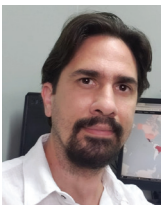
SKILLED LABOUR AND THE REDUCTION PROBLEM

Questioning the Exploitation Rate Equalization Hypothesis

Rodrigo Straessli Pinto Franklin, Rodrigo Emmanuel Santana Borges, César Sánchez and Everlam Elias Montibeler



Rodrigo Straessli Pinto Franklin (*left*) is Professor of Economics at the Universidade Federal do Espírito Santo (UFES). Email: rodrigo.franklin@ufes.br

Rodrigo Emmanuel Santana Borges (*right*) is a member of the board of directors of Latin America Political Economy Society (SEPLA) and coordinator of its Marxist Dependency Theory working group. Email: rodrigo@borges.net

César Sánchez is Professor of Economics at the José Simeón Cañas Central American University. Email: csanchez@uca.edu.sv

Everlam Elias Montibeler is a professor at the UFES. Email: everlamelias@gmail.com

Abstract: Empirical estimates derived in line with the Marxist framework are essential to fully address several topics, from the dynamics of profit and exploitation rates to unequal exchange, crisis and strategies. Edward Ochoa presented and implemented a pioneering practical proposal to perform such strand of calculations from widely available input–output data. That leveraged method has become widespread in empirical studies. This article focuses on a controversial aspect of such a proposal: the reduction of skilled or complex to simple unskilled labour. After a critical dialogue from a theoretical point of view, this article provides estimate comparisons based on available data for the period 1995 to 2009, discusses alternative proposals and stresses their virtues and caveats, pointing to the strength of methods that don't fully rely on wage indexes and to future paths of research needed.

Key words: labour values; skilled and unskilled labour; Marxist theory; value and price; surplus-value rate

DOI:10.13169/worlrevipoliecon.13.3.0362

Introduction

The famous debate on the transformation of values into production prices rendered more than a century of arguments on the advances or supposed weaknesses of Marx's labour theory of value, both from a logical and a qualitative perspective. The polemic was usually centred on formal and abstract aspects, which investigated the compatibilities between the "value system" (determined by the quantity of labour) and the price system (influenced by the dynamics of supply and demand). Even though this debate contributed to improving the formalization of Marxist theory, by achieving important results in regard to its mathematical logic, for most of the period it also lacked a more practical analysis to apprehend the concrete material reality.[1]

In parallel to that debate, the growing necessity to manage capitalist accumulation by the state throughout the 20th century obliged conceptual, methodological and statistical advancements in terms of social accounting. As such, there has been a significant accumulation of empirical data regarding production, prices, salaries and working time within a relatively coherent analytical framework.

Since the 1970s, the combination of mathematical solutions to the "transformation problem" with the statistics of input–output matrices allowed a series of estimates of categories which had been considered before as merely abstractions. The previous debate evolved in many directions and concrete interpretation of capitalist societies rigorously intertwined with Marxist categories was being shown an open path.

Standing on the shoulders of a series of previous advances, Edward Martin Ochoa (1984) wrote his doctoral thesis in a successful effort to provide a method and produce estimates on values, direct prices[2] and production prices, based on sectorial disaggregated information from data for the United States ranging between the years of 1947 and 1972. Advancing the approach initiated by Anwar Shaikh (1984), his thesis supervisor, Ochoa consolidated a methodological proposal to translate monetary, payroll and effective labour journey data, readily available, into statistics that fit the categories of Marxist theory.

Three issues were central in Ochoa's analysis, as implied by the broader decisions he had to make to build his approach: first, the issue of measurability of value; second, the difference between productive and unproductive labour; and finally, that which is the focus of the present essay, the matter of reduction of different qualities of labour—i.e., of how to "transform" information about labour time of different degrees of complexities (skilled labour) and intensity[3] into simple labour time of average intensity.

From then on, there have been numerous and increasingly robust studies. Empirical observation contributed more and more to strengthen and complement the qualitative dimension of the Marxist labour theory of value. Research on various countries such as the United States, the United Kingdom, Greece and Japan, among others, offered insights not only on the importance of labour time in determining prices, but also on the reality of exploitation, profit and the contradictory dynamics of accumulation.[4]

Although it is essential to recognize the merit presented by previous works in improving the methodology for the calculation of Marxist categories, it is necessary to assess some limitations in the most significant prevailing proposals. This article aims to contribute in this sense by investigating the effects of the method to solve the "reduction problem" designed and implemented by Ochoa (1984). To do so, we present a theoretical discussion about his proposal, after which we proceed with an empirical evaluation applying a range of alternative methodologies to the available data, comprehending the entire world divided into 41 countries and regions for the period between 1995 and 2009.

The subject of this article resulted from a theoretical issue we faced while building the World Labour Values Database (WLVD), where all the data and source codes required to replicate this analysis are available for download. To the best of our knowledge, the WLVD is the first publicly available, open and replicable dataset which provides information consistent with the Marxist framework for a broad set of countries. Therefore, in addition to contributing to the debate, this article serves to document the main processes of computing the variables that are available in our database.

Reduction of Skilled into Simple Labour in Ochoa

When considering methodological questions about the computation of values from market prices, Ochoa states that the issue of measurability of labour value is linked with the possibility of reducing concrete labour of different qualities to abstract simple labour. In particular, he brings back Ricardo's approach:

> [. . .] Ricardo, like Smith, was well aware that there are different kinds of labor, and he felt that their relative earnings were a reasonably good measure by which to reduce all varieties of skilled labor to unskilled labor. Thus, he relied on the market for an index of skill, but he considered the relation between different levels of skilled labor to be a material, presocial property of labor as a natural factor of production. This very characterization of labor, however, shows the unconscious acceptance of the concept of labor as a homogeneous substance, a concept which

> only emerged as a historical reality with the development of generalized commodity production and exchange. (Ochoa 1984, 35)

Relying on the market to establish this index means believing that competition among workers would make their earnings gravitate towards the product generated by their work. In these terms, if, on the one hand, this procedure reveals an acceptance of the concept of labour as a homogeneous substance, on the other hand, it is the genesis of the neoclassical concept that wages would be equivalent to the marginal productivity of labour. Anyway, at the beginning of the section on the reduction of different qualities of labour, Ochoa indicates clearly:

> We plan to use market wage rates prevailing in each sector as an index of the skill and intensity of labor in that sector relative to the others. Thus, if sector A has wages which are double the wages of the lowest-wage sector, say sector B, then we will assume that A's labor can be reduced to homogeneous labor (such as sector B's) by doubling the total worker-years actually expended there. (Ochoa 1984, 39)

Ochoa is aware that the value of the labour power and the magnitude of value created in a working day are two quantities determined by distinct (although related) social processes. Therefore, his proposition does not support the neoclassical view that workers receive the equivalent of their marginal productivity—i.e., the whole product of their labour. That is why it's worth bringing to the fore some reflections on these elements in order to put the author's approach in context.

According to Marx (1976, 274–276), the value of labour power is determined by the labour time required to produce the commodities necessary for the maintenance of the worker and the production of the worker's substitutes. This latter aspect includes costs of training and education in accordance with the degree of skill needed for such labour power.

These training costs, as long as they are also under the pressure of market competition, are determined in the same way as the value of all other commodities: by all the labour time employed to make that training possible. Therefore, there is no direct relation between these costs of production and the total value created by a working day after the worker has been trained.

Something similar may be observed in the relationship between the intensity of labour and the value of the labour power. The part of the value of labour power which is related to the daily maintenance of the worker must be larger the greater is the exhaustion taking place during the working day. However, there is no rule which guarantees that the degree of that enlargement of that part of the value of labour power will be equivalent to the degree of labour intensity.[5]

So, even though the Marxist perspective concludes that the value of the labour power must be greater for skilled workers and for those who work more intensively, there is no reason to suppose beforehand that the difference in wages will be the same as the difference between values created by these workers.

Nevertheless, there are some assumptions that, if observed, could validate the market wages as possible "undistorted index of skill and intensity." Ochoa (1984, 40) indicates the following, in decreasing order of plausibility: first, the consumption basket of all workers in all sectors should be considered the same; second, the exploitation rate would have to be uniform across sectors (and thus across strata of different labour complexity); and third, the labour markets must be in equilibrium.

With respect to the first assumption, Ochoa indicates that for the structure of nominal wages to mirror relative values of labour power—displaying greater values for those sectors where more skilled and/or greater intensity of labour are required—it is necessary that greater nominal wages also correspond to greater real wages. This result is secured by the assumption that all workers consume the same basket of goods, i.e., that the nominal wages are distributed in the same proportion through the same commodity collection.

As soon as wages classify all workers according to relative values of their labour power, the second assumption—of the same rate of surplus value—guarantees that relative differences between wages will reflect proportional differences in the relative quantity of simple average labour created by each worker (Ochoa 1984, 41–42). In other words, once the working class is exploited equally in all sectors (and in every labour skill stratum), the amount of surplus value appropriated by the capitalist class will be directly and strictly proportional to the amount of paid wages.

