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A New Analytical Framework

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UNPRODUCTIVE ACCUMULATION IN THE UNITED STATES: A NEW ANALYTICAL FRAMEWORK

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Abstract

In this paper I offer an innovative analysis of unproductive accumulation in the United States economy from 1947 to 2011. I develop a new theoretical and empirical framework to analyze the accumulation of capital in its productive and unproductive forms. I also develop a methodology to compute Marxist categories predicated on the idea that the production of knowledge and information is an unproductive activity that relies on the creation of knowledge-rents. In particular, I provide new empirical estimates to uncover the shifting balance between productive and unproductive forms of accumulation. The accumulation pattern observed during the 1947-1979 phase that prioritized productive accumulation gave way after the 1980s to a contrasting pattern prioritizing unproductive accumulation. Unproductive activity has been growing at a fast pace in terms of incomes, fixed assets, and employment. Among all forms of unproductive activity, my approach places special attention on how the production of knowledge and information has constituted a rising share of total unproductive income and capital stock. Additionally, productive stagnation and rapid unproductive accumulation have been intrinsically related to greater exploitation of productive workers and to widening income inequality.

Key-words: Unproductive Activity, Capital Accumulation, Exploitation, Inequality, Stagnation

JEL Codes: B51; E01; O34

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1. Introduction

In this paper I conceptualize and measure the accumulation of unproductive capital in the postwar United States economy. I focus on the shifting balance between productive and unproductive activity and the distribution of capital between these two categories. I develop a new methodology to compute Marxist categories and provide several empirical estimates of productive and unproductive forms of accumulation from 1947 to 2011. My methodology and results provide new evidence of how exploitation, inequality, and unproductive accumulation interact in an advanced capitalist economy.

I employ the term *unproductive accumulation* to indicate the growth either in the flow of income or in the stock of capital of unproductive activities. The distinction between productive and unproductive relies directly on the concept of surplus value and, as such, is predicated on the idea that value needs to come from somewhere. In no way does unproductive mean unnecessary, or less important, and it is not a derogatory term. There is also no connection between productive and tangible, since services and intangible commodities can be the output of productive activities.

A *productive activity* is any economic activity that produces surplus value. To be productive of surplus value an activity must have workers (either employed by capitalists or self-employed) creating useful commodities with value for sale [¹]. Other activities comprising all efforts to create new use-values or recirculate existing use-values, but not commodities with value, are considered to be *unproductive*. Unproductive activities create new use-values or recirculate existing use-values without adding any new surplus value to the economy. This implies that the incomes of unproductive activities represent flows drawn out of the value generated in productive activities. While productive activities create and also consume surplus value, unproductive activities only consume it.

Despite directly consuming the surplus from productive endeavors, unproductive accumulation can well enhance labor productivity or even boost aggregate demand in productive activities, and therefore indirectly improve the creation of surplus value. There is, hence, a double effect under consideration:

unproductive activity might *indirectly* increase labor productivity and boost productive accumulation while it draws on the surplus value that it does not *directly* produce. Even though *indirectly* affecting productive growth, unproductive activities per se do not *directly* add any new value to the economy.

Official income and product accounts and input-output matrices have to be translated to be used in a Marxist analysis since Marx developed his own system of concepts grounded on his unique understanding of the labor theory of value. Official data series, on the contrary, are constructed using concepts drawn from orthodox economics that conceptualize value in a different manner. In particular, official accounts do not distinguish between productive and unproductive activities.

To separate industries between productive and unproductive activities I introduce the *Marxist Industry Classification System*, whose main feature is the treatment of knowledge production and knowledge ownership as unproductive activities. Besides trade, finance, insurance, real estate, non-profit organizations, and government administration, I also classify as unproductive the production of software, data, pharmaceuticals, movies, recorded video and music, and published materials such as books and journals. The *re*-production of knowledge and information requires no labor time and therefore produces neither value nor surplus value, implying that these activities must be classified as unproductive. My estimates reveal that knowledge creation and finance have been the fastest growing unproductive activities both in terms of net income and capital stock.

The pattern of accumulation in the United States economy has changed substantially throughout the postwar period. Prior to 1980 the US experienced rapid productive accumulation, slower growth in unproductive fixed assets, non-increasing rates of exploitation of productive workers, and low levels of inequality. Throughout the postwar period workers gradually took on unproductive jobs and by the early 1970s the majority of employees were already unproductive workers. After 1980 the situation changed dramatically and the economy shifted to faster unproductive accumulation, faster growth in the stock of unproductive assets, exhibited an ever-increasing rate of exploitation of productive workers, and widening

income inequality. The total income of unproductive activities quadrupled relative to the total value generated in productive activities during the 1947-2011 period.

The post-1980 Neoliberal phase of United States capitalism has been characterized by the rising exploitation of productive workers while capitalists have at the same time shifted their investments to unproductive activities. Capitalists have been extracting more surplus value from a diminishing portion of the working class. The result is that for the Neoliberal period the general profit rate has fallen substantially behind the rate of exploitation. I attribute the rapid pace of unproductive accumulation as the possible reason for the post-1980 disconnection between exploitation and profitability.

2. Comparison with other Approaches

The crucial difference between the approach introduced in this paper compared to all other exiting approaches is the treatment of knowledge and information production as unproductive activity. Predicated on Teixeira and Rotta (2012), my methodology is the only one that provides estimates of Marxist categories considering *knowledge and information as valueless commodities*. I do so by first differentiating production from re-production and then following Marx when positing that value is determined by the labor time necessary to *re-produce* a commodity.

Knowledge is valueless because it requires labor to be originally produced but no labor to be further *re-produced*. In standard economic theory this unique characteristic of knowledge is known as *zero marginal cost* (Arrow, 1962; Stiglitz, 1999; Duffy, 2004; Shavell and van Ypersel, 2001), which in Political Economy translates as zero reproduction cost. Kenneth Arrow (1962) in his famous ‘learning by doing’ growth model paper noted that knowledge is inherently a public good with zero marginal cost, and therefore would not be supplied under perfect competition. Knowledge can only be produced for profit if supplied under imperfect competition and with state-sponsored intellectual property rights. Shavell and van Ypersel (2001, p.545) noted subsequently that the zero marginal cost property applies to industries producing pharmaceuticals, software, movies, recorded music, books, and visual products.

Despite potential indirect contributions to productive growth, knowledge creation and ownership *per se* produce no new value and should be classified as unproductive. With this key insight on the labor theory of value I can then provide new measures and a new analysis of productive and unproductive forms of accumulation in the United States economy.

The new methodology that I introduce therefore provides estimates of unproductive accumulation in a broader way compared to current attempts to measure financialization (as in Lapavitsas, 2013; Lazonick, 2013; Arestis, and Singh 2010; Orhangazi, 2008; Krippner, 2005; Epstein, 2005). While the notion of financialization remains circumscribed to financial circuits of capital, the Political Economy notion of unproductive accumulation includes the idea of financialization and additionally considers that many other unproductive activities also draw on the value that productive workers generate.

The mainstream of the Economics profession has nonetheless begun to embrace the idea that some forms of economic activity, named '*rent-seeking activities*', directly usurps productive wealth. The concept of 'rent seeking' identifies cases in which there is appropriation of uncompensated value from others with no contribution to productivity. The 'rent-seeking' and 'directly unproductive profit-seeking (DUP) activities' literature has been expanding (Krueger, 1974; Stiglitz, 2012; Colander, 1984; Bhagwati, 1982) and it clearly refers to the concept of rent in classical Political Economy, particularly in Adam Smith and David Ricardo.

For Marx, a crucial cause of inequality is exploitation, or simply 'how much workers *pay* to work'. My estimate of the rate of exploitation correlates very closely with measures of income inequality and its trend is in accordance with historical and institutional analyses on the transition from a Regulated to a Neoliberal phase of capitalism in the United States – as in Duménil and Lévy (2011), Lapavitsas (2014), Harvey (2005; 2003), and Kotz (2009; 2008). My measure of the rate of exploitation correlates at around 0.95 with the top 1% and top 0.1% income shares and also with the inverted Pareto-Lorenz inequality coefficient from Piketty (2014) and the World Top Income Database for the United States (Al-

varedo, Atkinson, Piketty, and Saez 2014). While my methodology is based on the functional distribution of income, Piketty's estimates are based on the personal distribution of income. The World Top Income Database is estimated using tax data from the Internal Revenue Service (IRS), a procedure that is much different from my methodology of employing input-output matrices and national income accounts, but the close similarity in terms of trends in inequality and exploitation is striking.

The methodology and estimates that I present also constitute a direct critique of the "immaterial labor" theories of Michael Hardt and Antonio Negri (2001), Maurizio Lazzarato (1996), Lazzarato and Negri (2001), and André Gorz (2010). The main claim of those who advocate the immaterial labor thesis is that Marx's original value theory has become inadequate in a knowledge society. By knowledge society they mean an advanced capitalist economy in which knowledge and information are crucial inputs to and outputs of production. Marx, they claim, theorized a capitalist world in which commodities consisted primarily of tangible goods, and hence developed a value theory that carried a 'physicalist' bias. In the world of tangible and material commodities the type of labor that plays a central role is that of material labor, but Marx's supposed focus on material labor and tangible commodities becomes out of date in contemporary societies in which immaterial labor and intangible commodities comprise the axis of capitalist production.

The key problem is that Antonio Negri, Michael Hardt, Maurizio Lazzarato, and André Gorz have not properly understood Marx's value theory. These authors have neither understood the difference between productive and unproductive activity nor the difference between production and reproduction. Furthermore, they do not recognize that knowledge is a valueless commodity. As long as one considers the distinction between activities that produce value and activities that consume value, and considers that value is determined by the labor time necessary to *re*-produce a commodity, there is no inadequacy in Marx's approach in this respect. The defenders of the immaterial labor thesis seem to be unaware of the crucial difference between production and *re*-production in Marx's theory.

The methodology that I develop builds on and extends the groundbreaking works of Shaikh and Tonak (1994) and Edward Wolff (1987). I also include more recent insights from the works of Mohun (2014; 2006; 2005), Paitaridis and Tsoulfidis (2012), and Moseley (1997; 1992; 1985). In the Appendix I provide a detailed description of data sources as well as a step-by-step explanation of how I have computed Marxist categories from available data for the United States between 1947 and 2011. Technical differences between my estimates and those of others as also explained in the Appendix.

3. Estimating Marxist Categories

Marxist Political Economy has a unique class theory of the production, appropriation, and distribution of surplus value, and therefore estimates of these categories provide a diagnosis of capitalism that differs substantially from more mainstream economic analyses. From the Marxist point of view, the official measures of gross and net outputs (such as GDP) contain systematic double counting of values and so constitute artificially inflated indicators of outputs and incomes.

Virtually every enterprise operates with a mix of productive and unproductive activities, with few firms actually being classified as purely productive or purely unproductive. For this reason I do not employ the term unproductive *sector* but rather unproductive *activity*. The purpose is to make clear that productive and unproductive endeavors are not separated into sectors but in fact into activities.

The value of any commodity (λ_i) can be decomposed into the indirect and direct labor necessary to reproduce it. Indirect or past labor appears through the use of means of production while direct or current labor appears through the employment of labor power. Indirect labor contributes to the value of a new commodity because the means of production used up are themselves commodities and therefore products of past human labor. The direct labor applied adds more value and, eventually, a surplus value (S_i) over and above that required to reproduce labor power as a commodity. The value of every commodity (λ_i) can thus be decomposed into the value transferred from the means of production used up, called constant capital (C_i), and the new value added by direct labor (VA_i). The constant capital C_i comprises

the value transferred from circulating constant capital (the inputs consumed all at once) and the value transferred from fixed constant capital (the inputs that gradually transfer their value over multiple production turnovers). Constant capital is therefore the sum of the raw materials and inputs immediately consumed plus the depreciation of productive fixed capital.

The direct labor applied (VA_i) can then be further decomposed into the value necessary to reproduce the laborers, called variable capital (V_i), and the extra value that workers produce but do not receive, named surplus value (S_i). The ratio of the realized surplus value to the variable capital spent to produce the surplus is the realized rate of surplus value ($s_i = S_i/V_i$), or the rate of exploitation of productive workers, an index of how much productive workers ‘pay to work’. Hence:

$$\lambda_i = C_i + VA_i = C_i + V_i + S_i = C_i + V_i(1 + s_i) \quad (1)$$

To arrive at the total value (TV) realized in an economy we simply sum the realized values of all n commodities. The total value is thus the sum of all constant capital used up ($C = \sum_{i=1}^n C_i$), all the variable capital used up ($V = \sum_{i=1}^n V_i$), and all the surplus value ($S = \sum_{i=1}^n S_i$) realized. The constant capital C reflects all the productive inputs used up when producing the value of all commodities, or simply all the past indirect productive labor transferred to current productive output. The sum of variable capital and surplus is the total Marxist value added ($VA = \sum_{i=1}^n VA_i$) in the economy and it reflects all the direct productive labor employed. Letting $s = S/V$ denote the economy-wide average rate of surplus value, we now have:

$$TV = \sum_{i=1}^n \lambda_i = C + VA = C + V + S = C + V(1 + s) \quad (2)$$

The total value TV measures the realized values of all n commodities in an economy. It is a gross measure of productive output since it includes the value transferred from the inputs. When we net out the value of constant capital C we arrive at the Marxist value added (VA) measure. The direct productive inputs consumed and the depreciation of productive fixed capital are both included in the measure of C , implying that the Marxist value added is both net of productive inputs used up and net of depreciation. The surplus value S is the residual that we obtain after subtracting from VA the value of the labor power of productive workers (V).

The constant capital C includes only inputs used up in productive activities that were themselves produced by productive labor. Inputs produced in unproductive activities that are then used up in productive activities are not included in the measurement of C , even if they were purchased at a positive price. For example, payments for land (land-rents) are not included in C . The same reasoning applies to the value of labor power, since the measure of variable capital V includes only the compensation of productive workers in productive activities. Unproductive workers in productive activities (such as supervisory workers) and all the workers in unproductive activities do not enter into the computation of V . Surplus value S is the new value that is then consumed to maintain all those activities that were excluded from the estimate of value added.

The economy-wide general profit rate (r) is simply the total surplus value realized relative to the total capital stock (K) employed in the economy: $r = \frac{S}{K}$. The organic composition of capital (OCC) can be computed as the stock of productive capital relative to variable capital. The stock of productive capital is the stock of fixed assets in productive activities (K_{PA}), hence: $OCC = \frac{K_{PA}}{V}$. The total stock of fixed assets in the economy comprises the fixed capital stock in productive (PA) and unproductive activities (UA) hence: $K = K_{PA} + K_{UA}$. Using $s = S/V$ as the economy-wide average rate of surplus value and $OCC = \frac{K_{PA}}{V}$ as the organic composition of capital it then becomes possible to rewrite the equation for the general profit rate as:

$$r = \frac{S}{K} = \frac{S}{K_{PA} + K_{UA}} = \frac{\frac{S}{V}}{\frac{K_{PA}}{V} + \frac{K_{UA}}{V}} = \frac{s}{OCC + UCC} \quad (3)$$

The new category that I introduce is the *unproductive composition of capital*: $UCC = \frac{K_{UA}}{V}$. The UCC captures the relationship between the accumulation of unproductive capital stock and the variable capital representing the workers generating surplus value in productive activities. It thus becomes evident that the general profit rate can rise if the rate of surplus value is rising, and it can fall if either the OCC or the UCC is rising, all else held constant. The profit rate falls if the rise in the rate of exploitation is not rapid enough to compensate for the effect of a rising unproductive composition of capital.

From the general profit rate, which has surplus value in the numerator, I compute the alternative net profit rate (r') by deducting the share of the surplus that covers the total compensation of unproductive workers (W_{UA}). W_{UA} includes the compensation of all employees in unproductive activities plus the supervisory workers in productive activities. By subtracting W_{UA} from the surplus value we arrive at a net measure of total profits ($\Pi = S - W_{UA}$), hence:

$$r' = \frac{\Pi}{K} = \frac{S - W_{UA}}{K_{PA} + K_{UA}} = \frac{\frac{S}{V} - \frac{W_{UA}}{V}}{\frac{K_{PA}}{V} + \frac{K_{UA}}{V}} = \frac{s - \frac{W_{UA}}{V}}{OCC + UCC} \quad (4)$$

Analogous to the total value TV and value added VA of productive activities it is possible to compute corresponding measures for unproductive activities. The corresponding measure to TV is the *gross income of unproductive activities* (GI_{UA}), and the corresponding measure to VA is the *net income of unproductive activities* (NI_{UA}). The difference between GI_{UA} and NI_{UA} is that the net measure excludes the intermediate inputs and the depreciation of unproductive fixed capital that are included in the gross measure of unproductive income.

Two other categories that I introduce capture the relative magnitude of unproductive to productive flows of income. The first is the *net unproductive burden* (*NUB*), estimated as the ratio of the net income of unproductive activities to the surplus value generated in productive activities: $NUB = \frac{NI_{UA}}{S}$. The second is the *gross unproductive burden* (*GUB*), estimated as the ratio of the gross income of unproductive activities to the total value generated in productive activities: $GUB = \frac{GI_{UA}}{TV}$. The UCC, NUB, GUB, and the $\frac{W_{UA}}{V}$ ratio are thus four different ways of measuring the size and pace of unproductive accumulation relative to that of its productive counterpart.

4. The Marxist Industry Classification System

The first step to transform official national accounts data into Marxist categories is to classify and separate the different industries into new groups that actually reflect Marxist theory. The industry classification scheme associated with Marxist theory is what I would like to call the *Marxist Industry Classification System* (MICS). In contrast to the official North-American Industry Classification System (NAICS) and the Standard Industry Classification (SIC), the MICS posits that the value created in productive activities cannot be recounted in unproductive activities. The MICS has only three industry groupings, meant to adjust the official SIC and NAICS so as to allow for the proper estimation of Marxist categories:

(i) *Productive activities* (PA): Includes all commodity-producing activities generating new value. Agriculture, mining, manufacturing, transportation, construction, maintenance, and productive government enterprises are counted here. Only productive services are counted.

(ii) *Trade, rental, and leasing* (TRL): Includes retail trade, wholesale trade, rental of equipment, and leasing of commodities. Retail and wholesale industries contain trade margins only, and the rental of equipment and leasing of commodities imply that values are being realized via piecemeal sales. However, the rentals of use-values that contain no value (such as land and knowledge) are not counted here.

(iii) *Unproductive activities* (UA): Accounts for all activities that either create new or re-circulate existing use-values without generating any new value. Included here are real estate (land-rents), finance, insurance, legal services, non-profit entities, government administration, and the knowledge-rents in advertising, pharmaceuticals, software production, data management, research and development, publishing, music recording, and movie production.

