

Value Capture and Value Production in the World Economy: A Marxian Analysis of Global Value Chains, 2000–2014

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Abstract

The paper estimates the production, realisation, and capture of economic value in the world economy from 2000 to 2014. Estimates show how value is produced and transferred across 56 sectors and 43 countries. The methodology builds on the Marxian literature and the productive-unproductive classification. Value production is the labour directly and indirectly required to produce goods and services within global value chains. Value capture is the deviation between value realisation and production. Results show that China is the largest giver of value while the USA is the largest capturer of value in the world economy. Unproductive activities (real estate, finance, and trade) and capital-intensive industries (manufacturing, mining, and oil) are value capturers. Labour-intensive industries (health, education, construction, agriculture, and services) transfer value away. The paper also demonstrates that the theory of unequal exchange is incompatible with the conventional assumption that all activities are productive. Only under the Marxian productive-unproductive classification do the results converge with unequal exchange theory.

Key words: world economy, global value chains, value capture, value transfer, unequal exchange

JEL classification: O11; B51; C82; E11

Author's note: The author thanks three anonymous referees for the constructive feedback.

Disclosure statement: The author reports there are no competing interests to declare. No funding was provided for this research.

1. Introduction

China's entry into the World Trade Organisation (WTO) in 2001 and the subsequent shift of manufacturing from the United States and Europe to Asia have dramatically reshaped global value chains. This new phase of globalisation, driven by China's ascent, has resulted in significant deindustrialisation in the United States and Europe, with profound impacts on wages, employment, politics, and income distribution. Against this backdrop, the present study provides a fresh empirical analysis of how economic value is produced and distributed in the global economy.

This paper has two main objectives. The first is to estimate the production, realisation, and capture of economic value in the world economy. The second is to identify the causes of value capture within global value chains. To achieve these goals, the empirical approach uses input-output data for 56 sectors across 43 countries from 2000 to 2014. The methodology is based on Marxian literature and the classification of economic activities into productive and unproductive categories.

The estimation methodology is based on the 'New Interpretation' of Marxian value theory (Duménil, Foley, and Lévy, 2009; Foley, 1982; Duménil, 1980) and applies this framework to the global economy. Marxian value theory is chosen because it enables the quantification of value creation, realisation, and capture across different industries and countries. In this respect, the paper employs the following definitions. *Value production* is the total (direct and indirect) labour embodied in commodities, where *commodities* are goods and services produced for profit. The labour input to production is the *direct* labour embodied, while the non-labour inputs (machines, plants, equipment, and raw materials) are the *indirect* labour embodied in production. Since commodity production occurs within global value chains, these definitions apply across industries and countries on a global scale. *Value realisation*, on contrary, is the total labour drawn from the global pool of value production. *Value capture* is the gap between value realisation and production. Broadly speaking, production determines contribution, realisation determines allocation, and capture determines transfer. These distinctions are important because national and industry income accounts record values realised, not necessarily produced.

These concepts are related to the literature on unequal exchange and to the definition of *exploitation* as the *unequal exchange of labour* (Cogliano, Veneziani, and Yoshihara, 2024, 2022). By expanding Marx's original definition of exploitation (within-firm appropriation of unpaid labour by capitalists), the concept of exploitation as the unequal exchange of labour encompasses two key aspects: (i) the *class relations* between workers and capitalists at the firm level; and (ii) the *trade relations* between industries and countries at the global level. Capitalists exploit workers at the firm level because capitalists draw more labour from workers than what capitalists contribute with their own labour to production, implying that the value that workers receive as wages is less than the value that they produce for the capitalist. In a similar way, industries and countries exploit one another at the global level when they draw more labour than what they contribute. The *class* and *trade* dimensions of exploitation (defined as the unequal exchange of labour) are correlated, and the present study provides estimates of both: activities with higher rates of exploitation are mostly labour-intensive activities that also tend to transfer value away, while activities with lower rates of exploitation are mostly capital-intensive activities that tend to capture value from other activities.

Marxian value theory additionally introduces the productive-unproductive classification of economic activities (Shaikh and Tonak, 1994; Mohun, 1996). *Productive activities* are economic activities that create value through the production of new commodities, as either goods or services produced for profit. *Unproductive activities* are economic activities that do not create new commodities and therefore consume or recirculate the value produced in productive activities. Finance, insurance, real estate, wholesale trade, retail trade, and not-for-profit government services do not create new commodities and thus must be classified as unproductive. This classification does not imply that unproductive activities are secondary, less important, or unnecessary; it simply splits the economy into the creation of value-added and the consumption of value-added. Unproductive activities are in many ways very much necessary for the production and realisation of value: finance provides credit for investment in productive activities; public schools provide skilled labour for the job market; government agencies provide research and development for high-risk high-return investments (as in the creation of the internet, GPS, and vaccines); and wholesale and retail traders distribute the commodities. In some other cases, on the contrary, unproductive activities can put a drag on value production: high taxes, rents, and interest

payments might draw excessively from the pool of value-added and thus limit the ability of productive activities to grow and invest.

Marx hypothesised that three factors explain why value realisation deviates from value production: (i) A share of the value created in the production sphere must pay for unproductive activities in the circulation sphere, which do not create new commodities but are necessary for the realisation of value through trade (Marx, 1991 [1894]: chapter 17, 394–416) and for the financing of commodity production (Marx, 1991 [1894]: chapter 19, 431–439); (ii) Labour-intensive activities tend to transfer value to capital-intensive activities due to differing capital/labour ratios and the tendency of competition to equalise profit rates relative to the capital advanced (Marx, 1991 [1894]: chapter 9, 254–272; chapter 10, 273–301; chapter 11, 302–306); (iii) The concentration and centralisation of capital can increase the market power of larger firms (Marx, 1982 [1887]: chapter 25, 762–871) and their ability to capture value from smaller firms (Marx, 1991 [1894]: chapter 15, 349–377), where concentration and centralisation are facilitated by the credit system (Marx, 1991 [1894]: chapter 27, 566–573). To test Marx's hypotheses on the causes of value capture, this paper employs econometric techniques and constructs a panel dataset with 36,120 observations at the country-industry level.

The empirical evidence from global value chains provides support to Marx's hypotheses on the mechanisms of value capture. Most importantly, the data reveal deviations between the *produced* and *realised* rates of exploitation. Due to value transfers across industries and countries, exploitation rates can be measured both in terms of values *produced* and values *realised*. Countries and sectors that transfer value away can have high rates of exploitation produced but low rates of exploitation realised. Conversely, countries and sectors that capture value can have low rates of exploitation produced but high rates of exploitation realised. This distinction is relevant because exploitation rates computed directly from national income accounts and input-output matrices are based on values realised, which can deviate substantially from the values actually produced.

The empirical results are relevant because they provide concrete estimates of what Mazzucato (2020) named 'value making' and 'value taking' in the world economy. Results for the 2000–2014 period indicate that China is the largest giver of value while the United States is the largest capturer of value in the world economy.

Alongside unproductive activities (real estate, finance, insurance, and trade), capital-intensive industries (manufacturing, mining, and oil) tend to capture value. On the other hand, labour-intensive industries (health, education, construction, agriculture, and services) tend to transfer value away. Because labour-intensive activities are mostly located in the service sectors and in developing economies, value tends to be transferred from poorer to richer countries and from services to capital-intensive industries. But the data also reveal the hierarchy among rich countries themselves, since developed nations transfer large sums of value to unproductive activities (finance, insurance, real estate, and trade) controlled by American companies. The United States captures value not only from developing countries but also from other developed economies.

Labour-intensive industries specialising in health, education, construction, agriculture, and productive services are the largest givers of value, and thus where the gap between *produced* and *realised* rates of exploitation are the largest. On the other hand, unproductive activities (real estate, trade, finance, and insurance) and capital-intensive industries (manufacturing, mining, and oil extraction) draw the largest sums from the global pool of value-added. This pattern can explain the central role of industrialisation and the rise in capital intensity associated with economic development. It can also explain the growing adoption of artificial intelligence (a capital-intensive labour-saving technology) in the service sectors. The automation of labour-intensive services through the employment of artificial intelligence raises the capital/labour ratio and is a potential source of value capture for capitalists in the service industries.

Lastly, the paper demonstrates that the theory of *unequal exchange*, which claims that rich countries exploit poorer countries (Dorninger et al., 2021; Hickel, Dorninger, Wieland, and Suwandi, 2022; Infante-Amate, Urrego-Mesa, Piñero, and Tello, 2022), is incompatible with the conventional assumption that all activities are productive. Only under the Marxian productive-unproductive classification do the empirical results converge with unequal exchange theory. This is a consequence of the massive relocation of productive capital to China and the growth of unproductive activities in the United States. The United States captures value from developed and developing countries alike, but does so primarily through unproductive activities—such as finance, real estate, and wholesale and retail trade—dominated by American companies.

The paper is organised as follows. **Section 2** presents the data sources and the classification of productive and unproductive activities. **Section 3** presents the estimation methodology. **Section 4** presents the empirical results. **Section 5** presents the econometric analysis on the causes of value capture. **Section 6** concludes the paper. Additional material is included in the **appendix**. The panel datasets constructed for this paper contain data at four different levels of aggregation: country-industry, country, industry, and global. The datasets are available for download in the **supplementary material** section.

2. Data Sources and the Productive-Unproductive Classification

The estimates in this paper derive from the World Input-Output Database (Timmer et al. 2016, 2015; Dietzenbacher et al. 2013). The WIOD provides global input-output tables and data on capital stock, employment, self-employment, and wages for 56 industries across 43 countries during the 2000–2014 period. **Table A1** in the appendix lists the countries included. The WIOD comprises the World Input-Output Tables (WIOT) and the Socio-Economic Accounts (SEA). Input-output matrices are taken from the WIOT. Data on capital stock, employment, self-employment, and labour compensation are taken from the SEA.

The WIOT are denominated in nominal US dollars while the SEA data are denominated in units of national currencies. To convert national currencies into US dollars, this paper uses the same nominal exchange rates that were used to construct the WIOT. All variables are then adjusted for inflation using constant 2015 dollars from the World Bank. Computations are conducted at the country-industry level, encompassing 2,408 observations (56 countries \times 43 industries) for each variable per year. When necessary, variables can be aggregated by either country or industry.

The WIOD relies on the United Nations' System of National Accounts (SNA) and thus, by convention, records the values *realised* by country and industry, not the values *produced*. To distinguish value realisation from value production, this paper estimates value production using labour values from Marxian theory, where *labour values* measure the average total labour (directly and indirectly) embodied in commodities. Rather than

measuring the labour realised by market prices, labour values measure the vertically integrated (i.e. upstream) labour embodied in commodity production.

Labour values from Marxian theory comprise a superior index of labour productivity when compared to the conventional labour productivity index based on value-added, since only labour values can properly measure the decreasing total labour content of goods and services (Flaschel, Franke, and Veneziani, 2013; Cogliano, Flaschel, Franke, Fröhlich, and Veneziani, 2018; and Cogliano, Veneziani, and Yoshihara, 2022). The conventional labour productivity index based on value-added per person or per work hour is biased by market power and by changes in relative prices unrelated to productivity. Marxian labour values, on the contrary, measure the total labour content of goods and services (which tends to decrease over time) and are thus less biased by monopoly prices and changes in relative prices unrelated to labour productivity.

More fundamentally, a crucial component of the empirical approach in this paper is the classification of productive and unproductive activities. Unproductive activities do not create value and thus must draw from the global pool of value-added. Likewise, the labour employed in unproductive activities is paid for from the value-added of productive activities. The paper employs the productive-unproductive classification from Tsoulfidis and Paitaridis (2019), Tsoulfidis and Tsaliki (2019), and Shaikh and Tonak (1994). **Table A2** in the appendix classifies the 56 industries of the WIOD into productive and unproductive activities. Productive activities exclude activities that do not create new commodities, such as: finance, insurance, real estate (but not construction), wholesale and retail trade (trade margins only), not-for-profit activities, and government administration. The same classification is implemented in Rotta and Kumar (2024) at the global level. The present study does not therefore implement the ‘knowledge rent’ approach of Rotta (2024; 2022; 2018), who classified as unproductive activity the production of knowledge in industries like pharmaceutical and chemical manufacturing, software, movie and music production. It is worth noting, in this respect, that the United Nations’ SNA has yet to improve the measurement of intangible goods and intangible capital.

Marxian value theory and the productive-unproductive classification have been, nonetheless, subject to critique (see Hornborg, 2022, for a recent example; and the literature addressed in Mohun, 1996; Yoshihara

and Veneziani, 2013; Cogliano, Flaschel, Franke, Fröhlich, and Veneziani, 2018; and in Shaikh, 2016: 129). At the theoretical level, the productive-unproductive categorisation derives from the fact that activities like trade, finance, and real estate are necessary for production but do not create new commodities. The Marxian tradition, however, has not yet reached a consensus on what should be classified as productive, and the productive-unproductive categorisation has thus been questioned for its ambiguous identification strategy. For example, there has been no universally accepted categorisation for the advertising, accounting, security, and legal service industries; Rotta (2024; 2022; 2018), Rotta and Teixeira (2019; 2016), and Rotta and Paraná (2022) classify knowledge creation as unproductive, contrary to most of the Marxian literature; and Isikara and Mokre (2022) compute price-value deviations in the world economy but ignore the productive-unproductive categorisation altogether.

In this respect, the present study compares the Marxian approach and the conventional SNA approach by computing all estimates twice: first, under the Marxian classification of productive-unproductive activities described in **Table A2** and, second, under the conventional SNA assumption that all activities are productive. This comparison reveals a major implication: the theory of unequal exchange is incompatible with the conventional SNA assumption that all activities are productive. Only under the Marxian productive-unproductive classification do the results converge with the theory of unequal exchange.

3. Estimation Methodology

Let subscripts PA indicate productive activities, UA indicate unproductive activities, i indicate the industry, c indicate the country, and t indicate the year. Let countries c be indexed as $1, \dots, m$ and let industries i be indexed as $1, \dots, n$. Vectors are column vectors by default, and superscript T indicates matrix transpose.

Let Z be the $(mn \times mn)$ square matrix of monetary input flows across n industries in m countries. Let v be the $(mn \times 1)$ column vector of *conventional* monetary value-added by country-industry, x be the $(mn \times 1)$ column vector of monetary gross output by country-industry, and f be the $(mn \times 1)$ column vector of monetary final demand by country-industry. Let $\vec{1}$ indicate the column unit vector used for row

summations. Hence, $Z_t \vec{1}$ is the $(mn \times 1)$ column vector of intermediate demand in year t , and $Z_t^T \vec{1}$ is the $(mn \times 1)$ column vector of intermediate inputs used up to produce the gross output vector x_t . The vectors of gross output and conventional value-added are adjusted to include taxes minus subsidies at the country-industry level, as explained in **section A1** of the appendix.

The Leontief input-output model used to construct the WIOT in each year t starts from the equality between total demand (intermediate demand $Z_t \vec{1}$ plus final demand f_t) and total output (intermediate input usage $Z_t^T \vec{1}$ plus the conventional value-added v_t):

$$Z_t \vec{1} + f_t = Z_t^T \vec{1} + v_t = x_t \quad (1)$$

The vector of value-added *realised* at the country-industry level is defined as the vector of conventional monetary value-added v_t . Given the vector of final demand f_t and the matrix of input flows Z_t , the vector of value-added realised is computed by solving the above equation for v_t :

$$v_t \equiv x_t - Z_t^T \vec{1} = (Z_t \vec{1} - Z_t^T \vec{1}) + f_t \quad (2)$$

The $(mn \times mn)$ square matrix of input-output coefficients is $A_t = Z_t(\hat{X}_t)^{-1}$, where \hat{X}_t is the $(mn \times mn)$ diagonal matrix with the gross output vector x_t placed along the main diagonal. Matrix A_t contains the monetary input requirements per unit of monetary gross output x_t . The intermediate demand vector $A_t x_t$ then equals the row sums of Z_t such that $Z_t \vec{1} = A_t x_t$. In the demand-driven Leontief input-output model, gross output x_t is a function of final demand f_t and this function is the inverse Leontief matrix $B_t \equiv (I - A_t)^{-1}$. Therefore:

$$x_t = Z_t \vec{1} + f_t = A_t x_t + f_t = (I - A_t)^{-1} f_t = B_t f_t \quad (3)$$

The next step is to compute the vector of labour inputs. WIOD data on labour hours are missing for workers in China and for self-employed workers in general, while employment data are complete. For this reason, the vertically integrated labour requirements are calculated not in terms of labour hours but in terms of employment levels. The employment vector must then be adjusted for self-employment and skills, where skill differentials are proxied by wage differentials relative to the *global* average wage in each year. The adjustment for skills approximates Marx's (1982 [1887]: chapter 1, 135–137) contention that complex and simple labour must be reduced to the same units. This paper follows the model of vertically integrated labour coefficients with heterogeneous labour from Duménil, Foley, and Lévy (2009) and thus converts complex and simple labour to units of labour of *average* complexity, using the *global* average wage as the reference wage for skill differentials.

