# Macroeconomic Instability: An Heterodox Model
# Instabilité macroéconomique: un modèle hétérodoxe

Jean-Guy Loranger et Gérard Boismenu

Université de Montréal

# Résumé

Le but de cet article est de développer et tester un modèle hétérodoxe qui fait la synthèse entre deux écoles de pensée : l'économie politique de Marx basée sur l'approche de Duménil-Lévy et l'économie politique de la régulation basée sur l'approche d'Aglietta-Boyer-Billaudot. La première partie de l'article indique comment l'approche DL repose sur deux hypothèses-clefs :

a) une politique monétaire exogène assez efficace pour stabiliser un régime d'accumulation qui pourrait être autrement instable en moyenne ou longue période;

b) un progrès technique exogène qui déplace les variables-clefs du système, notamment le taux de salaire et le taux de profit qui sont au cœur de toute analyse Marxiste.

Le réalisme de ces deux hypothèses est passé à la loupe dans la deuxième partie à la lumière du régime néolibéral. Puisque la principale caractéristique du régime néolibéral est la financiarisation de l'économie mondiale (ou, si l'on préfère, l'influence prépondérante des marchés financiers ), on va privilégier l'hypothèse d'une politique monétaire endogène à long-terme. Ce sera en particulier le cas pour le Canada où l'influence de la FED semble être plus importante que l'influence de la banque du Canada. On rejettera également l'hypothèse de changements technologiques exogènes en longue période en faveur de l'hypothèse de changements endogènes basés sur les externalités positives crées par un niveau général de connaissance.

Dans la troisième partie, on résume brièvement l'économie politique de l'école de la régulation en soulignant en particulier un changement structurel majeur dans l'ordre monétaire mondial lorsqu'on est passé d'un régime de taux de change fixe à un régime de taux de change flexible et à la financiarisation de l'économie mondiale. Ce changement majeur s'est produit au milieu des années 70 et s'est poursuivi jusqu'à la fin des années 80.

Malgré les nombreuses études empiriques faites par Boyer et d'autres régulationistes au sujet de la non existence d'un modèle canonique régulationiste, Aglietta et d'autres économistes sont maintenant prêts à accepter un nouveau modèle canonique qui va faire une place centrale à l'importance prépondérante des marchés financiers. C'est l'objectif de la quatrième partie où l'on présente un nouveau modèle hétérodoxe qui comporte une équation du taux d'intérêt spécifiée pour une économie ouverte et où le le taux de change et le taux d'intérêt étranger jouent un rôle majeur.

On présente enfin dans les deux dernières parties les résultats de deux modèles économétriques :

a) un modèle de productivité-demande basé sur 6 equations qui est ensuite réduit à un modèle à deux équations;

b) un modèle réel et financier pour un économie ouverte basé sur 9 relations qui est ensuite réduit à un modèle de 4 équations de comportement et deux relations de définition pour la fermeture du système.

On obtient des résultats pour chaque modèle selon 5 critères d'analyse : a) une estimation des relations de long terme ; b) l'impact à court terme des relations de long terme ; c) l'impact à court terme des variables prédéterminées ; d) l'analyse dynamique de court terme des variables dépendantes retardées ; e) un test de changement structurel.

# Abstract

Our aim is to build and test an heterodox model which is a synthesis of two schools of thought: the political economy of Marxism based on the Dumenil-Levy approach and the political economy of regulation based on the Aglietta-Boyer-Billaudot approach. In the first part of the paper, it will be outlined in particular that the Dumenil-Levy approach is based on two key assumptions: a) an exogenous monetary policy efficient enough to stabilize a regime which could otherwise be unstable in the mid or long-run period; b) an exogenous technical progress which moves the key variables of the system, namely the wage rate and the profit rate so central in the Marxist analysis.

In the second part, the realism of these two assumptions will be criticized in the light of the neoliberal regime. Because the main characteristic of the neoliberal regime is the financiarization of the world economy ( or the overwhelming influence of the financial markets ), we prefer the assumption of an endogenous monetary policy in the long-run, particularly so in the case of Canada where the influence of the FED seems to matter more than the influence of the central bank of Canada. We also reject the hypothesis of exogenous technological changes in the long-run and prefer the hypothesis of endogenous technological changes based on the positive externality of the general level of knowledge.

In the third part, the political economy of the Regulationist school will be briefly summarized by showing in particular a major structural change in the world monetary order by moving from a fixed exchange regime to a flexible exchange regime and the financiarization of the world economy. This major change occurred in the mid 70's and continued to unfold until the end of the 80's. Despite the many empirical papers written by Boyer and others about the non existence of a canonical Regulationist model, Aglietta and others are now ready to admit a new canonical model which would give a central place to the overwhelming importance of the financial markets. This is precisely the aim of the fourth part where a new heterodox model is presented with an interest rate equation specified for an open economy and where a flexible exchange rate and the foreign interest rate play a central role. The last two parts contain the results of two econometric models:

a) a productivity-demand model based on 6 equations which has been reduced to a two equation model;

b) a real and financial model for an open economy based on 9 equations which has been reduced to a four behavioral equation model and two quasi-definition relations for the closure of the system.

Econometric results are obtained for each model according to 5 criteria: a) estimated long-run relations; b) the short-run impact of long-run relations; c) impact of short-run predetermined variables; d) short-run dynamics of lagged dependent variables; e) test of a structural break.

**Macroeconomic Instability: An Heterodox Model**

*Jean-Guy Loranger, Gérard Boismenu*
jean.guy.loranger@umontreal.ca
gerard.boismenu@umontreal.ca

*Université de Montréal[1]*

# Introduction

In the heterodox economic literature, there are two main schools of thought concerning the long-term macroeconomic instability or economic crisis: the Keynesian or Regulationist school revolving around the hypothesis of an under-consumption or insufficient demand, (recall Keynes' under-full-employment equilibrium), the Marxian school based on the central hypothesis of an insufficient average profit rate, (recall Marx's law of the falling tendency of the rate of profit). The literature of both schools of thought is so vast that we will be forced in this paper to limit ourselves to only a few well-known economists since the aim of this paper is not to make a survey of the literature but to present a theoretical framework based on both approaches. We will choose the Dumenil-Levy contribution as contemporaneous leaders of the Marxian school and the Boyer-Billaudot-Aglietta contribution as leaders of the Regulationist school.[2]

Dumenil-Levy have contributed to may articles in various radical journals but the essential of their thinking can be found in their most recent book Economie Marxiste du capitalisme (2003) and also in the 1996 book La dynamique du capital, which was followed in 2000 by Crise et sortie de crise, which has just been updated and translated in English in 2004 under the title Capital Resurgent: Roots of the Neoliberal Revolution.

Boyer (2002, 2001, 1986, 1979), Billaudot (2001, 1976), (Aglietta, 1999, 1997, 1976) and many other authors have contributed to many articles and books on the subject. For the last seven years, the Association Recherche et Régulation (where R. Boyer has a leading role) published an annual review (L'Année de la Régulation) of the most important contributions on the subject. Although the Review accepts articles by English authors, the Regulationist school is still rather ignored by the English mainstream literature.

This paper contains six sections. In section 1, we will present the Dumenil-Levy political economy of Marxism, the core of which is based on the profit rate and the competitive capital market. Some empirical evidence from the long-run observation of the US economy will be offered to support their hypothesis. The section will also examine the causes of economic instability, namely the monetary policy, and the technical change. In section 2, we will outline some weaknesses the DL approach, namely the major change in the conduct of monetary policy and the importance of endogenizing the technical

---

[1] G. Boismenu is full professor and head of the Department of Political Science  and J.G. Loranger is honorary professor, Department of Economics, Université de Montréal.

[2] We deliberately choose these French economists because the Regulationist school is much more developed in French than in the English literature. But the American social structure of accumulation school developed by  Bowles-Gordon-Weisskopf (1983) and others at the University of Massachusetts has close similarities with the French Regulationist school. They have limited themselves to the study of the US economy while the French Regulationists have achieved many international comparisons.

progress. In section 3, we will present the political economy of the Regulation school, in particular the 5 institutional forms which characterize the Fordist regime, the structural change which led to the rejection of the Fordist regime and the difficulty in characterizing a new regime. In section 4, we will present a new heterodox model which is a synthesis of the Marxist and the Regulationist approaches. Finally, the last two sections will contain econometric results of two canonical forms estimated as an Error Correction Model, i.e. by multiple co-integration analysis. Econometric results have been obtained for each model according to 5 criteria: a) estimated long-run relations; b) the short-run impact of long-run relations; c) impact of short-run predetermined variables; d) short-run dynamics of lagged dependent variables; e) test of a structural break.

# 1. The political economy of the Marxist school

## 1.1 The core of the theory
Everyone has some knowledgeof Marx's Capital although very few have read it thoroughly. It is a well-known treaty of political economy where Marx lays down the major concepts about value creation and its distribution, class struggle, exploitation of the labor force, accumulation of capital, growth and crises, money, price, wage, rent, profit rate, interest rate and financial capital. However Marx's contribution is much greater than a treaty of political economy: it is also a theory of social change (historical materialism) where the history of society and its changes are characterized by the dialectical movement between the development of the productive forces (nowadays the new technology and productivity) and the production relations (built on the class structure, the state and other institutions). The class struggle, which develops on this material basis, leads to various crises and successive stages of development and production modes: slave mode, feudal mode, merchant mode, capitalist mode, and communist mode.

Therefore, the idea of defining a particular period corresponding to a specific regime is not a new idea developed by the Regulationist school. The novelty brought by the latter school is to subdivide the capitalist mode of production into two different stages or regimes: the competitive regime and the monopolist or Fordist regime, [3] dominated by large multinational firms. There seems to exist a broad consensus that a new regime, neoliberalism, has emerged since the mid 70's and has developed more intensively during the 90's. The main question is whether this new regime is better characterized by competition than monopoly or financiarization.

Dumenil-Levy reply that the concept of competition vs monopoly as a dividing line between two stages or regimes of capitalism is not acceptable from a Marxist standpoint since it ignores Marx's basis idea that what matters most is not competition of firms on a particular product market but competition on the capital market, which is the main cause of the tendency to the equalization of the profit rate between the various production branches or industries. The extraordinary development of the financial markets on a worldwide basis (or financiarization) is the new institution, which characterizes

---

[3] The Fordist denomination originated from the wage policy applied by Henry Ford and has been used for the first time by A. Gramsci in his description of the US accumulation regime. One of the main features of the Fordist regime is the sharing of the productivity gains between capital and labor.

neoliberalism and imposes the *domination* of financial capital and *competition* between large multinational firms.

Although the political economy of regulation has some important features of Marxism, such as institutionalism and historicism, Dumenil-Levy strongly dissociate themselves from the Regulationist school by focusing on the importance of the profit rate instead of the wage rate as the engine of growth and depression. They flatly reject the weakness of the wage rate (and the demand) as the major explanation of the great economic crisis of 1929 and the growth of wage rate as the key factor of growth during the next thirty years after the Second World War.

**1.2 The empirical evidence**

D-L produce aggregate data[4] for the pre-war and the post-war period that contradicts the Regulationist explanation: the real wage rate has the strongest average annual increase (2.34%) during the period 1900-1953 and has a weaker average annual increase (1.94%) during the thirty glorious post-war years. The figures for the annual profit rate for the post war period is consistent with Marx's law of the falling tendency (-1.05%), but it is less clear for the pre-war period where a rising tendency is observed (0.62%) for the period 1900-1953. So what is the Marxist explanation of the great depression of the 30's? Dumenil-Levy stress the lack of adequate financial regulation or macroeconomic policy, in particular the failure of the FED to develop an adequate monetary policy.[5] The Regulationist school could also supply a similar explanation. The Marxist explanation is more convincing for the neoliberal period where a strong rising tendency of the profit rate is observed (1.76%) while the real wage rate continues its growth at a slower pace (1.42%). which is, incidentally, the same pace as the one observed in the last thirty years of the 19th century.

 The sole argument of the profit rate against the wage rate is not, however, a totally convincing one since it is two faces of a same coin: indeed, there is an opposite relation between the two variables in the very definition of the profit rate. The profit rate also includes two other keys variables: the productivity of labor in the numerator and the capital/labor ratio in the denominator. The gap between Marxists and Regulationists is not as big as one might think. The key argument of the Regulationist school is not only the growth of productivity but also the share of productivity between labor and capital, which matters most for boosting the real wage rate and generating growth of the final demand. In Marxian terminology, it is the exploitation rate, which is the key parameter and determines the share of productivity between capital and labor. A reduction of the exploitation rate will favor the growth of the wage rate through a larger share of productivity to labor. The thirty glorious years of growth, which occurred during the post-war period, is a vindication of the Regulationist as well as the Marxist explanation because one can observe a strong labor productivity growth and an average annual increase of the real wage rate of almost 2%. The neoliberal growth period of the last twenty years is better understood by an increase of the exploitation rate, which has allowed a greater profit rate through a larger share of productivity to capital. This is outlined, in particular, by the growth of productivity of capital, which has reached the

---

[4] Duménil-Levy (2003) table 1, page 21. All the figures are based on the performance of the American economy.

