THE THREE DYNAMICS OF THE THIRD VOLUME OF MARX'S CAPITAL

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RÉSUMÉ

LES 3 DYNAMIQUES DU 3ÈME VOLUME DU CAPITAL DE MARX

Cette étude discute, d'un point de vue théorique et empirique, la pertinence des trois processus dynamiques que recèle le Livre III du *Capital* de Marx : (1) le cycle conjoncturel et la crise (les fluctuations du niveau général d'activité dans le court terme), (2) la concurrence (la formation des prix de production dans le long terme), (3) les tendances historiques (tout particulièrement la baisse du taux de profit). Les analyses proposées pour ces trois dynamiques, rejoignent les conclusions de Marx : (1) Le niveau général d'activité demeure constamment à la limite de la stabilité et de l'instabilité, en d'autres termes les phases de "prospérité" sont régulièrement interrompues par des crises, (2) L'équilibre de long terme est stable, c'est-à-dire que les prix gravitent autour des prix de production, et les fluctuations du cycle conjoncturel ne s'expliquent pas par les désajustements des proportions, et (3) La technique et la répartition gravitent autour de trajectoires historiques telles que celles décrites par Marx. De ce dernier point de vue, celui des tendances historiques (aux États-Unis, depuis la guerre de Sécession), deux telles trajectoires peuvent être observées à la fin du XIX$^{\text{ième}}$siècle et durant la seconde moitié du XX$^{\text{ième}}$siècle, correspondant à deux étapes du capitalisme. La première correspond au stade de maturité atteint après la révolution industrielle ; le second au capitalisme managérial. Dans l'intervalle, la transition progressive vers la nouvelle étape s'est manifestée par une tendance à la hausse du taux de profit au cours de la première moitié du XX$^{\text{ième}}$siècle. Cette étude considère également les relations entre ces trois dynamiques. La tendance à la baisse du taux de profit est, en particulier, un déterminant primordial des crises, à la fois dans le sens des récessions en tant que phases particulières du cycle conjoncturel, et des grandes crises telles que les crises de la fin des XIX$^{\text{ième}}$et XX$^{\text{ième}}$siècles, qui sont des crises de *rentabilité*.

ABSTRACT

THE 3 DYNAMICS OF THE 3RD VOLUME OF MARX'S CAPITAL

This paper discusses the theoretical and factual relevance of the three dynamic processes which can be identified in Marx's Volume III of *Capital*: (1) the business cycle and crisis (the fluctuations of the general level of activity in the short term), (2) competition (the formation of prices of production in the long term), and (3) historical tendencies (in particular, the falling profit rate). Analyses of these three dynamic processes conform quite adequately to Marx's conclusions : (1) The general level of activity is constantly maintained at the limit between stability and instability, *i.e.*, phases of "prosperity" are often interrupted by crises, (2) Long-term equilibrium is stable, *i.e.*, prices gravitate around prices of production, and disproportion does not account for business-cycle fluctuations, and (3) Technology and distribution gravitate around trajectories *à la Marx*. In this latter respect, that of historical tendencies (in the US, since the Civil War), two such trajectories are apparent in the late 19th century and second half of the 20th century, corresponding to two distinct stages of capitalism. In between, the progressive shift to the new stage, managerial capitalism, is manifested by an upward trend of the profit rate during the first half of the 20th century. There is also a relationship between these three dynamics. In particular, the tendency for the profit rate to fall is a crucial determinant of crises, both in the sense of recessions as they occur at in particular phase of the business cycle, and larger crises, such as the crises of the late 19th and 20th centuries, which are *profitability* crises.

MOTS CLEFS : Marx, crise, concurrence, prix de production, tendances historiques, taux de profit.
KEYWORDS : Marx, crisis, competition, prices of production, historical tendencies, profit rate.
J.E.L. Nomenclature : B14,B12,D50,E11,O51.

INTRODUCTION: THE THREE DYNAMICS OF VOLUME III

Marx's economic work was often presented, even by Marx himself, as a *criticism of political economy*, when it is primarily a criticism of *capitalism*. One of the main motivations of *Capital*—and Volume III in particular—was actually the detection of the numerous "flaws" or "internal contradictions" which account for the historical character of capitalism. At the beginning of chapter 15 of Volume III, precisely entitled *Development of the Law's Internal Contradictions*, Marx wrote :

> *"Thus economists like Ricardo, who take the capitalist mode of production for an absolute, feel here that this mode of production creates a barrier for itself* [...]. *The important thing in their horror at the falling rate of profit is the feeling that the capitalist mode of production comes up against a barrier to the development of productive forces which has nothing to do with the production of wealth as such ; but this characteristic barrier in fact testifies to the restrictiveness and the solely historical and transitory character of the capitalist mode of production ;* [...]" (K. Marx, *Capital, Volume III*, New York: First Vintage Book Edition, 1894, ch. 15, p. 350)

Following Marx's steps in this demonstration, students of *Capital* are often inclined to detect new indices of these internal contradictions—often *too eager* to do so. In spite of bouts of enthusiasm that the reader may occasionally share with the author, the view that emerges from a careful reading of *Capital* is actually *not* that everything goes astray (markets are a mess, crises are permanent, the profit rate falls to the abyss, etc.) within capitalism. The social cost can often be very large, but many of these problems are eventually dealt with adequately.

The purpose of this paper is to discuss Marx's view of the ability of capitalism to manage itself, and to illustrate the mixed success of such processes depending on the type of mechanisms considered. This will be done on three important components of Marx's analysis in Volume III :

1. Business cycle and crisis.
2. Competition and the formation of prices of production.
3. Historical tendencies.

These three fields share the common property of referring to *dynamic processes*. Business cycle describes a sequence of events, with recurrent destabilizations of the general level of activity. The formation of prices of production is based on the movements of capital among industries, led by profitability differentials ; the issue is whether these movements will ensure the gravitation of the variables around a position in which profit rates are equalized. Historical tendencies relate to the trajectories over time of the major variables explaining technology and distribution, such as labor productivity, the profit rate, etc. In each case, an *equilibrium*, or equilibrium trajectory, and its *stability* are involved.[1]

1. We use the term *equilibrium* in the mathematical sense of a fixed point within a dynamic system. *Stability* refers to the local stability of this fixed point. From a mathematical point of view, the three expressions *gravitation around...*, *convergence toward...*, and *stability of* an equilibrium are approximately equivalent.

Note that distinct *time frames* are implied in each of these analyses: (1) *short term*, for the business cycle, since productive capacity can be assumed constant in the study of business-cycle fluctuations; (2) *long term*, for the formation of prices of production, since capital stocks are modified; and (3) *very long term*, for historical tendencies, since the transformations of technology and distribution — or *structural change* for short — are considered.

One way of assessing the *ability of capitalism to manage itself* is to focus on its performance in the three above respects. The *failure* of any of these mechanisms (unstable equilibria) would create considerable problems — internal contradictions — within capitalist economies. This investigation will be conducted in section 1. In each case, we will successively *review* Marx's approach, test for its *factual relevance* (or explanatory power), and discuss the *theoretical consistency* of each framework. (Modeling is a very useful tool in this latter respect.)

The investigation of the properties of each of these dynamic processes considered separately leads to the following conclusions:

1. The general level of activity in the short term remains consistently at the limit of stability: recurrently stable during phases of steady growth, and recurrently unstable during other phases in which sudden fluctuations between overheating and recession are observed (section 1.1). The assessment of capitalism in this first respect is, therefore, mitigated. The progress of output is finally ensured, but at a very high price. (Appendix A.1 is devoted to the treatment of unemployment).
2. Long-term classical equilibrium with prices of production is *stable* (section 1.2). Therefore, prices do gravitate around prices of production. Casualties can in some cases be significant, but this defines the strongest point of capitalism (of "market economies").
3. Technology and distribution do tend to gravitate around historical trajectories *à la Marx*; historical trajectories are "stable" (section 1.3). The "contradiction" lies in one of the characteristics of these trajectories, *a falling profit rate*.

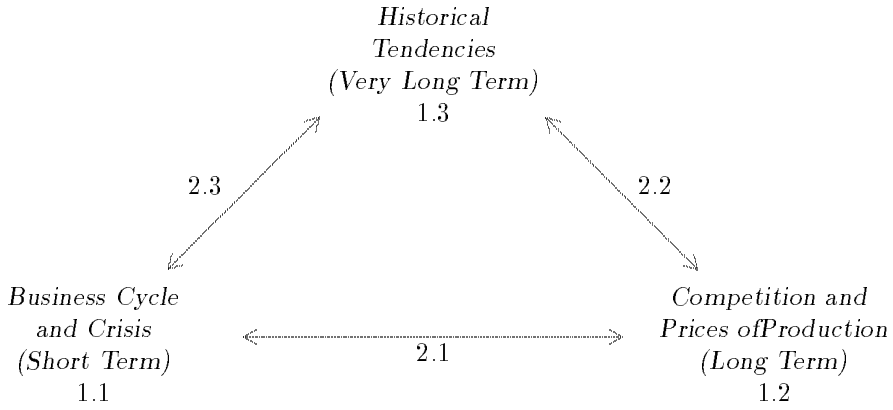

Diagram 1

As shown in diagram 1, these three dynamic processes can also be studied in their reciprocal relationships. This is done in section 2. Three major results are obtained:

1. The two fields, business cycle and the formation of prices of production, can be treated separately, as is the case in Volume III (section 2.1). The failure of gravitation around equilibrium, *i.e.*, disproportions in the allocation of capital, is not what accounts for business fluctuations.
2. The formation of prices of production within competition, or the equalization of profit rates *via* the allocation of capital, is compatible with structural change (section 2.2).
3. Historical tendencies and, in particular, the tendency for the profit rate to fall are crucial determinants of crises, both in the sense of recessions as they occur at a particular stage of the business cycle, and larger crises, such as the crises of the late 19th and 20th centuries, which are *profitability* crises (section 2.3).

Overall, we believe that Marx was quite right to emphasize this latter aspect of capitalism, as in the quotation above. The tendency for the profit rate to fall leads to lengthy phases of crisis, and was only superseded (once in the early 20th century) at the price of the emergence of a new phase of capitalism, managerial capitalism — a thorough transformation of relations of production. It is a key notion in the understanding of the historical character of capitalism.

