Structural Shocks and Labour Market Dynamics in a Small Open-Economy: Theory and Some Evidence

Patrice Borda*
Lead and Université des Antilles et de la Guyane

Nlandu Mamingi
University of the West Indies

November 5, 2009

Abstract

The aim of this paper is twofold : first, to measure the persistence of labour market distortions in general and unemployment in particular, to structural shocks in the context of small open economies; and second, to analyze the links that might exist between shocks. Using a rational expectations model and assuming that markets are controlled by insiders, we examine the link between structural shocks, labour market variables and exchange rate by theoretically and numerically solving a dynamic stochastic model. We perform parametrization and simulation for Barbados, Jamaica and Trinidad and Tobago.

JEL Codes: J51, E24, C15.

Keywords: Unemployment persistence, Hysteresis, Insider-outsider theory, Rational expectations.

*Address: Université des Antilles et de la Guyane, UFR des Sciences Juridiques et Economiques de la Guadeloupe, Campus de Fouillole BP. 270, 97157 Pointe-à-Pitre Cedex, Guadeloupe FWI. e-mail: salet@outremer.com. We would like to thank Georges Bresson, Damien Gaumont for helpful comments and suggestions and all participants of the seminar of LEAD-CEREGMIA, June, 25-26 2007, Schoelcher as well as the Central Bank of Barbados.

1 Introduction

Using a rational expectations model *à la* Blanchard and Summers (1986) and assuming that the labour market is controlled by insiders, this paper measures theoretically and empirically the persistence of unemployment due to various structural shocks in the context of small open economies under two different exchange rate regimes and also attemps to capture the links that potentially exist between structural shocks.

As pointed out by many authors, at the outset, two contrasting phenomena need to be signaled. Indeed, on the one hand, there is the rapidly adjusting labour market to disturbances or shocks noted in many Asian economies such as Hong Kong, Taiwan and the Republic of Korea. On the other hand, there is the relative slowness with which labour market seems to adjust to disturbances or shocks in emerging economies such as the Caribbean, the Latin American economies and some European economies.

The low performance of labour market in the latter economies due mainly to constraints generated by the openness of countries and their limited economies of scale, is an issue that needs to be dealt with to the extent that labour market rigidity is in general an impediment to economic growth. Put differently, the importance of this paper lies in the fact that in many economies a well behaved labour market is key to boosting or at the very least maintaining economic growth and achieving economic integration into the global market.

The analysis of the role of microeconomic rigidities on labour market distortions is not new in the labour literature. Indeed, distortions due mainly to persistence or hysteresis have been analyzed and found originating from the relationship between employment and insider status (see Lindbeck and Snower, 1986). For recall, labour markets are basically supposed to be controlled by insider trade unions or insiders[1]. In a dynamic perspective, adverse shocks that contribute to reduced labour demand change the number of insiders, lower the next periods employment target and affect the nominal wage rate. In other words, membership considerations go a long way in explaining the dependence of unemployment on insider power. The argument that the distortions in the labour market coming from wage setting where a trade union selects an employment target that consists only of current union membership has been provided as one explanation to the persistence of unemployment in industrialized countries (see, for example, Blanchard and Summers, 1986; Lockwood and Philippopoulos,

[1] The insiders are workers who have some connection with the firm at the time of the bargaining, and whose interests are therefore taken into account in the contract. (see Romer, 2001, 436-437).

1994; Blanchard and Wolfers, 2000).

The paper contributes to the literature in two ways. First, it extends the analysis of the sources of the persistence of unemployment to new emerging countries, precisely the Caribbean Countries (Barbados, Jamaica and Trinidad and Tobago). Second, acknowledging that the emerging small open economies may be seriously affected by their openness, the paper makes the case for introducing foreign shocks in the dynamic model of unemployment. Precisely, contrary to authors such as Blanchard and Summers (1986), besides from "domestic" shocks we analyze theoretically and empirically the role of foreign shocks in explaining the labour market dynamics. Naturally, we distinguish between two exchange rate regimes: fixed and flexible.

