

The reduction problem of heterogeneous labour: a theoretical and empirical evaluation of Ochoa's proposal

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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 proposal: the reduction of skilled or complex to simple unskilled labour. After a critical dialogue from a theoretical point of view, this essay provides estimate comparisons based on data provided by the World Input-Output Database 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.

Keywords: Labour values. Skilled and unskilled labour. Marxist theory. Value and price. Surplus rate.

Resumo: Estimativas empíricas consistentes com o arcabouço marxista são importantes para abordar os mais diversos temas, desde a evolução da taxa de lucro na conjuntura, taxas de exploração e troca desigual. Proposta prática pioneira e disseminada para realizar tais cálculos foi apresentada por Ochoa em 1984. O presente artigo concentra-se em um aspecto controverso de tal proposta: a redução de trabalho complexo a trabalho simples. Após diálogo crítico do ponto de vista teórico, colocam-se propostas alternativas e procede-se à comparação de estimativas a partir dos dados fornecidos pelo World Input-Output Database para o período 1995 a 2009, discute propostas alternativas e destaca suas virtudes e ressalvas, apontando para a vantagem de métodos que não dependem totalmente de índices salariais e para caminhos futuros de pesquisa necessários.

Palavras-chave: Valor trabalho. Trabalho simples e complexo. Teoria marxista. Valor e preços. Taxa de exploração.

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1 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 value theory, both from a logical and qualitative perspective. The polemic was usually centered at 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 improvements on 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.

In parallel to that debate, the growing necessity to manage capitalist accumulation and through 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 only in theory, or in solely aggregate manner, before. The previous debate evolved in many directions. Concrete interpretation of capitalist societies along rigorously intertwined Marxist categories was being show an open path.

Standing on the shoulders of a series of previous advancements, Edward Martin Ochoa (1984) wrote his doctoral thesis in a successful effort to provide a method and produce estimates on values, production and direct prices⁵, based on sectoral disaggregated information⁶, from data for the United States ranging between the years of 1947 and 1972. Ochoa's work consolidated a methodological proposal to translate abundantly available monetary, payroll and effective labour journey data 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, that of the difference between productive and unproductive labour. Finally, what is the stage 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 intensity⁷ into simple labour time of average intensity, in accordance with the real social process that occurs by the living movement of capitalist markets and the division of labour, that leads to abstract human labour, as brilliantly put and essential to Marx's analysis.

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 Turkey, United States, Greece, Japan and Italy offered insights not only on the importance of labour time in the determination of prices, but also on the reality of exploitation, profit and the contradictory dynamics of accumulation.

However, these advancements for Marxist theory also came with some notable limitations. In that context, the aim of this paper is twofold: first, to bring up shortcomings of Ochoa's proposal (1984) on how to "reduce" complex into simple labour and second, to present alternatives to that scheme. After presenting the theoretical discussion justifying these improvements, the paper presents empirical results

⁵ Prices proportional to values.

⁶ Ochoa advanced the approach initiated by Anwar Shaikh (1984), his thesis supervisor.

⁷ The conflation of intensity and skill responds to a different and practical issue: the information available renders it impossible to observe any of them isolatedly. The different theoretical nature and practical importance of the reduction of skilled labour can be assessed in Choonara (2018), for example.

for that improvements based on a selection of countries taken from the first compilation of the World Input-Output Database, which gathers data of 40 countries for the period between 1995 and 2009.

2 Reduction of skilled into unskilled labour in Ochoa

When considering methodological questions about the transformation of prices into values, Ochoa indicates 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 labour 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, p. 35)

In the beginning of the section on the reduction of different qualities of labour, the author 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, p. 39).

Ochoa is aware that the value of the labour power and the magnitude of value created in a workday are two quantities determined by distinct, although related, social processes. It is worth to bring to the fore some reflections on these two elements in order to put the author's approach in context.

The value of labour power is determined, according to Marx (2013, p. 245-247), by the labour time required to produce the commodities necessary to sustain current workers and the labour power to replace them in the future. As such, it includes costs of the training which is required for fulfilling those specific tasks under consideration in each commodity production.