In addition to the appendix on unemployment mentioned above, appendix A.2 is devoted to the treatments of equilibrium and disequilibrium in relation to Marx's analysis, and appendix A.3 discusses the explanatory power of the labor theory of value (from which the paper fully abstracts).

1 - BUSINESS CYCLE, COMPETITION, AND HISTORICAL TENDENCIES

This section considers separately each of the three dynamics. Section 1.1 is devoted to business fluctuations ; Section 1.2 considers competition and the formation of prices of production ; Section 1.3 focuses on historical tendencies.

1.1 BUSINESS CYCLE : DIMENSION IN THE SHORT TERM

This section is devoted to the analysis of the business cycle, or crisis, developed in Volume III of capital. The issue is that of the determination and stability of the general level of activity — what we call *dimension*. Section 1.1.1 recalls Marx's analysis ; our interpretation and the corresponding model are then introduced in section 1.1.2.

There will be no discussion in this section concerning the *existence* of business fluctuations, which have been a constant feature of the macroeconomy in the last two centuries. David Ricardo had already identified recurrent *states of distress* (D. Ricardo, *The Principles of Political Economy and Taxation*, London : Dent and Son, 1817, ch. 19), and the issue of the relative amplitude of business fluctuations prior to World War I and after World War II, in the US economy, is still controversial (see C.D. Romer, "Is the Stabilization of the Postwar Economy a Figment of the Data", *The American Economic Review*,

LXXVI (1986) p. 314-334 and "The Prewar Business Cycle Reconsidered : New Estimates of Gross National Product, 1869-1908", *Journal of Political Economy*, XCVII (1989) p. 1 -37, and N.S. Balke, R.G. Gordon, "The Estimation of Prewar Gross National Product : Methodology and New Evidence", *Journal of Political Economy*, XCVII (1989) p. 38-92).

1.1.1 Business Cycle in Volume III

The cyclical pattern of output was carefully described by Marx :

> *"If we consider the turnover cycle in which modern industry moves — inactivity, growing animation, prosperity, overproduction, crash, stagnation, inactivity, etc.,* [...]" (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 22, p. 482)

In a recession, the capacity utilization rate of fixed capital is diminished, and inventories are, at first, increased (crises were called *crisis of overproduction*, because of this accumulation of inventories) :

> *"As soon as any stagnation occurs, as a result of delayed returns, overstocked markets or fallen prices, there is a surplus of industrial capital,* [...]. *A great deal of commodity capital; but unsaleable. A great deal of fixed capital; but in large measure unemployed as a result of the stagnation in reproduction. Credit contracts* [...]. *Factories stand idle, raw materials pile up, finished products flood the market as commodities."* (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 30, p. 614)

In addition, the reserve army is re-formed. As already apparent in this quotation, Marx paid considerable attention to monetary and financial mechanisms in the analysis of the business cycle. Many references are made by Marx to the cyclical behavior of prices, of interest rates, of the provision of loans, of the quantity of money and of its speed of circulation, that are still quite relevant in contemporary capitalism. For example :

> "[...] *a low level of interest generally corresponds to periods of prosperity or especially high profit, a rise in interest comes between prosperity and its collapse* [...]" (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 22, p. 482)

Concerning prices, the money stock, or the "*greater velocity of circulation*," see in particular ch. 28, p. 578.

It is, however, impossible, to locate in *Capital* a coherent theory of the business cycle. Instead we find only recurrent flirtations with this difficult issue :

1. *Overaccumulation*. The analysis of section III of chapter 15 is well known. Accumulation pushes employment to the limits of the available labor force, thus creating a tension which induces a rise of wages. The profit rate declines, and this fall sparks the contraction of output and the devaluation of capital.
2. *Financial instability*. This topic is repeatedly evoked by Marx[2] :

2. However, this financial instability is not always connected to the fluctuations of output. Sometimes, Marx distinguishes between monetary crises and real crises : "*As long as the* social *character of labor appears as the* monetary existence *of the commodity,* [...] *monetary crises, independent of real crises or as an intensification of them are unavoidable.*" (ch. 33, p. 649).

"If the credit system appears as the principal lever of overproduction and excessive speculation in commerce, this is simply because the reproduction process, which is elastic by nature, is now forced to its most extreme limits; [...] credit accelerates the violent outbreaks of this contradiction, crises [...]" (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 27, p. 572)

3. *The rapidity of technical change.* Although the devaluation of capital is often presented by Marx as an effect of the contraction of output, crises may also be imputed to the potential devaluation of capital associated with the rapidity of the progress of productive forces :

   "The periodical devaluation of the existing capital [...] disturbs the given conditions in which the circulation and reproduction process of capital takes place, and is therefore accompanied by sudden stoppages and crises in the production process." (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 15, p. 358)

4. *Other causes :* Marx also addressed a broad variety of other circumstances that may explain the outbreak of a crisis ; for example, the rising price of some raw material :

   "Violent fluctuations in prices thus lead to interruptions, major upsets and even catastrophes within the reproduction process." (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 6, p. 213)

Several statements in chapter 15, or the even more famous assertion in chapter 30 "*the ultimate reason for all real crises always remains the poverty and restricted consumption of the masses* [...]" (ch. 30, p. 615) have created much confusion. The ambiguity lies in the concept of "ultimate reason" (*Letzte Grund*) (see G. Duménil, *Le concept de loi économique dans "Le Capital"*, avant-propos de L. Althusser, Paris : Maspero, 1978, p. 205-207).[3] It is also not correct to attribute to Marx a theory of crises based on disproportions (see section 2.1.1).

1.1.2 Instability in Dimension

The relative imprecision of Marx's analysis, the importance that he confers on money and finance, and the variety of mechanisms contemplated, render difficult the task of building a *Marxist theory of crises*. Many studies have been devoted to the Marxist analysis of crises and a number of models are available which produce fluctuations by drawing on one of Marx's mechanisms.[4] In several studies (recently in G. Duménil, D. Lévy, *The*

3. There is a very explicit refutation of underconsumption in Volume II : "*It is a pure tautology to say that crises are provoked by a lack of effective demand or effective consumption. The capitalist system does not recognize any forms of consumer other than those who can pay, if we exclude the consumption of paupers and swindlers. The fact that commodities are unsaleable means no more than no effective buyers have been found for them, i.e. no consumers* [...]. *If the attempt is made to give this tautology a semblance of greater profoundity, by the statement that the working class receives too small a portion of its own product, and that the evil would be remedied if it received a bigger share, i.e. if its wage rose, we need only note that crises are always prepared by a period in which wages generally rise, and the working class actually does receive a greater share in the part of the annual product destined for consumption.*" (K. Marx, *Capital, Volume II*, New York : First Vintage Book Edition, 1885, ch. 20, p. 486).

4. A set of such papers can be found in URPE, *The Imperiled Economy, Macroeconomics from a Left Perspective, Book I*, New York: Union for Radical Political Economics, 1987, introduced by James Devine's review (J. Devine, "An Introduction to Radical Theories of Economic Crises", *in* URPE (ed.), *The Imperiled Economy, Macroeconomics from a Left Perspective, Book I*, New

Economics of the Profit Rate : Competition, Crises, and Historical Tendencies in Capitalism, Aldershot : Edward Elgar, 1993 and "The Real and Monetary Determinants of Macro (In)stability", *in* M. Glick (ed.), *Competition, Technology and Money : Classical and Post-Keynesian Perspectives*, Aldershot : Edward Elgar, 1994, p. 118-140), we developed a framework (disequilibrium non-linear dynamic models), which combines real and monetary determinants, and is open to a variety of "triggers" which remain deliberately unspecified.

We call these models *general disequilibrium models*, in which involuntary inventories of unsold commodities may exist, capacity utilization rate may deviate from normal, and profit rates may differ. Individual agents react to the observation of disequilibrium (they adjust to disequilibrium).[5] Firms modify their prices and outputs depending on the level of their inventories. Money is issued as loans are provided to economic agents. Financial institutions simultaneously follow the signals sent by non-financial agents (for example, a large capacity utilization rate), but respond negatively to inflation or overindebtness, etc. Concerning demand, what matters is the cyclical character of its various components (materials, final consumption, investment, for distinct categories of agents, such as enterprises, households, public expenses, etc.).

An equilibrium exists (a short-term equilibrium by quantities). Centrifugal (destabilizing) and centripetal (stabilizing) forces combine their effects, and *the stability of equilibrium is conditional*. When stability conditions are satisfied, the economy reproduces itself or grows steadily. When these conditions are not met, the general level of activity diverges from equilibrium, and the macroecomy moves to overheating or recession :

$$\text{Stable Equilibrium} \leftrightarrow \text{Gravitation around Steady Growth}$$

$$\text{Unstable Equilibrium} \leftrightarrow \text{Large Fluctuations}$$

The analytical study of this model and its estimation for the US economy lead to the following conclusions, which, we believe, match well Marx's analysis :

1. The economy is constantly operating in a vicinity of its stability condition. Equilibrium alternates between stability and instability.[6] This echoes Marx's view of the sequence of the phases of the business cycle, including a period of "prosperity".
2. The effect of monetary mechanisms is ambiguous. Simultaneously, they stimulate expansion and usher in the phase of overheating — a dual aspect well perceived by Marx.
3. Inventories rise at the end of expansion phases, remain high during the first phase of contraction, and then decline, as described by Marx. In addition, a positive relation-

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York : Union for Radical Political Economics, 1987). We thoroughly agree with the emphasis on monetary mechanisms in J. Crotty, "The Role of Money and Finance in Marx's Crisis Theory", *in* URPE (ed.), *The Imperiled Economy, Macroeconomics from a Left Perspective, Book I*, New York : Union for Radical Political Economics, 1987. Note that, in Richard Goodwin's model (R.M. Goodwin, "A Growth Cycle", *in* C.H. Feinstein (ed.), *Socialism, Capitalism, and Economic Growth*, Cambridge : Cambridge University Press, 1967, p. 54-58), productive capacities are always entirely used ; consequently this model accounts for a cyclical pattern of accumulation, not for business fluctuations.

