

Was Marx right? Development and exploitation in 43 countries, 2000–2014

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ABSTRACT

We assess Marx's hypotheses about capitalist development on a global scale by constructing a new dataset of Marxist variables (profit rates, exploitation rates, composition of capital, and shares of productive activity) for 43 major economies, derived from world input-output data and national accounts in the 2000–2014 period. Consistent with Marx's hypotheses, the average profit rate declines at the world level, between countries, and within countries. The global rate of exploitation increases until 2008 but stagnates after the financial crisis, while capital intensity continued to increase. At the cross-country level, rich countries became increasingly dominated by unproductive activity. China absorbed much of the world's productive activity and kept the labor share of value added roughly constant at the world level.

1. Introduction

At the center of Marx's economic theory lie three fundamental claims. First, that the origin of value in capitalist societies is productive human labor. Second, that capitalist profit originates from surplus value through the exploitation of labor, which is the appropriation of unpaid labor time in productive economic activities. And, third, that competition forces companies to adopt capital-intensive labor-saving techniques of production. From these three fundamental claims, Marx predicted that economic development would be marked by technological advancement and by capital intensity rising faster than the rise in the rate of exploitation, leading to a long-term decline in the average rate of profit.

Marx defined the average profit rate as the ratio of surplus value to the capital tied up in production, which is equivalent to the ratio of the rate of surplus value to the organic composition of capital. The rate of surplus value is the rate of exploitation (the ratio of unpaid to paid labor time) of productive labor. The organic composition of capital is Marx's measure of capital intensity, defined as the capital-labor ratio in

production.

Was Marx right? To answer this question we first need to construct suitable empirical estimates of each of these variables for modern economies. Hitherto, attempts to measure Marxist variables remain absent at the multi-country level. Although precise empirical estimates of such data require technical coefficients of production, we can still estimate Marxist variables at the aggregate level using cross-country input-output matrices in monetary terms, since deviations of monetary measures from technical coefficients are minimized at higher levels of aggregation (Cogliano et al. 2018; Yoshihara 2017; Tsoulfidis and Tsilikis 2019; Işıkara and Mokre 2022).

A more important challenge is presented by the structure of modern national accounts (the go-to source for profits, capital, and wages country-by-country). The United Nations' System of National Accounts (SNA) – the benchmark for official national accounts – operates on the assumption that all incomes are compensation for productive economic activity. Marx and the classical economists, on the other hand, envisaged a set of productive activities that create value and a complementary set of unproductive activities that do not create value¹. Both types of

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¹ The adjective 'unproductive' has no moral connotation. The term 'unproductive' does not imply social rankings, interpersonal differences between individuals, or classification of time spent. For example, financial services are highly desirable, well-paying jobs in contemporary society, but they are unproductive in Marxist theory.

activities are present in every capitalist society². Surplus value, however, emanates only from the unpaid labor time in productive activities.

To address these challenges, this paper constructs a cross-country panel dataset which implements the productive-unproductive categorization of economic activity and uses it to assess fundamental questions vis-à-vis Marxist theory. We systematically convert the entire World Input Output Database (WIOD) into Marxist variables, using national accounts and input-output tables for 56 industries across 43 countries in the 2000–2014 period, which cover 63% of the world population in 2014. Our new panel data can be used by researchers in further empirical work. To the best of our knowledge, ours is the first ever attempt at producing a comprehensive global dataset of Marxist variables.

The time span of our data is limited but of special interest in the dynamics of capitalist societies. As [Milanovic \(2019\)](#) notes, this period represents a unique historical moment where capitalism alone dominates production and exchange in nearly every economy across the world. Global production and exchange were unified across national borders under the same system. Our dataset covers the entry of China into the WTO in 2001, the deepening of global value chains, and the greater mobility of capital across borders. Our dataset ends in 2014 just preceding the rise of populist nationalism and the inward turn of policy that became clear with the 2015 Brexit movement and the election of Donald Trump in 2016.

Using these data, we estimate Marxist variables on a global scale and decompose the global estimates into within- and between-country effects. Marx predicted that capital intensity would rise faster than the rise in the rate of surplus value, imparting a negative trend to the average profit rate. Consistent with Marx's hypotheses, we find that the average profit rate declined at the world level, between countries, and within countries from 2000 to 2014. The global rate of (realized) surplus value increased until 2008 but stagnated after the financial crisis, while capital intensity increased continuously.

Over the 2000–2014 period, our data show that productive activity declined in rich countries and relocated mostly to China. At a cross-country level, we find that the rate of surplus value, the organic composition of capital, and the ratio of productive-unproductive activity decline with per-capita GDP. As per our estimates, the rate of surplus value adjusted for self-employment is highest in Mexico and lowest in Japan. While the rate of profit on productive capital is relatively flat across countries, the rise of unproductive capital implies that the rate of profit on total capital declines in per-capita GDP, owing to the greater share of unproductive capital in rich countries. Given that unproductive activities increase with economic development, our finding adds a second mechanism to Marx's original prediction about the falling rate of profit.

The rapid decline in the world share of productive activities of the United States, Japan, and Germany are particularly striking in just 15 years of data. Alongside the rapid rise of productive activities in China, the United States remains a world outlier as the country with the greatest share of the global income of unproductive activity. Furthermore, China plays a major role in keeping roughly constant the world distribution of value added between capital and labor. China's rate of surplus value is lower than the rate predicted by its level of per-capita GDP, and thus the rapid rise of China in the production of value added has kept the Marxist labor share roughly constant at the global level. Our finding stands in contrast to the well documented decline in the world labor share using conventional national accounts ([Rodriguez and Jayadev 2013](#); [Karabarbounis and Neiman 2014](#)).

Our research is useful not only for classically minded economists, but

for development economists in general as well. For the former group, we make two contributions. Firstly, we provide a new methodology, new estimates, and a complete panel dataset for future research. While such users do not need to be persuaded about the distinction between productive and unproductive activity, our data overcome the constraint in conventional national accounts. Secondly, we outline new stylized facts which are useful for further theorizing. Our cross-country results indicate that the negative relationship between rates of surplus value and economic development should be understood as the product of both institutional and technical factors. From a Marxist perspective, one should expect the rate of surplus value to increase with productivity (hence per-capita GDP). However, this does not account for huge institutional differences between rich and poor countries and the relative labor surplus of the latter, which keeps wages very low in a globalized system of production.

For development economists our research provides new questions as well as answers. Conventional development theory already internalizes facets of classical economics ([Gollin 2014](#)), whether in the dual-sector Lewis model or in the prioritization of productive activity implicit in the industrialization literature ([Schlogl and Sumner 2020](#)). A takeoff in the manufacturing sector is seen as desirable for economic development, but much of the justification is based on scale and spillover effects, with the expectation that the expansion of the service sector is a feature of mature economies whose economic base can support the service sector ([Rodrik 2016](#)). The idea is not much different from the Marxist distinction between productive and unproductive activity. However, by tying productive and unproductive activities to a value theory in which productive labor is the source of value added, classical-Marxist economics remains consistent in a way that the conventional measures do not³.

The paper is organized as follows. [Section 2](#) compares our approach to previous studies. [Section 3](#) describes our methodology. [Section 4](#) presents our main results. [Section 5](#) summarizes our empirical findings and concludes. The **online appendix** and **supplementary material** include our panel dataset, complete description of variables, additional tables and plots.