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. There is no direct relation, thus, between these costs of production and the total value created by the worker after he/she 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 maintenance of the worker from day to day must be larger, the greater is the exhaustion taken place during the workday. 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.⁸

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

There are some assumptions that, if observed, would validate the market wages as possible "non distorted indexes for skilled degree and intensity". Ochoa indicates the following, in decreasing order of plausibility: first, the consumption basket of all workers in all sectors should be considered the same.

⁸ Cf. Marx (2013, p. 591-592).

Second, the exploitation rate would have to be uniform across sectors (and, thus, across labour of different complexities). Third, the labour markets must be 'in equilibrium'.

In respect to the first assumption, Ochoa indicates that, if the structure of nominal wages is to mirror the values of the labour power – greater values for those sectors which require greater training/intensity –, 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.

In that perspective, the second assumption is necessary since, if labours are classified according to the relative values of the labour power, the same rate of exploitation guarantees that the relative differences between wages will be reflected in proportional differences in the relative quantity of simple labour (OCHOA, 1984, p. 41-42). In other words, if the working class is exploited equally in all sectors (and in all levels of skilled labour), the amount of surplus value appropriated by the capitalist class would 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 the wages as an adequate measure for differentiating the quality of the labour power, the second assumption is the fundamental element that guarantees that wages will also express the exact amount of value created by the worker. So, even if the worker does not receive the whole new value created from his labour, he would always receive the same proportion of it.

The third assumption, finally, refers to either that the labour markets must be in equilibrium, or at least, that sectoral imbalances cancel each other out. Based on Ochoa's reasoning, this is closely attached to the assumption of a uniform rate of surplus value (second assumption), so that supposedly the movement of workers from one sector to the other assures the equalization of that rate.

3 Problems and theoretical limitations of Ochoa's approach to skilled labour

Ochoa was not exactly pioneer in proposing a formal method to reduce of complex or skilled and intense labour to a multiple of simple labour based on relative wages⁹. However, as far as recognized, he has the merit of showing for the first time and without ambiguities the necessary assumptions for validating this methodological solution. The author justifies the adoption of his assumptions by indicating the 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 [in the determination of the values of commodities] (OCHOA, 1984, p. 42).

However, it is necessary to pinpoint that production prices are a theoretical element of Marxist thought fundamentally distinct from the determination of 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 disturbing factor other than differing sectoral organic composition of capitals. The real counterpart of those prices – in other words, the prices that we observe in the concrete reality – are those called market prices. Market prices are the result of multiple determinations and they become distant from production prices because of shaping structures that avert the actual equalization of the profit rate¹⁰ and other counteracting forces. Given the difference between theoretical prices of production and actually observed market prices, the estimation of

⁹ Edward Wolff (1975), for example, applied that method in his analysis of the economy of Puerto Rico.

¹⁰ 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, 2017, p. 231-232).

prices of production is a precious exercise, for instance, to observe the actual size of their divergence from market prices.

As for the determination of commodities values, what one wants to measure are their concrete magnitude – that is, the labour time that society as a whole has employed on average to produce each commodity. In that sense, as opposite from 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 others disturbing factors. These theoretical values would not have a concrete counterpart with which they could be compared.

In addition, cause and effect relations linking, at one side, an equalized profit rate and, at another side, prices of production are different from those of the relation involving an equalized rate of exploitation and the magnitude of the value of commodities. For the formation of prices of production is the consequence of the process of capitalist competition across sectors which itself also generates the tendency to profit rate equalization. The magnitude of values, on their turn, is determined by a process that is not related to the process of equalization of surplus rates: values are determined in essence by socially necessary labour time for the production of commodities, while wages and the exploitation rate differ across sectors and across different levels of labour complexity, as a result of the overarching and permanent battles in class struggle. Hence, the exploitation rate does not determine the values of commodities, but only the parcel of these values that is appropriated by the capitalist class. An hypothetical equalization of the exploitation rate would be a result from processes such as a certain type and full mobility of workers, a mostly ideal presumed notion.

It thus follows that Ochoa's explanation for adopting the exploitation rate equalization hypothesis (which is that it is 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. Were they actually compatible with empirical observations, calculations based on such assumptions would present even greater theoretical significance. However, if revealed to be unreal, his results are the more in danger due to an implicit mistake of *petitio principii*: the amount of hours worked, the organic composition of capital, the transfer of value between sectors, the average and sectoral rates of exploitation, all these variables are effectively partially determined by the assumption of an equalized rate of surplus value, as will be shown with real world data. All these elements to calculate turn to be to a great extent predetermined by that assumption.