5. Several commodities may exist, but it is possible, and obviously simpler, to study a macro model. Growth may be considered, but simple reproduction is easier, etc.

6. Mathematically, this means that the dominant eigenvalue of the Jacobian matrix is *real and close to 1*, sometimes smaller, sometimes larger.

ship links the movements of money and credit, on the one hand, and output, on the other, and prices also move procyclically.[7]

4. In most of the models that we have built, the switch from one regime to another (from stability to instability, or *vice versa*) remains exogenous. However, various mechanisms can be implemented to produce endogenous business fluctuations, thus vindicating Marx's approach. The choice of the *empirically* most relevant mechanism is difficult, and may depend on the period under investigation.

Overall, the analysis of business fluctuations in Marx's Volume III points to a rigorous assessment of the issue of stability within capitalism, concerning the fluctuations of the general level of activity (the macroeconomy) : *It would not be correct to contend that the macroeconomy is constantly stable or unstable ; it is frequently, and recurrently unstable.* We denote this property as the *instability in dimension* of capitalist economies, to better contrast it with the other property, to which we now turn, concerning competition (and what we call *proportions*).

1.2 COMPETITION : PRICES OF PRODUCTION AND SOCIAL NEEDS

Volume III of *Capital* contains another *dynamic* analysis, in which equilibrium and stability are at issue : the analysis of *The Equalization of the General Profit Rate through Competition* in chapter 10. Section 1.2.1 briefly recalls Marx's presentation ; section 1.2.2 illustrates the explanatory power of this analysis concering modern capitalism ; section 1.2.3 is then devoted to our interpretation of these mechanisms.

1.2.1 The Formation of Prices of Production in Volume III

Marx's analysis of competition and the formation of prices of production is very close to those of Adam Smith and David Ricardo (A. Smith, *The Wealth of Nations*, London : Dent and Son, 1776, ch. 7, D. Ricardo, *The Principles, op. cit.* note 1, ch. 4), although Marx's treatment is more developed in some respects.

The definition of prices of production, which equalize profit rates, is well known (ch. 9, p. 257). It is important to stress, however, that these prices are associated with a set of quantities that Marx called *social needs*[8] (note that Marx considered here *market values* and only implicitly extends his point to prices of production) :

> "[...] *if this market price is to correspond to the market value, and not diverge from it, either by rising above or falling below, then the pressures that the various sellers exert on one another must be strong enough to put on the market the quantity of commodities that is required to fulfil the social need, i.e. the quantity for which the society is able to pay the market value.*" (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 10, p. 281)

Following Marx, the convergence of market prices toward *prices of production* and of outputs toward *social needs* in the absence of exogenous perturbations, or the gravitation

7. Such covariations among variables can be studied using the dominant eigenvector associated with the dominant eigenvalue of the Jacobian matrix (see G. Duménil, D. Lévy, *ibid.*, Section 6.2).
8. Social needs have always been determined socially, in particular within modern capitalism, where "preferences" are actually strongly influenced by the productive system.

around these values if such perturbations exist, derives from the behavior of economic agents. Three such behaviors are considered :

1. *Capital mobility by capitalists :*

   "Capital withdraws from a sphere with a low rate of profit and wends its way to others that yield higher profit. This constant migration, the distribution of capital between the different spheres according to where the profit rate is rising and where it is falling, is what produces a relationship between supply and demand such that the average profit is the same in the various different spheres [. . .]" (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 10, p. 297)

2. *The modification of prices in response to disequilibria between supply and demand.* Marx confers a crucial role to supply and demand. Enterprises react to deficient demand by diminishing their price and, conversely, tend to increase their prices, when demand is strong.

3. *The response of demand to prices.* It is inherent to the analysis of the formation of prices of production that an increased price is sanctioned by a diminished demand, and the reverse for a diminished price. Marx is very explicit in admitting the existence of demand functions :

   "As far as demand is concerned, this is self-evident, since this moves in the opposite direction to price, expanding when it falls and vice versa." (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 10, p. 303)

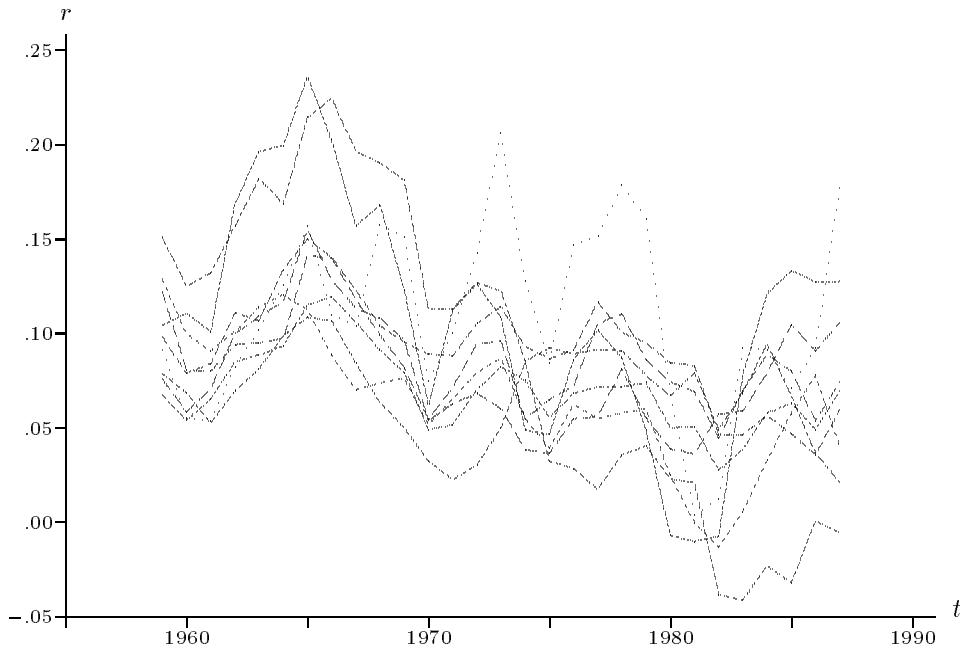
The fate that befell to this very convincing analysis of competition, within both orthodox and heterodox economics, is puzzling. In spite of Walras' early efforts (L. Walras, *Éléments d'économie politique pure, ou théorie de la richesse sociale*, Paris : R. Pichon et R. Durand-Auzias, 1874), the notion has been abandoned, with little exception, within mainstream noeclassical economics ; equalized profit rates are crucial to neo-Ricardians, but their formation within competition has long been overlooked ; many among heterodox consider these analyses as typical of 19th century capitalism in England, but no longer relevant within contemporary capitalism (this is a long tradition which goes back to Hilferding and Lenin).

1.2.2 Do Profit Rates Gravitate around a Common Value ?

The character of competition within modern capitalism does not contradict the thesis of a tendency toward profit rate equalization. Our view can be briefly summarized as follows : (1) There was no transformation in the *nature* of competition (no switch from "pure and perfect competition" to "monopoly"), and (2) There was no clear variation in the *degree* of competition. The increase in the size of firms is often used as an argument in favor of a diminished intensity of competition. This argument overlooks the considerable enlargement of markets and of the financial institutions in which capital mobility is performed, *i.e.*, transformations which considerably diminished the chances of protracted monopoly situations.[9]

9. We share this view with, for example, J.A. Clifton, "Competition and the Evolution of the Capitalist Mode of Production", *Cambridge Journal of Economics*, I (1977) p. 137-151 and P. Auebarch, P. Skott, "Concentration, competition and distribution - a critique of theories of monopoly capital", *International Review of Applied Economics*, II (1988) p. 42-61.

Figure 1 Profit rates in nine durable manufacturing industries (1959-1987) : $r =$ (profit − corporate business taxes) / (net fixed capital + inventories)



Last, in spite of serious measurement problems, one can show that profit rates do tend to gravitate around a common value.[10] The overall relevance of the theory is illustrated in figure 1 from G. Duménil, D. Lévy, *The Economics of the Profit Rate, op. cit.* note 4 (in spite of a few remaining problems, which we will not discuss here). It is also possible to test for behaviors within disequilibrium, such as the impact of profit rate differentials on investment differentials, and the effects of supply and demand on prices (see G. Duménil, D. Lévy, *ibid.*, Sections 5.6 and 11.5).

1.2.3 Stability in Proportions

The formation of prices of production in Volume III of *Capital* is one of the most explicit example of a *dynamic analysis* in Marx's work. Most aspects of a dynamical model are there, except the mathematics. The state of the economy in which prices of production and associated outputs are observed should be called a *long-term equilibrium*. The epithet *long-term* is justified by the fact that the movements of capital (investments) are central. The formation of prices of production corresponds to the problem of the stability of this equilibrium. Beginning out of equilibrium, and abstracting from shocks, the issue is whether the variables will tend to converge toward equilibrium, *i.e.*, whether market prices will tend toward prices of production and supply and demand be equalized. Or, after

10. It is interesting to notice that Industrial Organization literature never provided a convincing proof that concentration should be considered as an important explanatory variable of profitability differentials.

taking account of the recurrent occurrence of shocks, the problem becomes whether the system will gravitate around equilibrium.[11]

The dynamics involved in the classical analysis can be called *cross-dual*: disequilibria on prices (profitability differentials) have an impact on quantities and, symmetrically, disequilibria on quantities affect prices. The entire process can be symbolically represented as follows:

$$\cdots \rightarrow \begin{pmatrix} \text{supply} \\ \neq \\ \text{demand} \end{pmatrix} \rightarrow \begin{pmatrix} \text{changes} \\ \text{of} \\ \text{prices} \end{pmatrix} \rightarrow \begin{pmatrix} \text{changes of} \\ \text{profit} \\ \text{rates} \end{pmatrix} \rightarrow \begin{pmatrix} \text{movements} \\ \text{of} \\ \text{capital} \end{pmatrix} \rightarrow \begin{pmatrix} \text{new supply} \\ \text{and} \\ \text{demand} \end{pmatrix} \rightarrow \cdots$$

Up to the 1980s, research on prices of production focused on equilibrium. In the last ten years a number of conferences and publications have been devoted to the vindication of the classical analysis of competition, *i.e.*, the analysis of the convergence of market prices to prices of production.[12]

The overall conclusion of this investigation is that convergence can be obtained under "sensible" assumptions. In particular, agents must not overreact to the evidence of disequilibrium. For example, capitalist must not respond too strongly to profitability differentials in the displacement of their capital.

