

THE FIELD OF CAPITAL MOBILITY AND THE GRAVITATION OF PROFIT RATES (USA 1948-2000)

Gérard Duménil⁺ and Dominique Lévy⁺⁺

RÉSUMÉ

LE CHAMP DE LA MOBILITÉ DU CAPITAL ET LA GRAVITATION DES TAUX DE PROFIT

Cette étude est consacrée à l'étude empirique de la gravitation des taux de profit des diverses branches aux États-Unis depuis la seconde Guerre Mondiale. Le cadre théorique est celui proposé par les économistes classiques et Marx, et de nombreuses études contemporaines. La gravitation des taux de profit autour d'une valeur commune procède de la mobilité du capital, à la recherche d'un taux de profit maximal. Une question préalable est la détermination de l'extension du champ potentiel de cette mobilité du capital. Une partie de l'économie se trouve ainsi écartée du fait de la faiblesse de ses caractères capitalistes. Il apparaît alors que les taux de profit des branches tendent effectivement à graviter autour d'une valeur commune, mais un résultat important de cette recherche est que cette gravitation n'est pas observée dans un sous-ensemble d'industries, comme les *Transports* ou *Eau, gaz, électricité*, qui détiennent de très grandes quantités de capital fixe par rapport à leur emploi ou leur production.

ABSTRACT

THE FIELD OF CAPITAL MOBILITY AND THE GRAVITATION OF PROFIT RATES

This study is devoted to the empirical investigation of the gravitation of profit rates among industries around a single value in the US since World War II. The framework of analysis is that developed by classical economists and Marx, and used in many contemporary studies. The gravitation of profit rates around a single value results from the mobility of capital seeking a maximum profit rate. A preliminary concern is to determine the *field* in which this mobility of capital is likely to occur. A segment of the economy is excluded because of its deficient capitalist nature. After this exclusion, it appears that the profit rates of industries do tend to gravitate around a common value. An important finding of this study is that this gravitation is not observable within a subset of industries, such as *Transportation* or *Public utilities*, which utilize very large amounts of fixed capital in comparison to employment or output.

⁺ MODEM-CNRS, Université de Paris X-Nanterre, 200, av. de la République, 92000 Nanterre, France. Email: gerard.dumenil@u-paris10.fr.

⁺⁺ CEPREMAP-ENS, 48, bd Jourdan, 75014 Paris, France. Email: dominique.levy@cepremap.ens.fr.

Introduction

At the center of the analysis of competition by classical economists and Marx is the notion that the profit rates of various industries tend to gravitate around a common value. The mechanism that ensures this gravitation is described in a similar fashion in the works of Smith, Ricardo, and Marx.¹ More capital is invested where profit rates are larger, and these larger investments expand supply, lower prices, and tend to equalize profit rates. The corresponding prices are denoted as *prices of production*. Because of constant perturbations (such as demand shocks, technical change, etc.), actual prices actually tend to "gravitate" around such prices. The "movement" of capital among industries is known as the *mobility of capital*.

Much work has been devoted to the three major aspects of this analysis: (1) the mathematical properties of prices of production, (2) the dynamics of this process, and (3) the empirical verification of the thesis in contemporary capitalism:

1. The properties of prices of production have been thoroughly discussed since the beginning of the controversy on the so-called transformation problem and the work of Piero Sraffa.²
2. The classical-Marxian theory of competition and the formation of prices of production have been formalized in the last two decades, including our own work.³ Marxist economists have frequently questioned the relevance of the classical-Marxian analysis of competition vis-à-vis contemporary capitalism in relation to the development of monopolies and oligopolies. It is possible to show that prices of production are compatible with assumptions similar to those of monopolistic competition. It is also useful to recall that Marx stated clearly that the gravitation of profit rates among industries is obtained despite the continuing differences among enterprises, and the relevance of this important insight can be demonstrated.⁴
3. This paper is entirely devoted to the third issue: *the empirical relevance of the classical-Marxian thesis of gravitation*.⁵ The field of analysis is the nonfinancial US economy since World War II, over 50 years (1948-2000). The results obtained confirm the existence of such a gravitation process, with two important caveats, which are the original aspect of the present investigation.

A first issue is the definition of the proper field of capital mobility, and therefore, of the potential scope of gravitation. The economy can be divided in numerous sectors and industries, but the classical-Marxian mechanism does not apply to all of these components:

1. It is obvious, for example, that sectors such as *Government* or *Real estate* will not be part of this process. The capital of *Government* is not invested by the state with the goal of seeking maximum profitability; to a very large extent, the capital of *Real estate* (housings or residential

capital, and nonresidential capital) is owned by households, and held for personal use not as an investment.

2. The same is true of industries, that we denote as *Individual business*, where production is mostly performed by self-employed persons, such as, for example, medical doctors, where capital investment only supplements the main activity.

The second proviso represents one of the major findings of the present study. The empirical investigation reveals that some sectors, which display all the necessary capitalist features, are actually not part of gravitation. These industries possess a common character: They use very large amounts of capital compared to their output. For this reason we denote them as *Highly capital intensive industries*. Why these industries do not obtain the average profit rate on their capital? Is a basic economic mechanism at issue or are capital stocks overestimated? This remains to be determined.

A priori, the financial sector of the economy should also take part in the same gravitation process as other industries. The computation of the profit rate for *Finance* poses, however, quite specific problems. The sector itself is difficult to delineate, and a particular definition of profit rates must be adopted. For this reason, this important segment of the economy is not considered in this study.⁶

Gravitation is observed for five industries denoted as the *Nonfinancial core capitalist sector (NF-Core)*: *Durable goods (manufacturing)*, *Nondurable goods (manufacturing)*, *Wholesale trade*, *Retail trade*, and a subset of services that we call *Capitalist services*. Technology is very heterogeneous among these industries, some being rather capital intensive and others not; some industries hold large amounts of inventories, others do not; some pay large indirect business taxes, others do not. Prices take account of these structural differences. Conversely, the profit rates of *Highly capital intensive industries* (*Mining*, *Communications*, and *Transportation and public utilities*) do not gravitate with others.

Overall, the investigation in this paper concludes in favor of the empirical relevance of the classical-Marxian analysis of gravitation, though limited to a fraction of the economy. This limitation combines *a priori* elements--coherent with the theory itself--and *a posteriori* exceptions which refer to a common property, highly capital intensive features. The segment of the economy in which gravitation is observed accounts for 46.9% of the net product of the total economy, and 81.5% of the net product of the nonfinancial private economy, denoted as *NF-Business*.

This study divides into four parts. Part 1 defines the general framework of analysis, the definition of the profit rate and the discussion of the segment of the economy in which the gravitation of profit rates around a common value should, and can actually be, investigated. Part 2 is entirely devoted to the practical delimitation of this expected field of capital mobility. Part 3 presents the results: the industries in which gravitation is observed, and the *Highly capital intensive industries*, where it is not. Two more technical problems are discussed in part 4 opening the field for new research. An appendix provides technical information.

1 - General framework of analysis

Section 1 is devoted to the definition of profit rates to be considered in the analysis of gravitation. Section 2 discusses the contours of the field of capital mobility (Which industries provide *a priori* comparable alternative opportunities for investment to capitalists, allowing for the gravitation of profit rate?). It also defines what can be actually done on account of data limitation.

