The sources of profitability

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This paper is built around a theorem proved analytically and exemplified empirically in Flaschel, Franke and Veneziani (2010) which states that profitable capital-using labor-saving technical change is under mild conditions always reducing the labor content of commodities. This type of technical change therefore increases Marx's value rate of profit in a systematic way. Against this background the paper studies the relationship between the actual value and price rate of profit and derives expressions that show that the deviation between them may be of a secondary and unsystematic nature. This result is then exemplified empirically using flow as well as stock matrix data for the German economy. The paper argues on this basis that prices of production are in fact of a questionable nature and an unnecessary detor in the input-output oriented analysis of the profitability nexus between total labor costs and the actual prices of the considered commodities.

Key words: Labor values, Profit rates, Input-Output models
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1 Introduction

In the present paper we aim to show that the proper understanding of Marx's Labor Theory of Value (LTV) must be dual in nature, in the same way a System of National Accounts (SNA) expressed in real magnitudes – as constructed by Richard Stone in particular – forms a dual structure with respect to prices and quantities. A real SNA is designed to promote an understanding of the key processes driving the motion of nominal magnitudes (or appearance). Analogously, Marx's labor value aggregates were designed as the essential elements of an understanding of what happens underneath the surface of the process of capital accumulation. Essence and appearance are dual in nature in economics and any reliance on only one of them makes either theories empty or empirics blind (to borrow from Immanuel Kant).

One may argue, however, from a Neoricardian perspective that prices of production as determined in Sraffa (1960) are the essence and actual, market prices the appearance. That this is even compatible with a non-standard theory of labor values has recently been demonstrated by Wright (2011) who has proposed an innovative interpretation of the LTV by integrating capitalist consumption as necessary production costs into the matrix of intermediate inputs (starting from the case where capitalists do not save). This understanding is related to Pasinetti's work, see in particular Pasinetti (1981), as is forcefully shown in Reati (2011), where a survey and a brief formalization of his approach is presented for the case of a growing economy (and where in fact investment expenditures are treated similar to Wright's approach).[1]

Yet, the essence and end result of these modifications of the standard concept of labor values is that they become redefined as prices of production measured in terms of the wage unit.[2] In our view, this is incompatible with Marx's analysis of the *process of production of capital* in *Capital* Vol.I, where aspects of income distribution (as they are mirrored by prices of production measured in terms of labor commanded) do not matter for his definition of the labor time embodied in the various commodities. His labor values are production-based and in *Capital* Vol.I he considers on this basis the flow of labor through the input- output structure of the economy and the appropriation of part of this flow by capital through the wage contracts it concludes with labor. Prices of production in terms of the wage unit have empirical meaning, but not of the kind

[1] In an email correspondence with Angelo Reati he characterized Pasinetti's contribution as follows: 'It is true, indeed, that in much of his 1981 book there is a uniform rate of profit, but this is just a simplifying device, to focus on the essential, i.e. then relation between labor values (the inverse of productivity) and prices in a capitalist society. In any case, Pasinetti draws attention to the fact that the rates of profit could be very well differentiated. This distinguishes this kind of prices from the usual prices of production, where the uniformity of the rate of profit is an essential condition. Moreover, when Pasinetti introduces the 'fundamental' ('natural') level of analysis, the rates of profit differ from one sector to another and, precisely for this reason, "natural" prices do not correspond to the prices of production..' We are thankful to Angelo Reati for making us aware of this.

[2] This holds because in Wright's (2011) model all profits are consumed by capitalists and are assumed moreover to be part of the budget (obligations) of workers. This implies that workers directly or indirectly consume the whole net output of the economy which makes prices of production proportional to labor values.

envisaged by Marx's in his theory of the creation of absolute and relative surplus value in the capitalist process of production.

> "In particular, [I have shown] how he [Adam Smith, the authors] sometimes confuses, and other times substitutes, the determination of the value of *commodities* by the quantity of labour required for their production, with its determination by the quantity of living labor with which commodities can be bought, or, what is the same thing, the quantity of commodities with which a definite quantity of living labour can be bought. [...] Smith's investigations into the nature and origin of surplus-value, because in fact, without even being aware of it, whenever he examines this question, he keeps firmly to the correct determination of the exchange-value of commodities – that is, its determination be the quantity of labour or the labour-time expanded on them." (Marx, 1975, pp.70/71)

Quite apart from such a rigorous modeling of non-standard labor values, Kliman (2007) is a strong proponent of what is known as the Temporal Single-System Interpretation of Marx's LTV, see McGlone and Kliman (1996) for example, an approach which appends time-varying labor values to the study of prices of production or just actual prices in a way such that the identities between aggregate net output values and total labor input, aggregate profits and aggregate surplus value and the value and the price rate of profit all hold trough time. The order of presentation of Marx three volumes on 'Das Kapital' is here drastically reversed, in a way that makes labor values just a surface phenomenon, no longer the abstract labor skeleton of a capitalist economy.[3]

Our reading of Marx is that he has a dual system in mind when he states:

> "The transformation of values into prices of production serves to obscure the basis for determining value itself." (Marx, 1954, p.168)