These findings are quite is line with Marx's insight concerning competition. The allocation of capital among firms and industries, the setting of relative prices and outputs are tasks that capitalist economies perform rather efficiently. We refer to this property in terms of *stability in proportions*. It is, thus, interesting to compare the quite distinct properties of capitalism in these two respects, dimension and proportions: instability in dimension and stability in proportions. This will be the subject of section 2.1.

1.3 HISTORICAL TENDENCIES: TECHNOLOGY AND DISTRIBUTION IN THE VERY LONG TERM

There is a third category of dynamic processes in Volume III of *Capital*, which basically concerns the historical trends of technology and distribution. Section 1.3.1 briefly recalls

11. Recall that there is no difference in the formal treatments of convergence and gravitation.

12. Prior to the debate which developed in the 1980s, and in relation to a paper by H. Nikaido (H. Nikaido, Refutation of the Dynamic Equalization of Profit Rates in Marx's Scheme of Reproduction, Department of Economics, University of Southern California, 1977, published in "Marx on Competition", *Zeitschrift für Nationalökonomie*, XLIII (1983) p. 337-362), a large segment of the profession thought that the stability of classical long-term equilibrium was subject to unacceptable conditions. A number of objections were made later, concerning, for example, the number of commodities (I. Steedman, "Natural prices, Differential Profit Rates and the Classical Competitive Process", *The Manchester School*, LII (1984) p. 123-140) or the instability of the "pure cross-dual" model (L. Boggio, "On the Stability of Production Prices", *Metroeconomica*, XXXVII (1985) p. 241-267 and "The Dynamic Stability of Production Prices: A Synthetic Discussion of Models and Results", *Political Economy*, VI (1990) p. 47-58). These objections have now been refuted, and several models are available that convincingly show that the stability of long-term equilibrium in proportions can be obtained under various set of intuitive conditions The conditions are rather clearly set out (G. Duménil, D. Lévy, *The Economics of the Profit Rate, op. cit.* note 4, Appendix 6.A2), and many models exist (see the special issue of *Political Economy, Studies in the Surplus Approach* (1990, Vol 6, #1-2), A. Dutt, "Convergence and Equilibrium in Two-Sector Models of Growth, Distribution and Prices", *Zeitschrift für Nationalökonomie, Journal of Economics*, XLVIII (1988) p. 135-158, R. Franke, "Un modèle bisectoriel du processus de gravitation avec apurement continuel des marchés", *in* J. Cartelier (ed.), *La formation des grandeurs économiques*, Paris: Nouvelle Encyclopédie Diderot, Presses Universitaires de France, 1990, p. 263-284, etc.).

the main components of Marx's analysis of historical tendencies. Section 1.3.2 is devoted to the empirical relevance of Marx's thesis, with a special emphasis on the profile of the profit rate. Using the example of the US economy since the Civil War, we contend, in section 1.3.3, that the historical trajectory *à la Marx* prevailing in the late 19th century was provisionally superseded during the first half of the 20th century by a "managerial revolution," and has been reasserted since then. In section 1.3.4, we outline more technically our interpretation of historical tendencies, in terms of evolutionary dynamics.

1.3.1 Historical Tendencies in Volume III

The *law of the falling rate of profit* is too well known to need to be introduced here. It is, however, important to recall that this law is part of a broader system of tendencies analyzed in chapter 13, consisting of: (1) the rising productivity of labor (or the decline of the value of commodities), (2) the rising organic composition of capital (and the rising technical and value compositions of capital), (3) The constant or rising rate of surplus-value, (4) the falling profit rate, (5) the rising share of profit in the price of each commodity, (6) the rising amount of labor employed, (7) the rising amount of wages, (8) the rising amount of total profits (or total surplus-value), (9) the growing concentration of capital, (10) the acceleration of accumulation, etc.

None of these keen observations concerning very long term trends in capitalist economies posed the same problems as the tendency for the profit rate to fall. In particular, it is difficult to imagine what might lead enterprises to adopt new techniques which diminish their profit rate. This problem is well identified by Marx:

> *"No capitalist voluntarily applies a new method of production, no matter how much more productive it may be or how much it might raise the rate of surplus-value, if it reduces the rate of profit."* (K. Marx, *Capital, Volume III*, New York: First Vintage Book Edition, 1894, ch. 15, p. 373)

Marx's "solution" is as follows:

> *"But every new method of production of this kind makes commodities cheaper. At first, therefore, he [the capitalist] can sell them above their price of production, perhaps above their value. He pockets the difference between their costs of production and the market price of the other commodities, which are produced at higher cost.* [...] *But competition makes the new procedure universal and subjects it to the general law. A fall in the profit rate ensues — firstly perhaps in this sphere of production, and subsequently equalized with the others — a fall that is completely independent of the capitalist's will."* (K. Marx, *Capital, Volume III*, New York: First Vintage Book Edition, 1894, ch. 15, p. 373-374)

This "microeconomic" behavioral attempt to supersede an apparent contradiction is, indeed, very appealing. As is well known, however, Nobuo Okishio (N. Okishio, "Technical Change and the Rate of Profit", *Kobe University Economic Review*, VII (1961) p. 86-99) proved that this cannot be the case *under the assumption of a constant real wage*. Beginning with equalized profit rates, a new technique of production which increases the profit rate of its user also increases the average profit rate when a new equilibrium is reached and the former technique abandoned. This 33-year old theorem aroused a whole set of replies, and the controversy has not diminished.[13] All of these "refutations" of Okishio

13. For example, see A. Shaikh, "Political Economy and Capitalism: Notes on Dobb's Theory of

drop one of Marx's ideas (or one of Okishio's assumptions), for example, the view that capitalists maximize the profit rate as stated in the first part of the quotation above, or the equalization of profit rates.

The central difficulty in this discussion follows from the absence of an explicit tendential law concerning *real* wages in Marx's analysis. (A thesis on the rate of surplus-values has implications concerning wages in terms of value, but not in physical terms.) Marx states clearly that wages vary with the phases of the business cycle (in the short term), but, in the discussion of the historical trend of labor income, he sets aside the issue of real wages, as well as any considerations concerning use-values :

> *"We entirely leave aside here the fact that the same amount of value represents a progressively rising mass of use-values and satisfactions, with the progress of capitalist production and with the corresponding development of the productivity of social labor and multiplication of branches of production and hence products."* (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 13, p. 325)

In addition, Marx vacillates between a *constant* and *rising* rate of surplus-value. If a constant rate of surplus-value is assumed in combination with a rising labor productivity, the real wage must rise. In our opinion, including a *rising real wage* within what we call a *trajectory à la Marx* does not contradict Marx's analysis, provided that this new feature is compatible with "*the same or even a rising rate of surplus-value*" (ch. 13, p. 322).[14]

1.3.2 Does the Profit Rate Fall?

There is a number of empirical and theoretical difficulties in the assessment of the factual relevance of Marx's analysis of historical tendencies. Available data are never perfectly appropriate. The notion of "tendencies" is, itself, difficult to grasp ; historical tendencies may manifest themselves through important fluctuations, or, even, be superseded by countertendencies. However, these difficulties do not dismiss empirical analysis as irrelevant. They only prove that measurements must be interpreted carefully.

We will not discuss here the origin of Smith, Ricado, and Marx (and others) convergence on the (empirical) fact that the profit rate was declining in the late 18th and early 19th centuries in England, but confront Marx's analysis with the historical trends observed in the US since the Civil War. In this investigation we will ignore all difficulties related to the "correspondence" between Marx's categories and empirical series — and a few other problems[15] ! We will call the ratio *profit / labor income*, the "rate of surplus-value," and the ratio *capital at current prices / labor income*, the "organic composition of capital".

Crisis", *Cambridge Journal of Economics*, II (1978) p. 233-251 or P. Skott, "Imperfect Competition and the Theory of the Falling Rate of Profit", *Review of Radical Political Economics*, XXIV (1992) p. 101-113.

14. We share this view with Duncan Foley (D. Foley, *Understanding Capital, Marx's Economic Theory*, Cambridge : Harvard University Press, 1986).

15. In particular difficulties related to the distinctions between : (1) values and prices (to which appendix A.3 is devoted), (2) productive and unproductive labor, (3) fixed and circulating capital, etc. There is no doubt that the productive system is heterogeneous and that several segments should be distinguished. There is also no denying the fact that sources are questionable. We do not believe, however, that these problems fundamentally question the profiles observed below, with the exception of the rate of surplus-value which would rise if the income of unproductive workers were excluded from labor income (see F. Moseley, *The Falling Rate of Profit in the Postwar United States Economy*, New York : St. Martin's Press, 1992). In any case, these difficulties should not preclude any attempt to such measurements.

Table 1 - Average Annual Growth Rates (% per Year)				
	1869-1910	1910-1950	1950-1992	*1869-1992*
$\rho(NNP/L)$	1.22	2.33	1.48	*1.95*
$\rho(NNP/K)$	-1.22	1.39	-0.88	*0.04*
$\rho(K/L)$	2.07	0.40	2.24	*1.48*
$\rho(w)$	1.46	2.33	1.48	*1.95*
$\rho(r)$	-1.66	1.40	-0.88	*0.05*
$\rho(\gamma)$	0.97	-1.39	0.88	*-0.05*
$\rho(\tau)$	-0.38	0.01	-0.01	*-0.01*

We use the conventional description of production in which a certain amount of labor, L, is combined with an amount of capital, K, to obtain a product (Net National Product, NNP). Technology is described by three ratios: (1) labor productivity, NNP/L, (2) the productivity of capital, NNP/K, and (3) the capital-labor ratio, K/L. Technical change is measured by the growth rates of these three ratios. Considering, w, the relative price of labor in comparison to the product (called hourly labor cost, and approximately equal to the real wage), one can determine three additional ratios: (1) the profit rate r (NNP minus total labor income, i.e., profit, divided by the stock of fixed capital, both in current dollars), (2) the organic composition of capital γ (capital stock in current dollars/ labor income), and (3) the rate of surplus-value τ (profit/ labor income).