Don't those assumptions adhere neither to theory nor to empirical observation? This question requires closer and direct confrontation.

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*. It is a tendency in which the movement of equalization never reaches any type of final equilibrium because of specific forms of social relations of production¹¹ and other divergent forces¹².

Moreover, there is no direct theoretical reason for assuming that competition among workers of different skill levels leads to full or near-full equalization in the exploitation rate to which they are subjected. Such competition is responsible, to be sure, for the gravitation of wages around the value of the

¹¹ 'Barriers' such as time of training for changing activities or jobs, difficulty of movement to regions with wage differences, and more 'artificial barriers', such as migration barriers and registration requirements by professional guilds, for example.

¹² On one side, competition between workers equalizes wages, but on the other the struggle between each worker or worker's collective and his/her employer pushes to the differentiation of wages.

labour power (including training and education costs), but not for the created surplus value¹³. 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 strata 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 greater portion of their work hours.

From an empirical standpoint, it should be added that free mobility of the labour power never truly and structurally took place. Several socio-historic evolutions of relations of production may account for this: training time is so significant for the lifetime of an individual worker that few would feel stimulated enough to respond to an uncertainly fluctuating labour market conditions.¹⁴ In many countries there are educational monopolies¹⁵, 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.¹⁶

At the international level, the highlighted issues are, by far, most evident. Barriers to migration across countries are so intense that its related humanitarian crisis shows 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 from liberty by the migration controlling program of the USA government (NOWAK, 2019), many of which were taken away from their parents before detention. 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 nineteen hundred people (IOM, 2021). How can one migrate to pursue better opportunities ‘offered by the market’ if that involves the risk of detention, separation of children from parents and death?

Finally, Ochoa’s assumptions lead, by definition, to the idea that labour in richer countries is more intense and skilled than in poorer countries¹⁷ and that complex labour in poorer countries (where wage differentials are wider) creates disproportionately more output than simple labour in these countries.

Obviously, the critiques presented here would be innocuous were there not any alternative methods that proved to be more consistent and closer to observed reality and social dynamics. The task

¹³ 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, and this is actually evident throughout the real history of this mode of production.

¹⁴ For instance, data from Brazilian Social Information's Annual Register (BRASIL, 2019) indicate that workers with a university degree are hired in their first formal occupation with aged 30 years on average. The choice for an undergraduate course is taken at the age of 18. Since the average age to begin retirement in Brazil is near 60 years, we notice that the decision to change from sector involves a large part of the labouring life of the worker.

¹⁵ Data from SEMESP (2020, 2019) show that the average income of workers with a university degree in Brazil was R\$ 6.004,00 in 2018, and it was R\$ 2,180,00 for those with a high school degree. In the same year, the monthly cost of an undergraduate course was R\$ 1.000,00. The reality of medicine was different: while the monthly cost of an undergraduate course in medicine was R\$ 8.000,00 the minimum income established by the National Medics Federation was R\$ 14.100,00. In the same year, the Brazilian government suspended the creation of new undergraduate courses and dictated new rules for the existing ones.

¹⁶ Data from OXFAM Brasil (GEORGES, 2018) indicate that the proportion of wages of women in relation to men was of 70% in 2017. 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.

¹⁷ 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 50 times higher than the wage of an Indian bus driver, the Indian bus driver performs a much more intense labour and which requires a much greater skill than the labour of the Swedish bus driver (CHANG, 2013, p. 32).

of the next section is exactly to address and evaluate alternatives, based on comparing different methods with a similar subset of nations, period and estimates, as far as indicators such as total and new value, exploitation rate, its movement and distinction among different qualities/skills of labour, are concerned.