Moreover, if prices of production are devoid of empirical content in the explanation of the dynamics of market prices (and thus are purely academic in nature), the whole transformation exercise can be replaced by the direct relationships between Marxian labor values aggregates (the essence) and actual price aggregates (the appearance). In our view there is no uniform, single principle at work in the dynamic price formation processes of agriculture, manufacturing, services and banking, as the illustration used in this paper exemplifies, and by which the study of market forms, entry and exit conditions, significant spreads in the turn-over times, scope and size effects, etc. seems to become a matter of secondary importance.[4]

Marx had a clear interest in demonstrating the applicability of his LTV as providing the essential reasons behind the formation of a general rate of profit on the level of appearance. As such he could rely on the proposition that labor values by their definition imply the equality between the value of the net product and the labor input that

[3] Indeed, a number of authors have argued that many of the results of the Temporal Single-System Interpretation are essentially obtained either by arbitrary assumptions or by muddying the distinction between price and value magnitudes. See, for example, Mohun (2003) and Veneziani (2004).

[4] See also Reati (1986) on this matter.

went into it. And following the approach pioneered by Foley (1982),[5] it is also possible to identify aggregate surplus value with aggregate profit. But with respect to the denominator of the profit rate we would follow Marx when he writes

> "It is necessary to remember this modified significance of the cost-price, and to bear in mind that there is always the possibility of an error if the cost-price of a commodity in any particular sphere is identified with the value of the means of production consumed by it." (Marx, 1954, p.165)

However, this paper will show that such a logical error in the comparison of value and price magnitudes is – even for actual prices in place of production prices – empirically inessential for the validity of the Marxian theory of exploitation. This theory says that the observed general rate of profit is determined by three forces or central Marxian categories: the total labor time performed in the process of production of a certain year (for a given value of labor power), the value of labor power itself, and the labor value of the total capital stock. In the latter expression, which is Marx's constant capital C, our standard approach to the LTV can show that under capitalistic capital-using labor-saving technical change, the labor content of all commodities is falling through time, while the physical capital stock is rising. The change in C is therefore not obvious and it may be bad for capitalists as a whole if C is increasing and good for them in the opposite case.

All other means for changing the general rate of profit are unsystematic in nature and quantitatively negligible. Marx's value rate of profit, and its above decomposition, therefore explains the basic reasons by which the capitalist class as a whole can increase profitability, but – as Marx (1954, pp.167/8) notes – not necessarily in a uniform way for all the members of this class.

We will investigate the theoretical foundations of such a result and provide an illustration of their implications for the German economy, 1991-2000. We will do this for a fairly general understanding of labor values which includes the treatment of heterogeneous labor, fixed capital and open economy issues. Moreover, since we employ a highly aggregated seven-sectoral representation of the German economy the issues of joint production and unproductive labor can be safely ignored.

The Marxian transformation problem, we argue in this paper, is a misleading task, because labor values need not be distorted by deriving a strictly uniform rate of profit from them and because the central sources of, or restrictions for overall profitability are provided by Marx's analysis of *Capital*, Vol.I, even though there is no one-to-one correspondence at the micro-level between what happens in the formation of labor value expressions within production and the price analogues in the marketing of the commodities (a fact stressed by Marx in many occasions). The success of capitalists as a class, however, depends on the creation of absolute and relative surplus value as defined in Marx's *Capital* and on the decrease in the labor time needed to reproduce the capital stock.

[5] See also Duménil (1980), Mohun (2004), Duménil and Foley (2008), and Duménil, Foley, and Lévy (2009) on this interpretation of the Marxian concept of the value of labor power.

2 The point of departure: Value and price in the literature

Let the symbols $A, K, K_\delta, l, I, x, y = x - Ax - K_\delta x$ be defined as it is customary in input-output analysis, i.e., we start from a standard n-sectoral intermediate consumption of goods and labor input-output system A, l with a capital stock matrix K and a capital depreciation matrix K_δ, and from a given vector of final demands y based on a vector of gross outputs x. I denotes the identity matrix. It is assumed for the sake of simplicity that the aggregate consumption matrix $A + K_\delta$ is productive and the vector of labor inputs l strictly positive.

If wages w, a scalar, are paid out of profits, we can define – in distinction from the Sraffian approach to prices of production in a fixed capital environment – the Leontief-type production price equations

$$p = p(A + K_\delta) + wl + rpK, \quad py = lx. \tag{1}$$

The uniform rate of profit r is calculated on capital advanced,[6] not on capital consumed. It is well known that eq. (1) can be uniquely solved for any $w \in [0, 1]$, giving a positive price vector p and a positive rate of profit r, except for $w = 1$, where profits are zero and prices equal labor values v. In terms of labor commanded prices, eq. (1) leads to the following explicit solution:

$$p_w = \frac{p}{w} = l(I - (A + K_\delta) - rK)^{-1} = l \sum_{n=0}^{n=\infty} (A + K_\delta + rK)^n \tag{2}$$

Additionally, because prices are normalized by $py = lx$, eq. (1) gives rise to the following wage-profit curve:

$$w = \frac{lx}{l(I - (A + K_\delta) - rK)^{-1} y} = \frac{lx}{l \sum_{n=0}^{n=\infty} (A + K_\delta + rK)^n y} \tag{3}$$

which is strictly decreasing in r. Such matrix operations are common in Sraffian economics (though fixed capital is treated as a joint product there), yet they are not really needed for an analysis of what we observe at the level of nominal and real input-output data, where sectoral profit rates are significantly different and the dynamics of the average (aggregate) rate of profit can be better analyzed by using Marxian labor values in place of prices of production as we shall show in this paper.[7]

Solving eq. (1) for $w = 1$ ($r = 0$) defines input-output oriented labor values as in Brody (1970):

$$v = v(A + K_\delta) + l = l(I - A - K_\delta)^{-1} = l \sum_{n=0}^{n=\infty} (A + K_\delta)^n, \tag{4}$$

[6] Note that the production of all commodities requires some inventories and therefore there is a corresponding entry in the matrix of capital advancements.