It is possible to notice that while the first assumption is concerned with establishing wages as an adequate measure for differentiating the quality of the labour power, the second assumption is the fundamental element that would guarantee that wages will also express the exact amount of value created by the worker. Accordingly, despite the worker not receiving the whole product created from his labour, he would always receive the same and unique proportion of it.

Lastly, the third supposition postulates that labour markets must be in equilibrium, or at least that sectorial imbalances cancel each other out. In fact, Ochoa (1984, 42) points out that "this assumption can be seen as equivalent to the assumption of a uniform rate of surplus-value [. . .]," so that the movement of workers from one sector to another could be understood as the factor that assured the equalization of that rate.

Problems and Theoretical Limitations of Ochoa's Approach to Skilled Labour

Ochoa was not the first to propose a formal method to reduce complex or intensified labour to a multiple of simple average labour based on relative wages.[6] However, as far as we know, he had the merit of stating clearly and fully, for the first time, the necessary assumptions for validating this methodological solution. The author justifies the adoption of his assumptions based on their similarity with those assumptions of the system of prices of production:

> the assumption of equilibrium across sectoral labor markets [and the consequent uniform exploitation rate] is at the same level of abstraction as the idea of a uniform rate of profit across sectors. Since the latter is a defining characteristic of the production-price system, the former is equally legitimate here [for determining the values of commodities]. (Ochoa 1984, 42)

However, it is necessary to point out that production prices are a theoretical element of Marxist thought fundamentally distinct from determining the values of commodities. First of all, production prices are not real prices, but theoretical prices—i.e., prices that *would* be observed in the presence of an equalized rate of profit across sectors and in the absence of any other disturbing factors. The real counterparts of those prices—in other words, the prices that we actually observe in concrete reality—are those called market prices. Market prices are syntheses of many definitions and they become distant from production prices because of the existence of "barriers" to the equalization of the profit rate,[7] among other counteracting forces. Given the difference between theoretical prices of production and actually observed market prices, the estimation of the former is a precious exercise to observe, for instance, the actual size of their divergence from the latter.

As for determining commodities values, what one wants to measure are their concrete magnitudes—that is, the labour time that society as a whole has employed on average to produce each commodity. In that sense, in opposition to prices of production, labour values are not a mere formal abstraction, but a fact observed from concrete social reality.

Therefore, calculations based on Ochoa's hypothesis generate results that are "theoretical values," i.e., values that *would* be observed in the presence of an equalized rate of surplus across sectors and in the absence of any other disturbing factors. But these theoretical values would lack a "separate" concrete counterpart with which they could be compared.

In addition, cause-and-effect relations between an equalized profit rate and prices of production are different from those of the relation involving an equalized rate of exploitation and the magnitude of the value of commodities. The formation of prices of production is a consequence of the process of capitalist competition across sectors which itself also generates the tendency for profit rate equalization. In its turn, the magnitude of values is determined by a process that is not related to the process of equalization of surplus-value rates: while values are determined in essence by the labour time socially necessary for the production of commodities, wages and the exploitation rates fluctuate differently in each sector and stratum of labour complexity as a result of class struggle and of all the elements that may influence it (such as the behaviour of the supply and demand of work). Hence, neither the exploitation rate determines the values of commodities, nor do both share a common determinant.

It thus follows that Ochoa's rationale for adopting the exploitation rate equalization hypothesis—for being supposedly analogous to the hypothesis of equalization of the profit rates in the case of prices of production—appears unsustainable. The level of abstraction is different and the cause-and-effect relations are neither the same nor similar. As a matter of fact, Ochoa's hypotheses may create more problems than they solve. If they are compatible with empirical observations, then the calculations based on such assumptions would present theoretical significance. But, if they are revealed to be unrealistic, the results will be compromised due to a *petitio principii* mistake: the amount of value created, the organic composition of capital, the transfer of value between sectors, the average and sectorial rates of exploitation, all these variables are strongly affected by the exploitation rate equalization hypothesis. All elements we want to calculate turn out to be influenced to a great extent by that assumption.

And the misfortune is that such an assumption has low adherence to both theoretical predictions and empirical observations. From a theoretical perspective, there is no definitive prediction in Marxist thought that the exploitation rates will really equalize, but only the notion that the competition among workers that reached a certain level of skill generates a *tendency* to the equalization of *their wages*. Thus, in the first place we need to point out that it is a *tendency* in which the movement of equalization never reaches any type of final equilibrium due to the existence of "competition barriers"[8] and other divergent forces.[9]

Second, such competition is responsible for the gravitation of *wages* around the value of labour power (including training and education costs), but not for the amount of surplus value created.[10] Moreover, there is no theoretical reason for assuming that competition among workers of different skill levels leads to an equalization in the exploitation rate to which they are subjected. If higher skilled workers receive higher wages, an increase in labour supply—coming from sectors

of lower-skilled labour—will push wages down. However, as long as wages are higher than in lesser skilled stratum and enough to guarantee the reproduction of that labour power, these workers are not likely to quit their jobs to look for opportunities that pay less only because their employers appropriate a greater portion of their work hours.

From an empirical standpoint, it should be stressed that barriers to the free mobility of workers are not negligible at all. Several reasons account for this: training time is so significant for the lifetime of an individual worker that few would feel stimulated enough to respond to fluctuations in labour supply/demand;[11] educational monopolies represent barriers to attaining better-paid jobs in many countries,[12] geographical movements are costly and one cannot ignore or despise the challenges of cultural adaptation. Besides that, the historical and cultural formation of the labour market and the class struggle in many countries resulted in huge wage inequalities due to gender, race, sexuality and other differentiations, even between workers who perform the same task.[13]

At the international level, the highlighted issues are most evident by far. Barriers to free mobility across countries are so intense that multiple migration crises show the perverse reality of inequality between nations. In 2019 the average wage in the United States was 12.3 times higher than the average wage in Mexico (Ilostat 2021). At the same time, a United Nations study showed that around 100 thousand children were deprived of liberty for migration-related reasons by the government of the United States of America (Nowak 2019), many of whom were taken away from their parents before detention.[14] In the same time span, wage differences between the European Union and North-African or Middle-East countries reached a magnitude of 44 times (Ilostat 2021), while the number of total deaths of migrants trying to cross the Mediterranean sea was more than 1900 people (IOM 2021). How can someone migrate to pursue better opportunities "offered by the market" if this involves the risk of detention, separation from their own children and death?

As a matter of fact, Ochoa's assumptions lead to the idea that labour in richer countries is more intense and skilled than in poorer countries[15] and that complex labour in poorer countries (where wage differentials are wider) creates disproportionately more output than simple labour in these same countries.

In short, although Ochoa recognizes that wages are only part of the product of labour, he indicates a set of assumptions that would need to be observed in order for the structure of relative wages to express the relative productivity/intensities of labour. We argued that, since these assumptions are not robust both theoretically and empirically, the use of wage rates to reduce complex to simple work generates serious distortions in the analysis.

Anyway, the critiques presented here would be innocuous if there were no alternative methods that proved to be more consistent and closer to observed

reality. The task of the next section is exactly to address and evaluate alternatives, based on comparing different methods with a similar subset of nations, periods and estimates, with regard to indicators such as total and new value, exploitation rate and value transfers through international trade.

Empirical Evaluation

Proposal for Evaluation

In order to evaluate Ochoa's method and possible alternatives, we proceed to briefly expose the methodological procedures adopted and the points at which each method diverges from the others. The common base for all methods is centred on values and direct prices (prices proportional to values whose sum equals the sum of market prices).

The labour value of a commodity is composed not only of the labour time spent in the last stage of its production, but of all the socially necessary labour time spent in all different stages of the production process. Thus, it also takes into account the labour time spent in producing all the intermediate inputs consumed as well as the depreciated portion of fixed capital. Ochoa (1984, 47 *et seq*.) showed that the sum of the labour time required for those three elements (last stage of production, intermediate inputs and capital depreciation) is represented by:

$$v = a_o \left(I - A - D\right)^{-1}, \tag{1}$$

where v is the vector of labour value per unit of output of n sectors;[16] a_o is the vector of labour requirements; A is the matrix of technical coefficients of intermediate inputs; D is the matrix of depreciation coefficients of fixed capital; and I an identity matrix of order n. Labour requirements (a_o) represent the amount of reduced labour (l') directly employed in the jth sector by its output (x):

$$a_{0j} = \frac{l'_j}{x_j}, \tag{2}$$

It's from here that the chosen approaches begin to differ. Reduced labour (l') is constituted by the total amount of labour time (l) spent in each sector j; and a multiplier (z) which translates labour time into hours of simple labour, considering the composition of skilled and unskilled labour of each sector:

$$l'_j = l_j \cdot z_j. \tag{3}$$

As stated earlier, Ochoa proposes to use relative wages to determine this vector of multipliers (z). He applied this approach to the particular case of the United

States, but applying it to a broad selection of different countries involves further considerations not previously undertaken.