It is necessary to separate trade from unproductive activities because the input-output system that the BEA has developed is cast in producer's prices, with trade margins recorded in the retail and wholesale industries. If the official accounts were cast in final selling prices (purchaser's price) then trade would be directly incorporated into the unproductive activities groups, but since trade margins are recorded in their own rows and columns it becomes necessary to first distinguish them from both productive and unproductive activities. To estimate the measure of total value TV we then have to combine the incomes recorded under the productive activities (PA) grouping with the trade and rental margins recorded under the trade, rental, and leasing (TRL) grouping.

The unproductive nature of knowledge and information derives from the unique feature that the *re*-production of knowledge and information requires no labor time. Once initially produced, the labor time necessary to reproduce knowledge and information is zero. The value of a commodity is determined by the labor time required to *re*-produce it, not the labor time required in its original production. If no labor time is needed to reproduce the product of human labor then this product is valueless (Teixeira and Rotta, 2012). The valueless character of knowledge and information as commodities is a direct implication of what Marx himself stated in *Capital III*:

Apart from all the accidental circumstances, a large part of the existing capital is always being more or less devalued in the course of the reproduction process, since *the value of commodities is determined not by the labor-time originally taken by their production, but rather by the labor-time that their reproduction takes*, and this steadily decreases as the social productivity of labor develops. At a higher level of development of social productivity, therefore, all existing capital,

instead of appearing as the result of a long process of capital accumulation, appears as the result of a relatively short reproduction period. (Marx, 1994, p.522 – emphasis added)

Knowledge production is therefore an unproductive activity. Even more, the owners of knowledge and information become *knowledge-lords* analogously to how we commonly refer to the owners of land as landlords. Workers laboring for knowledge-lords produce no value and hence no surplus value. If no surplus value creation takes place in the production of knowledge and if certain capitalists become knowledge-lords due to the monopoly rights they possess over produced information, then all the profits knowledge-lords make are pure *knowledge-rents* (Teixeira and Rotta, 2012).

Even though the production of new knowledge does not generate surplus value it does give rise to rents that allow knowledge-lords to appropriate a share of the surplus value produced in productive activities. The role of intellectual property rights and of copyrights in general is to guarantee that the owners of knowledge and information get a fraction of the surplus value produced elsewhere in the economy. Intellectual property rights have a similar economic role compared to land ownership rights, namely that they assure a flow of surplus value to unproductive capitalists in the form of rents. In the case of commodified knowledge, market prices are gross overestimations of its null value.

I therefore classify several activities as unproductive on the grounds that they produce knowledge that requires no labor to reproduce: software, data, pharmaceuticals, movies, recorded video and music, and published materials. As an approximation, I classify the entire value of output of those industries as unproductive, despite the fact that a part of the value that these industries produce is attributed to new labor that is required each year. For example, the pharmaceutical industry must produce pills that require new labor as well as existing knowledge. Ideally it would be desirable to count part of the above industries' output as productive, but data limitations prevent me from doing so in this study.

5. Historical Trends in the US Economy

5.1 Exploitation, Inequality, and Unproductive Activity

I begin my evaluation of the United State economy by plotting in Figure 1 key Marxist measures together with their official counterparts from the Bureau of Economic Analysis (BEA). All series are nominal in millions of dollars. I compare the BEA measure of gross output with Marxist total value, indicating that the gap between the two series is due to the double counting of values in unproductive activities. I additionally compare the BEA measure of gross domestic product (GDP) with my estimate of the Marxist value added, also indicating that the gap between the two series is due to the double counting of value added in unproductive activities. I additionally plot my estimate of surplus value. The comparisons make clear how from a Marxist perspective the BEA artificially inflates its official annual measures of income and output by counting produced values more than once. Netting out unproductive activities from the measures of value creation makes a significant difference.

[Figure 1 about here]

In Figure 2 I plot my estimate for the rate of surplus value in the United States from 1947 to 2011. The rate of surplus value is the rate of exploitation of productive workers in productive activities measured as the flow of surplus value relative to the value of labor power. The value of labor power is, in turn, the variable capital measured as a flow of productive labor compensation.

The rate of surplus value was roughly stable during the ‘Golden Age’ from 1947 to 1966, implying that productive workers were exploited roughly at the same rate every year. Possibly due to labor militancy and low levels of unemployment, capitalists could not extract surplus value from workers at an increasing rate. From 1966 to 1980, the ‘crisis of Keynesianism’ period, the rate of surplus value dropped sharply. Possibly due to international competition with European and Japanese capitalists in global markets and to escalating labor militancy at home, the surplus of the capitalist class was indeed squeezed.

The Neoliberal period beginning in the early 1980s then produced a sharp recovery of the rate of exploitation. By the end of the 1980s it had significantly surpassed its previous peak in 1966. Possibly due to the erosion of workers' bargaining power and increased competition in labor markets, the rate of surplus value continued to rise to unprecedented levels in the entire postwar period. Raising from a low point of 125% in 1974 it reached 200% in 2011. This implies that in 2011 productive workers labored 1/3 of the time for themselves and 2/3 of the time for the capitalists.

[Figure 2 about here]

The rate of surplus value functions as an index of class struggle and indicates who has the margin of victory across different historical phases. The trends in the rate of exploitation of productive workers correspond to three different phases of postwar US capitalism. First, the Golden Age aligns with the years featuring a constant rate of exploitation (1947-1966). Second, the crisis of Keynesianism occurs when a falling rate of exploitation puts a squeeze on capitalists (1967-1979), suggesting that it was initially a crisis for capitalists which was transformed afterwards into a crisis for workers. The Neoliberal era then matches with a sustained increase in exploitation to record levels (1980-2011), suggesting that Neoliberalism is a class project of squeezing the compensation of productive workers to the benefit of the capitalist class.

In Figure 3 I plot my estimate of the rate of surplus value together with the profit-wage ratio calculated directly from the BEA data. To compute the profit-wage ratio I divide the gross operating surplus by total employee compensation series from the annual GDP by industry accounts under the Standard Industry Classification (SIC) system from 1947 to 1986 and under the North-American Industry Classification System (NAICS) from 1987 to 2011. The immediate conclusion is that the profit-wage ratio available from the official income accounts is not a good proxy for the rate of exploitation. Because it ignores the productive-unproductive distinction present in Marxist theory, the profit-wage ratio substantially underestimates the rate of surplus value. The profit-wage ratio homogenizes all economic activities while the rate

of surplus value explicitly considers that unproductive activities do not produce any surplus value. The gap between the two series reveals the weight of unproductive activity.

[Figure 3 about here]

In Figure 4 I plot my estimate of the rate of exploitation together with that from Shaikh and Tonak (1994). Not only is the level of the rate of surplus value different but also its trend. In contrast to my approach, Shaikh and Tonak classify all activities related to knowledge and information production as productive of surplus value, and they deduct supervisory workers from self-employed persons in productive activities. Other important technical differences in estimation methods are explained in detail in the Appendix.

[Figure 4 about here]

For Marx, exploitation is a crucial cause of inequality. To show how this relationship manifests in the postwar United States, I plot in Figure 5 my estimate of the rate of exploitation together with the top 0.1% income share (excluding capital gains) from Piketty (2014) and Alvaredo, Atkinson, Piketty, and Saez (2014). The similarity of trends is remarkable. The correspondence is all the more striking given that I estimate Marxist categories from input-output matrices while Piketty (2014) computes personal income inequality from Internal Revenue Service (IRS) tax data. The very high correlation between exploitation and inequality also holds if I use instead either the top 1% income share or the inverted Pareto-Lorenz inequality measure.

[Figure 5 about here]

In Table 1 I provide further evidence of how my new methodology can improve our understanding of the relationship among exploitation, inequality, and unproductive activity. I compute the correlation coefficients between my estimates of the rate of exploitation, Shaikh and Tonak's (1994) exploitation estimates, the official profit-wage ratio from the BEA, and Piketty's (2014) measures of income inequali-

ty for the US economy. The correlation coefficients between my estimate of exploitation and Piketty's top 1% income share is 0.95, 0.96 for the top 0.1% income share, and 0.94 for the inverted Pareto-Lorenz inequality coefficient. Correlation surely does not imply causality, but all measures are very close to unity. If we use instead Shaikh and Tonak's (1994) estimates we arrive at only 0.05, 0.26, and 0.45, respectively. If I truncate my estimates to stop in 1989, when Shaikh and Tonak's dataset ends, I still arrive at correlation coefficients between exploitation and inequality that are substantially higher. If we use the profit-wage ratio computed from the official BEA data, the correlations with Piketty's measures of inequality are also significantly lower than my estimates.

[Table 1 about here]

Since inequality is a different measure from exploitation in various ways, one would not expect the movements of the rate of exploitation to entirely explain movements of inequality. The rate of exploitation is computed from the functional distribution of income between productive workers and the surplus income that productive capitalists appropriate. Inequality is instead computed from the personal distribution of income across households, whether or not they are attached to productive activities. Despite the differences between the two measures, it is striking that the rate of exploitation is so closely correlated with the income share of the super-rich. This high correlation suggests that the rate of exploitation may be a major determinant of the degree of inequality.

5.2 The Magnitude of Unproductive Accumulation

Marxist theory posits that unproductive activity survive by consuming the surplus that productive activities generate. To better understand the magnitude of unproductive accumulation I plot in Figure 6 four different relative measures of unproductive accumulation, all in in terms of annual flows. The net income of unproductive activities relative to the surplus value generated in productive activities (the net unproductive burden, NUB) rises from a low point at 24.4% in 1948 to a peak at 78% in 2009, a rise of 220% in the period. The gross income of unproductive activities relative to the total value generated in

productive activities (gross unproductive burden, GUB) rises from a low point at 13.4% in 1948 to a peak at 53.6% in 2009, hence quadrupling over the same period. The net income of unproductive activities relative to the value added in productive activities rises from 14.1% in 1948 to 50.8% in 2009, a total rise of 260%. I then compute the surplus income of unproductive activities (SI_{UA}) as the net income of unproductive activities minus employee compensation in these activities, with no distinction between supervisory and nonsupervisory unproductive workers. The ratio of surplus income of unproductive activities to the surplus value from productive activities increases from 4.1% in 1948 to 16.8% in 2010, thus more than quadrupling over the period. These four estimates jointly offer strong evidence of the rapid pace of unproductive accumulation in the postwar US economy.

[Figure 6 about here]

In Figure 7 I further decompose the net income of unproductive activities (NI_{UA}) from 1947 to 2011 into the shares of five unproductive sub-categories: (i) government administration with the exception of productive government enterprises, consisting mostly of the government wage bill at all levels; (ii) finance and insurance; (iii) non-profit organizations and unproductive services, such as legal services and corporate management; (iv) real estate, comprising land-rents accruing to agents, managers, operators, and lessors (imputed owner-occupied rents are excluded); (v) knowledge and information rents, comprising all net incomes from activities involving advertising, pharmaceuticals, software production, data management, research and development, publishing industries, sound recording, and movie production.

[Figure 7 about here]

There is substantial growth in the shares of finance and insurance from 14% to 23.2%, and also in knowledge and information rents from 7.9% to 17.4%. Finance and knowledge rents combined have risen from 21.9% to 40.5% of the net income of all unproductive activity, hence nearly doubling in the postwar period. The share of government administration has shrunk from 37.7% to 29.9%, while the real estate sector has also shrunk from 23.8% in 1963 (when we began to have better real estate input-output data) to

16.8% in 2011. The share of non-profit, legal and corporate management services remained somewhat stable at around 11% since 1963 (when we also began to have better input-output data for these services).

Unproductive accumulation has its effect not only on value distribution but also on employment. Since the early 1970s the employment of unproductive workers has surpassed its productive counterpart. In Figure 8 I plot the number of productive and unproductive workers as shares of total employment. Productive workers are nonsupervisory workers in productive activities, and unproductive workers are supervisory workers in productive activities plus all workers in unproductive activities. The share of unproductive employment rises from 43% in 1947 to 56% in 2011, while the complementary share of productive workers drops from 57% in 1947 to 44% in 2011.

[Figure 8 about here]

In Figure 9 I plot the ratio of unproductive to productive employees together with the ratio of unproductive to productive compensation ($\frac{W_{UA}}{V}$). Up to 1986 the two series evolve closely with similar trends but move apart thereafter as unproductive labor compensation begins to increase faster than the increase in unproductive employment. Albeit using a different methodology, Mohun (2014; 2006) offers a decomposition of these two trends to reveal that the main culprit for the widening gap between compensation and employment after 1986 is the fast rise in wage inequality between supervisory and nonsupervisory employees in both productive and unproductive activities.

[Figure 9 about here]

The evidence so far presented indicates that while productive workers produce ever more surplus value, unproductive activities consume increasingly more of the surplus they produce. After 1980 the capitalist class in the United States has benefitted from increasing levels of labor exploitation in productive activities while concomitantly changing the composition of its investments away from productive activi-

ties. The effects of rising exploitation of productive labor combined with faster unproductive accumulation on profitability are analyzed in the next section.

5.3 Profitability and Unproductive Accumulation

In Figure 10 I plot my estimates of the general profit rate à la Marx (calculated through equation 3 as the flow of surplus value relative to the stock of fixed assets in all nonresidential activities) and the net profit rate (calculated through equation 4 by simply deducting the total compensation of unproductive employees from surplus value, so as to get a measure of net profit as $\Pi = S - W_{UA}$ relative to the total capital stock).

The general profit rate is an index of how the surplus value generated in productive activities compensates the investment in fixed assets in all productive and unproductive activities combined. It displays four distinct phases during the postwar period. First, during the Golden Age between 1947 and 1966 it is roughly stable at around 26.3%. Second, during the crisis of Keynesianism from 1966 to 1980 it plummets from 27.8% to 19.7%. Third, during the Neoliberal period it recovers from its depressed level at 19.7% in 1980 to a historical high at 28.6% in 1997, indicating that Neoliberal policies did restore profitability to the capitalist class. Fourth, from its peak at 28.6% in 1997 the profit rate falls significantly to 23% in 2009. The general profit rate was thus falling consistently during the ten years before the major crisis that began in late 2007.

The net profit rate shows how the share of surplus value that pays for unproductive labor affects profitability. It drops significantly from 12.2% in 1951 to 3.1% in 1974, and then hovers at around 4% thereafter with a low point at 2.6% in 2001.

[Figure 10 about here]

To portray the changing correlation between exploitation and profitability, in Figure 11 I plot the rate of surplus value together with the general profit rate. To facilitate the comparison I adjust the left and

right axes so as to make the two series overlap. The joint plot reveals a remarkable pattern. The rate of surplus value and the general profit rate tracked each other very closely until 1980. From 1947 to 1980 the trend of the general profit rate displayed the same behavior as the rate of exploitation of productive workers in productive activities. Beginning in the early 1980s, however, the rate of surplus value starts to rise significantly while the profit rate falls behind. The gap between the two series widens considerably every year between 1980 and 2011, indicating how profitability recovers but much less than the rising rate of exploitation of productive workers.

[Figure 11 about here]

In Figure 12 I plot the organic composition of capital ($OCC = \frac{K_{PA}}{V}$) together with the unproductive composition of capital ($UCC = \frac{K_{UA}}{V}$) for the entire 1947-2011 period. Both series rise over time even though with distinct behaviors. The OCC rises substantially from 1947 to a peak in 1982, but falls continuously until 2000. It then sharply recovers to record-high levels after 2000. The UCC rises continuously from 1953 to 1975 but stagnates from 1975 until the mid-1990s. Only by 1997 does the UCC reach its previous 1975 peak level. From 2000 onwards the UCC rises systematically to an extent that it outpaces the growth rate of the OCC. The joint plot in Figure 12 reveals that despite the historical rise in the OCC, the UCC has actually been rising faster and closing the gap between the two series since the 1980s.

[Figure 12 about here]

The unproductive capital stock has begun to increase faster than the productive capital stock exactly after 1980. I plot in Figure 13 the ratio of the UCC to the OCC, which is in turn equal to the ratio of the stock of fixed capital in all nonresidential unproductive activities relative to productive activities:

$\frac{UCC}{OCC} = \frac{K_{UA}}{K_{PA}}$. During the 1950s the $\frac{UCC}{OCC}$ ratio fluctuates around 70%, and then around 77% from 1963 to 1974. It then drops consistently until its lowest historical level in 1981. Beginning in 1981 the $\frac{UCC}{OCC}$ ratio

climbs faster and higher than in any other period. From 1981 to 2009 the ratio of unproductive to organic composition of capital rises 37.5%, a record increase for the postwar era.

[Figure 13 about here]

In order to check for the evolution of the determinants of profitability, in Figure 14 I plot jointly the rate of exploitation of productive workers, the OCC, the UCC, and the $\frac{W_{UA}}{V}$ ratio as index numbers (1980=100). Three remarks are necessary. First, during the crisis of Keynesianism from 1966 to 1979 the OCC rose substantially while the rate of exploitation fell, a combined effect that can explain the severe drop in profitability during this period. Second, the Neoliberal 1980-2011 era has been characterized by increasing levels of both exploitation and unproductive accumulation. Beginning in 1980, the UCC increases substantially above the OCC jointly with a rapid increase in unproductive labor compensation and a steep rise in the rate of exploitation. Third, two culprits for the drop in the general and net profit rates are the fast rise in the compensation of unproductive employees and the fast rise in the unproductive capital stock. Despite the rapid overall increase in the $\frac{W_{UA}}{V}$ ratio since 1947, the UCC rises faster than that for some brief periods and actually much faster than the $\frac{W_{UA}}{V}$ ratio after 2000.

[Figure 14 about here]

It is also possible to decompose the current-cost net stock of fixed assets of unproductive activities (inclusive of trade, rental, and leasing but excluding real estate) into five unproductive sub-categories: (i) trade, rental, and leasing; (ii) knowledge and information; (iii) finance and insurance; (iv) unproductive services; and (v) general government, excluding public enterprises. In Figure 15 I present the evolution of the shares of these five sub-categories from 1947 to 2011 in percentage terms. The major share still belongs to the general government even though it has shrunk from 86.2% in 1947 to 64% in 2011. The unproductive activities with the fastest growth rates in shares have been, in descending order: knowledge and information (from 0.8% to 5.0%); finance and insurance (from 1.7% to 10.3%); trade, rental, and

leasing (from 8.3% to 15.3%), and finally unproductive services (from 2.9% to 5.4%). Finance- and knowledge-related activities have grown their combined capital stocks six fold (or 502%) from 1947 to 2011 as a share of the total unproductive capital stock.

