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Analysis of Structural Changes in Canada
A Macroeconomic Model Based on a Heterodox Approach

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Abstract

The possibility of measuring structural changes with an econometric model appears a priori to be a difficult task. This project may hurt an empirical skeptic such as N. Taleb (the Black Swan, 2007) who denies any value in this type of Platonistic approach, but what else can be done? The aim of our model is not to predict but explain the past. The usefulness of a model is to simplify the analysis and going to the essential while ignoring the secondary aspects. One thing is sure however, the model is not based on the foundation of the neoclassical theory or the postulate of efficient markets. A dynamic heterodox model for an open economy is built from the Marxist and Regulationist approaches. Although the Error Correction Model (cointegration analysis) is rarely used by heterodox economists, that method of estimation is used for a long-run period 1947-2009 and for two sub-periods: 1947-75 and 1976-2009. The change in the magnitude of parameters validates what can be observed empirically by a simple examination of the data, i.e. the importance of structural changes that occurred between the Fordist period and the post-Fordist period, called a neoliberal regime. The main structural changes are the de-linkage of the US dollar from gold and the change of the exchange rate regime, the end of the cold war, the change of monetary policy, the change of the distribution rate in favour of capital (and financial capital via financial derivatives), the decreasing impact of productivity on real wage, the increase of the impact of global demand -hence the State- on productivity via its expenditures on education, health and other infrastructure expenditures. The specification of an interest rate equation lends more credibility to an open economy model and to institutional changes at the world level Before specifying these changes with the use of a model, priority will be given in the first section to the analysis of the Canadian quarterly series over a 60 year period. The theoretical foundations of the heterodox model are given in the second section. The third section contains preliminary specifications or choices required before estimating the parameters for a cointegrated model. The last section is entirely devoted to the analysis of the econometric results.

Key words: Regulation, dynamics, structural changes, cointegration, open economy.

Introduction

The possibility of measuring institutional changes with an econometric model appears a priori to be a difficult task-- if not an impossible one. Indeed, if one makes a descriptive analysis of a number of institutions (represented by state, labour markets, financial markets, competitive regime) analysed through the price system, money and the exchange rate then how can the analysis of the interactions between all these institutions be reduced to a model of a few equations where the structure changes over time? It is a challenge for the economist or any social science specialist who wants to analyse this very complex reality by using a few simple hypotheses (relations). The usefulness of a model is to simplify the analysis and going to the essential while ignoring the secondary aspects.

The purpose of the structural model is the measurement of institutional changes with the necessity to develop a dynamic analysis of institutions. The model cannot be simply static, even if it had been formulated that way in the in the first hand. Not only will it be necessary to estimate the parameters of an econometric model from observations over a specific period of time (Ex. 25 years), but also over a long-term period (Ex. 50 years) in order to measure structural changes. The estimation of structural parameters is made by an econometric method called the Error Correction Model (ECM) which allows for the distinction of mid-term (stable) relations from short-term or transitory variations. Structural changes or institutional changes can be observed only in the long-term by comparing two mid-term situations.

The Regulation School has already identified a certain number of these changes characterizing a Fordist accumulation regime over the period from 1945 up to mid70s and a post-Fordist regime since then. The latter referred to as a neoliberal accumulation regime, is associated with a period of intensive institutional changes such as the end of the Bretton Woods Agreements (or end of the US Dollar-Gold Standard) and a new regime of floating exchange rates officialised by the Jamaican Accords, the end of the Cold War followed by the implosion of the USSR. Fourquet (2004) interprets these major changes as the illustration that international relation is the dominant relation conditioning all other relations (wage, money, finance…). According to this author, the Cold War period gave birth to the Fordist regime by forcing capitalism to share productivity gains with labour because of the political competition with communism. The disappearance of the latter regime allowed a return to liberalism, hence the expression of neoliberalism for characterizing the last two decades[1].

We consider that the end of the Bretton Woods Agreements in 1971, followed by the generalization of the floating exchange rates in 1976, is the most important event characterizing the end of Fordism and the emergence of a new neoliberal regime that gave birth to financialisation with new financial derivatives, the new international division of labour based on forms of competition forcing states to adopt strategies of openness in almost every sectors. Fourquet is right when he states that the international relation is the dominant relation and this will justify the choice of our estimations around

[1] Of course, the transition toward neoliberalism started in the mid-seventies, but one can safely affirms that the full impact of neoliberalism is particularly relevant for the last two decades.

two turning points, 1976 and 1989.

Some economists like Bryan and Rafferty (2006) reject the concept of neoliberalism as being too vague and synonymous of deregulation in all sectors, and in particular, in the financial sector. According to these authors, the financialised regime based on financial derivatives[2] is a new mode of capitalist regulation adopted by large multinational corporations in accord with big banks and other large financial institutions. They consider that financial derivatives constitute a new form of international currency, a meta-commodity money the value of which varies in time and space. This new regime has developed not because there were no rules but because existing rules became ineffective. The necessity of a new regulation is required in order to confront this new type of capitalism. Other regulationist authors like Boyer (1999) share a similar viewpoint by asserting that the financialized accumulation regime is the one subjet to the global constraint of world financial markets. " [finance capital] occupies a structural position allowing it to impose its logic and its constraints to All other institutions built on a regulation mode" (Lordon, 1999, p.228).

Before specifying these changes using a model, priority will be given in the first section to the analysis of the Canadian quarterly series over a 50 year period. The theoretical foundations of the heterodox model are given in the second section. The third section contains preliminary specifications or choices required before estimating the parameters for a cointegrated model. The last section is entirely devoted to the analysis of the econometric results.

1.0 Canadian quarterly time series

1.1 Growth rate and change in the level of some variables

Some 20 quarterly series have been selected to represent stylized facts of the evolution of the Canadian economy for the period 1947-1999. Variables with DL letters measure their rate of change or growth rate because the data is in natural log form. Structural changes or breaks in the time series are analysed by comparing the annual growth rate between the Fordist period (1947-1975) and the post-Fordist period (1976-1999). Half a dozen of variables assumed a priori without trend are added to measure their average level change. Before estimating the parameters of a cointegrated model, the series reveals major breaks in the accumulation regime between the two periods. Obviously, a major reorganization between capital and labour occurred in the post-Fordist period in favour of capital and fundamental changes are observed about financial markets at the national and at the world level.

As it will be seen by the analysis of stylised facts, the Canadian neoliberal regime is typical enough of regimes observed in Anglo-Saxon countries, namely the US regime. Productivity is however lower in Canada than in US, namely because of the weakness of

[2] It is interesting to note the rapid development of new financial institutions in US after the disappearance of the US Dollar-Gold Standard. Option derivatives on exchange rates were introduced for the first time on the Chicago Mercantile Exchange in 1972; the Chicago Board Option Exchange was created in 1973 in order to regulate the option derivative contracts that were done previously Over the Counter (OTC); the Chicago Board of Trade introduced for the first time interest rate derivatives in 1975.

fixed capital investment in the private sector. Is it because of a branch plant development where research is done abroad or is it because of a lack of Canadian entrepreneurship?[i]

Another important feature of the Canadian economy is its degree of openness to the world economy and, in particular, to international financial markets. Our model contains a specific behavioural equation, the interest rate equation based on the balance of payment constraint, to account for this situation. The Canadian banking system is highly concentrated between half a dozen large banks and the latter are managed in a more prudential manner than other banks in the US or in Europe. This is the main reason why Canada avoided the subprime crisis and emerged more quickly from the economic crisis than in the US. Nevertheless, the Canadian economy remains strongly integrated to the American economy through NAFTA (the North American Free Trade Association). Obviously, a major reorganization between capital and labour occurred in the post-Fordist period in favour of capital and fundamental changes are observed about financial markets at the national and at the world level.

Table 1.1 Average annual growth rate (%), average level, % change between 1947-1975 and 1976-2009

Variables	47-75	76-09	47-09	Δ %
DLi (interest)	6.3	-9.2	-2.0	-250
DLr (profit)	-1.6	0.8	-0.4	150
DLrho (financial profitability)	8.1	-10.4	-1.6	-228
i (nominal interest)	4.1	7.4	5.9	80
i (real interest)	0.3	3.4	1.9	1033
r (profit rate)	5.9	5.1	5.5	-14
Rho (qi/r)	0.764	1.517	1.174	99