[5] On page 69, they affirm that the 1929 crisis is an institutional crisis as the consequence of the issue to the crisis at the end of the 19 century where a new financial world emerged without an adequate control.

highest average annual growth rate of 1.16% for the period 1982-2000. This figure exceeds the pre-war figure (0.66%) when capitalism was much less regulated. As already outlined, this resulted in a much slower increase of real wage. The explanation of a Fordist regime supported by a strong wage rate negotiated by labor unions is contrary to empirical evidence in the neoliberal period. Profits need to be taken into consideration.[6]

**1.3 Microeconomic foundations of economic fluctuations**

It is in chapters 4 and 5 that Dumenil-Levy develop their theory of economic fluctuations or macroeconomic instability. Competition in the product market is a necessary but not a sufficient condition in order to guarantee the rational economic behaviour of agents. It requires the objective function of profit maximization, which implies capital mobility between various branches. For neoclassical economists, the equilibrium is reached when the profit rate is zero. For Regulationist economists, the mobility of capital is far from perfect and there are permanent disequilibria that occur in certain branches, which lead to monopoly or oligopoly situations. For Marxist economists, there is a long-term economic equilibrium when the profit rate is the same in all sectors. On this particular theoretical issue, there is less difference between Marxist and mainstream economists than between Marxists and Regulationists. As DL state on page 46-48,[7]
"the fundamental principle of competition is not the market (where an equilibrium price guarantees the equality between supply and demand), but the gradual adjustment of production capacities (of supply) to demand by the mobility of capital…Capital mobility is therefore a major characteristic of capitalism as it emerges at the beginning of the XX century. Such a capitalism reveals itself at least as competitive as the one of the previous century, although in a different institutional framework…The maintenance of the gravitation of the various profit rates around a common value is the expression of a fundamental characteristic of capitalism."

Nowadays, capital mobility is possible at the world level because of the overwhelming importance of the financial markets or financial capital concentrated in large financial institutions such as banks, pension funds, and mutual funds. Even if a multinational firm is dominant in a particular sector, the power of the big financial capital can break the barrier to entry in any industry in any country in the world, provided that national governments accept the neoliberal rule of deregulation of their industrial and financial sectors.
Dumenil-Levy do not affirm that this long-term equilibrium is always realized, as some mainstream economists of the real business cycle school would say, but the common profit rate is a point of gravitation that defines a stable economic system. It implies dynamic microeconomic foundations, i.e. economic agents are continuously adjusting their behaviour in disequilibria. These disequilibria are of two types: different profit rates

---

[6] This is accepted with some recent contributions by Regulationists ( Lordon ,1997) where it is recommended to introduce a profit driven component in the wage equation. Boyer (2002, p 138) goes even further by stating that it is profits instead of wages which is now the main driving force behind the demand regime.
[7] All quotations are translated in English from the original French text. We assume responsibility for any inappropriate choice of words or sentences.

between firms and industries, and a gap between supply and demand on any particular market.

The adjustment to the first type of disequilibria is an increase of investment in industries that have higher profit rates. The adjustment to the second type is a variation of quantity and/or price of the product. Assuming for instance that demand is greater than supply, firms will increase their capacity utilization (hence, increase the quantity of the product on the market) and when the capacity is near full utilization, they will start increasing their price. This sounds very familiar to any mainstream economist who teaches comparative static equilibrium. What is typically Marxian is that the equilibrium adjustment is not established on the assumption of some fixed point theorem, (as it is usually in mainstream GE theory), but it is a gravitation process around a non zero general or average profit rate which is postulated as a long-term equilibrium of the economic system where the price variable is co-integrated with the profit rate, the wage rate and many other economic variables. Dumenil-Levy name such a system a general disequilibrium model where all variables are interdependent.

«This return [to equilibrium] can be achieved only progressively as the eventual outcome of a sequential process in which the whole economy is implicated. But along this process, shocks occur that move the economy away from equilibrium, transforming finally the convergence toward the equilibrium into a gravitation around its neighborhood. Once the framework and the behavior of agents are described, the problem boils down to the mathematical study of the properties of the model" (page50).

Assuming that the system is stable around this gravitation point, one can use the tools of mainstream economists of an Error Correction Model (ECM) where the co-integrated relations represent the long-run stability of the system and the change of the vector variables over a certain time horizon (or the vector autoregressive part of the model) the short-term dynamic adjustment of the economic system. The speed of adjustment toward the long-term equilibrium is also revealed by the coefficient matrix that is generated when estimating the long-term or co-integrated relations. However, the stability of the system is continuously threatened by the occurrence of shocks (stochastic trends) or changes in exogenous variables.[8] A structural change of the system (or regime change) occurs when some variables change role by appearing or disappearing from the system. Such a change is reflected by a parameter change in the co-integration matrix, which reflects the instability of the system.

**1.4 Money and technical change as a source of macro-instability**

…"Interdependence between agents can generate cumulative movements of up and down. It has been necessary to create institutional controls that regulate such movements the modern form of which is the regulation of credit by the monetary policy…The microeconomic theory of disequilibrium therefore leads to an interpretation of the crisis in terms of instability of the macroeconomic equilibrium" (DL p.51).

---

[8] In a dynamic model, exogenous variables are represented by a constant term or a component growing at a constant rate. The explicit treatment of exogenous shocks as stochastic or non stochastic variables is a particular way of dealing with a structural break of the constant term.

Concerning the role of the monetary policy (or the determination of the interest rate), DL assume that money (or credit money) is endogenous and can be a source of instability, but, if controlled by a central bank, the monetary policy can have an effective stabilization effect. This assertion is based on the assumption of an independent state, which is able to conduct an independent and credible monetary policy. A critical re-examination of this assumption will be presented in the second section. Concluding on the importance of the monetary policy, DL state (p.58-59) that …

"The problem of [aggregate] demand is the problem of the imperfection of the monetary policy (or of what it used to be in the past). As it has been explained, these disequilibria take the shape of quick cumulative processes leading to contractions or over-expansions of the economic activity."

This assertion states that one source of macroeconomic instability is the imperfection of monetary policy. The mental restriction "or what it used to be in the past" implies that the present monetary policy is different and may be the source of more macroeconomic instability, as will be explained in the second section.

Another cause of the structural change or macro-instability is the long-term relation between wage and profit. At the beginning of chapter 5, Dumenil-Levy state that there is no such thing as a normal wage, a normal profit rate or a normal interest rate. All these variables are determined by the class struggle. Therefore, one would be tempted to assume that they are all exogenously determined in an economic model. Nevertheless, they admit a few pages later that there exists a complex interrelationship between these variables: the profit rate is related to wage, the wage rate is related to employment, production is related to capital and labor, capital is related to the profit rate and, finally, labor and the profit rate are related to the new techniques, which are generated randomly or exogenously. On page 66, DL state that
…"in order to build a model, one has to introduce a minimum: the random outcome of innovations (new processes) resulting from the research and development activities ( it is therefore a dynamic stochastic model of technological change, borrowed from the classico-Marxist and evolutionist inspiration.)"

In order to arrive at a simple two equation model of the profit rate and the capital accumulation variable described by their diagram 2 (p.66), it is necessary to substitute the labor equation into the wage equation and the latter into the profit rate equation: the end result is a reduced form model of the profit rate and capital determined by the exogenous change in new techniques. Part of the diagram shown on page 66 is the same as the one shown on page 234 *La dynamique du capital*, D-L (1996) where a four equation model constitutes a formalization of the relations among the various variables. Importantly, despite the feedback effect of the profit rate on wage and technology (productivity and the capital/labor ratio), the wage rate and technology are assumed exogenous. These exogenous shocks are a second source of economic fluctuations which can, in the long-run, be the cause of a structural change. This is a major departure from the Regulationist approach where it will be assumed that technological and wage changes are endogenous.

Dumenil-Levy conclude that the two historical periods of the falling tendency of the profit rate were followed by structural crises which have led to major institutional changes. For instance, the 1950-1980 falling rate period has opened the way to new major changes in financial institutions (deregulation of financial markets), new technology of information and communication (TIC) and new management in private and public sectors. This leads us to the relevance of the hypothesis of endogenous technical progress in the short-term as well as in a long-term period.

## 2. Criticisms of the D-L approach

### 2.1 Inefficiency of the monetary policy
Even if D-L acknowledge on many occasions the overwhelming power of the financial markets, they do not seem ready to admit that the conduct of monetary policy has lost its efficiency in the stabilization of economic fluctuations. Nowadays, with the neoliberal regime dominated by world capital markets, outside the USA, central banks are subjected to the domination of private financial capital and have surrendered their autonomy to conduct independent monetary policy. Monetary policy (or the interest rate) is therefore largely endogenous and cannot be counted as an independent instrument of stabilization.[9] To quote M. Aglietta:
"Monetary policy is less instrumental or normative but more informative. Indeed, the reflexivity of financial markets must be taken into consideration. The opinion of the financial markets is part of the central bank policy. However, the latter do not make independent statements about the economy. They form expectations about the future actions of the central bank. This strategic game is far more complicated than an optimal control, that is the dynamic control of a mechanical system toward a predetermined target. There is a double trap of over-activism and inertia." (Aglietta, 1999, p. 58).

This change in monetary policy constitutes a radical departure from the previous regime when it was assumed that the central bank had a complete control over its monetary policy. Although this assertion seems to be rather bold for the countries of the European Union, the EU central bank does not appear to behave very differently from the Canadian central bank where it is assumed that fiscal policy is the only instrument that matters for macroeconomic stability. If one looks at any budget speech, one will observe that the few lines devoted to monetary policy are to remind us that the central bank is conducting its monetary policy in complete autonomy. But what does that mean exactly? Does it mean *following the dictates of the financial markets* or *having the capacity of influencing the financial markets?* Knowing that the aim of the Central bank is to avoid surprises in its policy formulation, one has a serious doubt about its ability to lead instead of being led. Moreover, even if one is ready to admit that the Central bank conducts an exogenous moetary policy, is it efficient for macro stabilisation? One could argue that, although financial markets in a particular country are influenced by a large number of economic variables, there are a certain number of foreign exogenous variables such as net exports, foreign interest rate, foreign price and exchange rate which make the domestic interest rate determination largely exogenous, therefore, the monetary policy remains exogenous. A really autonomous monetary policy would command that the

---

[9] See in particular Loranger-Boismenu (2003) for a more elaborate model on that point.

central banker can ignore these exogenous factors and remain totally independent in his choice , which is not the case. Dominant foreign exogenous forces are the negation of the autonomy of the central bank. Only the FED policy can be qualified as an a truly exogenous monetary policy.

The endogenous monetary policy hypothesis is closer to Marx's thinking because central bank interventions did not exist in the XIX century. What is required is a world monetary policy where many other countries in addition to USA have their word to say.[10] Meantime, macroeconomic instability will continue to threaten at the world level. The best examples of this instability are the various crises which occurred in less developed countries: Mexico in 1995, Thailand, Malaysia and Korea in 1997, Russia and Brazil in 1998. [11]

**2.2 Human capital and endogenous technological change**
In his search for a plausible explanation of changes in the growth rates of basic economic variables such as consumption per capita, production and capital accumulation, R. Lucas (1988) was led to postulate the endogenous growth of human capital as the main cause of progress or productivity increase instead of technical changes. He assumed a production function with human knowledge (or human capital) as a distinct production factor from the labor force able to generate increasing returns to scale. Moreover, he assumed that human knowledge is growing endogenously because the labor force devotes, at each period, a certain amount of time to the acquisition of new knowledge or qualification. Other economists have identified this phenomenon learning-by-doing or on-the-job-training. It is interesting to outline that Lucas' definition of one unit of human capital shares some similarity with Marx's definition of one unit of abstract or human labor in general since it is defined as a homogenous quantity of general qualification: an individual can have a level of twice that quantity or half of it. The total qualified labor force effectively devoted to production is the total number of man-hours employed aggregated for each level of qualification. Even if the number of man-hour remains constant, the total qualified labor force is growing over time because the level of qualification is growing. That does not explain why the production function has increasing returns to scale. If human capital or the level of qualification had no spillover effect, the hypothesis of a constant return to scale production function would be acceptable. The mere existence of a certain stock of accumulated knowledge or level of qualification creates a favorable environment as a positive externality for the other productive factors and, hence, on productivity: total productivity increases because the general level of knowledge is increasing. It may seem strange to Marxist economists to admit Lucas' contribution as a complement to Marx's labor value theory. Marx's affirmation is that human labor alone is the source of value creation. Lucas' theory is

---

[10] Aglietta shares a similar viewpoint when he writes that « the monetary policy plays a major role in stabilizing finance and dampening  the crisis periods which make it vulnerable. This policy, well established in the USA and to which Europe will be forced to adapt itself, posesses aims and methods very different from those of the past when monetarism  was characterized by the domination of banks over finance. » (Aglietta,1999, p. 56).
[11] Dumenil-Levy remain optimist in the long-run for capitalism to be able to create adequate stabilization instruments. Referring to their 1996 book, they define tendency instability as a permanent confrontation between innovations and institutional reactions. But in the long-run, macroeconomic stability will prevail.

simply a reformulation of that statement and makes a "qualified labor value theory" more relevant than ever.

P. Romer (1990) develops a similar theory of endogenous technological progress although he uses different wording by introducing new concepts such as rival vs non rival inputs, excludable vs non excludable inputs. In general, inputs used in the production of private goods are rival and excludable inputs while knowledge is a non rival and partially excludable input if, for instance, a design is protected by a patent. If accessible to everybody, then it is a free or public non excludable good. Knowledge or know-how is a distinct productive input and is the source of increasing returns to scale because it grows endogenously with production and its growth is equivalent or assimilated to technological change. It is produced by human capital which can be bought as a specialized labor force in the research and development sector or a labor force on-the-job-training. As already outlined, the stock of (qualified) human capital does not necessarily increase with the increase of population or the labor force. That is most likely the reason why there is no growth in countries with a large population and a weak level of knowledge.