1.1 - Which profit rates?

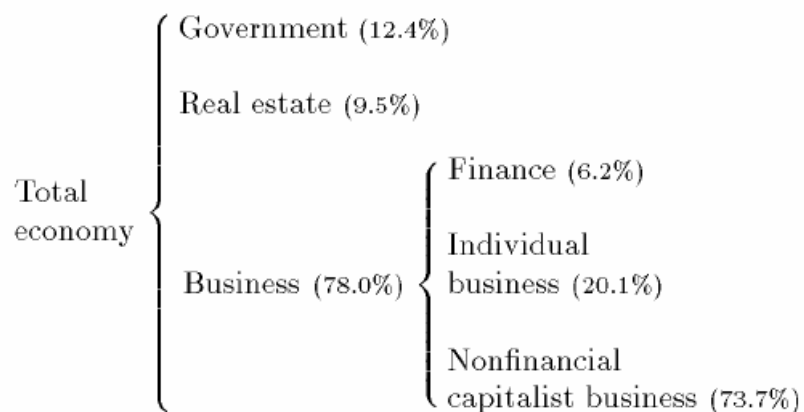
The measurement of profit rates is difficult in several respects. Should variables be measured in *values*, in the sense of Marx's labor theory of value, or in *prices*? The answer to this question is clear: Price measures must be adopted. This does not mean that the labor theory of value has no explanatory power, but only that it does not explain everything.⁷ What is at issue here is the behavior of economic agents, notably the decision to invest of capitalists, and the consequences of profitability levels. These mechanisms refer to variables measured in price terms. The basic contention is that firms and capitalists are not directly affected by variables expressed in values.⁸ There is no "true" *definition of the profit rate* independently of the topic under consideration. The analysis of *gravitation* requires a narrow definition of profits. Firms pay taxes, and profits must be computed net of indirect business taxes. This is important when profit rates of specific industries are at issue, since, in the US, *the rates of taxation are not uniform*. Profit taxes can also be deducted, but this deduction has less impact. Whether interest should be subtracted is unclear. Individual firms may go into debt for specific reasons. This should not impact the formation of prices of production and, from this viewpoint, profits should be considered prior to the payment of interest. When industries are studied instead of individual firms, there is also an important structural aspect to the pattern of indebtedness: Some industries go into debt more than others. This suggests that profits should be considered after payment of interest. Concerning capital, it is certainly necessary to include inventories, *i.e.*, to consider tangible assets, the sum of fixed capital and inventories. The total capital in a firm includes financial assets (cash, securities

such as bonds and shares, trade credits, etc.), but the firm also owes money to other agents. Because of this reciprocal aspect of monetary and financial relationships, the addition of financial assets to fixed capital and inventories, *i.e.*, the total balance sheet, does not yield an appropriate assessment of the amount of capital invested in a firm or industry. A useful measure of capital is tangible assets plus financial assets minus debt. This measure of capital is known as the *net worth* or *shareholders' equity*. It is not available by industry, and this represents an important limitation in the investigation of gravitation. For most sectors, tangible assets can be used as a proxy, but this is not true of *Finance* in which the financial components of balance sheets are crucial, and this is the sole reason why *Finance* is not considered in this study.

1.2 - The field of capital mobility

A difficult issue is the determination of the *field* within which the analysis of capital mobility must be conducted. The statement that capitalists choose to invest within particular industries must be made more specific. Is the entire spectrum of activities available to such investments? Are all institutional frameworks equivalent? Diagram I decomposes the *Total economy* in various subsectors.

Diagram I :



In this diagram, as in diagram II, the numbers within the parentheses indicate, for each sector, its relative average contribution to the net product of the sector on the left of the brace over the period 1948-2000.

We *a priori* exclude from the analysis of gravitation: *Government* (and government enterprises), as well as *Real estate*. Income in this latter industry primarily consists of the rental income of persons (corresponding to housings occupied by their owners, for which fictitious rents are

estimated, or to actual renting by households) and of the proprietor's income of self-employed, and very little to renting by corporations. We call the resulting sector *Business*. It can be broken down into three components:

1. *Finance (Finance and Insurance)* is certainly part of the capitalist sector of the economy, and investing in this sector is an alternative to investing in other capitalist industries. We will, however, exclude *Finance* because of the specific problems posed by the treatment of this sector to which we already alluded.

2. We isolate activities which we will not consider as part of the overall mobility of capital, and for which the notion of profit rate is not clearly relevant. The specific traits of the individuals which perform these activities, are often crucial in this sector (craftsmen, doctors, lawyers, etc.), and we denote this sector as *Individual business*. The capital advanced can be very low or null (as in the case of maids). We do not expect profit rate gravitation for these industries.

3. The last component corresponds to the *Nonfinancial capitalist business*, denoted *NF-Capitalist business*. *A priori*, we consider that the capitalist features of this sector are sufficiently strong to allow for the tendencial equalization of profit rate by capital mobility.

If data were available for corporations in each industry, it would be possible to limit the investigation to the corporate sector. Unfortunately, this is not the case.⁹ Whenever self-employed persons are involved in the industries selected as capitalist industries, it is necessary to provide an estimate of their "profits". The income of self-employed persons is known as *proprietors' income*, which combines the "wages" of the proprietor and the profits on his/her capital. The practical way to deal with this issue is to compute a *wage (labor compensation) equivalent* for the proprietor, to be aggregated with the labor compensation of wage-earners. Thus, profits for self-employed persons are equal to *proprietors' income* minus the *wage equivalent*. This correction for self-employed persons can bias the measurement of the profit rate to a certain extent, but this is the best that can be done. Provided that the fraction of the industry at issue is not too large, any bias is limited.

2 - Individual and capitalist business

This part is devoted to the separation between *Individual business* and *NF-Capitalist business*. Section 1 defines three variables which tend to provide a quantitative assessment of the capitalist features of industries. Section 2 presents the criteria used and the results.

2.1 - Three variables accounting for the capitalist features of industries

A classification of industries common to *National Income and Product Account (NIPA)*, *Gross Product Originating (GPO)*, and *Fixed Reproducible Tangible Wealth* is used. We only consider

the highest level of disaggregation possible (a total of 51 industries). For each industry and each year, we define three variables:

1. *Wage-earners*. A first variable compares the number of wage-earners (or employees) in the industry to its total employment including self-employed persons:

$$C1 = \frac{\text{Full-time equivalent employees}}{\text{Persons engaged in production}}$$

2. *Capital-labor ratio*. A second variable describes the more or less capital intensive technology in the industry:

$$C2 = \log \frac{\text{Fixed capital in constant dollars}}{\text{Persons engaged in production}}$$

3. *Corporations*. A third variable measures the importance of the corporate sector in comparison to the total. It is the ratio of corporate profits to total nonwage income:

$$C3 = \frac{\text{Corporate profits before tax}}{\text{Corporate profits before tax} + \text{Proprietors' income}}$$

Profits before tax means profits after indirect business tax and after net interest, but before profit tax. *Proprietors' income* is the total income of self-employed persons.