Let L_t be the $(mn \times 1)$ column vector of employment including both employees and self-employed workers. Let $l_t = (\hat{X}_t)^{-1} L_t$ be the $(mn \times 1)$ column vector of labour requirements per unit of monetary gross output x_t . Let W_t be the $(mn \times 1)$ column vector of labour compensation of both employees and self-employed workers. Let $\bar{\omega}_{i,c,t} = \frac{W_{i,c,t}}{L_{i,c,t}}$ be the average compensation of employees and self-employed workers in industry i in country c in year t . Let the global average labour compensation in year t be $\bar{\omega}_t = \frac{W_t}{L_t} = \frac{\sum_{i=1}^n \sum_{c=1}^m W_{i,c,t}}{\sum_{i=1}^n \sum_{c=1}^m L_{i,c,t}}$. The column vector of heterogeneous labour requirements \tilde{l}_t uses labour compensation differentials to proxy for skill differentials, where labour compensation differentials include both the within- and between-country differentials. Labour compensation differentials are computed as the country-industry average compensation $\bar{\omega}_{i,c,t}$ relative to the global average compensation $\bar{\omega}_t$. Hence, the elements $\{\tilde{l}_{i,c,t}\}$ inside the column vector \tilde{l}_t are constructed as follows:

$$\tilde{l}_t \equiv \{\tilde{l}_{i,c,t}\} = \frac{\bar{\omega}_{i,c,t}}{\bar{\omega}_t} l_{i,c,t} = \frac{\bar{\omega}_{i,c,t}}{\bar{\omega}_t} \frac{L_{i,c,t}}{x_{i,c,t}} = \frac{1}{\bar{\omega}_t} \frac{W_{i,c,t}}{x_{i,c,t}} \quad (4)$$

The *global* average wage is used as the reference wage in the computation of skill differentials in order to avoid the shortcomings of Isikara and Mokre (2022), who did use wage differentials to proxy for skill levels but inadvertently used the *national* average wage as the reference wage. By using national average wages as the basis for wage differentials, Isikara and Mokre (2022) eliminated all the between-country variability in skills and thus considered only the within-country variability in wages. Their procedure amounts to assuming that the average skill level is the same across countries. In the present study, on the contrary, skill levels are correctly adjusted for both the within- and between-country variability in relative wages.

The estimation of labour values must now consider the role of unproductive activity. In the Marxian approach, only productive activities create value and thus the vertical integration of labour requirements must include only the labour directly and indirectly required in productive activities. As argued by Basu and Moraitis (2023), unproductive activities do not enter the matrix of input-output coefficients used in the computation of labour values, which is a square matrix constructed row- and column-wise solely for productive activities. Because the SNA classifies all activities as productive, the matrices and vectors in the WIOD must be modified to reflect the productive-unproductive classification.

The first step is to rearrange the Z_t matrix such that the productive-unproductive categorisation applies both row- and column-wise. The modified Z_t^* matrix will have four types of sub-matrices: productive inputs to productive activities ($Z_{PA \rightarrow PA,t}^*$); unproductive inputs to productive activities ($Z_{UA \rightarrow PA,t}^*$); productive inputs to unproductive activities ($Z_{PA \rightarrow UA,t}^*$); and unproductive inputs to unproductive activities ($Z_{UA \rightarrow UA,t}^*$). **Figure A1** in the appendix shows the WIOT before the application of the Marxian classification of productive and unproductive activities, and **Figure A2** shows the WIOT after the classification is applied.

The next step is to compute the vector of Marxian *net output* y_t^* . Ideally, the Marxian net output y_t^* should be cast in pure quantities, not in monetary units. Empirical input-output matrices, however, are

constructed in monetary terms and thus \mathbf{y}_t^* is also in monetary units (dollar prices times quantities of net output). The same applies for the gross output vector \mathbf{x}_t , which should be ideally cast in pure quantities but is reported in monetary units (dollar prices times quantities of total output). Because the gross output \mathbf{x}_t and net output \mathbf{y}_t^* are both denominated in monetary units, there is some inevitable contamination of these vectors by relative prices and market power. In this paper, labour values are computed in order to mitigate the impact of relative prices and market power on the estimation of value-added *produced*, though it is impossible to completely eliminate these influences.

For productive activities, the Marxian *net output* $\mathbf{y}_t^* \equiv \{\mathbf{y}_{i,c,t}^*\}$ for each industry i in country c and year t is computed by deducting from the gross output $\mathbf{x}_t \equiv \{\mathbf{x}_{i,c,t}\}$ the summation of all *productive* inputs $\mathbf{Z}_{PA \rightarrow PA,i,c,t}^*$ that supply productive industry i . For unproductive activities, the entries in the vector \mathbf{y}_t^* are set to zero. Hence, the elements $\{\mathbf{y}_{i,c,t}^*\}$ inside the column vector \mathbf{y}_t^* are constructed as follows:

$$\mathbf{y}_t^* \equiv \{\mathbf{y}_{i,c,t}^*\} = \begin{cases} \mathbf{x}_{i,c,t} - \mathbf{Z}_{PA \rightarrow PA,i,c,t}^{*T} \vec{\mathbf{1}} & , i \in PA \\ 0 & , i \in UA \end{cases} \quad (5)$$

This procedure implies that the unproductive inputs used up in productive activities ($\mathbf{Z}_{UA \rightarrow PA,i,c,t}^*$) are part of, and thus paid from the Marxian net output \mathbf{y}_t^* of productive activities. Shaikh and Tonak (1994: 74) originally proposed this methodology, Rotta (2018) then updated it for the United States, and Rotta and Kumar (2024) generalised it to the world economy.

To prevent unproductive activities from transferring value to productive activities, the unproductive activities must be excluded from matrix \mathbf{A}_t *before* the computation of the inverse Leontief matrix \mathbf{B}_t in the Marxian model. Let $\mathbf{A}_t^* \equiv \mathbf{A}_{PA \rightarrow PA,t}$ be the input-output coefficients matrix defined row- and column-wise solely for productive activities. Let $\mathbf{B}_t^* = (\mathbf{I} - \mathbf{A}_t^*)^{-1}$ be the inverse Leontief matrix defined for productive activities only. Similarly, let $\vec{\mathbf{l}}_t^*$ be the column vector of skill-adjusted labour requirements, defined solely for productive activities. Let the column vector of labour values $\boldsymbol{\lambda}_t$ contain the vertically integrated *average* labour

requirements, including the direct labour (\tilde{l}_t^*) and the indirect labour ($A_t^* \lambda_t$) necessary to produce each unit of gross output x_t . For productive activities, the vector λ_t contains the labour values per unit of gross output x_t , appropriately adjusted for self-employment and heterogeneous skills. For unproductive activities, the corresponding entries in λ_t are set to zero. Hence:

$$\lambda_t^T \equiv \{\lambda_{i,c,t}^T\} = \begin{cases} \lambda_t^T A_t^* + \tilde{l}_t^{*T} = \tilde{l}_t^{*T} (I - A_t^*)^{-1} = \tilde{l}_t^{*T} B_t^* & , i \in PA \\ 0 & , i \in UA \end{cases} \quad (6)$$

It is now possible to define prices proportional to labour values. Let m_t be the ‘monetary expression of labour time’ (MELT), which is the scalar that converts labour values λ_t into US dollars. The global MELT can be estimated by applying the New Interpretation model of Duménil, Foley, and Lévy (2009) onto the global scale, considering that the present study uses employment levels rather than labour time to calculate labour values. The global MELT is determined, according to the New Interpretation, by the normalisation condition based on the Marxian net output y_t^* , rather than on the gross output x_t used by Shaikh (2016) and Isikara and Mokre (2022). The New Interpretation offers the most mathematically consistent interpretation of Marx’s value theory (Mohun and Veneziani, 2017) and it is the only approach that uses money to set the equivalence between labour values and market prices. At the empirical level, nonetheless, the difference between these two possible normalisations is minimal.

At the aggregate global level, the normalisation condition based on the net output is $m_t \lambda_t^T y_t^* = v_t^T \vec{1}$, where both sides of the equality are scalars representing total sums across all countries and industries. This normalisation condition states that the total sum of the Marxian net output in labour values $\lambda_t^T y_t^*$, appropriately converted to dollars via m_t , must match the total sum of the conventional value-added v_t realised in dollars. From this normalisation condition, the global MELT is defined as:

$$m_t \equiv \frac{v_t^T \vec{1}}{\lambda_t^T y_t^*} = \frac{\sum_{i=1}^{i=n} \sum_{c=1}^{c=m} v_{i,c,t}}{\sum_{i=1}^{i=n} \sum_{c=1}^{c=m} \lambda_{i,c,t} y_{i,c,t}^*} = \frac{v_t^T \vec{1}}{\tilde{l}_t^{*T} x_t^*} \quad (7)$$

The formula for m_t above uses the additional property that $\lambda_t^T y_t^* = \tilde{l}_t^{*T} x_t^*$, which is a core element of Marx's value theory. This equality states that the total (skill-adjusted) productive labour employed to produce the *gross output* of productive activities ($\tilde{l}_t^{*T} x_t^*$) generates the total labour value of the Marxian *net output* ($\lambda_t^T y_t^*$). To see why this is indeed the case, start from the Marxian net output $y_t^* = x_t^* - A_t^* x_t^* = (I - A_t^*) x_t^*$ and the definition of labour values $\lambda_t^T = \tilde{l}_t^{*T} (I - A_t^*)^{-1}$. Then, one finds that: $\lambda_t^T y_t^* = \tilde{l}_t^{*T} (I - A_t^*)^{-1} (I - A_t^*) x_t^* = \tilde{l}_t^{*T} x_t^*$. This equivalence also implies, through the concept of the MELT, that the productive labour \tilde{l}_t^* used to *produce* the gross output x_t^* of productive activities is the source of the conventional value-added *realised* v_t .

The next step is to estimate the Marxian value-added *produced* at the country-industry level. The column vector $m_t \lambda_t$ contains prices proportional to labour values, which are labour values λ_t converted to prices via the global MELT (the scalar m_t). Now let $\hat{\lambda}_t$ be the $(mn \times mn)$ diagonal matrix with the vector of labour values λ_t placed along the main diagonal. Hence, the column vector $\hat{\lambda}_t y_t^*$ is the Marxian net output y_t^* denominated in labour values λ_t . One can then use the global MELT m_t to convert $\hat{\lambda}_t y_t^*$ to prices proportional to labour values, thus obtaining the $(mn \times 1)$ column vector v_t^* of Marxian value-added *produced* in monetary units:

$$v_t^* \equiv m_t \hat{\lambda}_t y_t^* \quad (8)$$

Let the column vector v_t^c of value-added *capture* be the difference between the *realisation* and *production* of value-added: $v_t^c \equiv v_t - v_t^*$. The definitions of v_t^* and m_t thus imply that the global sum of value-added capture is always zero: $(v_t^c)^T \vec{1} = 0$; meaning that the Marxian value-added *produced* equals the conventional value-added *realised* at the aggregate global level: $v_t^{*T} \vec{1} = v_t^T \vec{1}$. To check this, sum the Marxian value-added

produced in money terms: $v_t^{*T} \vec{1} = [m_t \hat{\lambda}_t y_t^*]^T \vec{1} = m_t [\hat{\lambda}_t y_t^*]^T \vec{1} = m_t y_t^{*T} \hat{\lambda}_t \vec{1}$, noting that m_t is a scalar, $\hat{\lambda}_t$ is a diagonal matrix, so its transpose is itself ($\hat{\lambda}_t^T = \hat{\lambda}_t$), and that the transpose of a matrix product flips the order of the matrices. Note also that $\hat{\lambda}_t \vec{1} = \lambda_t$ and $y_t^{*T} \lambda_t = \lambda_t^T y_t^*$, hence: $v_t^{*T} \vec{1} = m_t y_t^{*T} \lambda_t = m_t \lambda_t^T y_t^*$. From the normalisation condition $m_t \lambda_t^T y_t^* = v_t^T \vec{1}$ one concludes that $v_t^{*T} \vec{1} = v_t^T \vec{1}$ and thus that $(v_t^c)^T \vec{1} = 0$.

At the country-industry level, the surplus value *realised* is the value-added realised $v_{i,c,t}$ minus labour compensation $W_{i,c,t}$, while the surplus value *produced* is the value-added produced $v_{i,c,t}^*$ minus labour compensation $W_{i,c,t}$. Hence, the rate of exploitation *realised* is $e_{i,c,t}^r \equiv \frac{v_{i,c,t} - W_{i,c,t}}{W_{i,c,t}}$ and the rate of exploitation *produced* is $e_{i,c,t}^p \equiv \frac{v_{i,c,t}^* - W_{i,c,t}}{W_{i,c,t}}$. Likewise, the profit rate *realised* is $r_{i,c,t}^r \equiv \frac{v_{i,c,t} - W_{i,c,t}}{K_{i,c,t}}$ and the profit rate *produced* is $r_{i,c,t}^p \equiv \frac{v_{i,c,t}^* - W_{i,c,t}}{K_{i,c,t}}$, where $K_{i,c,t}$ is the net capital stock at replacement cost in industry i in country c and year t . The ratio of capital to labour compensation is $\kappa_{i,c,t} \equiv \frac{K_{i,c,t}}{W_{i,c,t}}$ and the ratio of capital to employment is $\eta_{i,c,t} \equiv \frac{K_{i,c,t}}{L_{i,c,t}}$. These ratios can then be computed by country or industry by first aggregating the main variables accordingly.

The profit rate *produced* $r_{i,c,t}^p$ is simply an analytical category which has no real bearing on investment decisions. Furthermore, the *produced* and *realised* variables defined above could alternatively be referred to as *labour* and *price* variables, in line with the terminology used in the New Interpretation (Foley, 1982). **Section A1** in the appendix contains further details on the estimation methodology.

4. Value Capture and Exploitation in the World Economy

This section presents the stylised facts on value capture in the global economy, and the next section analyses its causes. **Figure 1** summarises the main estimates for selected countries and industries over 2000–2014. Positive entries indicate value-added captured, while negative entries represent value-added transferred out. **Figure 2** shows the production, realisation, and capture of global value-added in 2014 across countries. **Figure 3** shows the data for 2014 across industries. All data are in constant dollars of 2015. China is the largest

giver of value while the USA is the largest capturer of value. Across industries, unproductive activities (real estate, finance, and trade) and capital-intensive industries (manufacturing, mining, and oil) are value capturers. Labour-intensive industries (health, education, construction, agriculture, and services) transfer large amounts of value away. In the appendix, the heat map in **Figure A3** shows value-added captured by country and industry simultaneously. **Figure A4** shows value-added captured by industry within the USA and China, the world's largest economies.

[Figure 1 about here]

[Figure 2 about here]

[Figure 3 about here]

Figure 4 shows the *produced* and *realised* rates of exploitation and profit for selected countries over 2000–2014. The large gaps between produced and realised rates are caused by the substantial value transfers across industries and countries. Estimates based on values produced (as in the Marxian approach) lead to different conclusions than estimates based solely on values realised (as in the conventional SNA approach). Such differences are substantial in countries like China and the United States, or in labour-intensive industries (education, health, construction, and agriculture), where value transfers are the largest in the world. In China, for example, the *produced* rate of exploitation is much higher than the *realised* rate of exploitation, showing how much Chinese workers are exploited by capital in China and how much of their exploitation is siphoned to other countries through international value transfers. The exact opposite case holds for the United States. In the appendix, **Figure A5** shows the *produced* and *realised* rates of exploitation and profit across countries in 2014. **Figure A6** shows the data across industries in 2014. **Figure A7** shows the wage shares of value-added produced and realised by country over 2000–2014, and compares them to the global wage share.

[Figure 4 about here]

The equalisation of profit rates and exploitation rates has a long history in the development of the theory of labour values and prices of production, which are long-run prices corresponding to equalised profit

rates (for a detailed analysis see Cogliano, 2023; Mohun and Veneziani, 2017). Cogliano (2018), for example, implemented the productive-unproductive categorisation and employed the assumption of equalised exploitation rates to estimate transfers of surplus value in the United States from industry-level data over 1990–2015. Under the assumption of equalised exploitation rates, surplus value can be estimated by multiplying labour compensation in productive industries by the average rate of exploitation. In this regard, **Figure A8** in the appendix shows the *empirical* kernel densities of exploitation and profit rates from the full sample of 34,830 observations at the country-industry level. Kernel densities do indicate, nonetheless, substantial deviations from average values on the world scale and a more complex shape than the inverse Laplace distribution reported by Scharfenaker and Foley (2017) and Scharfenaker and Semieniuk (2017), or the Gamma distribution reported by Farjoun and Machover (1983). These latter studies measured exploitation and profit rates based solely on values *realised* and thus disregarded the kernel densities based on values *produced*.