4 Empirical evaluation

4.1 Proposal for evaluation

In order to evaluate Ochoa's method and possible alternatives, we proceed to explain briefly the methodological procedures adopted and the points in which each method diverges from each other. The common base for all methods is centered at direct values and prices (prices proportional to values whose sum equals the sum of market prices). To estimate labour values (λ) one has to solve the following equation:

$$\lambda = a_o(I - A - D)^{-1} \quad (1)$$

Where A is the matrix of technical coefficients (of s sectors), D is the matrix of depreciation coefficients, I is an identity matrix and a_o is the vector row of labour requirements. Labour requirements represent the amount of direct labour required per unit of production in sector j , so that vector a_o is the result of the multiplication of the amount of simple abstract labour hours (\mathbf{Ta}) by a vector of total production (\mathbf{X}), inverted and diagonalized:

$$a_o = \mathbf{Ta} \langle \mathbf{X} \rangle^{-1} \quad (2)$$

Here the chosen approaches for comparison begin to differ. In Ochoa's perspective, abstract labour (\mathbf{Ta}) is constituted by three components: the number of workers per sector (\mathbf{Tc}), the annual relative hours of labour (\mathbf{i}), and a multiplier of worked hours in sector i which translates labour time into hours of simple labour, considering the composition of skilled and unskilled labour (\mathbf{z}):

$$\mathbf{Ta}_j = \mathbf{Tc}_j \cdot \mathbf{i}_j \cdot \mathbf{z}_j \quad (3)$$

Ochoa applies that approach to the particular case of the United States. Applying that approach to a broad selection of different countries involves further considerations not previously undertaken.

We decided to follow two paths to better fit that approach to the international scope. First, we apply his method 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 \mathbf{z} by dividing the average wage (w) of each sector by the lowest average wage in the world.

$$z_j^{\text{Ochoa1}} = \frac{w_j}{w_{\min}} \quad (4)$$

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 \mathbf{z} is the result of division of the average wage in each sector by the average wage of the sector with the lowest average wage in that country. Therefore, lowest waged labour in each countries is equally considered as simple labour. This approach allows the exploitation rate not to be uniform across countries. However, it links directly 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 Petrovic (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 the equalization of the exploitation rate in each different level of skilled labour, and has the advantage of still considering the heterogeneity of labour skills within each sector. However, it depends on data availability about the proportion of worked hours within each sector according to the level of skilled labour as depicted in the following equation:

$$z_j^{\text{Petrovic}} = \frac{\bar{w}_{hs}}{\bar{w}_{ls}} \cdot h_{hsj} + \frac{\bar{w}_{ms}}{\bar{w}_{ls}} \cdot h_{msj} + h_{lsj} \quad (5)$$

With h_{hs} , h_{ms} and h_{ls} , representing, respectively, the proportion of labour hours of high, medium, and low skill levels.

We present two alternative and practical approaches not based on wage indexes, for the sake of comparing a broader set of results in terms of its relation to underpinning movements that would be reasonable expected from the Marxist framework. The first one (“Alternative 1”), the most parsimonious, assumes all labour is simple labour (so vector \mathbf{z} is a scalar 1). Such 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 (namely that differences between wages are only the outcome of differences in “complexity-intensity”).

The last proposal (“Alternative 2”) considers a feasible, but arbitrary, scale of multipliers of skilled labour and semi-skilled labour regarding simple labour (6,25x for high skilled labour and 2,5x for medium-skilled labour¹⁸). So, vector \mathbf{z} is determined in this case by the following equation:

$$z_j^{\text{Alternative2}} = 6,25 \cdot h_{hsj} + 2,5 \cdot h_{msj} + h_{lsj} \quad (6)$$

This approach is offered with illustrative purposes, to highlight the difference between using the current wage structure¹⁹ (Ochoa and Petrovic) and, although keeping different complexities and value generation capacities from each skill level of labour, not considering wages as good indexes of such difference. As such, it does not totally discards that dimension of complex labour as ‘Alternative 1’ does.

The five proposals herein presented also differ regarding the determination of the value of the labour power. In the absence of information about the expenditures of the working class alone, we used the proportions of the columns of household consumption in the input-output matrix to estimate the content of the basket of goods consumed by the working class. Methods “Ochoa 1” and Petrovic consider an equalization process of the exploitation rate at the international level, so 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 studied was obtained from the dataset. Methods “Alternative 1” and “Alternative 2”, on the other hand, do not depend on any equalization of the basket of goods. However, since no detailed information of workers consumption by skill was available, we had to assume that the basket of goods is the same in each country, just like in method “Ochoa 2”.

Finally, it is important to notice that there is a similarity between methods Petrovic and “Alternative 2”. Both consider hours of skilled labour in all countries as a multiple of the hours simple labour. While the multipliers of “Alternative 2” were chosen arbitrarily to minimize the occurrence of negative exploitation rates in results, method 'Petrovic' used the weighted average of relative wages²⁰. However, using average wages in this last method strongly directs one to consider also 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.