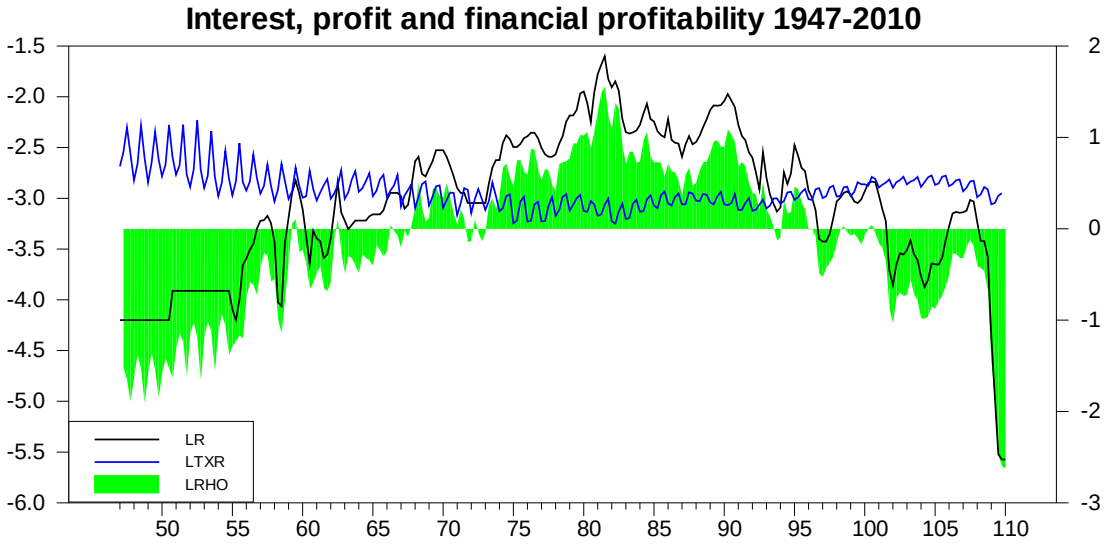
Although the data in the second part of table 1.1 refers to variables assumed a priori without trend, it can be seen a posteriori that those variables have non stationary trends (see table 2 for tests of unit root). This is also illustrated by the graph. Variables in graph 1 are measured in log, hence in level and where the slope is the rate of change, or the growth rate.

The most striking thing observed from the table is the large changes in the average value of this particular set of variables with the exception of the profit rate level. That is a good illustration of major structural changes in the accumulation regime from the Fordist period to the neoliberal period. For instance, the rate of growth of interest, profit and financial profitability are changing signs between the two sub-periods. It is observed from graph 1 that the profit rate is downward sloping in the Fordist period while its slope is reversed in the second sub-period. This is illustrated in table 1 by an average annual growth rate of -1.6% in the first period and a positive average growth rate of 0.8% for the profit rate in the neoliberal period. This is an interesting fact because it is a bone of contention among Marxist economists. Of course, one can arrive at a different result if a different measure of the profit rate is chosen[3]. That result is not contradiction with the

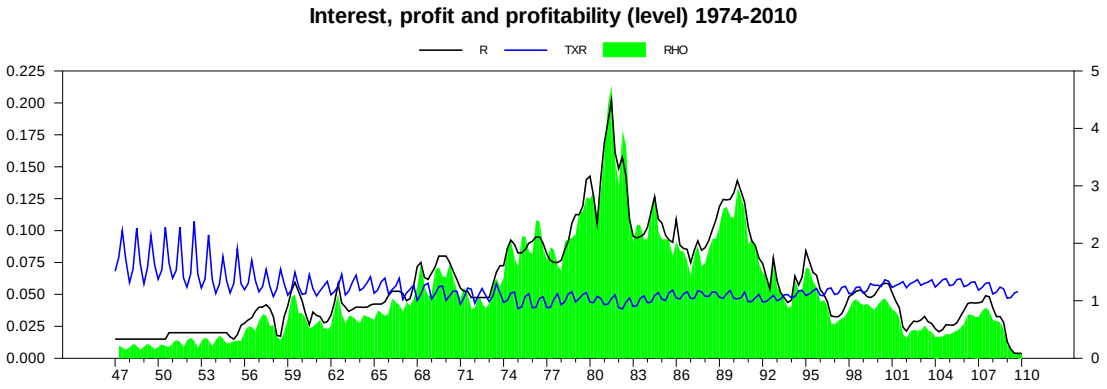
[3] If the net stock of fixed capital is chosen instead of the gross stock as it is the case in this article, the level

fact that the average level of the profit rate decreased by 14% between the two periods In graph 2 it is observed that the level of the profit rate is between 8 to 10% at the beginning of the Fordist period and around 5% in the 80s.[4]

Graph 1a



Graph 1b



The importance of the yield of the financial sector in the neoliberal period ought not to be neglected because it influences the average level of the profit rate. Statcan[5] publishes series on profit and yield for the financial and the non-financial sectors. The profit margin in the financial sector was 21.6%% in 2010 compared to 6.6% in the non-financial sector. That has the effect to boost the average profit to 8.11% for the whole economy. Therefore, without the financial sector, the profit rate would continue its decline.

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of the profit rate will be affected. The gross stock measure has the advantage of avoiding the problem of choosing among different types of depreciation.

[4] The strong seesaw movement observed from the period 1947-1955 is explained by the fact that StatCan did not publish annual series on the stock of fixed capital before 1955. The data for the early period were generated by extrapolation of a linear tendency between 1955-1964.

[5] Statcan (2011), Evolution of the financial situation, SCIAN, series V634754 and V634853.

Another important change is the growth rate decline of the interest rate between the Fordist and the post-Fordist period. To be more precise, the interest rate climbed to reach an unsurpassed summit until1981 and started declining toward near 0 in the first quarter of 2010. That illustrates a radical change in the monetary policy by the Central Bank of Canada after 1976. Indeed, the nominal rate almost doubled (7.4% compared to 4.1%) while the real rate increased by 1033 % between the two periods. Note that the average level of the real interest rate is 1.5% above its long-term value (1.9%) in the neoliberal period. That shows that financialisation has a cost which will impact on the real wage rate.

Given the choice of the measurement of rho, this variable is more an indicator of financial return for the rentiers and financiers class than an indicator of real return based on the profit rate, the latter varying inversely with rho. The criterion of financial profitability is very important since it combines two key variables for a capitalist regime – interest rate and profit rate. These influence prices, real wage and components of the aggregate demand -consumption and investment in particular. Although the growth rate of rho is decreasing in the post-Fordist period (-228%), its average increase level is near 100%. From the graphs, it is clearly seen that the value of this variable is dominated by the interest rate and, hence, by the monetary policy. Indeed, this change cannot be explained by a lower profit rate but by a higher interest rate. This shows also that a major institutional change occurred when the US Dollar's link to gold was abolished and a generalized flexible exchange rate took place after the Jamaican Agreement in 1976. Volatility of exchange rates and the creation in Chicago of financial derivatives on exchange and interest rates in the early 80s becomes in the last 20 years a new way for firms to protect themselves against financial risks.

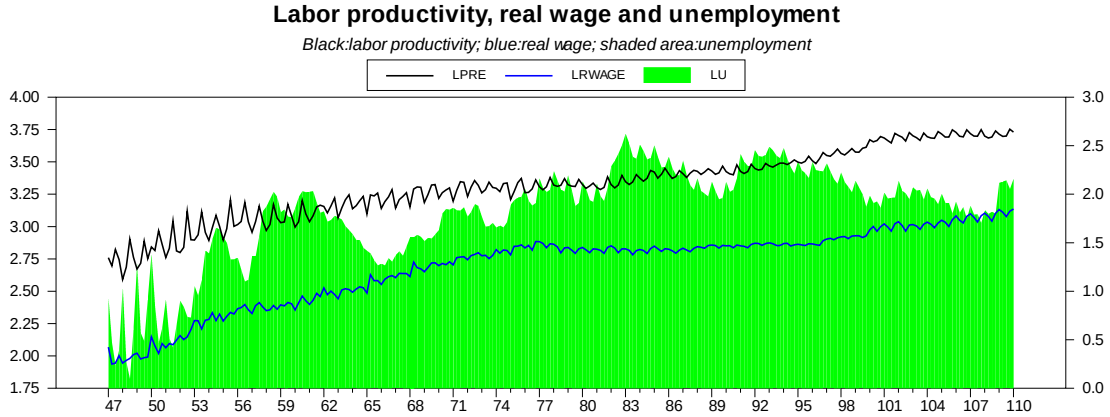
Table 1.2 Average annual growth rate (%), average level, % change between 1947-75 and 1976-2009

Variables	47-75	76-09	47-09	Δ%
DLY (aggregate demand)	5.0	2.8	3.6	-44
DL(Y/E) (Productivity)	2.4	1.2	1.6	-50
DL(w/p) (real wage)	3.2	0.8	2.0	-75
DLp (inflation rate)	3.8	4.0	4.0	6
DLu (unemployment)	5.3	0.4	2.8	-92
Y (GDP x 10^9)	62.4	192.4	133.1	208
w/p (real wage rate)	11.89	18.73	15.40	58
u (unemployment rate)	4.6	8.5	6.7	85

A 75% diminution of the growth rate of the real wage is observed between the Fordist and the post-Fordist periods. That can be compared to a 50% diminution of the growth rate of productivity. Capitalists took a larger share of productivity gains in the neoliberal period. This is a major structural change putting an end to the Fordist compromise of sharing productivity gains. Combined with the increase of the growth of profit rate, one can see how the distribution of the net product in favor of capital occurred in the

neoliberal period. In graph 2, one sees the steady growth rate of the real wage in the 1947-1975 period with a slope around 25 to 30 degrees. In the period starting in 1976 and on, the slope is flattened to near zero up to 1997. Growth of the wage rate resumed in 1998 but at a much slower pace. If the high income professionals are removed from the wage bill, the growth rate of real wage in the neoliberal period would probably be near 0. If in addition the wage earned in the financial sector is removed from the wage bill, the real wage in the non-financial sector would most likely be negative because employees in the financial sector are on the average paid 30% more than those in the non-financial sector[6]. Another way to look at the diminution of the labor share in the GDP is to observe that while the GDP growth is 208% between the two periods, the growth of the wage rate is only 58%.