2. Literature and concepts

We follow a rich tradition of theoretical debates and empirical estimations of Marxist variables. We contribute to this scholarship by developing a new panel dataset that encompasses developed and developing economies. At the core of our methodology is the estimation of productive and unproductive activities from multi-country input-output matrices across 56 industries in 43 countries from 2000 to 2014. Our dataset covers the largest number of countries in the existing literature.

[Wolff \(1979\)](#) computed rates of surplus value and the organic composition of capital from 1947 to 1967 in the United States. His initial attempt was criticized for being agnostic to the productive-unproductive distinction and was updated by [Moseley \(1988\)](#). [Shaikh and Tonak \(1994\)](#) were the first to develop the most comprehensive estimates of Marxist categories, but their methodology was limited to the United States as well. [Amsden \(1981\)](#) produced cross-country comparisons of rates of surplus value, considering differences in productive and unproductive economic activity, but her estimates were limited to the manufacturing sector. [Basu et al. \(2022\)](#) estimate profit rates, profit shares, and output-capital ratios for a large sample of countries, but do not use input-output data or discriminate between productive-unproductive categories. This means that even after 150 years from the publication of the first edition of Marx's volume I of *Capital* in 1867, there have been no appropriate data to test Marx's

² Even in the conventional national accounts, several activities that are considered productive today were not considered so in previous iterations. See [Christophers \(2011\)](#), [Coyle \(2015\)](#) and [Assa \(2018\)](#) for further discussion of the production boundary.

³ [Assa and Kvangraven \(2021\)](#) summarize the issues prevalent in the conventional SNA as a measure of development.

hypotheses on a world scale.

The most recent methodologies to estimate Marxist variables come from Rotta (2022; 2018), Tsoulfidis and Paitaridis (2019), Tsoulfidis and Tsiliki (2019), Paitaridis and Tsoulfidis (2012), which all derive from the earlier works of Shaikh and Tonak (1994) and Wolff (1987). Our approach generalizes the estimation of Marxist variables on the world scale using multi-country data from the World Input-Output Database (Timmer et al., 2016; 2015; Dietzenbacher et al., 2013). We now deliver a much wider set of estimates for the 43 countries listed in Table 1. In the **online appendix**, Table A1 presents the classification of productive and unproductive activity based on the 56 industries available in the WIOD. We follow the conventional industry classification from Tsoulfidis and Paitaridis (2019) and Tsoulfidis and Tsiliki (2019)⁴.

Unlike the utility theory of value, the labor theory of value provides an identification strategy of the origins of value and of the many potential reallocations of value already in existence. Productive activities generate new value by creating commodities that contain value added. Commodities are products and services produced for profit. Value added is the new value created in production and is thus the value of the net product, which is the value of the total gross product minus the value of the intermediate inputs. Unproductive activities do not produce commodities with value added and, hence, the net income of unproductive activity reallocates the value added originated in productive activity.

Most firms, employees, and government agencies actually perform a mix of productive and unproductive activities, with few organizations being classified as fully productive or fully unproductive. For this reason, we employ the term ‘activity’ rather than ‘sectors’ or ‘industries.’ The productive-unproductive classification applies ideally at the activity level, subject to data availability. In countries such as the United States, the ‘modified benchmark’ input-output matrices from the Bureau of Economic Analysis (BEA) provide detailed data at the activity level, but this type of data is not available for most countries and, in our

estimates, we rely on industry-level data rather than on the ideal activity-level data.

More recently, Basu et al. (2022) estimated profit rates at the global level using industry-level data from the Socio-Economic Accounts (SEA) of the World Input-Output Database (WIOD) and country-level data from the Extended Penn World Tables (EPWT). They find that the global profit rate had a negative trend from 1960 to 2019 and that the driver of the fall in profitability was the decrease in the output-capital ratio (or the rise in the capital-output ratio). The profit share did rise in the period but was not enough to compensate for the larger fall in the output-capital ratio, thus imparting a substantial negative trend to the average profit rate at the global level.

Our approach differs from that of Basu et al. (2022) as they only employ the more limited data of the SEA from the WIOD. We employ the much richer and detailed data from the multi-country input-output matrices, which decompose the gross output of every industry into value added and intermediate inputs for all 43 countries. Basu et al. (2022) decompose the average profit rate (profit over the capital stock) into the profit share (profit over the net product) and the output to capital ratio (net product over the capital stock), without employing the categorization of productive and unproductive activities. In contrast, we recalculate the value added of every industry using the decomposition between productive and unproductive activity. Basu et al. (2022) take as given the ‘gross value added’ from the SEA without correcting the value added estimates for productive and unproductive inputs. Basu et al. (2022) do produce a wide dataset at the world level, but they disregard both the productive-unproductive classification and the multi-country matrices from the World Input-Output Tables (WIOT). The SEA and the EPWT do not allow, unfortunately, for the correct estimation of the value added of productive activities or of the net income of unproductive activities. Notwithstanding these differences, we also find a negative trend in the global profit rate from 2000 to 2014 as in Basu et al. (2022), even though our measure of global profits differs from theirs. Our approach, in sum, goes further than previous contributions in the literature.

Table 1

List of countries in the world input-output database (WIOD).

Code	Country	Code	Country
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	ROW	Rest of the world combined
IND	India		
IRL	Ireland		

3. Methodology and data sources

Our main data source is the World Input-Output Database (WIOD), which consists of the World Input-Output Tables (WIOT) and the Socio-Economic Accounts (SEA), both covering 56 industries in the 43 countries listed in Table 1 above, with annual data from 2000 to 2014. Table A1 in the **online appendix** presents the classifications of productive (PA) and unproductive activities (UA) based on the 56 industries covered in the WIOD. Productive activities exclude finance, insurance, trade, real estate (but not construction), not-for-profit activities, and government administration. Table A2 in the **supplementary material** describes the variables available in the SEA. We use real GDP per capita in constant 2015 US dollars from the World Bank database as the proxy for a country’s level of development.

We first apply the productive-unproductive classification to the entire WIOD. Using Table A1 we regroup each of the 56 industries in the SEA and in the input-output matrices of the WIOT for every one of the 43 countries in every single year from 2000 to 2014. Classification of capital stocks, employment, and labor compensation from SEA data follow the same classification as gross output and value added from WIOT data. If an activity is classified as productive in the WIOT then the capital stock, employment, and labor compensation in that same activity are also classified as productive in the SEA.

Once the entire SEA and the multi-country input-output matrices in the WIOT are classified into productive and unproductive activities in every year, we compute nearly 400 variables for each of the 43 countries. Table A3 in the **supplementary material** presents the complete description and the formulas of the Marxist variables that we calculate for each country. We consolidate the Marxist variables listed in Table A3 into a dataset in panel format which is ready to be employed in further

⁴ We have experimented with alternative productive-unproductive classifications, such as the ‘knowledge rents’ approach from Rotta (2022; 2018), Rotta and Paraná (2022), Rotta and Teixeira (2019; 2016), and Teixeira and Rotta (2012). Our empirical findings are robust to the inclusion of knowledge production as a form of unproductive activity. Robustness tests are available from the authors upon request.

empirical and econometric work.