Figure 2 The historical profile of the profit rate: (•) series and (·) model of section 1.3.4

As shown in table 1, the organic composition of capital, γ, the profit rate, r, and the rate of surplus-value, τ, remained approximately constant over the entire period 1869-1992. It is, however, important to distinguish between various phases in this evolution. Although the rate of surplus-value remained approximately constant during the three subperiods 1869-1910, 1910-1950, and 1950-1992, the organic composition of capital and the profit rate displayed quite different trends : *rising / declining / rising* and *declining / rising / declining*. The first and third periods can be characterized as *periods à la Marx*, but not the intermediate period.

A similar periodization can be observed for variables defined in real terms (labor productivity, NNP/L, the productivity of capital, NNP/K, and the technical composition of capital, K/L). Labor productivity and the technical composition of capital grew throughout the period, but the growth within each period followed opposite patterns, *slow / rapid / slow* for labor productivity, and *rapid / slow / rapid* for the technical composition of capital. (Larger growth rates of the technical composition of capital, during the first and third periods, coincided with a rising organic composition of capital.) The movement of the productivity of capital was the same as that of the profit rate.

As suggested by the profile of the profit rate ($\bullet$) in figure 2 and the growth rates in table 1, a periodization in three stages emerges from an examination of these data : *Late 19th century / First half of the 20th century / Second half of the 20th century*. The profit rate declined during the first and third periods, and increased during our intermediary period. This does not mean, however, that Marx was only 66% per cent right ! The problem is to identify the *countertendency(ies)* at work during the intermediate period. This is the purpose of the following section.

1.3.3 Historical Trajectories à la Marx and the Managerial Revolution

We interpret the above trends as follows (see G. Duménil, D. Lévy, The Acceleration and Slowdown of Technical Progress in the US since the Civil War : The Transition Between two Paradigms, Contribution to the "EUNETIC Conference : Evolutionary Economics of Technological Change", European Parliament, Strasbourg, Cepremap, Modem, Paris, 1995). The first and third periods can be characterized as two distinct "*paradigms*" (encompassing under this label, technology, management, related institutions, and their historical dynamics), corresponding to two distinct stages of capitalism :

1. The first paradigm is typical of mature capitalism, and was inherited from the English industrial revolution. The main class contradiction is between the capitalist owner and the productive worker.
2. The second paradigm is that of *Managerial Capitalism*, as documented, in particular, by Alfred Chandler (A.D. Chandler, *The Visible Hand. The Managerial Revolution in American Business*, Cambridge : Harvard University Press, 1977 and *Scale and Scope. The Dynamics of Industrial Capitalism*, Cambridge : Harvard University Press, 1990). A new class of *managerial and clerical personnel* emerges, with it own internal contradiction, creating more complex class patterns (see G. Duménil, *La position de classe des cadres et employés. La fonction capitaliste parcellaire*, Grenoble : Presses Universitaires de Grenoble, 1975 and G. Duménil, D. Lévy, "The Economic Functions of Managerial and Clerical Personnel, A Historical Perspective", *in* N. Garston (ed.), *Bureaucracy : Three Paradigms*, Boston : Kluwer Academic, 1994, p. 155-187).

Each paradigm considered separately is subject to the tendency for the profit rate to fall. The intermediate period is interpreted as the progressive transition from the earlier to the more recent paradigm (see diagram 3).

The "revolution" observed between the two paradigms relates to the *more efficient use of resources*, capital and labor, after the managerial revolution. As the new organization is gradually extended to all segments of the productive system, the more efficient use of resources is manifested in the larger growth rates of labor productivity and the exceptional *rise* of the productivity of capital (paralleled by the simultaneous increase in the growth rate of real wages and a rising profit rate).[16] During the third period, when the diffusion of the new paradigm was almost completed, the resurgence of earlier trends echoes the fact that technical progress is largely subject to the same rules under the two paradigms. A profile similar to that observed during the first period is reasserted, a pattern *à la Marx*, since its combines the basic features described in Volume III, in particular a strongly rising capital-labor ratio (the composition of capital), and a declining profit rate.

Marx had a rather clear insight of these transformations at a very early stage of their emergence in England. In Volume III, he repeatedly refers to this metamorphosis of relations of production and the emergence of the new paradigm. There he analyzes the transfer of management from capitalist owners to salaried managers :

> *"Joint-stock companies in general (developed with the credit system) have the tendency to separate this function of managerial work more and more from the possession of capital, whether one's own or borrowed."* (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 23, p. 512)

These new groups are clearly identified as a class : "a *numerous class of industrial and commercial managers*" (ch. 23, p. 513). Marx probably underestimated the impact of this managerial phase of capitalism on technology and distribution, and its possible duration :

> *"This is the abolition of the capitalist mode of production within the capitalist mode of production itself, and hence a self-abolishing contradiction, which presents itself* prima facie *as a mere point of transition to a new form of production."* (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 27, p. 569)

Overall the tendency for the profit rate to fall accounts for a crucial historical tendency within US capitalism over the period considered. However, this tendency was superseded during the first half of the 20th century by the emergence of a new stage of capitalism, *managerial capitalism*, a deep metamorphosis of relations of production and class patterns.[17] This evolution came as a reaction to the declining profit rate in the late 19th century, and was responsible for the illusion that the law was abolished for a few decades, whereas it was still active within each paradigm. When the new paradigm was diffused to the entire productive system, the old tendency reasserted itself in a straightforward manner, proving

16. This interpretation can be constrasted with that given in the 1960s by Paul Baran and Paul Sweezy (P. Baran, P. Sweezy, *The Monopoly Capital*, Monthly Review Press : New York, London, 1966), who saw in the upward trend of the profit rate the effect of the transformation of competition. The increased size of firms is certainly related to the emergence of managerial capitalism, but, as contended in section 1.2.2, this transformation of competition did not render the classical analysis of competition irrelevant, and did not invert the trend of the profit rate.

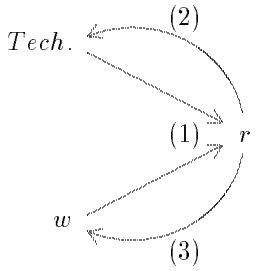
17. In G. Duménil, D. Lévy, The Great Depression : A Paradoxical Event ?, Cepremap, #9510, Paris, 1995, we interpret the Great Depression as a crisis expressing the difficult emergence of this new stage of capitalism.

that tendential laws in this new stage had not been truly metamorphosed. This is where we are now.

Note that this interpretation of historical trends allows for a better understanding of the dominant analysis among Marxists at the transition between the 19th and 20th centuries, for example, Lenin's view of imperialism, as *the highest stage of capitalism*. It is true that the prevailing historical trends could not be maintained for ever. There was actually two revolutions, the proletarian revolution in Russia and the managerial revolution within capitalist countries. One survived the other !

1.3.4 The Evolutionary Dynamics of the Very Long Term

The various components of historical tendencies cannot be analyzed separately but, instead, must be considered as a *system* of interdependent variables concerning *technology* (labor productivity, and capital productivity or the capital-labor ratio) and *distribution* (labor cost and profit rate). As symbolically represented in diagram 2, three primary relationships are involved :



(1) *Calculation of the profit rate*

(2) *Impact of the profit rate on the choice among techniques*

(3) *Feedback of the profit rate on the growth rate of wages*

Diagram 2

1. *The identity for the calculation of the profit rate.* With the notation in table 1, one has :

$$r = \frac{NNP - Lw}{K} = \left(\frac{NNP}{L} - w\right) \Big/ \frac{K}{L}$$

2. *The role conferred on the profit rate in the choice among techniques.* In several papers (G. Duménil, D. Lévy, "A Stochastic Model of Technical Change, Application to the US Economy (1869-1989)", *Metroeconomica*, XLVI (1995) p. 213-245, The Acceleration and Slowdown of Technical Progress in the US since the Civil War : The Transition Between two Paradigms, Contribution to the "EUNETIC Conference : Evolutionary Economics of Technological Change", European Parliament, Strasbourg, Cepremap, Modem, Paris, 1995, and "Complexity and Stylization", *op. cit.* note 15), we developed stochastic dynamical models of evolutionary inspiration to account for technical change. In these models, the outcome of R&D is represented as a random process. Firms select new techniques according to their comparative profitability at going prices.[18] This framework accounts for the effect of prices (in particular, wages)

18. In this respect, our approach is akin to that of Richard Nelson and Sidney Winter (R.R. Nelson, S.G. Winter, "Factor Prices Changes and Factor Substitution in an Evolutionary Model", *Bell Journal of Economics*, VI (1975) p. 466-486 and *An Evolutionary Theory of Economic Change*, Cambridge : Harvard University Press, 1982).

on technical change, because of the profitability criterion used in the selection of innovations.[19]

3. *A feedback effect of the profit rate on wages.* In addition to the direct negative effect of wages on the profit rate, we assume that there is a feedback of the value and variation of the profit rate on the growth rate of the real wage. (When the profit rate is low or declining, it is more difficult for wages to rise, and conversely.)

This dynamical stochastic model has interesting properties. As suggested by either one of the two doted straight lines in the three panels of diagram 3, one can generate trajectories which match the features of historical trajectories *à la Marx* with: (1) a declining profit rate, (2) an increasing labor productivity, and (3) an increasing organic composition of capital.[20] There is no internal contradiction within these evolutions, which could be prolonged "for ever". The problem is that the profit rate declines steadily — which, at some point, should raise a number of problems.

As suggested in diagram 3, the shift between the two paradigms corresponds to a transition between two such trajectories. The abilility of this model to account for observed historical patterns is illustrated in figure 2 by the reconstruction of the profit rate (·).