The second variable describes a technical aspect of production, and the third one accounts for an institutional feature of the industry. The first variable occupies an intermediate position in this respect. Note that the first and third variables are not equivalent: Self-employed persons can hire wage-earners and, thus, an industry could potentially use a large proportion of such workers and not be largely incorporated.

In their own way, these three variables assess the capitalist features of the industry. If the number of wage-earners compared to the total number of persons engaged in production (wage-earners and self-employed persons) is close to 1, this represents a capitalist activity. In a similar manner, if much fixed capital is used in comparison to labor, this may also indicate a further capitalist trait. Finally, the share of corporate profits in the industry is a direct indication that this industry is part of the capitalist world.

Considered separately, each of the above indicators is ambiguous, and this is why we use them jointly. If, for example, the two first variables are large, they reveal the capitalist nature of the industry, whereas an activity in which labor is mostly performed by self-employed, using little fixed capital, does not seem to provide an opportunity for investment to capital in general.

Obviously, many intermediary situations are possible (either much fixed capital and few wage-earners, or little fixed capital and many wage-earners).

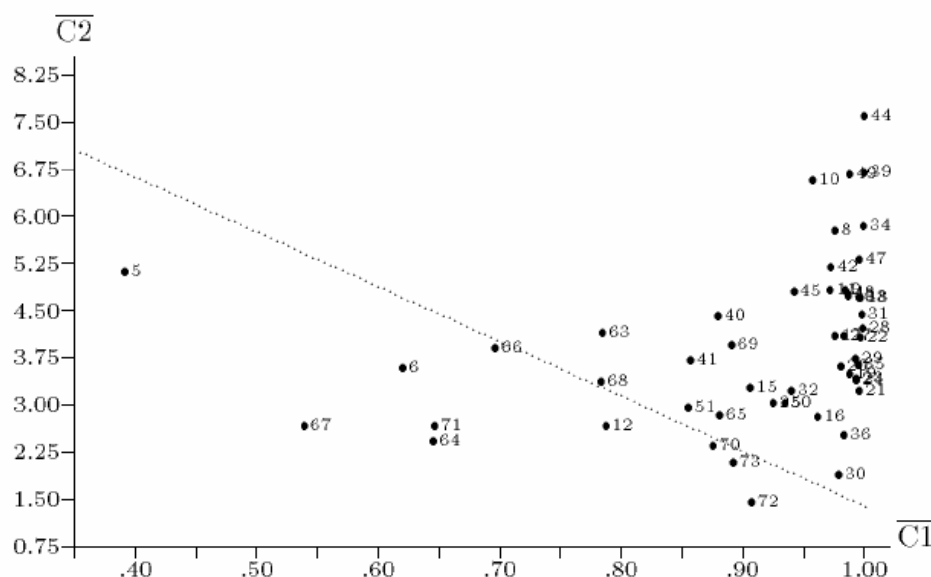
The three variables $C1$, $C2$, and $C3$ are defined for each year from 1948 to 2000, for each of the 51 industries. We use the average values, $\overline{C1}$, $\overline{C2}$, and $\overline{C3}$, of these three variables over the entire period 1948-2000 as indicator of the capitalist features of these industries.

2.2 - Three criteria in the separation between Individual and Capitalist business

There is obviously an arbitrary element in such a division, but a subset of 10 industries can be defined as *Individual business*, according to three converging criteria:

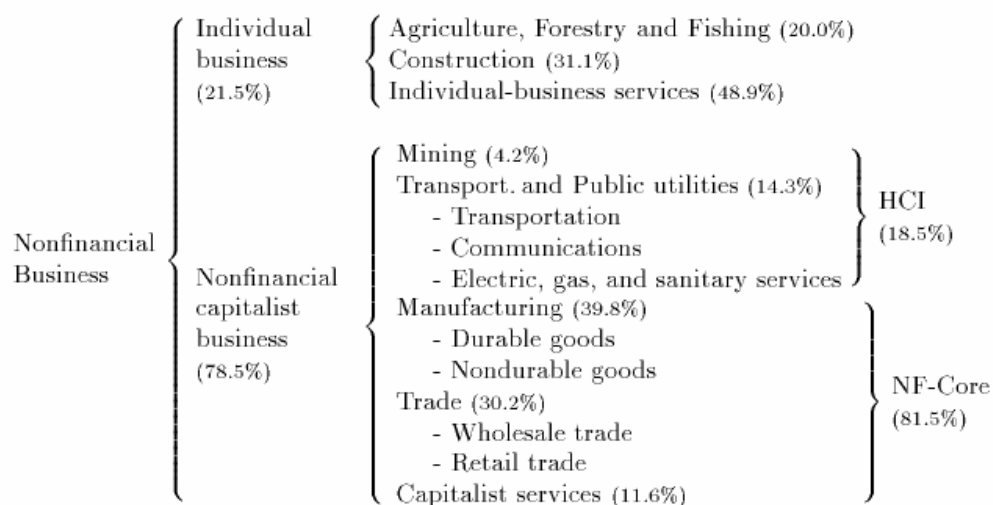
1. We first use factor analysis (principal components analysis). This method determines the linear combination of the variables ($\overline{C1}$, $\overline{C2}$, and $\overline{C3}$) which maximizes the dispersion of the observations (the 51 industries). This new variable is called *first factor* or *component*. Here, it provides a form of *aggregate measure* of the capitalist features of an industry. We select the 10 industries for which this measure is the lowest, as *Individual business*.
2. Figure 1 plots the 51 industries for $\overline{C1}$ and $\overline{C2}$. Note that many industries are located on the right half of the scatter. This means that most persons engaged in production are wage-earners (87.3% in *Business* in the average since World War II). An industry such as industry 44, *Pipelines, except natural gas*, to the extreme upper-right side of the plot, has never had any self-employed since 1948 ($\overline{C1} = 1$) and employs an extremely large amount of fixed capital in comparison to employment ($\overline{C2} = 7.59$, i.e., approximately 2 millions of [1996] dollars per worker). The converse is true of 67, *Miscellaneous repair services*, which is close to the origin (with only about 14.5 thousands of [1996] dollars per worker), i.e., 136 times less than for *Pipelines*. In this industry, only 54% of total employment is composed of wage-earners. An industry like 72, *Educational services*, on the lower-right side of the plot employs a comparatively large number of wage-earners, but uses little fixed capital. All industries forming *Individual business*, as defined by the first criteria, are located below the dotted line in the plot.¹⁰ They neither employ a large proportion of wage-earners, nor have a sufficient amount of fixed capital per worker.
3. These 10 industries can also be defined in a straightforward manner as those for which $\overline{C3}$ is the lowest (in which corporate profits are particularly low in comparison to total non-wage income).