It is not possible to compute Marxist categories solely from the SEA variables in the WIOD, as Basu et al. (2022) assumed, even though data on ‘gross value added’ are directly available from the SEA. It is also not possible to properly compute Marxist categories solely from national income accounts, as Maito (2018) and Li et al. (2007) assumed, even though data on ‘gross value added’ are available for a wide range of countries. As Rotta (2022, 2018), Shaikh and Tonak (1994), and Wolff (1987) explain, the correct computation of the Marxist gross value added and surplus value requires the use of input-output matrices, for it necessitates two major steps: (i) the classification of all industries into productive and unproductive activity; and (ii) the breakdown of intermediate inputs in all industries between those that originate in productive activity and those inputs that originate in unproductive activity. Input-output matrices describe the origin and destination of intermediate inputs across industries and countries. In the GDP series of national income accounts and in the SEA of the WIOD, on the contrary, every single intermediate input is deducted from the total gross product in each industry regardless of its origin. For this reason, the ‘gross value added’ data available are not good proxies for the Marxist gross value added.

In the computation of the Marxist gross value added, only intermediate inputs originating in productive activities should be deducted from the total gross output of each productive activity. The intermediate inputs originating in unproductive activities which are then employed in productive activities must be considered as part of the Marxist gross value added. Likewise, only the intermediate inputs originating in unproductive activities should be deducted from the total gross output of each unproductive activity in the calculation of the net income of unproductive activity. ‘Unproductive inputs’ to productive activities are part of the Marxist gross value added, and ‘productive inputs’ to unproductive activities are part of the net income of unproductive activities. This procedure ensures the internal consistency of the transformed input-output matrices and avoids the double counting of income flows, thus correctly measuring the value added of productive activities and the net income of unproductive activities.

$$\begin{aligned}
 & \text{Average Rate of Profit}_{i,t}^{WOIT+SEA} \\
 &= \frac{\text{SurplusValue}_{PA,i,t}^{WOIT+SEA}}{\text{Capital Stock}_{PA,i,t}^{SEA} + \text{Capital Stock}_{UA,i,t}^{SEA}} \\
 &= \frac{\text{Rate of SurplusValue}_{PA,i,t}^{WOIT+SEA}}{\text{Organic Comp. of Productive Capital}_{i,t}^{SEA} + \text{Organic Comp. of Unproductive Capital}_{i,t}^{SEA}} \\
 &= \frac{\text{Rate of SurplusValue}_{PA,i,t}^{WOIT+SEA}}{\text{Organic Comp. of Total Capital}_{i,t}^{SEA}}
 \end{aligned} \tag{8}$$

Computation of Marxist value added based on gross output data from input-output tables (and not from GDP data) ensures that the source of the net income of unproductive activity is automatically included in the estimate of the Marxist value added of productive activity. Surplus value is then calculated by deducting the compensation of productive workers from the value added of productive activity. Because the data in the WIOT are presented across countries, our procedure also ensures that the estimate of Marxist value added accounts for value flows both within and between countries, a feature which is particularly important given the rapid relocation of productive activity across borders and the growth of global value chains.

Let subscripts *PA* indicate productive activities, *UA* indicate unproductive activities, *i* indicate the country, and *t* indicate the year. Let superscripts *SEA* indicate that the variable is computed from the Socio-Economic Accounts and *WIOT* indicate that the variable is computed

from the World Input-Output Tables. In the WIOD, the WIOT are denominated in US dollars while the SEA are denominated in national currencies. We convert national currencies to US dollars using the exact same nominal exchange rates used to construct the WIOT in dollars.

The total value of productive activities ($\text{TotalValue}_{PA,i,t}^{WIOT}$) is computed in dollars from the WIOT as the summation of the gross outputs of all productive activities in year *t* for country *i*. Likewise, the gross income of unproductive activities ($\text{GrossIncome}_{UA,i,t}^{WIOT}$) is computed in dollars from the WIOT as the summation of the gross outputs of all unproductive activities in year *t* for country *i*. We then have that:

$$\text{ValueAdded}_{PA,i,t}^{WIOT} = \text{TotalValue}_{PA,i,t}^{WIOT} - \text{Inputs from PA}_{PA,i,t}^{WIOT} \tag{1}$$

$$\text{NetIncome}_{UA,i,t}^{WIOT} = \text{GrossIncome}_{UA,i,t}^{WIOT} - \text{Inputs from UA}_{UA,i,t}^{WIOT} \tag{2}$$

$$\text{SurplusValue}_{PA,i,t}^{WIOT+SEA} = \text{ValueAdded}_{PA,i,t}^{WIOT+SEA} - \text{LaborCompensation}_{PA,i,t}^{SEA} \tag{3}$$

$$\text{Rate of SurplusValue}_{PA,i,t}^{WIOT+SEA} = \frac{\text{SurplusValue}_{PA,i,t}^{WIOT+SEA}}{\text{LaborCompensation}_{PA,i,t}^{SEA}} \tag{4}$$

$$\begin{aligned}
 & \text{Organic Composition of Total Capital}_{i,t}^{SEA} \\
 &= \frac{\text{Capital Stock}_{PA,i,t}^{SEA} + \text{Capital Stock}_{UA,i,t}^{SEA}}{\text{LaborCompensation}_{PA,i,t}^{SEA}}
 \end{aligned} \tag{5}$$

$$\text{Organic Composition of Productive Capital}_{i,t}^{SEA} = \frac{\text{Capital Stock}_{PA,i,t}^{SEA}}{\text{LaborCompensation}_{PA,i,t}^{SEA}} \tag{6}$$

$$\begin{aligned}
 & \text{Organic Composition of Unproductive Capital}_{i,t}^{SEA} \\
 &= \frac{\text{Capital Stock}_{UA,i,t}^{SEA}}{\text{LaborCompensation}_{UA,i,t}^{SEA}}
 \end{aligned} \tag{7}$$

We first compute the total value (‘gross output’), value added, and intermediate inputs originating in productive activities using data in dollars solely from the WIOT (Eq. (1)). We then compute the gross income (‘gross output’), net income, and intermediate inputs originating in unproductive activities using data in dollars solely from the WIOT (Eq. (2)). Once gross output, value added, and intermediate inputs are computed for productive and unproductive activities across countries using WIOT, we add the SEA data to estimate surplus value (Eq. (3)), the rate of surplus value (Eq. (4)), organic composition of total capital (Eq. (5)), organic composition of productive capital (Eq. (6)), organic composition of unproductive capital (Eq. (7)), and average profit rate (Eq. (8)). Global aggregates of Marxist variables and country weights in the global aggregates are computed with variables first converted to US dollars.

Gross output and value added are adjusted for net taxes at the

industry level. Input-output matrices in the WIOD are presented in basic prices by default, where basic prices exclude value added taxes and similar duties and include subsidies as a production cost. Nonetheless, the WIOD has data on value added taxes by industry and country, so we adjust our estimates for net taxes. Due to data unavailability at the industry level, the depreciation of fixed assets cannot be accounted for.

Salaries and wages are often referred to as a naïve measures of labor compensation as they only count workers who are employees in formal economic activity (Gollin 2002). Because a larger fraction of the labor force is self-employed in poor countries, labor income from self-employment decreases in per-capita GDP. For this reason, we estimate labor compensation as employee compensation plus the imputed labor compensation for self-employment available in the SEA.