As indicated in the introduction, the definition of *exploitation* as the *unequal exchange of labour* (Cogliano, Veneziani, and Yoshihara, 2024, 2022) is broader than Marx’s original definition of exploitation, and it encompasses two dimensions: (i) the *class* dimension of exploitation, measured via the *produced* rate of exploitation, which refers to the extraction of unpaid labour from workers by capitalists at the firm level; (ii) the *trade* dimension of exploitation, which refers to transfers of embodied labour across countries and industries. **Figure A9** in the appendix demonstrates that the class and trade dimensions of exploitation are in fact highly correlated, for industries with higher rates of *produced* exploitation are industries that transfer most of the value-added away. The figure presents rates of exploitation realised (blue) and produced (red) plotted against value-added produced and the capital-labour ratio. The data are shown at the country-industry level over 2000–2014, and the corresponding regression lines are plotted with similar colours. Results indicate that industries with higher rates of *produced* exploitation tend to be labour-intensive industries that transfer away large amounts of value-added. Industries with higher rates of *realised* exploitation, on the contrary, tend to be capital-intensive industries that capture large amounts of value-added. This is why the two regression lines in each subplot of **Figure A9** move in opposite directions.

5. Unproductive Activity and Unequal Exchange

Let us now examine the causes of value capture. **Table 1** presents the correlations between value-added produced and realised at the country-industry level. The table compares these correlations based on the Marxian categorisation with those derived from the conventional SNA approach, which classifies all industries as productive. **Figure A10** in the appendix shows the underlying data by activity type. The correlation between value-added produced and realised is 0.96 for productive activities but drops to 0.48 when unproductive activities are included. This indicates that while prices proportional to labour values do correlate with market prices—as also evidenced by the high correlations reported in Shaikh (2016) and Isikara and Mokre (2022)—this strong correlation is confined to productive activities. The results demonstrate that unproductive activities play a significant role in value capture, as this capture occurs through various channels: national and local governments impose taxes, financial companies charge fees and interest, insurance companies collect premiums, real estate firms charge rent, and retail and wholesale traders capture a margin of the commodity’s selling price.

[Table 1 about here]

Table 2 uses panel econometrics to test Marx’s hypotheses on the determinants of value capture. As indicated in the introduction, Marx hypothesised that three factors explain why value realisation deviates from value production. First, a share of the value created in productive activities must pay for unproductive activities. This factor is controlled for by adding a dummy variable for unproductive activities at the country-industry level. Second, labour-intensive activities tend to transfer value to capital-intensive activities under profit rate equalisation. This factor is controlled for by adding the ratio of fixed capital to employment at the country-industry level. To control for potential nonlinearities, the econometric models also include the capital-employment ratio in quadratic and cubic forms. Third, the concentration and centralisation of capital can increase market power and allow larger firms to capture value from smaller firms. Hence, the econometric results should indicate a positive association between higher profit rates and greater value capture. This factor is controlled for by adding the *realised* profit rate as a regressor. To control for potential nonlinearities, the *realised* profit rate in quadratic form is included (pre-testing indicated that the cubic form was not significant). Lastly, the panel

models include country dummies to control for country-specific fixed effects. **Figure A11** in the appendix plots the panel dataset used to estimate the econometric models, showing value-added capture as a function of the capital-labour ratio, with activities colour-coded by type.

[Table 2 about here]

The econometric models regress value capture (realisation minus production) on each factor mentioned in the previous paragraph. Variables are converted to real US dollars in constant values of 2015, and about 7% of the 36,120 observations are missing at the country-industry level. The table shows standardised coefficients (in units of standard deviations) obtained from different models: pooled, fixed effects (from both the ‘within’ and ‘between’ transformations), and random effects. The pooled model is estimated three times: using country-industry data for all activities; using data only for productive activities; and using data only for unproductive activities. The fixed effects and random effects models include controls for the unobserved individual effects. Models are estimated with robust standard errors computed from heteroskedasticity- and autocorrelation-consistent (HAC) variance-covariance matrices, adjusted for group clustering. But instead of using the conventional Arellano estimator of standard errors, the models employ the Driscoll-Kraay (DK) estimator to correct the variance-covariance matrix for both cross-sectional dependence and group clustering.

The econometric results lend support to Marx’s hypotheses on the mechanisms of value capture, albeit with some important caveats. The most important factor explaining value capture is the existence of unproductive activities. The coefficient of the unproductive activity dummy is positive, significant at the 0.1% level, and it has the largest effect across all parameter estimates. On average, unproductive activities capture 65% more value-added than productive activities. Comparing parameter estimates is straightforward since all variables are standardised in units of standard deviations. The second largest effect comes from the capital-labour ratio. According to the fixed effects model using the ‘between’ transformation, an increase of one standard deviation in the capital-employment ratio increases value-added capture by 0.56 standard deviation (considering only the linear effect). This effect is significant at the 0.1% level. In the same ‘between’ model, the effect from the realised profit rate is not statistically significant and the size of the estimate is only 0.05 standard deviation

(considering only the linear effect). In the pooled model using data solely from productive activities, the effect from the realised profit rate becomes significant at the 0.1% level, but the size of the coefficient is 0.06 standard deviation (considering only the linear effect), placing it well behind other factors.

The preferred estimate is from the fixed effects model using the ‘between’ transformation, since this model focuses on the variation *between* country-industries. The R^2 coefficient indicates, however, that all factors combined can explain only 11% of the total variation in value capture at the country-industry level. Despite the inclusion of country dummies to control for country-specific effects, the low R^2 coefficient implies that other factors driving value capture have not yet been controlled for. It is possible that there are network effects at play, as highlighted by the growing literature on intellectual monopoly (Rikap, 2021; Rikap and Lundvall, 2021), and a greater role of intangible assets (Davis and Orhangazi, 2021; Orhangazi, 2019), or even a greater role for the entrepreneurial state as a market maker and early innovator in high-risk, high-impact technologies (Mazucato, 2013, 2020). The WIOD, however, has no data on network effects, intangible assets, or on the role of the entrepreneurial state. Future research will address this gap in the total variation of value capture.

Figure 5 further demonstrates the importance of unproductive activities for unequal exchange. The theory of unequal exchange defines exploitation as the unequal exchange of labour and argues that rich countries exploit poor countries (Dorninger et al., 2021; Hickel, Dorninger, Wieland, and Suwandi, 2022; Infante-Amate, Urrego-Mesa, Piñero, and Tello, 2022; Cogliano, Veneziani, and Yoshihara, 2024; Cogliano, Kaneko, Veneziani, and Yoshihara, 2022). To verify this assertion, **Figure 5** plots the capture of value-added in 2014 by country (top panel) and by industry (lower panel) under both the Marxian productive-unproductive classification (red bars) and the conventional SNA assumption that all activities are productive (blue bars). In the appendix, **Figure A12** shows the production, realisation, and capture of global value-added by country in 2014 under the SNA assumption that all industries are productive. **Figure A13** shows global value-added captured in selected countries and industries over 2000–2014, also under the SNA assumption that all industries are productive.

[Figure 5 about here]

Under the Marxian classification, China is the largest giver of value while the USA is the largest capturer of value. Under the conventional SNA classification, on the contrary, the USA is the largest giver of value while China is the largest capturer of value. This inversion happens because the conventional approach ignores the massive relocation of productive activities from the USA, Europe, and Japan toward China. The conventional classification also ignores the rapid growth of unproductive activities (finance, trade, and real estate) within the USA and Europe. The United States has, by far, the largest share of the global pool of income from unproductive activities in the world (Rotta and Kumar, 2024). By not accounting for the large value transfers from productive to unproductive activities, the conventional classification built into the SNA and WIOD inverts the value transfers between countries. For this reason, the theory of unequal exchange, which claims that rich countries exploit poorer countries, is incompatible with the conventional SNA approach that classifies all activities as productive.

The results also reveal the hierarchy among *developed* countries themselves, since value transfers are not restricted to the flows from poor to rich economies. Most rich economies (like Japan, Germany, UK, and France) transfer value to American companies via unproductive activities such as finance, insurance, retail and wholesale trade, and real estate. These value transfers, which also reflect the dollar hegemony as the world money, allow the United States to maintain the greatest share of the global income from unproductive activity. When unproductive activities are properly accounted for, *developed* economies can emerge as *value givers* to the United States. This result provides further evidence to the idea that exploiting countries tend to be *net lenders* in international credit markets—as argued in Cogliano, Veneziani, and Yoshihara (2024) and Cogliano, Kaneko, Veneziani, and Yoshihara (2022). By becoming net lenders, wealthy countries like the USA can capture value through fees and interest payments from net borrowers, who rely on international credit markets to finance domestic expenditures. It is therefore through *unproductive activity* that the unequal exchange of labour occurs between lenders and borrowers in international credit markets.

Concomitantly, the rapid growth of productive capital in China increased the value-added captured by developing countries. Brazil, Mexico, Indonesia, and India exported to China large quantities of agricultural

products (soybean, meat, and seafood) and mining products (iron ore, copper, steel, and oil) at rising prices, which placed these *developing* countries as *value capturers* over 2000–2014. Large exports of primary products to China, at rising prices, explain how a developing country like Brazil became a *value capturer*, accumulating 378 billion dollars in international reserves by 2019. For a historical perspective on this mechanism, **Figure A14** in the appendix plots the evolution of the shares of several key industries in the value-added and gross output *realised* in the global economy over 1965–2018. The figure combines historical data from the WIOD (1965–1995) for 22 major economies and OECD data (1995–2018) for 66 major economies. The measures show a very large increase in the share of primary products (agriculture and mining) in the 2002–2014 period, right after China joined the World Trade Organisation (WTO) in 2001. The huge boost in the value-added *realised* by primary products derives from the fast growth of the Chinese economy and from its high demand for the agricultural goods and raw materials produced in *developing* countries like Brazil, Mexico, Indonesia, and India.

Furthermore, the adjustment for complex and simple labour also plays a significant role in the empirical results. This is evident when comparing the estimates from the current study with previous studies in the unequal exchange literature that treated labour as homogeneous. In a widely cited study on unequal exchange, Dorninger et al. (2021) find that high income countries exploit poorer countries because developed economies *consume* more embodied labour and natural resources than what they contribute to the world economy. Dorninger et al.'s (2021) finding is based on the *consumption footprint* of rich economies and it does *not* rely on the Marxian classification of activities, which seems to challenge the results in the present paper. But as **Figure A15** in the appendix demonstrates, their methodology has limitations. The finding that high income countries exploit poorer countries relies on a comparison between the labour, land, energy, and raw materials directly and indirectly consumed via final demand, relative to the resources contributed to the world economy. However, empirical studies on unequal exchange like Dorninger et al. (2021), and even Hickel, Dorninger, Wieland, and Suwandi (2022), assume labour to be homogenous across industries and countries, for they do not adjust the labour vector for skill differentials. As shown in **Figure A15**, the assumption of homogenous labour overestimates the contribution from poorer countries and underestimates the contribution from richer countries.

Additionally, the unequal exchange literature has not yet fully accounted for the rapid rise of unproductive activity in developed countries or the massive relocation of productive capital to China. Instead of comparing value *realisation* with value *production*, the recent empirical studies on unequal exchange (Dorninger et al., 2021; Hickel, Dorninger, Wieland, and Suwandi, 2022; Infante-Amate, Urrego-Mesa, Piñero, and Tello, 2022) compare the *consumption footprint* with the *contribution* of countries in terms of social and natural resources. In doing so, however, these studies have not yet properly considered the uneven growth of productive and unproductive activities across countries. The literature on unequal exchange has, for example, overlooked the value transfers from *developed* countries to the unproductive activities of the United States, which can potentially position developed countries as value *givers* within global value chains. Likewise, these empirical studies have underestimated the surge in demand for agricultural and mining products from *developing* countries driven by China's rapid rise, positioning these developing economies as value *capturers* within global value chains.

6. Conclusion

This paper has extended Marxian value theory to a global scale and introduced a methodology for estimating the production, realisation, and capture of value-added within global value chains. Results indicate that value tends to flow from labour-intensive industries (health, education, construction, agriculture, and services) to capital-intensive industries (manufacturing, mining, and oil) and to unproductive activities (real estate, finance, trade, and government administration).

These results highlight the importance of the rise in capital intensity associated with industrialisation and economic development. The findings can also explain the growing adoption of artificial intelligence in the service sectors, which amounts to a substantial increase in capital intensity and is thus a potential mechanism for capitalists to capture more value in labour-intensive services. Moreover, the capture of value-added by real estate, finance, trade, and government administration highlights the economic cost of unproductive activities. In this context, the panel dataset constructed for this paper can be used to test which subtypes of unproductive activities may hinder or boost productive investment and economic growth.

The paper has additionally shown that unequal exchange theory is incompatible with the conventional assumption that all activities are productive. Only under the Marxian productive-unproductive classification do the results converge with unequal exchange theory. This finding is driven by the massive relocation of productive capital to China, while unproductive capital expanded rapidly in the United States and Europe between 2000 and 2014. These results demonstrate the strength and actuality of Marxian value theory and the assumption that not all activities produce economic value.

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Tables and Figures

Table 1: Correlation between value-added realised and produced by country-industry and activity type, 2000–2014.

Productive-unproductive classification	Marxian	Marxian	Conventional (SNA)
Activity type	Productive only	Productive and unproductive	All activities
Aggregation level	Industries by country per year	Industries by country per year	Industries by country per year
Correlation between realised and produced value-added	0.96	0.48	0.91
Observations used	27,735	34,830	36,120
Observations missing	3.6%	3.6%	0%

Note: ‘SNA’ is the United Nations’ System of National Accounts, which classifies all industries as productive. In the appendix, **Table A1** lists the countries included, **Table A2** lists the productive-unproductive classification in the Marxian approach, and **Figure A10** plots the underlying data.

Table 2: Determinants of value-added capture by country-industry, 2000–2014.
Panel regression models with standardised variables.

Dependent variable: Value-added capture						
	Pooled OLS	Pooled OLS (PA only)	Pooled OLS (UA only)	Fixed effects: between	Fixed effects: within	Random effects
Industry status: UA	0.6453 *** (0.0774)			0.6503 *** (0.0518)		0.6435 *** (0.0898)
Profit rate realised	0.0383 (0.0250)	0.0603 *** (0.0173)	-0.0745 (0.0870)	0.0457 (0.0493)	0.0429 * (0.0214)	0.0425 * (0.0212)
Profit rate realised (squared)	-0.0017 (0.0012)	-0.0029 ** (0.0009)	0.0118 (0.0104)	-0.0022 (0.0030)	-0.0012 * (0.0006)	-0.0012 * (0.0006)
K-to-employment ratio	0.3720 * (0.1668)	0.5984 *** (0.0981)	0.3473 * (0.1489)	0.5580 *** (0.0753)	0.1592 *** (0.0460)	0.1634 *** (0.0465)
K-to-employment ratio (squared)	-0.0340 (0.0182)	-0.1714 *** (0.0455)	-0.0287 (0.0159)	-0.0684 *** (0.0115)	-0.0058 ** (0.0020)	-0.0063 ** (0.0020)
K-to-employment ratio (cubic)	0.0006 (0.0004)	0.0107 ** (0.0036)	0.0005 (0.0003)	0.0016 *** (0.0003)	0.0001 * (0.0000)	0.0001 * (0.0000)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Controls for unobserved effects	None	None	None	Individual effects	Individual effects	Individual effects
Robust standard errors	HAC	HAC	HAC	None	DK HAC with group clusters	DK HAC with group clusters
Observations	33,535	26,800	6,735	2,237	33,535	33,535
R2	0.0996	0.1980	0.5725	0.1087	0.0107	0.0167

Note: Significance levels are ***0.001, **0.01, *0.05. Dependent variable is value-added capture (realisation minus production) by country-industry. Dependent variable and regressors are standardised, so the estimates are in units of standard deviations, and regressions exclude the intercept. Models include country dummies. Models are estimated with heteroskedasticity and autocorrelation consistent (HAC) standard errors. ‘DK’ is the Driscoll-Kraay estimator of HAC standard errors, which (unlike the Arellano HAC estimator) is also robust to cross-sectional dependence. ‘PA’ and ‘UA’ are productive and unproductive activities, respectively. All variables are in real terms, in constant 2015 US dollars.