Figure 1. Scatter: $\overline{C1}$, proportion of employees in total employment, and $\overline{C2}$, logarithm of the capital-labor ratio (1948-2000 averages)



The equivalence between the second and third criteria means that *all industries which are neither employing a large proportion of wage-earners nor a sufficient amount of fixed capital per worker are not incorporated to significant extent.*

Diagram II :


 } HCl
(18.5%)

 } NF-Core
(81.5%)

All selected industries form the *NF-Capitalist business*, and the 10 industries which are excluded form what we call *Individual business* (diagram II). The following remarks can be made:

1. All components of *Mining* (8 to 11), *Manufacturing* (15 to 36), *Transportation and Public utilities* (39 to 49), and *Trade* (50, 51) are selected.
2. The two components of *Agriculture* (5, 6) do not pass the test.
3. *Construction* (12) is also rejected. Obviously, this industry is very heterogeneous. Large corporations are active in this field, but much of the work is performed by self-employed persons and the share of corporate profit is low. Unfortunately, it is impossible to distinguish between these different components, and this important industry must be globally set aside.
4. Four components of *Services* (63, 65, 68, and 69) are retained out of 11.¹¹ This is the only industry, at this level of disaggregation, which must be divided as a result of this selection. We will use the terminology *Individual-business services* and *Capitalist services*.

The *NF-Capitalist business* still represents a large segment of the economy. It accounts for 73.7% of the net product of total *Business*, and holds 82.7% of its fixed capital.

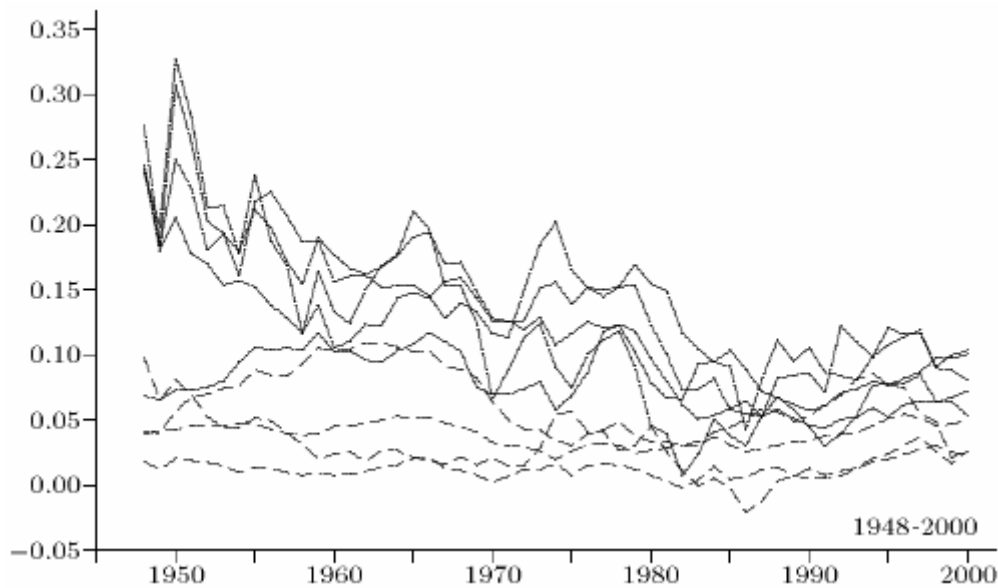
3 - The gravitation of profit rates

This section analyzes the gravitation of profit rates around a common value. Section 1 compares the profit rates of the 9 industries whose capitalist features are sufficiently strong to *a priori* expect such a gravitation to occur. Section 2 is devoted to a first group in which the hypothesis can be maintained, and section 3 to the capital intensive features of the industries for which the hypothesis must be rejected. Section 4 discusses the variation of the tightness of gravitation over time: Whether it became tighter during the last decades.

3.1 - The broad picture

We conduct our comparison of profit rates by industries within the *NF-Capitalist business*, for the 9 industries at the most disaggregated level of diagram II.¹² This comparison is made using a measure of the profit rate that is as close as possible to the variable which impacts the behavior of firms, taking account of data limitations.

Figure 2. Profit rate: The components of *Capitalist business*



The five industries (—) for which gravitation is observed are: (1) *Durable goods*, (2) *Nondurable goods*, (3) *Wholesale trade*, (4) *Retail trade*, (5) *Capitalist services*. The four industries (---) for which gravitation is not observed are: (1) *Mining*, (2) *Transportation*, (3) *Communications*, (4) *Electric, gas, and sanitary services*. Industries are identified individually in figures 3 and 5.

Profit rate = (Net product-Labor compensation-Indirect business taxes-Net interest) / (Fixed capital +Inventories).

The results are displayed in figure 2. Two categories of industries can be distinguished in this figure:

1. *Mining* and the three components of *Transportation and Public utilities* define a first group of four industries with comparatively low and significantly different profit rates (---). (They account for 18.5% of the net product of the NF-Capitalist business.)

2. A second group of five industries (—) is composed of *Manufacturing* (durable and nondurable goods), *Trade* (wholesale and retail), and *Capitalist Services*. Their profit rates: (1) have similar values; (2) tend to fluctuate in concert; (3) decline together. *Globally, for these industries, one observes a significant tendency for profit rates to gravitate around a common value.* We denote these five industries considered globally, as the *Nonfinancial core capitalist business* or *NF-Core*. In the average since World War II, the net product of this sector represented 81.5% of the net product of the *NF-Capitalist business*, and 60.1% of *Business* (64.0% of the *NF-Business*).

Thus, an important result emerges from this investigation. Two groups of industries must be distinguished within *NF-Capitalist business*: (1) a group of industries whose profit rates tend to gravitate around a common value, and (2) a group of industries whose profit rates are lower, sometimes dramatically lower, and whose profit profiles and levels are significantly different from one another.

Table 1 - Capital-labor ratio: The components of *Nonfinancial capitalist business*

	K/L
<i>NF-Core</i>	
Retail trade	19.2
Wholesale trade	21.0
Capitalist services	23.9
Durable goods	40.6
Nondurable goods	56.2
<i>HCI</i>	
Communications	186.9
Transportation	216.5
Mining	419.9
Electric, gas, and sanitary services	837.6

Thousands of [1996] dollars per worker ($K/L = \exp(\overline{C2})$) is the geometric average of the variable over the period 1948-2000). The figures for the two component of *Trade* provide a low estimate of the capital invested in these industries, since inventories are not included.

These industries which are not part of gravitation share the common property of holding very large amounts of fixed capital, and this accounts for their name: *Highly capital intensive industries*. This is shown in table 1, which displays the geometric average by industry of the capital-labor ratio over the period 1948-2000. The ratio obtained for *Communications*, the lowest of all *Highly capital intensive industries*, is already more than three times larger than the largest ratio (for nondurable goods) in the core.