[Figure 15 about here]

In Table 2 I summarize the real growth rates of key measures of productive and unproductive forms of accumulation. Estimates are broken down into averages for the whole 1948-2011 postwar period, the Regulated period from 1948 to 1979, and the Neoliberal period from 1980 to 2011. I deflate each nominal series of current-cost fixed assets by the producer price index (PPI) and each nominal series of flow measures of income by the implicit GDP deflator to obtain real growth rates in 2005 dollars.

[Table 2 about here]

All measures of productive accumulation (total value, Marxist value added, surplus value, and the productive capital stock) exhibit substantial declines in the Neoliberal era compared to the earlier Regulated phase. The real growth rates of total value and of the productive capital stock are cut in half after 1980. The real growth rates of unproductive forms of accumulation, on the contrary, tended to be higher than their productive counterparts for the whole postwar period. The gross income and surplus income of unproductive activities, besides growing significantly faster than their productive analogues, also grew faster in the Neoliberal phase than in the Regulated period. The net income of unproductive activities and the unproductive capital stock (including trade, rental, and leasing, and excluding real state) grew slower in the Neoliberal phase but were still way above their productive counterparts during the same period. The growth rates of fixed assets in unproductive activities remained below the growth rates of fixed assets in productive activities prior to 1980, and stayed above after 1980. Finally, the empirical evidence shows that the transition period from an accumulation strategy prioritizing productive activities to a new pattern of accumulation prioritizing unproductive activities occurred between 1975 and 1986.

6. Conclusion and Implications

Marx developed a powerful value theory to critically analyze the evolution of capitalism. Marx, however, did not develop a value theory of commodified knowledge in capitalism. Not even the great Frankfurt School could offer a labor theory of value of knowledge and information as commodities. Predicated on Teixeira and Rotta (2012) I introduced the theory of knowledge as a valueless commodity that gives rise to knowledge-rents. I then integrated this key insight on the labor theory of value with the scholarship on unproductive accumulation in order to estimate the growing importance of rents associated with knowledge production. Together with other unproductive activities, knowledge production has contributed to the faster growth of unproductive accumulation and to the decoupling between exploitation and profitability. The empirical evidence indicates a close association between faster unproductive accumulation, greater exploitation of productive workers, rising overall inequality, and slower productive accumulation in the United States from 1947 to 2011.

With the new data series that I have estimated in this paper it becomes possible to carry out econometric analyses of the dynamic links between productive and unproductive forms of capital accumulation in the US economy — a contribution that will be the subject of another paper.

Footnotes

[1] According to Marxist theory, wagedworkers belong to the capitalist mode of production while self-employed workers belong to a different mode of production. Most of the Marxist literature views producers who both do the labor and own the means of production as “simple (or independent) commodity producers” and views a mode of production based on them as a non-class mode of production called “simple (or independent) commodity production” in which there is no surplus appropriation. In most of the Marxist literature it is assumed that some modes of production are not class-based, including primitive communism, simple commodity production, and communism. Contrary to this tradition, Resnick and Wolff (2006) interpret self-employed workers as belonging to the “ancient mode of production” in which the producers individually appropriate the surplus they produce. According to Resnick and Wolff, every mode of production has its own concept of surplus and therefore its own class structure. The concept of

productive labor derives from the concept of surplus, which in turn derives from the concept of mode of production. Each mode of production, they claim, has its own type of surplus and therefore its own criterion of productive labor. In any case, waged workers and self-employed workers can both produce commodities with value. In my analysis of productive labor I therefore prefer to combine the capitalist and the simple commodity production (or ancient) modes of production. Most current self-employed workers actually produce commodities with value and in many cases self-employment is just disguised capitalist exploitation. Many workers are not hired as workers but as unincorporated businesses because the true capitalists want to avoid payroll taxes and social security.

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Tables and Figures for the Main Text

Table 1: Exploitation and Inequality in the United States – Correlations (1947-2011)

	Correlation
Rate of Surplus Value and Top 1% income share - 1947 to 2011	0.95
Rate of Surplus Value and Top 0.1% income share - 1947 to 2011	0.96
Rate of Surplus Value and Inverted Pareto-Lorenz coefficient - 1947 to 2011	0.94
Rate of Surplus Value (Shaik and Tonak 1994) and Top 1% income share - 1948 to 1989	0.05
Rate of Surplus Value (Shaik and Tonak 1994) and Top 0.1% income share - 1948 to 1989	0.26
Rate of Surplus Value (Shaik and Tonak 1994) and Inverted Pareto-Lorenz coef. - 1948 to 1989	0.45
Rate of Surplus Value and Top 1% income share - 1948 to 1989	0.63
Rate of Surplus Value and Top 0.1% income share - 1948 to 1989	0.71
Rate of Surplus Value and Inverted Pareto-Lorenz coefficient - 1948 to 1989	0.70
Profit-Wage Ratio (from BEA) and Top 1% income share - 1947 to 2011	0.41
Profit-Wage Ratio (from BEA) and Top 0.1% income share - 1947 to 2011	0.34
Profit-Wage Ratio (from BEA) and Inverted Pareto-Lorenz coefficient - 1947 to 2011	0.29

Sources: Author's calculations; Shaikh and Tonak (1994); Piketty (2014); Alvaredo, Atkinson, Piketty, and Saez (2014); and BEA.

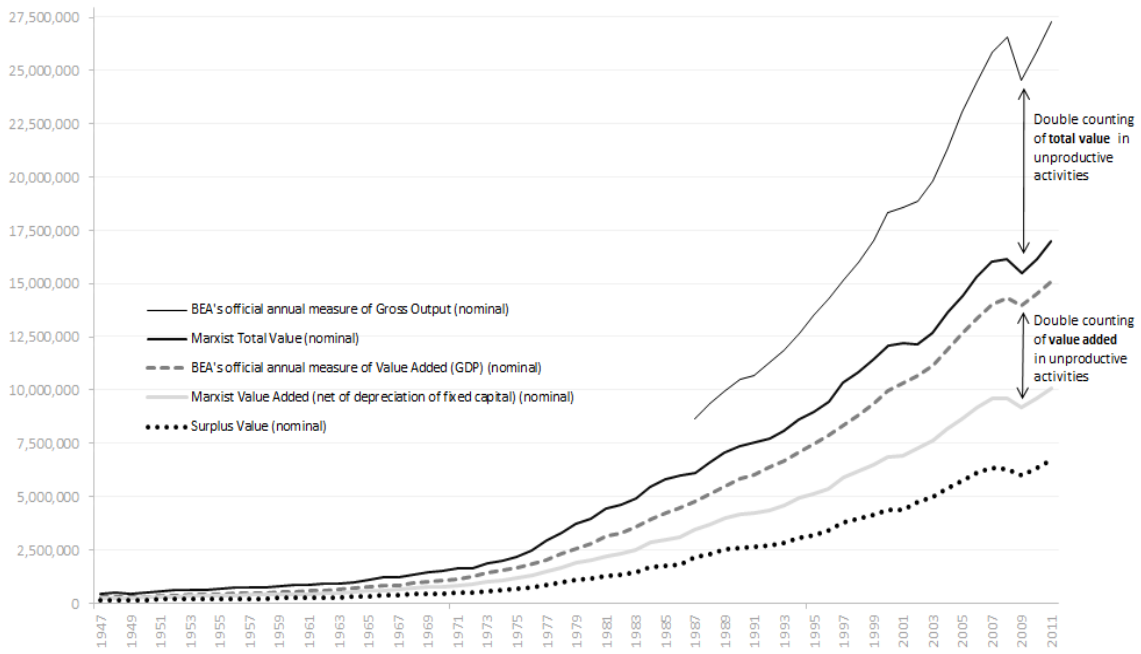
Table 2: Average Real Growth Rates (1948-2011)

	Whole period (1948-2011)	Regulated period (1948-1979)	Neoliberal period (1980-2011)
Productive Activity (PA)			
Total Value of PA	2.66%	3.46%	1.86%
Marxist Value Added of PA	2.89%	3.42%	2.37%
Surplus Value of PA	3.19%	3.50%	2.89%
Capital Stock of PA	3.30%	4.44%	2.16%
Unproductive Activity (UA)			
Gross Income of UA	4.73%	4.61%	4.84%
Net Income of UA	4.90%	5.62%	4.19%
Surplus Income of UA	10.31%	9.41%	11.21%
Capital Stock of UA (nonresidential only)	3.29%	3.47%	3.12%

Sources: Author's calculations. Real growth rates are all in 2005 dollars.

Notes: Real growth rates were obtained by deflating nominal flow measures by the implicit GDP deflator, and nominal stock measures by the producer price index (PPI). Marxist VA, surplus value, gross and net incomes of unproductive activities are all net of depreciation of fixed assets.

Figure 1: Marxist Categories and Official Measures of Output (1947-2011) – Millions of Dollars



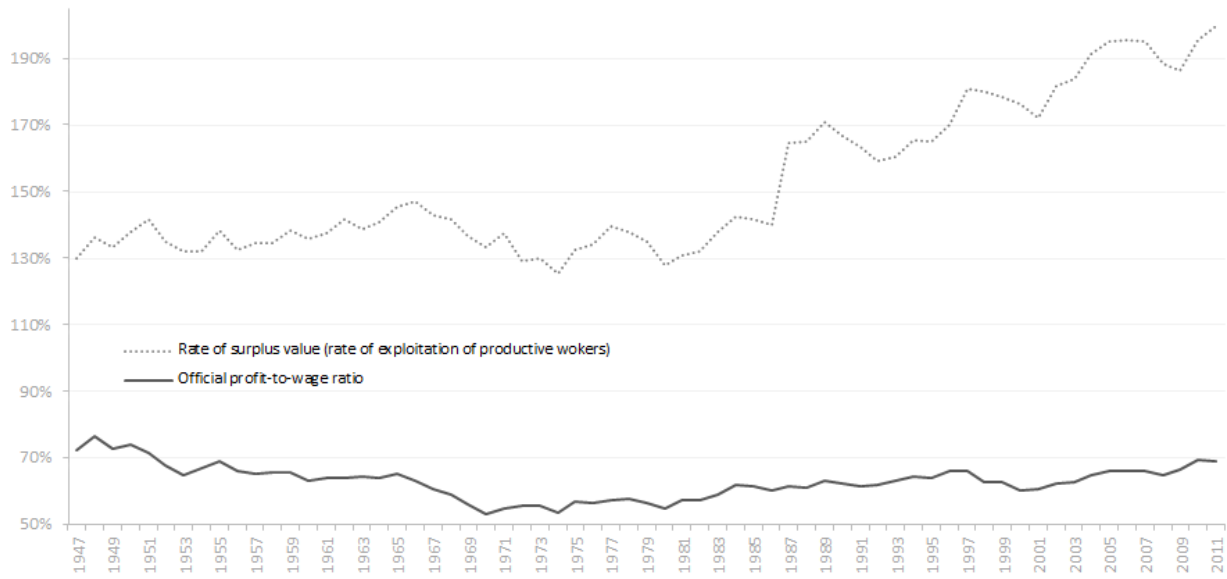
Sources: Author's calculations and BEA. All figures are nominal in millions of US dollars.

Figure 2: Rate of Surplus Value (1947-2011)



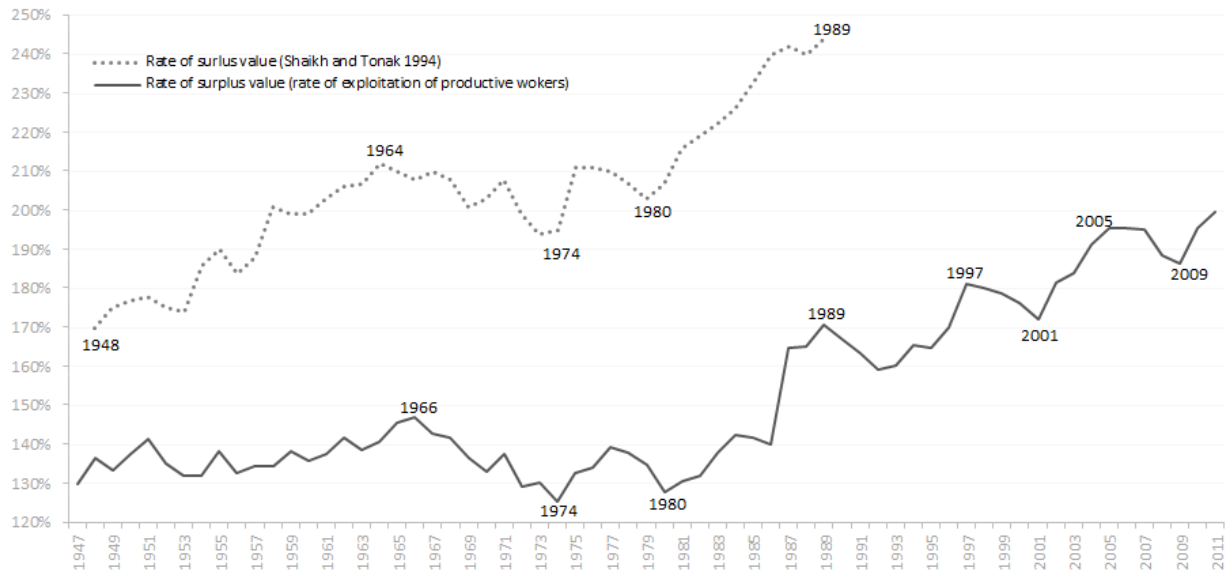
Sources: Author's calculations.

Figure 3: Rate of Surplus Value and Profit-Wage Ratio (1947-2011)



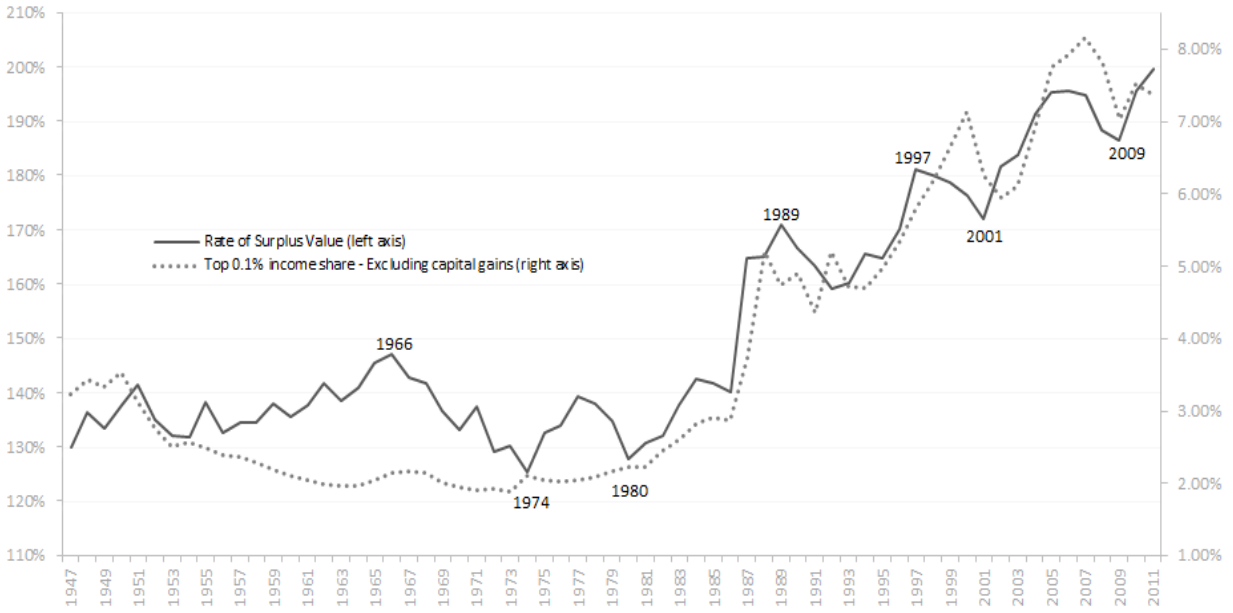
Sources: Author's calculations and BEA.

Figure 4: Comparison between Rates of Surplus Value (1947-2011)



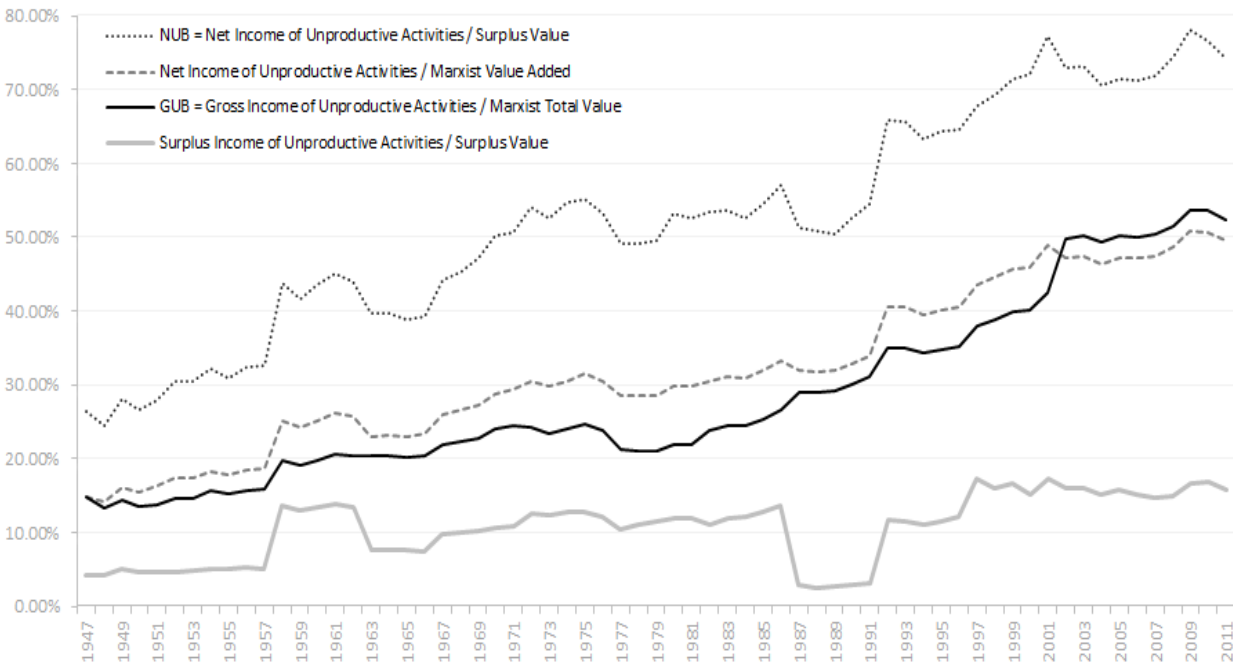
Sources: Author's calculations, and Shaikh and Tonak (1994).