Ideally, labor compensation should consider only non-supervisory workers in productive activity, as Rotta (2022, 2018), Tsoulfidis and Paitaridis (2019), Paitaridis and Tsoulfidis (2012), and Shaikh and Tonak (1994) estimated for the United States. The WIOD, however, does not discriminate between supervisory and non-supervisory employees. This data limitation constrains us to classify all labor in productive activity as productive labor. Because of this constraint, our measures of labor compensation in productive activity overestimate the true value and, hence, our estimates of the rate of surplus value and average profit rate underestimate their true values.

4. Stylized facts and main results

This section presents the main results from our dataset. We study the evolution of the rate of surplus value (s/v), organic composition of capital (c/v) and the rate of profit (s/c), where 's' stands for surplus value, 'v' for variable capital (or the value of labor power) and 'c' for constant (circulating plus fixed) capital. We break down worldwide trends into the dynamics between different countries and dynamics within individual countries, analyzing the interaction between compositional effects among countries and trends within each country. We begin by presenting the evolution of Marxist variables aggregated for the world economy over 2000–2014. We then analyze Marxist variables both within and across countries, relative to their levels of development

(measured as real GDP per capita in US dollars), similar in spirit to 'Kuznets curves'.

4.1. The world profit rate and the 2008 financial crisis

Fig. 1 shows estimates at the world level for the average rate of profit, rate of (realized) surplus value, organic composition of capital, and a comparison of profit rates in productive and unproductive activity. The average global profit rate is estimated twice: first as surplus value over the total capital stock, and second as surplus value over the private capital stock, which excludes government fixed assets. Both rates show an overall negative trend over the 2000–2014 period. The global rate of profit on total capital reached its peak at 13.7% just prior to the 2008 financial crisis, plummeted temporarily, and continued its gradual decline to 12.7% in 2014. The profit rate on private capital followed a similar trend, albeit at a higher level due to the smaller denominator.

Marx argued that the decline in profitability is driven by the faster growth of c/v relative to s/v over the process of technological advancement. The period we study is too short to uncover a general tendency and is marked by the great financial crisis of 2008. Still, Fig. 1 shows that the rate of profit declined due to a stagnation in the rate of (realized) surplus value after the 2008 crisis, while the organic composition of capital increased continuously over 2000–2014. As per our estimate adjusted for self-employment, s/v was 101% in 2000, increased to 119% in the lead up to the 2008 financial crisis, then stagnated around 113%. From 2000 to 2014, the global rate of surplus value increased 12.4% in total. The rate of surplus value for the world economy does not decline, save for a perturbation around the financial crisis due to our estimation based on realized surplus value, which is partially consistent with Marx's assertion that capitalist development tends to increase the rate of exploitation.

The increase of 12.4% in the rate of surplus value suggests that the decline in the global rate of profit was driven by a larger increase in capital intensity. The productive capital-labor ratio rose 25.8% (from 314% to 395%) while the total capital-labor ratio rose 16.8% (from 763% to 892%) over 2000–2014. The decline in the world rate of profit was therefore driven by the faster growth of the global c/v compared to

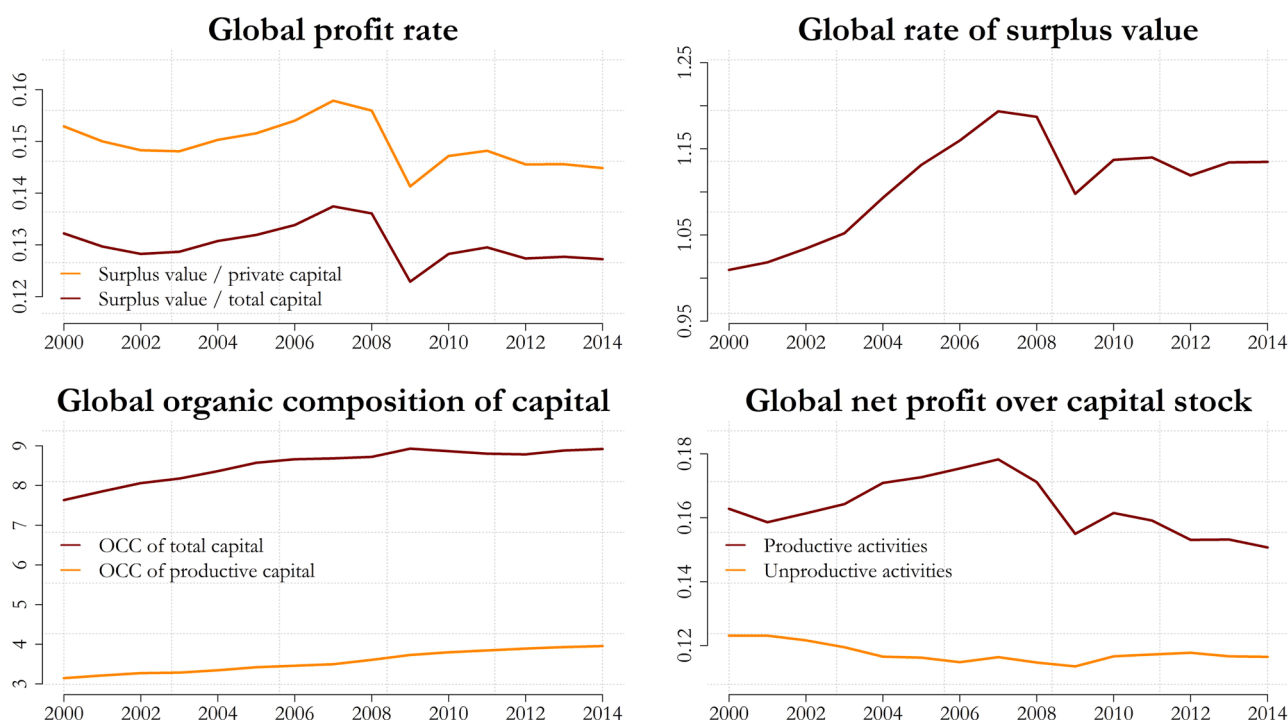


Fig. 1. Weighted global averages, adjusted for self-employment, 2000–2014. Source: data appendix.

Table 2
Weighted global averages regressed on linear time trend.

Dependent variable	Global time trend
Rate of surplus value	0.008721***
Organic composition of productive capital	0.062268***
Organic composition of total capital	0.084159***
Organic composition of unproductive capital	0.021891*
Rate of profit on total capital (surplus value/total capital stock)	-0.000253
Rate of profit on productive capital (surplus value/productive capital stock)	-0.002885***
Net profit rate: productive activities (using conventional value added)	-0.000882*
Net profit rate: unproductive activities (using conventional value added)	-0.000424***
Net income of unproductive activity over the value added of productive activity	-0.003722***
Capital stock: unproductive to productive ratio	-0.0177***
Persons engaged: unproductive to productive ratio	0.005371***
Number of employees: unproductive to productive ratio	-0.000902**
Employee compensation: unproductive to productive ratio	-0.003563***
Employee plus self-employed compensation: unproductive to productive ratio	-0.002375***

Note: Significance levels are 10%(*), 5%(**), 1%***). OLS estimates. Independent variables: intercept and linear time trend. Dependent variable in levels. Regressions include global aggregates for the 43 countries listed in Table 1 over the 2000–2014 period. Persons engaged are employees plus self-employed workers. Variables adjusted for self-employment in productive and unproductive activities.

the growth in s/v , as Marx expected. Our dataset additionally reveals that the rise in the capital-labor ratio has been greater in productive activity (25.8%) than in unproductive activity (13.9%), suggesting that it has been more difficult to mechanize and automate unproductive activities.