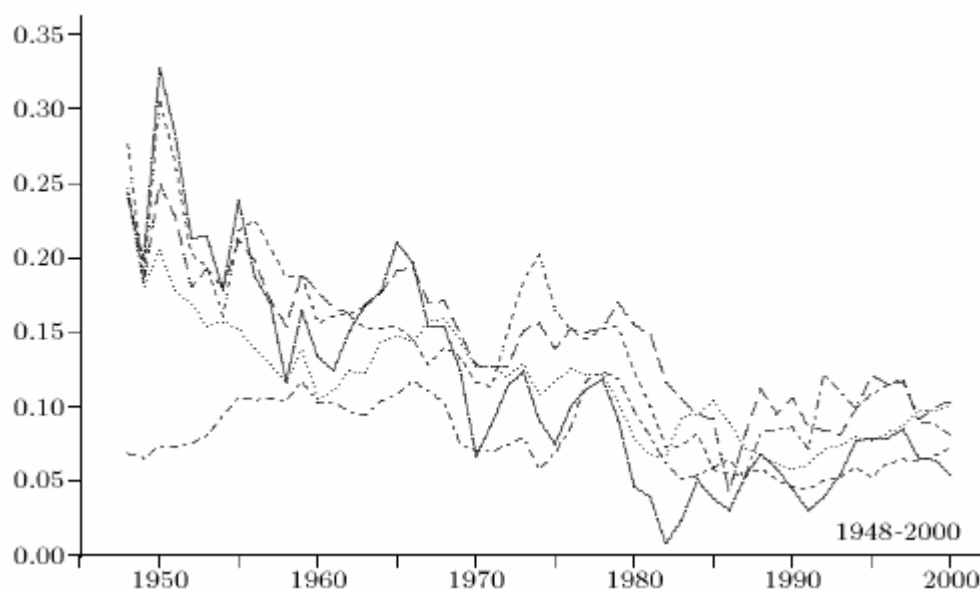
3.2 - The Nonfinancial core capitalist business

This section provides a more in depth discussion of the five industries for which the gravitation around a common average is observed: *Durable goods*, *Nondurable goods*, *Wholesale trade*, *Retail trade*, and *Capitalist services*.

The movement of the profit rates for these five industries which compose the *NF-Core* is described in figure 3. It is certainly possible to contend that the band in which these profit rates fluctuate remains significantly large. But it is also important to understand that these various industries differ to considerable extent, and that the gravitation in figure 3 is not trivial. This is clearly demonstrated by the consideration of any less (theoretically) relevant definitions. This is illustrated in figure 4 which displays the profit rates of the same industries, using the definition of the profit rate generally considered in the analysis of the tendency for the profit rate to fall:

$$\text{Profit rate} = (\text{Net product} - \text{Labor compensation}) / \text{Fixed capital}.$$

Figure 3. Profit rate: The components of the *NF-Core*



Profit rate = (Net product - Labor compensation - Indirect business taxes - Net interest) / (Fixed capital + Inventories).

Durable goods (—); *Nondurable goods* (---); *Wholesale trade* (---); *Retail trade* (.....), *Capitalist services* (- · - ·).

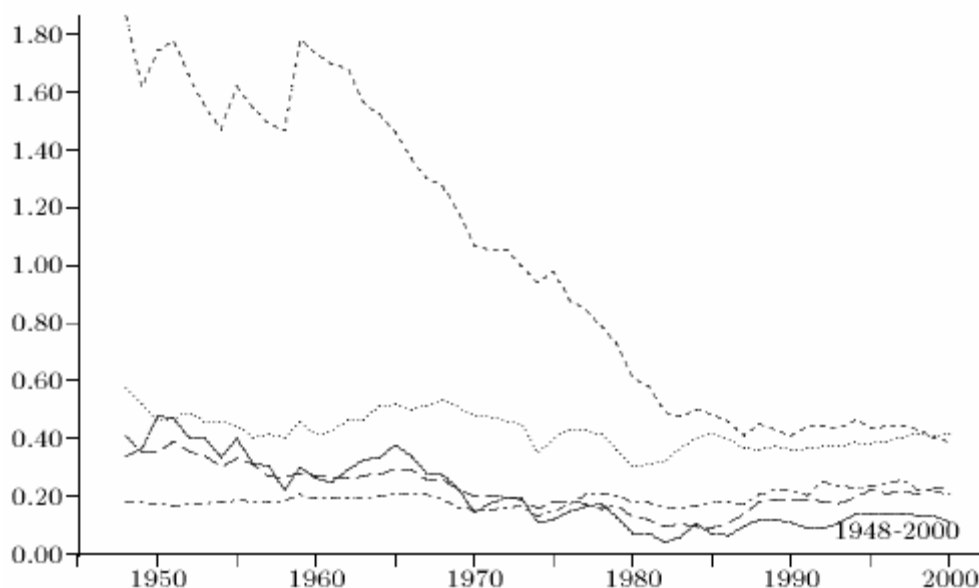
The difference is striking. It is clear that the formation of prices takes accounts of differences concerning technology, inventories, and taxation. We already pointed out the specific problems posed by *Services*. Nonetheless, the profit rate for this industry moves in concert with the four others. It is also obvious that the capitalist features of these industries increased over time.¹ It is also clear that the restoration of the profitability of this industry since the mid-1980s is sharper than for the four other industries considered. This probably mirrors the corporatization of this sector (apparent in the recent rise of C3) and its organizational and technical transformation during the last years.

The less problematic sectors are *Manufacturing* and *Trade*. It is interesting to focus more carefully on the movements of the profit rate within these industries:

1. Consider first *Trade*. The gravitation of the two components of *Trade*, wholesale p.tir and retail p.o.in, around one another appears very circumscribed--surprisingly tight when one considers the limitations of the data and of the large differences between the two industries.¹
2. Considering the two components of *Manufacturing*, durable goods (—) and nondurable goods (---), again the gravitation is very tight, but only until the late 1960s. In the years that followed, the two profit rates move in tandem, but the profit rate of *Durable goods* tends to be significantly lower than that of *Nondurable goods*. Note that the two series get closer in the last few years.

This divergence within *Manufacturing*, during the second half of the period, is puzzling. We tend to believe that it is not a mere artifact of the data, since these movements are in line with other evolutions: The share of *Durable goods* and *Nondurable goods* in the net product of total business evolved differently with a significant break at the beginning of the 1970s signaling a relative decline of *Durable goods*, consistent with the lower profit rate in this industry.¹

Figure 4. Profit rate (alternative definition): The components of the *NF-Core*

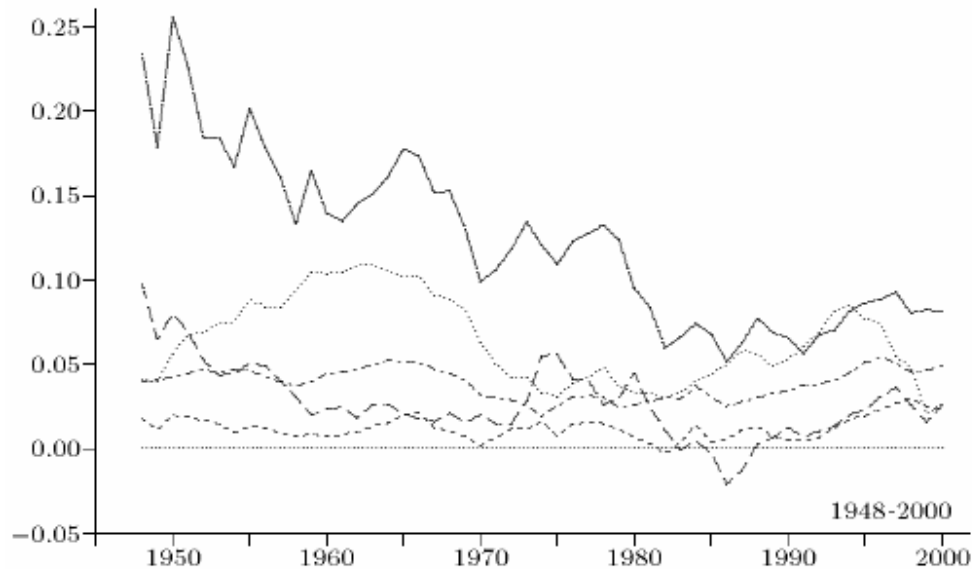


Profit rate = (Net product - Labor compensation) / Fixed capital. *Durable goods* (—); *Nondurable goods* (---); *Wholesale trade* (---); *Retail trade* (.....); *Capitalist services* (- · - ·).