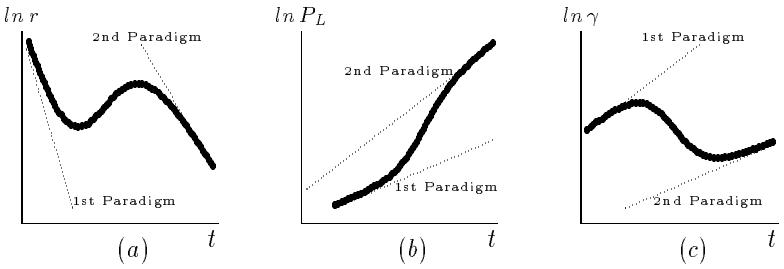


Diagram 3

This model clarifies a number of assumptions underlying Marx's analysis. Trajectories such as that in diagram 3 (·) are obtained under the assumption that it is "difficult" to come out with profitable innovations. Relaxing this difficulty, which is controlled parametrically in the model, it would be possible to generate trajectories with a *rising* profit rate. (Note that to obtain trajectories *à la Marx*, it is not necessary, but it may be helpful to introduce an *a priori* capital-consuming bias in the emergence of new innovations.[21]) These properties relate, in our opinion, to Marx's crucial insight: *Technical change is difficult and it is, in particular, not easy to find new techniques in which the progress of labor productivity is not paid for by a considerable increase of the capital stock.* This property is central in the understanding of the falling profit rate.

19. Properties similar to those traditionally derived from a production function with factor substitution are obtained without assuming such a function.
20. The labor cost (or real wage rate) rises and the rate of surplus-value is constant.
21. Such a bias is considered in the reconstruction (·) in figure 2.

2 - INTERCONNECTIONS

Considered in isolation, the three dynamics of Volume III provide fundamental insights into the functionings of capitalism. It is, however, also important to examine their potential interconnections. It is well known, for example, that Marx saw a relationship between historical tendencies, *viz.* the falling profit rate, and stability in dimension, *viz.* the occurrence of crises. The point here is not only to discuss the consistency of the three dynamics, but to explicate their potential combined explanatory power. (Recall that the three dynamic processes studied in section 1 unfold within distinct *time frames*, short term, long term, and very long term — a difference which justifies their separate treatment, but does not preclude their potential interactions.)

The present section deals successively with the three possible relationships among the three elements (see diagram 1). Section 2.1 considers business cycle and prices of production ; section 2.2, structural change and prices of production ; and section 2.3, historical tendencies and business cycle.

2.1 BUSINESS CYCLE AND PRICES OF PRODUCTION

This section is devoted to the relationship between the analysis of business cycle and that of the formation of prices of production. First, section 2.1.1 considers the separation between the two issues in Marx's analysis. Then, section 2.1.2 presents the conclusion which can be drawn from a joint treatment of the two issues in a single model.

2.1.1 The Separation between Proportions and Dimension in Marx's Analysis

In Volume III of *Capital*, Marx juxtaposes the analysis of crises (the business cycles) and that of the formation of prices of production. He clearly separates between the two issues and the quite distinct properties of capitalism in these two respects. In our terminology, equilibrium is stable in proportions, and unstable in dimension. This clear distinction is, we believe, a very strong point of Marx's analysis.[22]

Note that a loose relationship exists between the two problems, since centripetal forces toward equalized profit rates are more active during phases of expansion than during crises :

> *"As long as everything goes well, competition acts, as is always the case when the general rate of profit is settled, as a practical freemasonry of the capitalist class, so that they all share in common booty in proportion to the size of the portion that each puts in. But as soon as it is no longer a question of division of profit, but rather of loss, each seeks as far as he can to restrict his own share of this losss and pass it on to someone else."* (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 15, p. 361)

The strong disconnection between the two fields relates to the explanation of crises by *disproportions*. Marx does not deny possible difficulties arising within particular industries

22. Note that this distinction is also crucial in Keynes' analysis, and justifies a macroeconomic approach to the determination of the general level of activity, thus abstracting from proportions.

or types of goods, for example concerning raw materials (see K. Marx, *Capital, Volume III*, New York: First Vintage Book Edition, 1894, ch. 6, p. 214). The most explicit discussion of this issue can be found, however, in the *Theories of Surplus-Value*, where Marx discusses Ricardo's theory of crises, precisely based on disproportions. There, he distinguishes between "*general over-production*" (K. Marx, *Theories of Surplus Value*, Moscow: Progress Publisher, 1862, Part II, p. 523), and "*partial crises*" which can "*arise from disproportionate production*" (p. 521), a problem which relates to the analysis of competition and the formation of prices of production:

> This can only be dealt with in connection with the competition of capitals. In that context it has already been stated that the rise or fall of market values [*read "market prices"*] which is caused by this disproportion results in the withdrawal of capital from one branch of production to another. This equalization itself however already implies as a precondition the opposite of equalization and may therefore comprise crisis; the crisis itself may be a form of equalization. Ricardo etc. admit this form of crisis.[23].

The problem is, however, to "admit" another type of crises whose main feature is a *general "glut" of the market*:

> [...] Ricardo admits that a glut of certain commodities is possible. What is supposed to be impossible is only a simultaneous general glut of the market.[24].

2.1.2 A General Disequilibrium Model for Proportions and Dimension

As a preliminary to the investigation below, it may be helpful to consider in some details the two distinctions between proportions and dimension, on the one hand, and short and long terms, on the other (see G. Duménil, D. Lévy, *The Economics of the Profit Rate, op. cit.* note 4, ch. 9). These distinctions lead to the definition of the four following cases:

	Long term	Short term
Proportions	[1]	[2]
Dimension	[4]	[3]

A priori, the four cases are meaningful. Business cycle refers to [3]. The issue of proportions and the formation of prices of production (and associated outputs) has two aspects: the equalization of supply to demand in the short term by the adjustment of capacity utilization rates with given capital stocks, as in case [2], on the one hand, and capital mobility in the long term, as in case [1], on the other. Last, case [4], dimension in the long term relates, for example, to accumulation (as in Goodwin's model), and is also clearly meaningful.

It is possible to combine the mechanisms involved in the formation of prices of production, [1] and [2], and the analysis of the business cycle, [3], in a single model. We built several such models (see, for example, G. Duménil, D. Lévy, "Stability in Capitalism: Are Long-Term Positions the Problem?", *Political Economy*, VI (1990) p. 229-264

23. K. Marx, *ibid.*, p. 521.
24. K. Marx, *ibid.*, p. 529.

and *The Economics of the Profit Rate, op. cit.* note 4, ch. 7).[25] A unique *disequilibrium microeconomics* is used, within a *general disequilibrium model*.

This exercise proves that the two theories are compatible—and this is an important result—and it shows, as can be guessed, that "everything depends on everything". However, additional findings of prominent importance also emerge:

1. The stability conditions can be factorized into three terms[26], which relate to *dimension in the short term* (the business cycle), *proportions in the long term* (capital mobility), and *proportions in the short term* (adjustment of supply to demand). This means that the conditions for stability in these three respects are *independent*. The factorization *proportions (in the short and long terms) / dimension* directly echoes, and justifies, Marx's dichotomy between the analysis of business fluctuations and the formation of prices of production within competition.[27] The question of stability within capitalism cannot be answered globally. *Assuming "convergence" to prices of production (stability in proportions) is not apologetic, and does not preclude the development of a theory of business cycle.*
2. The model also provides further insight into the coexistence of these two diverging properties within capitalist economies. The overall idea is as follows: *Stronger reactions by enterprises to certain disequilibria are simultaneously favorable to stability in proportions and detrimental to stability in dimension.*

This latter property can be made rather intuitive by considering the direct reaction of firms to disequilibria between supply and demand, by adjusting their output (case [2]). When demand is larger than supply, there is an inducement to scale up production, and conversely when demand is deficient. This mechanism is very helpful in adjusting the supply of a particular firm to demand in the short term, and favorable to the control of proportions in the short term and, indirectly, in the long term. It explains why inventories of unsold commodities rarely reach considerable proportions within particular industries, independent of the macroeconomy. However, the same mechanism may jeopardize the stability of the macroeconomy (stability in dimension), since it can initiate cumulative movements of total output, upward or downward (for example: *production* $\searrow \Rightarrow$ *income* $\searrow \Rightarrow$ *demand* $\searrow \Rightarrow$ *production* $\searrow \Rightarrow \cdots$).

Overall, the separate treatment of the business cycle and the formation of prices of production as in Volume III appears quite relevant and, above all, not contradictory. However, their joint treatment within a single framework may also uncover a number of interesting connections.

2.2 STRUCTURAL CHANGE AND PROPORTIONS

This section takes up the issue of competition and the formation of prices of production, but under the assumption of continuous structural change. Section 2.2.1 is devoted to Marx's analysis in Volume III, and section 2.2.2 to the modeling of the classical analysis of competition under the assumption of structural change.

25. In these models, we abstract from dimension in the long term.
26. See G. Duménil, D. Lévy, *ibid.*, ch. 7. The polynomial characteristic of the Jacobian matrix of the relation of recursion can be factorized. The roots of this polynomial characteristic (the eigenvalues of the Jacobian matrix) control the stability of the equilibrium.
27. The other factorization (*proportions in the short term / proportions in the long term*), allows for the building of models in which the convergence to prices of production is obtained as a result of a sequence of short-term equilibria by quantities.

2.2.1 Convergence with Structural Change in Volume III

The interconnection between historical tendencies and prices of production defines another interesting field of analysis. Recall the quotation cited in section 1.3.1, concerning the "microeconomics" of the falling profit rate. In this quotation, Marx refers to the impact of technical change on long-term equilibrium with prices of production. A new, more profitable, process is developed creating a profitability differential. It is used by one producer, who pockets an extra profit. Then, the use of this process is gradually generalized to the entire economy, and competition leads to a new equilibrium with new different prices of production and equilibrium outputs. This analysis explicitly relates the formation of prices of production to technical change (*i.e.*, to the set of historical tendencies, or to *structural change*).

Marx discusses in chapter 10 the heterogeneous character of technology — an issue which is closely related to that of the slow diffusion of technical change among enterprises. If several enterprises use different techniques within the same industry, as is always the case, a unique price tends to be established, and equalization concerns *average profit rates* in each industry :

> *"What competition brings about, first of all in one sphere, is the establishment of a uniform market value and market price out of the various individual values of commodities. But it is only the competition of capitals in different spheres that brings forth the production price that equalizes the rates of profit between those spheres."* (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 10, p. 281)

This analysis implicitly assumes that structural change only imparts a slow movement to the average technology (slow in comparison to the strength of competitive centripetal forces). However, the discussion of these comparative forces is not held in *Capital*.