Graph 2



The growth rate of unemployment reverses itself after 1983 although the average rate nearly doubled between the two periods (4.6% to 8.5%). The increase of the unemployment rate is characterized by two tendencies: the period 1947-1983 is a strong upward tendency and in the last period 1983-2010 is marked by a reversal of the tendency, although the average level remains high. Deregulation and labor flexibility was the hallmark of the Reagan administration.[7] The Canadian businessmen and politicians - who are always ready to follow what is going on south of the border- jumped into the footsteps of their American counterparts. Flexibility of the labor force means more part-time, temporary and autonomous jobs. This is what sociologists call atypical or precarious employment. According to Statcan[8], the percentage of part-time employees was 12.4% of the total labor force in 1976. That proportion is now 18.4% in the first quarter of 2010. That represents a jump of 50% of the importance of part-time workers in the total labor force. The turning points of unemployment rate coincide with the business cycle: end of the Korean war in 1954, recession in 1958-61, recession in 1971-72, stagflation 1973-1982, end of the Gulf war followed by a recession in 1991, the technological bubble in 2001 and the great financial crisis in 2008.

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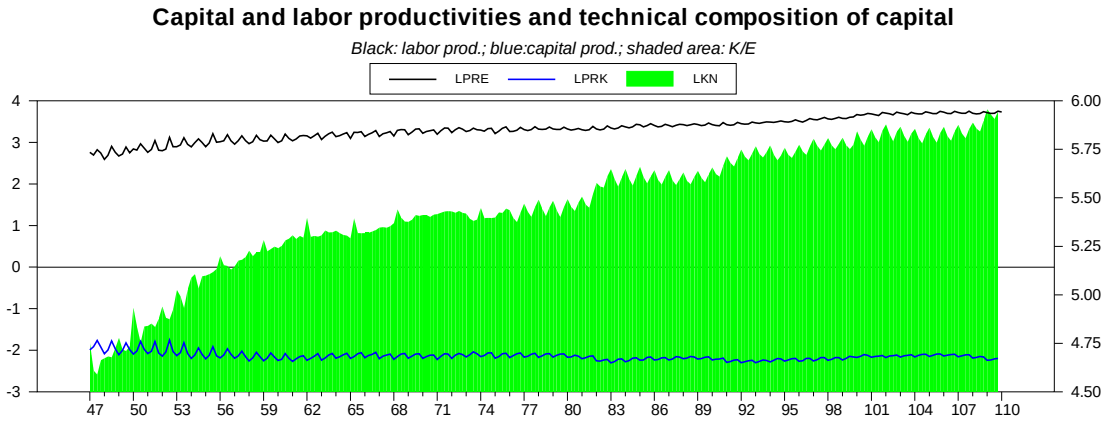
[6] Statcan (2011), Average weekly earnings, series V1558664 and V1558902.
[7] Recall that one of the first steps that Reagan did in 1983 was to smash the air controller strike by replacing them with people from the army.
[8] Statcan (2011), Quarterly survey of employment, 1976-2010, series V2091114 and V2091051

Table 1.3 Average annual growth rate (%), average level, % change between 1947-75 and 1976-2009

Variables	47-75	76-09	47-09	Δ%
DL (Y/E) (labor productivity)	2.4	1.2	1.6	-50
DL (Y/K) (capital productivity)	-0.6	-0.1	-0.4	83
DL (K/E) (capital/labor)	2.9	1.6	2.0	-45
Y/E (labor product. level) 10^{-2}	.225	.336	.285	49
Y/K (capital product. level)	.124	.113	.118	-9

Interestingly, graph 3 shows the decomposition of the capital/labour ratio into its two components: the productivity of labour and productivity of capital where by definition K/E = (Y/E) / (Y/K). Also interesting to note is that while labour productivity increases, the productivity of capital decreases during the whole period (see the level change of the two variables). The decline of the growth rate stops after 1982. Since capital productivity is the denominator of K/E, then the combined effect is to raise the technical composition of capital which has negative feedback on the profit rate.

Graph 3



As already noted from previous table the pace of growth of labor productivity is reduced by half in the neoliberal period while the pace of the decline of the capital productivity growth is stopped in the second period.[9]

Investment in fixed capital did not help to raise productivity while investment in human capital seemed to have contributed to productivity increase. This could explain why productivity in Canada is lagging behind productivity in the USA. The Shaw report (2000) validates the productivity paradox which has been observed in many other countries. For instance, even if there has been a major investment in computers in the

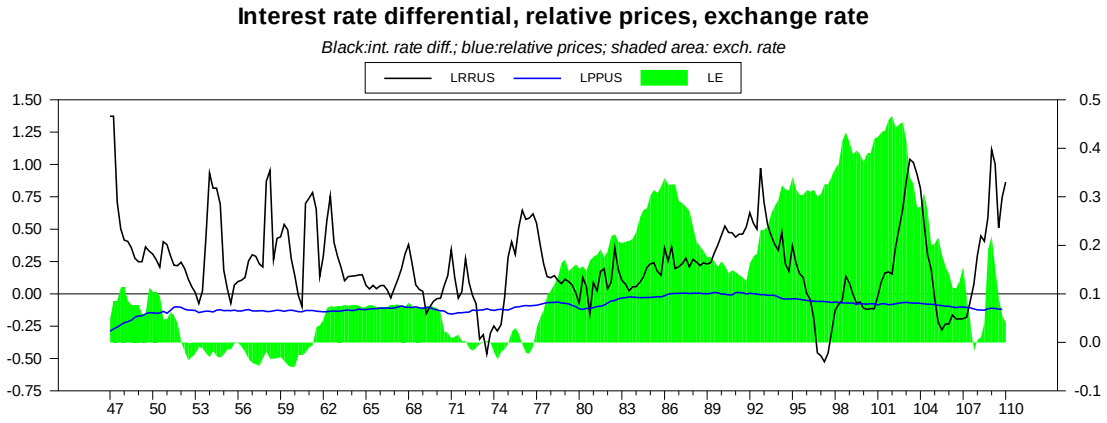
[9] Here again differences in the level of capital productivity might be observed if the net stock of capital is chosen instead of the gross stock.

service industries (64%) between 1992 and 1995, total productivity increased only by 1.2%, Canadian entrepreneurs are hesitant to invest in new and better performing technologies and prefer the shelter of successive money devaluations than facing competition with better equipment[10].

Table 1.4 Average annual growth rate, average level(%), % change between 1947-75 and 1976-2009

Variables	47-75	76-09	47-09	Δ%
DL(i/i*) (int.cdn/ int.usa)	-3.0	0.8	-0.8	127
DL(p/p*) (p cdn/ p usa)	0.6	-0.1	0.4	-117
DLe (exchage rate)	-0.2	0.1	-0.1	150
Exchange rate US/CDN$	1.028	1.269	1.159	23

Graph 4



Many interesting features can be seen in table 1.4. Note the increased pace of growth of the interest rate differential between the Fordist and the post-Fordist periods (127%). This illustrates that the Canadian monetary policy has been much tighter than the USA policy in the post-Fordist period. This is particularly true in 1975-78 when the governor of the central bank opted for a tight monetary policy. He received Milton Freedman' congratulations as the best disciple in applying his policy recommendations. In the 1992-94 period, the central bank applied again a tight monetary policy for no good reason since inflation was no more a treat. Although the interest rate has been reduced to near zero during the 2008 great financial crisis, the Governor, M. Carney, is again ahead of its US counterpart.

Another interesting feature is the accelerated pace of devaluation of the $CDN in the second period (150%). Since log 1 is 0 (right coordinate in graph 4), the Canadian dollar was at par with the US dollar in 1975-76. It must be recalled that during the period 1952-1962, Canada opted for a flexible exchange rate and this can be seen by the shaded area in graph 4 where

[10] Shaw (2000) argues that a weaker productivity is more frequent in industries under the control of Canadians. He calculated that productivity in Canada was 10% less than the USA in 1977 and that gap has doubled in 1999. But this was compensated by the fact that the Canadian dollar was 20% below parity with the US dollar

the CDN$ was above parity with respect to the US$ due to a large influx of foreign capital. After 1962, Canada opted for a fixed exchange rate under the par value with respect to the US$. This situation prevailed until the end of the Bretton Woods Agreements in 1971. The CDN$ floated around parity for the period 1971-1976. Then it started to depreciate until 2002. The rapid appreciation that followed put the CDN$ at par in 2008. It is now above par in 2011. This can also be observed by looking at the average level between the two periods: the devaluation increase is 23%. The Canadian dollar value increased for a brief period in 1985-1992 after the Plazza and the Louvres Accords where it was agreed to let the US dollar depreciate with respect to other monies. Note that the slope of the relative prices (domestic vs foreign) is rather flat in both periods.