Figure 5: Rate of Exploitation and Top 0.1% Income Share (1947-2011)



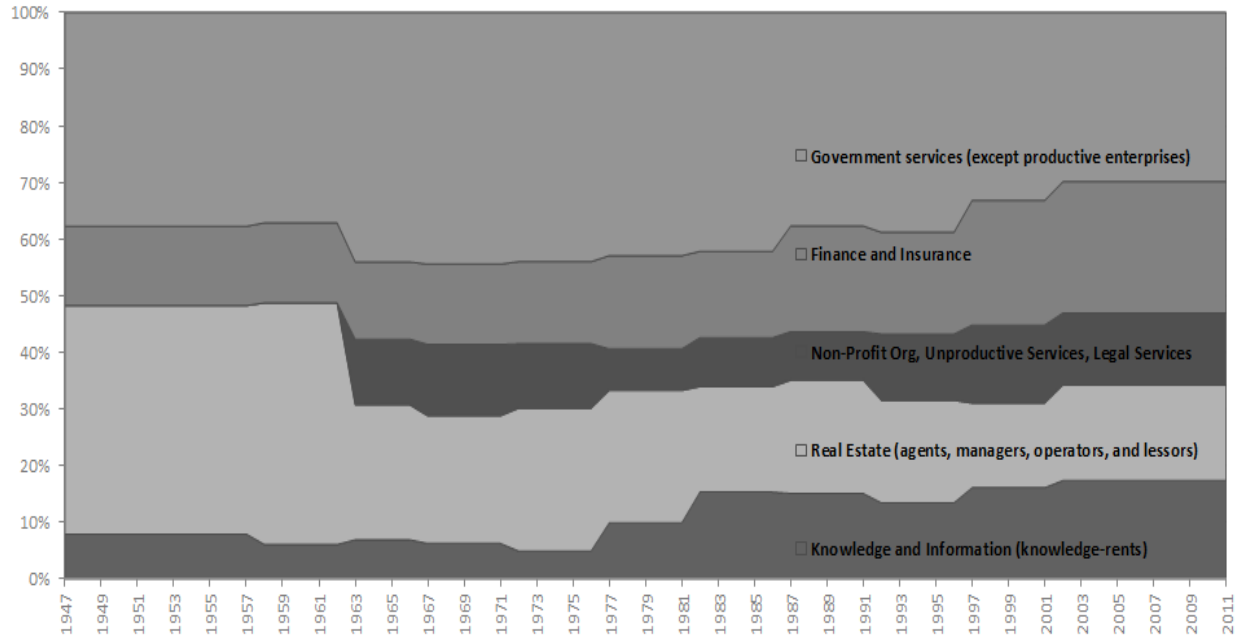
Sources: Author's calculations; Piketty (2014); Alvaredo, Atkinson, Piketty, and Saez (2014).

Figure 6: Relative Measures of Unproductive Accumulation (1947-2011)



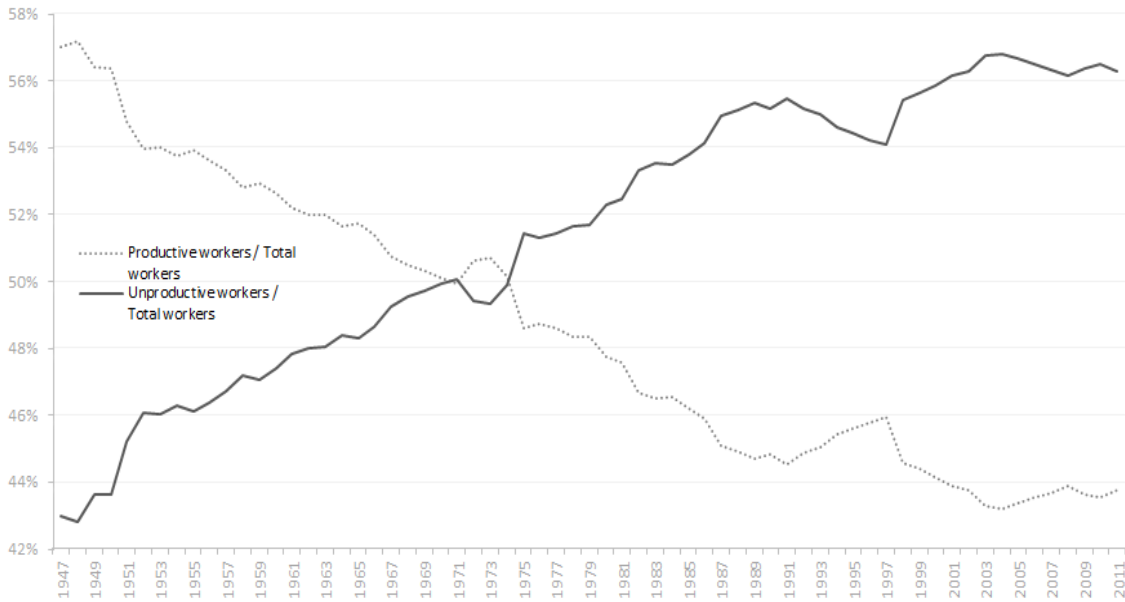
Sources: Author's calculations.

Figure 7: Decomposition of the Net Income of Unproductive Activities (1947-2011)



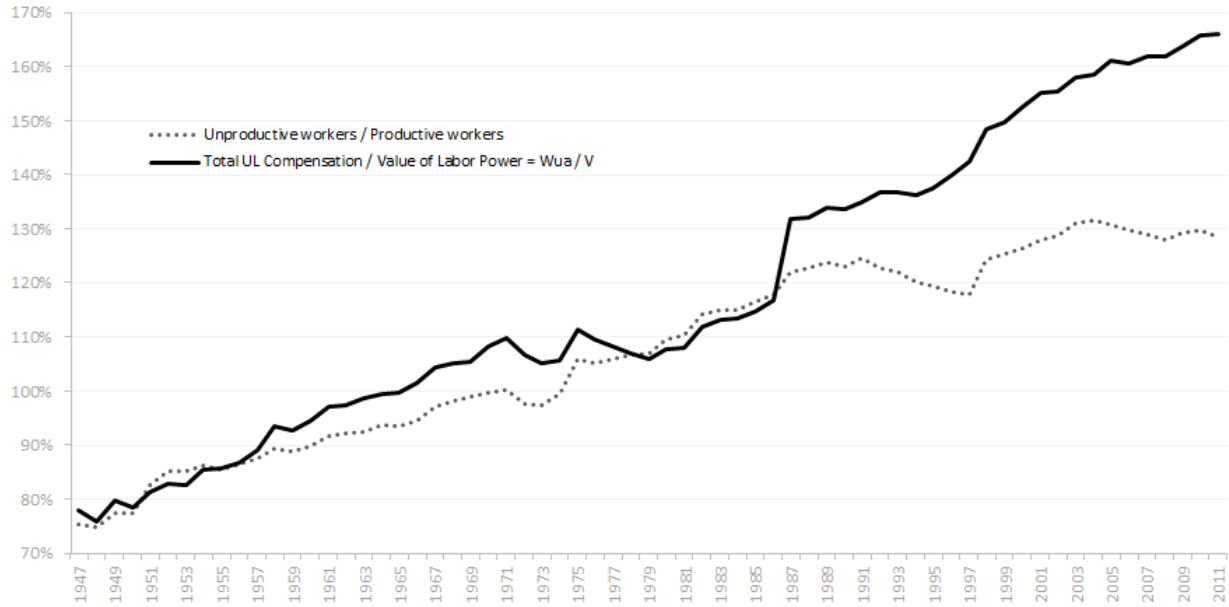
Sources: Author's calculations.

Figure 8: Productive and Unproductive Shares of Total Employment (1947-2011)



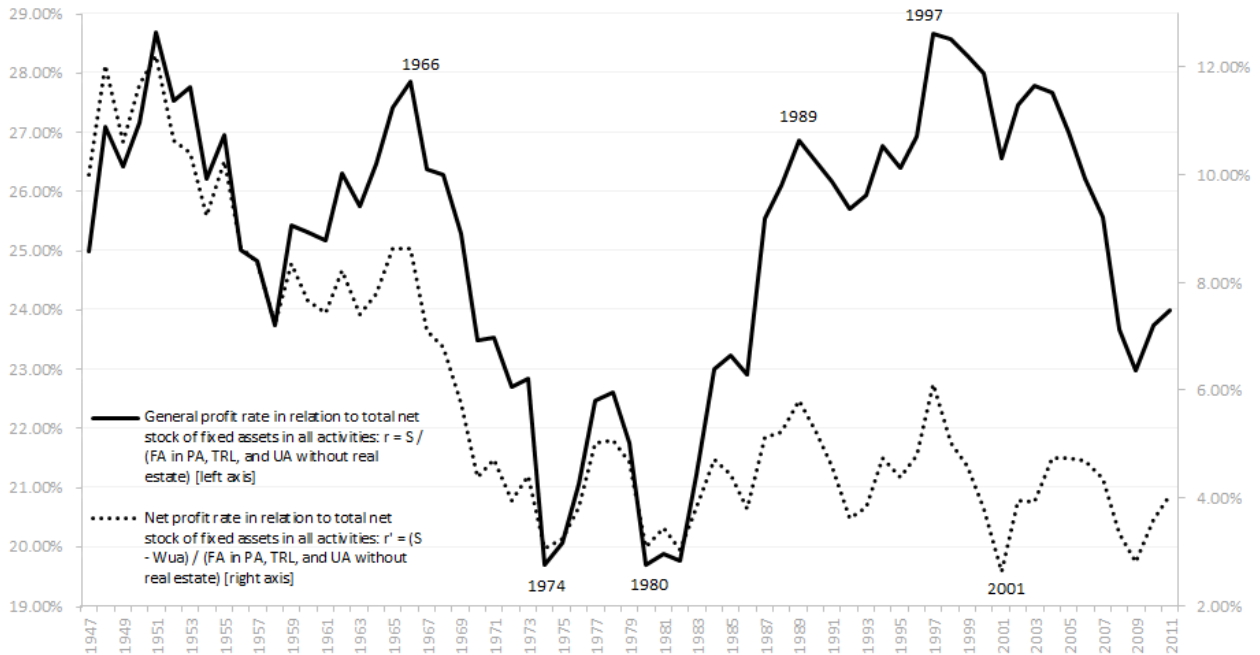
Sources: Author's calculations.

Figure 9: Employment and Compensation of Unproductive Workers Relative to Productive Workers (1947-2011)



Sources: Author's calculations.

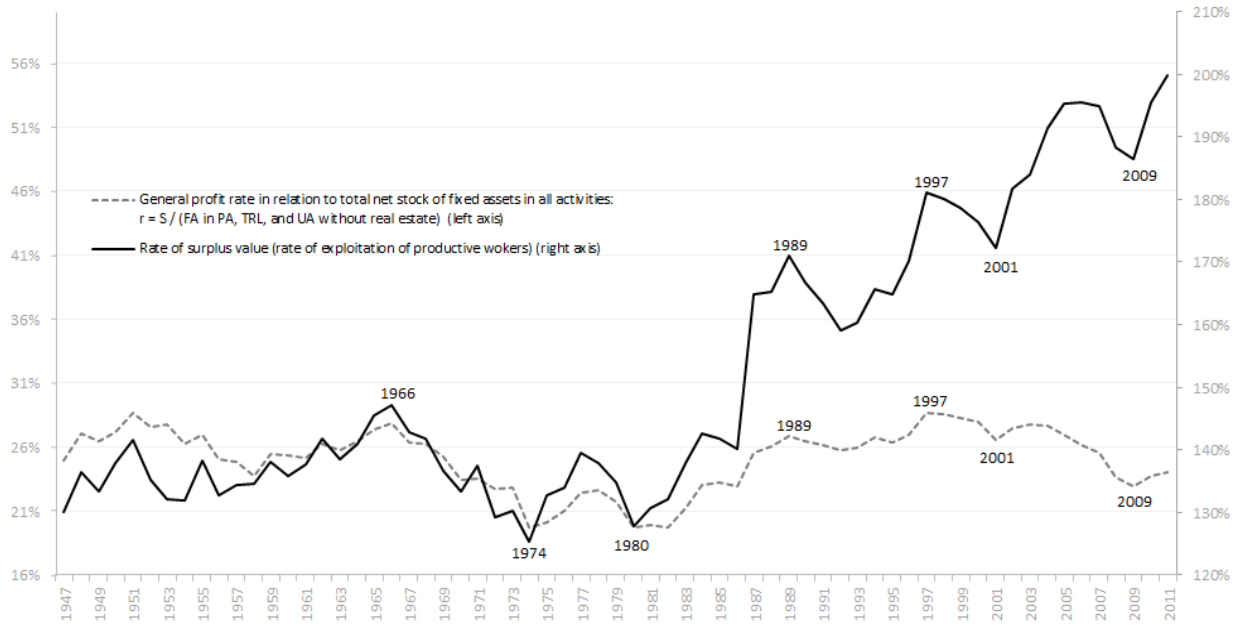
Figure 10: General Profit Rate and Net Profit Rate (1947-2011)



Sources: Author's calculations using equations 3 and 4 above.

Note: S = surplus value; Wua = total compensation of unproductive labor; PA = productive activities; TRL = trade, rental, and leasing; UA = unproductive activities; FA = fixed assets.

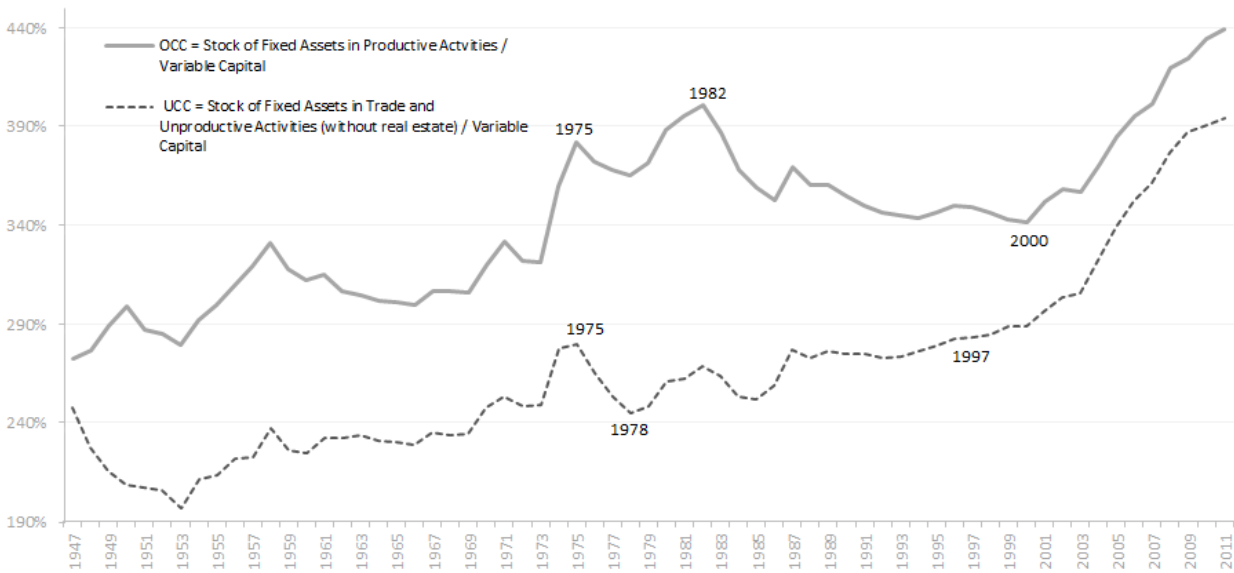
Figure 11: General Profit Rate and Rate of Surplus Value (1947-2011)



Sources: Author's calculations.

Note: S = surplus value; PA = productive activities; TRL = trade, rental, and leasing; UA = unproductive activities; FA = fixed assets; r = general profit rate.

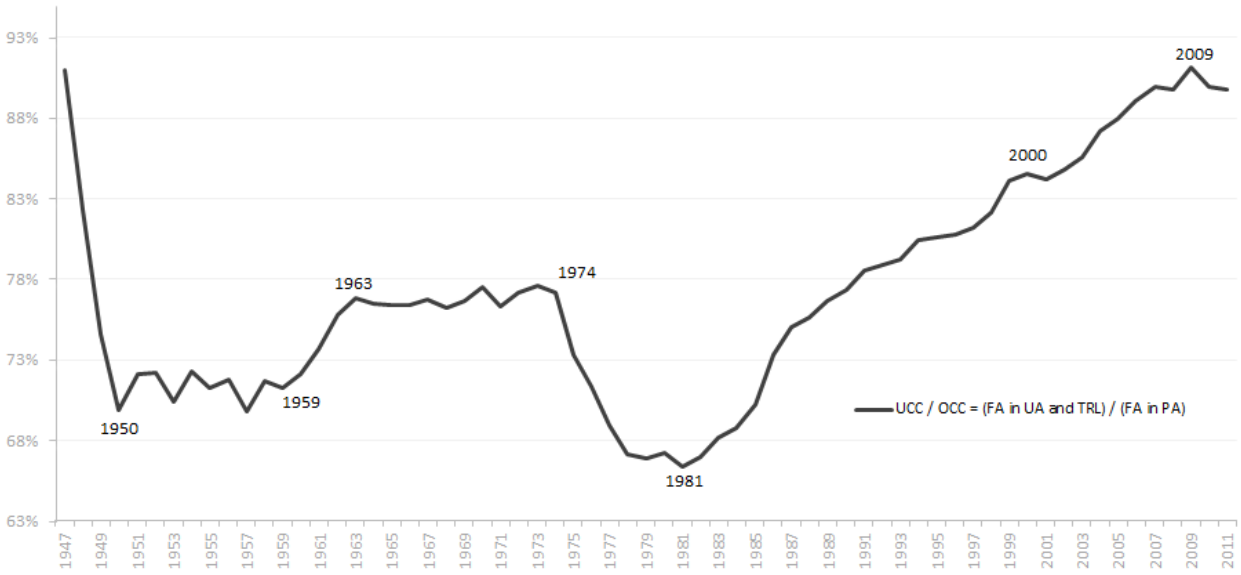
Figure 12: Organic and Unproductive Compositions of Capital (1947-2011)



Sources: Author's calculations.

Note: OCC = organic composition of capital; UCC = unproductive composition of capital.