The endogenous growth of productivity is the cornerstone of any Regulationist model. It has been formalized by a linear production function, designated as the Kaldor-Verdoorn law, and, more recently by Lordon (1997), as a non linear function of production under the form of a logistic curve.[12]  It is now time to examine a more formal presentation of the Regulationist approach.

## 3. The political economy of Regulation

Regulation theory is an approach that allows an analysis of the reproduction of the capitalist regime (or its reproduction crisis) given that the economic, social, political, cultural, and religious structures are stable in the mid-term and changing slowly over the long-term. In economics, regulation theory pertains to the field of growth theory and has very little to do with the legal or bureaucratic aspect of regulating an economic sector. The field of analysis is applied to institutional forms that allow the reproduction or the changes of the partial regulations (relations), which characterize a particular regime of accumulation, whether the latter is a competitive regime or any other type. It is a multidisciplinary approach that can be applied to the fields of social sciences and environmental studies instead of being limited just to economics alone. According to R. Boyer (2002, p. 185), the essence of the regulation theory (RT) is

…"to maintain a clear interest for the analysis of historical processes [of capitalism], beyond the attempts of formalization".

### 3.1 The Fordist regime
Therefore, a good contribution should include a growth model of a capitalist regime and some empirical study of its behavior over time. What kind of regime and regime change should we discuss? In the early stages of development of RT in the mid-seventies, there was only one main form of capitalism: the Fordist regime which was considered the best

---

[12] The first economist to have outlined the endogenous thechological change is A. Young (1928).

alternative explanation (compared to the mainstream approach) for the growth of western capitalist economies since the Second World War. M. Aglietta (1976) explained the growth of the US economy and the beginning of its crisis by developing a Fordist approach which is based on five main institutional forms:

1. A wage relation based on an acceptable agreement of sharing the productivity gains between capital and labor;
2. A form of competition in which firms are evolving: oligopoly and monopoly as the dominant form (also described as intensive accumulation);
3. A monetary regime characterized at the national level by credit money which has the virtue of creating money from ex nihilo or produce liquidity at will and, at the international level by a fixed exchange rate;
4. A state intervention in the economy which defines appropriate laws for the labor market, for competition among firms and for stabilization policy ( fiscal and monetary policy);
5. An international insertion in institutions regulating trade ( GATT), foreign investments, aid from the World Bank, fixed and flexible exchange rates closely supervised by the IMF, etc.

**3.2 Toward a new regime**
The Fordist approach and the explanation of its crisis went unchallenged until the mid-eighties but, as outlined by Boyer (2002, table 1), international comparisons between various countries led to the observation of a great variety of institutional forms, trajectories and no particular convergence toward a canonical model or regime. Therefore, RT cannot even predict what kind of regime change is underway since the mid-seventies when a large consensus emerged about a Fordist regime change. B. Jessop (1997) concluded that the RT died with the Fordist crisis. Boyer, who has been one of the main leaders of the approach[13], is now looking at the new institutionalism school called Variety of Capitalisms (VOC), but rejects the idea of a convergence toward a canonical form of capitalism (the US regime). According to the VOC School, the main tenet of which is based on the hierarchical organization of firms, there are only two possibilities: either a capitalist regime converges to a liberal market economy (LME) or to a coordinated market economy (CME). Boyer rejects this too simplified classification and insists that, from international comparisons and historical studies, one can differentiate four forms of capitalism (Boyer, 2002, table 4, pp. 158-159):

1. The market regulation or the Anglo-Saxon model of the market economy (USA, UK, Canada, Australia, New Zealand);
2. The meso-corporatist or managerial form of capitalism where the power of conglomerates is dominant (South Korea, Japan);
3. The social-democrat regulation where the role of social partners is dominant (the Scandinavian countries);

---

[13] The first thinkers of the regulation approach are M. Aglietta (1976), B. Billaudot (1976), R. Boyer (1979), A. Lipietz (1979). For a good retrospective coverage of the regulation theory, see Boyer-Saillard (1995). For a more recent coverage, the reader is invited to read the most recent issues of the annual publication L'Année de la Régulation., in particular, Boyer (2001, 2002)

4. The state form of capitalism where the influence of the state over the economy is dominant (most European Union countries).

However, considering the drastic changes in the international environment which took place since 1990, Boyer seems now ready to admit that there might be a convergence toward a dominant financial market form of capitalism:
"[The Regulationist researches] ...show the internal limits of most forms of capitalism, other than the social-democrat form, but also especially the radical change created by the uncertainties of the international environment, caused by the domination and the impact of financial market capitalisms," (Boyer, 2002 p. 184).

This idea was first outlined by Aglietta[14] and Boyer seems to endorse it fully:
"...the financial market capitalism of the Anglo-Saxon type appears to many analysts (among others Aglietta 1998) as the only viable model, since many reasons seem to support this exclusivity." ( Boyer, 2002, p. 169).
The reasons enumerated are:
1. The dynamism of the US economy and its hegemonic role on real and financial markets;
2. The stagnation of the Japanese economy and the slowdown of the German economy in the 90's;
3. The lack of flexibility of the various European Union economies to adjust to the changing international environment;
4. The Washington Consensus defined by the international institutions such as the IMF, the World Bank, the OECD and WTO concerning the neoliberal regime.

Comparing these causes of change to the 5 institutional forms of the Fordist regime, one can see better the importance of the structural change in the third form (the control of monetary policy) and the fifth form (international insertion and the free movement of capital) as the basic determinants of a regime change. Whatever name is given to that change (neoliberal regime or any other name) has no importance. What matters is the fact that there is a new canonical form of capitalism and the difference between the political economy of regulation and the political economy of Marxism is narrower than ever, because both approaches put financiarization of the world economy at the center of their explanation as the main characteristic of the new capitalist mode or regime. Whether it is profit or wage which is the most relevant variable of the system is not so much important in a model where all these variables are treated together as endogenous. It is now time to present our new formalization which will unfold into two parts:
1. The canonical model
2. The dynamic econometric model.

## 4. A new heterodox model

### 4.1 The canonical model

---

[14] It goes without saying that this idea was circulating since the mid 90's but was unpublished. See for instance Loranger (1995).

First, we will start  by developing a Fordist (Regulationist) model and then a certain number of hypotheses will be relaxed in order to develop a more hybrid model integrating Regulationist and Marxian features. In the fourth part of his book, Billaudot (2001) develops the macroeconomic theory of Fordism, of its crisis and issue. More specifically, chapter VIII on regulation and growth contains a short-term and a long-term model, the latter being designed by Billaudot as a mid-term model, because of his preference to reserve the long-term period for structural changes in the regime. Nine behavioral equations, one equilibrium condition and three definition relations characterize the Fordist model (see Table 1)[15]. The endogenous variables described by the behavioral equations are productivity, employment, wage, price, consumption, investment, the rate of investment obsolescence in the gross stock of capital, the money demand and the interest rate. The endogenous variable pertaining to the macro equilibrium condition is that aggregate supply equals the components of the aggregate demand, i.e. consumption and investment, and the government expenditures that are lumped with autonomous consumption. Variables pertaining to the definition relations are the financial profitability norm, the profit rate, and the gross stock of capital. When an equation has a different specification in the competitive regime compared to the Fordist regime, its specification appears in a *nota bene* immediately below the Fordist equation. Most equations have a non-linear form but are easily adaptable to a log-linear form which is readily suitable for a growth model in an Error Correction Model.

**1) The productivity equation:**      $Y/E = f_1(Y, K/E, H, TU, t)$

Productivity in the short-run depends on the scale of the economy (Y), on technical changes embodied in new equipment, in the new technical division of labour (K/E), on the reduction of the average length of the labour period H and on the degre of capacity utilization (TU). The main justification for an endogenous productivity (or endogenous technological progress) is based on the Kaldor-Verdoorn law or the hypothesis of an increasing-returns-to-scale production function because the level of knowledge is increasing over time. This could be justified by the expenditure that the private and the public sectors spend on research and development in each period. A third justification would be the amount of state expenditures in the education and health sectors. Indeed, the quality of human capital is not only in the level of education but also in the quality of the health services a country has developed. The other determinant of productivity is the capital/labor ratio which embodies innovations and a new division of labor. Some Regulationists (Billaudot) assume that this variable is constant in the mid-term, showing capital and labor growing at the same rate. If this hypothesis is rejected and it is assumed instead that this variable changes stochastically in order to simulate the Schumpeterian innovation process, ( a hypothesis closer to Dumenil-Levy), then the variable contains a random error component which will make the model closer to a Marxian trajectory, not to mention that it could also fit  the real business cycle approach. However, in the mid-term equilibrium period, if productivity depends solely on the growth rate of potential output and full employment, it is assumed that the degree of capacity utilization and the unemployment rate are fully adjusted to the desired level and are constant. The relaxation

---

[15] The geometric or log form of the behavioral equations in Table 1 are not Billaudot's specification, neither are the last two equations  concerning money and the financial sector.

of the constancy of the structural unemployment rate in the mid-term would be equivalent to a Keynesian under-employment equilibrium. The relaxation of the constancy of the degree of capacity utilization would be closer to a Kaleckian equilibrium.

**2) The employment equation:** $\quad$ E $= f_2(TU, t)$

Employment in the short-term is a function of the desired mid-term level of (full) employment and the productivity gap observed in the previous period[16]. The productivity gap depends on the degree of capacity utilization of the previous period, and hence, employment in the short-run is a direct function of the degree of capacity utilization (TU). However, in the mid-term, since the latter is assumed fully adjusted to the desired level and, therefore, constant, the mid-term equilibrium employment is growing at a constant rate.[17]

**3) The wage rate equation:** $\quad$ w $= f_3(p, Y/E, TU, u, t)$

In the Fordist model, the short-run wage is a positive function of price (p), productivity (Y/E) and the degree of capacity utilization (TU) and a negative function of the degree of unemployment (u)[18]. Since the capacity utilization is fully adjusted in mid-term, the equilibrium wage depends only on price, productivity and the unemployment rate. If one assumes that the labor market is fully adjusted in the mid-term, like Billaudot does, then the mid-term equilibrium real wage is growing at the same pace as productivity if prices and wage are growing at the same pace. This is a standard mainstream result which is also arrived at by Dumenil-Levy (1996, p.236). Note that, in the competitive model, the short-term wage depends positively on the number of hours worked and the degree of employment. Since the number of hours worked is assumed fully adjusted in the mid-term, the equilibrium wage is a positive function of employment, therefore, a typical Phillps' curve which would be vertical in a mid-term equilibrium. Because of the persistence of a long-term rising tendency of the unemployment rate, the hypothesis of a fully adjusted labor market with a vertical Plillips curve is rejected by most heterodox economists. Therefore, our wage equation will contain the unemployment rate as an exogenous variable which will reflect this mid-term disequilibrium of the labor market.

**4) The price equation:** $\quad$ p $= f_4(w, \rho, Y/E, Y/K, TU)$

In the Fordist model, the short-term price is a function of the price level in the competitive sector and in the monopoly sector. The short-term price in the competitive sector is a positive function of the degree of capacity utilization (TU) while the mid-term

---

[16] Here as well as in other equations, the reference to a previous period can mean many past periods in a model of error correction which is a VAR of order k where k is the number of lagged periods.

[17] In the Dumenil-Levy, employment E is growing at a constant rate determined by the exogenous growth rate of the technological progress.

[18] The power of disciplining the labor force is eroded when employment and the degree of utilization of capacity are increasing towards their normal or potential level.

equilibrium price is constant. The short-term price in the monopoly sector is far more complicated. It depends positivelyon the current wage-productivity gap (w/(Y/E)), on a financial profitability criterion (ρ), and on a factor that is supposed to reflect the state of the demand measured by a price-productivity gap of the previous period $(p/Y/K)_{-1}$ . The wage-productivity gap can be viewed as a proportionnality relation between the real wage (w/p) and productivity (Y/E).  The financial profitability criterion is a ratio between the interest rate adjusted for a risk factor and the profit rate ρ=(i/r). If this ratio is too high because of either a thight monetary policy or an increase in the risk premium, firms will try to catch up by rising their price in order to increase their profit rate. This means that a rise in the financial cost will push up the price and, hence, the profit rate. Therefore, a positive relation between price and the financial profitability criterion is expected. Similarly, a decrease of the profit rate will rise the profitability criterion and will cause a price rise which will feedback on the profit rate.Billaudot assumes that the productivity of capital and the profitability criterion are stable  in the mid-term period and, therefore, the equilibrium price depends only on wage and productivity. If the constancy hypothesis of the profitability criterion is relaxed, the regime becomes much closer to the present day explanation of an overwhelming power of financial markets on the economy. Price and, hence inflation, would be positively related to the nominal interest rate and negatively related to the profit rate. *Therefore, the real wage would be positively related to the profit rate*. It can explain why a positive relation is observed between real wage and profit as outlined in the Dumenil-Levy empirical finding (D-L, 1996, p. 221-222 )[19].