2.0 Theoretical foundation of a heterodox model

2.1 Heterodox theories

Our goal is to measure changes with a macro-model of six behavioural equations and with a few definition relations. What theory or approach is used for the specification of the equations? The model is a heterodox model inspired by Regulationist and Marxist approaches. The Regulationist approach outlines the importance of the wage rate relation and aggregate demand while the Marxist approach gives pre-eminence to the profit rate and the mobility of financial capital. While selecting Duménil-Lévy's contributions to represent the Marxist School, Aglietta-Boyer-Billaudot-Petit's contributions were chosen to represent the Regulationist School[11].

For Duménil-Lévy, Marx's basic idea is that what matters most is not the competition of firms for a particular product market but competition for the capital market being the main cause for the tendency of equalization of the profit rate between the various production branches or industries. Hence, the profit rate and the evolution of its components being those of exploitation rate and organic composition of capital form the engine of growth for the capitalist system. With the exception of a difference in vocabulary, Marxist and Regulationist approaches have much more in common than one would expect. Indeed, the exploitation rate is the ratio of profits to labour compensations which can be expressed by labour productivity and the inverse of real wage rate[12]. Similarly, the organic composition of capital is the product of the technical composition and the inverse of real wage. The profit rate which is defined as the ratio of the exploitation rate over the organic composition of capital is therefore a (non-linear)

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[11] Duménil-Lévy have written many articles for leftist reviews, but the essence of their thinking can be found in three of their books (2004, 2003, 1996). The Regulationist school is represented by Aglietta (2004, 1999, 1976), Boyer (2004, 1995, 1986, 1976), Billaudot (2001, 1976) and Petit (2005, 2002, 1991). Although Keynes' theory is developed on a short-term basis, most Keynesian and post-Keynesian economists have developed long-term models and identify themselves as heterodox economists close to the Regulationist school with aggregate demand at the core of their approach.

[11] Assuming ε = exploitation rate, the inverse $(\varepsilon + 1)^{-1} = \beta$ = labour share in value added.

function of labour productivity, the capital/labour ratio and the real wage rate. Since the capital/labour ratio is the ratio of labour productivity over capital productivity, the profit rate can be expressed as a function of capital productivity.

Regulation theory is an approach that allows an analysis of the reproduction of the capitalist regime (or its crisis) given that the economic, social, political, cultural, and religious institutions are stable in the mid-term and changing over the long-term. In economics, regulation theory pertains more to the field of dynamics or growth theory than the legal or bureaucratic aspect of regulating an economic sector. The capitalist regime is characterized by institutional forms that allow the reproduction or the changes of the partial regulations (relations) whether the latter is a competitive regime or any other type. The Fordist regime which prevailed between 1945 to the mid-seventies has been described by Aglietta (1976) or Boyer (1979) using five institutional forms: a wage relation, a competitive or monopoly regime, a monetary system and the corresponding exchange rate regime, the role of the state and the international institutions.

There is another important difference with the Regulationist approach where productivity is assumed endogenous. To that extent, Regulationists are closer to mainstream economists like R. Lucas (1988) or P. Romer (1990) who have developed a theory of endogenous technological progress, although, from a very different basis[13].

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." This quotation means that our heterodox model must not be a simple formal macro model but must be a macro-dynamic model. Therefore, one must choose an econometric methodology that fits a dynamic structural model. The Error Correction Model (ECM) or the estimation of the parameters of long-term relations specified over a cointegration space will be the core of the empirical analysis in the last part of the paper.

In the fourth section 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. We have enlarged Billaudot's approach to an open economy model, in particular, by specifying an interest rate equation derived from the balance of payment constraint. The endogenous variables described by seven behavioural equations are consumption, investment, productivity, wage, price, money demand and interest rate. The endogenous variable pertaining to the macro equilibrium condition is that aggregate supply (production) equals the components of the aggregate demand with no inventory variation. Variables pertaining to the definition relations are employment, the profit rate and the financial profitability norm (gap between interest rate and profit rate). Variables that are important in the short-run such as the degree of capacity utilization are left out of the mid-term equilibrium model. 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

[13] The Regulationist hypothesis of endogenous technological change is inspired by the following authors: Young (1928), Kaldor (1966), Verdoorn (1980).

Correction Model. In order to reduce the number of cointegration relations, employment, consumption and investment will be substituted into the aggregate demand. Price and wage equations will be replaced in many cases by a real wage equation.

2.2 Equation system of the model

2.2.1 The productivity equation: Y/E = f1(Y, K/E, t) Productivity depends on the scale of the economy (Y), on technical changes embodied in new equipment and in the new division of labour (K/E). The main justification for an endogenous productivity (or endogenous technological progress) is based on the Kaldor-Verdoorn law (1980) based on the scale of production or demand. Lucas (1988) and Romer (1990) give another justification for the hypothesis of an increasing-returns-to-scale production function: the level of knowledge is increasing independently from capital and labour. Therefore, the scale of the economy (Y) is an explicit argument of the productivity function. This could be justified by the expenditure of the private and the public sectors spent on research and development. Another justification would be the amount of state expenditures in education, health and other infrastructures. Indeed, the quality of human capital is not only in the level of education but also in the quality of the health services that a country has developed. Note in passing the importance of the state as a regulating institution. The other determinant of productivity is the capital/labour ratio (K/E) which embodies the Schumpeterian innovation process and a new division of labour. It is assumed endogenous by Regulationists (Petit, 2005) and exogenous by D-L.

2.2.2 The employment equation: E = Y/Y/E = f2(t)

The mid-term equilibrium employment is growing at a constant rate, and E will be substituted in the consumption function by its definition[14]. The substitution of employment in the consumption function and the latter in the aggregate demand can make productivity appear in the final demand equation with a negative sign if the real wage rate is not specified. Since the state and private sector use the labour market for adjusting the capitalist regime, it would not be a total surprise if the market is in disequilibrium in the mid-term. This is seen if the unemployment rate is significant in the wage and demand equations.

2.2.3 The real wage rate equation: w/p = f3(ρ, Y/E, u, t)

The equilibrium wage depends only on price, productivity, financial profitability and unemployment rate. With the demand equation, the wage equation is most fundamental in the Regulationist approach, since it contains the major determinants explaining the growth of a capitalist economy. If one assumes that the labour market is fully adjusted in the mid-term, then the equilibrium real wage is growing at the same pace as productivity if price and wage are growing at the same pace. This is a result that Dumenil-Levy (1996, p.236) also arrived at.

Given the income distribution parameters, the real wage rate is also dependent on the

[14] The trend term t will be left out from the co-integration space and will appear as a constant in the difference equation

profit rate that is included in the financial profitability criterion. In a competitive regime, there exists a negative link between wage and profit, which implies a positive coefficient for ρ. However, in a monopolist regime where the entrepreneur has the choice of transferring rising financial costs to the consumer by increasing price-- profit rate and real wage can move in the same direction, implying that the rho coefficient is negative and that financial profitability pushes down the real wage[15].

Because of the persistence of a the long-term rising tendency of the unemployment rate, most heterodox economists reject the assumption of an equilibrium labour market and assume that the wage equation is not following a Philips curve with a negative coefficient. Therefore, in addition to productivity, the wage equation will contain the unemployment rate (u) as an exogenous variable.

2.2.4 The price equation: p = f4(w, ρ, Y/E, t)

In a mid-term competitive equilibrium, prices are constant. Prices in a monopolist regime are far more complicated. It depends positively on the current wage-productivity gap (w/(Y/E) and on a financial profitability criterion (ρ). The rho sign coefficient is the same as in the real wage equation but results are inverted. The rho coefficient must be negative since a price rise increases the profit rate and diminishes the financial profitability rate. A rise in the relative price (p/w) is equivalent to a fall of the real wage. Even if most of the time our specifications constrain price and wage therefore moving at the same pace, the price equation remains a fundamental equation that reflects the state of competition in the economy, where prices appear not only in the wage equation but also in the money demand equation and in the interest rate equation.

2.2.5 The consumption equation: C = f5(E, w/p, ρ, t)

The consumption is a function of direct income, therefore includes employment and 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. The coefficient of the social transfer variable was not significant while the coefficient for credit was significant but with a weak elasticity. In order to minimize the number of (stochastic) exogenous variables, we have chosen to amalgamate credit and transfers with the constant term. This equation constitutes one of the basic tenets of the Regulationist approach: the growth of the system is generated by the growth of demand which is dependent on the growth of the real wage rate and the employment. Therefore, after substituting the determinants of the real wage rate, (Y/E, u and ρ) and the determinants of employment (E=Y/Y/E), consumption can be seen as a positive function of the profit rate and productivity and a negative function of the interest rate and the unemployment rate. Consequently, the ρ coefficient has a negative sign. Note in passing that the interest rate in the consumption function plays the same role as the credit variable explicitly introduced in the 1995 model: an accommodating monetary policy increases consumer credit and generates the contrary with a tight monetary policy.

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[15] Let $w/p = \beta\rho$ with $\beta < 0$. If $dr>0$, $\rightarrow d\rho<0$, $\rightarrow d(w/p) >0$. Let $d(qi) > 0 \rightarrow d\rho >0$. $\rightarrow d(w/p) <0$.

2.2.6 The investment equation: I = f6(C, ρ, t)

In the mid-term competitive equilibrium, investment is solely a function of past profits. This assumption is also made by Dumenil-Levy whereby the rate of investment or the capital stock growth rate is a positive function of the profit rate included in the financial profitability rate. The negative sign of the ρ coefficient is also justified with the presence of the interest rate in the numerator.