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 Which, at a global scales involves much more than solely differences of complexities.

²⁰ In the period between 1995 and 2009, this implied multipliers of 7,5x and 3,2x for high and medium-skilled workers, not far from the values chosen for “Alternative 2”.

To investigate which effect each of the methods proposed has over the reduction of complex labour into simple labour, we make a descriptive analysis of the results by applying them to the data of the World Input-Output Database (WIOD) for the years from 1995 to 2009 (TIMMER et al. 2015) and we comparing them with the predictions of the Marxist theory.

For the purposes and limits of the paper, we also selected to present data and estimates related to four striking countries: 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 bring 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.

For all calculations, only productive sectors were taken into account for computing values and Marxian categories and to compare market data and labour value data²¹.

In addition, we discuss the results and their evolution regarding more general reasonable expectations derived from Marxian thought.

4.2 Analysis of the results

Table 1 shows a first comparison, made for the data on output in market 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 express the magnitude of values, proportional to them), for four selected economies. Table 2 summarizes the information about new value created in the same period, that is, a Marxian gross domestic product in terms of value added for the year 2009.

Table 1 – Total Product in terms of market (MP) and direct prices (DP) – 2009 - US\$ trillions – Brazil, Mexico, USA and Japan

Country	MP	Ochoa 1		Ochoa 2		Petrovic		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: Authors' calculations, based on the WIOD dataset.

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 it 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.

²¹ Since most detailed available data was on sectors and only on three skill levels of workers, there wasn't an option to deal with productive or unproductive labour better than by entire sectors. For the purposes of this essay, the following sectors were deemed unproductive, from a total of 35 sectors: 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.

Table 2 – GDP in market and direct prices – 2009 – US\$ trillions

Country	MP	Ochoa 1		Ochoa 2		Petrovic		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: Authors' calculations, based on Timmer et alii (2015).

The other methods present similar deviations among themselves, particularly showing for the richer countries (Japan and United States) direct prices that turn to be more distant 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.

In any case, this first evaluation indicates that the chosen method – and all their accompanying assumptions – to reduce complex labour into simple labour may have great influence over 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 in literature as unequal exchange in international trade).

4.2.1 Exploitation rates

Table 3 presents data on the surplus 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" obtain directly from the assumptions of that method, as previously derived and noted. The information presented seems to contradict the practical perception that there are wide wage and unemployment rates differentials, and migration movement restrictions across countries, to say the least, accruing from historical particularities of class struggle around different nations in the world stage.

Table 3 – World and selected countries surplus rates - 2009

Country	Ochoa 1	Ochoa 2	Petrovic	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, based on Timmer et alii (2015).

When the assumption of an international equalized exploitation rate is dropped (in all but Ochoa 1 method), we observe higher rates in dependent countries than in core economies. In peripheral countries wages are as a norm lower in nominal terms, but the workday is usually as long or longer than in richer nations. Hence, such difference in exploitation rates seems to match reality, with lower unit labour costs in peripheral countries (see, for example, Suwandi, 2019).

When we observe the results of "Ochoa 2", United States and Japan estimates indicate significant negative magnitudes²², what seems very unpalatable, to say the least. As a matter of fact, wage inequality is higher in poor countries than in rich countries²³, so those methods that considered the equalization of the exploitation rate within nations result in purportedly larger amount of value creating in them (because in average their skilled labour would appear to be disproportionately more skilled/intense).

²² Indeed, 31 from 40 countries showed negative exploitation rates when this method is applied to 2009.

²³ For example, for countries of the example above, the Gini index for concentration of wages per hours 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).

This, in turn, inflates Japan 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 Petrovic's approach²⁴. This is the result, mainly, of 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 present 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, 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 (where there is a huge industrial reserve army in that sector), for prices much lower than their values, the quantity of labour time absorbed by them was double of the time absorbed by the workers in the United States. In the US, by opposition, a large part of their workers income is spent in 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, for the sake of adaptation of Petrovic's approach from one country to the international arena, that workers of both countries consume the same basket of goods, the value of labour power in the United States was considered 20 times higher than the value of the Indian labour power.