The bottom-right panel of Fig. 1 plots the ‘net profit rate’ in productive and unproductive activities at the global level. We define the ‘net profit rate’ as the conventional gross value added minus the compensation of labor, adjusted for self-employment, relative to the stock of fixed assets. We compute the net profit rate for productive and unproductive activities using data from the SEA only, where all inputs are deducted from the gross output regardless of their origin. Our estimates show that the net profit rate in productive activities was about 4 percentage points higher than its unproductive counterpart, but the gap diminished after 2008, given that the financial crisis reduced the profitability of productive activities much more than of unproductive activities.

Table 2 shows the coefficients of Marxist variables regressed on a linear time trend at the world level. We find negative trends for the ratios of unproductive to productive activity, such as the ratio of the net income of unproductive activity to the value added of productive activity, the ratio of the capital stock tied up in unproductive activity relative to productive activity, employment levels, and labor compensation in unproductive activity relative to productive activity. These negative trends underline the fact that, at the global level, productive economic activity increased at a faster rate relative to unproductive activity in the 2000–2014 period. The unproductive-productive ratio of employees plus the self-employed is the only ratio to rise at the global level in the period, indicating that most of the rise in self-employment occurred in unproductive activity. The statistical insignificance of the negative trend in the average profit rate is due to the small sample size. Net profit rates in productive and unproductive activity at the world level decline in the period as well.

Our findings on increasing capital intensity and declining profit rate in the global economy are limited to 2000–2014, but they are consistent with Marx’s prediction regarding capitalist development, even though not fully because of the nearly stationary rate of surplus value after 2008. The estimates further demonstrate that the gross income, net

income, capital stock, employment, and capital-labor ratio of productive activity increased faster than in unproductive activity at the world level.

4.2. Global reallocation of productive activity

We now address the impact of between-country changes in economic growth and accumulation in the determination of aggregate trends for the world economy. As is well known, economic growth in advanced economies fell far behind emerging economies during the 2000–2014 period. With China’s outsized role in global manufacturing, it should be expected that the weight of different countries in productive output underwent a significant change. In Fig. 2 we show country shares (or weights) in global productive and unproductive activities over 2000–2014 in terms of both net outputs and capital stocks.

In just 15 years, China rapidly increased its weight in global value added from 5.3 to 19.3%. Concurrently, the weight of the United States in global value added fell from 30.1 to 22.3%, and Japan’s weight shrunk from 16.3 to 6.7% in the same period. Although the shares are smaller, there is also a rapid downward shift for Germany from 6.6 to 6.0%. China also became the country with the greatest share of the global capital stock of productive activity, rapidly increasing its weight from 6.0 to 23.6%. This compared to a fall of the United States’ weight from 24.8 to 17.4%, Japan from 21.2 to 8.8%, and Germany from 6.5 to 4.6%. There are notable movements upward for India and Brazil. The BRICS countries essentially dominated productive value addition to the world economy during the period. Fig. 2 additionally shows that the United States dominated the shares of global income and capital stock in unproductive activity.

These global shifts in productive activity are important also because of their role in determining the distribution of value added at the world level, plotted in Fig. 3. We aggregate value added of productive activity for all countries in our sample and compute the shares of surplus value (s) and variable capital (v). We also aggregate the net income of unproductive activity and compare it to the value added of productive activity on the world scale. The share of surplus value in global value added increased slightly from 50 to 52.7% while the share of the net income of unproductive activity declined from 74.1 to 70.4%. The 12.4% rise in the rate of exploitation of productive workers translated into a drop of -5.8% (or -2.8 percentage points) in the labor share of global value added. Due to the rapid reallocation of productive activity towards China, the drop in the labor share of global value added is less pronounced than in the traditional measures of the labor share whose decline over the same period has received increasing attention in the literature (Karabarbounis and Neiman 2014).

The rising weight of productive output from China balanced the decline in the wage share of workers employed in productive activities in rich countries. The rate of surplus value in China decreased in the 2000–2014 period and remained lower than predicted by China’s level of development (see further below). Hence, the wage share fell in rich countries whose weight in the global production of value added was rapidly decreasing; and the wage share rose in China whose weight in the global production of value added was rapidly climbing. In this way, despite the fall in the wage share of developed countries, the fast rise of the Chinese economy kept the wage share of the world economy roughly constant during the 2000–2014 period.

4.3. Evolution of marxist variables between and within countries

According to Marx, advanced capitalist economies should exhibit higher rates of surplus value, higher organic composition of capital, and lower average profit rates. These hypotheses are predicated upon the tendency towards identical technological advancement in all countries which follow the capitalist mode of production. Marx stressed four mechanisms in this regard. First, companies have an incentive to increase the rate of exploitation of their employees since this will likely translate into greater profits at the firm level. Second, market