The emergence of the profit rate into the price equation is rather unexpected from  the Dumenil-Levy approach since they remain completely silent about the price level and their approach implicitly assumes that inflation is not a problem to be analysed explicitly. Their implicit assumption is that the price movement is well co-integrated with the wage variable and any other nominal variables such as money or the nominal interest rate. If it is a reasonable assumption to be made with the wage rate and the money stock, it is far less obvious with the interest rate.

**5) The consumption equation:**       $C = f_5(E, w, p)$

The consumption is a function of direct income, i. e. employment, and the real wage. In a previous empirical work (Boismenu-Loranger-Gravel, 1995) it was assumed that consumption was also dependent on credit and indirect income received as transfer payments. This equation constitutes one of the basic tenets of RT: the growth of the system is generated by the growth of demand which is dependent on the growth of the real wage rate. As already mentioned previously, this constitutes a major departure with the Dumenil-Levy model where the engine of growth is supply oriented and centered on the profit rate which is determined by the rate of growth of exogenous technological changes. The difference however is not as great as it looks once the real wage rate

---

[19] In chapter 16, D-L decompose into three components (short-term, long-term and historical tendency) the fluctuations of the wage rate and the profit rate series of the US economy over more than a century. The profit rate is positively correlated with the wage rate in the short-term period, negatively correlated in the long-term but,again, positively correlated with the historical tendency which is represented as a moving average over the whole period (1869-1989). Once the short-term fluctuations have been eliminated from the series, the long-term fluctuations are measured as variations around the historical tendency.

equation is substituted into the consumption equation. Consumption then becomes a (negative) function of the profitability criterion that contains a profit rate component and a positive function of (endogenous) productivity. The wage growth has been less important than profit growth over the last twenty years and, therefore, more importance need to be given to another component of aggregate demand, the investment function, since, according to the old saying, "past profits are tomorrow's investments".

**6) The investment equation:** $\qquad I = f_6(C, \rho, TS)$


There is an important difference between the investment function in the competitive regime and in the Fordist regime. In the competitive regime, investment is a positive function of past profits, with obsolete investment (TS) removed from the gross stock of capital, and of the degree of capacity utilization(TU)[20]. Since the last two variables are constant in the mid-term, the competitive equilibrium investment is solely a function of past profits. This is the type of assumption also made by Dumenil-Levy: the rate of investment or the capital stock growth rate is a linear function of the profit rate.
In the Fordist regime, investment is a positive function of past levels of consumption (C) and the obsolescence rate (TS) of the gross stock of capital. It is a negative function of the financial profitability criterion ($\rho$). Assuming that the obsolescence rate is constant in the mid-term, the profitability criterion makes this equilibrium investment function close to an IS curve. Indeed, the decomposition of the profitability criterion makes on one hand investment a negative function of the interest rate and on the other hand a positive function of the profit rate. We therefore obtain the Marxian Dumenil-Levy profit rate relation, the Regulationist demand pull effect with past consumption, and a typical pseudo-Keynesian IS curve between investment and the interest rate.

**7) The capital obsolescence equation:** $\qquad TS = f_7(TU)$

In the competitive regime, the obsolescence rate of the gross stock of capital is an exogenous variable measuring the degree of obsolete investment removed from the gross stock of capital. In the Fordist regime, the obsolescence rate is a positive function of the degree of capacity utilization since the short-run increase of production induces firms to plan for an accelerated obsolescence of equipments (Aglietta, 1976). However, this last variable is constant in the mid-term, and the obsolescence rate of the gross stock of capital is constant when the system is in equilibrium. It should be noted that, in all these equations, if the capacity utilization is a key variable in the short-term, its influence vanishes in the mid or long-term where the system is in equilibrium. That explains why this variable does not appear into any co-integration relation. The Regulationist approach outlined here substantially differ from the post-Keynesian growth models where the degree of capacity utilization plays a major explanatory role.[21]

**8) The money and interest rate equation:** $i/i^* = f_8 \{(IM/X), (e), (p/p^*)\}$

---

[20] In the short-run, the sign of the coefficient of capacity utilization could be positive because of the positive effect of a wage increase on the aggregate demand. However, in the long-term, the wage increase will reduce the profit rate and that will feedback negatively on investment.
[21] See in particular Lavoie-Rodriguez-Seccareccia (2002).

The money supply is assumed endogenous to the money demand which is is a positive function of transactions (i.e. price and output) and a negative function of the interest rate. The interesting question here is to specify how the interest rate is determined endogenously. The endogenous character of the interest rate is determined directly through price and indirectly through output via the exchange rate which can be substituted for the external trade balance. This is different from the mainstream assumption of an exogenous money supply. The choice of fixing the short-term interest rate must be done within the following constraints:

- The short-term interest rate is regulated by the balance of payment constraint which is defined as the zero sum of the current account and the capital account. Therefore, a positive capital account balance must have the opposite sign of the current account balance, i.e. is equal to the current account deficit.[22]
- The capital account is assumed to be a positive function of the interest rate differential (i/i*), -foreign capital is attracted by a higher domestic rate and, therefore, the current account deficit is positively related to the interest rate differential-.
- The capital account is a negative function of the nominal exchange rate e - a money devaluation increases exports, reduces the current account deficit and therefore is negatively related to the interest rate differential-. With a flexible exchange rate, the central bank has no obligation to raise the domestic interest rate. The choice between devaluation and a rise of the interest rate is the cornerstone of its "independence". For a long time, the policy rule of the Bank of Canada has been based on a monetary index which is some weighted average of the short-term interest rate and the exchange rate. Note also that, contrary to many monetary policy rules, these rates are nominal instead of real rates.
- The capital account is positively related to the price differential (p/p*) – inflation increase the current account deficit by deteriorating the terms of trade and, hence, is positively related to the interest rate differential.- This variable, combined with the nominal exchange rate defines a measure for the real exchange rate $e_r$. Indeed, by definition, $e_r = e(p^*/p)$. If the capital account function CA or the current account deficit (IM/X) is explicited with respect to the interest rate differential (i/i*), the equation is

$$(i/i^*) = A(IM/X)^\alpha [e(p^*/p)]^{-\beta} = A(IM/X)^\alpha e^{-\beta} (p/p^*)^\gamma, \text{ where } \alpha, \beta \text{ and } \gamma > 0. \text{ [23]}$$

One can see that the central bank has little autonomy in determining its monetary policy. The optimal policy would be to accommodate the demand for money inside those constraints. According to Taylor's historical analysis (2001b), this has been the policy rule followed by the Treasury at the time of the international gold standard and it has remained more or less like that after the Second World War until the end of the 60's.

 The central bank's reaction function assumed here is of a rather different type from the one usually specified for a closed economy. The target interest rate taken here is the foreign interest rate. The target inflation rate can be identified with the foreign inflation rate. The target growth rate of output is the growth rate of external demand (imports and exports). It is the  exchange rate variation which gives to the central bank the flexibility to conduct an independent monetary policy. Therefore, one can introduce a target exchange rate as a substitute for a target output as a monetary policy choice and substitute directly the exchange rate into the aggregate production-demand equation. The simultaneous link between the interest rate equation and production is therefore more obvious because the financial criterion, which enters the price equation and also the aggregate demand, contains the interest rate and the latter is a function of price.[24]
Note that, in an Error Correction Model, all equilibrium variables are measured in level instead of growth rate. However, since all our variables are log-transformed, the short-term variations measured by first differences in the VAR model are growth rate variables. Therefore, in the short-term, the monetary policy is dominated not only by the inflation rate and the growth rate of the other endogenous variables such as aggregate output but also by the growth rate of the other (exogenous) variables which characterize an open economy.

The central banker has always the possibility to change or abandon the rule and let the exchange rate plays its role of a shock absorber,  but the Governor of the central bank is continuously repeating that one of his main tasks is to maintain the confidence of the business community and avoid creating shocks or surprises. In these conditions, *the monetary policy is put into an endogenous state or a non autonomous state, that is the central banker refuses to lead and becomes dependent of the financial markets*. This is the reason why the Minister of Finance has so little to say about monetary policy when he presents the economic policy. He speaks a lot about fiscal policy, free trade and the restructuring of the economy, namely the need for labor market flexibility, but remains almost totally silent about the monetary policy. It is as if it is irrelevant! In a dominant economy such as found  in the USA, it can always be argued that the FED's monetary policy is relatively independent from all these foreign variables and that the FED  will give the proper signal to the rest of the world. However, in the mid or long-term period, even the FED must consider the growing deficit of the current account balance and

---

[24] Ball (2001) is one of the rare economists at the NBER Conference who specifies a three equation model for an open economy: an output, a price and an interest rate equation where the exchange rate variable appears in each equation. He deducts his monetary policy rule after substitution of the output and the price equations into his interest rate equation. Although our Regulationist approach is quite different from his three equations, nothing forbids us to make appropriate substitutions in order to have a similar result with the output expressed as a function of the interest rate and the exchange rate, the (relative) price equation a function of output and the exchange rate and the interest rate a function of the price and the exchange rate.

increase the interest rate unless it is agreed that the dollar should fall. Again, the corner stone of independence is the flexible exchange rate.

## 4.2 The dynamic econometric model

The general representation of a dynamic structural model is by a differential equation of the first order (or of a higher order) such as

$$y' = f(y; \beta)$$

where $f(y;\beta)$ is an unknown function. If y is a function of time, then y' measure the rate of change of y over a time period, $\beta$ is a structural parameter that is usually assumed constant over a mid-term period, although it may also be assumed to change slowly over a long-run period. In that case, $\beta$ is also a function of time. The structural stability of the system is not the same concept as the stability of a particular solution of a differential equation. By solving a differential equation, one can look to the conditions which guarantee a stable or convergent solution over time. This depends on the set of particular values of the structural parameters and initial conditions. This may be an interesting exercise achievable with a growth model of one or only a few equations, once the value of parameters have been properly estimated or specified otherwise. One can check the stability of the growth model by verifying if all variables have the same growth rate or converge to different growth rates.

However, this is not our main preoccupation in studying macroeconomic fluctuations with a Regulationist or Marxist structural model by using advanced econometric tools. The model that will be specified and estimated from time series of quarterly Canadian data is a structural dynamic simultaneous system that sometimes have more than half a dozen equations. [25] The model will be linear in its parameters, the variables will be in log-transform in order that the first difference of a variable will measure its rate of growth. Time will be measured in discrete periods as its suits a quarterly representation, the order of the difference equations will vary between 6 to 8 periods, because sometimes it takes 6 to 8 quarters before the effect on a variable is fully adjusted (for instance the effect of a change of monetary policy or a change in the interest rate on the economy). Each equation will be supplemented with a stochastic term which is related to a stationary condition. Because it is always easier to understand a single equation system, let us introduce a difference equation of order k:

$$z_t = \beta_0 + \beta_1 z_{t-1} + \beta_2 z_{t-2} + \ldots\ldots + \beta_k z_{t-k} + \varepsilon_t$$

Now, if one assumes that the system has p equations, it is almost the same representation except that each $z_{t-i}$ is a px1 vector and each coefficient is a pxp matrix.

$$z_t = \beta_0 + A_1 z_{t-1} + A_2 z_{t-2} + \ldots\ldots + A_k z_{t-k} + \varepsilon_t$$

This system is called a VAR or vector autoregressive model of order k. $\beta_0$ and $\varepsilon_t$ are also px1 column vectors. The econometrics of time series[26] requires as a condition for a

---

[25] A first econometric model was published (Boismenu-Loranger-Gravel, 1995) in order to explain and apply a Fordist regime to Canada. The model was estimated by three stage least squares and the sample was subdivided into three sub-periods in order to test for structural changes in parameters.

[26] The reader interested to know more about the econometrics of time series should read Hamilton (1994)

stationary stochastic term $\varepsilon_t$ that each element of the vector z must be integrated of order 0, i.e. I(0), which means that the system has no unit root and each difference equation is a stationary linear combination of terms. However, the reality is that some if not all the observed series are non stationary in their level of observation, i.e. they are I(1), which implies that the system has some unit roots. It is only by measuring them in their first differences that most of the time a stationary state can be achieved. This transformation is essential if one wants to arrive at unbiased estimated results by least square methods. Since econometric interdependence between the stochastic term of each equation is postulated, one has to choose an appropriate method of estimation. Our choice is based on the Hansen-Juselius method of estimating an Error Correction Model which has the following econometric form:

$\Delta z_t = \mu_0 + A_1 \Delta z_{t-1} + A_2 \Delta z_{t-2} + \ldots\ldots + A_k \Delta z_{t-k+1} + \Pi z_{t-k} + \varepsilon_t$
$\Delta z_{t-i}$ is the first difference of z at time t-i

$\Pi = \boldsymbol{\alpha\beta'}$

$\Pi$ is a pxp impact matrix, $\boldsymbol{\alpha}$ is a pxr adjustment matrix and $\boldsymbol{\beta'}$ is a rxp co-integration matrix. The ECM assumes that there is a certain number of co-integration relations between the variables of the system represented by $\boldsymbol{\beta'}z_{t-k}$. The number of co-integration relations is the number of stationary linear combinations that can be formed with the variables of the system, although each of them may not be stationary when taken individually. Note that the structural relations $\boldsymbol{\beta'}z_{t-k}$ are equilibrium relations in the mid-term and the matrix $\boldsymbol{\alpha}$ measures the speed of adjustment toward this mid-term equilibrium. The algebraic form of a particular co-integrated or equilibrium relation is in the case of the first relation

$$z_1 - \beta_{21} z_2 - \beta_{31} z_3 - \ldots\ldots - \beta_{p1} z_p = \varepsilon.$$

Note that the first coefficient has been standardised to 1. Since the number of co-integration relations is less than the number of structural equations, the identification between the two sets becomes impossible unless more information is supplied and imposed on the $\boldsymbol{\beta}$ matrix.