Global Value-Added Captured by Country and by Industry (2000-2014)

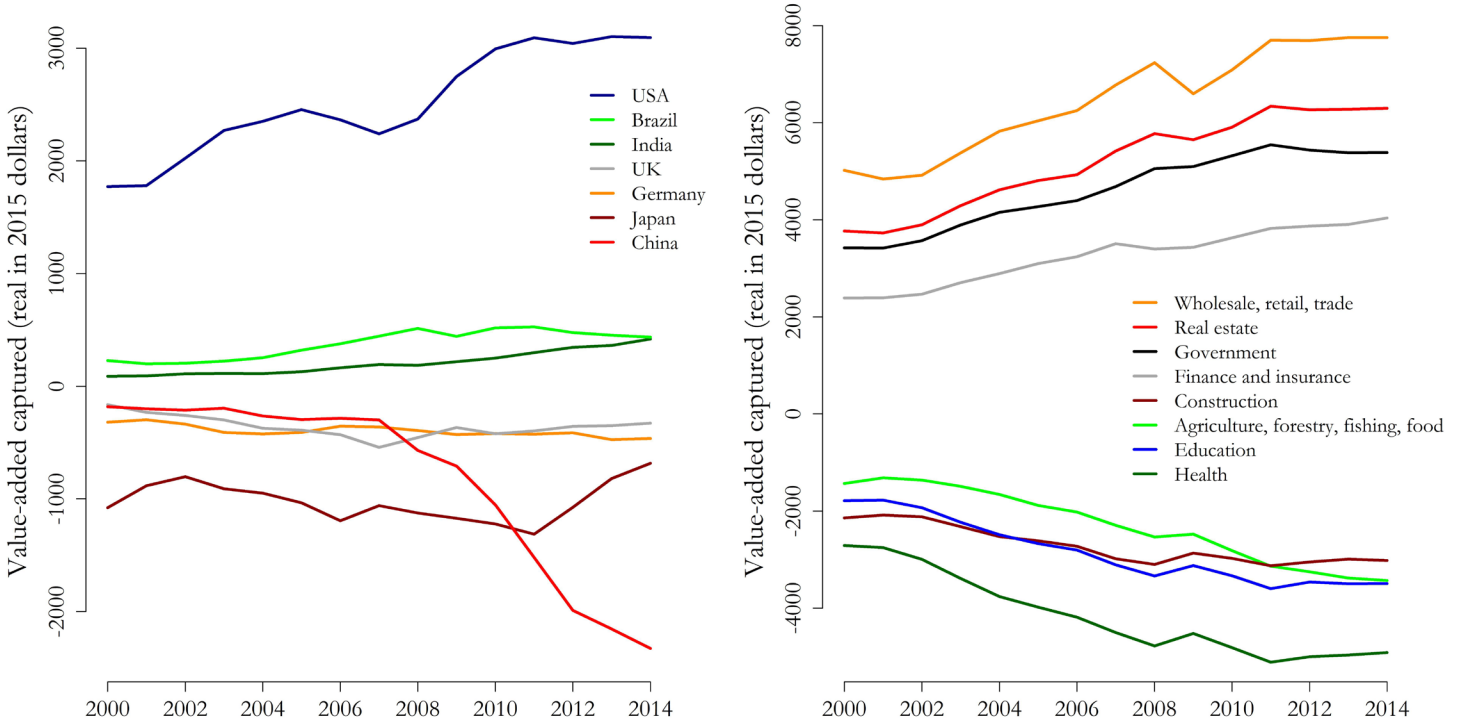


Figure 1: Global value-added captured in selected countries and industries, 2000–2014.

Global Value-Added in 2014: Production and Capture by Country

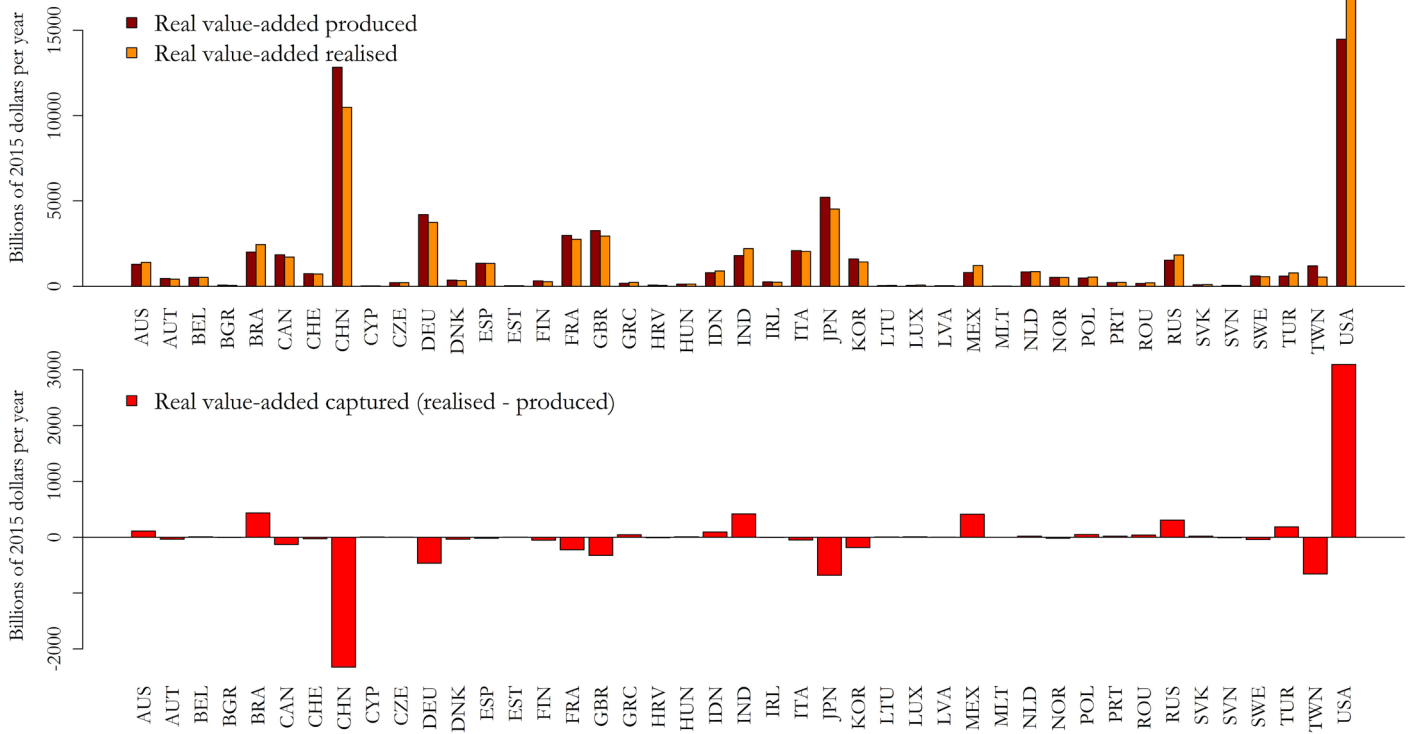


Figure 2: Production, realisation, and capture of global value-added by country, 2014.

Global Value-Added in 2014: Production and Capture by Industry

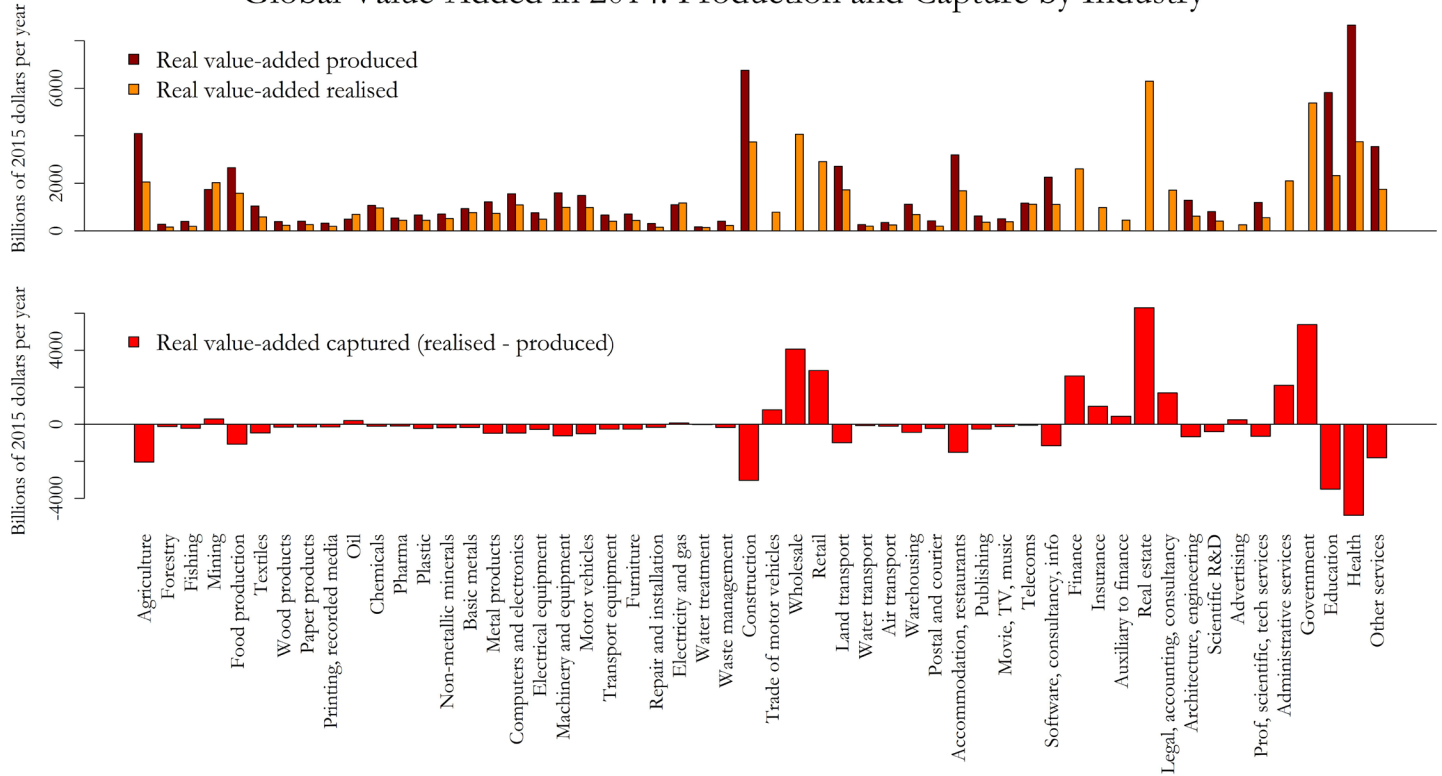


Figure 3: Production, realisation, and capture of global value-added by industry, 2014.

Exploitation and Profit Rates by Country (2000-2014)

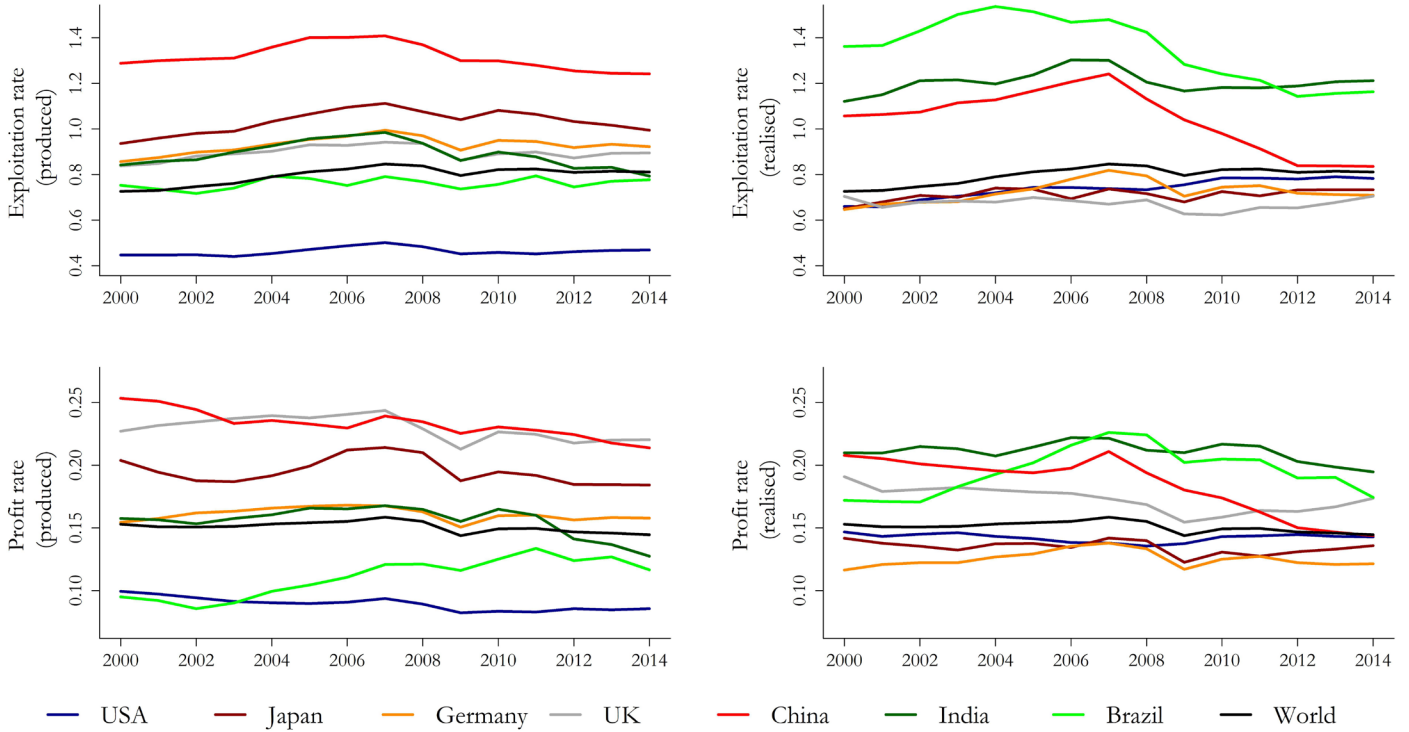


Figure 4: Average rates of exploitation and profit for selected countries, 2000–2014. Left column: produced rates. Right column: realised rates.

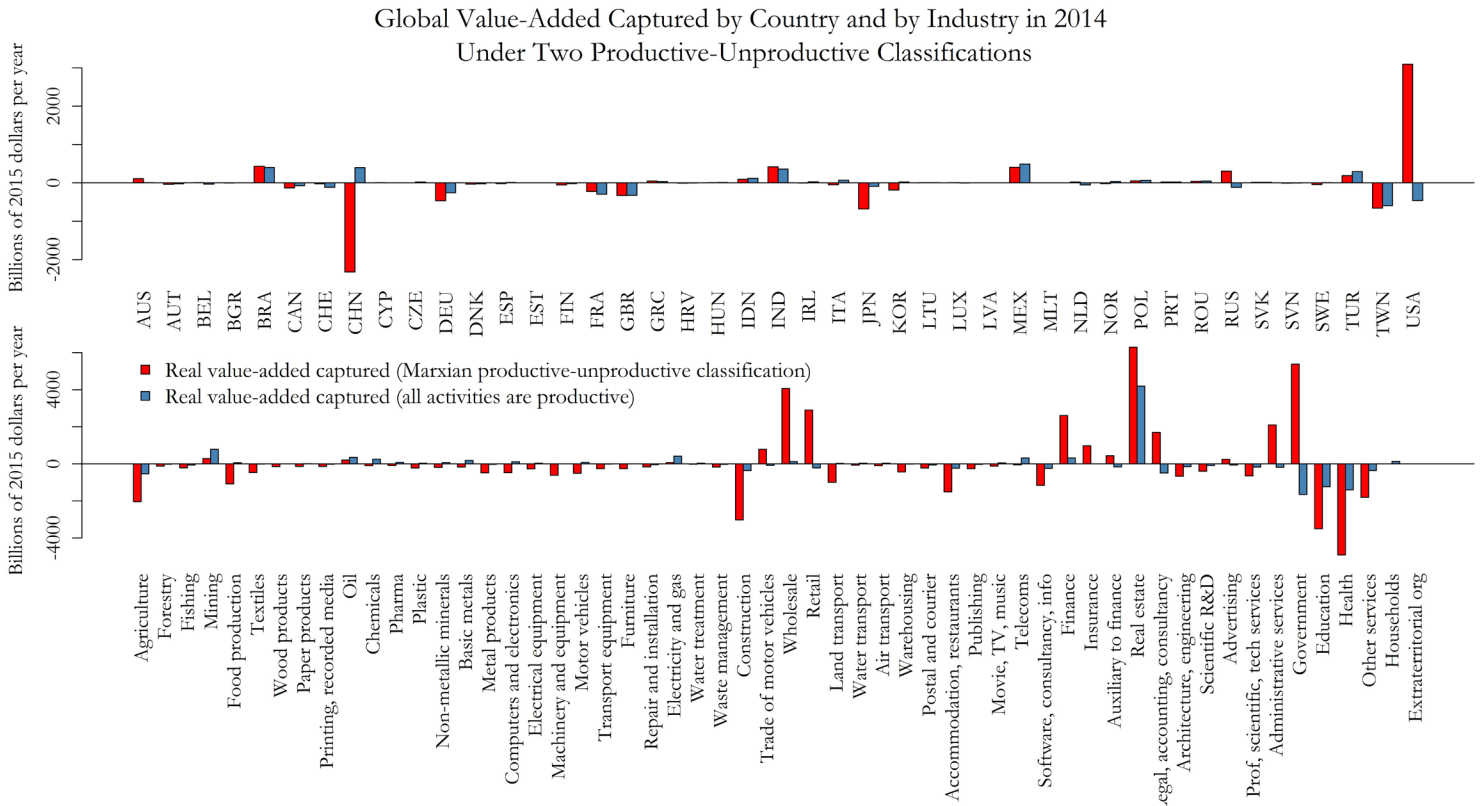


Figure 5: Capture of global value-added by country and by industry in 2014 under the Marxian productive-unproductive classification (red bars) and under the conventional assumption that all activities are productive (blue bars).