2.2.2 Chasing a Moving Target

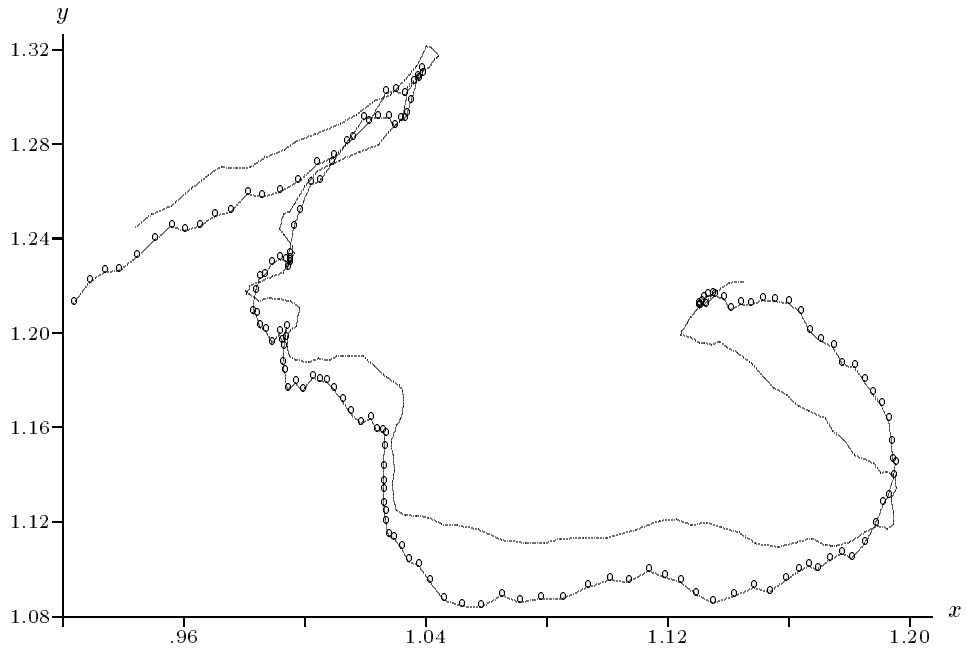
In G. Duménil, D. Lévy, "Structural change and prices of production", *Structural Change and Economic Dynamics*, VI (1995) p. 397-434, we present a model which "generalizes" the models described in section 1.2.3, with the same *disequilibrium microeconomics*. Agents act within disequilibrium (in particular, they confront unequal profit rates) and react to the evidence of disequilibrium. The unique difference is that the parameters which define technology, distribution, the rate of accumulation, and final demand are repeatedly shocked. Thus, equilibrium drifts over time randomly. This framework includes both of Marx's approaches in the two quotations concerning respectively the emergence of a new more profitable technique and the convergence back to equilibrium, on the one hand, and technological heterogeneity at a given point in time, on the other.

In our model, we consider a simple economy with two industries. The ratio of the prices of the two goods in these industries is denoted x, and the ratio of the capital stocks, y. In each period t, structural parameters (technology, wages, etc.) are determined, and the corresponding equilibrium is defined by a relative price, $\overline{x}_t$ (prices of production), and a relative capital stock, $\overline{y}_t$. This moving equilibrium can be described as a "moving target".[28] Actual relative prices and capital stocks, (x_t, y_t), vary over time as a result of

28. Note that no economic agent knows this target, and levels at this target. Consequently, the expressions *following or chasing a moving target* are abusive.

decisions made by enterprises and capitalists. Because of the reaction of economic agents to disequilibrium, which is constantly recreated by structural change, the variables seem to "chase" the moving target.

Figure 3 Following a moving target : (x_t, y_t) $(\bullet)$ and $(\overline{x}_t, \overline{y}_t)$ $(\circ)$



A simulation is presented in figure 3, where the black dot $(\bullet)$ denotes the trajectory of equilibrium positions $(\overline{x}_t, \overline{y}_t)$, and the hollow dot $(\circ)$, the variables (x_t, y_t). This figure clearly illustrates the properties of the model :

1. Equilibrium drifts with time. Growth is clearly non-homothetical. (Homothetical growth would correspond to a horizontal line.)
2. The variables gravitate around the sequence of equilibrium positions. This means that they are simultaneously "attracted" by this position, but never reach it because of the continuous changes to which it is subject.
3. A closer examination of the figure reveals that lengthy deviations between long-term equilibria and the actual movement of the variables may be manifested recurrently, although these shifts are small in comparison to the overall effect of structural change on equilibrium.

In this model, it is possible to study the problem of the relative strength of centripetal forces (reactions of economic agents) in comparison to the rapidity of structural change. If the reactions of economic agents to disequilibrium are weak, the gaps will be larger.

In our opinion, the assumption of a "slow" structural change, in comparison to the dynamics of competition is quite relevant. It is important to understand in this respect,

that technology is embodied within fixed capital, and is, to a large extent, *putty-clay*. The diffusion of new techniques within the productive system is conveyed by the *flow of new investments* and discards. Consequently, investment creates a congenial link between the comparative speeds of *capital mobility* and *technical change*. Concerning consumption, it is financed out of incomes (wages, dividends, etc.), which only vary slowly. The rules governing the composition of final demand are also only slowly modified.

Overall, we believe that capital mobility, and associated equilibration mechanisms, are very efficient in comparison to ongoing structural change, as shown by the "gravitation" of profit rates in figure 1. In any case, the field of investigation opened by the confrontation of historical tendencies and the analysis of competition appears very promising.

2.3 HISTORICAL TENDENCIES AND CRISES

The third and last relationship between the three dynamics of Volume III connects *historical tendencies* and *crises*. There is, however, some ambiguity concerning the term *crisis* istself. In the analysis of the business cycle, as in section 1.1, crises refer to *recessions*. They can be denoted as *"small" crises*. However, the term crisis is also often used to designate accumulations of difficulties of which the occurrence of recessions is only one aspect. In addition to the repetition of overheating and recession, the symptoms of such situations can include inflation, persistent unemployment, stubborn deficits, and frantic attempts to transform institutions (for example, regulations), etc. This use of the term crisis refers to disequilibria of a larger amplitude or lengthier duration than recessions. They are typically called *large crises*. For example, advanced capitalist economies are said to have undergone a "crisis" in the 1970s or, even, to have lived through a crisis since the 1970s.

Marx's use of the term crisis in Volume III is often ambiguous in this respect. Does he consider business fluctuations or larger perturbations? The answer is clearly: *both*. For this reason in the discussion of the link between historical tendencies and "crises," we will broaden the scope of our investigation to include such large crises.

Section 2.3.1 briefly recalls Marx's analysis in Volume III of the relationship between historical tendencies (primarily the falling profit rate) and crises. The historical relevance of this analysis is, then, discussed in section 2.3.2.

2.3.1 The Falling Profit Rate and Crises in Volume III

The connection between the falling profit rate and crises is a central theme of Marx's analysis in Volume III, and the object of chapter 15. Marx states at the beginning of this chapter:

> *"On the other hand, however, in view of the fact that the rate at which the total capital is valorized, i.e. the rate of profit, is the spur to capitalist production (in the same way as the valorization of capital is its sole purpose), a fall in this rate slows down the formation of new, independent capitals and thus appears as a threat to the development of the capitalist production process; it promotes overproduction, speculation and crises, and leads to the existence of excess capital alongside a surplus population."* (K. Marx, *Capital, Volume III*, New York: First Vintage Book Edition, 1894, ch. 15, p. 350)

Unfortunately, the exact mechanisms by which the falling profit rate leads to such small or large crises are not precisely described in the chapter or anywhere else.

In fact, Marx's investigation is very broad. He discusses (with himself, often attacking Ricardo) the various "internal contradictions" which are implicit in the *system* of tendencies that he previously described. Often this notion of conflicting tendencies remains rather vague, however. For example, one can locate several remarks such as the following :

> "[...] *the development of labour productivity involves a law, in the form of the falling of the rate of profit, that at certain point confronts this development itself in a most hostile way and has constantly to be overcome by way of crises ;* [...]" (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 13, p. 367)

2.3.2 The Falling Profit Rate and Crises since the Civil War

With the definition of large crises given earlier, one can detect three such episodes over the period 1869-1992, that we studied :

1. In the late 19th century, after a period of falling profitability, important fluctuations of the general level of activity are manifested. The 1870s and 1890s are known as periods of "depressions," sometimes christened "great depressions".
2. Since the 1970s, a new crisis situation has been created, similar in many respects to the above. This crisis also occurs after a lasting period of declining capital productivity and profit rate. The rates of growth of labor productivity and wages are dramatically reduced. A new strong instability of the general level of activity is manifested.
3. The Great Depression is a paradoxical manifestation of the tremendous restoration of the trends of the main variables concerning technology and distribution in the first half of the 20th century, and of important institutional weaknesses concerning, for example, the organization of the banking system and the inadequate social control of stability. This crisis is specific and will not be discussed here (see G. Duménil, D. Lévy, The Great Depression, *op. cit.* note 17).

Two among these three crises were observed at the end of episodes à la Marx, with an actual decline of the profit rate. In our opinion, this observation clearly vindicates Marx's emphasis on the falling profit rate.

The link between profitability and business fluctuations can be easily illustrated on the example of the US economy in the 1970s (see G. Duménil, D. Lévy, "Why does Profitability Matter ? Profitability and Stability in the U.S. Economy since the 1950s", *Review of Radical Political Economy*, XXV (1993) p. 27-61 and *The Economics of the Profit Rate, op. cit.* note 4, ch. 12). As is well known, the 1970s coincided with a significant and sharp decline of the profit rate and exceptionally strong fluctuations of the general level of activity. In our opinion, this coincidence is not fortuitous. This can be shown using the dynamical model mentioned in section 1.1.2, by testing the impact of the profit rate on the parameters of the model, with the following conclusions :

1. The profit rate is a significant explanatory variable in the stability condition (far more significant than the rate of interest, for example).
2. This effect can be more precisely located, on the supply side, in the degree to which firms react to disequilibria between supply and demand, by directly adjusting their levels of activity.