The short-term effect is represented by a difference equation system of order k-1 where the variables of the vector autoregressive model are measured by their first differences (or growth rate if the variables have already been measured in log-transform). The system is said to be structurally stable if the matrix of structural parameters $\boldsymbol{\beta}$ is constant while the state variables are growing over a time horizon. The system will encounter a structural change if one or more parameters of the $\boldsymbol{\beta}$ matrix are changing over time, i.e. $\boldsymbol{\beta = \beta(t)}$. RATS-CATS is a software package which allows the estimation of all the structural parameters and also some tests for the structural change of $\boldsymbol{\beta}$. What about the other parameters in the matrix $A_i$ and the constant vector $\mu_0$? They represent the short-term structure which, by assumption, is constant. The introduction of a sub-set of exogenous variables in the long-run relations or co-integration relations is a particular way of dealing with structural changes since the value of these variables is changing in the mid-term period. They are stochastic common trend variables. If they are excluded from the co-integration relations, they can still be specified explicitly as deterministic trend variables or fixed predetermined variables the influence of which matters only in the short-run or they can be buried into the constant term and one could test for a

structural break from the constant term. One way to test for weak exogenous variables in the co-integration relations is to constraint the matrix $\boldsymbol{\alpha}$ and test how sensitive or different are the coefficients of matrix $\boldsymbol{\beta}$. It is now time to turn to the empirical estimation of various canonical forms of the structural model of the Canadian economy.

## 5. Econometric results : the productivity-demand model

The software package CATS/RATS allows us to conduct some preliminary tests about long-run exclusion, stationary and weak exogenous variables. With a small number of stochastic variables ( 8 or less ), there are some variables such as the average length of the labor period H or the capital-labor ratio K/E which can be excluded from the long-run relations or the co-integration space. With a larger number of stochastic variables and a larger number of co-integration relations, the number of exclusions tends to disappear or is replaced by key variables such as wage or productivity which are at the heart of our explanation. It might be important to remember the word of caution stated by Hansen and Juselius (1995, page 640 …"a highly relevant variable can get an insignificant test value as a result of strong multicollinearity with other variables". Bearing that in mind, we proceed to the interpretation of the other test results. With the number of co-integration relations r varying between 1 to 9, there is no stationary variable: all stochastic variables are integrated of order 1 or to a higher order. This result has already been confirmed in another study (Loranger-Boismenu, 2003) by individual tests of the Dickey-Fuller type. The test of weak exogenous variables is accepted for certain variables such as the exchange rate or the foreign interest rate for r =5 but is rejected for a higher number of co-integration relations. Finally, even if the full effect of a monetary policy change can be spread over two years, we decided to limit the order of the VAR (or the short-term influence) to 6 quarters. This restriction become essential if one wants to use the CATS recursive option in order to test for the beta constancy over the most recent period.[27]

The relevant equations that characterize the productivity-demand model are the followings:

$$Y/E = f_1(Y, K/E, H, TU, t)$$
$$Y = g( C, I, G, X, IM)$$
$$C = f_5(E, w, p)$$
$$I = f_6(C, \rho, TS)$$
$$w = f_3(p, Y/E, TU, u, t)$$
$$p = f_4(w, \rho, Y/E, Y/K, TU)$$

After substitution of p and w into C and the latter into I and both into Y, the demand or aggregate output equation[28] is

---

[27] Even if the greatest impact is felt over the first three periods, as it will be seen by the short-term analysis, it is important to specify three more lagged endogenous variables in order to take into account the possibility of autocorrelated disturbances.

[28] It is assumed throughout the empirical tests that aggregate output equals aggregate demand since there is no inventory adjustment variable.

Y = g( Y/E, G, X, IM, u, ρ, Y/K, TU, TS, t)

In a first difference log model, the constant term is the coefficient of the constant rate of growth of the dependent variable. Therefore, there is no point in specifying more explicitly the trend term t either in the productivity or the demand equation. Although the preliminary tests did not reveal any particular indication to exclude TU and Y/K, in order to keep the number of stochastic variables to a minimum, it has been decided to assume that K/E, H, Y/K, TS and TU are predetermined or fixed variables having influence only in the short-term period. We also introduced a one period lag for each of them. However, it was necessary to exclude the Y/K variable from the system because of its too close correlation with Y/E.[29] Therefore, the stochastic model include 7 endogenous variables: (Y/E, Y, G, X, IM, u, ρ) and 8 predetermined variables (TS, TU, H, K/E) and (TS, TU, H, K/E)$_{-1}$ . Since the rank test is no more valid for a sub-model (because of the predetermined variables), the estimated model was done by specifying two co-integration relations, which means that G, X, IM, u and ρ are common stochastic trend variables. They act as disturbing shocks on the equilibrium of co-integration relations. By imposing 0 a priori restrictions on coefficients in each equation, we examine two types of specification for the aggregate demand.

**5.1 Estimated long-term relations**

Table 1
Results of the constrained BETA matrix (or co-integration space)
of the productivity-demand model

| LY/E | LY | LG | LX | LIM | LU | LRHO |
|---|---|---|---|---|---|---|
| 1.000 | -0.154 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| .154 | 1.000 | -0.926 | -0.613 | 0.426 | -0.368 | 0.256 |

| ALPHA | | T-VALUES FOR ALPHA | | | |
|---|---|---|---|---|---|
| DLPRE | -0.319 | -0.034 | -3.560 | -2.643 | |
| DLY | -0.308 | -0.027 | -3.400 | -2.112 | |

N.B. L = ln or natural log, D = Δ or the first difference operator. The Student t values are valid only asymptotically.

ΔlnY/E =  -.319(lnY/E - .154lnY) - .034( lnY +.154lnY/E - .926lnG - .613lnX + .426lnIM - .368lnu + .256lnρ)

ΔlnY = -.308(lnY/E - .154lnY)  -.027( lnY +.154lnY/E - .926lnG - .613lnX + .426lnIM - .368lnu + .256lnρ)

---

[29] The inclusion of the Y/K variable among the set of predetermined variables would remove the significance of the Y/E as a meaningful variable in the long-run stochastic model.

A constant term should be included into the co-integration relations but the assumption here is that the variables contain linear trends outside the co-integration relations. That is the reason why the empirical results about the constant term are presented with the short-term analysis.[30] Note that the long-run results are presented in terms of a disequilibrium or error in the short-term equations. Therefore, the signs of the long-run coefficients have to be read with the opposite sign. The positive sign of the demand level coefficient (.154) in the productivity equation is a vindication of the Kaldor-Verdoorn law of increasing returns due to the level of knowledge. This is a clear illustration of the importance of the endogenous technical progress in the long-run relation.

The negative sign of the productivity level coefficient (-.154) in the demand equation is more a validation of the Marxian approach  as specified by  Duménil-Lévy than the Regulationist approach. Indeed, it is assumed by the regulation theory that there exists some proportionnality between productivity and wage. Therefore, if consumption and, hence aggregate demand, is pushed by real wage, the productivity coefficient ought to be positive. Moreover, the negative sign for the profitability criterion is another confirmation of the validation of the IS-LM and Marxist approaches over the Regulationist approach: aggregate demand is sensitive to the interest rate and to the profit rate. It is also an illustration of the relevance of financiarization as a fundamental characteristic of the neoliberal regime. . However, the fact that the coefficient of the unemployment rate is positive is an indication that the labor market does not correspond to the long-run Phillips curve: the labor market is not in equilibrium in the long-run. Note also that the impact of u and $\rho$ is greater than the long-term influence of Y/E.

Turning now to the other stochastic tendencies represented by (G, X, IM), they all have the right expected sign. It is important to include these variables in the co-integration space, otherwise, any change in these variables could be reflected by a structural break of the constant. Note that the size of their elasticity coefficient is more important than the size of the productivity coefficient or the size of the other two common stochastic trends. It is a clear indication that fiscal policy and external trade are the most important influences for convergence or divergence toward an equilibrium value.

Before discarding too quickly the Regulationist approach, it is important to run a second test of the long-run demand by introducing  real wage rate instead of  productivity. With this exactly identified model with respect to the number of cointegration relations, the Hansen-Juselius estimator gives the standard error matrix of the beta coefficients.

Table 2
Results of the constrained BETA matrix (or co-integration space)
of the productivity-demand model with real wage

| LY/E | LY | LW/P | LG | LX | LIM | LU | LRHO |
|---|---|---|---|---|---|---|---|
| 1.000 | -0.315 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.000 | 1.000 | 0.480 | -0.844 | -0.460 | 0.355 | -0.227 | 0.162 |

"STANDARD ERRORS" FOR BETA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.034 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

---

[30] The role of a constant term in the co-integration relations could be assimilated to some target or normal levels toward which the two stochastic variables converge in equilibrium.

0.000    0.000    0.256    0.118    0.095    0.091    0.046    0.030

Here again the coefficient of the real wage is negative but not significantly different from 0 since its size is less than twice the size of its standard error. All the other coefficients are significant and, in particular, the profitability coefficient is negative as expected by the mainstrean and Marxist approach. Moreover, by substituting directly the real wage in the demand equation, one should expect that the coefficient of the unemployment rate should be negative since there is a direct link between consumption and employment ( or unemployment). The fact that the unemployment coefficient is positive and significant is a rather severe blow to the regulation approach based on the hypothesis that mass consumption is the engine of growth of aggregate demand. The choice of standardisation of each cointegration relation to a particular variable is not influencing this conclusion since we also tried to identify the demand relation with the first cointegration relation and similar results were obtained.

## 5. 2 The short-run influence of long-run relations and of predetermined variables

There is no particular interest to reproduce the full matrix for ALPHA since our attention is focused on the first two endogenous variables. Since each column of alpha represent the influence (or speed of adjustment) of the disequilibrium of each co-integration relation on the productivity and demand change, it is observed that the disequilibrium of first co-integration relation identified to productivity has a rather strong influence compared to the second one. It means that output adjusts more rapidly toward its equilibrium value (potential output) than productivity. Indeed, its adjustment coefficients (-.034 and -.027) are near 0 in both short-run equations while the adjustment coefficients for productivity are (-.319 and -.308).

Table 3
Estimated results of the coefficients of predetermined variables

| LTS | LTS1 | LK/E | LK/E1 | LH | LH1 | LTU | LTU1 |
|---|---|---|---|---|---|---|---|
| 0.000 | -0.002 | 0.920 | -0.765 | -0.046 | -0.016 | 0.664 | -0.502 |
| -0.002 | -0.002 | -0.077 | 0.226 | -0.033 | -0.010 | 0.681 | -0.511 |
| | | | t-values | | | | |
| 0.028 | -0.785 | 9.619 | -6.931 | -0.396 | -0.142 | 6.981 | -5.005 |
| -1.152 | -1.001 | -0.797 | 2.033 | -0.279 | -0.085 | 7.087 | -5.049 |

| SEA(1) | SEA(2) | SEA(3) | CONST |
|---|---|---|---|
| 0.004 | -0.028 | -0.026 | -0.833 |
| 0.004 | -0.030 | -0.026 | -0.913 |
| | t-values | | |
| 0.244 | -1.735 | -1.640 | -1.783 |
| 0.227 | -1.819 | -1.598 | -1.936 |

N.B. SEA is for seasonal variation

Turning now to the short-run impact of the other exogenous variables outside the co-integration space, it is observed that productivity is a positive function of the short-term level and change in the capital/labor ratio and in the degree of capacity utilization since the coefficients for the current and first lagged periods are both significant according to the t value. Note in passing that the average time worked per period (H) and the capital allowance (TS) are not significant in any equation. The assumption made by Marxists as well as neoclassical economists about exogenous technical progress embodied in the capital/labor ratio has some empirical foundation in the short-run since the elasticity of productivity change with respect to change in the capital/labor ratio is rather high (.765). The results could be rewritten as

$$\Delta lnY/E = .155\ lnK/E + .765\ \Delta lnK/E + .162\ lnTU + .502\ \Delta lnTU - .833.$$

As outlined by Marxists as well as by post-Keynesian economists, the change in the degree of capacity utilization is a key variable in the short-run with an elasticity of .502, but it has been kept constant in the long-run (i.e. outside the co-integration space) because it is assumed to be fully adjusted to its normal level in the long-run. In conclusion, productivity in the short-term is more influenced by short-term exogenous variables than by long-run disequilibria. Note also the downward productivity trend measured by the negative constant (-.833). This is fully in accordance with the empirical observation about the productivity trend since the golden age of the 60's.

A similar short-term influence is also observed for the demand equation: the level of the capital/labor ratio of the previous period and the current level and change in the degree of capacity utilization are significant at the 5% level. This result also vindicates the key role of the capacity utilization in the short-run growth rate of output, a key role that Lavoie-Rodriguez-Seccareccia (2002) would like to assume for the long-run as well. The short-term results can be re-written as

$$\Delta lnY = .226\ lnK/E_{-1} + .170 lnTU + .511\ \Delta lnTU - .913.$$

Note also that the current influence of the capital/labor ratio is not significant: only the level of the previous period seems to matter with an elasticity of .226, a value nearly as important as the coefficient of the productivity variable. The capacity utilization variable has approximately the same impact on the short-run changes of output as it has on productivity changes. Note also that the constant is negative (-.913) and, hence, reflect a slower growth rate trend since the golden age of Fordism in the 60's. All in all, these results show that the most important effect in the short-run is not the disequilibria of the long-term relations but the impact of the level and change in the capital/labor ratio and the capacity utilization.