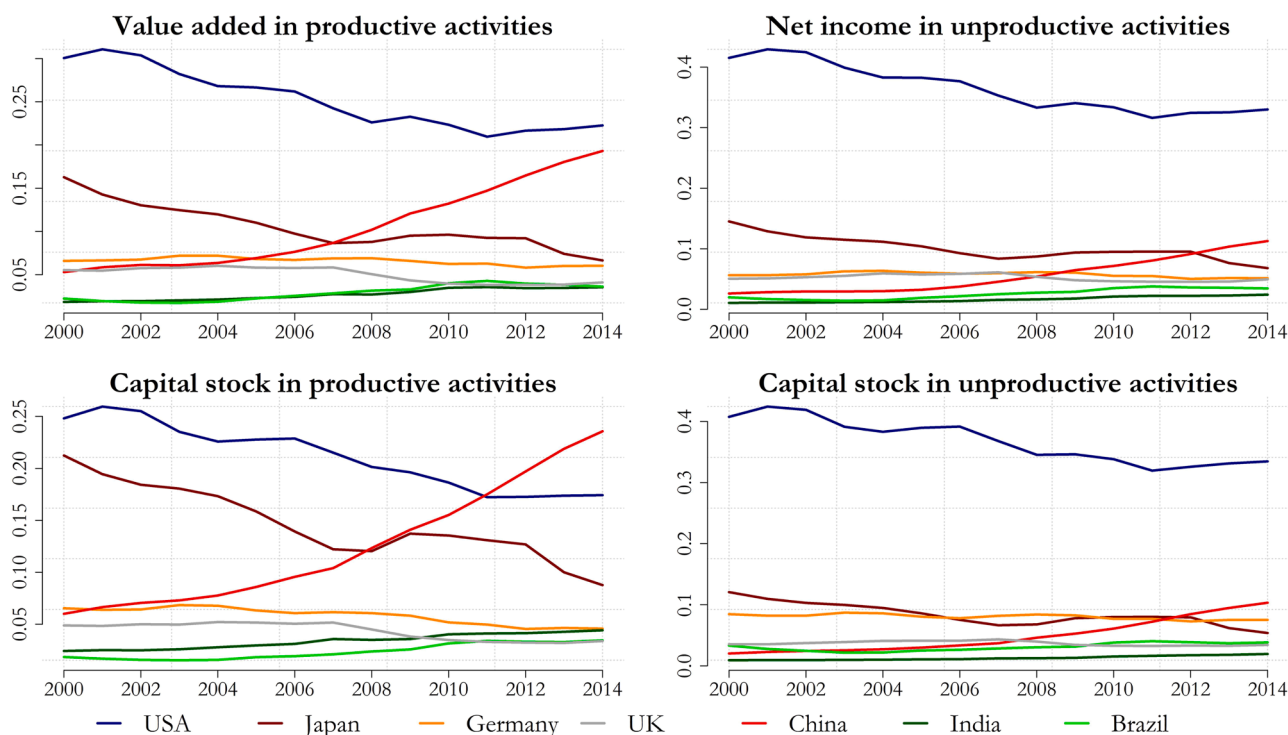


Fig. 2. Country shares (weights) in the global economy, 2000–2014. Source: data appendix.

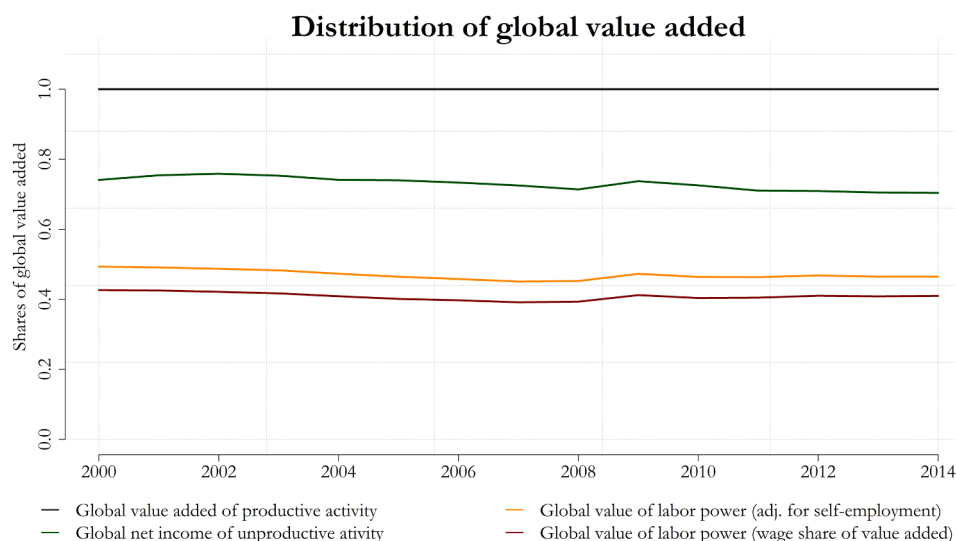


Fig. 3. Distribution of global value added, 2000–2014. Source: data appendix.

competition induces companies to adopt capital-intensive labor-saving techniques that increase the organic composition of capital. Third, technological change reduces the labor time necessary to reproduce consumption goods, and thus decreases the value of labor power. Fourth, capital-intensive labor-saving technology uses machines that displace the source of value (productive labor) and tends to reduce the average profit rate, which induces companies to increase the rate of surplus value of their employees to prevent the profit rate from falling further. Because of continuous pressure to adopt capital-intensive labor-saving technologies, the rise in the organic composition of capital tends to be greater than the rise in the rate of surplus value over long periods, and the average profit rate tends to fall as capitalism advances.

In light of Marx's hypotheses about capitalist development, we further decompose world trends into the dynamics between and within

countries. This breakdown reveals important features of the 2000–2014 period. First, location-based inequality between countries dominated exploitation-based inequality within countries. Second, unproductive activity is greater in developed countries. Third, the rise of unproductive capital is one of the drivers of the decline in the profit rate.

Fig. 4 plots the rate of surplus value, organic composition of productive capital, profit rate on productive capital (surplus value over the productive capital stock), and the profit rate on total capital (surplus value over the productive and unproductive capital stock combined). Averages of these four variables are plotted for 43 countries (vertical axis) against the log of real per-capita GDP in 2015 dollars (horizontal axis). Circle sizes represent the weight of each country in global value added in 2014.

The red lines in Fig. 4 represent between-country regressions

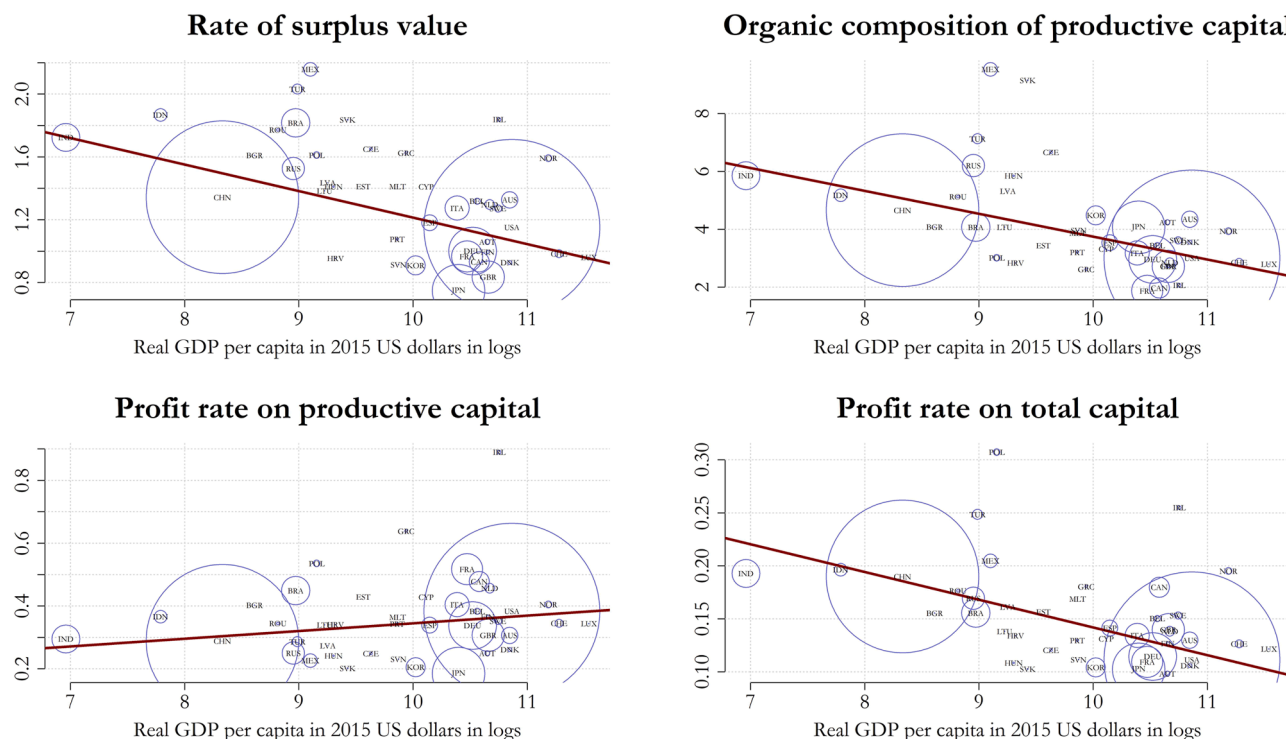


Fig. 4. Weighted averages across countries and real GDP per capita, 2000–2014. Source: data appendix.