3.3 - Highly capital intensive industries

The difference between the above industries in the *NF-Core* and the remaining industries which compose *Capitalist business* —*Mining* and the three components of *Transportation and Public utilities*) is significant. Figure 5 depicts the average profit rate of the *NF-Core* and of the four above industries. Although the gap between the profitability of these two categories of industries tended to diminish progressively, in relation to the decline observed for the first group, the profit rates of *Mining*, and of the components of *Transportation and Public utilities* are considerably lower. This was particularly the case just after World War II. *This is the primary exception to profit rate equalization.*

Figure 5. Profit rate: *NF-Core*, *Mining*, and the components of *Transportation and Public utilities*



NF-Core (—); *Mining* (---); *Transportation* (---); *Communications* (.....); *Electric, gas, and sanitary services* (- · - ·).

The profit rate in *Communications* is significantly larger than in *Mining* and the two other components of *Transportation and Public utilities*. Already by the 1960s, it had reached the band in which the profit rates of the components of the *NF-Core* usually fluctuate (figure 2), but only provisionally. It eventually converged to similar levels during the later decade, and could be now included in the *NF-Core*. The worst case is that of *Transportation* whose profit rate remained constantly extremely low.

Table 2 - Net product (NP), employment (L), and fixed capital (K): Shares of *Mining*, and *Transportation and Public utilities* and their components in the *NF-Capitalist business* (average 1948-2000)

	NP	L	K
NF-CAPITALIST BUSINESS	100.0	100.0	100.0
NF-Core	81.5	88.8	43.8
Mining, and Transportation and Public utilities	18.5	11.2	56.2
Mining	4.2	1.5	9.3
Transportation and public utilities	14.3	9.7	46.9
Transportation	6.6	6.2	21.2
Communications	3.7	2.1	8.2
Electric, gas, and sanitary services	4.0	1.4	17.5

Table 2 presents the shares of the components of the *NF-Capitalist business*, for the net product, employment, and fixed capital. The following observations can be made:

1. The *NF-Core* accounted for 81.5% of the net product of the *NF-Capitalist business* (average 1948-2000), and the other industries for 18.5%. *Mining*, with 4.2% is quite smaller than *Transportation and public utilities*, with 14.3%.
2. The overall picture for employment is similar (88.8% and 11.2%). *Mining* uses 1.5% of the employment of the total, and *Transportation and Public utilities*, the remaining 9.7%.
3. The important point concerns fixed capital. We already described in table 1 the large capital-labor ratios of the *Highly capital intensive industries*. For 1948-2000, the *NF-Core* held only 43.8% of the capital stock of the *NF-Capitalist business*, and *Mining, Transportation, and Public utilities* 56.2%. Thus, these latter industries produced 18.5% of the net product using 56.2% of the total fixed capital stock. This is even more true for *Public utilities, i.e., Electric, gas, and sanitary services*, which performed 4.0% of the net product of the *NF-Capitalist business*, using 17.5% of the fixed capital. The paroxysmal example of this is, however, *Railroad transportation* (a component of *Transportation*) whose net product represents 1.8% of the net product of the *NF-Capitalist business* and utilizes 14.2% of the stock of fixed capital! These industries are all located in the upper-right corner of the scatter in figure 1 (7, 38, 46, and 49).

3.4 - Did gravitation become tighter during the last decades?

Figure 2 suggests a tighter gravitation in recent years, a kind of "historical convergence". It is, however, misleading. This illusion is due to the *decline of the profit rate* in the sector for which gravitation prevails. Dividing the profit rates in each year by the average of the year, one can define *relative profit rates*. If these relative profit rates are plotted in a figure such as figure 3, a different impression emerges: Gravitation does not appear tighter in recent years.

A better assessment of the tightness or looseness of gravitation can be obtained determining an indicator of dispersion, a quantitative estimate of the distance of individual profit rates, r_i^t , from the average profit rate \bar{r}^t . We compute, for each year, the following variable:

$$\sigma_t = \frac{1}{n} \left(\sum_{i=1}^n \left(\frac{r_i^t - \bar{r}^t}{\bar{r}^t} \right)^2 \right)^{\frac{1}{2}} \quad \text{with} \quad \bar{r}^t = \frac{1}{n} \sum_{i=1}^n r_i^t$$

Thus, we can determine the average values of σ_t for various subperiods. *We divide the entire period in 5 subperiods of 10 years*. This is performed for three groups of industries: *NF-Capitalist business*; *NF-Core*; and *Highly capital intensive industries*. The results are displayed in table 3.

Table 3 - A quantitative indicator of the dispersion of profit rates by subperiods: The components of (1) *NF-Capitalist business*; (2) *NF-Core*; (3) *Highly capital intensive industries*

	(1)	(2)	(3)
1950-1959	.21	.12	.28
1960-1969	.19	.09	.38
1970-1979	.22	.11	.24
1980-1989	.23	.15	.44
1990-1999	.17	.12	.28

One can first check that the indicator of dispersion is smaller for the components of the *NF-Core*, as could be expected. The largest deviations are observed for the *Highly capital intensive industries*.

Concerning the variation of the dispersion over time, the indicator does not decline over time and, thus, no historical convergence is apparent for the three groups. Rather, the gravitation of the 5 industries of the *NF-Core* was tighter during the second and third subperiods. These measurements suggest the following interpretations:

1. Investment is congenial to the mobility of capital, and gravitation is tighter during periods of large investment and steady trends of technology, as during the 1960s and first half of the 1970s. The opposite is true during periods of crisis.
2. The larger dispersion during the last period, 1990-1999, the recovery from the structural crisis of the 1970s and 1980s, was probably the effect of more profound technological shocks and growing heterogeneity among enterprises.

The case of *Communications* must be discussed separately. In some periods, as in the last decade of the study, the profit rate of this industry moves closer to the components of the *NF-Core*. If this industry is added to the *NF-Core*, the standard deviation is only increased during the fourth period, and diminished for the three earlier periods.

4 - Open ends

As stated in the introduction, the findings in this paper support the relevance of the classical-Marxian analysis of gravitation. The industrial extension of this mechanism is, however, limited to a segment of the economy. Two types of properties are at issue. First, the industry considered must display sufficient capitalist features. Second, a number of industries, *Highly capital intensive industries*, with high capital-labor ratios display, very low profit rates, which do not move in concert with the profit rates of other industries.

This section elaborates on two unresolved issues raised by this investigation. More research is certainly required in these fields: (1) Why are *Highly capital intensive industries* different? (2) Could econometrics help in the distinction of various subsectors?