**5. 3 The short-run dynamics of lagged dependent variables**

Let turn now to the results of short-term influence of the change of lagged dependent variables. Since the order of the VAR chosen is 6, there are for each stochastic variable 5

changes to be analysed. Again, by concentrating only on the first two equations related to DLY/E and DLY, only the first two lines of the GAMMA matrices will be presented with their Student t values.[31]

Table 4
Estimated short-term influence of the change of lagged dependent variables on productivity and demand

Time: t-1

| DLY/E | DLY | DLG | DLX | DLIM | DLU | DLRHO |
|---|---|---|---|---|---|---|
| -0.024 | -0.470 | -0.053 | 0.020 | 0.096 | -0.036 | 0.009 |
| -0.026 | -0.484 | -0.053 | 0.021 | 0.098 | -0.036 | 0.009 |
| t-values | | | | | | |
| -0.339 | -4.459 | -1.387 | 0.523 | 2.329 | -2.224 | 0.868 |
| -0.354 | -4.554 | -1.384 | 0.550 | 2.349 | -2.232 | 0.821 |

Time: t-2

| DLY/E | DLY | DLG | DLX | DLIM | DLU | DLRHO |
|---|---|---|---|---|---|---|
| -0.101 | -0.247 | 0.027 | -0.004 | 0.045 | 0.001 | 0.025 |
| -0.102 | -0.261 | 0.022 | -0.007 | 0.045 | 0.003 | 0.024 |
| t-values | | | | | | |
| -1.420 | -2.111 | 0.709 | -0.089 | 1.055 | 0.107 | 2.366 |
| -1.433 | -2.210 | 0.581 | -0.171 | 1.052 | 0.218 | 2.263 |

Time: t-3

| DLY/E | DLY | DLG | DLX | DLIM | DLU | DLRHO |
|---|---|---|---|---|---|---|
| -0.030 | -0.308 | 0.018 | 0.060 | -0.071 | -0.020 | 0.004 |
| -0.031 | -0.322 | 0.014 | 0.056 | -0.070 | -0.019 | 0.004 |
| t-values | | | | | | |
| -0.438 | -2.850 | 0.479 | 1.481 | -1.931 | -1.408 | 0.355 |
| -0.450 | -2.959 | 0.383 | 1.382 | -1.883 | -1.294 | 0.338 |

Time: t-4

| DLY/E | DLY | DLG | DLX | DLIM | DLU | DLRHO |
|---|---|---|---|---|---|---|
| -0.067 | 0.332 | -0.004 | 0.012 | 0.004 | -0.003 | 0.002 |
| -0.069 | 0.323 | -0.007 | 0.008 | 0.012 | -0.002 | 0.001 |
| t-values | | | | | | |
| -1.069 | 3.378 | -0.111 | 0.302 | 0.093 | -0.197 | 0.157 |
| -1.095 | 3.255 | -0.203 | 0.190 | 0.300 | -0.139 | 0.110 |

Time: t-5

---

[31] There is no interest to carry a Granger-Sims causality test because most of the short-term coefficients are not significant and a Granger-Sims test would necessitate the re-estimation of the model with other a priori short-run restrictions, which is neither the aim of this paper nor within the possibility of the RATS-CATS package. It should be remembered that the justification for 5 lagged differences is to cope with the short-tems influences and the autocorrelation problem linked to lagged endogenous variables.

| DLY/E | DLY | DLG | DLX | DLIM | DLU | DLRHO |
|---|---|---|---|---|---|---|
| -0.027 | 0.114 | 0.104 | 0.031 | -0.035 | 0.008 | 0.008 |
| -0.028 | 0.107 | 0.101 | 0.027 | -0.030 | 0.010 | 0.008 |
| t-values | | | | | | |
| -0.569 | 1.360 | 2.814 | 0.841 | -0.967 | 0.533 | 0.744 |
| -0.571 | 1.269 | 2.698 | 0.725 | -0.817 | 0.684 | 0.741 |

Although the t values are valid only asymptotically, they can be an indication of the short-term influence of the stochastic variables on the two main dependent variables DLY/E and DLY. What is remarkable is that the latter are influenced by the same set of lagged changes of stochastic variables: $DLY_{-1}$, $DLY_{-2}$, $DLY_{-3}$, $DLY_{-4}$, $DLIM_{-1}$, $DLIM_{-3}$, $DLU_{-1}$, $DLRHO_{-2}$ and $DLG_{-5}$ with almost the same value for the coefficients. This had to be expected since the results already examined for the two equations are very similar. It is an indication that, in the absence of any a priori restriction on the GAMMA matrices, the productivity equation is not well identified in the short-run and the results for this equation can be ignored If one considers that the change in G in the fifth quarter is equivalent to a change in Y and similarly for IM in the first and third quarter, the lagged rate of change of output is the overwhelming influence on the current change in productivity and demand. The autoregressive character of the demand equation is significant and well identified. Employment change does not seem to be important in the short-run: except for the first quarter where the lagged change in the unemployment rate has a negative coefficient as to be expected. The rho coefficient is not significant except in the second lagged quarter and with a wrong sign. In summary, the short-run dynamic analysis does not reveal anything important.

## 5. 4 Test for a structural break

The RATS-CATS package has a sub-routine REC which enables to check for the constancy of the co-integration space $\beta$. The test is based on the comparison of the estimated co-integration space over the whole sample with a sub-sample specified for a sub-period. The $\beta$ matrix is re-estimated for each quarter of the sub-period and a statistic is calculated at the 5% level. If the statistic exceeds unity, the null hypothesis (that is no structural break) is rejected. Since the year 1975 is the turning point for a radical change of the monetary policy in Canada, the test for a structural break starts with the fourth quarter of 1975. Graph 01 in appendix contains two tests: one with $\beta'z_t$ and a second one with $\beta'R_t$. The first one is carried with the observed stochastic variables, that is including the short-term variations, while the second one with $\beta'R_t$ is done with the transformed stochastic variables purged from their short-run variations. One can see that the short-term variations exaggerate the structural breaks between 1976 to 1991, but after that new turning point, the two tests are rather the same. The important point however is to note that everywhere the statistic for $\beta_t$ is above unity. Since the important point here is to test for structural breaks in the long-run, the statistic with $\beta'R_t$ seems to be more relevant. For the 1976-1999 period, the statistic with $\beta'R_t$ is in the interval between 1.5 and 2.5. It

means that the re-estimated co-integration space for each quarter after 1975 is significantly different from the whole sample 1948-1999. Recalling that 1975 is he turning point in monetary policy in Canada, the beginning of the crisis of the Fordist regime is well illustrated by this beta constancy test.

Another test is the one-step prediction as shown in graph 2 in the appendix. Here again, a 5% level coincides with the statistic valued at unity. When the untransformed observations are used, the model is rather bad for predicting the short-term variations, in particular for the period 1976-1985, but the transformed data purged from short-term variations give a much more reliable prediction. The model misses the point only in four quarters: 80.03, 81.03, 92.03 and 92.04. This last observation would be consistent with the null hypothesis of a no structural break for $\beta$ over the whole period. It shows that the two equation model is rather robust for long-run prediction despite some possible structural break.

What should be concluded from this first estimation of the two equation model? The model can be quite sensitive either to the rank chosen, to the type of exogenous variables excluded from the co-integration space or to constraints imposed in the co-integration space. A number of other re-estimations were done and results obtained. For instance, if no a priori restrictions are imposed on the coefficients of u or $\rho$ in the productivity equation, it will change the sign of $\rho$ in the demand equation. Knowing the importance of this variable in the demand equation for discriminating between the Regulationist approach and the Marxist approach, it is too early to conclude that one approach fits better the Canadian data than the other.

## 6. Econometric results : A real and financial model for an open economy

In order to reduce the number of equations to a two equation model, it was necessary to substitute 4 equations into the demand equation. The model was re-estimated by adding a third equation, the real wage equation w/p, but the results obtained were rather disappointing. Instead, it was decided to estimate an open economy model which would take into consideration the financial sector by introducing explicitly an interest rate equation:

$$i/i^* = f_8 \{(IM/X), (e), (p/p^*)\}.$$

The main purpose of this new model is to see what influence the financial world economy has on a system where money has been ignored up to now. It will be assumed that the supply of money accommodates a Keynesian money demand, the latter being a positive function of price and output and a negative function of the interest rate. There is no particular interest in estimating the money demand relation but a major interest in specifying an equation for the monetary policy through an interest rate equation.
The obvious link between this equation and the rest of the model is the trade balance, the price vaiable and the $\rho$ variable which appears in the price and the investment equation.

Therefore, in order to close the model and create a link with the interest rate variable, a definition relation is also specified

$\rho = (i/r_{-1}) = f_9(i/r)$.

Since the profit rate is so central in the Marxist approach, it is necessary to specify a quasi definition relation for the average profit rate r :

$r = f_{10}(Y/E, w/p, K/E)$.

Therefore, the complete model is

$$Y/E = f_1(Y, K/E, H, TU, t)$$
$$Y = g(C, I, G, X, IM)$$
$$C = f_5(E, w, p)$$
$$I = f_6(C, \rho, TS)$$
$$w = f_3(p, Y/E, TU, u, t)$$
$$p = f_4(w, \rho, Y/E, Y/K, TU)$$
$$\rho = f_9(i/r)$$
$$r = f_{10}(Y/E, w/p, K/E)$$
$$i/i^* = f_8\{(IM/X), (e), (p/p^*)\}$$

In order to reduce the multicollinearity between certain variables, it is assumed that there is a proportionality relation between the exchange rate e and the current commercial balance $(X - IM)$. Therefore, the interest rate equation can be re-written as $i = f_8\{(i^*, (e), (p/p^*)\}$. The exchange rate e will also appear in the demand equation.

After substituting C into I and both into Y, the demand equation is

$Y = g(E, w, p, \rho, e, TS, G)$.

Assuming a proportionnality relation between E and u, which implies that the expected sign for the un employment rate coefficient is negative, and assuming G included with the constant term, the final demand equation is $Y = g(u, w, p, \rho, e, TS)$.
 Since H and TS were non significant exogenous variables in the previous estimation, they were left out and the set of exogenous variables outside the co-integration relations is reduced to (TU, K/E) and $(TU, K/E)_{-1}$. To avoid the estimation of two separate relations for the wage and the price, we constrained the estimation to the real wage (w/p) and assumed that p is a stochastic common trend as the four other variables (u, e, $i^*$, $p^*$).[32] Note also that K/E being assigned outside the co-integration relations, the r equation becomes more a behavioural equation than a definition. Therefore, the model which is finally estimated is a 6 equation system, (4 behavioral equations and 2 definition relations) which implies that one must identify at least 6 co-integration relations:

---

[32] The particular meaning of that assumption is that w and p being of order I(1) separately are well co-integrated together and that w/p is integrated of order 0. In another article, (Loranger-Boismenu 2003), a different estimation was done with p identified to a particular co-integration relation and the results were very good, in particular for the Regulationist approach. The estimation was done with 8 co-integration relations and 15 stochastic variables.

$$Y/E = f_1(Y)$$
$$Y = g( u, w/ p, \rho, e)$$
$$w/p = f_3(Y/E, u, \rho)$$
$$i = f_8 \{(i^*, (e), (p/p^*)\}$$
$$\rho = f_9( i / r )$$
$$r = f_{10}(Y/E, w/p)$$

It should be noted immediately that there is another way of specifying the demand equation by substituting productivity to the real wage rate. This latter specification would be closer to the one already specified in the simple two equation model for the closed economy. Note however that this implies some proportionnality relation between productivity and the real wage rate and the sign of the productivity coefficient should be positive. Therefore, since our major aim is to test the Regulationist approach versus the Marxist approach with the Canadian quarterly series, the signs of the productivity coefficient, the real wage rate coefficient and the the profitability coefficient in the demand equation become crucial to watch. The estimated coefficient of productivity or of real wage should be positive and the sign of the profitability coefficient should be negative.

### 6.1 Estimated long-run relations

Three tests of of estimated long-run relations will be performed: the first two estimations with the real wage rate in the long-run demand equation and third estimation with the productivity variable instead of the real wage rate.