Online Appendix

A1. Estimation Methodology: Additional Details

Definitions of exploitation

This paper defines *exploitation* with respect to the *unequal exchange of labour*, which is a broader definition than Marx's own. To clarify the differences, let us see each definition in detail.

Marx's definition of exploitation refers to the appropriation of unpaid labour from workers by capitalists at the firm level. According to this definition, it is not possible to claim that one company exploits another company, or that one country exploits another country. Marx's concept of exploitation is confined to the within-company relations: capitalists exploit workers. The surplus value extracted can then be redistributed, but this redistribution of surplus value is not defined as exploitation.

The definition of exploitation as the unequal exchange of labour refers to the appropriation of embodied labour in excess of one's own contribution. According to this definition, exploitation can take place within firms, between firms, between sectors, and between countries. This concept includes the Marxist definition of exploitation, but it also encompasses the value transfers between firms, industries, and countries. Under this definition, it is correct to claim that country A exploits country B if country A draws more embodied labour than what it contributes to country B. In the terminology employed in this paper, country c is an exploiter if $v_{c,t}^c > 0$, since the value-added realised is greater than the value-added produced: $v_{c,t} > v_{c,t}^*$. Likewise, country c is exploited if $v_{c,t}^c < 0$, because $v_{c,t} < v_{c,t}^*$.

The global sum of value-added *produced* (which corresponds to the paid and unpaid labour performed by workers at the firm level) is a large positive sum, whilst the global sum of value-added *captured* (which

measures transfers of value-added) is always zero for any given year. Likewise, the global sum of surplus value *produced* (which corresponds to the unpaid labour extracted from workers at the firm level) is a large positive sum, whilst the global sum of surplus value *captured* (which measures transfers of surplus value) is always zero for any given year.

These mathematical properties reflect Marx's contention that value is created in the sphere of production and distributed in the sphere of circulation. The main difference between Marx and unequal exchange theory is that Marx employs the concept of exploitation only within the sphere of production (where value is created), whilst the theory of unequal exchange extends the concept of exploitation to also encompass the sphere of circulation (where value is transferred). Both approaches, nonetheless, assume that there is no value creation in the sphere of circulation.

Competition over value-added produced, not only over surplus value

The definition of value-added capture $v_t^c \equiv v_t - v_t^*$ introduced in this paper indicates that capitalists compete over the entire pool of value-added v_t^* produced. This definition stands in contrast to Marx's original assumption that capitalists compete solely over the pool of surplus value (value-added minus labour compensation). In chapter 9 of volume III of *Capital*, Marx (1991 [1894]: 254–272) introduced a model of value transfer across industries. By *assuming* that the entire wage bill was advanced at the beginning of every production period, Marx concluded that capitalists compete over the distribution of surplus value only. But Marx's reasoning is valid solely in the case when the entire wage bill is paid *ex ante*, before production begins. In reality, a share of labour compensation $W_{i,c,t}$ is paid *ex post* and is *conditional* on factors such as performance, the quantity of net product y_t^* effectively produced, and the amount of value-added v_t effectively realised. Labour compensation paid through bonuses, performance awards, sales commissions, and wages for hours effectively worked imply that a share of $W_{i,c,t}$ is endogenous to the realisation of v_t , and thus that $W_{i,c,t}$ cannot be completely determined *ex ante*, before production begins. Successful companies that can grab a greater share of the global pool of value-added produced v_t^* can pay higher salaries and bonuses *ex post*, at the end of the production period.

Therefore, due to this partial endogeneity of $W_{i,c,t}$ with respect to value-added capture v_t^c , capitalists do compete over the entire pool of value-added v_t^* produced.

The value of labour power in the New Interpretation

This paper adopts the New Interpretation of Marxian value theory. A key axiom of the New Interpretation is that the money wage corresponds to the value of labour power, with this equivalence determined by the ‘monetary expression of labour time’ (MELT). This axiom has two important implications. First, there is no divergence between the value of labour power and the money wage. Second, the value of labour power equates to the wage share of value-added.

The paper further argues that capitalists compete over the entire pool of value-added, not just over the surplus value (value-added minus labour compensation). As discussed in the previous subsection, this is because labour compensation is partly determined ex ante (before production begins), but also partly ex post (once value-added is realised by firms). The ex post component of labour compensation renders the wage share partially endogenous to the realised value-added. In principle, this ex post component (such as bonuses, performance awards, sales commissions, or wages for actual hours worked) introduces the possibility of a divergence between the ex-ante value of labour power and the ex-post money wage (or the wage share of value-added).

The direction of causality between the wage share and the value of labour power is not immediately clear, and the New Interpretation does not specify how the value of labour power is determined (Foley, 1982; Mohun and Veneziani, 2017). However, it does offer a definition that automatically equates the wage share with the value of labour power at the end of the production period, without proposing a specific causal mechanism (Foley, 1982: 38). This paper adopts this approach, asserting the ex post equivalence between the value of labour power and the money wage, converted to labour time via the MELT. Further research is necessary to explore the direction of causality between the money wage and the value of labour power.

Limitations of the proxy for skill differentials

While certainly an imperfect measure, relative wages remain the most practical proxy for skill differentials given the available data at the country-industry level. In countries like China, however, institutional factors such as the hukou system and the party-state's monopoly on trade unions can distort wage signals, making them less reliable indicators of skill. Similarly, a bus driver in India may possess greater skills than one in Norway, despite earning a much lower wage. The adjustment for skill levels, moreover, could consider educational attainment, but data on years of schooling are not sufficiently detailed at this level. Mapping education to productivity is also impractical due to the lack of adjustment for educational quality across countries, and the challenge of linking education to industry-specific value-added. Despite these limitations, relative wages remain the most viable proxy for assessing skill differentials.

Adjustment for net taxes (taxes minus subsidies)

The WIOT are presented in *basic prices* and thus exclude taxes on value-added. This would require the removal of government administration from the computations, since the source of the value-added that supports government services would be missing. But because the present study classifies government administration as an unproductive activity, the estimations need to include *net taxes* (taxes minus subsidies) into the measures of gross output and value-added at the country-industry level. Luckily, the WIOT do have data on net taxes by industry and country for all years in the sample. By adjusting gross output and value-added for net taxes, government administration can be included in the set of unproductive activities.

Further details on value-added, total value, and gross output

The paper estimates the monetary value-added *produced* as $v_t^* \equiv m_t \hat{\lambda}_t y_t^*$, which is the product of three elements: the MELT m_t , the diagonalised vector of labour values λ_t per unit of gross output, and the vector of Marxian net product y_t^* . The entries in the vector of Marxian net product y_t^* are set to zero for unproductive activities, and are equal to $y_t^* = x_{i,c,t} - Z_{PA \rightarrow PA,i,c,t}^* \vec{1}$ for productive activities. The latter equation means that

only the productive inputs ($Z_{PA \rightarrow PA}^*$) are deducted from the gross output $x_{i,c,t}$ of productive activities, thus leaving the unproductive inputs ($Z_{UA \rightarrow PA}^*$) to be paid from the Marxian net product of productive activities.

Since unproductive activities are funded by the value-added generated in productive activities, this might suggest that productive activities cannot become value capturers (i.e. realise more value-added than they produce). However, in productive industries with high capital/labour ratios and significant markups (such as mining and oil, as shown in **Figure 3**), these industries can still realise more value-added than they generate, thereby becoming value capturers within the global economy.

Furthermore, the computation of the Marxian net product of productive activities in the equation $y_t^* = x_{i,c,t} - Z_{PA \rightarrow PA,i,c,t}^T \vec{1}$ relies on the vector of gross output x_t , which is denominated in dollars in empirical input-output tables like the WIOT, thus reflecting market prices times quantities produced. The vector of gross output x_t is also the basis for the computation of total value produced and total value realised, where *total value* is the sum of value-added and the total intermediate inputs used up. The total value *produced* at the country-industry level in monetary form are the entries in the column vector $V_t^* \equiv m_t \hat{\lambda}_t x_t$, where the MELT m_t converts the total value *produced* in labour value terms $\hat{\lambda}_t x_t$ to prices proportional to labour values $m_t \hat{\lambda}_t x_t$. Note that, by construction, the vector of labour values λ_t per unit of gross output has positive entries for productive activities and null entries for unproductive activities. This means that the column vector $V_t^* \equiv m_t \hat{\lambda}_t x_t$ of total value *produced* in monetary form will also have positive entries for productive activities and null entries for unproductive activities. The column vector of total value *realised* in monetary form V_t is assumed to be identical to the vector of gross output in monetary units: $V_t \equiv x_t$. In this way, the vectors of total value *produced* V_t^* and total value *realised* V_t will not coincide at the country-industry, country, or industry levels of aggregation.

The paper follows the New Interpretation and therefore assumes, at the aggregate global level, the normalisation condition $m_t \lambda_t^T y_t^* = v_t^T \vec{1}$ based on the Marxian net product y_t^* , not on gross output x_t . This normalisation condition is built into the definition of the MELT as $m_t \equiv \frac{v_t^T \vec{1}}{\lambda_t^T y_t^*}$, which ensures that the global

sum of value-added produced v_t^* and realised v_t are equal for any given year t : $v_t^{*T}\vec{1} = v_t^T\vec{1}$. However, this normalisation in terms of the Marxian net product y_t^* does *not* guarantee that the global sums of total value produced V_t^* and realised V_t will be equal. Hence, in general, we have that: $V_t^{*T}\vec{1} \neq V_t^T\vec{1}$. For this reason, the equations for the determination of total value produced V_t^* and realised V_t are not included in the main body of the paper. The value transfers across industries and countries take place in terms of value-added, not in terms of total value.

Limitations of the WIOD

The WIOD has some important limitations that will be addressed in future research. First, the WIOD has no data on fixed capital depreciation, thus the matrix A_t of input-output coefficients cannot take capital depreciation into account. Second, despite the WIOD having input-output data on the ‘rest of the world’ combined, the SEA have data neither on employment, wages, nor capital stock for the ‘rest of the world’. This implies that the region defined as the ‘rest of the world’ cannot be considered in the estimates. Third, the WIOD has data only for the 2000–2014 period. Fourth, the SEA do not differentiate between supervisory and non-supervisory employees, and the estimates in this paper consider all labour in productive activities to be productive labour. Lastly, not-for-profit hospitals and schools might be included in the health and education industries, which are then classified as productive activities even in countries where these activities are state-run and free of charge.

A2. Countries, Industries, and the Productive-Unproductive Classification

Table A1: List of countries

Country code	Country name	Country code	Country name
AUS	Australia	ITA	Italy
AUT	Austria	JPN	Japan
BEL	Belgium	KOR	South Korea
BGR	Bulgaria	LTU	Lithuania
BRA	Brazil	LUX	Luxembourg
CAN	Canada	LVA	Latvia
CHE	Switzerland	MEX	Mexico
CHN	China	MLT	Malta
CYP	Cyprus	NLD	Netherlands
CZE	Czech Republic	NOR	Norway
DEU	Germany	POL	Poland
DNK	Denmark	PRT	Portugal
ESP	Spain	ROU	Romania
EST	Estonia	RUS	Russia
FIN	Finland	SVK	Slovakia
FRA	France	SVN	Slovenia
GBR	UK	SWE	Sweden
GRC	Greece	TUR	Turkey
HRV	Croatia	TWN	Taiwan
HUN	Hungary	USA	USA
IDN	Indonesia		
IND	India		
IRL	Ireland		

Table A2: Classification of productive and unproductive activities

Industry code	Industry row	Productive Activities
A01	1	Crop and animal production, hunting and related service activities
A02	2	Forestry and logging
A03	3	Fishing and aquaculture
B	4	Mining and quarrying
C10-C12	5	Manufacture of food products, beverages and tobacco products
C13-C15	6	Manufacture of textiles, wearing apparel and leather products
C16	7	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	8	Manufacture of paper and paper products
C18	9	Printing and reproduction of recorded media
C19	10	Manufacture of coke and refined petroleum products
C20	11	Manufacture of chemicals and chemical products
C21	12	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	13	Manufacture of rubber and plastic products
C23	14	Manufacture of other non-metallic mineral products
C24	15	Manufacture of basic metals
C25	16	Manufacture of fabricated metal products, except machinery and equipment
C26	17	Manufacture of computer, electronic and optical products
C27	18	Manufacture of electrical equipment
C28	19	Manufacture of machinery and equipment n.e.c.
C29	20	Manufacture of motor vehicles, trailers and semi-trailers
C30	21	Manufacture of other transport equipment
C31_C32	22	Manufacture of furniture; other manufacturing
C33	23	Repair and installation of machinery and equipment
D35	24	Electricity, gas, steam and air conditioning supply
E36	25	Water collection, treatment and supply
E37-E39	26	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
F	27	Construction
H49	31	Land transport and transport via pipelines
H50	32	Water transport
H51	33	Air transport
H52	34	Warehousing and support activities for transportation
H53	35	Postal and courier activities
I	36	Accommodation and food service activities
J58	37	Publishing activities
J59_J60	38	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
J61	39	Telecommunications
J62_J63	40	Computer programming, consultancy and related activities; information service activities
M71	46	Architectural and engineering activities; technical testing and analysis
M72	47	Scientific research and development

M74_M75	49	Other professional, scientific and technical activities; veterinary activities
P85	52	Education
Q	53	Human health and social work activities
R_S	54	Other service activities
Unproductive Activities (Finance)		
K64	41	Financial service activities, except insurance and pension funding
K65	42	Insurance, reinsurance and pension funding, except compulsory social security
K66	43	Activities auxiliary to financial services and insurance activities
Unproductive Activities (Real Estate)		
L68	44	Real estate activities
Unproductive Activities (Government)		
O84	51	Public administration and defence; compulsory social security
Unproductive Activities (Trade)		
G45	28	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	29	Wholesale trade, except of motor vehicles and motorcycles
G47	30	Retail trade, except of motor vehicles and motorcycles
Unproductive Activities (Additional)		
M69_M70	45	Legal and accounting activities; activities of head offices; management consultancy activities
M73	48	Advertising and market research
N	50	Administrative and support service activities
Excluded Activities		
T	55	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	56	Activities of extraterritorial organizations and bodies

A3. Modified World Input-Output Tables

		Intermediate Demand				Final Demand				Total Demand
		Industry 1 Industry 2 Industry 3 ... Industry 56	Industry 1 Industry 2 Industry 3 ... Industry 56	Household consumption Government consumption Investment Changes in inventories	Household consumption Government consumption Investment Changes in inventories	Total output				
		Country 1	Country 43	Country 1	Country 43	Totals				
Intermediate Inputs	Industry 1	Country 1	Inputs from country 1 to outputs in country 1	Inputs from country 1 to outputs in country 43	Inputs from country 1 to final demand in country 1	Inputs from country 1 to final demand in country 43	Total output			
	Industry 2		Industry 1	Inputs from country 43 to outputs in country 1	Inputs from country 43 to outputs in country 43	Inputs from country 43 to final demand in country 1		Inputs from country 43 to final demand in country 43		
	Industry 3		Industry 2	Industry 3	Industry 3	Industry 3		Industry 3		
		
	Industry 56		Industry 56	Industry 56	Industry 56	Industry 56		Industry 56		
	...	Totals	Sum of inputs	Sum of inputs						
	...									
	...									
	...									
	...									
Net Product	taxes less subsidies on products									
	Cif/ fob adjustments on exports									
	Direct purchases abroad by residents									
	Purchases on the domestic territory by non-residents									
Gross Product	Value added at basic prices	Value added	Value added							
	International Transport Margins									
	Output at basic prices	Gross output in country 1	Gross output in country 43	Final demand in country 1	Final demand in country 43	Total global output				

Figure A1: World input-output table (WIOT) before the application of the productive-unproductive classification

		Intermediate Demand				Final Demand				Total Demand
		Productive activities		Unproductive activities		Productive activities		Unproductive activities		Total output
		Household consumption	Government consumption	Investment	Changes in inventories	Household consumption	Government consumption	Investment	Changes in inventories	
		Country 1	Country 2	Country 1	Country 2	Totals				
Intermediate Inputs	Productive activities	Country 1	Country 2							
	Unproductive activities									
Net Product	taxes less subsidies on products									
	Cif/ fob adjustments on exports									
Gross Product	Direct purchases abroad by residents									
	Purchases on the domestic territory by non-residents									
	Value added at basic prices									
	International Transport Margins									
	Output at basic prices	Gross output	Gross output	Final demand in country 1	Final demand in country 43	Total global output				

Figure A2: World input-output table (WIOD) after the application of the productive-unproductive classification. ‘PA’ and ‘UA’ indicate productive and unproductive activities, respectively.