Note: Circle sizes reflect country weights in global value added of productive activities in 2014, and the within-country averages are adjusted for self-employment. The red line is the between-country estimator weighted for country shares in global value added of productive activities in 2014.

estimated with weighted least squares, using country shares in global value added as weights. The between-country regressions indicate the rate of surplus value, organic composition of productive capital, and profit rate on total capital all decline as per-capita GDP rises. The regression slope of the profit rate on productive capital, on the contrary, is mostly flat against per-capita GDP.

The rate of surplus value (adjusted for self-employment) averages around 60–200% for most countries in our dataset, implying that the average worker spends 37–67% of the working day in unpaid labor time⁵. The variation in these estimates across countries, however, is remarkably high. In Mexico, s/v is the highest at around 216%, which corresponds to a share of 68.3% of unpaid labor time in the average working day. In Japan the rate of exploitation is the lowest in our sample at 74.7%, which corresponds to 42.8% unpaid labor time in the average working day.

If labor productivity is higher in rich countries, why is the rate of surplus value higher in poor countries? As Rodrik (2016) argues, the share of employment in manufacturing fell more swiftly than output in advanced countries under the pressure from labor-saving technical change and globalization. Then, higher productivity should have resulted in more unpaid labor time, or higher rates of exploitation in rich countries. The main explanation of why the rate of exploitation declines with economic development, in our view, is the relative importance of institutional differences between rich and poor countries.

Conditional on institutions such as wage bargaining power, one could expect s/v and c/v to increase with technological advancement as Marx himself expected. However, this assumes away lumpiness in institutional progress across countries. In direct relation to this point, Amsden (1981) showed that s/v in the manufacturing sector (a productive activity in our definition) declines with per-capita GDP across a sample of countries in the 1970s. Expanding on Marx's intuition, she

proposes that s/v increases with technological development (productivity) but is also positively dependent on the length of the working day. Conversely, the bargaining power of workers likely depresses s/v . In this regard, there is substantial institutional variation across countries regarding wage bargaining and the length of the working day. Interestingly, the relationship between s/v and per-capita income had an inverted-U shape in Amsden's study because her sample covered a wider range of countries, including countries that would still be classified as low-income countries. By contrast, the poorest country in our sample (India) would be classified as lower-middle income over 2000–2014. Amsden argues that countries in the middle of the per-capita income distribution are in a stage of uneven development: while capitalist production utilizes advanced technology, wage bargaining is much weaker, and labor is still in surplus compared to rich countries. Workers in middle-income countries are neither attached to traditional sector employment (agriculture) nor sufficiently consolidated as a bargaining group in modern capitalist sectors. Thus, the rate of exploitation in productive activities is higher in the capitalist sector of middle-income countries.

To test for the intensity to which labor is subjected, Table A4 in the online appendix compares unpaid labor time and hours spent in production per week (assuming 50 weeks of work a year) against average real wages and labor productivity in productive activities. As expected, labor productivity is higher in rich countries. However, the intensity of exploitation depends on the length of the working day: workers in lower income countries labor longer hours per week. In India, Brazil and Mexico, workers spend over 40 hours per week on work. Hours are in general higher in Asian countries and East European countries. In the richest countries, mean working hours are much lower at usually less than 30 hours per week. Therefore, even though value added per worker increases with per-capita income, the gap between labor productivity and wages is reduced by the higher monetary cost of reproduction of the prototypical efficient laboring class. Wage rates per hour are an order of magnitude higher in rich countries: while the ratio of labor productivity

⁵ The share of paid labor time in the average working day is $1 / (1 + (s/v))$, and the share of unpaid labor time is $(s/v) / (1 + (s/v))$.

between India and USA is 5%, the ratio of wages is only 2%.

Hourly wage rates are also central to cross-country differences in the rates of surplus value and organic composition of capital⁶. At the time of Marx and Engels' writing of the Communist Manifesto in the late 1840s, it was reasonable to expect that the wage rates of the working class were not too dissimilar across countries in which the capitalist mode of production prevailed. Workers from different countries were unified by the fact that class-based inequality between capitalist and workers was the main scourge of their living conditions. Such a situation is not realistic anymore as workers of the world are no longer united by their standard of living. Differences in per-capita incomes, and interpersonal income inequality between rich and emerging countries have fallen since 1950, but yet remain large enough such that location-based inequality across countries dominates class-based inequality within countries (Milanovic 2016). Differences in interpersonal incomes between citizens of the same country are less important than differences in mean incomes between countries. In 2008, for example, nearly the entire German population was placed higher than the world mean income, compared to only the top 5% of the Indian population (Milanovic 2015). Thus, being a worker in India implies substantially lower wages than being a worker in France or Germany.

The same logic applies to the organic composition of capital. With similar wage rates, c/v would be higher in more technologically advanced countries, as Marx expected. But if differences in wage rates are high enough across countries, then we are likely to find lower c/v in more advanced countries. For instance, if developed countries have 2–3 times the capital-labor ratio in productive activity, compared to developing countries, but also have 5–10 times the wage rate, then the organic composition of capital will be higher in developing countries. The denominator effect from very low wages in poor countries dominates the higher capital-labor ratios in advanced economies. Hence, c/v decreases with per-capita GDP.

Our data also provide empirical support to Marini's (2022) 'super-exploitation' hypothesis, according to which the rate of surplus value tends to be higher in poorer countries. First, poor countries tend to be export-led economies in which the realization of the surplus value produced domestically takes place in international markets, quite independently of domestic wages. Export-led economies tend to not need a strong domestic market based on high wages and, therefore, can increase domestic profits by raising the rate of surplus value without causing a domestic under-consumption crisis. Second, poor countries have inferior technology and thus face higher production costs compared to the superior technology in rich countries. The higher costs associated with the inferior technology create the need to raise the rate of surplus value or pay lower wages to maintain a profit rate equivalent to that of the superior technology in rich countries.

4.4. Profit rates between and within countries

In the 1860s, Marx had theorized that the average profit rate would decline over long periods. In the early 1960s, however, Okishio's (1961, 2001) theorem formally demonstrated that profit maximization and capital-intensive labor-saving technical change increase the average profit rate in the long run. This theorem, nonetheless, has two key assumptions: it assumes that the real wage is constant and that all capital is productive. Our findings indicate that Okishio's theorem is not so relevant empirically, since the real wage and the share of capital tied up in unproductive activity both rise with economic development, which explains why in Fig. 4 richer countries have lower profit rates on total capital. Fig. A2 in the online appendix further shows that the profit rate on total capital falls as the real wage increases across countries.

⁶ The probability distribution of hourly wage rates is bimodal. See Fig. A1 in the online appendix. There is one large cluster of countries near wages of 10–20 USD per hour, and another cluster situated around 60 USD per hour.

Table 3

Between- and within-country components of Marxist variables regressed on log of real GDP per capita, weighted by country shares of global value added.