4.1 - Why are Highly capital intensive industries different?

It is very striking that competitive mechanisms do not ensure "normal" profit rates to *Highly capital intensive industries*. Whether this observation can be imputed to a bias in the data or to an actual feature of the economy is, however, unclear. It may be difficult to distinguish between these two types of explanation. Clearly, the economic system does not recognize the entire fixed capital invested in *Highly capital intensive industries* for what it is in BEA data. Note that the recent revision of the capital stock series by the BEA considerably *aggravated this problem*.¹ The ratio of the fixed capital stock in the new BEA series to the old measures is slightly above one for *Manufacturing*. Within *Transportation*, it was equal to approximately 1.85 up to the 1980s, and reached 2.21 in 2000. Thus, for these industries the new estimates doubled the capital stock, dividing the profit rate in the same proportion.

It is not just that the amount of capital in these industries is large. The estimation of a stock of capital resulting from a continuously large flow of investment in components of "average" *service life* would not raise specific problems. The difficulty is that the service life of capital is specifically long within these declining industries. This is particularly true of *Railroads*, in which large investments were made in the 19th century. As long as the industry grew, the large investment required could be associated with larger prices and have favorable consequences on profit rates. In a period of relative decline, the opposite situation prevails, and capital tends to be gradually devalued--a phenomenon which is not considered within national accounting frameworks.

It is also well known that some of these industries are regulated, and this regulation could possibly have important economic consequences. The combination of the two types of difficulties, measurements and specificities of the formation of prices in these industries (therefore, of their financing) points to the need of other data sources--with their own particular problems--and a quite distinct methodology.

4.2 - Could econometrics help in the distinction of various subsectors?

One can *a priori* think of *cointegration* to discuss gravitation. The existence of a maximum number of relations of cointegration among the components of the *NF-Core* would be a strong argument in favor of gravitation. Unfortunately, the number of observations is not sufficient to perform this analysis convincingly.

Table 4 - Deviation of profit rates: Correlations among the components of *Nonfinancial capitalist business*

<i>Durable goods</i>	1.000		
<i>Nondurable goods</i>	.419	1.000	
<i>Wholesale trade</i>	.606	.787	1.000

<i>Retail trade</i>	.384	.791	.698	1.000					
<i>Capitalist services</i>	-.280	.411	-.066	.292	1.000				
<i>Mining</i>	-.476	-.896	-.691	-.882	-.493	1.000			
<i>Transportation</i>	-.564	-.960	-.831	-.847	-.378	.947	1.000		
<i>Communications</i>	-.446	-.566	-.748	-.500	.182	.331	.522	1.000	
<i>Public utilities</i>	-.689	-.903	-.924	-.785	-.185	.861	.960	.646	1.000

The variable used is $\left(r_i^t - \bar{r}^t \right) / \bar{r}^t$.

A straightforward method is to compute correlations among the deviations of the profit rates of industries from the average profit rate: $\left(r_i^t - \bar{r}^t \right) / \bar{r}^t$. The results are displayed in table 4. This investigation can be developed using variance analysis, decomposing the total variance into intra and intergroup components. The findings confirm the distinction of the two sectors:

1. With the exception of *Capitalist services*, the correlations among the components of the *NF-Core* are always positive.
2. The correlations among the components of the *Highly capital intensive industries* are always positive.
3. The correlations between the components of the *NF-Core* and *Highly capital intensive industries* are negative, with only a single exception (the correlation between *Capitalist services* and *Communications*).
4. The correlations between *Capitalist services* and the other components of the *NF-Core* are looser (2 coefficients are slightly negative).
5. In addition, one can notice the tight correlation within the *NF-Core* between *Nondurable goods*, *Wholesale trade*, and *Retail trade* (with a coefficient always larger than 0.70).

All these results confirm the visual impression from the figures.

Technical appendix

• Main sources:

1. *Gross Product Originating* (GPO).

GPO contains annual estimates of the components of the gross product originating by industry in current dollars (1947-2000) and chained [1996] dollars (1977-2000). We use:

GPC	Current Dollar Gross Product Originating
COMP	Compensation of Employees
PROINC	Proprietors' Income
NCCA	Noncorporate Capital Consumption Allowance
CCCA	Corporate Capital Consumption Allowance

FTPT	Full-Time and Part-Time Employees
FTE	Full-Time Equivalent Employees
PEP	Persons Engaged in Production

2. *National Product and Income Accounts (NIPA).*

We use:

PI Table 6.17 Corporate Profits Before Tax

3. *Fixed Asset Tables.*

Fixed Asset Tables contain estimates of net stocks, consumption of fixed capital, and investment measured at current-cost valuation, at historical-cost valuation, in chain-type quantity indexes, and chained [1996] dollars. We use:

K Table 3.1ES Current-Cost Net Stock of Fixed Private Capital, Nonresidential and Residential, by Industry.

• GPO and NIPA:

All variables in GPO and NIPA are identical, with the exception of two: "Corporate profits" and "Corporate capital consumption allowance". In GPO, they are determined on "an establishment-industry basis", and in NIPA on "a company-industry basis". The conversion is made using a matrix ("that converts NIPA corporate profits and capital consumption allowance from a company-industry basis to an establishment-industry basis"). We use GPO, except for *Corporate profits*.¹

• The wage equivalent of self-employed persons:

The wage equivalent of self-employed persons, COMP*, is equal to the product of a unit wage, w , by the number of self-employed (PEP-FTE):

1. A first issue is the unit of analysis in which the average labor compensation of wage-earners is computed (*Business*, the particular industry whose profit rate is computed).

2. A second difficulty concerns the number of employees. One can divide the total labor compensation by the number of part-time and full-time employees, or by the number of full-time equivalent employees.

In this study, we use: Total compensation in the industry divided by the number of full-time and part-time employees ($w = \text{COMP}/\text{FTPT}$). The remaining fraction of proprietors' income (PROINC- COMP*) is added to corporate profit (PI).

• Inventories (INV):

We use:

NIPA, Table 5.12, Inventories and Domestic Final Sales of Business, by Industry.

There is no breakdown for some industries, which hold only small inventories. We allocate the total ("other" in NIPA) proportionally to the gross product of each component.