The actual decline of the profit rate induces modifications of firm behavior which have a destabilizing effect on the macroeconomy. These transformations initiate phases of instability which require new changes in the institutional framework responsible for the macroeconomic stability of the economic system — a correction which may come after important delays. The relevant observation in the historical analysis of stability is, therefore, not the *absolute level* of the profit rate, but its recurrent declines.

APPENDICES

A.1 UNEMPLOYMENT

Little emphasis has been placed in this study on the analysis of unemployment, in spite of its obvious prominent importance. Unemployment actually relates to several aspects of the analysis in this paper.

It is traditional to distinguish between *cyclical* and *structural* unemployment :

1. *Cyclical unemployment.* The fluctuations of unemployment follow those of the general level of activity (see G. Duménil, D. Lévy, *ibid.*, Section 11.8). This component of unemployment corresponds to Marx's re-formation of the reserve army.
2. *Structural unemployment.* The expression refers to more "stubborn" manifestations of employment. They may be related to *accumulation* or *technical change*.[29]

Consider, first, *accumulation*[30], under the assumption of a constant technology (a given *capital / labor* ratio) ; there is obviously no reason that capital accumulation ensures the full utilization of labor power. If accumulation remains too slow for a considerable period of time, the capital stock, even used at normal or full capacity, is not adequate to employ all potential workers. This form of unemployment is typical of large crises, since deficient profit rates are reflected in deficient rates of growth of fixed capital. In addition, during such large crises, this type of structural unemployment is usually combined with cyclical unemployment, as a result of the multiplication of "small" crises.

Consider now the effects of technical change under the assumption of a given rate of accumulation. If the *capital / labor* ratio rises rapidly, accumulation only creates a limited amount of employment, and structural unemployment may prevail. (The appropriate variable in this analysis is the *capital / labor ratio*, not labor productivity.)

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29. The importance of the variations of the composition of output on employment should not be overstated, and will not be discussed here (see L. Pasinetti, *Structural Change and Economic Growth*, Cambridge : Cambridge University Press, 1981 and *Structural Economic Dynamics, a Theory of the Economic Consequences of Human Learning*, Cambridge : Cambridge University Press, 1993).

30. The analysis in this paragraph and the following is based on the relationship $L = uK/(\overline{K/L})$, in which u is the capacity utilization rate, and $\overline{K/L}$, the *capital / labor* ratio under normal utilization of productive capacities. (We abstract from the degree of rigidity of employment in the short term.)

A.2 EQUILIBRIUM AND DISEQUILIBRIUM

Many Marxists or economists working in the classical tradition shy away from the term *equilibrium*, because of its neoclassical flavor. We disagree with this attitude which relies, in our opinion, on a confusion between terminology and content.

The prevalence of prices of production and associated outputs, in which profit rates, as well as supply and demand, are equalized clearly refers to an *equilibrium* position, actually a *long-term* equilibrium. Marx himself recurrently resorts to the same terminology (*Gleichgewicht*, translated by *balance*). For example :

> *"The average rate of profit appears when the forces of competing capitalists balance one another. Competition can produce this balance, but not the rate of profit which appears when the balance is given."* (K. Marx, *Capital, Volume III*, New York : First Vintage Book Edition, 1894, ch. 50, p. 1005)

All equilibria are not equivalent, however. A neoclassical equilibrium is an *ex ante* short-term equilibrium by prices, thoroughly different from the classical equilibrium.[31] The reliance on this specific definition of equilibrium is not fortuitous, but originates from the clear ideological bias of mainstream economics, which sacrified all forms of factual relevance to the demonstration of the optimal character of capitalist market relations.

Keynesian economics emphasize another notion of equilibrium, a *short-term equilibrium by quantities*. This equilibrium does not suffer from the same weaknesses as neoclassical equilibrium, and can be usefully implemented within a classical analysis.

The notion of equilibrium is also often rejected by heterodox economists, independently of its precise content, because the economy is constantly subject to perturbations and structural change. For example, balance growth paths are viewed as "stupid" or ideological. In our opinion, the consideration of structural change does not detract from the importance of equilibrium positions, but simply opens new avenues for research (see section 2.2.2).

Consider now stability analysis. The Walrasian *tâtonnement* is a totally unrealistic account of the formation of equilibrium (centralized and without transactions). As contended in section 1.2.3, Marx's analysis of the formation of prices of production is, on the contrary, typically that of the stability of an equilibrium in a disequilibrium framework. Actual disequilibrium prevails, and agents act within disequilibrium. The notion of behavioral "mechanisms" is crucial to Marx's analysis. The *laws* of capitalism can be abstractly defined independently of such operative mechanisms, but their prevalence can only be understood in reference to the actions of economic agents :

> [. . .] the immanent laws of capitalist production manifest themselves in the external movement of the individual capitals, assert themselves as the coercive laws of competition, and therefore enter into the conciousness of the individual capitalist as the motive which drives him forward [. . .][32].

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31. The *Marxian General Equilibrium* of John Roemer (J.E. Roemer, *Analytical Foundations of Marxian Economic Theory*, Cambridge : Cambridge University Press, 1981) is an hybrid of Walrasian general equilibrium *à la Arrow-Debreu* and classical long-term equilibrium. Its common points with Walrasian equilibrium are : (1) the formal framework, (2) a similar account of behaviors (for example, enterprises are price-takers, and have no problem of outlets), and (3) the consideration of a short-term equilibrium (*i.e.*, an equilibrium with any set of initial endowments). It shares with classical equilibrium the fact that capitalists are subject to a capital constraint ; consequently, prices are equal to prices of production.

32. K. Marx, *Capital, Volume I*, New York : First Vintage Book Edition, 1867, p. 433.

There is no reason to abandon the fields of competition and behaviors to the mainstream. The work of classical economists, and Marx, in particular, contains a *specific* approach to behaviors in general.[33]

On all of these issues, see G. Duménil, D. Lévy, *The Economics of the Profit Rate, op. cit.* note 4, ch. 10.

A.3 VALUES OR PRICES ?

There is a rather widespread belief among Marxists that the reference to *labor values* provides key insights into many, if not all, aspects of the analysis of capitalism. For example, the reference to values would be crucial to the analysis of crises or historical tendencies. This view repeats, and extends, the confusion which surrounded the so-called "transformation" problem : *The determination of values has long been considered as a preliminary to the computation of prices of production (because Marx performs such a computation in Volume III).*[34] We thoroughly disagree with this view.

The analysis of competition, business cycle, or historical tendencies does not require reference to values. When firms interact on the market, prices and outputs are at issue (not values) ; the profit rate which is equalized must be computed in terms of prices ; a profitability squeeze is felt in terms of profits, and must be assessed on the basis of actual market prices.

In some cases, the consideration of values, instead or prices, may be used as a simplifying assumption[35], as Marx often does in *Capital* (for example, in the analysis of exchange in Volume I, in the analysis of reproduction schemes in Volume II, and in most of his analyses of the falling profit rate). However, the use by Marx of a simplifying assumption must not be mistaken for the construction of a "meta-theory".

This does not mean obviously that the labor theory of value is irrelevant to the analysis of capitalism. On the contrary, it is crucial to the theory of *exploitation*. Marx's general purpose is related to historical materialism. He shows that the capitalist mode of production is simply a new variant of a class society based on the appropriation of surplus

33. *Marxist microeconomics* may involve class struggle, for example in the analysis of "labor market" relationships (see, for example, S. Bowles, H. Gentis, "Contested Exchange : New Microfoundations for the Political Economy of Capitalism", *Politics and Society*, XVIII (1990) p. 165-222).

34. Actually, the relationship between values and prices is fully independent from the fact that profit rates are equalized. We will not restate here analyses related to the presentation of the so-called *new interpretation* of the transformation problem. G. Duménil and D. Foley independently developed a new analysis of the transformation problem (G. Duménil, *De la valeur aux prix de production*, Paris : Economica, 1980, "Beyond the Transformation Riddle : A Labor Theory of Value", *Science and Society*, XLVII (1983) p. 427-450 and "The So-Called 'Transformation Problem' Revisited : A Brief Comment", *Journal of Economic Theory*, XXXIII (1984) p. 340-348, D. Foley, "Value of Money, the Value of Labor Power and the Marxian Transformation Problem", *Review of Radical Political Economics*, XIV (1982) p. 37-47 and *Understanding Capital, Marx's Economic Theory*, Cambridge : Harvard University Press, 1986, G. Duménil, D. Lévy, "Jerzy Szumski's Validation of the Labor Theory of Value", *Cambridge Journal of Economics*, XV (1991) p. 359-364). This analysis was later adopted by A. Lipietz (A. Lipietz, "The So-Called 'Transformation Problem' Revisited", *Journal of Economic Theory*, XXVI (1982) p. 59-88). A comparison of this new interpretation with earlier analyses can be found in H. Ehrbar, M. Glick, "The Labor Theory of Value and its Critics", *Science and Society*, L (1986) p. 464-478 or M. Glick, H. Ehrbar, "The Transformation Problem : An Obituary", *Australian Economic Papers*, XXVI (1987) p. 294-317.

35. Recall that within prices of production equations, values are equal to prices for $r = 0$.

labor. In the previous modes of production, the channels of the appropriation of surplus labor were transparent, as in the case of forced labor by the serfs in feudalism. In this case, surplus labor is realized simultaneously to its appropriation. If a tax is paid in kind, surplus labor is embodied in a product, which clearly represents a fraction of the toil of the worker. According to Marx, a similar relation of exploitation is maintained in capitalism, a commodity-producing economy of a specific category, where labor power is a commodity. However, appropriation and realization of surplus-value are separate. Surplus-value is appropriated proportionally to labor inputs, but realized (under ordinary circumstances) proportionally to capital advanced. This separation between appropriation and realization hides the existence of exploitation. The concept of value is, thus, a necessary component of the theory of exploitation under capitalism, whose analysis was a primary purpose of Marx's work in *Capital*.

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