Dependent variable	Panel fixed effects: between countries	Panel fixed effects: within countries
Rate of surplus value	-0.194***	-0.143***
Organic composition of productive capital	-0.884***	0.459***
Organic composition of total capital	0.28	0.85***
Organic composition of unproductive capital	1.164***	0.391***
Rate of profit on total capital (surplus value/total capital stock)	-0.027***	-0.04***
Rate of profit on productive capital (surplus value/productive capital stock)	0.024	-0.064***
Net profit rate: productive activities (using conventional value added)	-0.003	-0.064***
Net profit rate: unproductive activities (using conventional value added)	-0.043	-0.01
Net income of unproductive activity over the value added of productive activity	0.168***	0.044***
Capital stock: unproductive to productive ratio	0.561***	-0.009
Persons engaged: unproductive to productive ratio	0.186***	0.101***
Number of employees: unproductive to productive ratio	0.178***	0.041***
Employee compensation: unproductive to productive ratio	0.158***	0.072***
Employee plus self-employed compensation: unproductive to productive ratio	0.133***	0.078***

Note: Significance levels are 10%(*), 5%(**), 1%(***). Fixed effects include individual effects. Independent variable: log of real GDP per capita in 2015 US dollars. Dependent variable in levels. Regressions include the 42 countries listed in Table 1 over the 2000–2014 period, excluding Taiwan due to lack of data on real GDP per capita. Persons engaged are employees plus self-employed workers. Variables adjusted for self-employment in productive and unproductive activities. 'Between' and 'within' panel estimators weighted by country shares of global value added.

Countries with higher real wages do have lower rates of profit when all activities (productive and unproductive) are considered.

The fact that the rate of profit declines with per-capita GDP corresponds to the neoclassical prediction that returns to capital are higher in capital scarce economies, and is also related to the cross-country capital flow puzzle (Gourinchas and Jeanne, 2013): capital flows appear to not gravitate towards high growth developing economies. Given that returns are higher in poorer countries, capital should flow towards them. In this respect, Fig. 4 offers one (though not necessarily the only) parsimonious resolution to this puzzle as a first approximation: if capital flows are related to returns on productive capital, and if those returns are not related to economic development, then for capitalists it makes sense to park capital in more stable advanced economies as opposed to emerging economies.

Fig. 4 shows that the profit rate on productive capital (surplus value over the productive capital stock) is roughly flat with respect to development levels, and that the profit rate on total capital (surplus value over the productive and unproductive capital stock combined) declines with respect to development levels. This pattern indicates that richer countries have lower profit rates due to the greater stock of fixed capital tied up in unproductive activity.

Unproductive activities are greater in post-industrial (mostly rich) nations whose service sector is larger, and where manufacturing activity has stagnated or reduced under globalization. Both Adam Smith and

Karl Marx argued that economic progress would lead to the emergence of a range of activities which are supported by productive activity⁷. But advanced countries have become specialized in services while offshoring manufacturing to low-wage countries. Since unproductive activity is more present in the service sector, this amounts to transferring away productive activity to poorer countries.

In Table 3 we use the panel features of our dataset to decompose global trends into between- and within-country effects. Between-country effects are the variation across country averages, holding constant the variation within countries. Within-country effects, on the contrary, are the variation within countries over time, holding constant the variation between countries. We regress Marxist variables against the log of real GDP per capita in dollars and use country shares of global value added as weights in the panel estimators. Country fixed effects control for unobserved heterogeneity across countries.

The ‘between’ estimator in Table 3 shows that the rate of surplus value, the profit rate on total capital, and organic composition of productive capital decline across countries as per-capita GDP rises, as also shown in Fig. 4. The net income, capital stock, and employment in unproductive activity rise relative to their productive counterparts when real GDP per capita increases. The ‘within’ estimator shows that unproductive activity increased relative to productive activity both within and between countries, and that profit rates declined not only across countries but also within countries over time. The decline in profit rates within countries was driven by a rise in the organic composition of capital and by a decline in the rate of surplus value within countries. The rise in the capital-labor ratio within countries is in accordance with Marx’s hypothesis. The fall in the rates of surplus value within countries occurred possibly due to the negative effect of the 2008 financial crisis on realized surplus value, and also due to the rise of real wages in China, given that our ‘between’ and ‘within’ estimators are weighted by country shares in global value added.

Table 2 showed that the net income, capital stock, and employment of unproductive activity all decline relative to productive activity at the global level. Table 3 shows, on the contrary, that the net income, capital stock, and employment of unproductive activity all rise relative to productive activity at the country level. This inversion between the country and global levels is caused by the rapid relocation of productive activity from advanced economies to China, as shown in Fig. 2. Productive activity is rising in countries that are increasing their weight in the global economy, like China, while unproductive activity is rising in countries whose weights are falling in the global economy, like the United States, Western Europe, and Japan.

5. Conclusion

To better capture the essence of Marx’s theory of capitalist development, one must argue based on empirical evidence across a large set of economies. In this paper we produced a new dataset which makes progress on this issue. Our dataset estimates Marxist variables at a moment when the capitalist mode of production dominates the global economy. Our primary aim was to produce new stylized facts at the world level in line with Marx’s insights.

We estimated Marxist variables at the world level in the 2000–2014 period and decomposed them into between- and within-country dynamics. The world rate of profit declined driven mostly by a secular rise in capital intensity and as the weight of emerging economies increased in global output. The global relocation of productive activities has been swift, gravitating towards China and other BRICS countries and thus keeping the Marxist labor share of the world economy roughly stable. In

⁷ A canonical example is the welfare state, which from the Marxist perspective is not productive. Rich countries have larger welfare states that can be an additional factor behind higher reservation wages and a potential cause for lower rates of surplus value.

2014, China already sustained the highest share of the global capital stock in productive activities. Due to great differences in wages, location-based inequality between countries also dominated exploitation-based inequality within countries.

Profit rates declined at the aggregate global level, across countries, and within countries. Besides the rise in capital intensity in productive activities, as Marx expected, structural transformations in post-industrial economies also contributed to the fall in profitability. The capital stock, net income, and employment of unproductive activity increase relative to productive activity as per-capita GDP rises. This increase of unproductive activity occurred both across and within countries, thus lowering surplus value per unit of total capital. Interpretations of Marx’s theory should therefore be updated considering the empirical evidence on the relocation of productive capital to emerging markets and the greater share of unproductive activity in developed countries.

The stylized facts presented in the dataset, however, face important limitations. First, the data are limited to the 2000–2014 period and marked by the great financial crisis of 2008. Second, due to data limitations, our procedure classifies as productive all labor in productive activity, thus underestimating the true rate of surplus value and rate of profit. Despite these limitations, our paper is the first to develop a methodology to estimate a comprehensive set of Marxist variables from multi-country input-output data that account for cross-border value flows and global value chains. Our methodology is fully automated and can be easily updated once new data are published.

This paper only touches the surface of some important debates within the Political Economy tradition and is a first step towards other applications that include econometric testing of poverty, income inequality, deindustrialization, global value chains, and capital-output ratios using Marxist variables. We leave these applications for future research.

Declaration of Competing Interest

None. The authors declare no conflicts of interest and no funding or grants for this research paper.

Data availability

The data are available as supplementary material online.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.strueco.2023.12.001](https://doi.org/10.1016/j.strueco.2023.12.001).

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