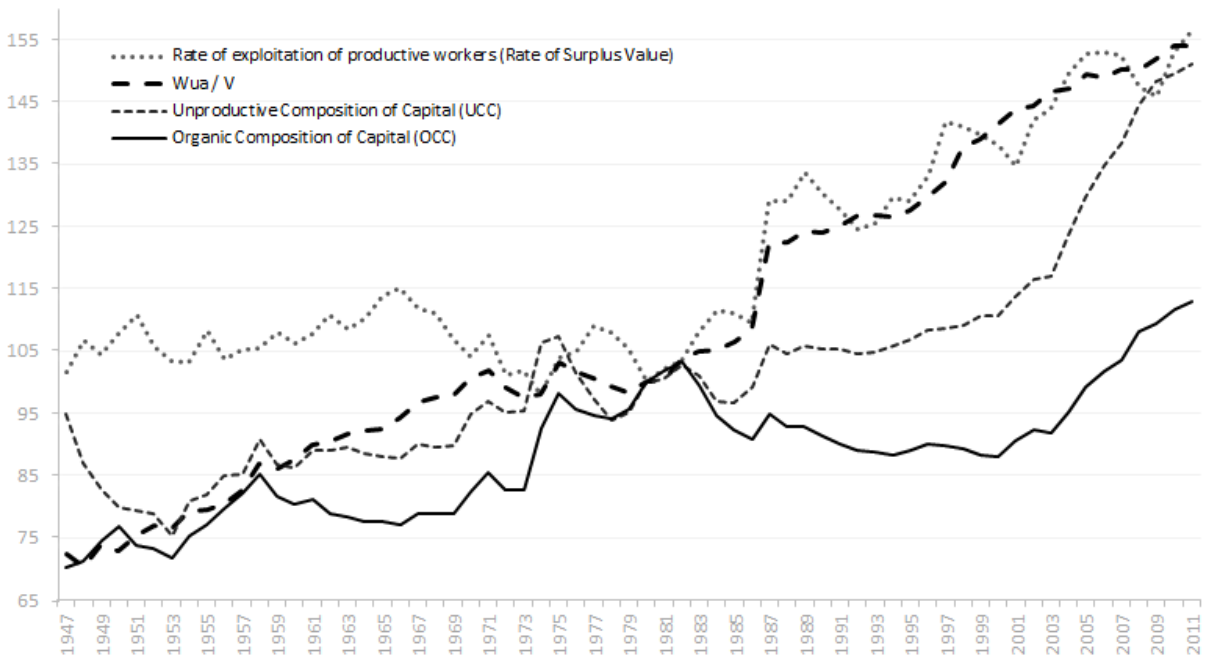
Figure 13: Ratio of Unproductive to Organic Composition of Capital (1947-2011)



Sources: Author's calculations.

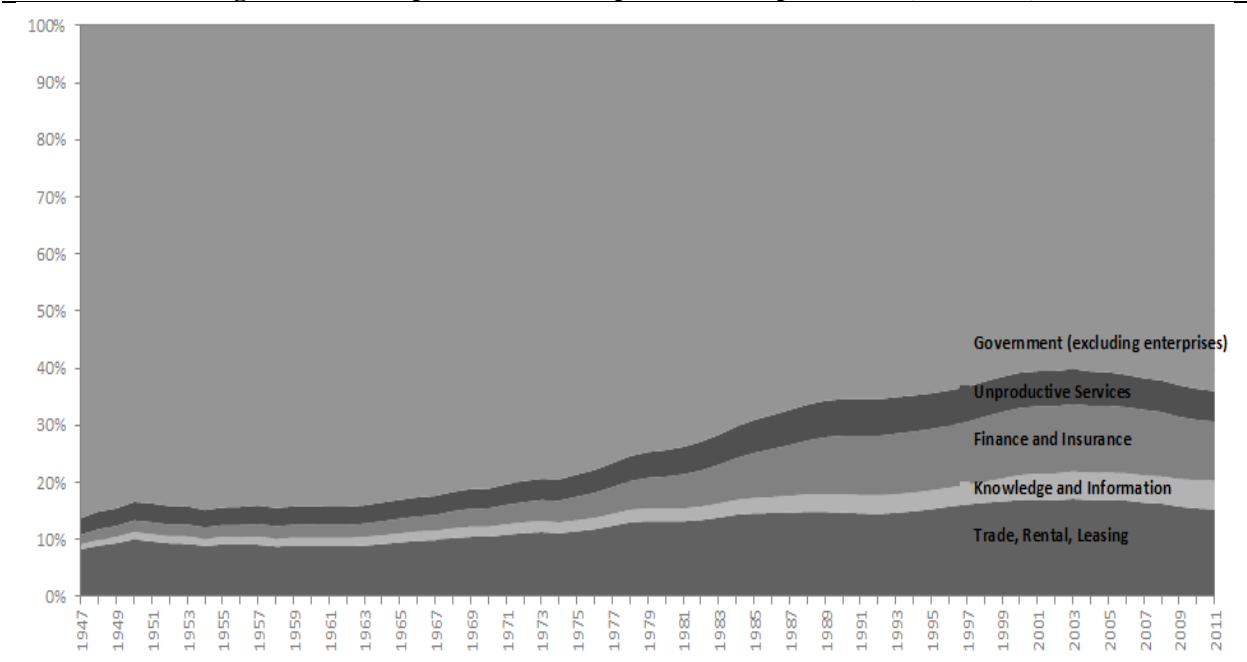
Notes: OCC = organic composition of capital; UCC = unproductive composition of capital; FA = fixed assets; PA = productive activities; TRL = trade, rental, leasing; UA = unproductive activities.

Figure 14: Components of Profitability (1947-2011)



Sources: Author's calculations. All measures are cast in index numbers, 1980=100.

Figure 15: Decomposition of the Unproductive Capital Stock (1947-2011)



Sources: Author's calculations.

APPENDIX

ESTIMATING MARXIST CATEGORIES FOR THE UNITED STATES ECONOMY

A.1 Introduction

In this appendix I explain step-by-step how I estimated Marxist categories for the postwar United States economy using publicly available information from 1947 to 2011. I explain in detail: (i) how to obtain the necessary data from input-output matrices, national income accounts, and employment statistics; (ii) how to apply the Marxist Industrial Classification System (MICS); and (iii) how to convert official income and asset measures into estimates of Marxist categories.

A.2 Data Sources

In order to estimate the Marxist total value produced in the United States it is necessary to have detailed industry-level information on the national gross output, which includes both the value added as well as the inputs used up. The only way to obtain historical information on value added and intermediate inputs with the required level of detail is through the benchmark input-output matrices. For any single year, an input-output table consolidates the three approaches to value added: the sum of final uses or expenditures, the sum of all incomes, and the sum of all contributions from all industries net of their respective inputs. However, since benchmark input-output matrices are calculated roughly every five years it is also necessary to interpolate with estimates from annual GDP by industry data.

Aggregate and industry-level information are available through the Bureau of Economic Analysis (BEA) and the Bureau of Labor Statistics (BLS). From the BEA I use: (a) the benchmark input-output tables, compiled roughly every five years; (b) annual GDP by industry data using both the most recent North American Industry Classification System (NAICS) and the former Standard Industrial Classification (SIC); (c) data on stocks of fixed assets from the BEA Fixed Assets Accounts (FAA); (d)

annual data on total employees and nonsupervisory workers per industry from the BLS; (e) price indices such as the producer price index (PPI) from BLS.

The first obstacle in estimating historical series is that BEA's methodologies and industry classification systems are neither stable nor consistent across input-output tables and GDP by industry accounts for the same year. The second obstacle is that BEA's methodologies and the industry classification systems are not entirely consistent through time. Even more, employment data from the BLS is based on a different industry classification system and hence must be adjusted when combined with the BEA series.

Benchmark input-output (I-O) matrices are available for 1947, 1958, 1963, 1967, 1972, 1977, 1982, 1987, 1992, 1997, and 2002. The closer to the present date the more details they contain. The I-O tables for 1947 and 1958 are available at the two-digit SIC level for 85 industries. For 1963 it is available at the four-digit SIC level for 387 industries. For 1967, 1972, 1977, 1982, 1987, and 1992 they are available at the six-digit SIC level for 484, 496, 537, 498, 570, 498 industries, respectively. The 1997 and 2002 benchmark I-O tables shift to the NAICS system and display, respectively, 494 and 428 industries. Prior to 1982 it is necessary to manually mount each I-O matrix and manually assign industry labels to every single row and column.

Input-output matrices display at the same time the income (revenues) side as well as the expenditure (uses) side of gross output and gross product. Incomes for each industry are organized vertically in columns while expenditures for the same industries are organized horizontally in rows. Inter-industry exchanges are shown as intermediate inputs on the income side and as intermediate demands on the expenditure side. Beginning in 1977 the value added component of each industry in the detailed I-O tables is decomposed into employee compensation, indirect business taxes, and gross operating surplus. For the summary I-O tables, which display 85 industries only, the decomposition of value added by industry begins in 1967. This implies that information on employee compensation and profit-type

incomes is not available at all before 1967 and available between 1967 and 1977 solely at the summary level with industries grouped at the two-digit SIC system.

In 1987 the BEA also began to publish redefined benchmark I-O matrices by reassigning some secondary products and their associated inputs to the industry in which they are the primary products. The standard I-O tables assign both primary and secondary products to each industry as originally reported by businesses. From the original standard tables the BEA then computes the redefined tables to include the redefinitions made when the input structure of the industry's secondary product differs significantly from the input structure of its primary product. For example, the restaurant services in hotels are redefined from the accommodations industry to the food services industry. These redefined tables are referred to as 'after redefinition'. Redefinitions affect numerous industries in the I-O accounts, mainly wholesale trade, retail trade, construction, publishing industries, and accommodations and food services. As a result of redefinitions, the total value of secondary products is decreased, and the total value of primary products is increased by the same amount. However, commodity outputs are not affected, only industry outputs (BEA, 2009; 2011).

For the years not covered in the benchmark I-O tables it is necessary to interpolate with the BEA GDP by industry data available annually from 1947 to 2011. Through the GDP by industry sheets it is possible to obtain information on value added, employee compensation (EC), profit-type income (gross operating surplus), full-time and part-time workers (FTPT), full-time equivalent workers (FEE), and persons engaged in production (PEP). Annual data on gross output and input costs are available only from 1987 onwards. The GDP by industry series are available at the industry level but unfortunately with a different industry classification system than the I-O tables since the aggregation methods that the BEA employs are different between I-O tables and GDP by industry series.

Besides the differences concerning the aggregation method employed in I-O matrices for any single year, the GDP by industry aggregation method also changes through time. From 1947 to 1997 the

BEA uses the SIC system while from 1977 to 2011 it employs the NAICS. Unfortunately, in the 20 years from 1977 to 1997 when the two methods overlap the SIC and NAICS systems do produce different results. The methodology that I propose to transform the official series into Marxist categories corrects for the *cross-sectional* and *temporal* differences and therefore generates more consistent annual estimates.

Information on stocks of fixed assets and depreciation by industry is available through the BEA's Fixed Assets Accounts (FAA). For the Marxist estimates I use series on current-cost net stocks of fixed assets by industry, which comprises stocks of buildings, equipment, and software at replacement costs. For stocks of assets and their respective depreciations I combine the datasets from nonresidential private entities with the federal, state, and local government entities.

The official measure of fixed asset depreciation includes the physical deterioration of buildings and equipment as well as the obsolescence due to new technological advances, implying that depreciation also measures early retirements and discards as assets are withdrawn from service while still being productive. For the annual depreciation estimates the BEA no longer applies the straight-line depreciation model with assumed patterns of retirements. It now uses a new model with a geometric pattern approximating the empirical evidence on the prices of used equipment and structures in resale markets (Fraumeni, 1997). A geometric pattern is a specific type of accelerated pattern which assumes higher dollar depreciation in the early years of an asset's service life than in the later years. The geometric pattern of depreciation is also the default option when information on specific assets is unavailable. For some assets such as autos, computers, missiles, and nuclear fuel, the BEA uses a nongeometric pattern of depreciation.

Finally, to separate supervisory from nonsupervisory employees I use industry-level data from the BLS on the total number of employees and the number of production and nonsupervisory workers. Also from BLS I use the producer price index (PPI).

A.3 Applying the Marxist Industry Classification System

The Marxist Industry Classification System (MICS) provides a way to regroup industries into three categories that reflect Marxist theory and the fact that knowledge-commodities are valueless and whose production belong to unproductive activity. The initial task consists of applying the MICS to the available data from the BEA and BLS. In the tables and figures that follow I explain the steps of this procedure.

I use the MICS to also make compatible the North-American Industry Classification System (NAICS) and the Standard Industry Classification (SIC) methodologies. Earlier works (as in Shaikh and Tonak, 1994, and Wolff, 1987) did not have to consider the compatibility issue since the SIC system was the only one available. However, starting in 1997 the official industry classification changed to the more recent NAICS. A key difference between the two systems is the treatment of the real estate sector, given that in the NAICS the fictitious ‘owner-occupied housing’ industry is implicitly included in the measure of value added. The transition between industry classification methodologies poses two problems. First, the NAICS and SIC produce different estimates for the years when the two series overlap. Second, the change in methodology creates discrete jumps over time in some of the series. The MICS provides a common ground necessary to deal with datasets that differ in methodology across series and over time, and therefore allows for the construction of more consistent estimates covering the entire 1947-2011 period.

In Table A.1 I apply the MICS to the 2002 benchmark I-O matrix, the last one that the BEA has made available. Earlier I-O matrices were regrouped in a similar way. In Table A.1 I also display the input-output industry codes to facilitate identification.

[Table A.1 about here]

In Table A.2 I apply the MICS to the BEA GDP by industry accounts that originally employed the SIC system for the 1947-1997 period.

[Table A.2 about here]

In Table A.3 I apply the MICS to the BEA GDP by industry accounts that originally employed the NAICS for the 1977-2011 period. In Table A.2 and Table A.3 the indentation indicates the level of industry aggregation: the more to the left the greater is the level of aggregation, and the more to the right the lower the level of industry aggregation. In Table A.1, on the contrary, there is no indentation and all industries are at the lowest level of aggregation.

[Table A.3 about here]

In Table A.4 I apply the MICS to the BEA net stock of fixed assets and depreciation accounts (FAA) under the NAICS for the 1947-2011 time period, combining private and public nonresidential fixed assets. Unlike the GDP by industry accounts that use both the NAICS and the SIC system, the BEA has a complete series for the whole postwar period for fixed assets and depreciation using only the NAICS.

[Table A.4 about here]

In Table A.5 I apply the MICS to the 1947-2011 BLS series on total employees per industry under the NAICS. The series are from the national annual Current Employment Statistics (CES) survey, not seasonally adjusted. In Table A.5 I also display the BLS industry codes to facilitate identification.

[Table A.5 about here]

[Table A.6 about here]

In Table A.6 I apply the MICS to the 1947-2011 BLS series on production and nonsupervisory workers per industry that originally used the NAICS and the SIC system. The series are from the national annual CES survey, not seasonally adjusted. The series using the SIC were discontinued in 2002 so it is necessary to combine it with the series under the NAICS. In Table A.6 I also display the BLS industry and series codes to facilitate identification.

A.4 Transforming Official Data into Marxist Categories

The task of this section is to provide a step-by-step explanation of how to transform the official BEA and BLS series into the desired Marxist categories.

Step 1: Apply the MICS to the Benchmark Input-Output Matrices

All benchmark I-O tables from 1947 to 2002 are available through the BEA. The first task is to properly mount the ‘*use*’ matrices and assign industry labels corresponding to each SIC and NAICS codes for every row and column. Matrix sizes vary across years but each detailed I-O table is usually a matrix with roughly 500 rows by 520 columns. Rows indicate the industries producing outputs that are then used as inputs by the industries indicated in columns.

When read vertically, columns in I-O tables show industry gross outputs (GO) in current dollars. Inputs are displayed first and the decomposition of value added appears at the bottom. Value added usually appears divided into four rows: inventory valuation adjustment (IVA), employee compensation (EC), indirect business taxes (IBT), and gross operating surplus (GOS). When read horizontally, rows in I-O tables show industry gross products (GP) in current dollars. Intermediate demands are displayed first and the decomposition of final demand appears at the right-end of the table. Final expenditures usually appear divided into standard categories: personal consumption, investment in fixed assets and inventory adjustments, government purchases (local and federal, military and nonmilitary), imports and exports.

Input-output tables published prior to 1997 have industries assorted according to the SIC system. The NAICS has been applied solely to the 1997 and 2002 matrices. As long as each industry for every benchmark year is properly labeled with the corresponding codes and names, it is then possible to re-assort rows and columns according to the MICS. After the MICS has been applied, the interior input matrix of the Marxist I-O table should be symmetrical in term of industries in rows and columns. At the bottom we still have the decomposition of value added, and the far right we still have the decomposition of final demand.

In Figure A.1 I show a stylized Marxist I-O table that represents how actual benchmark I-O tables are to be organized after applying the MICS, independently of their sizes. The procedure is similar to that of Shaikh and Tonak (1994, p.74) but with the key difference that activities associated with the production of knowledge and information are classified as unproductive. The procedure deals solely with incomes and revenues by industry and not with expenditures or uses, hence I do not show the expenditures side of the I-O matrix. In a Marxist I-O table we should have productive activities (PA) grouped together row- and column-wise at the top-left, then trade margins and rentals (TRL) in the middle-center, and finally unproductive activities (UA) grouped together row- and column-wise at the bottom-right. The dummy industries (government, household, rest of the world, scrap, and noncomparable imports) should be placed right after unproductive activities.

[Figure A.1 about here]

The total shaded grey area in Figure A.1 represents the total value (TV) produced. The dark grey area represents a first approximation to surplus value (S). The top-left light grey area represents the circulating (non-fixed) part of constant capital (C), while the lower light grey area represents a first approximation to variable capital (V). Since official I-O tables are cast in producers' prices, the rows corresponding to trade margins must also be included in the light grey area representing the productive inputs to productive activities. For the same reason the first approximation to surplus value (S) must

include all columns associated with trade and rentals. The gross income of unproductive activities (GI_{UA}) is the row-sum of all columns grouped under unproductive activities. I additionally indicate the areas representing the productive inputs to productive activities (which corresponds to a first approximation to the measure constant capital), unproductive costs to productive activities (which is part of surplus value), productive inputs to unproductive activities, and finally unproductive costs to unproductive activities.

Step 2: Deal With Specific Industries

From the Marxist I-O tables reflecting the MICS we can then proceed to fine-tune some specific industries. The necessary changes are as follows.