[7] Wright (2011) makes use of these prices measured in terms of the wage unit as a foundation of his non-standard labor values (and employs suitably augmented input matrices in order to motivate his interpretation of these prices).

which satisfy by definition the equation $vy = lx$. These are the labor values around which the transformation problem of values into prices of production is often debated, see Brody (1970) and Foley (1982) for details.

Following Foley's (1982) methodological considerations, we are however not interested here in showing how vectors of labor values are transformed into prices of production because:

- this is just an academic or exegetical exercise for which no real world application exists,
- we are interested in demonstrating that labor values can contribute to the analysis and empirical investigation of actual prices dynamics and the average rate of profit the latter define,
- prices of production as in Sraffa (1960) are but an algebraic detor to the understanding of the actual evolution of prices and quantities of an economy, since they do not measure anything that happens in reality.

Labor values have a clear role in Richard Stone's and the UN's (1968) System of National Accounts in that they (and only they) measure labor productivity as is shown in detail in Flaschel (2010) and Flaschel, Franke and Veneziani (2011b).[8] We here go from this statement immediately into the study of what such measures of labor content (and, in reciprocal form, of labor productivity) can contribute to the analysis of actual prices and profitability, not using prices of production as an intermediate step, a step rightly criticized by Farjoun and Machover (1983) as being overly restrictive, redundant and not justifiable by real observations.

Following Foley (1982), we start from given vector y and wages $w \in (0, 1)$ and define a capitalist redistribution of value by a solution p of eq. (1) with respect to these data. This solution of course fulfills

$$rpKx = py - wlx = vy - wlx, \tag{5}$$

i.e., profits must equal (or are a redistribution of) surplus values if w is interpreted to represent Marx's 'value of labor power'. Finally, if the rate of surplus value e is defined by $e := (1 - w)/w$, there immediately follows from eq. (5)

$$r = \frac{(1-w)lx}{pKx} = \frac{1-w}{w}\frac{wlx}{pKx} = e\frac{V}{C}, \tag{6}$$

i.e., a third aggregate relationship relating labor values not only to prices of production, but to actual prices in general. Such aggregate relationships will also hold in our approach to labor values as the SNA oriented full labor costs schedule behind the surface of actual price and quantity dynamics.

[8] They were also used in this way in the United Nations' (1968) SNA, without noticing the intimate relationship of the UN measures of labor productivity with Marx's concept of embodied labor.

3 Aggregate labor value ratios: The systematic components in their price expressions

As mentioned above, we view labor values as a theoretical skeleton behind the surface of price-quantity dynamics, i.e. as part of the UN's (1968) SNA which is designed to define measurable categories to understand the capitalist process of economic and social reproduction. [9] Viewed in this way, there is nothing to 'transform'. Rather, one should show how labor values can be used to detect the laws of motion of capitalism. From a Marxian perspective, the first and most important step is to understand the determinants of the movements in the average (not a uniform) price rate of profit or – put differently – to what extent the generation of absolute and relative surplus value (measured in labor values) drives this rate, as well as the role of the Law of Falling Labor Content (LFLC) in the evolution of profitability.

For a thorough discussion of the LFLC from a probabilistic point of view, see Farjoun and Machover (1983, ch.s 4,7), and Flaschel, Franke and Veneziani (2011b) for weak conditions that imply this law for the case of capital-using labor-saving technical change in a general n-sectoral input-output approach as it is used in this paper.[10] Note however that this law counteracts increases in the value of the capital stocks as they come about by increases in the physical capital stock, implying that an increasing technical composition of capital, as analyzed in Marx (1954), may be prevented by the LFLC in specific historical periods of capital-using, labor-saving technical change.

Let w be the value of labor power as in Foley (1982). We define the average value rate of profit as follows:

$$r_v = \frac{v(I - A - K_\delta)x - wlx}{vKx} = (1 - w)\frac{lx}{vKx} \tag{7}$$

The average price rate of profit r_p is defined similarly, by taking actual nominal prices and wages p_n, w_n and normalizing them by setting $p := \frac{lx}{p_n y} p_n$, so that $py = lx$ and $w_n = w$. This normalization obviously does not change the price rate of profit.

Using (6) and (7), we obtain the following relation for the deviation from the actual price rate of profit to the value rate of profit:

$$\frac{r_p}{r_v} = \frac{(v - p)Kx}{pKx} + 1 \quad \text{or} \quad \frac{r_v}{r_p} = \frac{(p - v)Kx}{vKx} + 1 \tag{8}$$

The average value rate of profit depends on three fundamental measures, the wage share w in national income $py = lx$, the amount of hours worked and the labor value of the total capital stock.[11] The first aspect relates the Marxian theory of exploitation

[9] See also Pasinetti (1981), in particular VII.4, for a similar perspective regarding the Marxian LTV.