The remainder of the paper is organized as follows. Section 2 discusses the basic framework underlying the stochastic open economy. Section 3 develops the extended model based on a New Keynesian macroeconomic model, which focuses on the effect of international business cycles on labour market dynamics. Section 4 calibrates the model for Caribbean economies (Barbados, Jamaica and Trinidad and Tobago). Section 5 concludes the paper.

2 Labour Market in The Caribbean : Some Stylised Facts

The Caribbean region is at the same time homogeneous and diverse. This note centers on the characteristics of the labour market in the English-speaking region; precisely, Barbados, Jamaica and Trinidad and Tobago. The note follows closely Downes (2009).

At the outset, it is worth point out with Downes (2009, p.13) that "The labour market in the Caribbean has seen significant changes over the past decades in response to both demographic and production changes". Precisely, on the supply side, the labour force growth has been low as a result of a very low population growth. Concretely, the three countries of interest registered for the period 2000-2006 a population growth of 0.36, 0.52 and 0.36 percent in Barbados, Jamaica and Trinidad and Tobago, respectively, which translated into a stagnant growth of labor force participation rate of -0.6 for Barbados, -0.6 percent for Jamaica and 2.7 percent for Trinidad and Tobago. A direct consequence of this state of affairs is the emergence of ageing population. Noteworthy, female labour participation has gained ground compared to male's. Despite that, male rate participation is still higher than that of females. The labour force has been improving in terms of education attainment as time passes. Indeed, there is an increase in the educational attainment of those entering the labour force with universal primary level education and high enrolment rates at the secondary level. The tertiary level attainment is less than the lower levels. For example, in 2000, only between 5 to 13 percent of the LF has attained the tertiary level. Noteworthy the strive in professional activities as a result in the educational level attainment.

On the demand side, the image of the Caribbean with sugar plantations all over the places has given place to a Caribbean where services are booming. That is, there has been a noticeable shift from agricultural activities to services production. For example, in Barbados the services occupied 80.8 percent of total employment in 2006 compared to 78.6 per cent in 2000, in Jamaica it reached 64.8 percent in 2006 compared to 56 percent in 2000 , and in Trinidad it amounted to 65 percent in 2006 compared to 56.9 per cent in 2000. " The agricultural sector has regressed to about 5 percent of labor force employed in each country." Other characteristics uncovered on the demand side include increase in the number of self-employed persons, increase in small and micro-enterprises, a significant presence of the informal sector and a rather insignificant growth of the formal sector employment. On the institutional side, it is worth pointing out the gradual decrease in unionization of the work force despite the strength of unions in some key sectors of the economy (ports, public service, utilities, see Downes, 2009, 13). The number of people employed is on the rise up to recently and so is the employment rate at least in Jamaica and Trinidad and Tobago. Up to recently, unemployment rate has been on the decline. In Barbados, it went from 11.4 percent in 2000 to 9.8 percent in 2006, in Jamaica it fell from 15.6 percent to 10.3 percent during the same period and in Trinidad and Tobago it went from 12.1 percent to 6.2 percent. Nevertheless, unemployment is still high for females compared to males and young persons(15-24 years of age). No firm lesson can be drown for the wage level except that the nominal wage has been on the rise and that the level reached is the result of bargaining process with unions and/or labor legislation. The minimum wage scheme is an example of labor legislation used in many Caribbean countries.

3 The Basic model

We consider an augmented insider-outsider model with open-economy and stochastic process considerations. The firm maximizes its profits with respect to the labor demand taking the unions wage level as given.