A4. Value-Added Capture by Country and Industry

Heat map by industry and country, no clustering: Value-added capture in global value chains (2014)

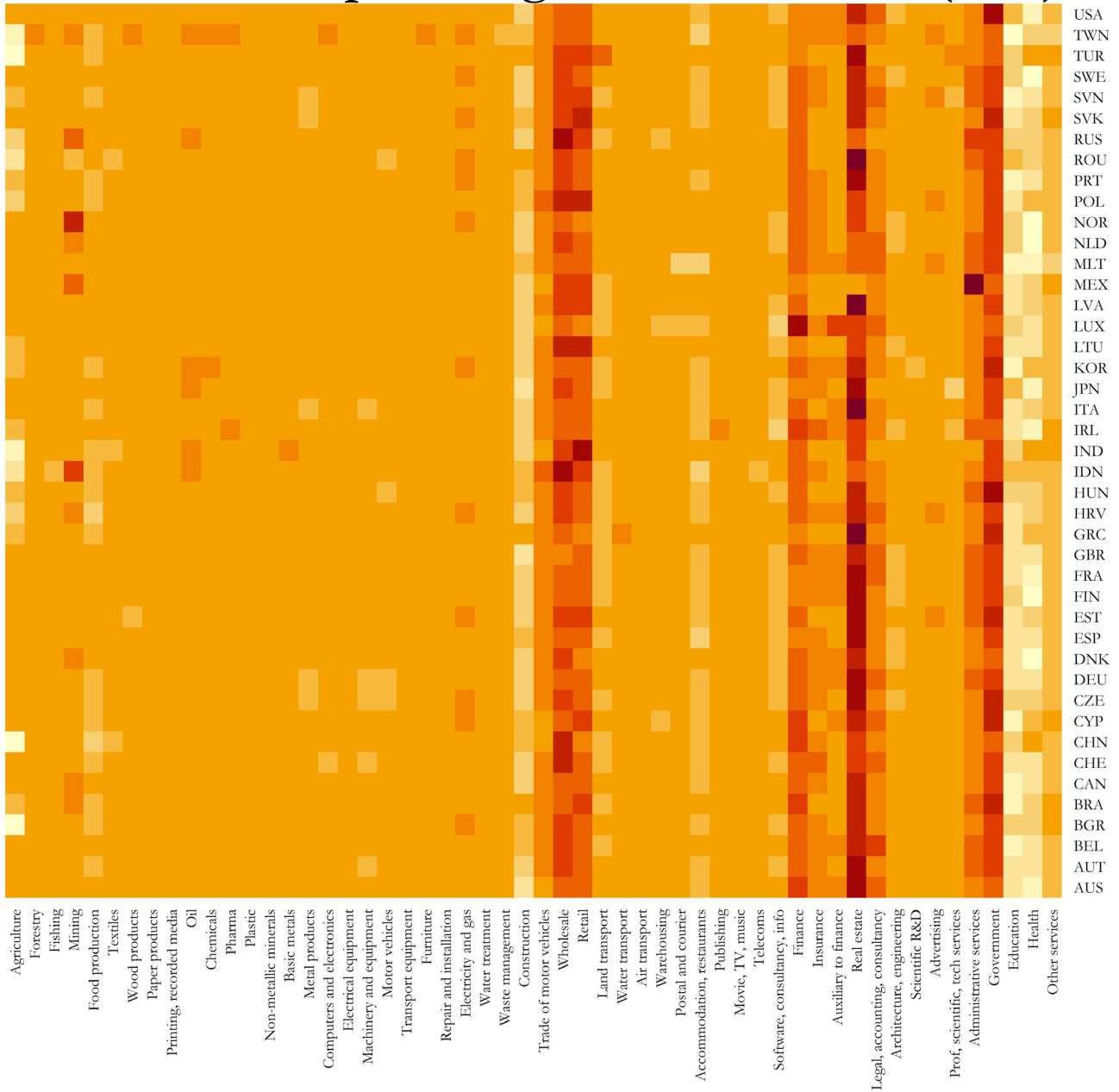


Figure A3: Heat map by country and industry depicting value-added capture in global value chains, 2014. Darker regions indicate greater value capture.

Value-Added Captured by Industry in 2014: USA versus China

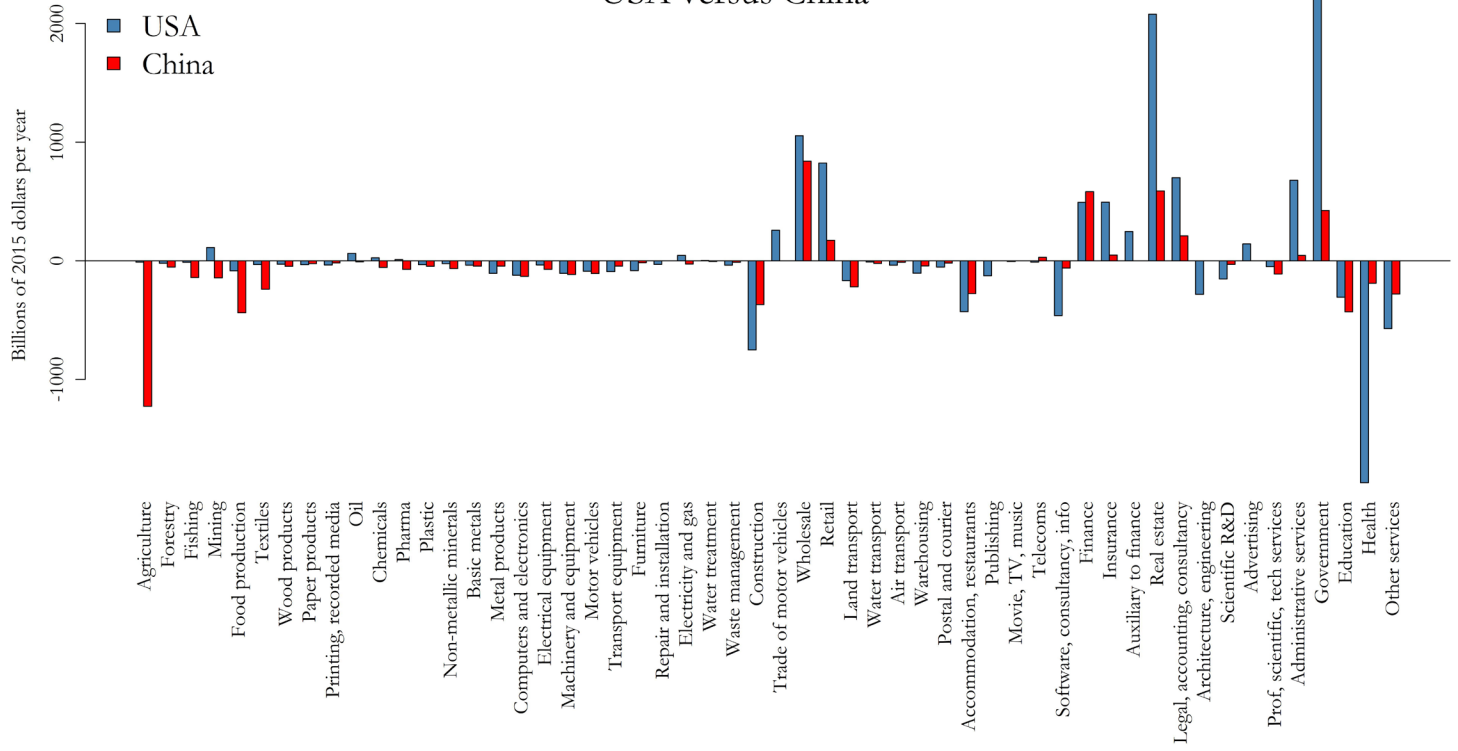


Figure A4: Value-added captured in the USA and China, by industry, in 2014.

A5. Exploitation and Profit Rates by Country and Industry

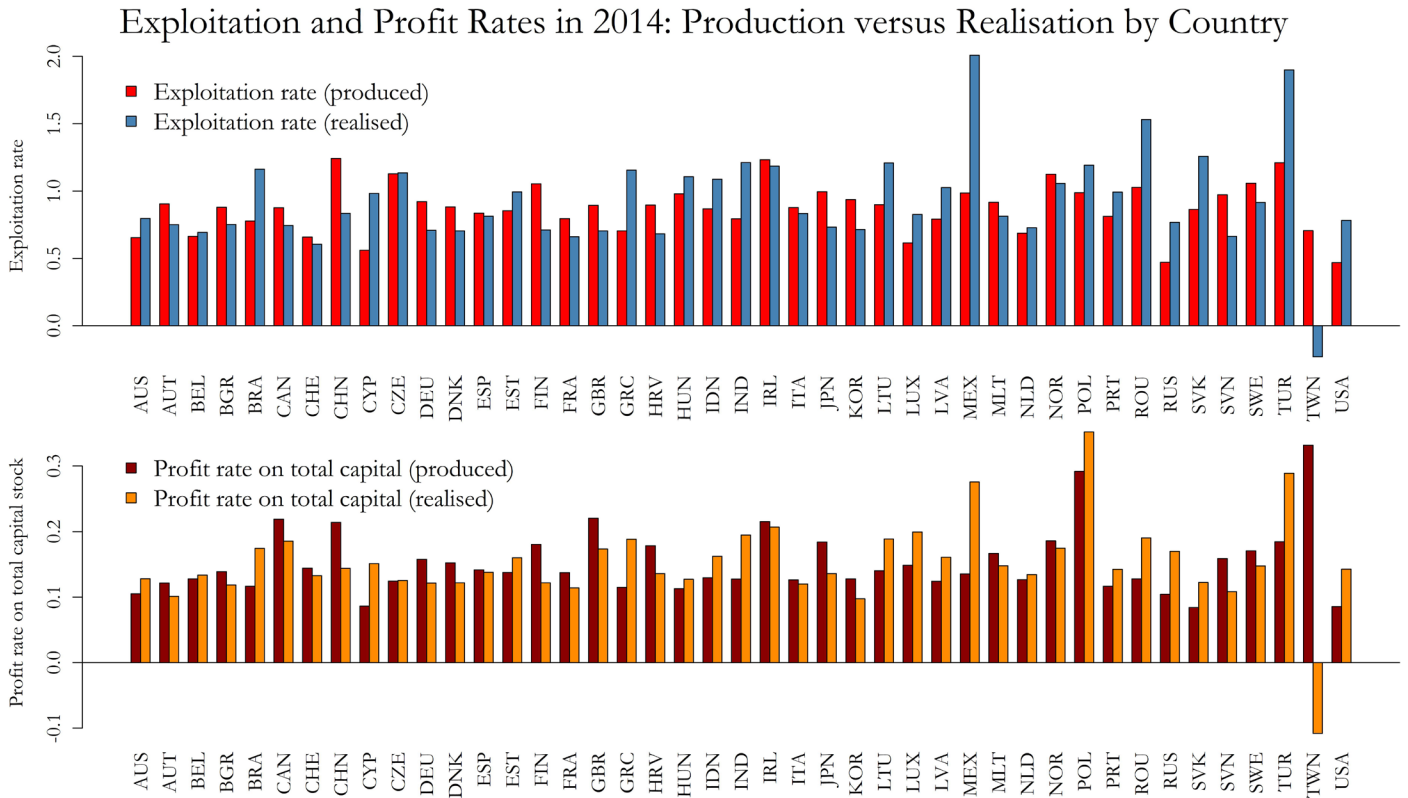


Figure A5: Realised versus produced rates of exploitation and profit by country, 2014.

Exploitation and Profit Rates in 2014: Production versus Realisation by Industry

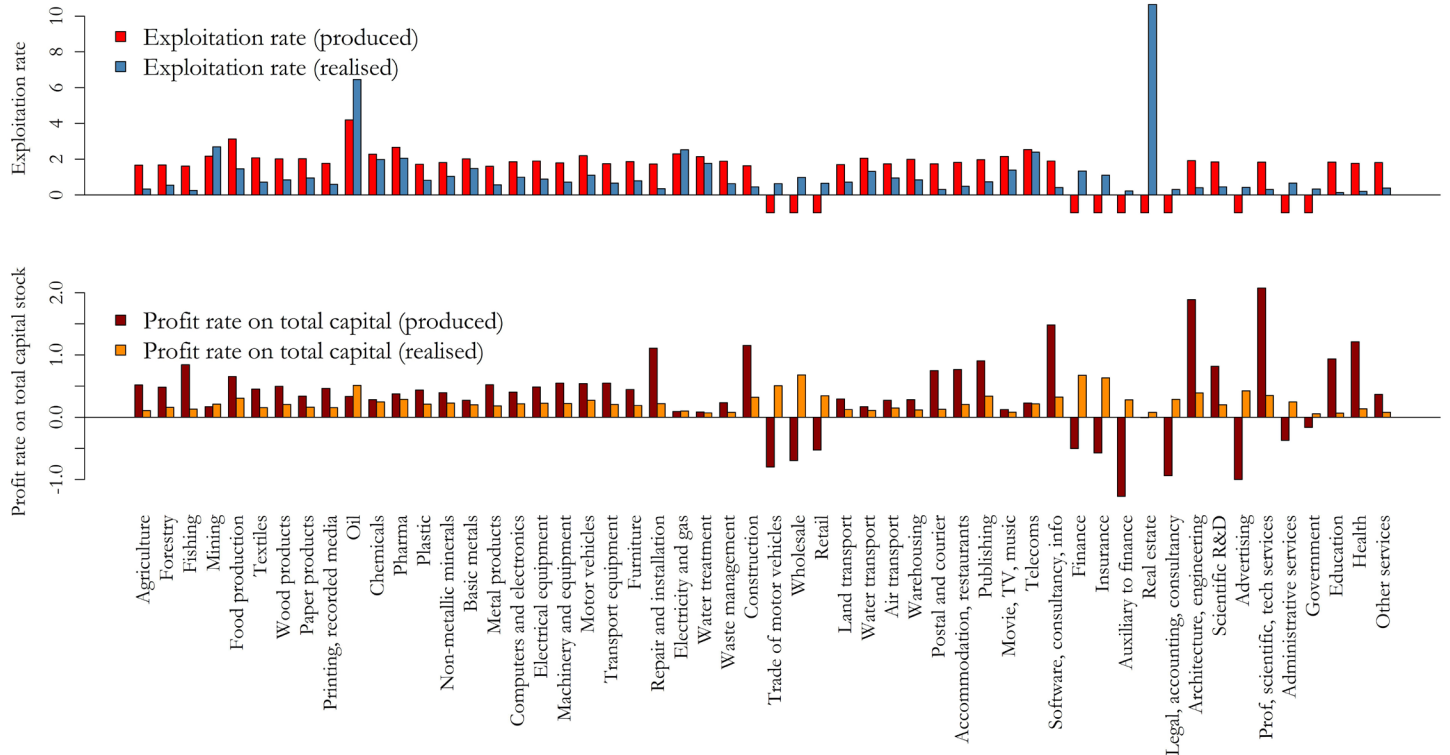


Figure A6: Realised versus produced rates of exploitation and profit by global industry, 2014.