[10] 'In Flaschel, Franke and Veneziani (2011b), technical change is K-using and l-saving if and only if it increases the monetary value of fixed capital per unit of output at constant prices and it decreases the amount of direct labour used in a given sector.

[11] In other words, intermediate and capital consumption do not matter for the value of labor power as defined by Foley (1982).

to Goodwin's (1967) distributive cycle, and thus to the reserve army mechanism, and is related to what Marx called the generation of relative surplus value. The second item (underlying the generation of absolute surplus value) provides the hours actually worked by the workforce for the given wage share, which can be increased if monthly hours worked are increased, if absenteeism is forced down, if holidays are reduced and if (not covered by the model) work intensity is increased.

The third factor contributing to the forces that increase the value rate of profit is the LFLC, which was shown to hold at the theoretical level under mild assumptions in Flaschel, Franke and Veneziani (2011b), if technical change is K-using and l-saving. However, the decrease in labor content must outweigh the physical increases in the capital stock matrix K in order to contribute to an increase in the value rate of profit. This may be considered a fundamental contradiction in the capitalist process of technical change and is related to Marx's discussion of changes in the technical composition of capital (vKx/lx). Although the LFLC seems to hold both empirically and theoretically, it may do so weakly so that the progressiveness it entails is not reflected in the labor time contained in the operated capital stock. We will come back to this issue in section 5 below.

To summarize: basic forces driving an increase in the value rate of profit would be a decrease in the wage share and an increase in the hours performed by workers for a given wage share. Further, Marxian technical change might increase the value rate of profit, provided it leads to a significant change in the labor content of commodities through K-using technical change, yielding a fall in vKx if the decreases in v outweigh the increases in K. The relative difference $\frac{vKx}{pKx} - 1$ thus exhibits two counteracting systematic components: falling labor contents and increasing physical capital usage.[12] Because the price vector p has been normalized by $py = lx$, this difference need not mirror that the actual price of the capital stock Kx.

If the total labor costs of the commodities produced explain the bulk of costs mirrored by actual prices, then deviations between r_v and r_p should be small. Hence, the theoretical value rate of profit and the actual price rate of profit would differ only by unsystematic, historically determined price-value deviations. A rising technical composition of capital $(vKx)/(lx)$ would therefore in general not only lower the value rate of profit, but also the price rate of profit, unless it is offset by a rising rate of exploitation e.[13] We will investigate this empirical issue in the next section. This topic, in our view, represents the fundamental issue on the basis of which Marx's value theory of the price rate of profit r_p, i.e., its deviation from the value rate r_v, and thus the meaning of the so-called transformation problem should be evaluated further – by means of suitable theoretical *as well as* empirical examinations of the relative difference shown (8).

Hence, Marx's central arguments can be examined and tested by focusing on the labor values, or productivity indexes v, as measured by input–output analysts. The real issue

[12] Capital-using labor-saving technical change has indeed characterized most of the phases in the evolution of capitalism (see Marquetti 2003).

[13] See Farjoun and Machover (1983, chapter 7) on how such an argument can be made more precise from a probabilistic point of view.

for a Marxian theory of profit, therefore, is to test whether the production–based rate r_v can provide a proxy for the average price rate of profit r_p, or at least whether there exists a robust correlation between those two rates, since the forces underlying the evolution of the value rate of profit would then drive changes in the price rate of profit. In this case, the Marxian theory of exploitation would provide the foundation for the analysis of profitability in capitalism: the three factors discussed above which determine the motion of the value rate of profit would be the essential forces that drive the price rate of profit.

4 A general approach to the measurement of Marxian labor values

The data for our empirical investigation are taken from Kalmbach et al. (2005) and concerns the German economy with respect to the above used input-output model, $A, K, K_\delta, l, I, x, y$, for the years 1991-2000.[14] Kalmbach et al. group the 71 original sectors into seven macro-sectors, as shown in table 1. The industrial sector is divided into agriculture, manufacturing, and construction. Within manufacturing itself, Kalmbach et al. further distinguish more traditional industries from the so-called '*export core*' (a crucial subsector in an export-oriented country like Germany), which comprises the four single production sectors with the highest exports: chemical, pharmaceutical, machinery, and motor vehicles. They also distinguish between three main types of services: business-related services, consumer services, and social services. For their aggregation, Kalmbach et al. (2005) adopt a broad definition of business-related services by including wholesale trade, communications, finance, leasing, computer and related services, research and development services, in addition to business-related services *in a narrow sense*. Consumer services instead include: retail trade, repair, transport, insurance, real estate services, and personal services. Table 1 summarizes the seven (macro) sectors thus obtained and the sectoral output shares (in percentages, for the year 2000).

The technological coefficients of the 7-sectoral aggregation are reported in table 2, which shows the intermediate IO matrix A of the German economy for the year 1995 per million Euro of output value. The double-deflated coefficients $\tilde{a}_{ij}$ are used to characterize the entries of A. There are also (not shown) a depreciation matrix, K_δ, based on a fixed capital matrix, K, and a vector of labor coefficients, l.