We decided to follow two paths to better fit this approach to the international scope. First, we apply his method by considering a process of equalization of the exploitation rate at the world level (from now on, referred to as method "Ochoa 1"). Here, we build the vector of multipliers z by dividing the average wage ($\overline{w}$) of each sector by the lowest average wage in the world.

$$z_j^{Ochoa1} = \frac{\overline{w}_j}{\overline{w}_{min}} \tag{4}$$

A second proposal ("Ochoa 2") was calculated considering that the process of equalization of the exploitation rate is restricted to the area within national borders. In this proposal, vector z is the result of the division of the average wage in each sector by the average wage of the sector with the lowest average wage in that country. Therefore, the lowest waged labour in each country is equally considered simple labour. This approach allows the exploitation rate not to be uniform across countries. However, it directly links the magnitude of total value created to the degree of wage dispersion in each country.

A third proposal was constructed based on that developed by Pavle Petrović (1987), a modified approach departing from Ochoa's, in which the reduction of complex or skilled labour to its equivalent in terms of simple labour is obtained by using the relationship between the average wage of each skill level of the labour power and the average wage of the least complex labour, as weights. This alternative, as a matter of fact, implies assuming that the equalization of the exploitation rate occurs between each level of skilled labour, and still has the advantage of considering the heterogeneity of labour skills within each sector. However, it depends on data availability on the proportion of worked hours within each sector according to the level of skilled labour, as depicted in the following equation:

$$z_j^{Petrovic} = \frac{\overline{w}_{hs}}{\overline{w}_{ls}} \cdot h\_hs_j + \frac{\overline{w}_{ms}}{\overline{w}_{ls}} \cdot h\_ms_j + h\_ls_j, \tag{5}$$

with h_hs, h_ms and h_ls, representing, respectively, the proportion of labour hours of high-, medium- and low-skill levels for each j sector; while $\overline{w}$ represents the average wage of each of these skill levels.

We also present two alternatives not based on wage indexes. The first one ("Alternative 1") is the most parsimonious and treats all labour as simple abstract labour (so vector z is scalar 1).[17] Such an alternative reads the differences between wages only as differences in the rates of exploitation, which can be seen as the extreme opposite of what Ochoa considered (which attributes these differences only to differences in "complexity–intensity").

The last proposal ("Alternative 2") considers a feasible, but arbitrary, scale of multipliers of high- and medium-skilled labour regarding low-skilled labour (6.25x for high-skilled and 2.5x for medium-skilled labour[18]). So, vector z is determined in this case by the following equation:

$$z_j^{Alternative\,2} = 6.25 \cdot h\_hs_j + 2.5 \cdot h\_ms_j + h\_ls_j. \quad (6)$$

This illustrative approach aims to highlight the importance of considering the multiplier property of skilled labour without relying on relative wages for establishing such an index. Thus, it doesn't totally discard that dimension of complex labour as "Alternative 1" does, but neither ignores that relative wages at a global scale involve much more than solely differences of complexities (as suggested by Ochoa's and Petrović's approaches).

The five proposals presented here also differ with regard to determining the value of labour power. Methods "Ochoa 1" and "Petrović" consider an equalization process of the exploitation rate at the international level, so they consider a unique structure of a basket of goods for all workers of the world. As for method "Ochoa 2," which considers the equalization of the exploitation rate limited to national borders, a basket of goods is supposed for each country. Methods "Alternative 1" and "Alternative 2," on the other hand, do not depend on any equalization of the exploitation rate, so the basket of goods can diverge from sector to sector as long as there is available data.

Finally, it is important to notice that there is a similarity between methods "Petrović" and "Alternative 2." Both consider the hours of skilled labour in all countries as a multiple of the hours of simple labour. While the multipliers of "Alternative 2" were chosen arbitrarily to minimize the occurrence of negative exploitation rates in the results, the "Petrović" method used relative average wages.[19] However, using average wages in this last method implies also considering that the basket of goods is the same in the whole world, so that higher nominal wages represent a higher value of the labour power in the same amount. Although this assumption does not have any influence on the computation of labour values, it is of utmost importance with regard to the assessment of the exploitation rate, as will be seen.

Data Source

To investigate which effect each of the methods proposed has on the reduction of complex labour into simple labour, we will present a descriptive analysis of the results by applying them to the same dataset encompassing the same period of time. We chose the World Input–Output Database (WIOD) in its version released in 2013, which has enough data for the years from 1995 to 2009 (Timmer et al. 2015).

The WIOD combines the official data of supply, demand and international trade of 35 sectors for the 27 countries of the European Union and for 13 other countries/regions as well as aggregated information for the "rest of the world" (RoW). The choice of WIOD in this particular version was due to the fact that it presents a broader set of data needed for the computations proposed in this article than other similar datasets.[20]

With WIOD data, all computations for each methodology, as presented in the previous section, were made once for the entire world, so they were made for a number of sectors n equal to the number of sectors in each country multiplied by the number of countries/regions ($n = 35 \times 41 = 1435$).[21] To do so, we used the information presented in the World Input–Output Tables (WIOTs) and in the July 2014 release of the Socio Economic Accounts (SEA).[22] Each necessary variable was obtained as follows.

The matrix of technical coefficients A_{nxn} was computed from data of the transactions of the intermediate inputs subset of the entire world (T_{nxn}) and the vector of the output in market prices (x_n)—both from the WIOTs:

$$a_{ij} = \frac{t_{ij}}{x_j}. \tag{7}$$

For the matrix of depreciation coefficients, a more complex procedure was necessary. Data regarding capital stock per sector are available in the SEA only at an aggregated level,[23] which is the reason why they needed to be decomposed in a K_{nxn} matrix. To do so, we used the data on capital composition from the EU KLEMS database (van Ark and Jäger 2017) when available,[24] combined with the structure of the gross fixed capital formation provided by WIOTs. After the K_{nxn} matrix was obtained, we applied depreciation rates consistent with EU KLEMS suppositions to get a matrix of capital depreciation C_{nxn}. Thus, the matrix of depreciation coefficients D_{nxn} was computed by dividing each element of this matrix by the gross output of the correspondent sector:

$$d_{ij} = \frac{c_{ij}}{x_j}. \tag{8}$$

For the labour requirements vector, the SEA provides data on total hours worked by persons engaged ($l_j = H\_EMP_j$). The vector of multipliers z was calculated from a distinct set of data from SEA for each proposal (except for "Alternative 1," in which $z = 1$). For "Ochoa 1" and "Ochoa 2," average wages of each sector were computed from data of labour compensation (LAB)[25] and total hours worked by persons engaged (H_EMP):

$$\bar{w}_j = \frac{LAB_j}{H\_EMP_j}. \tag{9}$$

For "Petrović" and "Alternative 2," data regarding the share of hours worked by each skill level were provided directly by SEA (*H_HS*, *H_MS* and *H_LS*). In addition, to obtain the average wage of each skill stratum as required for the "Petrović" method, we also used data on the share in total labour compensation for each skill level (*LABHS*, *LABMS* and *LABLS*) and we had proceeded with a similar calculus for each stratum:

$$\bar{w}_{hs} = \frac{\Sigma LAB_j \cdot LABHS_j}{\Sigma H\_EMP_j \cdot H\_HS_j}. \tag{10}$$

Finally, to obtain the value of labour force we had to establish baskets of goods in accordance with the assumptions of each method. In the absence of information about the expenditures of the working class alone, we used the proportions of the columns of final consumption expenditure by household in the WIOTs to estimate the content of the basket of goods consumed by them. For "Ochoa 1" and "Petrović" we built a unique basket of goods, taking the weighted average basket of all countries. As for method "Ochoa 2," which considers the equalization of the exploitation rate limited to national borders, a basket of goods for each country was obtained from the dataset. For methods "Alternative 1" and "Alternative 2," since we had no detailed information on workers' consumption by sector, we had to assume that the basket of goods is the same in each country, just like in method "Ochoa 2."

All data estimations in this article resulted in part from the efforts of the World Labour Task Force of the Group of Concrete Studies on the Theory of Value for the construction of the WLVD. This database seeks to support the empirical work of different theoretical and methodological frameworks for those interested in issues related to values and prices, without limiting them as far as possible to assumptions of any particular methodological perspective. In addition to all data presented here, the WLVD provides information regarding other Marxist categories, such as prices of production, the organic composition of capital and profit rate.[26]

Analysis of the Results

For the purposes and limits of this article, we chose to present data and estimates of four striking countries: the United States and Japan, two of the most important core economies, and Brazil and Mexico, as big and dependent or semi-peripheral nations. We also added several world estimates, since the dataset integrates the entire globe. This choice is justified to allow a clear comparison among these two groups of economies, which cover both different predicted patterns and relations that are generally derived from Marxist studies and analyses. In addition, we

discuss the results and their evolution regarding reasonable broader expectations derived from Marxian thought.