Table 5a
Results of the constrained BETA matrix (or co-integration space)
Open economy model with the real wage in the demand equation

| LY/E | LY | LU | LRHO | LW | LP | Lr | Li | Li* | Lp* | Le |
|---|---|---|---|---|---|---|---|---|---|---|
| -0.532 | 0.000 | -0.028 | -0.043 | 1.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.000 | 1.000 | 0.144 | 0.168 | 0.190 | -0.190 | 0.000 | 0.000 | 0.000 | 0.000 | -0.047 |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -4.423 | 0.000 | 1.000 | -1.034 | 4.423 | 1.099 |
| 1.000 | -0.336 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 0.981 | -0.981 | 0.000 | 0.000 | 0.000 |
| -2.533 | 0.000 | 0.000 | 0.000 | -2.748 | 2.748 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 |

"STANDARD ERRORS" FOR BETA (transposed)

| 0.184 | 0.000 | 0.008 | 0.005 | 0.000 | 0.000 | 0.000 | 0.000 |
|---|---|---|---|---|---|---|---|

0.000  0.000  0.000
0.000  0.000  0.032  0.020  0.220  0.220  0.000  0.000
0.000  0.000  0.015
0.000  0.000  0.000  0.000  0.000  0.461  0.000  0.000
0.047  0.461  0.207
0.000  0.006  0.000  0.000  0.000  0.000  0.000  0.000
0.000  0.000  0.000
0.000  0.000  0.000  0.000  0.000  0.000  0.003  0.003
0.000  0.000  0.000
0.667  0.000  0.000  0.000  0.206  0.206  0.000  0.000
0.000  0.000  0.000

The wage rate has  a positive relation with productivity but the elasticity is about only half of what should be expected. The rho coefficient is also positive which is contrary to expectation. Therefore, the regulation theory is far from confirmed with this first equation. But when one looks at the demand equation, the results are even worse for the Regulationist approach: the real wage coefficient is negative but not singnficant from 0. However, the other coefficients in the demand equation are in full agreement with the Marxian and other mainstrean approaches: the unemployment rate coefficient and the profitability coefficient are both significantly negative and the external trade variable represented by the exchange rate has a positive coefficient. The interest rate equation is in full agreement with the overwhelming influence of the US monetary policy with a unit elaticity coefficient (1.034) and the Canadian monetary policy is nominally independent from other influence with a negative exchange rate (-1.099) and can  be rather sensitive to price change with a strong positive elasticity coefficient (4.423). In principle, these results could be compatible with the hypothesis of an independent monetary policy conducted by the central bank. In practice, if the central bank chooses a dirty float policy for its exchange rate (that is some secret target for the exchange rate), it could also be compatible with an endogenous monetary policy under the tutelage of a foreign monetary policy, that is the FED policy.

The result of the other behavioral equation,  productivity, confirms the endogenous character of the thechnological changes: the size of the output coefficient (.336) is more than twice the one already observed with the closed economy model. As far as the other two relations, they are not of a great interest except to confirm or infirm the correctness of the identification of the co-integration relations to our structural system. There is though a dark point in the picture: the coefficient of the wage rate in the profit rate equation should be negative instead of positive as observed. We could easily get rid of that anomaly by permuting the order of the structural equations in the cointegration matrix. For instance, by permuting the order of the demand with the productivity in the cointegration matrix, that is standardizing productivity with the second cointegration relation and demand with the fourth cointegration relation, the coefficients of the profit rate equation have the correct signs: the profit rate is a positive function of productivity and a negative function of the real wage rate. However, that will not change in a significant manner the results already observed in the demand equation and in the other equations.

Table 5b
Results of the constrained BETA matrix (or co-integration space)
open economy model without the profitability variable in the demand equation

| LY/E | LY | LU | LRHO | LW | LP | Lr | Li | Li* | Lp* | Le |
|---|---|---|---|---|---|---|---|---|---|---|
| -2.814 | 0.000 | -0.110 | -0.188 | 1.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.000 | 1.000 | 0.368 | 0.000 | -4.052 | 4.052 | 0.000 | 0.000 | 0.000 | 0.000 | -0.581 |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -3.992 | 0.000 | 1.000 | -0.970 | 3.992 | 1.311 |
| 1.000 | -0.361 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 0.982 | -0.982 | 0.000 | 0.000 | 0.000 |
| -1.945 | 0.000 | 0.000 | 0.000 | 1.358 | -1.358 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 |

"STANDARD ERRORS" FOR BETA (transposed)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.264 | 0.000 | 0.037 | 0.020 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.000 | 0.000 | 0.052 | 0.000 | 0.468 | 0.468 | 0.000 | 0.000 | 0.000 | 0.000 | 0.141 |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.416 | 0.000 | 0.000 | 0.042 | 0.416 | 0.202 |
| 0.000 | 0.020 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.003 | 0.003 | 0.000 | 0.000 | 0.000 |
| 0.037 | 0.000 | 0.000 | 0.000 | 0.042 | 0.042 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

In order to check the importance of the profitability variable in the demand equation, the same model was re-estimated by constraining to 0 the coefficient of rho. The results (table 5b) speak by themselves:
- the wage rate is now strongly elastic to productivity with a coefficient of 2.814;
- the aggregate demand is strongly elastic to the real wage rate with a coefficient of 4.052;
- the aggregate demand reacts more strongly to the external trade effect with a coefficient of .581 and negatively to the unemployment rate with a coefficient of -.368;
- the profit rate is negatively related to the real wage rate (-1.358) and positively related to productivity (1.945).

As far as the other equations are concerned, the results are quite the same. Therefore, the Regulationist approach can have some empirical foundation only by negating two major key variables in the demand equation: the profit rate and the interest rate! There is however another chance for the Regulationist approach: use the productivity variable as a substitute for wage in the demand equation.

Table 5c
Results of the constrained BETA matrix (or co-integration space)
Open economy model with productivity in the demand equation

| LPRE | LY | LU | LRHO | LW | LP | LTXR | LR | LRUS | LPUS | LE |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.352 | 1.000 | 0.076 | 0.255 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.118 |
| -3.325 | 0.000 | -0.135 | -0.223 | 1.000 | -1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| -1.950 | 0.000 | 0.000 | 0.000 | 1.468 | -1.468 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1.000 | -0.352 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -4.081 | 0.000 | 1.000 | -0.981 | 4.081 | 1.246 |
| 0.000 | 0.000 | 0.000 | 1.000 | 0.000 | 0.000 | 0.982 | -0.982 | 0.000 | 0.000 | 0.000 |

The results of table 5c, especially the demand equation, are again contradicting the Regulationist approach: the productivity coefficient is negative (-.352), the unemployment rate is weakly negative and the external trade variable (the exchange rate) has a negative coefficient contrary to expectation. There is however only one good result in this equation: the negative coefficient (-.255) of the profitability variable, which is an indication that the Marxian and other mainstream approaches based on the profit rate receive a stong support from the Canadian data.

Different other permutations of the demand equation in the cointegration matrix has not given the expected result: in all these various attempts, the productivity coefficient remained negative! The only good news for the Regulationist approach is with the wage equation with a strong positive elasticity coefficient (3.325) for the productivity variable. But it may be too good to be true since the coefficient of the rho variable is positive (.223) which is contrary to expectation. As far as the rest of the results are concerned, they are not too different from what has already been observed in the previous tables. Before turning to the short-run analysis, it should be noted that, if these results seem to confirm the superiority of the Marxian approach over the Regulationist approach, one should be very careful before drawing a definitive conclusion. Indeed, by specifying a larger model with more variables and more co-integration relations, Loranger-Boismenu (2003) obtained results which were highly favorable to the Regulationist approach. Statistics and econometrics never prove a theory but illustrate its relevance according to given specifications.

## 6.2 The short-run impact of long-run relations

Table 6
ALPHA matrix: estimated coefficients for the short-run adjustment disequilibria

```
ALPHA        LW       LY        Li       LY/E      LRHO       Lr

DLY/E     -0.163   -0.088    0.007    -0.392     0.013    -0.055
DLY        0.127   -0.011    0.005    -0.130     0.061     0.025
DLRHO      5.590    0.748   -0.111     1.214     0.623     1.356
DLW       -0.844   -0.269   -0.023    -0.920    -0.280    -0.258
DLr       -1.818   -0.461    0.031    -1.453     0.303    -0.490
DLi        6.243    0.889   -0.105     1.687     1.326     1.528
T-VALUES FOR ALPHA
       -0.188   -0.391     0.746    -0.615     0.067    -0.228
        0.141   -0.048     0.531    -0.198     0.301     0.101
        1.027    0.532    -1.884     0.303     0.507     0.904
       -2.087   -2.574    -5.165    -3.096    -3.071    -2.318
       -1.047   -1.028     1.628    -1.139     0.774    -1.024
        1.151    0.635    -1.785     0.423     1.082     1.022
```

Recall that each column of the ALPHA matrix refers to a co-integration relation and each line contains the adjustment coefficients of long-run disequilibria for each stochastic variable.[33] For instance, disequilibria in all co-integration relations have a significant impact on short-term nominal wage change ( the fourth line) , but the impact is most important with disequilibria in productivity and wage. This is perhaps an indication that the assumption of a well cointegrated wage/price relation is not having an optimal specification in the model since the nominal wage variation is so sensitive to disequilibria or error in the long-term co-integration relations. It might have been preferable to use the real wage instead of two constrained separate variables w and p in the co-integration relations.

## 6.3 Impact of short-term exogenous variables

Table 6
Estimated results of the coefficients of predetermined variables

```
             LKN      LKN1     LTU      LTU1
   DLY/E    0.936   -0.838    0.579   -0.496
   DLY     -0.061    0.187    0.601   -0.526
   DLRHO    0.110    2.241    1.389   -0.584
   DLW      0.920   -1.027    0.290   -0.210
   DLr     -0.031   -0.231    0.798   -0.650
   Dli      0.120    2.346    1.372   -0.585


                    t-values
```

---

[33] Lines related to stochastic variables assumed as stochastic common trends (u, p, i*, p*, e) are omitted.

```
   16.991    -4.376     6.245    -5.045
   -1.072     0.944     6.278    -5.182
    0.317     1.865     2.385    -0.946
   35.851   -11.506     6.699    -4.589
   -0.278    -0.602     4.295    -3.302
    0.350     1.958     2.364    -0.951
```

As with the previous productivity-demand model, the average period of work H was not significant in any equation and it was dropped from the model. Similarly, the the depreciation rate TS was ignored. The capital/labor K/E (current and lagged) is significant in the productivity equation and, hence, validates the hypothesis of short-term exogenous technical progress. This variable also appears in the wage equation with a positive sign, an indication of the relevance of the Dumeni-Levy hypothesis about the exogenous variations of technological changes. Although the coefficient is not significant according to the t value, it is interesting to note in passing that the K/E coefficient has the expected sign (-.278 and -.602) in the profit rate relation. Finally, the most significant short-term exogenous variable is the degree of capacity utilization TU (current and lagged by one period). It appears significant in all equations for the current period and in four out of six equations for the first lagged quarter. These results confirm again the importance of the capacity utilization as a key variable in the short-term adjustments.

**6.4 The short-run dynamics of lagged dependent variables**

It would be too fastidious to read the 5 matrices (11x11) of the short-term dynamic coefficients. Instead, only the "significant" results for 4 main equations will be reported: productivity, demand, wage and interest rate.

$DLY/E + .771LY/E_{-1} +.591DLY/E_{-2} +.519DLY/E_{-3} = .366DLY_{-4} + .729DLW_{-1} + .514DLW_{-2} -.877DLP_{-2} + .449DLW_{-3} +.797DLP_{-4} + .685DLP_{-5} -.839DLP*_{-5} -.366DLr_{-4} + .023Dli*_{-2} +.019Dli*_{-4}$

In addition to change in the capital/labor ratio and in the degree of capacity utilization, productivity changes are caused in the short-run by a lagged change in output in the fourth quarter. Therefore, even in the short-run, the endogenous character of productivity based on changes in the level of knowledge is confirmed. Productivity changes are also caused by wage and price variations over the previous year and only mildly by variations in the foreign interest rate. Note however that wage and price variables appear in the short-run as unconstrained variables while they were constrained to real wage in the long-run analysis.

$DLY -.449DLY_{-4} = -.460DLr_{-4} + .848DLP_{-4} + .633DLP_{-5} -.761DLP*_{-5} + .026Dli*_{-2}+ .018Dli*_{-4}$

The short-run change in demand, in addition to change in the capacity utilization, is a negative function of lagged change in the profit rate in the fourth quarter. The negative sign

result is somewhat a surprise since if the profit rate is the central variable in the accumulation process. Another result is that, in the short period, output growth would go along with inflation, in particular with lagged price changes of the fourth and the fifth quarter. The influence of the lagged changes of the foreign interest rate is mild though. One must remember however that these results are valid only asmptotically.

$$DLW + .381DLW_{-2} + .344DLW_{-3} = .380DLP_{-3} + .413DLY/E_{-2} + .356DLY/E_{-3} - .202DLY_{-2} + .264DLY_{-4} -.016DLU_{-1} -.033DLU_{-2} -.036DLU_{-3} -.034Dli*_{-1} -.015Dli*_{-2} -.029Dli*_{-3} -.019Dli*_{-4} -.018Dli*_{-5} -.147Dli_{-2} -.121Dli_{-4} + .038Dli_{-5} -.141DLe_{-1} - .013DLe_{-2} + .306DLP*_{-1} + .314DLP*_{-3} + .343DLP*_{-4} + .354DLr_{-1} + .185DLr_{-5} + .176\rho_{-2} + .142\rho_{-4} - .026\rho_{-5}$$

Change in the short-term nominal wage, in addition to change in the capital/labor ratio and in capacity utilization, is a positive function of lagged price and productivity changes, a result that is in agreement with the Regulationist approach. Wage also increases in the short-run when the unemployment rate is decreasing as expected. The surprising result here is the significant negative impact of the US interest rate on the Canadian wage determination. Its influence seems to have more importance in the five quarters than the monetary policy of the Bank of Canada. Indeed, the domestic interest rate has a significant impact only in the fourth quarter and only a weak influence in the fifth quarter. Note however that the coefficient of the domestic rate is more important than any coefficient of the lagged changes in the foreign interest rate. This can be interpreted as a signal that economic agents are as much sensitive to the US monetary policy as to the policy of the Canadian central bank. One may question here the independence of the central bank even in the short-term. Short-run wage variations are also influenced by two other variables: the profit rate and the profitability criterion. The fact that the profit rate and the wage rate are both nominal variables makes their positive correlation perfectly acceptable in the sort-run. Even if the wage equation is the one which contains the largest number of significant coefficients, this highly simplified short-run dynamics analysis does not reveal more information than what is already known by the long-run analysis.

$$Dli - .465Dli_{-5} = 4.962DLY/E_{-1} + 2.162DLY/E_{-2} + 3.612DLY/E_{-3} + 2.713DLY_{-2} + 4.072DLp_{-2} + 3.073DLY_{-5} - 4.361DLW_{-1} - 3.133DLW_{-3} - 3.726DLr_{-1} + .200Dli*_{-1} -.137Dli*_{-2} -.144Dli*_{-4} -1.451Dle_{-1} + 2.530Dle_{-3} - .403\rho_{-5.}$$

Turning now to the short-term interest rate change, in addition to change in the current capacity utilization, it is observed that the productivity changes over the first three quarters have a strong positive influence with an elasticity coefficient between 2 and 4. This is a rather surprising result, because when productivity is rising, one could expect a more accomodating monetary policy unless these productivity rises occur during a near full capacity running economy. Note however the strong positive influence of output changes on the monetary policy variable: output is, in the short-run, a target variable for the central bank. The surprising result is that the price variable does not appear to be significant in the short-run. Worse, the wage variable, which moves usually in the same direction as the price variable, enters with a negative sign, which is an indication of a weak specification since,

in the long term, these two variables were constrained to move together. Therefore, the importance of inflation cannot be evaluated correctly in the determination of the short-term monetary policy. One thing is sure however is that price changes matter in the long-run equilibrium as it has already been observed with a significant coefficient (4.423) of the relative price variable.