We have constructed the price vector p from data for nominal output levels x_n and real output levels x, the latter based on constant prices of the year 1995. Moreover the average nominal wage level is defined in Kalmbach et al. (2005) by dividing the sum of all wage incomes $\sum_{ij} w^n_{ij} l_{ij}$ by total employment lx, where i is the type of worker working in sector j. This fact (also mirrored in the wage share to be used below) implies that wage differentials are used for making labor input homogeneous when defining labor values. It also should be noted that employment is measured in terms of workers and not in term of hours worked. Finally, the matrix A is constructed in Kalmbach et al. (2005) using data of the industrial consumption of domestic and imported commodities.

[14] We have to thank Reiner Franke for supplying us with the data needed for the present paper.

Table 1: The 7-sectoral structure of the economy

S1:	Agriculture	1.33
S2:	Manufacturing, the export core	12.37
S3:	Other manufacturing	22.55
S4:	Construction	6.29
S5:	Business-related services	21.36
S6:	Consumer services	23.35
S7:	Social services	12.75

Source: Kalmbach et. al (2005)

Table 2: Technological coefficients of the 7-sectoral aggregation (Germany, 1995)

	S1	S2	S3	S4	S5	S6	S7
S1	0.030	0.000	0.047	0.000	0.000	0.002	0.002
S2	0.081	0.241	0.050	0.021	0.003	0.008	0.014
S3	0.159	0.226	0.338	0.286	0.030	0.060	0.065
S4	0.010	0.005	0.009	0.020	0.007	0.034	0.020
S5	0.137	0.107	0.126	0.088	0.291	0.118	0.080
S6	0.032	0.044	0.045	0.100	0.071	0.139	0.044
S7	0.034	0.008	0.013	0.007	0.009	0.014	0.025

Source: Kalmbach et. al (2005)

It thus provides the technological matrix of intermediate inputs irrespective of the origin of the commodities that are used in production.

Concerning the definition of labor values given in (4), this data implies that we measure them on the basis of the employed domestic technology and thus independently from the conditions under which the imported commodities were actually produced. This in our view is the proper way of dealing with (or at least a starting point for it) international labor values. Thus, we reject the solution proposed by Steedman (2003) in his equation (6), where terms of trade enter the definition of labor values. Since the terms of trade however influence the actual prices of the domestically produced commodities, we have to note here that this may increase the deviations of our measure of labor value aggregates and their price expressions. The role of the terms of trade for calculating and comparing value and price rates of profit concern the issue of international exploitation which must be left here for future research.

Our approach is thus much simpler than Steedman's (2003), in that it measures labor values as if foreign commodities were domestically produced, see Gupta and Steedman (1971) for the same approach in an empirically oriented paper. This is an adequate approach if one wants to study the economy not only from the viewpoint of labor productivity, but also from a reproduction perspective where the flow relationships of actual

inputs to outputs are the focus of interest, independently of whether the inputs are produced domestically or internationally (or even stolen). International exploitation is thus not an issue in our formulation of a domestic labor theory of value. It may however be approached on this basis by comparing such labor values for specific countries of the world economy.

As noted above, the determination of the aggregate wage level w_n (and implicitly also the use of the wage share in the following sections) implies that wage differentials are used to convert skilled labor into ordinary one, since lx is just the number of workers, while the sum of all wage incomes of course includes the wage differentials paid to workers of different skills.

Finally, it is worth noting that in the definition of labor values, we are using the depreciation matrix K_δ, and therefore we can ignore physical joint production. And since we are using a highly aggregated IO structure, we can also ignore the complications related to the distinction between productive and unproductive labor. The notion of labor values employed in this paper is therefore very general, but also very specific in its treatment of international trade (where domestically applied techniques matter, but not the origin of the consumed inputs) and of heterogeneous labor (where wage differentials are used to compare different skills).

It is on the basis of such a broad definition of labor values that we will consider the deviation between the value and the price rate of profit in the next section. We will find that the Marxian theory of the main determinants of profitability remains valid, even though the central relevance of living labor, its results in the process of production (embodied labor) and the conflict about income distribution is not immediately clear – at the level of appearance of economic phenomena – to economic agents.

5 Three sources of profitability

This section provides an empirical illustration of the analysis in the previous sections, based on the above-mentioned IO data set constructed by Kalmbach et al. (2005).

Let $\langle x \rangle$ denote the diagonal matrix formed by the column vector of real outputs x. Additionally, x_n is the column vector of nominal production levels and u is a row vector of 1's. Based on Foley (1982), our empirical results are obtained by applying the following definitions:

$$p_n := \langle x \rangle^{-1} x_n, \quad \text{(price vector – column representation)} \tag{9}$$

$$\gamma := \frac{lx}{p_n y} \quad \text{(value of money)}^{15} \tag{10}$$

$$p := \gamma p_n \quad \text{(normalized price vector)} \tag{11}$$

$$w := \gamma w_n \quad \text{(value of labor power)} \tag{12}$$

For the price rate of profit $r_p = (1-w)\frac{lx}{pKx}$ and the value rate of profit $r_v = (1-w)\frac{lx}{vKx}$

[15] This expression is the reciprocal of what is often called the MELT (Monetary Equivalent of Labour Time).