Proposals "Alternative 1" and "Alternative 2" present at this respect more plausible results: there are few cases of negative exploitation rates²⁵ and highest exploitation rates were found in dependent or semi-peripheral nations. The difference between these two approaches is clearer when assessing the differences in the exploitation rates according to different labour skill intensities (as shown in Table 4).

Table 4 – World and selected countries surplus rates by skill level - 2009

Country	Petrovic			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, based on Timmer et alii (2015).

As "Alternative 1" assumes all working hours are equal, the exploitation rate are higher for low skilled labours – 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'.

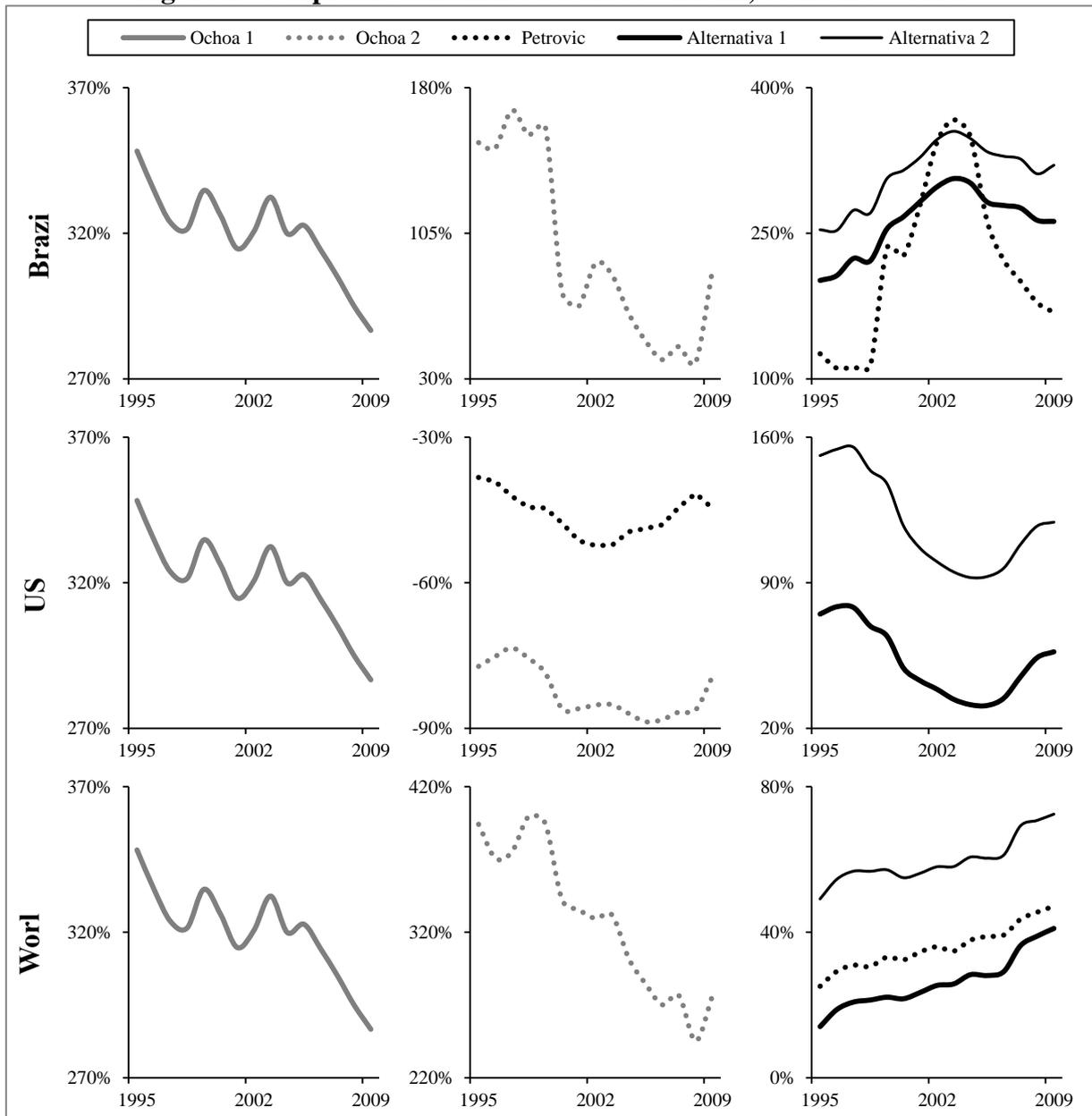
The option of elect a multiplier that equalizes the global exploitation rate between all strata (Petrovic) – aside from the earlier noted negative effects of considering one unique basket of goods for all workers in the world – it eliminates the possibility of evaluates any real divergences among those rates by definition. On the other hand, "Alternative 2"'s approach, based on a totally arbitrary choice for skill multipliers, always result in a reduction of the exploitation rate of simple labour and to an increase of the exploitation rate of complex labour, in relation to "Alternative 1". This follows from the fact that, when considering an hour of skilled labour a multiple of an hour of simple labour, the quantity 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 value created by skilled labourers is always higher than the increase of the value of their