The official real estate sector comprises three different activities: (i) real estate brokerage, officially named ‘real estate’, which must be shifted to the unproductive group since it represents land rents; (ii) fictitious rents imputed to owner-occupied dwellings, which must be excluded altogether since the BEA treats homeowners as businesses renting their homes to themselves; (iii) rental and leasing of equipment, which must be shifted to the trade, rental, and leasing (TRL) group since it consists of piecemeal sales of commodities.

The entries in the household dummy industry row and column contain payments and incomes of household servants when they are not hired by an enterprise. Since household servants do not create any surplus value but merely use-values directly consumed by the household, they are part of a non-capitalist mode of production. Household do produce a surplus product but they are paid out of incomes, not capital. When servants are hired by an enterprise, such as home cleaning business, it then appears as a productive service. As it stands, the household dummy row and column should be excluded altogether.

The dummy row and column associated with ‘rest of the world adjustment’ can also be excluded. This entry reflects the incomes of US businesses abroad and therefore consists of an adjustment industry that offers the bridge between the domestic and national products. I exclude these entries since my focus is the domestic and not the national production of surplus value.

Federal, state, and local government enterprises should be put together with productive activities. Federal, state, and local government administration, on the other hand, should be grouped with unproductive activities. The revenues that support government offices and civil servants are deductions from surplus value and in order to avoid double counting of values they must be grouped together with unproductive activities. Additionally, the BEA records the wages and salaries of government employees in a dummy column and row (often labeled 'general government') whose entries represent the wage bill of civil servants. Since these wages are incomes drawn from surplus value, the respective row and column must be shifted to the unproductive activity grouping.

The retail and wholesale trade rows and columns can be directly grouped as trade activities. The rental of equipment and the lease of commodities should also be added to the trade activities group. The rental of information and knowledge-commodities such as the rental of movies, DVDs, CDs, and software, however, should be considered unproductive activity since those commodities carry no value or surplus value.

Every industry should be properly classified and separated both column- and row-wise into one of the three grouping specified in the MICS. We can then proceed to simplify each Marxist I-O table so as to make them resemble the one depicted in Figure A.2, in which I show the simplified Marxist I-O matrix derived from the official 2002 benchmark I-O table. It is a simplified matrix because it shows only the row and column sums within each MICS grouping.

[Figure A.2 about here]

As long as all benchmark I-O matrices are transformed into Marxist I-O tables using the MICS, and as long as we deal with specific industries as outlined above, we can then construct a simplified Marxist I-O table similar to the one in Figure A.2 for each of the BEA benchmark I-O matrices.

Step 3: Interpolate with Annual Data Converted to MICS

Benchmark I-O matrices are much more complete and detailed than any other industry series. Only benchmark I-O tables have detailed information on the inter-industry flows of inputs and outputs, but unfortunately these matrices cover only some specific years. To bridge this gap it is possible to interpolate the years not covered by the benchmark tables using the BEA annual data on GDP by industry. The GDP by industry series, contrary to I-O matrices, do not have information on the production and uses of intermediate goods. The solution is to calculate the ratios of the benchmark I-O entries to corresponding entries in the annual GDP by industry series and then extrapolate them to the non-benchmark years.

First, as explained in Step 1, I apply the MICS to all official benchmark I-O matrices using Table A.1 in order to get Marxist I-O matrices just like the one depicted in Figure A.1. Second, as explained in Step 2, I fine-tune specific industries and then calculate the row and column sums within each of the three MICS groupings. It is then possible to calculate simplified Marxist I-O matrices similar to the one depicted in Figure A.2 for each benchmark year. Third, I apply the MICS to the BEA GDP by industry series on value added. From 1947 to 1997 I use the SIC series on value added and apply the MICS as specified in Table A.2. From 1977 to 2011 I use the NAICS series on value added and apply the MICS as specified in Table A.3. I do not use the NAICS series on value added prior to 1977 because data is missing for many industries. Unfortunately the methodologies used under the NAICS and SIC are different and a quick check on the overlapping years from 1977 to 1997 reveal that they do produce different estimates.

The purpose of Step 3 is to estimate a series of value added for productive activities, trade, and unproductive activities from 1947 to 2011 from the GDP by industry annual data that can then be used for interpolation. In this procedure, special care must be taken with the real estate row. In the SIC series the real estate industry can be broken down into ‘housing’ (consisting of the fictitious imputation for owner-occupied housing) and ‘other real estate’ (consisting of land rents). As can be seen in Table A.2 I simply

delete the 'housing' row and then move the 'other real estate' row to the unproductive activities group. The problem emerges, surprisingly, with the newer NAICS series in which it is not possible to exclude the fictitious imputation for owner-occupied housing given that only one row is displayed for the entire real estate sector. In this case I exclude the owner-occupied imputation from the NAICS series by comparing the SIC and NAICS series during the 20 years from 1977 to 1997 when the two datasets overlap. I calculate that between 1947 and 1997 the SIC real estate sector was on average composed of 25% of land rent and 75% of fictitious owner-occupied housing. I then exclude 75% of the real estate row entries in the NAICS series, which brings it very close to the real estate sector estimate without owner-occupied housing in the SIC series for the overlapping years between 1977 and 1997. Since this method produces a very close estimate for land rents between the two series I then apply it to the whole 1977-2011 period in the NAICS data.

With this procedure I can obtain value added for every year for the three industry groupings in the MICS. The removal of the owner-occupied housing brings the 1977-2011 NAICS series in line with the 1947-1976 SIC series on value added per Marxist industrial grouping. The end result is three 1947-2011 time series of value added for productive activities, trade, and unproductive activities that properly combine the original SIC and NAICS series.

The next task consists of calculating the ratios of the entries in the simplified Marxist I-O matrices to the respective value added estimates from the annual GDP by industry dataset for all of the benchmark years. Starting from the scheme depicted in Figure A.2 I divide all the main entries in the 'productive activities' column in the simplified Marxist I-O by the value added of productive activities obtained from the GDP by industry annual series. I then divide all the main entries in the 'trade, rental, leasing' column in the simplified Marxist I-O by the value added of trade obtained from the GDP by industry annual series. Finally I divide all the main entries in the 'unproductive activities' column in the simplified Marxist I-O by the value added of unproductive activities obtained from the GDP by industry annual series. I repeat this procedure for all entries in the simplified Marxist I-O tables except for the

decomposition of value added (labor compensation, indirect business taxes, and gross operating surplus), and I do it for all the years covered by the benchmark I-O tables. The coefficients that I obtain are then extrapolated for the years immediately following the benchmark publications until a new benchmark I-O table appears. The coefficients are hence updated every year in which a new benchmark I-O table is published, and then remain fixed for the subsequent years. These same coefficients are then all multiplied by the corresponding 1947-2011 series of value added of productive activities, trade, and unproductive activities.

Let $i = (PA, Trade, UA)$ be the industry grouping in the MICS, t any year from 1947 to 2011, and b any year for which there is a benchmark I-O table. Now let $X_{i,t=b}^{IO}$ indicate the I-O entry for the Marxist industry grouping i for any year $t = b$ when a benchmark matrix is published, then let $VA_{i,t=b}^{GDP}$ indicate the value added calculated from the GDP by industry annual series for the same Marxist industry grouping i for the same year ($t = b$) when a benchmark I-O matrix is published. Therefore the benchmark interpolation coefficients are $x_{i,t=b} = \frac{X_{i,t=b}^{IO}}{VA_{i,t=b}^{GDP}}$, which I then extrapolate for the non-benchmark years ($t \neq b$) when multiplying them by the value added for the same industry grouping i , namely $VA_{i,t \neq b}^{GDP}$. Letting $X_{i,t \neq b}$ indicate the extrapolated Marxist I-O entry for a non-benchmark year ($t \neq b$), we have:

$$X_{i,t \neq b} = x_{i,t=b} \cdot VA_{i,t \neq b}^{GDP} = \left(\frac{X_{i,t=b}^{IO}}{VA_{i,t=b}^{GDP}} \right) \cdot VA_{i,t \neq b}^{GDP} \quad (A.1)$$

The end result are annual series for the entire 1947-2011 period containing estimates for the main entries in the simplified Marxist I-O tables as if we had simplified Marxist I-O tables for every year. The basic idea is to extrapolate the proportions of the I-O matrices to the annual GDP by industry series after applying the MICS. The application of the MICS against the BEA GDP by industry series also has the nice consequence of making the SIC and NAICS series compatible with each other through time.

Step 4: Calculate the Number of Workers

Input-output matrices have information on labor compensation but no information on the number of workers employed in each industry. From the BEA GDP by industry dataset it is possible to obtain the number of full-time equivalent employees (FEE) and the number of persons engaged in production (PEP). The FEE and PEP annual series are available under the SIC system from 1948 to 1997 and under the NAICS from 1998 to 2011. The evident obstacles are that the industry classification and aggregation systems are very different across I-O tables and GDP by industry series, including the change in methodology from 1998 onwards with the introduction of the NAICS.

The first task is to make compatible the I-O, SIC, and NAICS methodologies. I hence regroup industries according to the MICS in the exact same way I did for value added in Step 3. For the SIC series on FEE and PEP I apply the MICS using Table A.2 while for the NAICS series on FEE and PEP I apply the MICS using Table A.3. The MICS therefore offers the common ground across the I-O, SIC, and NAICS datasets. I then construct the full 1948-2011 series combining the 1948-1997 SIC series and the 1998-2011 NAICS series for the three Marxist industry groupings: productive activities, trade, and unproductive activities. Since no data are available for 1947 I simply suppose that 1947 had the same employment level as 1948. This procedure produces annual information on FEE and PEP for the whole 1947-2011 period.

The second task is to calculate the number of self-employed workers (SEP) recalling that PEP is the sum of FEE and SEP. Let $i = (PA, Trade, UA)$ be the industry grouping in the MICS, and t any year from 1947 to 2011, we have:

$$SEP_{i,t} = PEP_{i,t} - FEE_{i,t} \quad (A.2)$$

By subtracting the FEE from PEP for each year I estimate the corresponding number of self-employed workers within each Marxist industry grouping.

Step 5: Calculate Employee Compensation

A similar procedure as the one used in Step 4 for the number of workers can be applied to employee compensation (EC). The data are available through the BEA GDP by industry accounts. The EC annual series are available under the SIC format from 1947 to 1997 and under the NAICS format from 1987 to 2011. I then regroup industries according to the MICS in the exact same way I did for value added in Step 3. For the SIC series on EC I apply the MICS using Table A.2 while for the NAICS series on EC I apply the MICS using Table A.3. I can thus obtain annual estimates of EC from 1947 to 2011 for the three industry groupings in the MICS by combining the SIC series from 1947 to 1986 with the NAICS series from 1987 to 2011.

The employee compensation series from the GDP by industry accounts cover only the compensation of full-time equivalent employees ($EC_{i,t}^{FEE}$). Since I use persons engaged in production ($PEP_{i,t}$) as the measure of employment I then need to impute a compensation for self-employed workers ($EC_{i,t}^{SEP}$). Self-employed workers constitute the ‘unincorporated business sector’ and the BEA does not break down the value added that they produce each year into labor compensation and gross operating surplus. In this procedure I therefore suppose that self-employed workers receive on average the same compensation as their full-time counterparts in incorporated businesses. I follow Shaikh and Tonak (1994) by imputing a wage equivalent to self-employed workers in the unincorporated business sector. Let $i = (PA, Trade, UA)$ be the industry grouping in MICS, and t any year from 1947 to 2011, we have:

$$EC_{i,t}^{PEP} = EC_{i,t}^{FEE} + EC_{i,t}^{SEP} = EC_{i,t}^{FEE} + \left(\frac{EC_{i,t}^{FEE}}{FEE_{i,t}} \right) \cdot SEP_{i,t} \quad (A.3)$$

I estimate $EC_{i,t}^{SEP}$ by imputing the average compensation of full-time equivalent employees $\left(\frac{EC_{i,t}^{FEE}}{FEE_{i,t}} \right)$ to self-employed workers ($SEP_{i,t}$); and $SEP_{i,t}$ is in turn obtained from Step 4 through equation A.2. I then finally estimate the compensation of PEP as the sum of the compensation of full-time

equivalent employees ($EC_{i,t}^{FEE}$) and the imputed compensation of self-employed workers ($EC_{i,t}^{SEP} = \frac{EC_{i,t}^{FEE}}{FEE_{i,t}} \cdot SEP_{i,t}$).

Step 6: Net Out Supervisory Workers from Productive Activities

Productive workers are workers performing productive activities within industries classified as productive in the MICS. Unproductive workers in productive activities and workers in trade and unproductive activities are considered to be unproductive laborers. To net out unproductive labor from productive activities I use the BLS series on total and nonsupervisory employees by industry.

The procedure consists of applying the MICS against the BLS series on total employees and nonsupervisory workers. Both series are organized by industry so the MICS can be applied directly as shown in Tables A.5 and A.6. The BLS series on total employees per industry is complete for all years and is organized solely under NAICS from 1947 to 2011, hence I apply the MICS using Table A.5.

For nonsupervisory workers the BLS has two series: one using the SIC from 1947 to 2002 and another using the NAICS from 1947 to 2011. The first task is to apply the MICS to the SIC and NAICS series on nonsupervisory workers using Table A.6. It is necessary to work with both series at the same time since data for many years are missing: NAICS data for nonsupervisory workers is complete from 1972 onwards but missing for all services from 1947 to 1963, and missing also for transportation, warehousing, and utilities from 1947 to 1971; SIC data is also missing prior to 1964 for services, transportation, and utilities.

To overcome the problem of missing data I proceed as follows. First, I calculate the ratio of nonsupervisory workers in productive activities to ‘total private’ nonsupervisory workers under NAICS from 1972 to 2011. This ratio is stable at around 70%. From 1964 to 1971 I use ‘total private’ nonsupervisory workers from the NAICS data and then multiply it by the stable ratio of 70% to get nonsupervisory workers in productive activities only. From 1947 to 1963 I use ‘total private’

nonsupervisory workers from the SIC data and then multiply it by the stable ratio of 70% to get nonsupervisory workers in productive activities only. Combining the three pieces (1947-1963, 1964-1971, and 1972-2011) I get a complete 1947-2011 estimate of the number of nonsupervisory workers in productive activities. Since I treat all workers in trade and in unproductive activities as unproductive labor I do not need to estimate the share of supervisory workers in them.

I thus have complete series from 1947 to 2011 for both total employees and nonsupervisory workers in productive activities. I then divide one by the other to get annual estimates for the share of nonsupervisory workers in productive activities. I find that on average 18% of all employees in productive activities should be classified as unproductive labor. Letting $\Omega_{i,t}$ indicate the share of nonsupervisory workers in total employment in the industry grouping $i = (PA, Trade, UA)$ we now have:

$$\Omega_{i,t} = \frac{(\text{nonsupervisory workers})_{i,t}^{BLS}}{(\text{total workers})_{i,t}^{BLS}} \quad (\text{A.4})$$

I can then multiply the percentage of nonsupervisory workers in productive activities ($\Omega_{PA,t}$) by the full-time equivalent employees in productive activities ($FEE_{PA,t}$) estimated in Step 4. Notice that I multiply the percentage of nonsupervisory workers by $FEE_{PA,t}$, not $PEP_{PA,t}$, since the persons engaged in production series also includes self-employed workers ($SEP_{PA,t}$).

My method differs from that of Shaikh and Tonak (1994) in regard to the procedure of estimating the compensation of unproductive and productive workers. As much as possible I try not to blend series from different sources, and hence I refrain from using wage and compensation data from the Bureau of Labor Statistics (BLS). I also avoid mixing data on employment by sector from the BLS with data on employment compensation from the BEA. The only instance in which I employ data from the BLS is to calculate the percentage of nonsupervisory workers in productive activities. Even more, within productive activities I exclude supervisory workers solely from the full-time equivalent (FEE) employees, contrary to

Shaikh and Tonak’s procedure of also excluding the supervisory jobs of self-employed persons (SEP). From my perspective there is no meaning in separating unincorporated businesses into supervisory and nonsupervisory workers.

Mohun (2005; 2006; 2013) is critical of Shaikh and Tonak’s (1994) procedure of estimating employees’ compensation and the share of nonsupervisory workers, especially in the service sectors. Even though my estimates follow a different computational procedure than that of Shaikh and Tonak, my estimates would still have some of the aggregation problems that Mohun (2005) uncovered. However, my procedure offers a way of estimating Marxist categories for the entire 1947-2011 period taking into account the discrepancies between the SIC and NAICS systems that Mohun did not face in his dataset that begins only in 1964. Given my preference for the whole 1947-2011 period and the fact that I classify knowledge production as an unproductive activity, lack of more detailed data for several years prevents me from implementing the fine-tuning that Mohun proposed. In any case, Mohun’s estimates still contain some simplifications that I avoid here — see Paitaridis and Tsoulfidis (2012, p.221, footnote 4).

Step 7: Estimate the Value of Labor Power

I estimate variable capital (V), or the value of labor power, as the compensation of productive workers in productive activities. The estimate of variable capital has two components: the compensation of nonsupervisory full-time equivalent workers in productive activities ($\Omega_{PA,t} \cdot EC_{PA,t}^{FEE}$), and the imputed compensation of self-employed workers in productive activities ($EC_{PA,t}^{SEP}$). To estimate the compensation of nonsupervisory full-time equivalent workers in productive activities I simply multiply the ratio of nonsupervisory workers to total employees ($\Omega_{PA,t}$) calculated from the BLS data by the compensation of full-time equivalent employees in productive activities ($EC_{PA,t}^{FEE}$) calculated from the BEA data. The imputed compensation of self-employed workers in productive activities is obtained in Step 5 as $EC_{PA,t}^{SEP} =$

$\frac{EC_{PA,t}^{FEE}}{FEE_{PA,t}} \cdot SEP_{PA,t}$. Using equations A.2 through A.4 I can then estimate variable capital (V) in year t as:

$$V_t = \Omega_{PA,t} \cdot EC_{PA,t}^{FEE} + EC_{PA,t}^{SEP} \quad (\text{A.5})$$

Step 8: Calculate Stocks of Fixed Assets and Depreciation

To estimate fixed assets and their depreciation per MICS grouping I use the BEA annual data on the current-cost net stock of fixed assets and depreciation by industry for both nonresidential private and government entities as available in the Fixed Assets Accounts (FAA).

For my estimates I use the series on current-cost net stocks of fixed assets by industry, which comprises stocks of buildings, equipment, and software at replacement costs. For stocks of assets and their respective depreciations I combine the datasets from nonresidential private entities with the federal, state, and local government entities. The official measure of fixed asset depreciation includes the physical deterioration of buildings and equipment as well as the obsolescence due to new technological advances, implying that depreciation also measures early retirements and discards as assets are withdrawn from service while still being useful.