Table 3: Price rate of profit (r_p) and value rate of profit (r_v)

Year	r_p	r_v	r_v/r_p
1991	14.71	15.05	1.023
1992	13.33	13.70	1.028
1993	12.15	12.39	1.020
1994	12.80	13.10	1.024
1995	12.79	12.95	1.013
1996	12.76	12.84	1.006
1997	13.48	13.61	1.010
1998	13.37	13.41	1.003
1999	13.03	13.06	1.002
2000	12.82	13.02	1.016

we have shown:

$$\frac{r_v}{r_p} = \frac{pKx}{vKx} = \frac{(p-v)Kx}{vKx} + 1 = \frac{(p\langle v\rangle^{-1} - u)\,\langle v\rangle Kx}{vKx} + 1 \tag{13}$$

Table 3 shows the levels‘ of the value and the price rate of profit as well as their relative deviation. Clearly, the price rate of profit is mirroring the value rate of profit up to a deviation of negligible degree.[16] It is worth noting, however, that the value rate of profit is always larger than its price analogue, a phenomenon for which there is no obvious explanation.

These figures are only an empirical illustration of what might be called the “fuzziness connection” between the average price and value rate of profit. We only assert here that the relationship between actual prices and labor values is in general so close that their deviation becomes irrelevant at the level of the economy-wide rate of profit (see Fröhlich, 2010, for a more detailed empirical study in this regard). Labor values, based on the standard IO measure of the labor contents of commodities, are the theoretical construct (the theoretical essence) behind actual (average) market prices (the appearance) and have been designed by Marx to understand the laws of motion of capitalism at the level of appearance. Labor values represent the substance of human interrelationships, namely the abstract type of labor that agents are providing for and interchanging with their fellow countrymen.

We can consider an economy from the viewpoint of the physical flow of commodities, from the viewpoint of nominal (price) flow magnitudes, but also from the viewpoint of abstract labor flows, understood as the SNA labor time skeleton that underlies the monetary flows. Relating this labor-time oriented SNA with the flow of actually observed magnitudes is not a ‘transformation problem’, because measures of abstract labor are

[16]The strong correlation between value and price rates of profit is illustrated in table 8 and figure 1 (see Appendix) which both present the results obtained from running an Ordinary Least Squares (OLS) regression for r_v (exogenous variable) and r_p (endogenous variable).

Table 4: Price-value ratios

Year	S1	S2	S3	S4	S5	S6	S7
1991	0.5580	1.127	1.0171	0.9700	1.179	1.025	0.8942
1992	0.5835	1.099	1.0041	0.9975	1.172	1.027	0.9062
1993	0.5882	1.054	0.9896	0.9996	1.190	1.037	0.9168
1994	0.6071	1.078	0.9905	1.0000	1.181	1.039	0.9097
1995	0.6236	1.124	0.9812	0.9705	1.149	1.045	0.9095
1996	0.6749	1.112	0.9923	0.9555	1.127	1.056	0.9046
1997	0.6815	1.137	1.0122	0.9487	1.110	1.057	0.8934
1998	0.6583	1.136	1.0001	0.9415	1.107	1.051	0.8981
1999	0.6530	1.105	1.0083	0.9447	1.112	1.052	0.9026
2000	0.6650	1.154	1.0565	0.9412	1.081	1.034	0.8916

not of the type of a substance being associated with the produced commodities and getting redistributed through capitalist competition. Instead they are just representing the economy from a different angle, see in particular Stahmer (2000) for such a point of view.

By definition, in the year under consideration, the value of the net product is equal to the total labor time performed and total profits are equal to total surplus value. Instead, only a fuzziness relationship, or connection, holds between the average rate of profit and the average value rate of profit, as shown in table 3. This relationship is, however, so strong as to suggest that the Marxian concepts of absolute and relative surplus value and his measure of the technical composition of capital suffice to explain the forces that drive the motion of the average price rate of profit.

Table 4 analyzes price-value deviations,[17] and it forcefully shows that prices and values (though normalized in the same way) differ substantially in some of the seven sectors. As a result, the strong correlation between value and price rates of profit is unlikely to hold at the sectoral level. In Marxian terms this suggests that distinct processes may regulate the generation and the distribution of profits. At the aggregate level, profitability can be increased solely by Marxian mechanisms: an increase in absolute surplus value ($lx \uparrow$) or in relative surplus value ($w \downarrow$) and a decrease in the labor value of the capital stock, through capital-using labor-saving technical change which raises labor productivity (lowering labor values) to a sufficient degree.[18] The latter phenomenon seems however absent in the German economy over the considered period, as shown in table 5. Although labor productivity, $1/v_j, j = 1, \ldots, 7$, increased in the German economy over 1991-2000 (see Appendix), the aggregate value of the capital stock did not unambiguously decrease as shown in table 5.

Table 3 shows that the average price rate of profit was falling in 1991-1993, 1994-1996 and again in 1998-2000. This can be related to tendencies in the technical composition

[17]The absolute size of labor values and normalized prices are shown in the Appendix.

[18]Innovations similar to Harrod-neutral technical change would be an example of such a situation.

Table 5: Wage share, employment, labour value of capital stock, price value of capital stock, and technical composition

Year	w	lx^1	vKx^1	pKx^1	$(vKx)/(lx)$
1991	0.698	38.5	77.1	78.9	2.01
1992	0.717	37.9	78.3	80.5	2.07
1993	0.728	37.4	82.2	83.8	2.20
1994	0.715	37.3	81.2	83.1	2.18
1995	0.714	37.4	82.5	83.5	2.21
1996	0.713	37.3	83.4	83.9	2.24
1997	0.699	37.2	82.3	83.2	2.21
1998	0.700	37.6	84.3	84.5	2.24
1999	0.706	38.1	85.6	85.8	2.25
2000	0.710	38.8	86.5	87.8	2.23

[1] Measured in million persons

of capital to rise as shown in table 5 and tendencies that concerned the values of labor power w also shown in table 5 (where increases in the latter variable counteracted the former phenomenon to a certain degree).