Wage Share by Country (2000-2014)

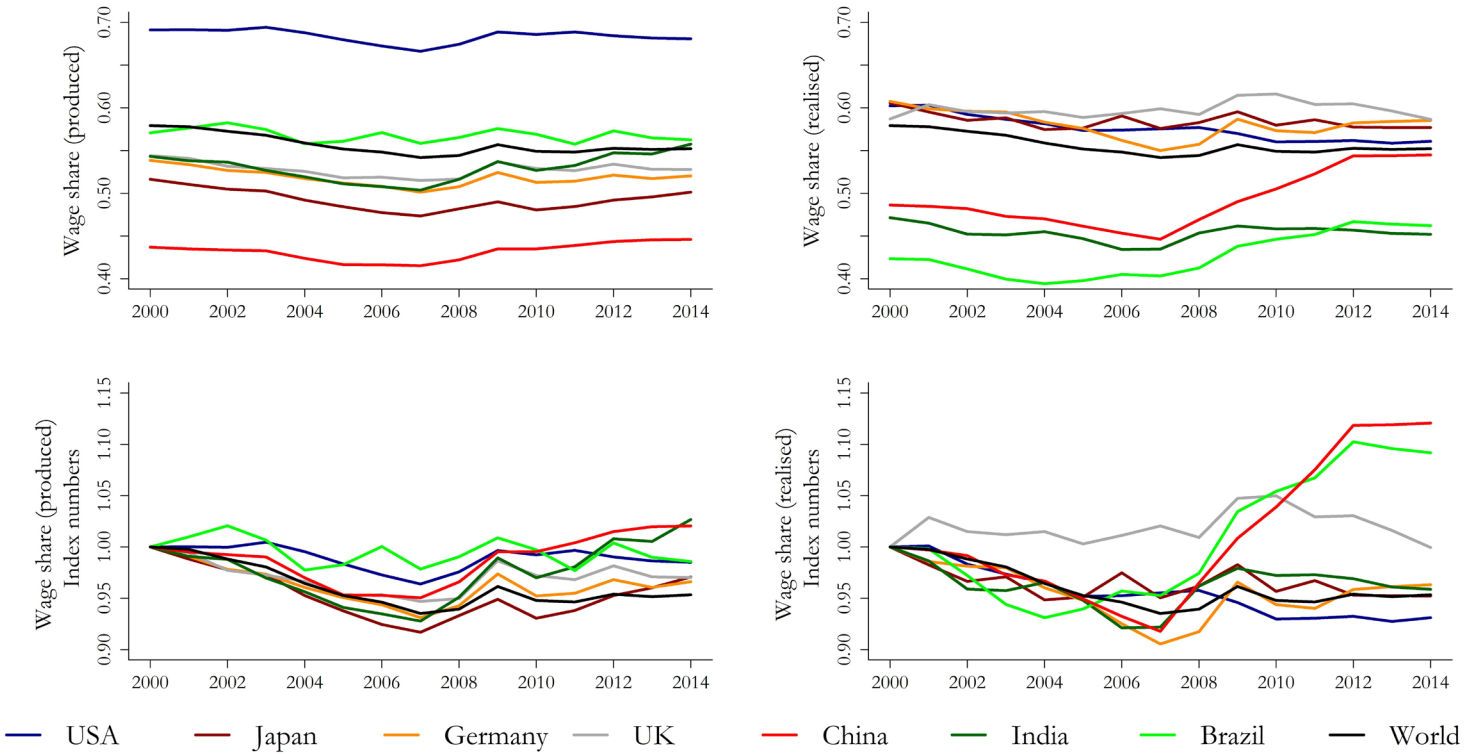


Figure A7: Wage share in the world and in selected countries, 2000–2014.
 Left column: wage share of value-added produced.
 Right column: wage share of value-added realised.

Kernel Densities (54 Industries in 43 Countries over 2000-2014)

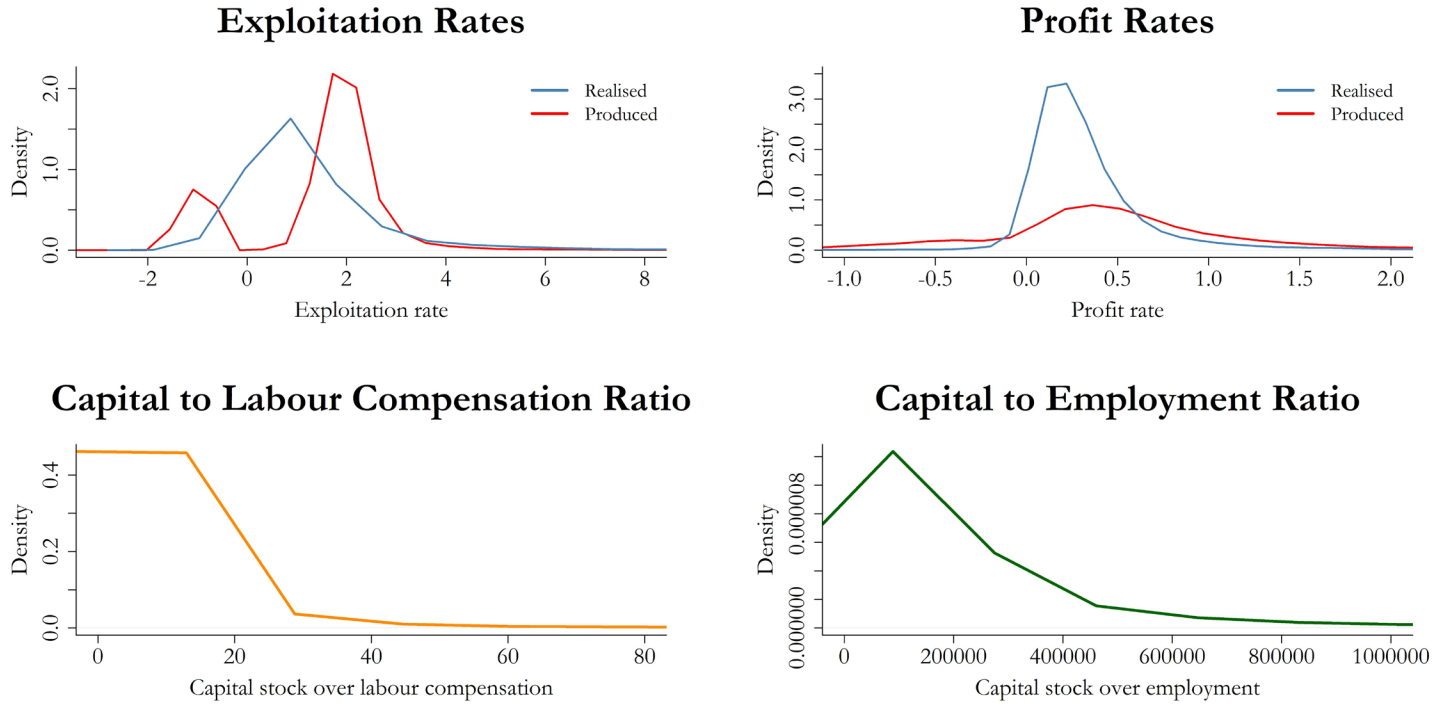


Figure A8: Kernel densities (probability distribution functions) for selected variables, computed across 34,830 observations from 54 industries in 43 countries over 2000–2014.

Class and Trade Dimensions of Exploitation, by Country-Industry (2000-2014)

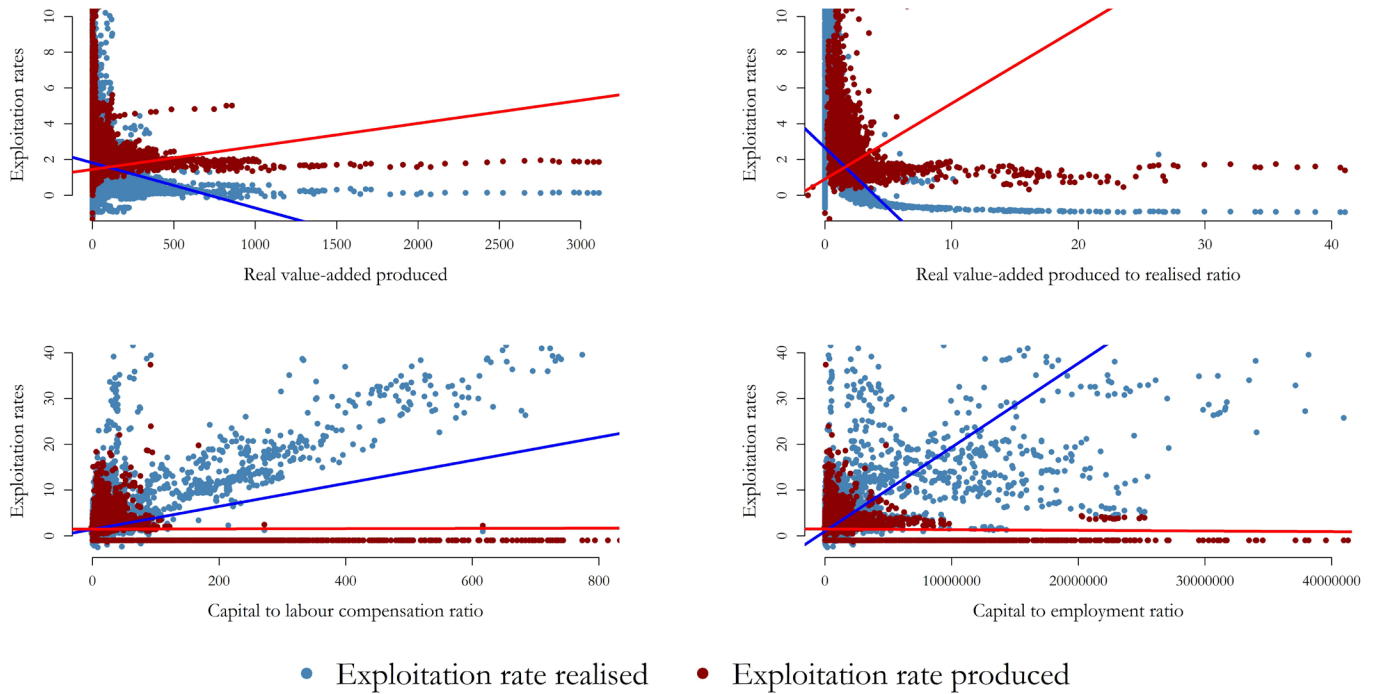


Figure A9: Rates of exploitation realised (blue) and produced (red) plotted against value-added produced and against the capital-labour ratio by country-industry, 2000–2014. Corresponding regression lines plotted with similar colours.

A6. Value Capture and Unproductive Activity

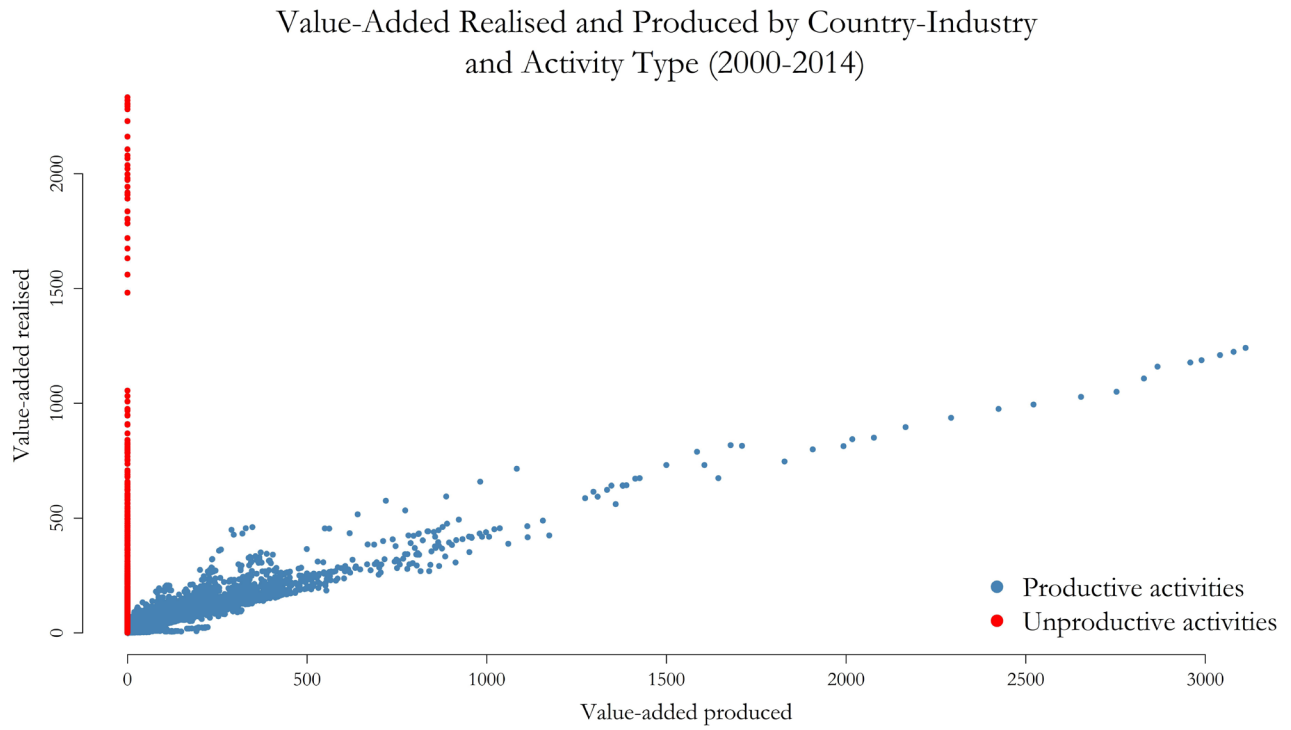


Figure A10: Scatterplot of value-added realised and produced by country-industry and activity type, 2000–2014.

Value-Added Capture and Capital-Labour Ratios by Country-Industry and Activity Type (2000-2014)

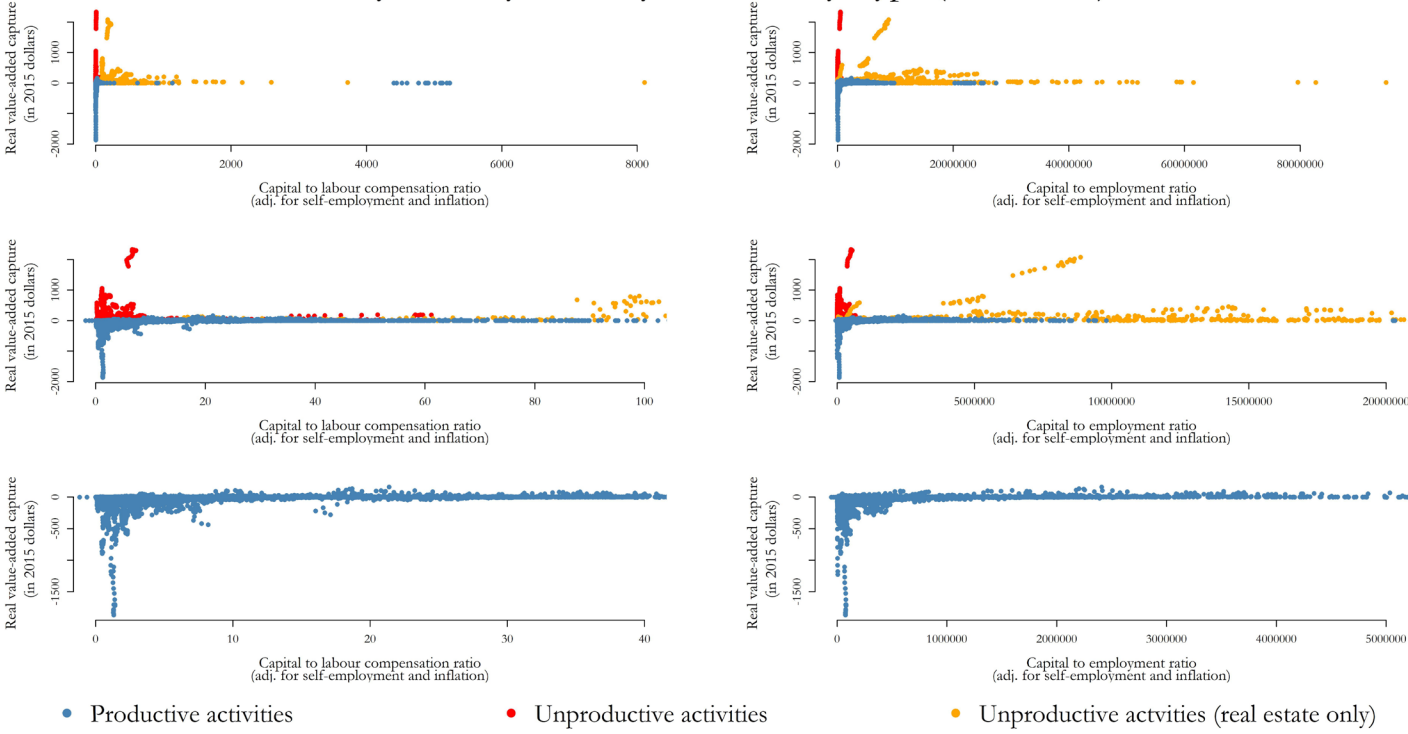


Figure A11: Global value-added capture and capital-labour ratios by country-industry and activity type, 2000–2014. The plots in the second and third rows are truncated versions of the plots in the first row.