I firstly obtain data on current-cost net stock of fixed assets, yearend estimates, from the FAA under NAICS for the entire 1947-2011 period. I use data for both private and government-owned fixed assets through the BEA Tables 3.1ES, 7.1A, and 7.1B. Total fixed assets include stocks of equipment, software, and structures at replacement costs. I then apply the MICS using Table A.4 to classify and separate industries and subsequently combine the data for private and government-owned fixed assets. To make numbers compatible with other Marxist estimates I finally convert units to millions of dollars. In order to exclude residential assets I estimate net stocks in unproductive activities net of the real estate sector.

The purpose of classifying the stock of fixed assets into the three industry groupings according to the MICS is to break down the annual estimate of the total capital stock (K) in the economy as the sum of

the capital stocks in productive activities (K_{PA}), in trade, rental, and leasing (K_{TRL}), and finally in unproductive activities net of real estate (K_{UA}):

$$K_t = K_{PA,t} + K_{TRL,t} + K_{UA,t} \quad (\text{A.6})$$

The next task consists of applying a similar procedure to the current-cost depreciation of the stocks of fixed assets using data for both private and government-owned fixed assets from BEA Tables 3.4ES, 7.3A, and 7.3B. I apply the MICS according to Table A.4 so as to classify and separate industries and subsequently combine the data for private and government-owned fixed assets. To make numbers compatible with other Marxist estimates I finally convert all units to millions of dollars. Also, in order to exclude the depreciation of residential assets I estimate the depreciation of net stocks in unproductive activities net of the real estate sector.

The purpose of classifying depreciation according to the three industry groupings in the MICS is to break down the annual estimate of total capital stock depreciation (δ) in the economy as the sum of capital stock depreciations in productive activities (δ_{PA}), in trade, rental, and leasing (δ_{TRL}), and finally in unproductive activities net of real estate (δ_{UA}):

$$\delta_t = \delta_{PA,t} + \delta_{TRL,t} + \delta_{UA,t} \quad (\text{A.7})$$

Step 9: Estimate Constant Capital

I estimate constant capital (C) as the use up of productive inputs in productive activities. Productive inputs ($A_{i,t}^{PA}$) are the outputs of productive activities that are then used as inputs by any other activity i . For the measure of constant capital I only consider the outputs of productive activities that are then used as inputs by productive activities. Constant capital (C) then consists of two parts: the productive inputs directly consumed in productive activities ($A_{PA,t}^{PA}$), which correspond to circulating

capital, and the depreciation of the stock of fixed assets in productive activities ($\delta_{PA,t}$), which corresponds to the fixed capital used up. Let $A_{i,t}^j$ indicate the outputs of activity j that are used as inputs by activity i in time t , then:

$$C_t = A_{PA,t}^{PA} + \delta_{PA,t} \quad (\text{A.8})$$

The productive inputs used up in productive activities can be obtained from the simplified Marxist I-O tables in Step 2 and also from the annual interpolations for the non-benchmark years in Step 3. The depreciation of the capital stock is obtained in Step 8. As displayed in Figure A.1, since I-O matrices are cast in producers' prices the estimate of $A_{PA,t}^{PA}$ has to include the corresponding rows of trade margins.

Step 10: Estimate Total Value, Marxist Value Added, and Surplus Value

The total value (TV) produced in the United States economy can now be estimated from the series obtained in previous steps. From the simplified Marxist I-O tables and the annual interpolations it is possible to estimate TV for each year from 1947 to 2011 as the sum of the gross output of productive activities (GO_{PA}) and the gross output of trade, rental, and leasing (GO_{TRL}). Since I-O matrices are cast in producers' prices the gross output of TRL needs to be added to the measure of total value. Trade, rental, and leasing clearly belong to the sphere of circulation and therefore are unproductive activities from the Marxist perspective, but because I-O matrices put trade margins in trade industries we then have to add these activities to the measure of total value produced in order to consider both the full production and piecemeal realization of value.

[Figure A.3 about here]

In Figure A.3 I display the correspondences between key Marxist categories and the modified measures of income derived from the official national accounts after the application of the MICS. The

mathematical correspondences are as follows. Let $A_{i,t}^j$ indicate the outputs of activity j that are used as inputs by activity i in time t , and let $NO_{i,t}$ indicate the net output of activity i . The gross output of any activity i is the sum of all the inputs used up ($\sum_j A_{i,t}^j$) and the net output:

$$GO_{i,t} = \sum_j A_{i,t}^j + NO_{i,t} \quad (\text{A.9})$$

I estimate the Marxist total value in year t as the sum of the gross outputs of productive activities together with trade, rental, and leasing:

$$\begin{aligned} TV_t &= GO_{PA,t} + GO_{TRL,t} \\ &= A_{PA,t}^{PA} + A_{PA,t}^{UA} + NO_{PA,t} + A_{TRL,t}^{PA} + A_{TRL,t}^{UA} + NO_{TRL,t} \end{aligned} \quad (\text{A.10})$$

The Marxist value added (VA) is then estimated as the total value less the value of constant capital. The measure of constant capital from equation A.8 includes depreciation, hence the measure of Marxist value added becomes net of depreciation:

$$VA_t = TV_t - C_t \quad (\text{A.11})$$

I finally estimate the surplus value (S) produced in the United State economy for each year as the Marxist value added minus variable capital, which is the value of labor power calculated through equation A.5:

$$S_t = TV_t - C_t - V_t = VA_t - V_t \quad (\text{A.12})$$

It then becomes simple to estimate other Marxist categories.

Step 11: Estimate Measures of Unproductive Accumulation

As long as Steps 1 through 10 are followed correctly it also becomes straightforward to compute measures associated with unproductive accumulation. Using the general scheme depicted in Figures A.1 through A.3, as well as equations A.9 through A.12, we can estimate the gross unproductive burden (GUB), net unproductive burden (NUB), and the unproductive composition of capital (UCC).

The gross income of unproductive activities (GI_{UA}) is estimated analogously to the total value (TV) from productive activities. The net income of unproductive activities (NI_{UA}) is estimated analogously to the value added (VA) from productive activities. I use the input-output matrices and the annual interpolations similarly to what is explained above in Steps 1 to 3.

Since benchmark matrices are only available for certain specific years it becomes necessary to interpolate the years not covered by the benchmark matrices with annual data from the estimated ‘value added’ of unproductive activities, analogously to what is described in Step 3. Let t be any year from 1947 to 2011, and b any year for which there is a benchmark I-O table. Now let $H_{UA,t=b}^{IO}$ indicate any I-O unproductive sub-category (as in figure A.4) for any year $t = b$ when a benchmark matrix is published; then let $VA_{UA,t=b}^{GDP}$ indicate the ‘value added’ of unproductive activities calculated from the GDP by industry annual series for the same year ($t = b$) when a benchmark I-O matrix is published. Therefore the benchmark interpolation coefficients are $h_{i,t=b} = \frac{H_{UA,t=b}^{IO}}{VA_{UA,t=b}^{GDP}}$, which I then extrapolate for the non-benchmark years ($t \neq b$) when multiplying them by the value added of unproductive activities, namely $VA_{UA,t \neq b}^{GDP}$. Letting $H_{i,t \neq b}$ indicate the extrapolated unproductive sub-category for a non-benchmark year ($t \neq b$), we have:

$$H_{i,t \neq b} = h_{i,t=b} \cdot VA_{UA,t \neq b}^{GDP} = \left(\frac{H_{UA,t=b}^{IO}}{VA_{UA,t=b}^{GDP}} \right) \cdot VA_{UA,t \neq b}^{GDP} \quad (A.13)$$

The interpolation coefficients $h_{i,t=b}$ that I obtain are extrapolated for the years immediately following the benchmark publications until a new benchmark I-O matrix appears. The coefficients are then updated every year in which a new benchmark I-O table is published, and remain fixed for the subsequent years.

Since the Marxist value added of productive activities is net of productive depreciation ($\delta_{PA,t}$), the net income of unproductive activities is also net of unproductive depreciation ($\delta_{UA,t}$). I then compute the annual surplus income of unproductive activities (SI_{UA}) as the net income of unproductive activities (NI_{UA}) minus employee compensation in these same activities:

$$SI_{UA,t} = NI_{UA,t} - EC_{UA,t}^{PEP} \quad (\text{A.14})$$

In the case of unproductive activities I make no distinction between supervisory and nonsupervisory workers, which implies that the total employee compensation $EC_{UA,t}^{PEP}$ can be obtained directly via equation A.3 for unproductive workers in unproductive activities. The surplus income of unproductive activities and the surplus value from productive activities are both net of depreciation of their respective capital stocks.

Step 12: Break Down Unproductive Accumulation into Its Subcomponents

The gross and net incomes of unproductive activities ($GI_{UA,t}$ and $NI_{UA,t}$ respectively) can be further decomposed into five sub-categories: (i) government administration with the exception of productive government enterprises, consisting mostly of the government wage bill at all levels; (ii) finance and insurance, including the former federal commodity credit corporation (CCC); (iii) non-profit organizations and unproductive services, such as legal services and corporate management; (iv) real estate, comprising land-rents accruing to agents, managers, operators, and lessors (excluding imputed owner-occupied rents); (v) knowledge and information rents, comprising all incomes from activities

involving advertising, pharmaceuticals, software production, data management, research and development, publishing industries, sound recording, and movie production.

For each Marxist benchmark I-O matrix, as depicted in Figure A.1, I separate unproductive industry columns according to these five sub-categories, and then compute a summary sheet as shown in Figure A.4. Using equation A.13 and Figure A.4 it is possible to arrive at annual estimates for the five unproductive sub-categories for both the gross and net incomes of unproductive activities.

[Figure A.4 about here]

From Step 8 it is also possible to decompose the current-cost nonresidential net stock of fixed assets of unproductive activities (excluding real estate), trade, rental, and leasing into five sub-categories: (i) trade, rental, and leasing; (ii) knowledge and information; (iii) finance and insurance; (iv) unproductive services; and (v) general government, excluding public enterprises. Annual data is available through the BEA FAA under the NAICS for the entire 1947-2011 period.

Tables and Figures for the Appendix

Table A.1: MICS Applied to the 2002 BEA Benchmark Input-Output Matrix

Productive Activities	code	Productive Activities (continued)	code
Oilseed farming	1111A0	Rolling mill and other metalworking machinery manufacturing	33351B
Grain farming	1111B0	Turbine and turbine generator set units manufacturing	333611
Vegetable and melon farming	111200	Speed changer, industrial high-speed drive, and gear manufacturing	333612
Tree nut farming	111335	Mechanical power transmission equipment manufacturing	333613
Fruit farming	1113A0	Other engine equipment manufacturing	333618
Greenhouse, nursery, and floriculture production	111400	Pump and pumping equipment manufacturing	333911
Tobacco farming	111910	Air and gas compressor manufacturing	333912
Cotton farming	111920	Material handling equipment manufacturing	333920
Sugarcane and sugar beet farming	1119A0	Power-driven handtool manufacturing	333991
All other crop farming	1119B0	Packaging machinery manufacturing	333993
Dairy cattle and milk production	112120	Industrial process furnace and oven manufacturing	333994
Cattle ranching and farming	1121A0	Other general purpose machinery manufacturing	33399A
Poultry and egg production	112300	Fluid power process machinery	33399B
Animal production, except cattle and poultry and eggs	112A00	Electronic computer manufacturing	334111
Logging	113300	Computer storage device manufacturing	334112
Forest nurseries, forest products, and timber tracts	113A00	Computer terminals and other computer peripheral equipment manufacturing	33411A
Fishing	114100	Telephone apparatus manufacturing	334210
Hunting and trapping	114200	Broadcast and wireless communications equipment	334220
Support activities for agriculture and forestry	115000	Other communications equipment manufacturing	334290
Oil and gas extraction	211000	Audio and video equipment manufacturing	334300
Coal mining	212100	Electron tube manufacturing	334411
Iron ore mining	212210	Bare printed circuit board manufacturing	334412
Copper, nickel, lead, and zinc mining	212230	Semiconductor and related device manufacturing	334413
Gold, silver, and other metal ore mining	2122A0	Electronic connector manufacturing	334417
Stone mining and quarrying	212310	Printed circuit assembly (electronic assembly) manufacturing	334418
Sand, gravel, clay, and ceramic and refractory minerals mining and quarrying	212320	Other electronic component manufacturing	334419
Other nonmetallic mineral mining and quarrying	212390	Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	33441A
Drilling oil and gas wells	213111	Electromedical and electrotherapeutic apparatus manufacturing	334510
Support activities for oil and gas operations	213112	Search, detection, and navigation instruments manufacturing	334511
Support activities for other mining	21311A	Automatic environmental control manufacturing	334512
Electric power generation, transmission, and distribution	221100	Industrial process variable instruments manufacturing	334513

Natural gas distribution	221200	Totalizing fluid meters and counting devices manufacturing	334514
Water, sewage and other systems	221300	Electricity and signal testing instruments manufacturing	334515
Nonresidential commercial and health care structures	230101	Analytical laboratory instrument manufacturing	334516
Nonresidential manufacturing structures	230102	Irradiation apparatus manufacturing	334517
Other nonresidential structures	230103	Watch, clock, and other measuring and controlling device manufacturing	33451A
Residential permanent site single- and multi-family structures	230201	Magnetic and optical recording media manufacturing	334613
Other residential structures	230202	Electric lamp bulb and part manufacturing	335110
Nonresidential maintenance and repair	230301	Lighting fixture manufacturing	335120
Residential maintenance and repair	230302	Small electrical appliance manufacturing	335210
Dog and cat food manufacturing	311111	Household cooking appliance manufacturing	335221
Other animal food manufacturing	311119	Household refrigerator and home freezer manufacturing	335222
Flour milling and malt manufacturing	311210	Household laundry equipment manufacturing	33522A
Wet corn milling	311221	Other major household appliance manufacturing	335228
Fats and oils refining and blending	311225	Power, distribution, and specialty transformer manufacturing	335311
Soybean and other oilseed processing	31122A	Motor and generator manufacturing	335312
Breakfast cereal manufacturing	311230	Switchgear and switchboard apparatus manufacturing	335313
Beet sugar manufacturing	311313	Relay and industrial control manufacturing	335314
Sugar cane mills and refining	31131A	Storage battery manufacturing	335911
Chocolate and confectionery manufacturing from cacao beans	311320	Primary battery manufacturing	335912
Confectionery manufacturing from purchased chocolate	311330	Communication and energy wire and cable manufacturing	335920
Nonchocolate confectionery manufacturing	311340	Wiring device manufacturing	335930
Frozen food manufacturing	311410	Carbon and graphite product manufacturing	335991
Fruit and vegetable canning, pickling, and drying	311420	All other miscellaneous electrical equipment and component manufacturing	335999
Cheese manufacturing	311513	Automobile manufacturing	336111
Dry, condensed, and evaporated dairy product manufacturing	311514	Light truck and utility vehicle manufacturing	336112
Fluid milk and butter manufacturing	31151A	Heavy duty truck manufacturing	336120
Ice cream and frozen dessert manufacturing	311520	Motor vehicle body manufacturing	336211
Poultry processing	311615	Truck trailer manufacturing	336212
Animal (except poultry) slaughtering, rendering, and processing	31161A	Motor home manufacturing	336213
Seafood product preparation and packaging	311700	Travel trailer and camper manufacturing	336214
Bread and bakery product manufacturing	311810	Motor vehicle parts manufacturing	336300
Cookie, cracker, and pasta manufacturing	311820	Aircraft manufacturing	336411
Tortilla manufacturing	311830	Aircraft engine and engine parts manufacturing	336412
Snack food manufacturing	311910	Other aircraft parts and auxiliary equipment manufacturing	336413
Coffee and tea manufacturing	311920	Guided missile and space vehicle manufacturing	336414
Flavoring syrup and concentrate manufacturing	311930	Railroad rolling stock manufacturing	336500
Seasoning and dressing manufacturing	311940	Ship building and repairing	336611
All other food manufacturing	311990	Boat building	336612
Soft drink and ice manufacturing	312110	Motorcycle, bicycle, and parts manufacturing	336991
Breweries	312120	Military armored vehicle, tank, and tank component manufacturing	336992

Wineries	312130	All other transportation equipment manufacturing	336999
Distilleries	312140	Wood kitchen cabinet and countertop manufacturing	337110
Tobacco product manufacturing	3122A0	Upholstered household furniture manufacturing	337121
Fiber, yarn, and thread mills	313100	Nonupholstered wood household furniture manufacturing	337122
Broadwoven fabric mills	313210	Institutional furniture manufacturing	337127
Narrow fabric mills and schiffli machine embroidery	313220	Propulsion units and parts for space vehicle and guided missiles	33641A
Nonwoven fabric mills	313230	Metal and other household furniture (except wood) manufacturing	33712A
Knit fabric mills	313240	Office furniture and custom architectural woodwork and millwork manufacturing	337212
Textile and fabric finishing mills	313310	Showcase, partition, shelving, and locker manufacturing	337215
Fabric coating mills	313320	Wood television, radio, and sewing machine cabinet manufacturing	33721A
Carpet and rug mills	314110	Mattress manufacturing	337910
Curtain and linen mills	314120	Blind and shade manufacturing	337920
Textile bag and canvas mills	314910	Laboratory apparatus and furniture manufacturing	339111
All other textile product mills	314990	Surgical and medical instrument manufacturing	339112
Apparel knitting mills	315100	Surgical appliance and supplies manufacturing	339113
Cut and sew apparel contractors	315210	Dental equipment and supplies manufacturing	339114
Men's and boys' cut and sew apparel manufacturing	315220	Ophthalmic goods manufacturing	339115
Women's and girls' cut and sew apparel manufacturing	315230	Dental laboratories	339116
Other cut and sew apparel manufacturing	315290	Jewelry and silverware manufacturing	339910
Apparel accessories and other apparel manufacturing	315900	Sporting and athletic goods manufacturing	339920
Leather and hide tanning and finishing	316100	Doll, toy, and game manufacturing	339930
Footwear manufacturing	316200	Office supplies (except paper) manufacturing	339940
Other leather and allied product manufacturing	316900	Sign manufacturing	339950
Sawmills and wood preservation	321100	Gasket, packing, and sealing device manufacturing	339991
Reconstituted wood product manufacturing	321219	Musical instrument manufacturing	339992
Veneer and plywood manufacturing	32121A	Broom, brush, and mop manufacturing	339994
Engineered wood member and truss manufacturing	32121B	All other miscellaneous manufacturing	33999A
Wood windows and doors and millwork	321910	Air transportation	481000
Wood container and pallet manufacturing	321920	Rail transportation	482000
Manufactured home (mobile home) manufacturing	321991	Water transportation	483000
Prefabricated wood building manufacturing	321992	Truck transportation	484000
All other miscellaneous wood product manufacturing	321999	Transit and ground passenger transportation	485000
Pulp mills	322110	Pipeline transportation	486000
Paper mills	322120	Scenic and sightseeing transportation and support activities for transportation	48A000
Paperboard mills	322130	Postal service	491000
Paperboard container manufacturing	322210	Couriers and messengers	492000
Coated and laminated paper, packaging paper and plastics film manufacturing	32222A	Warehousing and storage	493000
All other paper bag and coated and treated paper manufacturing	32222B	Radio and television broadcasting	515100
Stationery product manufacturing	322230	Cable and other subscription programming	515200
Sanitary paper product manufacturing	322291	Telecommunications	517000
All other converted paper product manufacturing	322299	Accounting, tax preparation, bookkeeping, and payroll services	541200