Values and Prices Deviations

Before delving into the country data, and in line with most research done on the subject of empirical estimates of values, direct prices and other Marxian categorical variables, we begin by assessing the market-direct price deviations of the entire dataset. As in all of our cross-sectional analyses, we used the year 2009, as it's the most recent year with complete data available.

Some remarks are necessary before describing some notable features of the metrics displayed in Table 1 below. First of all, we compare whole global estimates since the source data is at the world level, and all methods are solved by departing from a world IO matrix. Another important note refers to the exclusion of unproductive sectors, for which values and direct prices are supposed to be 0 (as per the designed and implemented method just described). Not doing so would imply introducing bigger divergences derived from our method's design choices. Hence our assessment is done excluding the effect of unproductive labour.[27] Moreover, because of heteroscedasticity concerns regarding direct price and market price vectors (Ochoa 1984, 130–131) and since price-value deviation graphs are commonly depicted with logarithmic values, the metrics displayed were produced on the natural logarithms of direct and market prices.

Finally, we present the most important and common price-value deviation metrics: R, R squared, mean absolute percentage deviation (MAD), mean absolute weighted percentage deviation (MAWD), a normalized vector distance (NVD), as in Ochoa (1984), root mean squared percentage deviation (RMSPD), as in Petrović (1987), the angle between direct price and market price vectors (θ), the distance related measure (d) and the coefficient of variation of the ratios of direct to market prices (cv), the latter three metrics as suggested by Steedman and Tomkins (1998).

Table 1 shows that the "Ochoa 1" method, as expected (see above), results in direct prices that are closer to market prices than all the other methods, in every metric, and shows a R^2 value of 97.1%. Even though the "Ochoa 2" method also displays the second highest Pearson correlation related measures, on all other measures it remains closest to "Alternative 1," which holds both lowest correlation measures, even though still relatively high (R^2 of 86.3%), and highest deviations as measured in both "numeraire-dependent" measures (MAD, MAWD, NVD and RMSPD) and the "numeraire-free" θ, d and cv.

Overall, the data displays relatively strong correlations and small deviations as measured by the other metrics. θ remains close to 5 degrees or below; and MAD, MAWD, NVD, RMSPD, cv and d constitute values mostly in the vicinity of 12%, and in most cases near to 10% or below.

Table 1. Measures of Association and Deviation between Vectors of Direct Prices and Market Prices for the Whole World, 2009

Metric	*Ochoa 1*	*Ochoa 2*	*Petrović*	*Alternative 1*	*Alternative 2*
R	0.9856	0.9396	0.9376	0.9290	0.9369
R^2	0.9714	0.8828	0.8791	0.8631	0.8778
MAD	0.0688	0.1068	0.0839	0.1007	0.0855
MAWD	0.0629	0.1020	0.0804	0.0967	0.0820
NVD	0.0697	0.1151	0.0946	0.1114	0.0961
RMSPD	0.0964	0.1290	0.1057	0.1226	0.1071
θ	3.8141	6.0900	5.7857	6.2687	5.8212
cv	0.0667	0.1067	0.1013	0.1098	0.1019
d	0.0666	0.1062	0.1009	0.1094	0.1016

Source: authors' calculations available at WLVD (http://worldlabourvalues.org).

National Aggregates of Direct Prices

As indicated above, Ochoa applied his approach to a single country, so that in his studies there was an equality between the sum of market prices and the sum of production prices for national aggregate. Although this equality is verified at the world level in our calculations, it is not observed in the national aggregate. This section intends to assess the relation between market prices and direct prices for the national aggregate, in order to investigate how the way to solve the reduction problem impacts determining the product generated in terms of value.

Table 2 shows a comparison made for the data on output in market prices and value terms. It summarizes information about the sum of prices of commodities produced in the year 2009, contrasting market prices with direct prices (i.e., prices that are proportional to the magnitude of the values), for four selected economies. Table 3 summarizes information on the new value created in the same period, that is, a Marxian gross domestic product in terms of value added for the year 2009.

What both tables reveal is that Ochoa's estimates with international equalization ("Ochoa 1") and with national equalization ("Ochoa 2") differ by far from all other methods. In "Ochoa 1," direct prices remain very close to market prices (as can be seen in the column "%"), and in "Ochoa 2" the same prices remain very low for all countries. The deviations are similar, comparing Brazil with Japan and United States with Mexico.

The other methods present similar deviations, particularly showing that for the richer countries (Japan and the United States) direct prices are further away from market prices. This result seems to confirm theoretical intuition in the sense that prices should be higher than values in sectors where the organic composition of capital is higher—a corollary of Marx's analysis of prices of production.

Table 2. Total Product in Market Prices (MP) and Direct Prices (DP)—2009—US$ Trillions—Brazil, Mexico, USA and Japan

Country	*MP*	*Ochoa 1*		*Ochoa 2*		*Petrović*		*Alternative 1*		*Alternative 2*	
		DP	%	DP	%	DP	%	*DP*	*%*	*DP*	*%*
Brazil	2.74	2.97	108%	0.95	35%	2.28	83%	2.24	82%	2.28	83%
USA	24.80	17.73	71%	3.70	15%	4.58	18%	3.19	13%	4.40	18%
Japan	9.39	10.23	109%	3.32	35%	2.84	30%	2.05	22%	2.74	29%
Mexico	1.47	1.19	81%	0.43	29%	1.30	88%	1.17	80%	1.28	87%

Source: market prices are obtained from WIOD (Timmer et al. 2015); direct prices are authors' calculations available at WLVD (http://worldlabourvalues.org).

Table 3. GDP in Market and Direct Prices—2009—US$ Trillions

Country	*MP*	*Ochoa 1*		*Ochoa 2*		*Petrović*		*Alternative 1*		*Alternative 2*	
		DP	%	DP	%	DP	%	DP	%	DP	%
Brazil	1.40	1.75	125%	0.27	19%	1.38	99%	1.26	90%	1.37	98%
USA	14.12	11.47	81%	0.11	1%	2.14	15%	1.19	8%	2.02	14%
Japan	4.92	5.34	109%	0.11	2%	1.08	22%	0.66	13%	1.02	21%
Mexico	0.84	0.65	78%	0.15	17%	0.86	102%	0.74	88%	0.84	100%

Source: market prices are obtained from WIOD (Timmer et al. 2015); direct prices are authors' calculations available at WLVD (http://worldlabourvalues.org).

In any case, this first evaluation indicates that the chosen methods—and all their accompanying assumptions—to reduce complex labour into simple labour may have a great influence on the results. However, in order to better assess each method, we go on to observe their effects on specific variables. Next, we analyse the results for the exploitation rates and for value transfer between countries stemming from international trade (generally referred to in the literature as an unequal exchange in international trade).

Exploitation Rates

Table 4 presents data on the surplus-value rate of both productive and unproductive wage workers for selected countries and for the world. We should notice that the equalized exploitation rates observed in "Ochoa 1" are the very assumptions of that method. This seems to contradict the practical perception that there are wide wage differentials across countries, in addition to continuous migration flows and distinct structural unemployment rates.

When the assumption of an international equalized exploitation rate is abandoned (in all but the "Ochoa 1" method), we observe higher rates in the periphery

Table 4. World and Selected Countries Surplus-Value Rates—2009

Country	*Ochoa 1*	*Ochoa 2*	*Petrović*	*Alternative 1*	*Alternative 2*
Brazil	287%	86%	168%	262%	320%
USA	287%	–79%	–45%	57%	119%
Japan	287%	–78%	–37%	59%	136%
Mexico	287%	189%	236%	345%	409%
World	287%	276%	47%	41%	72%

Source: authors' calculations available at WLVD (http://worldlabourvalues.org).

than in core economies. In peripheral economy countries, wages are typically lower in nominal terms, but the working day is usually as long as or longer than in richer nations. Hence, such a difference in exploitation rates seems to match reality.

When we observe the results of "Ochoa 2," the United States and Japan estimates indicate significant negative magnitudes,[28] which seems very unplausible, to say the least. As a matter of fact, wage inequality is higher in poor countries than in rich countries,[29] so methods that consider the exploitation rate equalization to occur within national borders result in a purportedly larger amount of value created in the formers. This, in turn, inflates Japan's and USA's workers commodity basket value (because of the imported share) in such a way to contribute strongly to such abnormalities as negative exploitation rates.

Negative exploitation rates are also common in our adaptation of Petrović's approach.[30] This results mainly from considering a unique basket of goods for all countries. If, on one side, nominal wages in rich countries are higher than in poor countries, on the other side, we observe that the consumption of the working class in poor countries presents a higher portion of goods coming from the agrarian sector, in which prices are normally lower than their values, with consequences for the estimates.