A7. Value-Added Capture Under the Conventional SNA: All Activities Are Productive

Global Value-Added in 2014: Production and Capture by Country

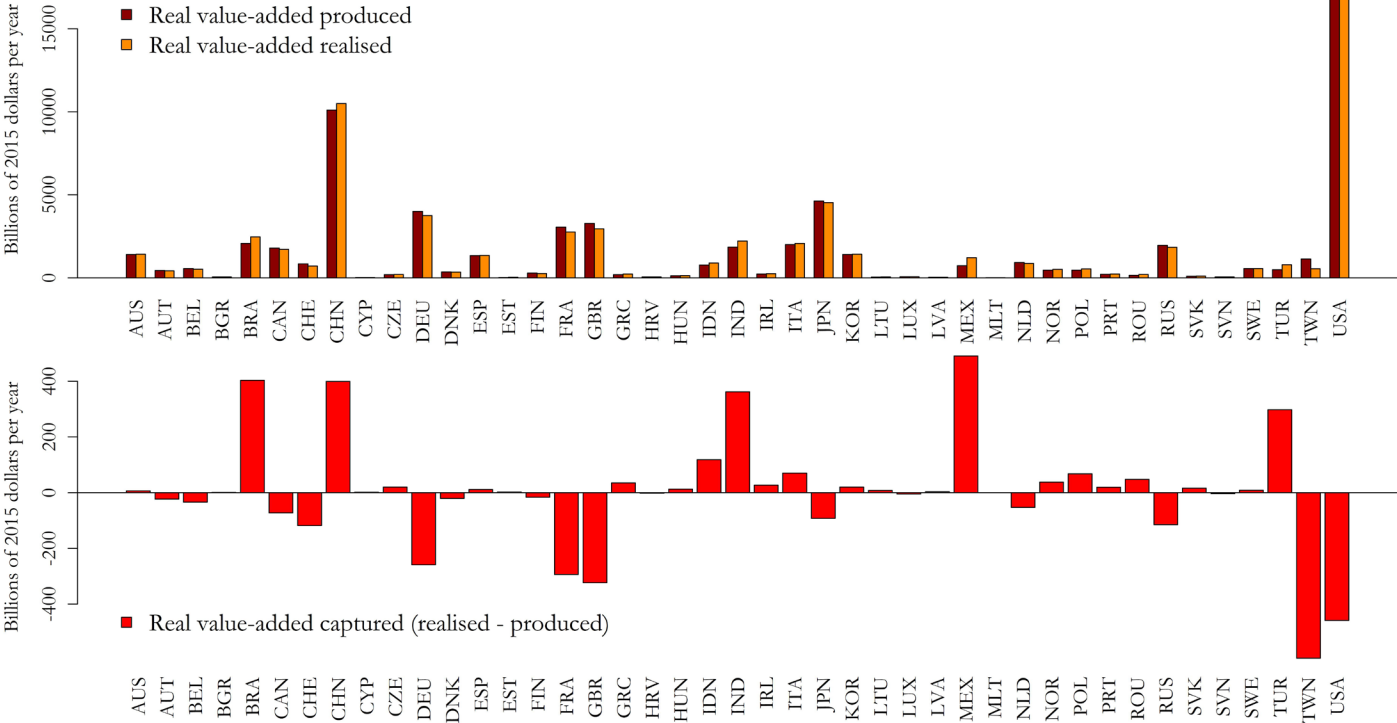


Figure A12: Production, realisation, and capture of global value-added by country, 2014. All industries classified as productive.

Global Value-Added Captured by Country and by Industry (2000-2014)

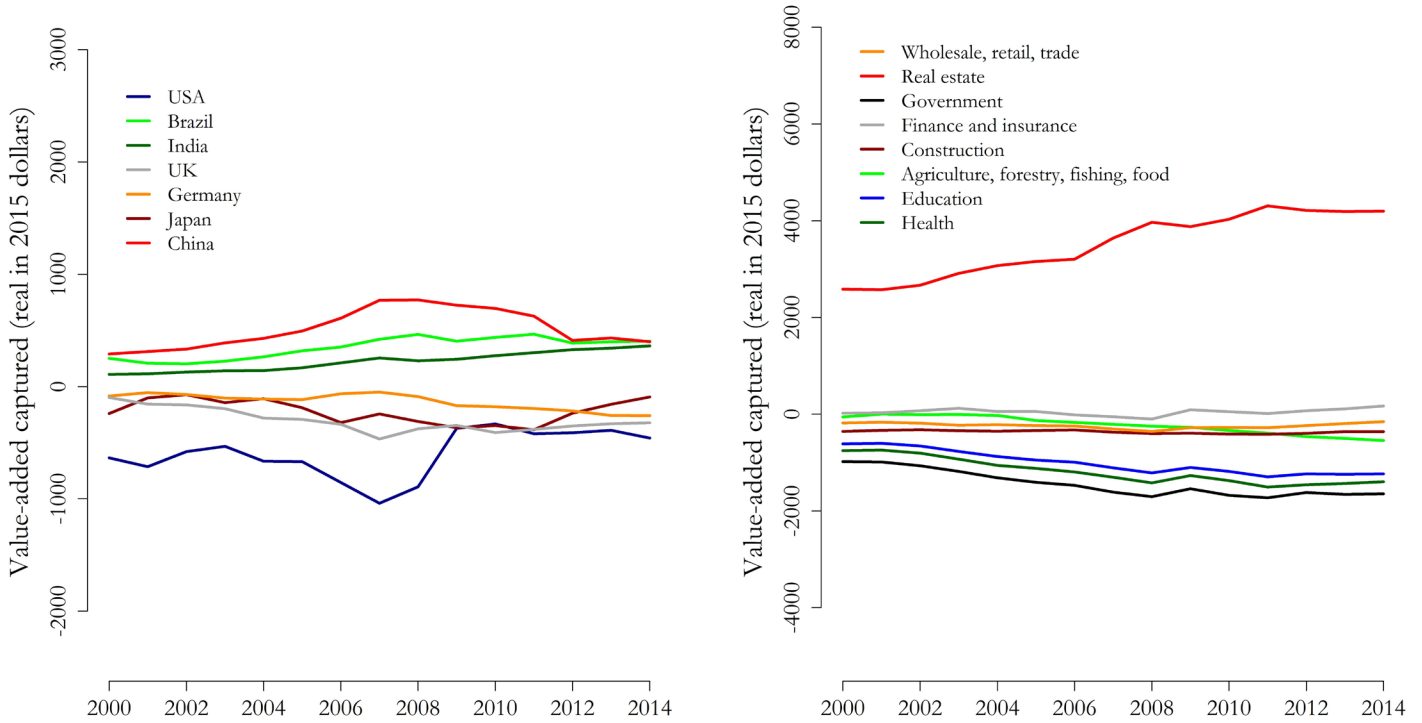


Figure A13: Global value-added captured in selected countries and industries, 2000–2014.
All industries classified as productive.

Sectoral Shares in Conventional Global Value-Added and Gross Output (1965-2018)

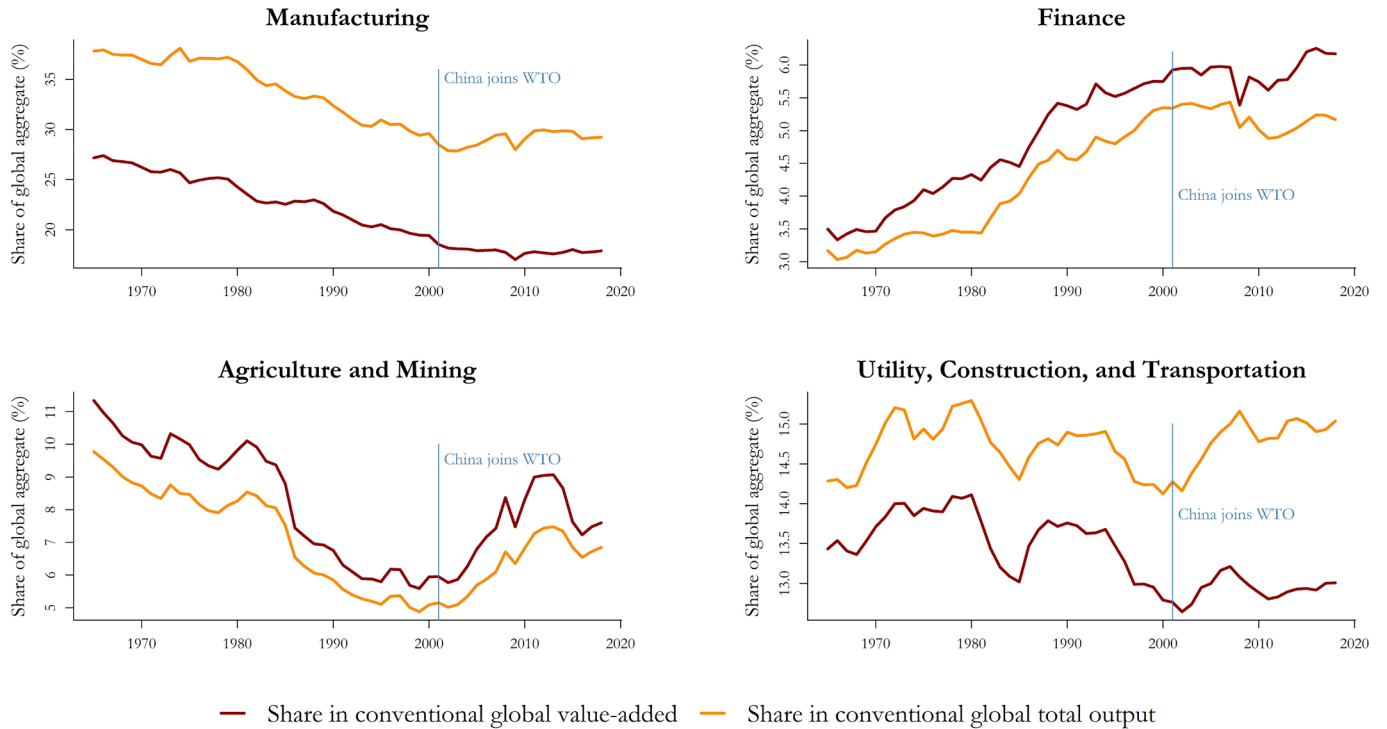


Figure A14: Shares of conventional global value-added and gross output for selected industries (1965–2018).

A8. Adjusting Dorninger et al. (2021) for Skill Differentials

Dorninger et al. (2021) compute *labour capture* as the labour embodied in consumption minus the labour contributed to the world economy. Let Z_t be the matrix of input-output transactions in dollars, and f_t the column vector of final demand expenditures in dollars. Let A_t be the square matrix of input-output coefficients, and let $B_t = (I - A_t)^{-1}$ be the Leontief inverse matrix. Let \hat{X}_t be the diagonal matrix with the gross output vector x_t placed along the main diagonal. Let L_t be the column vector of employment (unadjusted for skills) of both employees and self-employed workers. Let $l_t = (\hat{X}_t)^{-1}L_t$ be the column vector of labour requirements per unit of monetary gross output x_t . Let \hat{l}_t be the diagonal matrix with the vector of labour requirements l_t placed along the main diagonal. Let \hat{f}_t be the diagonal matrix with the vector of final demand f_t placed along the main diagonal. Then let the square matrix C_t for each year t be defined as follows:

$$C_t \equiv \hat{l}_t B_t \hat{f}_t = \hat{l}_t (I - A_t)^{-1} \hat{f}_t \quad (\text{A.1})$$

The elements $C_{i,j,t}$ of matrix C_t measure the quantity of labour embodied in the direct and indirect inputs from sector i required to satisfy the final demand for sector j . Matrix C_t thus shows how total labour is allocated to satisfy final demand. The *row sums* of matrix C_t are equal to the column vector L_t , which contains the *labour contributed* to the world economy: $C_t \vec{1} = L_t$. The *column sums* of matrix C_t are equal to the column vector L_t^c containing the *labour consumed* from the world economy via final demand: $C_t^T \vec{1} = L_t^c$. At the aggregate global level, the sum of labour contributed L_t and the sum of labour consumed L_t^c are equal: $L_t^T \vec{1} = (L_t^c)^T \vec{1}$.

Dorninger et al. (2021) assume labour to be homogenous across countries and industries. To correct for labour skills, one can replace the unadjusted vector of labour requirements l_t with the skill-adjusted vector of labour requirements: $\tilde{l}_t \equiv \{\tilde{l}_{i,c,t}\} = \frac{\bar{\omega}_{i,c,t}}{\bar{\omega}_t} \frac{L_{i,c,t}}{x_{i,c,t}} = \frac{1}{\bar{\omega}_t} \frac{W_{i,c,t}}{x_{i,c,t}}$. Hence, the column vector of *unadjusted labour capture* is $L_t^{cap} \equiv L_t^c - L_t$, while the column vector of *skill-adjusted labour capture* is $\tilde{L}_t^{cap} \equiv \tilde{L}_t^c - \tilde{L}_t$.

The L_t^{cap} and \bar{L}_t^{cap} vectors are plotted by country and by industry in **Figure A15**. To ensure comparability with the estimates in Dorninger et al. (2021), all activities are classified as productive. As can be readily seen, the adjustment for labour skills makes a substantial difference in the estimates of Dorninger et al. (2021), with large impacts on the sizes and signs of labour capture across countries and industries worldwide. Due to these large differences, the unadjusted labour capture estimated in Dorninger et al. (2021) is not robust to the adjustment for skill differentials.

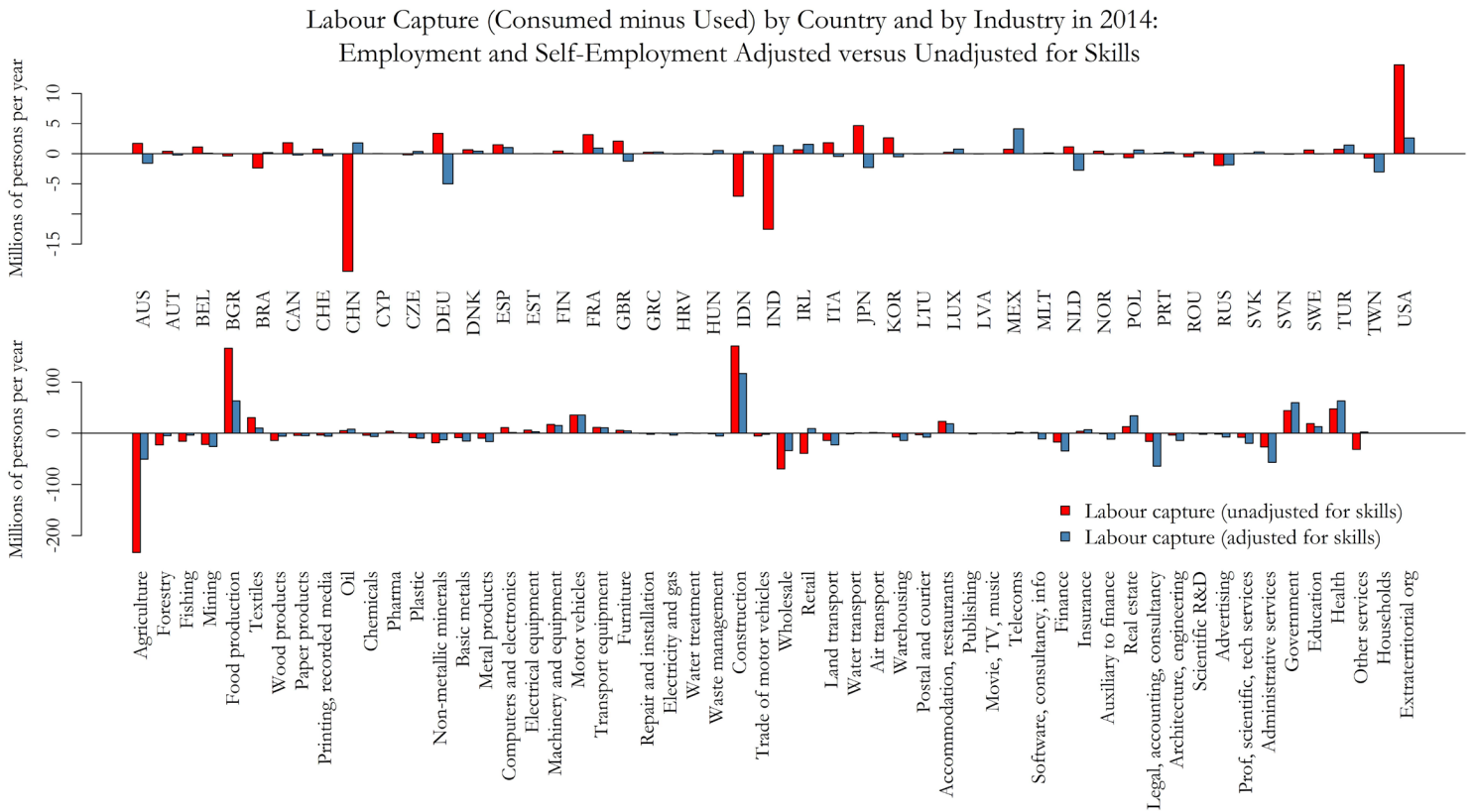


Figure A15: Labour capture by country and by industry in 2014. Labour is employment and self-employment adjusted for skill differentials (blue bars), and unadjusted for skill differentials (red bars). Labour capture is the labour embodied in final demand minus the labour used up in production. All industries are classified as productive.