Printing	323110	Architectural, engineering, and related services	541300
Support activities for printing	323120	Specialized design services	541400
Petroleum refineries	324110	Other computer related services, including facilities management	54151A
Asphalt paving mixture and block manufacturing	324121	Management, scientific, and technical consulting services	541610
Asphalt shingle and coating materials manufacturing	324122	Environmental and other technical consulting services	5416A0
Petroleum lubricating oil and grease manufacturing	324191	All other miscellaneous professional, scientific, and technical services	5419A0
All other petroleum and coal products manufacturing	324199	Photographic services	541920
Petrochemical manufacturing	325110	Veterinary services	541940
Industrial gas manufacturing	325120	Office administrative services	561100
Synthetic dye and pigment manufacturing	325130	Facilities support services	561200
Alkalies and chlorine manufacturing	325181	Employment services	561300
Carbon black manufacturing	325182	Business support services	561400
All other basic inorganic chemical manufacturing	325188	Travel arrangement and reservation services	561500
Other basic organic chemical manufacturing	325190	Investigation and security services	561600
Plastics material and resin manufacturing	325211	Services to buildings and dwellings	561700
Synthetic rubber manufacturing	325212	Other support services	561900
Artificial and synthetic fibers and filaments manufacturing	325220	Waste management and remediation services	562000
Fertilizer manufacturing	325310	Elementary and secondary schools	611100
Pesticide and other agricultural chemical manufacturing	325320	Junior colleges, colleges, universities, and professional schools	611A00
Paint and coating manufacturing	325510	Other educational services	611B00
Adhesive manufacturing	325520	Home health care services	621600
Soap and cleaning compound manufacturing	325610	Offices of physicians, dentists, and other health practitioners	621A00
Toilet preparation manufacturing	325620	Medical and diagnostic labs and outpatient and other ambulatory care services	621B00
Printing ink manufacturing	325910	Hospitals	622000
All other chemical product and preparation manufacturing	3259A0	Nursing and residential care facilities	623000
Plastics packaging materials and unlaminated film and sheet manufacturing	326110	Community food, housing, and other relief services, including rehabilitation services	624200
Unlaminated plastics profile shape manufacturing	326121	Child day care services	624400
Plastics pipe and pipe fitting manufacturing	326122	Individual and family services	624A00
Laminated plastics plate, sheet (except packaging), and shape manufacturing	326130	Performing arts companies	711100
Polystyrene foam product manufacturing	326140	Spectator sports	711200
Urethane and other foam product (except polystyrene) manufacturing	326150	Independent artists, writers, and performers	711500
Plastics bottle manufacturing	326160	Promoters of performing arts and sports and agents for public figures	711A00
Other plastics product manufacturing	32619A	Museums, historical sites, zoos, and parks	712000
Tire manufacturing	326210	Fitness and recreational sports centers	713940
Rubber and plastics hoses and belting manufacturing	326220	Bowling centers	713950
Other rubber product manufacturing	326290	Amusement parks, arcades, and gambling industries	713A00
Pottery, ceramics, and plumbing fixture manufacturing	32711A	Other amusement and recreation industries	713B00
Brick, tile, and other structural clay product manufacturing	32712A	Hotels and motels, including casino hotels	7211A0
Clay and nonclay refractory manufacturing	32712B	Other accommodations	721A00
Flat glass manufacturing	327211	Food services and drinking places	722000

Other pressed and blown glass and glassware manufacturing	327212	Car washes	811192
Glass container manufacturing	327213	Automotive repair and maintenance, except car washes	8111A0
Glass product manufacturing made of purchased glass	327215	Electronic and precision equipment repair and maintenance	811200
Cement manufacturing	327310	Commercial and industrial machinery and equipment repair and maintenance	811300
Ready-mix concrete manufacturing	327320	Personal and household goods repair and maintenance	811400
Concrete pipe, brick, and block manufacturing	327330	Personal care services	812100
Other concrete product manufacturing	327390	Death care services	812200
Lime and gypsum product manufacturing	3274A0	Dry-cleaning and laundry services	812300
Abrasive product manufacturing	327910	Other personal services	812900
Cut stone and stone product manufacturing	327991	Federal electric utilities	S00101
Ground or treated mineral and earth manufacturing	327992	Other state and local government enterprises	S00203
Mineral wool manufacturing	327993	Noncomparable imports	S00300
Miscellaneous nonmetallic mineral products	327999	Scrap	S00401
Iron and steel mills and ferroalloy manufacturing	331110	Used and secondhand goods	S00402
Steel product manufacturing from purchased steel	331200		
Secondary smelting and alloying of aluminum	331314		
Alumina refining and primary aluminum production	33131A		
Aluminum product manufacturing from purchased aluminum	33131B	Wholesale trade	420000
Primary smelting and refining of copper	331411	Retail trade	4A0000
Primary smelting and refining of nonferrous metal (except copper and aluminum)	331419	Automotive equipment rental and leasing	532100
Copper rolling, drawing, extruding and alloying	331420	Commercial and industrial machinery and equipment rental and leasing	532400
Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying	331490	General and consumer goods rental except video tapes and discs	532A00
Ferrous metal foundries	331510		
Nonferrous metal foundries	331520		
Custom roll forming	332114		
All other forging, stamping, and sintering	33211A		
Crown and closure manufacturing and metal stamping	33211B	Medicinal and botanical manufacturing	325411
Cutlery, utensil, pot, and pan manufacturing	33221A	Pharmaceutical preparation manufacturing	325412
Handtool manufacturing	33221B	In-vitro diagnostic substance manufacturing	325413
Plate work and fabricated structural product manufacturing	332310	Biological product (except diagnostic) manufacturing	325414
Ornamental and architectural metal products manufacturing	332320	Software, audio, and video media reproducing	33461A
Power boiler and heat exchanger manufacturing	332410	Newspaper publishers	511110
Metal tank (heavy gauge) manufacturing	332420	Periodical publishers	511120
Metal can, box, and other metal container (light gauge) manufacturing	332430	Book publishers	511130
Hardware manufacturing	332500	Directory, mailing list, and other publishers	5111A0
Spring and wire product manufacturing	332600	Software publishers	511200
Machine shops	332710	Motion picture and video industries	512100
Turned product and screw, nut, and bolt manufacturing	332720	Sound recording industries	512200
Coating, engraving, heat treating and allied activities	332800	Internet publishing and broadcasting	516110
Plumbing fixture fitting and trim manufacturing	332913	Internet service providers and web search portals	518100

Valve and fittings other than plumbing	33291A	Data processing, hosting, and related services	518200
Ball and roller bearing manufacturing	332991	Other information services	519100
Fabricated pipe and pipe fitting manufacturing	332996	Nondepository credit intermediation and related activities	522A00
Ammunition manufacturing	33299A	Securities, commodity contracts, investments, and related activities	523000
Arms, ordnance, and accessories manufacturing	33299B	Insurance carriers	524100
Other fabricated metal manufacturing	33299C	Insurance agencies, brokerages, and related activities	524200
Farm machinery and equipment manufacturing	333111	Funds, trusts, and other financial vehicles	525000
Lawn and garden equipment manufacturing	333112	Monetary authorities and depository credit intermediation	52A000
Construction machinery manufacturing	333120	Real estate	531000
Mining and oil and gas field machinery manufacturing	333130	Video tape and disc rental	532230
Plastics and rubber industry machinery manufacturing	333220	Lessors of nonfinancial intangible assets	533000
Semiconductor machinery manufacturing	333295	Custom computer programming services	541511
Other industrial machinery manufacturing	33329A	Computer systems design services	541512
Optical instrument and lens manufacturing	333314	Legal services	541100
Photographic and photocopying equipment manufacturing	333315	Scientific research and development services	541700
Other commercial and service industry machinery manufacturing	333319	Advertising and related services	541800
Vending, commercial, industrial, and office machinery manufacturing	33331A	Management of companies and enterprises	550000
Heating equipment (except warm air furnaces) manufacturing	333414	Religious organizations	813100
Air conditioning, refrigeration, and warm air heating equipment manufacturing	333415	Grantmaking, giving, and social advocacy organizations	813A00
Air purification and ventilation equipment manufacturing	33341A	Civic, social, professional, and similar organizations	813B00
Industrial mold manufacturing	333511	Other Federal Government enterprises	S00102
Special tool, die, jig, and fixture manufacturing	333514	General Federal defense government services	S00500
Cutting tool and machine tool accessory manufacturing	333515	General Federal nondefense government services	S00600
Metal cutting and forming machine tool manufacturing	33351A	General state and local government services	S00700

Table A.2: MICS Applied to the 1947-1997 BEA GDP by Industry Accounts under SIC

Productive Activities	Trade, Rental, Leasing
Agriculture, forestry, and fishing	Wholesale trade
Mining	
Construction	Retail trade
Manufacturing	
Transportation	
Electric, gas, and sanitary services	
Telephone and telegraph	
Radio and television	
Hotels and other lodging places	
Personal services	
Auto repair, services, and parking	
Miscellaneous repair services	
Amusement and recreation services	
Health services	
Educational services	
Social services	
Business services	
Statistical discrepancy	
Federal Government enterprises	
State and local Government enterprises	

Unproductive Activities
Banking
Credit agencies other than banks
Security and commodity brokers
Insurance carriers
Insurance agents, brokers, and service
Holding and other investment offices
Other real estate
Motion pictures
Legal services
Membership organizations
Miscellaneous professional services
Federal General government
State and local General government

Table A.3: MICS Applied to the 1977-2011 BEA GDP by Industry Accounts under NAICS

Productive Activities	Trade, Rental, Leasing
Agriculture, forestry, fishing, and hunting	Wholesale trade
Mining	Retail trade
Utilities	Rental and leasing services and lessors of intangible assets
Construction	
Manufacturing	
Transportation and warehousing	
Broadcasting and telecommunications	
Educational services, health care, and social assistance	
Arts, entertainment, recreation, accommodation, and food services	
Other services, except government	
Federal Government enterprises	
State and local Government enterprises	
	Unproductive Activities
	Administrative and waste management services
	Administrative and support services
	Waste management and remediation services
	Publishing industries (includes software)
	Motion picture and sound recording industries
	Information and data processing services
	Finance and insurance
	Real estate
	Legal services
	Computer systems design and related services
	Miscellaneous professional, scientific, and technical services
	Management of companies and enterprises
	Federal General government
	State and local General government

Table A.4: MICS Applied to the BEA 1947-2011 Fixed Assets and Depreciation Accounts under NAICS

Productive Activities	Trade, Rental, Leasing
Agriculture, forestry, fishing, and hunting	Wholesale trade
Mining	
Utilities	Retail trade
Construction	
Manufacturing	Rental and leasing services and lessors of intangible assets
Transportation and warehousing	
Broadcasting and telecommunications	
	Unproductive Activities
Educational services	Publishing industries (includes software)
Health care and social assistance	Motion picture and sound recording industries
Arts, entertainment, and recreation	Information and data processing services
Accommodation and food services	Finance and insurance
Other services, except government	Real estate
Government enterprise fixed assets	Legal services
	Computer systems design and related services
	Miscellaneous professional, scientific, and technical services
	Management of companies and enterprises
	Administrative and support services
	Waste management and remediation services
	General government fixed assets

Table A.5: MICS Applied to the BLS 1947-2011 Series on Total Workers under NAICS

Productive Activities	industry code	Trade, Rental, Leasing	industry code
Mining and logging	10000000		
Construction	20000000	Wholesale + Retail	calculated
Manufacturing	30000000		
Transportation + warehousing + utilities	calculated		
		Unproductive Activities	industry code
Professional and business services	60000000	Information (includes publishing, software, motion picture and sound recording, video production, movie production, movie exhibition, broadcasting, TV, radio, cable TV, telecommunications, wired carriers, wireless carriers, data processing, hosting, internet)	50000000
Education and health services	65000000		
Leisure and hospitality	70000000	Financial activities (includes finance, insurance, real estate, rental, leasing, lessors, lessors of intangible assets)	55000000
Other services	80000000		
		Government	90000000

Table A.6: MICS Applied to the BLS 1947-2011 Series on Nonsupervisory Workers under SIC and NAICS

system	Productive Activities	industry code	series code	system	Trade, Rental, Leasing	industry code	series code
NAICS	Mining and logging	1000000	CEU1000000006	NAICS	Wholesale + Retail Wholesale and retail trade	calculated 500000	EEU50000003
SIC	Mining	100000	EEU10000003				
NAICS	Construction	2000000	CEU2000000006				
SIC	Construction	200000	EEU20000003				
NAICS	Manufacturing	3000000	CEU3000000006				
SIC	Manufacturing	300000	EEU30000003				
				system	Unproductive Activities	industry code	series code
NAICS	Transportation + warehousing + utilities	calculated		NAICS	Information	50000000	CEU5000000006
NAICS	Professional and business services	60000000	CEU6000000006				
NAICS	Education and health services	65000000	CEU6500000006				
NAICS	Leisure and hospitality	70000000	CEU7000000006				
NAICS	Other services	80000000	CEU8000000006	NAICS	Financial activities Finance, insurance, and real estate	55000000 700000	CEU5500000006 EEU70000003
SIC	Transportation and public utilities	400000	EEU40000003				
SIC	Services	800000	EEU80000003				
SIC	Transportation + Utilities + Services	calculated					

Figure A.1: Stylized Marxist Input-Output Matrix Using MICS

		Intermediate Product / Inputs													
		Productive Activities				TRL			Unproductive Activities				dummies		
		agricul- ture	manufa- cturing	transport ation	productive services	whole sale	retail	rental and leasing	publishing, software, movies, recordings, drugs	finance and insurance	real estate	unproductive services	Gov	households (exclude)	rest of the world (exclude)
Intermediate Output / Costs	Productive Activities	agriculture	productive inputs to productive activities				productive inputs to trade			productive inputs to unproductive activities					
		manufacturing													
		transportation													
		productive services													
	TRL	wholesale	productive inputs to productive activities				productive inputs to trade			productive inputs to unproductive activities					
		retail													
		rental and leasing													
	Unproductive Activities	publishing, software, movies, recordings, drugs	unproductive costs to productive activities				unproductive costs to trade			unproductive costs to unproductive activities					
		finance and insurance													
		real estate													
unproductive services															
dummies	Gov	unproductive costs to productive activities				unproductive costs to trade			unproductive costs to unproductive activities						
	households (exclude)														
	rest of the world (exclude)														
Net Output (NO)	labor compensation	labor compensation in productive activities				labor compensation in trade			labor compensation in unproductive activities				Gov labor compensation		
	indirect business taxes (IBT)	IBT on productive activities				IBT on trade			IBT on unproductive activities						
	gross operating surplus (GOS)	GOS in productive activities				GOS in trade			GOS in unproductive activities						
Gross Output	GO = Inputs + NO	Total Value (TV)							Gross Income of UA						

Notes: The total shaded grey area represents total value (TV) produced. The dark grey shaded are represents a first approximation to surplus value (S). The top-left light grey area represents the circulating (non-fixed) part of constant capital (C), while the lower light grey area represents a first approximation to variable capital (V). This stylized matrix is similar to that of Shaikh and Tonak (1994, p.74) but with the inclusion of knowledge and information production as unproductive activity.

Figure A.2: Simplified Marxist Input-Output Matrix Using MICS for 2002

	Productive Activities	Trade+Rental+Leasing	Unproductive Activities
Productive Activities	3,866,754	284,844	1,082,179
Trade + Rental + Leasing	432,703	57,137	67,975
Unproductive Activities	1,122,032	259,425	1,079,658
Value Added	4,852,474	1,285,745	3,818,040
Compensation of employees	3,164,865	699,708	2,203,645
Taxes on production and imports, less subsidies	205,795	278,253	140,699
Gross operating surplus	1,481,813	307,784	1,409,941

Sources: Author's calculations; BEA.

Note: Nominal figures in millions of 2002 dollars.

Figure A.3: Mapping between Marxist Categories and Modified Measures of Incomes using MICS

Marxist Categories		Modified Measures of Incomes Using MICS			
Marxist Total Value (TV)	Value Transferred (indirect labor)	Constant Capital	productive inputs to PA depreciation of fixed capital in PA	Intermediate Inputs to PA	
	Marxist Value Added (MVA) (direct labor)	Variable Capital (value of labor-power)	compensation of productive workers in PA	Gross Output in PA	
		Surplus Value	unproductive costs to PA profits in PA	Gross Output in TRL	
	Value Recirculated (unproductive labor)	Unproductive Uses of Surplus Value	productive inputs to TRL unproductive costs to TRL labor compensation in TRL profits in TRL	Net Output of PA	Gross Output of PA and TRL
			productive inputs to UA unproductive costs to UA depreciation of fixed capital in UA	Intermediate Inputs to UA	Gross Income of UA
			labor compensation in UA profits in UA	Net Income of UA	

Notes: PA = productive activities; TRL = trade, rental, and leasing; UA = unproductive activities; MICS = Marxist Industry Classification System.

Figure A.4: Decomposition of Unproductive Activities for the 2002 Input-Output Matrix

Decomposition of Unproductive Activities	Net Income (VA or Nlua)	Gross Income (Glua)
Knowledge and Information (knowledge-rents)	663,075	1,083,920
Real Estate (agents, managers, operators, and lessors)	642,766	815,660
Finance and Insurance	884,082	1,514,384
Non-Profit Org, Unproductive Services, Legal Services	486,637	801,786
Government services (except productive enterprises)	1,141,479	1,832,104
Total	3,818,040	6,047,852

Sources: Author's calculations; BEA.

Note: Nominal figures in millions of 2002 dollars.