In the Regulationist approach, investment is a positive function of past levels of consumption (C) and a negative function of the financial profitability criterion (ρ). The profitability criterion makes the investment function a negative function of the interest rate and a positive function of the profit rate. We therefore obtain the Marxian profit rate relation and the Regulationist demand effect with past consumption. Note again the key role played by the financial profitability criterion: if the profit rate is fully adjusted to the interest rate in the mid-term (a Sraffian equilibrium for instance), then investment becomes a function of consumption alone. However, this last hypothesis is not a realistic one since our heterodox model must also take into consideration the case of competitive firms whose past profits are future investments.

2.2.7 The money and interest rate equation: i/i* = f7 {(IM/X),(e),(p/p*)}

The money supply is assumed endogenous to the money demand which is a positive function of transactions (i.e. price and output) and a negative function of the interest rate[16]. The endogenous interest rate assumption is a matter of controversy. According to Mandel's impossibility triangle (1968), only two of three following situations can be achieved: i) a fixed exchange rate regime; ii) a free flow of financial capital; iii) an autonomous monetary policy (exogenous interest rate fixed by the central bank). In Canada, there were periods where the exchange rate was fixed and other periods where it was floating, sometimes a dirty float and other times a free float. During the period 1991-2000, the central bank based its monetary policy on an index of monetary conditions (IMC) weighted according to the exchange rate and the interest rate[17]. The endogenous interest rate policy is linked with the first two conditions that prevailed in 1947-1952 and 1962-1971 (see graph 4). During the period 1953-1962, the central bank had the possibility of acting more autonomously. This independence of the monetary policy was also a possibility, although the period of dirty float 1991-2000 hampered the autonomy of the central bank. One must remember that the Canadian economy is largely dominated the US economy and it is difficult to ignore movements in the value of the US dollar. This point was well outlined by Le Héron (2001):

"Far from an exogenous monetary policy determined by an independent central bank, it is observed instead [the Canadian case] an endogenous monetary policy that seeks to hide the reality. That is even truer in countries dominated monetarily."

The Mendel impossibility triangle necessarily refers to the balance of payment and this is

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[16] A more complete model of the business cycle, inspired from the Minsky approach, would include in the money demand financial transactions and derivatives.

[17] For a more detailed explanation about the IMC, see Le Héron (2001).

another way of viewing the endogenous character of the interest rate which has to be determined inside the of the following constraints:

- The constraint of the balance of payment which is, by definition, a zero sum with the current account and the capital account. Consequently, a positive balance in the capital account must be compensated by a negative balance in the current account (a deficit), and vice versa. It is assumed that the capital account is a positive function of the interest rate differential between the domestic rate and the foreign rate (i/i*). Foreign capital is attracted by a higher domestic rate.
- The interest rate is determined by the price differential between the domestic price and the foreign price (p/p*), whose function is to reflect the state of international competition.

The capital account is a negative function of the nominal exchange rate e (CDN$/US$) with a money devaluation increasing exports, reducing the current account deficit and therefore there is negative relation to the interest rate differential. The capital account is positively related to the price differential (p/p*) – inflation increases the current account deficit and, hence, is positively related to increase of the capital account and 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, $e_r = e(p^*/p)$[18].

If the interest rate gap is made an explicit function of the capital account function or the current account deficit (IM/X), the equation is $i/i^* = A(IM/X)^{\alpha} [e(p^*/p)]^{-\beta} = A(IM/X)^{\alpha} e^{-\beta} (p/p^*)^{\gamma}$, where α, β and $\gamma > 0$.

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 (2001) this was the policy rule followed by the Treasury at the time of the international gold standard and it remained more or less like that after the Second World War until the beginning of the 70's when dollar-gold convertibility was abandoned. It is the exchange rate flexibility which allows the central bank the possibility of conducting an independent monetary policy. Therefore, a completely endogenous monetary policy exists if the central bank chooses to regulate the exchange rate.

3.0 Preliminary specifications before estimation

3.1 Specification of a dynamic 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'

[18] One might think that in the mid-term equilibrium our model is based on the purchasing power parity theory with unitary elasticities for the variables e and p/p*. In truth, these two variables are assumed as common stochastic tendencies and therefore non-cointegrated. The substitution of net exports by the exchange rate in the aggregate demand and in the interest rate equation will influence the magnitude of the e and p/p* coefficients.

measure the rate of change of y over a time period, β is a structural parameter that is usually assumed constant over a mid-term period, although it may also be assumed to change over a long-run period. In that case, β is also a function of time. One should not confuse the structural stability of a system with the stability of a particular solution of a differential equation. The solution of a differential equation leads us to analyse conditions that guarantee a stable or convergent solution over a certain time horizon. That depends on a certain set of values of structural parameters and initial conditions. This is an interesting exercise in the case of a growth model based on a differential equation after estimating its structural parameters. The stability of the model can be checked when all variables have the same growth rate or have different growth rates.

It is important to estimate the structure before attempting to simulate the inherent stability of the model. The model is specified and estimated from time series of quarterly Canadian data (1947-2009) and is a structural dynamic simultaneous system that has 6 equations and two definition relations. The model is linear in parameters, and the variables are in log-transform so that the first difference of a variable measures its rate of growth. Time is measured in discrete periods for a quarterly representation, and the order of the difference equations varies between 4 to 6 periods (See table 2 for the choice of the order of the VAR). Each equation is supplemented with a stochastic term which is related to a stationary condition. The software package CATS in RATS (Dennis, 2006) is based on the Johansen (1995,1996) and Juselius (2006) method of estimating simultaneous cointegrated relations of a certain number of endogenous variables. Our model specifies 15 variables and 8 cointegration relations and therefore 7 variables are common stochastic trend variables -variables that are exogenous in our structural model. The number of cointegration relations can vary according to certain particular specifications. Obviously, with a system containing more than one cointegration relation, there is the problem of identifying a particular cointegration relation to a structural equation which becomes very difficult unless some a priori restrictions are specified on the coefficient matrix of the cointegration space. Finally, tests of structural changes are presented by comparing results obtained for two sub-periods: the Fordist period 1947-1975 and the post-Fordist period 1976-2009.

3.2 The specified model

After substitution of C and I in the aggregate demand Y and dropping all variables which may be important in the short-term period but are left out of the cointegration space, the model estimated is a 8 equation system, (6 behavioural equations and 2 definition relations) which implies that one must identify at least 8 cointegration relations:

$Y/E = f1\ (Y, K/E)$

$Y = f2\ (E, w/p, u, \rho, G, e)$

$w = f3(Y/E, u,) = f4\ (Y/E, \rho)$

$p = f4(Y/E, \rho)$

$i = f5\{(i^*, (M/X), (e), (p/p^*)\}$

$r = f6(Y/E, w/p, K/E)$

$\rho = f7(iq/r)$

$M1/p = f8\ (Y, i)$

In order to eliminate multicollinearity and avoid a singular general matrix with no inverse, the ρ equation is eliminated from the system and replaced by a constraint on i and r each time ρ appears in the other equations. Note that in the demand equation the exchange rate e has replaced the external trade account (X/IM). In certain specifications, the government expenditure variable G is amalgamated with the constant term. A similar substitution is made in the interest rate equation where the external deficit (M/X) is replaced by the exchange rate e. These substitutions are necessary if one wants to reduce the number of variables in the cointegration space. The cointegration space could have been reduced to 6 equations by ignoring the definition relation (r) whose main role was to close the system. It was decided to keep it as a check for identification purpose. If the choice of particular constraints gives the wrong signs in the definition relation, this indicates that a better one needs to be chosen. For productivity to appear in the demand equation and test the Regulationist cumulative causation hypothesis (Boyer-Petit 1991), it is necessary to replace E by its definition in the final demand equation. Therefore, the signs of the productivity coefficient, the real wage rate coefficient, the profitability coefficient and the exchange rate coefficient in the demand equation become crucial to watch.

3.3 Preliminary results before estimation

Table 2 Test of unit roots

Variable (log)	T-stat.	Unit root
LY	-3.1906	yes
Lp	-0.2962	yes
Lw	-2.0634	yes
L(w/p)	-3.9865	no
Li	-1.1345	yes
Lr	-2.0169	yes
Lrho	-1.1635	yes
LM1	1.3363	yes
Le	-1.3865	yes
Li*	-2.0662	yes
Lp*	0.6970	yes
L(Y/E)	-3.0807	yes
L(Y/K)	-2.2266	yes
L(K/E)	-3.1555	yes
Lu	-3.5184	no
DLp	-3.2251	yes(1%)

The 5% critical level is -2.8732 and the 1% level is -3.4587. If the calculated T value is **algebraically** above these levels, the null hypothesis of 0 unit root is rejected and the hypothesis of a unit root is accepted.

3.3.1 Test of unit roots

Before beginning the tests for the mid-term model, it is important to make unit root tests for all the variables of the model. Results are contained in table 2. All variables are I(1). Hence, the cointegration analysis with short-term variables in first differences is well indicated.