For instance, data from WIOD (Timmer et al. 2015) show that the sum of all wages paid to workers in India was equal to 5% of what all workers in the United States received as wages in 2009. However, as around 50% of the income of those workers was used to buy agricultural goods from India itself[31] (where there is a huge industrial reserve army in that sector) for prices much lower than their values,[32] the quantity of labour time absorbed by them was double the amount of time absorbed by the workers in the United States.[33] In the United States, by opposition, a large part of their workers' income is spent on commodities of higher technological content, i.e., commodities coming from sectors with a high composition of capital, where prices are usually higher than values. So, when we assume that workers of both countries consume the same basket of goods (as in "Ochoa 1" and "Petrović"), the value of labour power in the United States appears to be 20 times higher than the value of the Indian labour power.

Proposals "Alternative 1" and "Alternative 2" present more plausible results in this respect: there are few cases of negative exploitation rates[34] and the highest exploitation rates were found in dependent or semi-peripheral nations. The difference between these two approaches is clear when assessing the differences in the exploitation rates according to different labour skill levels (as shown in Table 5).

As "Alternative 1" assumes all working hours are equal, the exploitation rates are higher for low-skilled labour—since the wage per hour of more skilled labour is normally higher. This result shows that it makes sense to consider that the more qualified strata create a greater mass of value per hour worked than the simpler stratum. What remains undetermined is how to account for the magnitudes of these "multipliers."

The option of electing a multiplier that equalizes the global exploitation rates along each stratum (Petrović)—aside from the already mentioned shortcoming of considering a single basket of goods for all workers in the world—eliminates by definition any possibility of evaluating real divergences among those rates. On the other hand, the "Alternative 2" approach, based on a totally arbitrary choice for skill multipliers, always results in a reduction of the exploitation rate of simple labour and in an increase of the exploitation rate of complex labour, in comparison to "Alternative 1." This stems from the fact that by considering an hour of skilled labour a multiple of an hour of simple labour, the amount of value created by low-skilled workers remains the same, while the value of their labour power increases (since their consumption basket includes commodities produced with skilled/more intense labour). On the contrary, the increase of the value created by skilled labourers is always higher than the increase of the value of their corresponding labour power (since unskilled labour is also used to produce their consumption basket).

Finally, Figure 1 presents the historical series of the exploitation rate in Brazil, the United States and the whole world for the period between 1995 and 2009. The first thing to observe is that the estimates of "Ochoa 1" are the same for all

Table 5. World and Selected Countries Surplus Rates by Skill Level—2009

Country	*Petrović*			*Alternative 1*			*Alternative 2*		
	High	*Average*	*Low*	*High*	*Medium*	*Low*	*High*	*Medium*	*Low*
Brazil	140%	232%	128%	26%	311%	694%	280%	396%	284%
USA	–36%	–50%	–73%	5%	94%	196%	158%	91%	16%
Japan	–21%	–45%	–78%	13%	87%	109%	204%	102%	–10%
Mexico	331%	199%	218%	132%	277%	1030%	569%	336%	422%
World	47%	47%	47%	–33%	46%	136%	95%	76%	29%

Source: authors' calculations available at WLVD (http://worldlabourvalues.org).

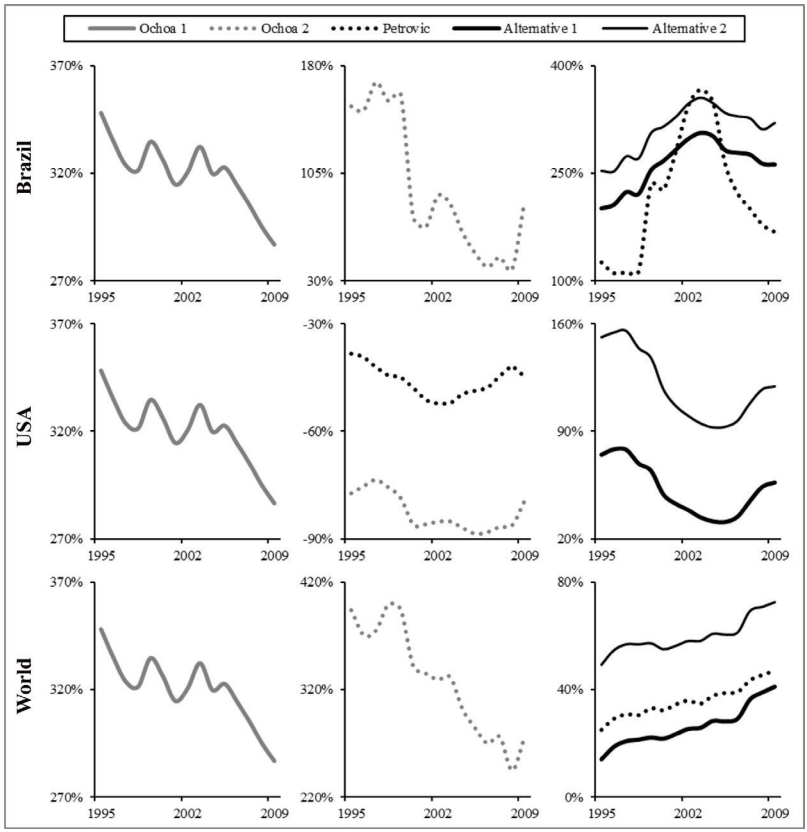


Figure 1. Surplus Rate from 1995 to 2009—Brazil, USA and World

Source: authors' calculations available at WLVD (http://worldlabourvalues.org).

countries, so that national phenomena that influence the exploitation rate cannot be captured by this method—such as the subprime crisis that began in 2007 mainly in the United States, or the economic policy of increasing the minimum wage in Brazil from 2004 to 2015. Furthermore, even when considering the whole world, it is possible to observe that the exploitation rate presented in either method based on Ochoa's approach evolves in an opposite and awkward direction in comparison to other estimates.

Remarkably, the behaviour of the exploitation rates computed by methods "Petrović," "Alternative 1" and "Alternative 2" is quite similar. The divergence between the first one and the other two derives from its assumption of a single consumption basket for all workers of the world. It's why their results are so divergent for each isolated country, but closer for the entire world. This assumption of

the "Petrović" approach changes the average size of the exploitation rate and also totally blurs any effects accruing from local changes in relative surplus value (those deriving from changes in the value of the labour power).

"Alternative 1" and "Alternative 2" show very similar movements and tendencies of the exploitation rate, and a divergence only in absolute terms. When we consider the effect of the multiplier of complex labour, there is a tendency for the total quantity of value created by workers to rise more than the value of the labour power, so that "Alternative 2" normally presents higher rates of surplus.

Unequal Exchange

There is still another topic of interest that can be analysed with these data and estimation methods. It is known in the Marxist literature as "unequal exchange" and it is related to the transfer of value via international trade. The "unequal exchange" thesis was proposed originally by Arghiri Emmanuel (Emmanuel and Bettelheim 1962). Based on the labour theory of value, Arghiri Emmanuel rewrote Raúl Prebisch's thesis that over the long run the price of exported primary commodities would decline in relation to the price of imported manufactured goods, implying a deterioration of the terms of trade for primary commodity exporter countries. Even though Emmanuel associated the inequality of trade exclusively with divergences between prices and values stemming from differences in the exploitation rates across countries, his theory was rapidly absorbed by many Marxist authors who included other causes, such as the monopolist markets and differences over national organic compositions of capital, average intensities of labour and labour productivities.

Estimates of the amount of value transferred through international trade are summarized in Table 6 for the chosen countries.[35] Net value appropriation appears with a positive sign. In this dimension, "Ochoa 1" results diverge from all the others in two fundamental aspects: first, it presents very low quantities of value transfers between all countries. Second, it points to the richer countries as the most harmed countries by this dynamic, while peripheral economies, such as Mexico, appear as beneficiary economies of those value flows. Both results, untenable on

Table 6. Value Transfers in International Trade—2009 (% of New Value Produced)

Country	*Ochoa 1*	*Ochoa 2*	*Petrović*	*Alternative 1*	*Alternative 2*
Brazil	–0.3%	124.0%	3.6%	–0.3%	3.2%
USA	–2.1%	1931.4%	72.8%	134.4%	77.4%
Japan	–3.1%	1328.1%	66.3%	113.3%	70.4%
Mexico	15.2%	90.3%	–2.3%	–3.2%	–2.4%

Source: authors' calculations available at WLVD (http://worldlabourvalues.org).

theoretical grounds as far as the majority of accumulated debate and propositions on this subject are concerned, are a consequence of the assumption of the equalization of the exploitation rate. Worked hours in central countries are considered as producing values in the exact amount that equalizes surplus rates.

We find the opposite effect in the "Ochoa 2" results. This time, it follows from the restriction of the surplus-value rate equalizing process to national borders: where there are larger wage inequalities, typically in dependent countries, this procedure greatly increases the attributed weight of better-paid labourers and, as such, of value transfers. The other solutions present similar results and are in accordance with most theoretical predictions. It is worth noting the Brazilian case: while it appears in a slightly negative position in "Alternative 1," it becomes a small beneficiary in both "Petrović" and "Alternative 2" methods. These results go in line with interpretations that portray Brazil in a semi-peripheral/sub-imperialist position, being as it is in an intermediary position in the flow of surplus value from extreme dependent nations towards the core economies.