- Profit rates:

Two main profit rates are considered. The first profit rate, r_b , is the ratio of a "broad" measure of profits (the net product minus total labor compensation) to fixed capital. It is appropriate in an analysis *à la Marx* of the trend of the profit rate, focusing on technology and distribution. The second profit rate, r_n , is the ratio of a "narrow" measure of profits (profits after indirect business tax and interest) to the sum of fixed capital plus inventories. One has:

$$r_b = \frac{\text{GPC} - (\text{NCCA} + \text{CCCA}) - (\text{COMP} + \text{COMP}^*)}{K}$$

$$r_n = \frac{\text{PI} + (\text{PROINC} - \text{COMP}^*)}{K + \text{INV}}$$

REFERENCES

- Duménil G., Lévy D., 1987, "The Dynamics of Competition: A Restoration of the Classical Analysis", *Cambridge Journal of Economics*, Vol. 11, # 2, pp. 133-164.
- Duménil G., Lévy D., 1989, "The Analytics of the Competitive Process in a Fixed Capital Environment", *The Manchester School*, Vol. LVII, # 1, pp. 34-57.
- Duménil G., Lévy D., 1990, "Stability in Capitalism: Are Long-Term Positions the Problem?", *Political Economy*, Vol. 6, # 1-2, pp. 229-264.
- Duménil G., Lévy D., 1991, "Micro Adjustment Toward Long-Term Equilibrium", *Journal of Economic Theory*, Vol. 53, # 2, pp. 369-395.
- Duménil G., Lévy D., 1993, *The Economics of the Profit Rate: Competition, Crises, and Historical Tendencies in Capitalism*, Edward Elgar, Aldershot, England.
- Duménil G., Lévy D., 1995, "Structural change and prices of production", *Structural Change and Economic Dynamics*, Vol. 6, pp. 397-434.
- Duménil G., Lévy D., 1996, *La dynamique du capital. Un siècle d'économie américaine*, Presses Universitaires de France, Paris.
- Duménil G., Lévy D., 1999, Profit rates: Gravitation and Trends, www.cepremap.cnrs.fr/~levy/dle1999e.pdf, Cepremap, Modem, Paris.
- Ehrbar H., Glick M., 1988, "Profit Rate Equalization in the U.S. and Europe: An Econometric Investigation", *European Journal of Political Economy*, *Europäische Zeitschrift für Politischeökonomie*, Special Issue, Vol. 4, # 1, pp. 179-201.
- Glick M., 1985, Competition vs Monopoly: Profit Rate Dispersion in U.S. Manufacturing industries, PhD Dissertation, New School for Social Research, New York.
- Glick M., Ehrbar H., 1990, "Long-Run Equilibrium in the Empirical Study of Monopoly and Competition", *Economic Inquiry*, Vol. XXVIII, pp. 151-162.
- Herrera J., 1990, *La différenciation des taux de profit dans la concurrence, l'exemple des États-Unis*, Thèse de Doctorat, Université de Paris X-Nanterre.
- Katz A.J., Herman S.W., 1997, "Improved Estimates of Fixed Reproducible Tangible Wealth, 1929-95", *Survey of Current Business*, Vol. 77, # 5, pp. 69-92.
- Marx K., 1981, *Capital, Volume III (1894)*, First Vintage Book Edition, New York.
- Ochoa E., 1984, Labor Values and Prices of Production: An Interindustry Study of the U.S. Economy, 1947-1972, Dissertation, New School for Social Research, New York.
- Ricardo D., 1975, *On the Principles of Political Economy and Taxation (1817)*, Cambridge University Press, Cambridge.
- Smith A., 1976, *An Inquiry on the Wealth of Nations (1776)*, Clarendon Press, Oxford.

Notes

¹ A. Smith, 1976, ch. 7; D. Ricardo, 1975, ch. 4; K. Marx, 1981, ch. 10.

² First in simple, and then in joint production. This literature is vast and well known.

³ See the synthesis in the special issue *Political Economy, Studies in the Surplus Approach*, VI, 1990. See also G. Duménil, D. Lévy, 1987; 1989; 1990; 1991; 1993; 1995.

⁴ G. Duménil, D. Lévy, 1993, ch. 8.

⁵ We already investigated gravitation in earlier works, though more superficially (G. Duménil, D. Lévy, 1993, ch. 3, and 1996, ch. 2). See also E. Ochoa, 1984; M. Glick, 1985; M. Glick, H. Ehrbar, 1990; H. Ehrbar, M. Glick, 1988; J. Herrera, 1990. These studies usually focus on manufacturing industries.

⁶ A number of results are presented in G. Duménil, D. Lévy, 1999.

⁷ G. Duménil, D. Lévy, 1993, appendix 3.A1.

⁸ Marx's distinction between productive and unproductive labor is another issue. A very clear-cut distinction is made by Marx between labor expended for production, and labor expended in commercial activities and management in general (from the organization and discipline of the workshop to the control of inventories and liquidities). Taking "management" in a very broad sense, and simplifying considerably, unproductive labor corresponds to the activity of managerial and clerical personnel. This distinction is not helpful in the measurement of profit rates, since, from the viewpoint of capital profitability, the wages of productive workers as well as those of unproductive workers are *costs*. It would be interesting to distinguish between these two categories of labor for analytical purposes, because of the specific roles they play in the formation of profit rates. Productive labor creates value and, therefore, within capitalism, surplus-value; unproductive labor is used to maximize the profit rate. Marx's analysis of prices, as forms of value, stresses that value is created in each industry in proportion to productive labor, and realized in proportion to total capital invested (including industries such as *Trade* or *Finance*, where no value is created since only unproductive workers are involved).

⁹ The *Bureau of Economic Analysis* provides data: (1) by industry in *National Income and Products Accounts* (NIPA, tables 6.1 to 6.22), and in *Gross Product Originating* data (GPO), or (2) by *legal forms of organization* (NIPA, table 1.15), with more detailed information for the *Corporate sector* (NIPA, table 1.16). Unfortunately, it is impossible to combine the two types of data. The same is true of the stock of capital from *Fixed Asset Tables*.

¹⁰ This corresponds to the condition: $8.7 \overline{C1} + \overline{C2} < 10.1$.

¹¹ It has been necessary to adjust for the modification, in 1987, of the SIC 1972 classification: "The combination of 1987 SIC industries "business services" and "other services" is the equivalent of the SIC 1972 industries "business services" and "miscellaneous professional services". Consequently, 73 "Other services", which did not pass the test, was included within "Capitalist services". Among *Individual-business services*, we also include "Private household" services representing 0.14% of the gross product of the total economy in 2000.

¹² The further disaggregation of industries poses specific problems which are not addressed in this study, where only rather "large" industries are considered.

¹³ Considering *Capitalist services* globally, C1 rose from 0.83 in 1948 to 0.86 at the end of the 1950s, then fluctuated, before rising again in the 1990s. The same is true of C2 which increased from 3.0 to 3.3 over the entire period, increasing the capitalist features of these industries. A more sophisticated treatment would suggest to eliminate these industries, or some of them, during the first years.

¹⁴ See the matrix of correlations in table 4.

¹⁵ Several hypotheses can be made. A first point is that *Durable goods* produces investment goods, whose demand was reduced during the later decades, when the rate of accumulation was diminished. Notice also that this industry is more severely affected by cyclical recessions, in particular in 1982. It is, therefore, penalized by a depressed macroeconomic juncture. Demand could also be affected by new trends in the technology, such as the recovery of the productivity of equipment, which implies less and less capital goods for a same output. A second point is that *Manufacturing* goods are at the center of international trade and competition. If the competitiveness of the US with respect to Japan was particularly affected for *Durable goods* or, if this industry was more exposed to international competition in comparison to *Nondurable goods*, the relative profitability of the two industries was necessarily biased to the disadvantage of *Durable goods* (until technological adjustment was performed).

¹⁶ A.J. Katz, Herman S.W., 1997.

¹⁷ The impact of the use of one or the other source, for the two variables which differ, is discussed in appendix 6 of G. Duménil, D. Lévy, 1999