Another positive influence on the short-term rate is the foreign interest rate change with an elasticity of .200 in the first (lagged) quarter. This influence is however counterbalanced by negative coefficients in two following quarters. The change in the exchange rate has a negative influence in the first (lagged) quarter (-1.451) as it should be expected since a devaluation of money makes the central bank more independent in its choice of monetary policy. However, a change in the exchange rate two quarters before can feedback on the interest rate change with a stronger positive elasticity coefficient (2.530). Another short-term influence on the interest rate change is the strong negative effect of the change in the profit rate during the first (lagged) quarter with respective an elasticity of –3.726. An increase in the profit rate would be a signal of a healthy economy and instead of an overheated economy. To conclude the short-term analysis, one should remember that it is important to separate the short-term influences from the long-term, but the analysis of scattered "significant" coefficients in each equation is not very informative and reliable.

**6.5 Test of a structural break**

Graph 4 in the appendix is a test of constancy of the co-integration space over the period 1985 to 1999. Since the statistic is well above unity for the whole period with observations including short-term variations β'z as well as with data cleaned from short-run fluctuations β'R, it can be safely concluded that a major structural break exists between the whole period for which β has been estimated and the last sub-period 85-99 which corresponds to the neoliberal regime.

The one-step prediction reported into graph 5 with observations purged from short-term variations also shows a poor performance in years 86:03-87:04, 90:04, 92:04-92:04, 94:01, 97:02-98:02 and 99:04. This is another indication of the poor performance of the model and the illustration of a regime change over the period 1985-1999. If one compare these new results with the previous real two equation model, the introduction of the financial sector has an overwhelming influence and substantially improves the test of the beta constancy, which turns out to be a strong rejection of the null hypothesis. If the major break from the past comes from the financiarization of the world economy since the mid 80's, our empirical findings support such a regime change and our canonical model fits the new neoliberal regime.

# Conclusion

Our aim was to build and test an heterodox model which is a synthesis of two schools of thought: the political economy of Marxism based on the Dumenil-Levy approach and the political economy of regulation based on the Aglietta-Boyer-Billaudot approach. In the first

part of the paper, it has been outlined in particular that the Dumenil-Levy approach is based on two key assumptions:

a) an exogenous monetary policy efficient enough to stabilize a regime which could otherwise be unstable in the mid or long-run period;

b) an exogenous technical progress which moves the key variables of the system, namely the wage rate and the profit rate so central in the Marxist analysis.

In the second part, we criticized the realism of these two assumptions in the light of the neoliberal regime. Because the main characteristic of the neoliberal regime is the financiarization of the world economy ( or the overwhelming influence of the financial markets ), we prefer the assumption of an endogenous monetary policy in the long-run, particularly so in the case of Canada where the influence of the FED seems to matter as much if not more than the influence of the central bank of Canada. We also reject the hypothesis of exogenous technological changes in the long-run and prefer the hypothesis of endogenous technological changes based on the positive externality of the general level of knowledge.

Econometric results have been derived from two models:

c)   a productivity-demand model based on 6 equations which has been reduced to a two equation  model;

d)   a real and financial model for an open economy based on 9 equations which has been reduced to a four behavioral equation model and two quasi-definition relations for the closure of the system.

Econometric results have been obtained for each model according to 5 criteria: a) estimated long-run relations; b) the short-run impact of long-run relations; c) impact of short-run predetermined variables; d) short-run dynamics of lagged dependent variables; e) test of a structural break.

a) Estimated long-run relations

The choice between the two theories which have been proposed as an explanation of macroeconomic instability must be based on the results obtained from the estimation of long-run relations or equilibrium relations. In both models, Canadian data seem to fit much better the Marxian explanation based on the profit rate than on the wage rate. Therefore, if the regulation approach had a golden period with the Fordist regime for the post-war period, it has not survived as a plausible explanation after the mid-seventies. However, the empirical results obtained in this paper should not be considered as definitive, since there are many ways to specify an econometric model, as it has been shown in a previous study (Loranger-Boismenu, 2003). Indeed, by enlarging the model to 15 variables and 8 co-integration relations, and changing the specification in some equations, we have shown that the Regulationist approach can have an as good chance to fit the Canadian data.

b) The short-run impact of long-run relations

In the two equation model, it is only the disequilibrium of the productivity relation which has some impact on the short-run productivity-demand changes. In the open economy model, the results are quite different: disequilibria in all co-integration relations have a

significant impact mainly on the short-run wage variations. That could be an indication of some error of specification in the co-integration space.

c) Impact of the short-run predetermined or exogenous variables

The impact of the capital-labor ratio on the short-run variations of productivity is significant in both models. These results are a vindicaton of the relevance of an exogenous technological change hypothesis as assumed in the Dumenil-Levy approach, at least for the short-term period. Current and lagged capacity utilization TU have a significant coefficient for productivity and output in both models. TU is also relevant in the wage rate, the profit rate and the interest rate equations in the larger model. These results confirm the importance of this variable in the short-run variations. It would be interesting to re-estimate the model by including this variable into the co-integration space.

d) The short-run dynamics of lagged dependent variables

The results from short-run dynamic analysis are not as interesting as one would have expected. The main reason for that is that the results are so numerous that it is impossible to analyse 121 coefficients for each lagged period. Although the t values are valid only asymptotically, the "significant" coefficients are rather scattered and the results for a particular equation are not very informative. For instance, the demand equation, which is so important in the long-run analysis, has only a few significant coefficients in the short-run analysis. Similarly for the productivity equation.

e) Test of a structural break

The hypothesis of the constancy of the co-integration space $\beta$ is rejected at the 5% level with the first two equation model for the sub-period starting in 1976 and is also rejected with the open economy model for the sub-period 1985-1999. These two sub-periods have a particular significance for testing the hypothesis of a structural break. Indeed, 1976 is the year when the new flexible exchange rate regime was generalized to the world with the Jamaican Agreement. 1985 is the new era of Reaganomics with deregulation in particular in the financial sector. These two major changes paved the way for a new accumulation regime that is now called the neoliberal regime. The hypothesis of a new canonical model designed for an open economy and associated to this new regime is more relevant than ever.

## Bibliography

Aglietta, M. (1976), Régulation et crises du capitalisme. L'expérience des États-Unis, Paris, Calmann-Lévy, 334 p.

Aglietta, M. (1998). « Le capitalisme de demain », Note de la Fondation Saint Simon, Paris, nov. 1998.

Aglietta, M. (1999). « La globalisation financière », in L'économie mondiale 2000, La Découverte, collection Repères, Paris, 1999, p. 52-67.

Ball, L. (2001), "Policy Rules for Open Economies", in Monetary Policy Rules, J.B. Taylor (ed.), NBER, University of Chicago Press, Chicago.

Billaudot,B. (1976), L'accumulation intensive du capital, thesis, Universite Paris-I.

Billaudot, B. (2001), Régulation et croissance: une macroéconomie historique et institutionnelle, L'Harmattan, Paris, 2001.

Boismenu, G., Loranger, J.-G., Gravel, N. (1995), "Régime d'accumulation et régulation Fordiste. Estimation d'un modèle à équations simultanées", Revue économique, 46, no.4, pp.1121-1143.

Bowles, S., Gordon, D., Weisskopf, T. (1983) Beyond the Waste Land, doubleday, NY.

Boyer, R. (1979), "La crise actuelle: une mise en perspective historique", in Critiques de l'economie politique, no 7-8,pp. 3-11.

Boyer, R. (1986a), Capitalisme fin de siècle, Paris, PUF, 268 p.

Boyer, R. (1986b), La théorie de la régulation : une analyse critique, Paris, La Découverte, 142p.

Boyer, R., Saillard, Y. (1995) Théorie de la régulation: l'état des savoirs, Paris, La Découverte, 568

Boyer, R. (2001), « L'après consensus de Washington : institutionaliste et systémique ? », L'Année de la régulation, vol. 5, Paris, Presses de Sciences Politiques, p. 13-56.

Boyer, R. (2002), « Variété du capitalisme et théorie de la régulation », L'Année de la régulation, vol. 6, Paris, Presses de Sciences politiques, p. 125-194.

Duménil, G., Lévy, D. (1996), La dynamique du capital : un siècle d'économie américaine, PUF-Actuel Marx, Paris, 1996.

Duménil, G., Lévy, D. (ed.) (1999), Le triangle infernal : crise, mondialisation et financiarisation, PUF-Actuel Marx, Paris, 1999.

Duménil, G., Lévy, D. (2000), Crise et sortie de crise : ordre et désordres néo-libéraux, PUF-Actuel Marx, Paris 2000.

Duménil, G., Lévy, D. (2003), Économie Marxiste du capitalisme, La Découverte, Paris, 2003.

Duménil, G., Lévy, D. (2004), Capital Resurgent. Roots of the Neoliberal Revolution, Harvard University Press, Mass.

Hamilton, J. D., (1994), Time Series Analysis, Princeton University Press, New Jersey.

Hansen, H. Juselius, K. (1995), "CATS in RATS Cointegration Analysis of Time Series", Instruction Manual, Estima, Evanston, 87 p.

Kaldor, N., (1966), "Marginal Productivity and the Macro Economic Theory of Distribution", Review of Economic Studies, Oct. 1966.

Keynes, J.M., (1936), The General Theory of Employment Interest and Money, Harcourt Brace, New-York, 1936.

Lipietz, A.. (1979), Crise et inflation: pourquoi? Paris, Maspero.

Lavoie, M., Rodriguez, G., Seccareccia, M., (2002), « Post-Keynesian and Marxist Rconomics: Twin or Distant Cousins? A Theoretical and Empirical Investigation of Competing Investment Functions », Dept of Economics, University of Ottawa

Loranger, J.G. (1995) « Neoliberalism and the Overwhelming Power of Financial Markets », Paper presented at the International Symposium on Economic and Financial Cycles and NAFTA, Mexico, June 7-9, 1995, Mimeo, Dept. of Economics, Université de Montréal, 28p.

Loranger, J.G., Boismenu, G. (2001), "Régime d'accumulation et analyse de coïntégration: un modèle alternatif de croissance équilibrée", Congrès Actuel-Marx International III, Paris, 26-29 sept. 2001.

Loranger, J. G., Boismenu, G. (2002). "Un modèle de politique monétaire endogène: application à l'économie canadienne", Colloque international du CEMF et de l'ADEK, Politiques économiques: perspectives de l'hétérodoxie keynésienne, Université de Bourgogne, Dijon, 14-16 nov. 2002.

Loranger, J.G., Boismenu, G. (2003). « Is the Canadian Monetary Policy Endogenous ? A Cliometric Analysis », Historical Social Research ( An International Journal for the Application of Formal Methods to History), Vol. 2, 2003.

Lordon, F. (1997), « Endogenous Structural Change and Crisis in a Multiple Time-Scale Growth Model », Journal of Evolutionary Economics, Vol. 7, 1997, p. 1-21.

Lucas, R. (1988), « On the Mechaniscs of Economic Development », Journal of Monetary economics, Vol. 22, 1988, p. 3-42.

Romer, P. (1990), « Endogenous Technological Change », Journal of political Economy, vol. 98, no 5, 1990, p. 71-102.

Taylor, J.B. (2001a), Monetary Policy Rules, A Conference Report, NBER, University of Chicago Press, Chicago.

Taylor, J.B. (2001b), "A Historical Analysis of Monetary Policy Rules", in Monetary Policy Rules, NBER, University of Chicago Press, Chicago.

Young, A.,(1928), "Increasing Returns and Economic Progress", Economic Journal, Dec. 1928.