Figure 2 shows the historical series of the bilateral "unequal exchange" in trade between Brazil and Mexico with the United States. Approaches "Ochoa 1" and "Ochoa 2" greatly diverge from the prevalent theoretical predictions. In both

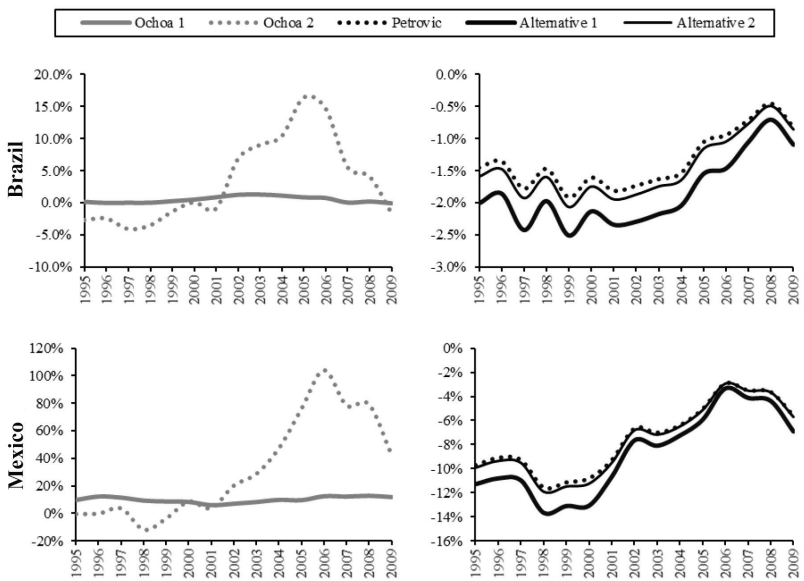


Figure 2. Value Transfers regarding Brazil and Mexico Trade Relations with the United States—1995 to 2009—% of Total New Value

Source: authors' calculations available at WLVD (http://worldlabourvalues.org).

cases, unequal exchange effects would be regarded as positive for Brazil and Mexico during most part of the period. For example, Mexico would have received a quantity of value equal to all value created by its economy in the year 2006.

With respect to the remaining methods, the absolute results are similar and coherent with the most common theoretical arguments for all years. Notice that the shapes of the curves are very similar. In summary, methods that differentiate skilled labour (such as "Petrović" and "Alternative 2"), when applied according to the corresponding sectorial composition, present results that are similar to the results obtained when all labour is considered simple labour ("Alternative 1").

A clear conclusion that derives from the analysed data is: any hypotheses of the equalization of exploitation rates (at national or international level or restricted to each labour skill stratum), besides rendering comparisons of real divergences impossible, exert significant influence over the reached results. On the other hand, contrasting the results presented by "Alternative 1" and "Alternative 2," it seems proper to consider as distinct the magnitudes of values created by an hour of work of workers from distinct skill strata.

However, we must notice two important limitations of an approach such as "Alternative 2." First, it is obviously inadequate to arbitrarily choose a multiplier for labour skills. It would be better to obtain that multiplier from an independent source, one that might even be related to the costs of education and training of the labour power.[36] However, this information is not, to the best of our knowledge, readily available. Another shortcoming of "Alternative 2" is that many available input–output datasets allowing for computations of values from market prices do not provide any information on differences between skilled and unskilled labour.

In the absence of detailed information about the composition of labour's skills and about the multipliers of labour hours according to skill levels, the most parsimonious alternative of considering all labour as simple labour seems the righteous methodological choice for two reasons. In the first place, it avoids making the results determined by the assumptions adopted; second, even if the absolute values of exploitation rates and of unequal exchange vary, the movements and tendencies of these variables seem to remain similar to the results which would have been obtained if the differences of skilled and unskilled labour were treated accordingly with the theory.

Conclusion

This article provided a critical assessment, on theoretical and wide empirical grounds, of the approach consolidated by Edward Ochoa that picks relative wages as a measure to reduce heterogeneous/concrete to homogeneous/abstract labour. After explaining his proposal and its underlying assumptions, we pointed out that

Ochoa suggests that relative wages are an adequate proxy for the level of labour complexity when three elements are present: an identical worker's consumption basket, a totally equalized exploitation rate and a labour market "in equilibrium."

Next, theoretical and empirical issues revealing shortcomings and problems with such assumptions were raised. From a theoretical point of view, we argued that the Marxist theory does not foretell that rates of surplus values will be equalized in all sectors and/or in all levels of skills—both because that competition between workers is guided by wages (and not by the unpaid portion of the working day) and that trends predicted by the theory must be seen as forces that set the economy in motion, not ever reaching a final still, stable or fixed stage (Shaikh 2016).

As for the empirical issues, we pondered that those barriers to the free movement of the labour power are relevant, even more when considering the international level. Thus, we argued that the low likelihood of Ochoa's proposition leads to a *petitio principii* problem, creating results that are greatly predetermined by the adopted assumptions.

Finally, we empirically evaluated Ochoa's method by comparing it with alternative approaches, applying all procedures to the same dataset (World Input–Output Database) from 40 countries in the period 1995–2009. Estimates showed unequivocally that Ochoa's assumptions eliminate the possibility of assessing reasonable expected different exploitation rates among countries, and influence the absolute size and the historical tendency of fundamental variables (such as the surplus-value rate and value transfers from international trade), with results that seem very unlikely by the prism of common or prevalent theoretical predictions.

The limits of this research include the absence of detailed information about the workers' consumption basket. Thus, we needed to consider a single consumption basket for each country, even in the methods that do not postulate in such a way ("Alternative 1" and "Alternative 2"). This, however, requires further effort to complete these datasets with the information required by the methods applied.

Nevertheless, our analysis suggests that considering the multiplying capacity of more skilled labour in relation to simple labour leads to better results. However, two difficulties arise: first of all, the exact relation between different degrees of skill would need to be obtained from a source independent of market wage data (a point that remains open to future research); second, data about the qualification of labour power in the detailed level required to proceed the calculations indicated in this paper are not always at disposal. As such, considering all labour as simple labour—i.e., all work hours as the same—imposes itself as the most reasonable choice, as much for being a more parsimonious approach for the estimates based on this approach being in line with theoretical expectations about the tendencies of the exploitation rates and value transfers as also being similar to those obtained

when we differentiate skilled from simple labour without the need to assume a full national or international equalization of the exploitation rates.

Notes

1. One can trace the beginning of the controversy over Marx's insights into the relation and "transformation" of values into production prices (Marx 1981, chap. 9) to Böhm-Bawerk ([1896] 1949), who argued of the existence of a contradiction between the first and the third volume of *Das Kapital*. Although Böhm-Bawerk's criticisms were refuted by Hilferding ([1904] 1949), the controversy on the transformation problem remained subject to long debates on different angles. A first solution was proposed by Bortkiewicz (1907)—introduced to Anglophone readers by Paul Sweezy (1942). Over the last decades, after formal solutions became evident and consistent, several conflicting views persisted and emerged on the subject: there are those who claim Marx's labour theory of value is inconsistent with the formation of a general rate of profit (Samuelson 1957, 1971, 1974; Steedman 1977); those who interpret that a solution to the problem is possible, but not in terms presented by Marx—among whom we can mention Bortkiewicz (1907), Winternitz (1951), Seton (1957), Morishima and Catephores (1978) and Eatwell (1975); and, finally, those who proposed solutions or interpretations consistent with the theory of value present in *Das Kapital*. Within this Marxian group, it is worth mentioning: the "New Interpretation" of Duménil (1983), Foley (1982, 2000), Lipietz (1982) and Campbell (1997); the "Radical Reconceptualization" of Wolff, Roberts and Callari (1982); the "Temporal Single-System Interpretation" of Freeman (1996), Kliman and McGlone (1999); the "Probabilistic Approach" developed by Farjoun and Machover (1983); and the "Macro-Monetary Interpretation" of Moseley (2000, 2015). For a comprehensive and thought-provoking summary of the debate on the transformation problem, refer to Lopes (2019).
2. Prices proportional to values.
3. The conflation of intensity and skill answers to a different and practical issue: the information available renders it impossible to observe any of them in isolation. The different theoretical nature and practical importance of the reduction of skilled labour can be assessed in Choonara (2018), for example.
4. In this line, we can mention the works of Petrović (1987) to Yugoslavia; Ochoa (1989), Shaikh and Tonak (1994) and Chilcote (1997) to the USA; Cockshott, Cotrell and Michaelson (1995) to the UK economy; Guerrero (2000) to Spain; Tsoulfidis and Maniatis (2002) to Greece; Tsoulfidis and Paitaridis (2008) to Japan; Fröhlich (2010) to Germany; Sánchez and Montibeler (2015) to China; and Franklin and Borges (2020) to Brazil; in addition, Franklin (2015) and Işıkara and Mokre (forthcoming) performed analyses for the 40 economies covered by the World Input–Output Database, the same data source for the calculations performed in this article.
5. See Marx (1976, 660–662).
6. Edward Wolff (1975), for example, applied that method in his analysis of the economy of Puerto Rico.
7. Such as, for example, production monopolies, a low development of the credit system, the presence of non-capitalist modes of production in some sectors, the difficulties of mobility of the labour power across sectors, etc. (Marx 1981, 298).
8. "Barriers" such as time of training for changing activities or jobs, the difficulty of movement to regions with wage differences, and more "artificial barriers," such as migration barriers and registration requirements by professional guilds, for instance.
9. On one side, competition between workers equalizes wages, but on the other the struggle between each worker and his/her employer pushes for the differentiation of wages.

