Germany	donor	advanced	Oman	recipient	not-advanced
Antigua	recipient	not-advanced	Ghana	recipient	not-advanced	Pakistan	recipient	not-advanced
Argentina	recipient	not-advanced	Greece	donor	advanced	Panama	recipient	not-advanced
Armenia	recipient	not-advanced	Greenland	donor	not-advanced	Papua New Guinea	recipient	not-advanced
Aruba	recipient	not-advanced	Guatemala	recipient	not-advanced	Paraguay	recipient	not-advanced
Australia	donor	advanced	Guinea	recipient	not-advanced	Peru	recipient	not-advanced
Austria	donor	advanced	Guyana	recipient	not-advanced	Philippines	recipient	not-advanced
Azerbaijan	recipient	not-advanced	Haiti	recipient	not-advanced	Poland	donor	not-advanced
Bahamas	recipient	not-advanced	Honduras	recipient	not-advanced	Portugal	donor	advanced
Bahrain	recipient	not-advanced	Hong Kong	recipient	advanced	Qatar	recipient	not-advanced
Bangladesh	recipient	not-advanced	Hungary	donor	not-advanced	Romania	recipient	not-advanced
Barbados	recipient	not-advanced	Iceland	donor	advanced	Russia	recipient	not-advanced
Belarus	recipient	not-advanced	India	recipient	not-advanced	Rwanda	recipient	not-advanced
Belgium	donor	advanced	Indonesia	recipient	not-advanced	Samoa	recipient	not-advanced
Belize	recipient	not-advanced	Iran	recipient	not-advanced	San Marino	donor	advanced
Benin	recipient	not-advanced	Iraq	recipient	not-advanced	Sao Tome and Principe	recipient	not-advanced
Bermuda	recipient	advanced	Ireland	donor	advanced	Saudi Arabia	recipient	not-advanced
Bhutan	recipient	not-advanced	Israel	recipient	advanced	Senegal	recipient	not-advanced
Bolivia	recipient	not-advanced	Italy	donor	advanced	Serbia	recipient	not-advanced
Bosnia and Herzegovina	recipient	not-advanced	Jamaica	recipient	not-advanced	Seychelles	recipient	not-advanced
Botswana	recipient	not-advanced	Japan	donor	advanced	Sierra Leone	recipient	not-advanced
Brazil	recipient	not-advanced	Jordan	recipient	not-advanced	Singapore	recipient	advanced
British Virgin Islands	recipient	not-advanced	Kazakhstan	recipient	not-advanced	Slovakia	donor	advanced
Brunei	recipient	not-advanced	Kenya	recipient	not-advanced	Slovenia	donor	advanced
Bulgaria	recipient	not-advanced	Kuwait	recipient	not-advanced	Somalia	recipient	not-advanced
Burkina Faso	recipient	not-advanced	Kyrgyzstan	recipient	not-advanced	South Africa	recipient	not-advanced
Burundi	recipient	not-advanced	Laos	recipient	not-advanced	South Korea	donor	advanced
Cambodia	recipient	not-advanced	Latvia	recipient	advanced	South Sudan	recipient	not-advanced
Cameroon	recipient	not-advanced	Lebanon	recipient	not-advanced	Spain	donor	advanced
Canada	donor	advanced	Lesotho	recipient	not-advanced	Sri Lanka	recipient	not-advanced
Cape Verde	recipient	not-advanced	Liberia	recipient	not-advanced	Sudan	recipient	not-advanced
Cayman Islands	recipient	not-advanced	Libya	recipient	not-advanced	Suriname	recipient	not-advanced
Central African Republic	recipient	not-advanced	Liechtenstein	donor	advanced	Swaziland	recipient	not-advanced
Chad	recipient	not-advanced	Lithuania	recipient	not-advanced	Sweden	donor	advanced
Chile	recipient	not-advanced	Luxembourg	donor	advanced	Switzerland	donor	advanced
China	recipient	not-advanced	Macao SAR	recipient	advanced	Syria	recipient	not-advanced
Colombia	recipient	not-advanced	Madagascar	recipient	not-advanced	Taiwan	recipient	advanced
Congo	recipient	not-advanced	Malawi	recipient	not-advanced	Tajikistan	recipient	not-advanced
Costa Rica	recipient	not-advanced	Malaysia	recipient	not-advanced	Tanzania	recipient	not-advanced
Cote dIvoire	recipient	not-advanced	Maldives	recipient	not-advanced	TFYR Macedonia	recipient	not-advanced
Croatia	recipient	not-advanced	Mali	recipient	not-advanced	Thailand	recipient	not-advanced
Cuba	recipient	not-advanced	Malta	recipient	advanced	Togo	recipient	not-advanced
Cyprus	recipient	advanced	Mauritania	recipient	not-advanced	Trinidad and Tobago	recipient	not-advanced
Czech Republic	donor	advanced	Mauritius	recipient	not-advanced	Tunisia	recipient	not-advanced
Denmark	donor	advanced	Mexico	recipient	not-advanced	Turkey	recipient	not-advanced
Djibouti	recipient	not-advanced	Moldova	recipient	not-advanced	Turkmenistan	recipient	not-advanced
Dominican Republic	recipient	not-advanced	Monaco	donor	advanced	UAE	recipient	not-advanced
DR Congo	recipient	not-advanced	Mongolia	recipient	not-advanced	Uganda	recipient	not-advanced
Ecuador	recipient	not-advanced	Montenegro	recipient	not-advanced	UK	donor	advanced
Egypt	recipient	not-advanced	Morocco	recipient	not-advanced	Ukraine	recipient	not-advanced
El Salvador	recipient	not-advanced	Mozambique	recipient	not-advanced	Uruguay	recipient	not-advanced
Eritrea	recipient	not-advanced	Myanmar	recipient	not-advanced	USA	donor	advanced
Estonia	recipient	advanced	Namibia	recipient	not-advanced	Uzbekistan	recipient	not-advanced
Ethiopia	recipient	not-advanced	Nepal	recipient	not-advanced	Vanuatu	recipient	not-advanced
Fiji	recipient	not-advanced	Netherlands	donor	advanced	Venezuela	recipient	not-advanced
Finland	donor	advanced	Netherlands Antilles	recipient	not-advanced	Viet Nam	recipient	not-advanced
Former USSR	recipient	not-advanced	New Caledonia	recipient	not-advanced	Yemen	recipient	not-advanced
France	donor	advanced	New Zealand	donor	advanced	Zambia	recipient	not-advanced
French Polynesia	recipient	not-advanced	Nicaragua	recipient	not-advanced	Zimbabwe	recipient	not-advanced

Appendix 2. Trade balance between China and the North.



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