It appears therefore that income distribution represents the hand gear whereby a rise in the profit rate can be enforced despite these countervailing tendencies. Yet it should be noted that the data shows only a cyclical movement of the wage share w over time (see table 5), but not a decrease which would rise profitability continuously. We conclude that in the German economy (1991-2000) there is no clearcut tendency for a (significant) improvement in average profitability. This analysis forcefully shows how the Marxian categories can be used to explain the tendencies observed in the evolution of the general price rate of profit.

6 Conclusions

This paper shows how the central aggregates of Marx's theory of exploitation provide the essential determinants of the formation of the general (average, not uniform) price rate of profit of a capitalist economy. The systematic changes in profitability can be represented by labor value magnitudes which are more informative than the corresponding price expressions, due to the – from the viewpoint of theory – 'chaotic' nature of interacting processes of commodity exchange in space and time, and with respect to contingencies. We thus regard the evolution of labor values (or total labor costs) as capturing, when suitably aggregated, the essential and the inertial laws of motion behind the generation of profitability in capitalist economies. Corresponding actual market price averages, though based on significantly varying price formation schemes, may also lose their theoretical arbitrariness when deviations between economy-wide price and value aggregates are compared, in particular concerning the building blocks in the formation of average rates

of profit.

In a capitalist society, labor power is the only commodity which is not produced by firms and where no profits accrue in the course of its reproduction (in contrast to slavery). Moreover labor is indispensable for social reproduction, while all other commodities can in one way or another be substituted for each other. Reducing the value of labor power – through either a lengthening of the work-day, or a reduction in workers' hourly wages and consumption – is therefore one of the central mechanisms by which the average rate of profit of an actual capitalist economy can be increased. Labor-productivity increasing technical change can also reduce the reproduction value of the capital stock of the economy and thus contribute to an increase in its general rate of profit, but only if the quantity increase in the capital stock is smaller than its falling labor content.

Summarizing we can state that essence (the flow of indirect and direct labor through the economy and the appropriation of part of it by capitalists) and appearance (average market exchange ratios) may deviate to a certain degree. This deviation is however characterized only by a small amount of fuzziness at the aggregate level and the correlation between the value and the price rate of profit, in particular, is robust. The main factors analyzed by Marx in *Capital*, Vol.I in his theory of exploitation and technical change not only determine profitability in the sphere of essence, but also at the level of appearance. Marx's general law of capitalist accumulation (as initially formalized for example by Goodwin, 1967) regulates the value of labor power w in the conflict about income distribution, whereas the conflict between capital and labor within production drives the technical composition of capital $(vKx)/(lx)$. These two conflicts determine the central variable for capital as a whole, namely the average rate of profit it can realize over time.

The analysis in this paper leaves open the issue of a theory of market prices, given that neither the Walrasian theory nor the Neoricardian approach provide a sound basis from an empirical perspective as Flaschel, Franke and Veneziani (2011a) have shown. This search for a non-competitive, empirically meaningful price theory is an important avenue for future research.

The existence of such an open price-theoretic problem however confirms that there is no need to transform labor values into hypothetical prices of production in order to demonstrate their usefulness for an analysis of the process of capital accumulation and the formation of the general rate of profit. Here, labor values can be considered as part of Richard Stone's System of National Accounts, as forcefully suggested by Flaschel (2010). Viewed in this way, they can then be used to study what happens at the level of appearance, namely the actually observed price-quantity dynamics of capitalist economies.

References

[1] Bródy, A. (1970): *Proportions, Prices and Planning.* North Holland: Amsterdam.

[2] Duménil, G. (1980): *De la Valeur aux Prix de Production.* Economica: Paris.

[3] Duménil, G. and D.K. Foley (2008): The Marxian Transformation Problem. In: S.N. Durlauf and L.B. Blume (eds.) *The New Palgrave: A Dictionary of Economics*, Basingstoke: Palgrave Macmillan.

[4] Duménil, G., Foley, D.K. and D. Lévy (2009): A Note on the Formal Treatment of Exploitation in a Model with Heterogenous Labor. *Metroeconomica,* 60, 560-567.

[5] Farjoun, E. and M. Machover (1983): *Laws of Chaos.* London: Verso Edition and NLB.

[6] Flaschel, P. (2010): *Topics in Classical Micro- and Macroeconomics.* Heidelberg: Springer Verlag.

[7] Flaschel, P., Franke, R. and R. Veneziani (2011a): The Measurement of Prices of Production: An Alternative Approach. *Review of Political Economy,* forthcoming.

[8] Flaschel, P., Franke, R. and R. Veneziani (2011b): Labor Productivity and the Law of Decreasing Labor Content. Bielefeld University: Working paper.

[9] Foley, D. (1982): The value of money, the value of labor power and the Marxian transformation problem. *Review of Radical Political Economy*, 14, 37-47.

[10] Fröhlich, N. (2010): Labour values, prices of production and the missing equalization of profit rates: Evidence from the German economy. Chemnitz University of Technology: Working paper.