²⁴ 22 from 40 countries presented negative rates of exploitation in 2009 with this method.

²⁵ While in "Alternative 1" only the Netherlands and Belgium presented negative results, in "Alternative 2" only Belgium presented such result for 2009.

corresponding labour power (the higher this difference the higher proportion of unskilled labour into workers consumption basket).

Figure 1 – Surplus rate from 1995 to 2009 - Brazil, USA and World



Source: Authors’ calculations, based on Timmer et alii (2015).

Finally, figure 1 presents the historical series of the exploitation rate in Brazil, the United States and for 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 countries, so that national phenomena that influence the exploitation rate cannot be captured by this method – such as, for instance, 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 from the perspective of the aggregates, it is possible to observe that the exploitation rate presented in either method based on Ochoa’s approach evolves in opposite and awkward direction in comparison to other estimates and real world perceptions of the increase in exploitation from the impulse to extend more precarious labour relations during that period.

Remarkably, the behaviour of the exploitation rates computed by methods Petrovic, “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 – which makes their

values so divergent when we analyse each isolated country, but closer when observed for the entire world. This assumption 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.

4.2.2 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 in 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 to 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.

Table 5 – Value transfers in international trade - 2009 (% of new value produced)

Country	Ochoa 1	Ochoa 2	Petrovic	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%

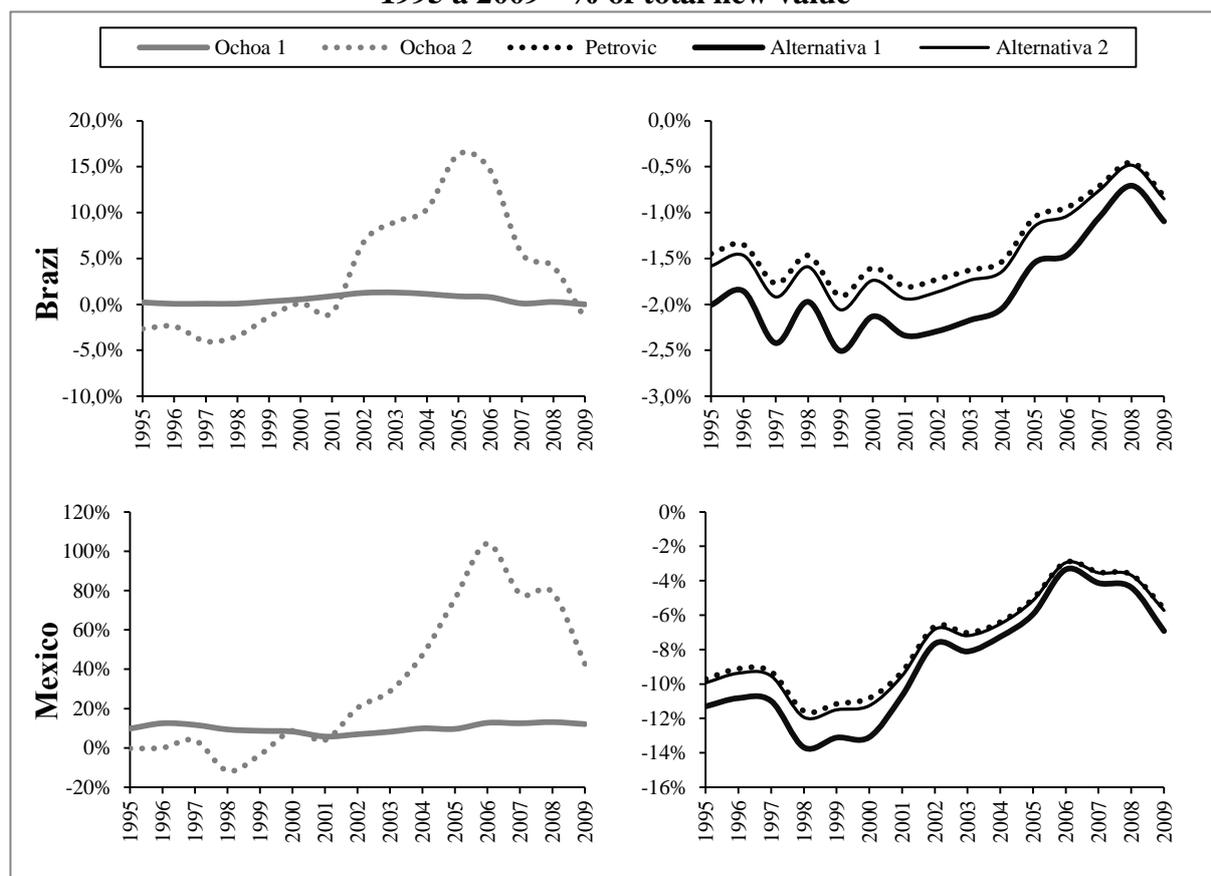
Source: Authors’ calculations, based on Timmer et alii (2015).