3.3.2 Choice of a constant term

Before determining the cointegration space for each specification, the CATS software allows one to check whether a constant needs to be included or excluded from the cointegration relations.

The results are not reported here but the best choice was to select a constant outside the

cointegration relation, representing a constant in the first difference equation that gives a deterministic trend for variables measured in level. Three dummy variables were added for seasonal variations.

3.3.3 Specification of the order of the VAR

The Error Correction Model is based on a vector autoregressive model (VAR) of order k. According to table 3, the HQ criterion for an optimal k is 6 while the optimal value is 4 according to the SC criterion. In order to minimize the possibility of autocorrelated residuals and also because some policy effects are spread over 18 months, we chose k=6.

3.3.4 Determination of the rank of matrice Π = αβ'

Matrix Π contains coefficients of level variables corresponding to mid-term equilibrium relations added to the short-term variations of the system. The matrix dimension is equal to the number of the variables (h) in the system. If all variables are stationary, the rank s of the matrix is equal to h; this is impossible if the non stationary variables are cointegrated together. Therefore, the rank of the matrix is less than the number of variables (s<h) -the rank determining the number of cointegration relations. Matrix **Π** can be decomposed to form two matrices of which one is the matrix of the coefficients **β'** of the cointegration relations (dimension s x h). Following that **α** is a matrix of dimension s x h and the latter is called the "loadings" matrix or the adjustment matrix. Its role is to take into account the possible disequilibrium in some of the cointegration relations.

Concerning the other variables that are not characterized by a cointegration relation, their number is (h-s) and represents common stochastic tendencies that are described as

Table 3 Choice of the order of the VAR

Nb. Lags	3	4	5	6	7
HQ (Hannan-Quinn)	-31.58	33.24	-33.42	-33.44*	-33.27
SC (Schwarz)	-30.67	-32.09*	-32.02	-31.81	-31.38

moving average processes. Their number also corresponds to the number of unit roots in the system. These common stochastic trends take on the role of shocks on the equilibrium of the cointegration relations. For the analysis of structural changes, the investigation is limited to the estimated results of the **β** matrix, even if it would be interesting to examine the coefficients of the **α** matrix or of those of the short-term variations of variables in the system (6 matrices if k=6). The CATS software gives the above table 3 for choosing the rank.

Table 4

Rank test with a 15 variable system

h-s (no of unit roots)	s (no of coint. relat.)	Eig. Value	Trace	Frac95	P-Value
15	0	0.407	798.6	508.6	0.000
14	1	0,389	670.6	446.7	0.000

13	2	0.348	550.1	388.8	0.000
12	3	0.292	445.2	334.9	0.000
11	4	0.237	360.6	285.0	0.000
10	5	0.201	294.4	239.1	0.000
9	6	0.193	239.5	197.2	0.000
8	7	0.156	186.9	159.3	0.001
7	8	0.142	145.3	125.4	0.001
6	9	0.108	107.8	95.5	0.005
5	10	0.100	79.7	69.6	0.006
4	11	0.086	53.8	47.7	0.011
3	12	0.075	31.7	29.8	0.029
2	13	0.049	12.7	15.8	0.12
1	14	0.001	0.264	3.8	0.61

For a system of 15 variables and 7 cointegration relations, the trace test rejects the hypothesis of 7 unit roots (h-s) = 7 since the calculated value 186.9 exceeds the 5% critical level of 159.3. We will estimate a system of 7 relations associated to 7 endogenous variables (Y, Y/E, w, p, M1, r, i,) and 8 exogenous variables (u, K/E, G, X, M, i*, p*, e) or common stochastic trends associated to 8 unit roots.

Being that the rank is above 7, the parameters of the cointegration matrix will not be identified with certainty and the risk of an improperly specified model increases. Nevertheless, after trial and error, a reasonably well defined structure was identified. By eliminating G and M1, the size of the model is reduced to 13 variables. The rank test for the system is presented in table 5.

Table 5

Rank test with a 13 variable system

h-s	s	Eig. Value	Trace	Frac95	P-Value
13	0	0.415	578.7	388.2	0.000
12	1	0.333	447.0	334.9	0.000
11	2	0.231	347.2	285.0	0.000
10	3	0.202	282.5	239.1	0.000
9	4	0.196	227.0	197.2	0.001
8	5	0.164	173.2	159.3	0.006
7	6	0.140	129.1	125.4	0.029
6	7	0.093	91.9	95.5	0.087
5	8	0.091	68.1	69.6	0.066
4	9	0.080	44.6	47.7	0.097
3	10	0.053	24.1	29.8	0.202
2	11	0.040	10.7	15.4	0.232
1	12	0.003	.816	3.8	0.366

At the 5% level, the hypothesis of 7 unit roots is rejected in favour of 6 unit roots for 7 cointegration relations. It is necessary to reduce further the number of variables in the

system. Constraints will be imposed on w and p, on M and X, on i and i* and on p and p,* the definition relation r will be eliminated from the system and ρ will be reintroduced explicitly. A reduced model of 4 equations is specified where productivity, real wage, demand and interest rate are 4 endogenous variables with 6 exogenous variables (ρ, u, K/E, M/X, p/p*, e). These fundamental equations are identified to 4 cointegration relations and 6 common stochastic tendencies.

Table 6
Rank test with a 10 variable system

h-s	s	Eig. Value	Trace	Frac95	P-Value
10	0	0.302	333.3	239.1	0.000
9	1	0.253	244.8	197.2	0.000
8	2	0.161	173.1	159.3	0.007
7	3	0.147	129.9	125.4	0.025
6	4	0.105	90.7	95.5	0.104
5	5	0.086	63.5	69.6	0.142
4	6	0.072	41.4	47.7	0.176
3	7	0.053	23.1	29.8	0.246
2	8	0.038	9.7	15.4	0.303
1	9	0.001	0.201	3.8	0.654

At the 5% level, the hypothesis of 7 unit roots is rejected and 6 unit roots is accepted along with 4 cointegration relations, this being the best identified model estimated for the long-run period 1947-2009 and the two sub-periods –the Fordist period 1947-75 and the neoliberal periods 1976-2009.

4.0 Estimated results

The estimated results are sensitive not only to the rank specification but also to the number of variables defining the system, the constraints imposed on some of these variables and to the number of lags which define the dynamic of the system. In order to illustrate all these aspects, the following tables contain the results of 5 different specifications.

Table 7 Variables in each specification
(r=rank, p=number of variables, k= number of lags)

System r6p15k6
(Lw - Lp) Lr LM1 LY Li L(Y/E) LK/E LG LX LM Lu Li* Lp* Le
System r4p13k5

(Lw - Lp) Lr LY Li L(Y/E) LK/E LX
LM Lu Li* Lp* Le

System r4p10k6

L(w/p) L(i/i*) LY L(Y/E) Lρ LK/E L(M/X) Lu L(p/p*) Le

System r4p10k6e

L(w/p) Li Li* LY L(Y/E) LK/E Lρ Lu L(p/p*) Le

System r5p10k5

L(w/p) L(i/i*) LY Lr L(Y/E) Lρ LK/E Lu L(p/p*) Le

Note that the variable M/X is eliminated from the last two specifications.

Variable identification

w	nominal wage rate
p	domestic price
r	profit rate
M1	money demand
Y	aggregate demand
i	nominal domestic interest rate
ρ	financial profitability rate
Y/E	labor productivity
K/E	capital labor ratio
G	public expenditure
X	exports
M	imports
u	unemployment rate
i*	foreign nominal interest rate
p*	foreign price
e	exchange rate (CDN$/US$)

Note that figures in ( ) are calculated **t** values. Since aggregate demand is not exactly identified, **t** values are not reported.

4.1 Estimated results for the long-run period 1947-2009

Table 8.1 Real wage equation 1947-2009

System	L(Y/E)	Lρ	Lu
R6p15k6	0.712 (6.551)	0.081 (2.923)	-0.604 (-10.566)
R4p13k5	1.662 (9.719)	0.384 (5.656)	-0.531 (-3.770)
R4p10k6	1.115 (22.919)	0.086 (7.121)	-0.084 (-2.521)
R4p10k6e	1.389 (26.897)	0.082 (10.320)	0.028 (1.194)
R5p10k5	1.348 (6.159)	-0.016 (-0.391)	0.720 (7.105)

Table 8.2 Productivity equation 1947-2009

System	LY	L(K/E)
R6p15k6	4.545 (14.774)	-8.711 (-11.903)
R4p13k5	0.464 (66.576)	-0.111 (-5.247)

R4p10k6	-1.055 (-5.348)	3.719 (7.827)
R4p10k6e	-0.444 (-3.581)	3.081 (9.701)
R5p10k5	0.211 (9.206)	0.473 (8.750)

Table 8.3 Aggregate demand equation 1947-2009

System	L(w/p)	L(Y/E)	Lu	Lρ	Le
R6p15k6	0.989	0.868	-0.603	0.076	0.439
R4p13k5	1.063	0.787	0.288	-0.239	0.140
R4p10k6	0436	0.542	-0.688	-0.017	2.777
R4p10k6e	1.404	1.018	0.173	-0.182	3.455
R5p10k5	1.842	0.270	2.042	-0.499	1.486

Table 8.4 Interest rate differential and financial markets 1947-2009

System	L(M/X)	L(p/p*)	Le
R6p15k6	3.419 (9.185)	3.011 (3.152)	-0.259 (-0.639)
R4p13k5	3.983 (9.302)	2.759 (2.774)	-0.325 (-0.457)
R4p10k6	2.170 (5.511)	1.992 (2.269)	-2.109 (-4.418)
R4p10k6e		9.415 (8.728)	-11.555 (-9.564)
R5p10k5		8.865 (9.534)	-2.455 (-5.797)

The wage rate equation is rather robust with productivity coefficients having an elasticity greater than 1 except for the first specification. The elasticity of real wage with respect to financial profitability is small but positive. The elasticity of the real wage with respect to the unemployment rate is negative and significant for the first three specifications. That is a validation of the Phillips' curve.
The productivity equation is very sensitive to different specifications. It will be interesting to analyse the results from the two sub-periods.
The aggregate demand is robust to the 5 specifications with elasticity coefficients having the expected sign for each variable.
The interest rate differential is also robust with respect to the 5 specifications, having the expected positive sign for the current account deficit and the relative prices. It also has the expected negative sign for the devaluation of the CDN$.