[11] Goodwin, R. (1967): A growth cycle. In: C.H. Feinstein (ed.): *Socialism, Capitalism and Economic Growth.* Cambridge, UK: Cambridge University Press, 54-58.

[12] Gupta, S. and I. Steedman (1971): An Input-Output Study of Labour Productivity in the British Economy. *Oxford Bulletin of Economics and Statistics*, 21-34.

[13] Kalmbach, P., Franke, R. , Knottenbauer, K. and H. Krämer (2005): Die Interdependenz von Industrie und Dienstleistungen – Zur Dynamik eines komplexen Beziehungsgeflechts. Berlin: Edition Sigma.

[14] Kliman, A. (2007): Reclaiming Marx's Capital: A Refutation of the Myth of Inconsistency. London: Lexington Books.

[15] Marquetti, A. (2003): Analyzing historical and regional patterns of technical change from a classical-Marxian perspective. *Journal of Economic Behavior and Organization*, 52, 191-200.

[16] Marx, K. (1954): *Capital. A Critique of Political Economy, Vol.I.* London: Lawrence & Wishart.

[17] Marx, K. (1975): *Theories of Surplus Value, Part I.* London: Lawrence & Wishart.

[18] McGlone, T. and A. Kliman (1996): One system or two? The transformation of values into prices of production vs. the transformation problem. In: A. Freeman and G. Carchedi (eds.): *Marx and Non-equilibrium Economics.* Cheltenham, UK: Edward Elgar.

[19] Mohun, S. (2003): On the TSSI and the exploitation theory of profit. *Capital and Class*, 81, 85-102.

[20] Mohun, S. (2004): The Labour Theory of Value as Foundation for Empirical Investigations. *Metroeconomica*, 55, 65-95.

[21] Pasinetti, L. (1981): *Structural Change and Economic Growth. A Theoretical Essay on the Dynamics of the Wealth of Nations.* Cambridge: Cambridge University Press.

[22] Reati, A. (1986): The deviation of prices from labor values: an extension to the non-competitive case. *Cambridge Journal of Economics*, 10, 35-42.

[23] Reati, A. (2011): Power relations and economic paradigms – or why the post-Keunesian theory is not dominant. *Review of Radical Political Economy*, 43, 1-12.

[24] Sraffa, P. (1960): *Production of Commodities by Means of Commodities.* Cambridge, UK: Cambridge University Press.

[25] Steedman, I. (2003): Marx after Sraffa and the Open Economy. Discussion Papers in Economics, Manchester Metropolitan University.

[26] Stahmer, C. (2000): The Magic Triangle of Input-Output Tables. In S. Simon and J. Proops, eds.: *Greening the Accounts.* Cambridge: University Press, 155–180.

[27] United Nations (1968): *A System of National Accounts.* New York: Studies in Methods, Series F, No.2, Rev.3.

[28] Veneziani, R. (2004): The Temporal Single-system Interpretation of Marx's Economics: A Critical Evaluation. *Metroeconomica*, 55, 96-114.

[29] Wright, I. (2011): Classical macrodynamics and the labor theory of value. The Open University: Discussion Papers in Economics.

Appendix: Additional data

Table 6: Labor values (Persons per million Euro of output value)

Year	S1	S2	S3	S4	S5	S6	S7
1991	54.68	26.53	30.23	28.53	24.45	27.22	30.69
1992	47.44	25.82	28.78	27.40	23.82	26.67	29.88
1993	45.24	26.55	28.55	27.77	23.62	26.95	30.04
1994	44.65	25.09	27.48	27.12	23.40	26.32	29.63
1995	42.95	23.83	27.30	27.60	23.32	25.64	29.45
1996	38.76	23.87	26.46	27.65	23.06	25.29	29.45
1997	37.81	22.98	25.62	27.02	22.83	25.02	29.11
1998	37.42	22.94	25.63	26.92	22.39	25.02	28.92
1999	36.46	23.46	24.89	26.65	21.82	24.93	28.86
2000	35.90	22.39	23.79	26.14	22.03	24.99	28.63

Table 7: Normalized price vector (Persons per million Euro of output value)

Year	S1	S2	S3	S4	S5	S6	S7
1991	30.51	29.89	30.75	27.67	28.82	27.91	27.44
1992	27.68	28.37	28.89	27.33	27.92	27.38	27.08
1993	26.61	27.99	28.25	27.76	28.12	27.94	27.54
1994	27.11	27.05	27.22	27.12	27.63	27.34	26.95
1995	26.78	26.78	26.78	26.78	26.78	26.78	26.78
1996	26.16	26.54	26.26	26.42	25.99	26.70	26.64
1997	25.77	26.13	25.94	25.64	25.34	26.45	26.01
1998	24.64	26.07	25.63	25.34	24.79	26.30	25.98
1999	23.81	25.93	25.10	25.17	24.26	26.22	26.05
2000	23.88	25.84	25.13	24.60	23.82	25.84	25.52

Table 8: OLS regression results for r_v (exogenous variable) and r_p (endogenous variable)

	Estimate	Std. Error	t value	Pr(>|t|)
Intercept	0.73	0.733	0.99	0.351
r_v	0.93	0.055	16.93	< 0.000
R^2	0.97			

Figure 1: Regression line for the value rate of profit and the price rate of profit