Estimates on the amount of value transferred through international trade²⁶ are summarized in table 5 for chosen countries. Net value appropriation appears with positive sign. In this dimensions, “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 in 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 “Ochoa 2” results. This time, it follows from the restriction of the ‘surplus rate equalizing process’ to national borders: where there are larger wages inequalities, typically 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 in accordance with most part of theoretical predictions. It is worth noticing the case of Brazil: while it appears in a slightly negative position in “Alternative 1”, it becomes a small beneficiary in both Petrovic and “Alternative 2” methods. These results go in line with interpretations that portray Brazil in a semiperipheral/subimperialist position, being as it is in an intermediary position in the flow of surplus value from extreme dependent nations towards core economies.

²⁶ A detailed account of the method used to calculate these values can be found in Franklin and Borges (2020).

Figure 2 – Value transfers regarding Brazil and Mexico trade relations with the United States - 1995 a 2009 - % of total new value



Source: Authors' calculations, based on Timmer et alii (2015).

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

In respect to the remaining methods, the absolute results are similar and coherent with most common theoretical arguments for all years. Notice that the shapes of the curves are very similar. In summary, methods that differentiate skilled labour (as such Petrovic 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 equalization of exploitation rates (at national or international level, or restricted to each labour skill strata), besides rendering comparisons of real divergences impossible, it 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 skill. It would be better to obtain that multiplier from an independent source, one that might even be related to costs of education and

training of the workforce²⁷. However, this information is not, to the best of our knowledge, readily available. Another shortcoming of “Alternative 2” is that many available input-output based datasets allowing for transformation of prices into values do not even 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 work hours according to skill levels, the most parsimonious alternative of considering all labour as simple ones seems the righteous methodological choice for two reasons. In 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 seems 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.

5 Final remarks

This essay 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 pinpointed 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 rates 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 of competition between workers is guided by wages (and not by the unpaid portion of the working day); as by the fact 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 barriers to the free movement of the labour power are relevant, even more when considering at international level. Thus, we argued that the low likelihood of Ochoa's proposition leads to a *petition 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, influence the absolute size and the historical tendency of fundamental variables (such as the surplus rate and value transfers from international trade), with results that are seem very unlikely by the prism of common or prevalent theoretical predictions.

In despite of our analysis has indicated that considering the multiplying capacity of more skilled labour in front of simple labour leads to better results, two difficulties arises: first of all, the exact relation between different degree of skills need to be obtained from a source independent of wage data (which remains open to future research); second, data about qualification of workforce 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 as for the estimates based on this approach being in line with theoretical expectations about the tendencies of the exploitation rates and value transfers and being also similar to those obtained when we differentiate skilled from simple labour without the need to assume a full national or international equalization of exploitation rates.

²⁷ According to the suggestion of Hilferding (*apud* SHAIKH;GLENN, 2018).

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