4.2 Estimated results for the Fordist period 1947-9175

Table 9.1 Real wage equation 1947-1975

System	L(Y/E)	Lρ	Lu
R6p15k6	1.228 (31.097)	0.149 (15.460)	0.234 (37.049)
R4p13k5	1.644 (41.846)	0.027 (2.793)	0.032 (3.136)
R4p10k6	0.762 (12.046)	0.165 (11.077)	0.088 (4.922)
R4p10k6e	2.833 (15.061)	-0.287 (-5.611)	-0.007 (-0.196)
R5p10k5	1.348 (6.159)	-0.016 (-0.391)	0.720 (7.105)

Table 9.2 Productivity equation 1947-1975

System	LY	L(K/E)

R6p15k6	0.068 (17.727)	0.660 (87.763)
R4p13k5	0.402 (107.701)	0.046 (6.549)
R4p10k6	0.147 (10.633)	0.562 (21.085)
R4p10k6e	0.177(10.752)	0.538 (17.226)
R5p10k5	0.132 (234.256)	0.557 (28.524)

Table 9.3 Aggregate demand equation 1947-1975

System	L(w/p)	L(Y/E)	Lu	Lρ	Le
R6p15k6	0.797	0.329	1.559	0.689	3.589
R4p13k5	1.034	0.629	0.005	-0.036	0.162
R4p10k6	0.375	0.441	-0.199	0.343	-0.624
R4p10k6e	1.796	0.576	0.446	-0.578	2.212
R5p10k5	0.863	0.644	0.067	0.065	-0.034

Table 9.4 Interest rate differential and financial markets 1947-1975

System	L(M/X)	L(p/p*)	Le
R6p15k6	0.566 (7.716)	34.981 (109.498)	-12.005 (43.176)
R4p13k5	-1.714 (-5.915)	12.312 (11.309)	-2.564 (-5.110)
R4p10k6	-0.917 (-3.695)	-0.878 (-1.110)	-1.801 (-4.049)
R4p10k6e		10.623 (10.766)	-1.238 (-1.471)
R5p10k5		9.392 (8.779)	0.032 (0.073)

The real wage equation is robust for all 5 specifications except the fourth R4p10k6e where the elasticity of wage with respect to the financial profitability is negative and significant.
The Phillips'curve is not validated in the Fordist period with a positive sign for the unemployment rate.
Contrary to the results observed for the long-run period 1947-2009, the productivity equation is robust for all 5 specifications in the Fordist period.
Aggregate demand is less robust because the coefficients of u and ρ are changing signs in certain specifications.
The interest rate differential is quite sensitive to different specifications, in particular those specifications containing explicitly the current account deficit (M/X).

4.3 Estimated results for the neoliberal period 1976-2009

Table 10.1 Real wage equation 1976-2009

System	L(Y/E)	Lρ	Lu
R6p15k6	0.987 (32.242)	0.050 (10.718)	0.208 (26.167)
R4p13k5	0.735 (9.900)	-0.011 (1.031)	0.251 (7.336)
R4p10k6	0.659 (9.566)	-0.037 (-2.656)	0.116 (3.660)
R4p10k6e	0.900 (12.658)	-0.023 (-2.670)	0.271 (7.580)
R5p10k5	0.939 (21.914)	0.010 (2.857)	0.208 (13.621)

. **Table 10.2 Productivity equation 1976-2009**

System	LY	L(K/E)
R6p15k6	0.927 (46.564)	-0.253 (-12.189)

R4p13k5	2.428 (15.543)	-2.823 (-8.836)
R4p10k6	0.686 (150.016)	-0.050 (-6.971)
R4p10k6e	3.234 (9.977)	-5.698 (-8.606)
R5p10k5	1.843 (20.160)	-2.382 (-11.735)

Table 10.3 Aggregate demand equation 1976-2009

System	L(w/p)	L(Y/E)	Lu	Lρ	Le
R6p15k6	0.834	0.817	0.130	0.011	0.195
R4p13k5	1.192	0.242	4.035	-0.013	3.646
R4p10k6	1.067	0.694	-0.074	0.027	-0.014
R4p10k6e	0.825	1.015	-0.327	-0.011	-0.880
R5p10k5	0.316	0.565	-1.026	-0.060	-1.168

Table 10.4 Interest rate differential and financial markets 1976-2009

System	L(M/X)	L(p/p*)	Le
R6p15k6	5.969 (22.444)	-1.787 (-5.603)	1.415 (7.213)
R4p13k5	5.277 (10.887)	-0.401 (-0.740)	1.058 (2.999)
R4p10k6	9.425 (16.000)	2.615 (4.532)	3.380 (7.899)
R4p10k6e		-16.695 (-9.029)	-13.449 (-8.695)
R5p10k5		-2.157 (-2.919)	-3.205 (-10.947)

The real wage equation is rather robust except for the ρ coefficient which change sign in the first and the last specification. The positive elasticity of wage with respect to the unemployment rate does not validate the Phillips'curve law and is an indication that the labor market is not efficient.
The productivity equation is robust to the various specifications but the negative sign the capital-labor ratio K/E is rather surprising. Since the latter is the ratio of (Y/E)/(Y/K), a lower capital productivity would increase K/E and hence reduce the labor productivity. This result observed for the neoliberal period is contrary to what is observed for the Fordist period.
The aggregate demand is robust with respect to real wage w/p and productivity Y/E but the coefficients of the other variables are rather sensitive to various specifications.
Finally, the interest rate differential is highly sensitive to the various specifications and coefficients with contrary expected sign appear in each specification.

4.4 Changes between the two periods

In order to compare with results already estimated in a previous publication (Loranger-Boismenu 2010) with a sample period 1947-75 and 1947-1999, specification R4p10k6e is chosen for the analysis of structural changes between the Fordist and the neoliberal period.

Table 11.1 Real wage equation

L(w/p)	L(Y/E)	Lρ	Lu

1947-1975	2.833 (15.061)	-0.287 (-5.611)	-0.007 (-0.196)
1976-2009	0.900 (12.658)	-0.023 (-2.670)	0.271 (7.580)
Change	-1.933	0.264	0.278
	-68.2%	92%	3971.4%

Table 11.2 Productivity equation

L(Y/E)	LY	L(K/E)
1947-1975	0.177 (10.752)	0.538 (17.226)
1976-2009	3.234 (9.977)	-5.698 (-8.606)
Change	3.057	-6.236
	1727,1%	-1159.1%

Table 11.3 Aggregate demand equation

LY	L(w/p)	L(Y/E)	Lu	Lρ	Le
1947-1975	1.796	0.576	0.446	-0.578	2.212
1976-2009	0.825	1.015	-0.327	-0.011	-0.880
Change	-0.971	0.439	-0.773	0.567	-3.092
	-54.1%	76.2%	-173.3%	98.1%	-139.8%

Table 11.4 Interest rate equation

L(i/i*)	L(p/p*)	Le
1947-1975	10.623 (10.766)	-1.238 (-1.471)
1976-2009	-16.695 (-9.029)	-13.449 (-8.695)
Change	-27.318	-12.211
	-257.2%	-986.3%

Change in the parameter structure is important and significant in all equations between the two sub-periods. The hypothesis of a regime change is validated.

In the wage equation, the effect of productivity is decreasing (68%). This is in accordance with what has already been observed in table 1.2 where the growth of productivity is reduced in the 1976-2009 period. Now, it is observed that not only productivity is decreasing in the neoliberal regime, but its impact on wage is strongly diminished.

The change of the financial profitability on real wage is increasing in the second sub-period (92%). However, this change needs to be interpreted carefully. The move is from a negative influence toward a near 0 influence. That means that while the interest rate had a negative impact on wage in the Fordist period, this influence is vanishing in the neoliberal regime. As already observed in graph 1, the profit rate is decreasing in the first sub-period and, hence, financial profitability is increasing and the feedback is negative on the wage rate. The result is contrary to the theory of an efficient labor market. Therefore, a tight monetary policy adopted by the central bank after 1975 had a negative impact on

the growth rate of the real wage but after 1983, the interest rate started declining and its influence on the wage rate became less important.