10. An exception is a hypothetical situation where an industrial reserve army does not exist. In this case, capitalists would be forced to raise wages as long as their gains increase. However, Marx makes the argument that the capitalist mode of production creates and maintains an industrial reserve army, which assures that wages gravitate around the value of labour power.
11. For instance, available data for the Brazilian economy suggests that workers with a university degree are hired in their first formal occupation aged 30 years on average (Brasil, Ministério da Economia 2019). Given that the choice for an undergraduate course is taken at the age of 18, and that the average age to begin retirement in this country is near 60 years, we notice that the decision to change from sectors involves a large part of the labouring life of the worker.
12. In line with the example of the previous footnote, the average income of workers with a university degree in Brazil for the year 2018 was R$ 6,004.00, versus R$ 2,180.00 for those with a high school degree. In the same year, the monthly cost of an undergraduate course was about R$ 1,000.00 (Semesp 2020, 2019). The barrier to the medical labour market was even greater: while the monthly cost of an undergraduate course in medicine was R$ 8,000.00, the minimum income established by the Federal Medicine Council (*Conselho Federal de Medicina*—CFM) was R$ 14,100.00. In the same year, under the pressures of the CFM, the Brazilian government suspended the creation of new undergraduate courses in medicine and dictated new rules for the existing ones.
13. Still, for the Brazilian economy, the proportion of wages of women in relation to men was 70% in 2017, while the average income of black workers was equal to 53% of the average income of white workers. Besides, it is important to notice that wage inequality due to race and gender in Brazil is higher within higher levels of skilled labour (Georges 2018).
14. The actual number is unknown. It could be supposed to be in the thousands.
15. Is the work of a bus driver in Sweden more complex and intense than the work of a civil engineer in India? Even if it is very hard to answer that question because of the qualitative difference between these concrete labours, Ha-Joo Chang concludes that, even if the wage of a bus driver in Stockholm is 50x higher than the wage of an Indian bus driver, the Indian bus driver performs much more intense labour, which requires much greater skill than the labour of the Swedish bus driver (Chang 2010, Thing 3).
16. As Ochoa attested in his work, it doesn't matter if this output is measured by physical or monetary units (Ochoa 1984, 61–63).
17. This approach is similar even if not because of the same reasoning as Farjoun and Machover (1983, 220–221).
18. These values were chosen so to minimize the occurrence of negative exploitation rates (all applied methods exhibited such abnormality), as we will see in the analysis of the results.
19. In the period between 1995 and 2009, these multipliers were about 9.5x and 3.2x for high and medium-skilled workers, not far from the values chosen for "Alternative 2."
20. Just to mention the advantages of WIOD (release 2013) over the most significant databases: both the EORA database (Lenzen et al. 2012) and the WIOD (release 2016) do not have data on the qualification of the workforce; on the other hand, the EXIOBASE (Stadler et al. 2018), which also presents these data, is not accompanied by an estimate of the capital stock for each sector, which makes it difficult to determine the depreciation coefficients matrix.
21. In fact, only sectors considered as "productive" were taken into account in our computations. For the purposes of this article, the following sectors were deemed unproductive: "Sale, Maintenance and Repair of Motor Vehicles and Motorcycles/Retail Sale of Fuel"; "Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles"; "Retail Trade, Except of Motor Vehicles and Motorcycles/Repair of Household Goods"; "Hotels and Restaurants"; "Other Supporting and Auxiliary Transport Activities"; "Activities of Travel Agencies"; "Post and

Telecommunications"; "Financial Intermediation"; "Real Estate Activities"; "Renting of M&Eq and Other Business Activities"; "Public Admin and Defence"; "Compulsory Social Security"; "Other Community, Social and Personal Services"; and "Private Households with Employed Persons." We tried our best to follow the instructions presented by Shaikh and Tonak (1994, chap. 2), but in our preliminary checks and comparisons, the selection of which sector to consider unproductive did not meaningfully change the comparison between the models assessed.

22. Although the SEA contains information on the 40 economies covered by WIOD, it does not provide any data for the region called RoW. Some assumptions were made in order to fulfil the data gap in those aspects necessary for the computations. For the total hours worked by sector, it was assumed that the hours worked per person engaged for each RoW sector were equal to the WIOD sample mean; while the number of persons engaged was obtained from World Bank estimations (World Bank 2021a, 2021b) and distributed by each sector in accordance with the weighting of the average employment required by the countries analysed to generate the value added of each sector. The capital stock for each sector was supposed to be proportional to the value added on a similar basis to the group of the least developed country of the WIOD sample. Finally, the sectorial share of hours worked and labour compensation for each skill level was considered equivalent to the average of the sample. We understand that, despite that assumptions are still open for discussion, they don't interfere in our comparisons because they generate similar effects in each method.
23. Actually, the SEA presents information on real fixed capital stock at 1995 prices of national currency (K_GFCF). For our calculations, it was necessary to first inflate this value using the appropriate price index (GFCF_P) and then convert it into the same international currency. For this last step, we used the exchange rates applied by WIOD itself, in order to make all values comparable.
24. For countries that did not have adequate information, it was assumed that the composition of capital was equal to the average composition of the sample available in EU KLEMS.
25. Again, data on labour compensation are provided in SEA only in national currency. For our calculations, we converted it into the same international currency, using the exchange rates applied by WIOD itself.
26. Further info, online panel, detailed and replicable methods and dataset downloads can be found at http://worldlabourvalues.org.
27. Unproductive labour effects can and should be introduced, but it would distance us from our focus of this article. It shall be the subject of further works. As a side note, out of the remaining 943 sectors, five sectors were also left out since there was no proper data from them (their total product was reported as zero; maintaining them would render all percentage deviation metrics impossible).
28. Indeed, 31 of 40 countries showed negative exploitation rates when this method was applied in 2009.
29. For instance, in this dataset, the Gini index for the concentration of wages per hour worked in each sector is 0.45 and 0.37 for Brazil and Mexico, respectively, while Japan and the United States showed more distributed values (0.21 and 0.18).
30. The 22 countries from 40 countries presented negative rates of exploitation in 2009 with this method.
31. As can be seen from the composition of the final consumption expenditure by households of that country (Timmer et al. 2015).
32. The market prices of this sector proved to be significantly lower than the direct prices computed in all approaches (from 58% lower in Ochoa 1 to 96.7% lower in Alternative 1).
33. As computed in "Alternative 1," while it was 138% higher for "Alternative 2."
34. While in "Alternative 1" only the Netherlands and Belgium presented negative results, in "Alternative 2" only Belgium presented such result for 2009.

35. A detailed account of the method used to calculate these values can be found in Franklin and Borges (2020).
36. According to the suggestion of Hilferding, as cited in Shaikh and Glenn (2018).

References

Böhm-Bawerk, E. (1896) 1949. "Karl Marx and the Close of His System." In *Karl Marx and the Close of His System*, edited by P. Sweezy, 1–118. New York: Orion.

Bortkiewicz, L. 1907. "Zur Berichtigung der Brundlegenden Theoretischen Konstruktion von Marxism 3. Band des *Kapital*" [On the Correction of Marx's Fundamental Theoretical Construction in the Third Volume of *Capital*]. *Jahrbucher fur Nationalokonomie und Statistik* 34: 319–335.

Brasil, Ministério da Economia. 2019. *Manual de Orientação da Relação Anual de Informações Sociais (RAIS)*: *Ano Base 2019* [Guidance Manual for the Annual List of Social Information (ALSI): Base Year 2019]. Brasília: Ministério da Economia.

Campbell, A. 1997. "The Transformation Problem: A Simple Presentation of the 'New Solution.'" *Review of Radical Political Economics* 29 (3): 59–69.

Chang, H. 2010. *23 Things They Don't Tell You about Capitalism*. London: Penguin Books Limited.

Chilcote, E. 1997. "Interindustry Structure, Relative Prices and Productivity: An Input–Output Study of the U.S. and O.E.C.D Countries." PhD diss., New School for Social Research.

Choonara, J. 2018. "Complex Labour, Value and the Reduction Problem." *Science & Society* 82 (2): 234–247.

Cockshott, P., A. Cottrell, and G. Michaelson. 1995. "Testing Marx: Some New Results from UK Data." *Capital and Class* 55 (Spring): 103–129.