The insignificant value (-0.007) of the unemployment rate coefficient in the first sub-period and the positive and significant coefficient (0.271) in the second sub-period is again contrary to the mainstream theory because it is contrary to the Phillips curve law.

The change in the magnitude of the structural parameters in the productivity equation is overwhelming between the two sub-periods. In the 1947-1975 period, values of both coefficients are positive. The hypothesis of an endogenous productivity caused by the scale of the economy is validated. The increasing-returns-to-scale production is generated by the growth of infrastructure in education, health and public works. The role of the State is of crucial importance in generating that positive externality.

The productivity equation also contains the capital-labor ratio the change of which is viewed as external shocks on productivity. The results of the post-Fordist period is rather surprising: external shocks would impact negatively on labor productivity. As already observed in table 1.3, the growth rate of capital productivity is stagnant or even slightly decreasing in the 1976-2009 period. By definition, K/E= (Y/E)/(Y/K). Hence, a decrease of (Y/K) will increase (K/E). With a negative sign in the productivity equation, this change will impact negatively on labor productivity. The external shock on labor productivity seems to come from capital productivity. That result validates the productivity paradox: despite a significant investment in the new technologies of information and communication (NTIC), the increase in productivity is a deception.

The impact of real wage on aggregate demand diminished between the Fordist and the neoliberal regime (-54%). That is in accordance with the reduction of the growth rate of real wage between the two sub-periods as already observed in table 1.2. This result is compensated by an increase of the influence of labor productivity on aggregate demand (76%). Therefore, the Regulationist hypothesis of cumulative causation between demand and productivity is validated. An increase of productivity has a feedback on demand and an increase of the scale of production has a feedback on productivity. Productivity is a thoroughly endogenous variable.

The change in the impact of unemployment rate on demand is impressive (-173%).and illustrates the major structural break in the labor market between the two periods. Permanent jobs characterized the labor market in the Fordist period while flexibility of labor became the buzz word in the neoliberal regime. The negative relation between demand and unemployment is validated in the neoliberal period while it is not the case in the Fordist period. With increased competitiveness in 1976-2009, aggregate demand is more responsive to a higher level of employment, most likely because it is easier to enter the labor market with part-time jobs, a phenomenon which was far less important in the Fordist period.

Since the financial profitability criterion is dominated by the interest rate variable, a negative relation is observed for both sub-periods. The two main components of

aggregate demand, that is consumption and investment, are sensitive to the central bank monetary policy. Note however the big change (98%) in the magnitude of the two coefficients: the decline of the interest rate in the neoliberal period coupled with the easiness of getting credit, reduced the impact of this variable on consumption and investment.

The influence of the exchange rate on aggregate demand is strongly positive in the Fordist period while its effect is negative in the neoliberal period. That is reflected by a change of -140% in the magnitude of the two coefficients. Flexible exchange rate regime after 1976 reduces the importance of a devaluation of the Canadian dollar on external trade. The price of basic commodities such as oil, copper, gold, potash, wheat… has more importance on aggregate demand than the devaluation of the CDN$. In fact, the long-term expectation rise of these commodity prices contributes to the appreciation of the CDN$ especially over the last 6 years (graph 4).

Finally, the independence of monetary policy is validated by the negative sign of the exchange rate coefficient: when money is depreciated, the central bank can maintain or reduce its interest rate. This is particularly the case in the neoliberal period after 1992 when the Bank of Canada started reducing its interest rate while the CDN$ was devaluated. The magnitude of the change in the estimated coefficients (-986%) reflects the importance of the volatility of the exchange rate market. The impact of financial derivatives on exchange rate is the most important phenomenon that characterized the exchange market after the US$ had no more official link with gold.

The impact of relative prices on the interest rate is positive as expected in the Fordist period: the monetary policy rule is to fight inflation by raising the interest rate. However, in the neoliberal period, the central bank seems to be motivated by other objectives than the fight against inflation. The negative sign of the relative price coefficient is somewhat puzzling from a domestic viewpoint but is quite reasonable from abroad. Assuming for instance that the cause of this negative impact is exogenously caused by inflation in USA, then, the Fed raises its interest rate which causes a decrease in the interest rate gap. The explanation of such a change is that in the Fordist period inflation in Canada influenced positively the interest rate gap while in the neoliberal period, the negative influence from abroad dominated the interest rate gap. That result is another illustration of a major break between the two periods.

Conclusion

The analysis of the Canadian quarterly series validates the hypothesis of major structural breaks between the Fordist period 1947-1975 and the neoliberal period 1976-2009. It also validates the choice of our heterodox model where wage rate and profit rate are key variables to be watched in terms of regime change. The interest rate and the financial market behaviour open the economy to the rest of the world. That is a clear advantage over other macro-economic models limited to closed economy. Those changes are characterized by the diminishing pace of growth for the real wage rate and by a cessation in the decreasing tendency for the profit rate in the post-Fordist period. This phenomenon

would be more accentuated if high wage earners were removed from the wage bill and if the latter was limited to the non-financial sector. A rising tendency of the interest rate, surpassing the profit rate from the 70s on, reaches its climax in 1982 and reverses to a decreasing tendency. In the neoliberal period, the real interest rate is one time and a half of its long term value (2%) while it is near 0 in the Fordist period. The financial profitability rate is dominated more by the interest rate than the profit rate. A radical change in the monetary policy since 1976 succeeded in keeping inflation under control. The declining tendency of the profit rate in the Fordist period was stopped and slightly reversed after 1982 when flexibility on the labor market became the new fashion. If profits earned in the financial sector were removed from our data, it is quite likely that the declining tendency would flattened in the neoliberal period. The unemployment rate follows a growing tendency that is reversed after 1982. Finally, the generalized floating exchange rate regime since 1976 gives Canada the opportunity to abandon parity with the US dollar in favour of more competitive devaluations. Let us now summarize the results obtained from our econometric analysis.

The aim of estimating the model from 5 different specifications is to analyse the sensitivity or robustness of the parameter estimation of 4 equations. It is observed that in some equations, the model is sensitive to the number of variables, lags and the rank or the number of cointegration relations. The wage and the productivity equations are rather robust to any specification but the demand and the interest rate are rather sensitive to the various specifications. Therefore, one particular specification is chosen to analyse the structural changes between the Fordist and the neoliberal periods. In order to compare with a previous research (loranger-Boismenu 2010) for the 1947-75 period, we chose the model with 10 variables, 6 lags and no explicit specification of the current account deficit in the interest rate equation. Our main findings are:

The impact of productivity on wage decreased substantially in the neoliberal regime

The negative impact of financial profitability on wage is falling to near 0 in the 1976-2009 period.

The negative sign of the rho coefficient is an indication that the labor market is inefficient because when the profit rate is falling, the real wage is also falling. This is contrary to mainstream theory.

The positive sign of the unemployment rate coefficient in the neoliberal period is another indication that the labor market is not efficient according to the mainstream theory because it contradicts the Phillips curve law.

The hypothesis of endogenous productivity is validated in both periods with a significant increase of the demand coefficient in the neoliberal period. This result confirms the positive influence on productivity of state expenditures on infrastructures: education, health, public works...

Productivity can also be influenced by external shocks which are caused by capital productivity changes.

The reduction of the impact of wage on aggregate demand is substantial in the neoliberal regime. This is another indication that a stagnant real wage can hinder the growth of the economy.

The increase of the influence of productivity on demand validates the Regulationist hypothesis of cumulative causation: productivity positively influences aggregate demand

and the latter influences productivity.
The change of sign of the unemployment rate coefficient in the demand between the two periods (from + to -) indicates that a major structural break occurred in the labor market moving from a permanent job market to a flexible one.
The negative influence of financial profitability on demand felt almost to nothing in the neoliberal period. It may be an indication that the easiness to get credit is more important than the interest rate itself.
Devaluation in the Fordist period has more impact on demand than in the neoliberal period where the coefficient turns negative.
The independence of the monetary policy of the central bank is validated in both periods with a much larger influence of the exchange rate on the interest rate differential in the neoliberal period.
The positive impact of domestic inflation on the interest rate is validated in the Fordist period but the negative sign of the relative price coefficient in the neoliberal regime seems to indicate that external shocks coming from the US monetary policy has more importance than what is happening on the domestic front.

In conclusion, the use of an Error Correction Model in estimating a macroeconomic model is a rare exercise for heterodox economists. The originality of this paper is to show how cointegration analysis can be applied to a macro-model and can validate results that are otherwise shown by a simple inspection of time series. The Canadian neoliberal regime fits pretty well the world tendency of a new capitalist regime where the domination of financial markets imposes its short-term profitability law to the private enterprises through financial derivatives.. Firms and state at various levels attempt to shift the cost of adjustments to the labor force by repressing the growth of wages, by cutting in social benefits and by privatizing large portions of the public sector in health and education. The obvious aim is to transfer these social costs to individuals instead of increasing taxes on firms and high wage earners. The end of the dollar-gold standard in 1971 and the end of the Cold War in 1989 are the two major changes that contributed to the birth of new international relations through the development of financial derivatives. One question remains after the big financial crisis: will this regime survive or will it be replaced by a new regime more respectful of nature and human beings?

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