Duménil, G. 1983. "Beyond the Transformation Riddle: A Labor Theory of Value." *Science & Society* 47 (4): 427–450.

Eatwell, J. 1975. "Mr. Sraffa's Standard Commodity, and the Rate of Exploitation." *Quarterly Journal of Economics* 89 (4): 543–568.

Emmanuel, A., and C. Bettelheim. 1962. *Echange inégal et politique de développement* [Unequal Exchange and Development Policy]. Paris: Ecole Pratique des Hautes Etudes. Centre d'étude de planification socialiste.

Farjoun, E., and M. Machover. 1983. *Laws of Chaos*. London: Verso.

Foley, D. 1982. "The Value of Money, the Value of Labor Power, and the Marxian Transformation Problem." *Review of Radical Political Economics* 14 (2): 37–49.

Foley, D. 2000. "Recent Developments in the Labor Theory of Value." *Review of Radical Political Economics* 32 (1): 1–39.

Franklin, R. S. P. 2015. "Teoria da dependência: categorias para uma análise do mercado mundial" [Dependency Theory: Categories for an Analysis of the World Market]. PhD diss., Universidade Federal do Rio Grande do Sul.

Franklin, R. S. P., and R. E. S. Borges. 2020. "Transferência de valor e troca desigual no Brasil de 1995 a 2009" [Value Transfer and Unequal Exchange in Brazil from 1995 to 2009]. Paper presented at the annual meeting for the Sociedade Brasileira de Economia Política, Salvador, November 10–13.

Freeman, A. 1996. "Price, Value and Profit—A Continuous, General Treatment." In *Marx and Non-equilibrium Economics*, edited by A. Freeman and G. Carchedi, 225–279. Cheltenham: Edward Elgar.

Fröhlich, N. 2010. *Dimensional Analysis of Price-Value Deviations*. Chemnitz: Chemnitz University of Technology.

Georges, R. 2018. *País estagnado: um retrato das desigualdades brasileiras* [Stagnant Country: A Portrait of Brazilian Inequalities]. São Paulo: OXFAM Brasil.

Guerrero, D. 2000. "Insumo-producto y teoría del valor-trabajo" [Input–Output and Labor Theory of Value]. *Política y cultura* 13: 139–168.

Hilferding, R. (1904) 1949. "Bohm-Bawerk's Criticism of Marx." In *Karl Marx and the Close of His System*, edited by P. Sweezy, 119–196. New York: Orion.

Ilostat. 2021. *Wages and Working Time Statistics*. Geneva: ILO.

IOM (International Organization for Migration). 2021. *Missing Migrants' Project*: *Latest Global Figures—Recorded Migrant Deaths by Region*. Geneva: IMO.

Işıkara, B. G., and P. Mokre. Forthcoming. "Price-Value Deviations and the Labor Theory of Value. Evidence from 42 Countries, 2000–2017." *Review of Political Economy*.

Kliman, A., and T. McGlone. 1999. "A Temporal Single-System Interpretation of Marx's Value Theory." *Review of Political Economy* 11: 33–59.

Lenzen, M., K. Kanemoto, D. Moran, and A. Geschke. 2012. "Mapping the Structure of the World Economy." *Environmental Science & Technology* 46 (15): 8374–8381.

Lipietz, A. 1982. "The So-Called 'Transformation Problem' Revisited." *Journal of Economic Theory* 26 (1): 59–88.

Lopes, T. C. 2019. "The Transformation Problem of Values into Prices: From the Law of Value to Economic Planning." *New Proposals: Journal of Marxism and Interdisciplinary Inquiry* 10 (1): 29–42.

Marx, K. 1976. *Capital: A Critique of Political Economy*, vol. 1. London: Penguin Books.

Marx, K. 1981. *Capital: A Critique of Political Economy*, vol. 3. London: Penguin Books.

Morishima, M., and G. Catephores. 1978. *Value, Exploitation and Growth: Marx in the Light of Modern Economic Theory*. London: McGraw-Hill.

Moseley, F. 2000. "The 'New Solution' to the Transformation Problem: A Sympathetic Critique." *Review of Radical Political Economics* 32 (2): 282–316.

Moseley, F. 2015. *Money and Totality: A Macro-Monetary Interpretation of Marx's Logic in* Capital *and the End of the "Transformation Problem."* Leiden/Boston: Brill.

Nowak, M. 2019. *The United Nations Global Study on Children Deprived of Liberty*. Geneva: The United Nations.

Ochoa, E. M. 1984. *Labour-Values and Prices of Production: An Interindustry Study of the U.S. Economy, 1947–1972*. PhD diss., New School for Social Research.

Ochoa, E. M. 1989. "Values, Prices and Wage-Profit Curves in the U.S. Economy." *Cambridge Journal of Economics* 13 (3): 413–429.

Petrović, P. 1987. "The Deviation of Production Prices from Labour Values: Some Methodology and Empirical Evidence." *Cambridge Journal of Economics* 11 (3): 197–210.

Samuelson, P. 1957. "Wages and Interest: A Modern Dissection of Marxian Economic Models." *American Economic Review* 47 (6): 884–912.

Samuelson, P. 1971. "Understanding the Marxian Notion of Exploitation: A Summary of the So-Called Transformation Problem between Marxian Values and Competitive Prices." *Journal of Economic Literature* 9 (2): 399–431.

Samuelson, P. 1974. "Insight and Detour in the Theory of Exploitation: A Reply to Baumol." *Journal of Economic Literature* 12 (1): 62–70.

Sánchez, C., and E. E. Montibeler. 2015. "The Labour Theory of Value and the Prices in China." *Economia e Sociedade* 24 (2): 329–354.

Semesp. 2019. *Mapa do ensino superior no Brasil* [Higher Education Map in Brazil]. 9th ed. São Paulo: Semesp.

Semesp. 2020. *Mapa do ensino superior no Brasil* [Higher Education Map in Brazil]. 10th ed. São Paulo: Semesp.

Seton, F. 1957. "The 'Transformation Problem.'" *Review of Economic Studies* 24 (3): 149–160.

Shaikh, A. 1984. "The Transformation from Marx to Sraffa." In *Ricardo, Marx and Sraffa*, edited by A. Freeman and E. Mandel, 43–84. London: Verso.

Shaikh, A. 2016. *Capitalism: Competition, Conflict, Crises*. New York: Oxford University Press.

Shaikh, A., and K. Glenn. 2018. "The Classical Treatment of Skilled Labour." The New School for Social Research Working Paper No. 11/2018.

Shaikh, A., and E. A. Tonak. 1994. *Measuring the Wealth of Nations: The Political Economy of National Accounts*. Cambridge/New York: Cambridge University Press.

Stadler, K., R. Wood, T. Bulavskaya, C.-J. Södersten, M. Simas, S. Schmidt, and A. Usubiaga. 2018. "EXIOBASE 3: Developing a Time Series of Detailed Environmentally Extended Multi-Regional Input–Output Tables." *Journal of Industrial Ecology* 22 (3): 502–515.

Steedman, I. 1977. *Marx after Sraffa*. London: New Left Books.

Steedman, I., and J. Tomkins. 1998. "On Measuring the Deviation of Prices from Values." *Cambridge Journal of Economics* 22 (3): 379–385.

Sweezy, P. 1942. *The Theory of Capitalist Development*. New York: Monthly Review Press.

Timmer, M., E. Dietzenbacher, B. Los, R. Stehrer, and G. de Vries. 2015. "An Illustrated User Guide to the World Input–Output Database: The Case of Global Automotive Production." *Review of International Economics* 23 (3): 575–605.

Tsoulfidis, L., and T. Maniatis. 2002. "Values, Prices of Production, and Market Prices: Some More Evidence from the Greek Economy." *Cambridge Journal of Economics* 26 (3): 359–369.

Tsoulfidis, L., and D. Paitaridis. 2008. "On the Labor Theory of Value: Statistical Artefacts or Regularities?" *Research in Political Economy* 25: 209–232.

van Ark, B., and K. Jäger. 2017. "Recent Trends in Europe's Output and Productivity Growth Performance at the Sector Level." *International Productivity Monitor* 33 (16): 8–23.

Winternitz, J. 1951. "Values and Prices: A Solution of the So-Called Transformation Problem." *Economic Journal* 58 (June): 276–280.

Wolff, E. N. 1975. "The Rate of Surplus Value in Puerto Rico." *Journal of Political Economy* 83 (5): 935–949.

Wolff, R., B. Roberts, and A. Callari. 1982. "Marx's (Not Ricardo's) 'Transformation Problem': A Radical Reconceptualization." *History of Political Economy* 14 (4): 564–582.

World Bank. 2021a. "Population, Total." *World Development Indicators*. Accessed December 3, 2021. https://data.worldbank.org/indicator/SP.POP.TOTL.

World Bank. 2021b. "Employment to Population Ratio, 15+, Total (%) (Modeled ILO Estimate)." *World Development Indicators*. Accessed December 3, 2021. https://data.worldbank.org/indicator/SL.EMP.TOTL.SP.ZS.