3.1 Aggregate supply and labour demand relations

Let us consider an economy which is endowed with only one sector in which firms produce a consumer good denoted Y_t with a Cobb-Douglas technology $Y_t = A_t L_t^{\alpha}$, where $\alpha \in [0,1]$, L_t and A_t are employment level and technology level, respectively, and t stand for time index. The technology level is precisely captured by:

$$A_t = A_{t-1}\bar{G}E_t^s. \tag{1}$$

Equation (1), allows to derive the technology level in terms of the deviations from steady state as follows:[2]

$$\widehat{a}_t = \widehat{a}_{t-1} + g + \epsilon_t^s, \tag{2}$$

where, g is the technical progress and ϵ_t^s is an i.i.d random variable satisfying $E\left[\epsilon_t^s\right] = 0$ and a constant variance. The exogenous disturbance can be thought as a domestic supply shock. As firms are price-takers, real wage is equal to marginal product of labour. Labour demand is obtained in terms of deviations from steady state as follows (see appendix A1 for derivation):

$$\widehat{\ell}_t^d = -\frac{1}{1-\alpha}\left(\widehat{w}_t - \widehat{p}_t - \widehat{a}_t\right) \;\Leftrightarrow\; \widehat{\ell}_t^d = -\delta\left(\widehat{w}_t - \widehat{p}_t - \widehat{a}_t\right), \tag{3}$$

where "d" stands for demand, $\delta = (1-\alpha)^{-1}$, $\widehat{p}_t$ is price in deviation from the steady state. As expected, labour demand is a decreasing function in real wage. Nominal wage is set by minimizing a 1-period loss function[3]:

$$\min_{\widehat{\ell}_t^d} \; \Omega_t = \frac{1}{2}E_{t-1}\left(\widehat{\ell}_t^d - \ell_t^{\star}\right)^2. \tag{4}$$

[2] The basic rule followed for linear approximation is:

$$\Psi(X_t) \approx \Psi(X) + \sum_{i=0}^{n}\left(\frac{\partial\Psi(X_t)}{\partial x_{it}}\right)\left(\frac{x_{it}-x_i}{x_i}\right)x_i,$$

where $X_t = (x_{1t}, ..., x_{nt})$. As $\Psi(X) = 0$, the previous relation becomes:

$$\Psi(X_t) \approx \sum_{i=0}^{n} x_i\left(\frac{\partial\Psi(X_t)}{\partial x_{it}}\right)\left(\frac{x_{it}-x_i}{x_i}\right)\widehat{x}_{it}.$$

where $\widehat{x}_{it}$ is the percentage deviations from steady state.

[3] In the rest of the paper, we shall use the notation $E_{t+k}x_{t+i}$ for the expectations' framed for the period $t+i$, on the basis of information available at time $t+k$, k being positive or negative.

Equation (4) indicates that insiders accept any wage in order to maintain their status[4] given $\ell_t^{\star}$. The latter is formed according to the following law :

$$\ell_t^{\star} = \gamma \widehat{\ell}_{t-1}^d + (1-\gamma)\,\bar{\ell} \qquad \gamma \in [0,1]\,, \tag{5}$$

where $\bar{\ell}$, is the constant labor force and γ is the proportion of insiders or the measure of insider power in wage setting and $(1-\gamma)$ represents the proportion of outsiders. We assume that at each point in time $\widehat{\ell}_t^d = \widehat{\ell}_t$. Equation (5) indicates that at each point in time the union's targeted rate of employment is a weighted sum of the past labor demand and labor force. Thus if $\gamma = 1$ the labor market exhibits an hysteresis phenomenon, that is, shocks are long lasting. On the contrary, if $\gamma = 0$ union's policy is independent of history and so shocks are not persistence. The first order condition yields:

$$E_{t-1}\left(\widehat{\ell}_t^d - \ell_t^{\star}\right) = 0. \tag{6}$$

Using (2), (3) and (5) in (6) helps derive the nominal wage setting:

$$\widehat{w}_t = E_{t-1}\widehat{p}_t + \widehat{a}_{t-1} + g - \frac{\gamma}{\delta}\widehat{\ell}_{t-1}^d - \frac{1-\gamma}{\delta}\bar{\ell}. \tag{7}$$

Equation (7) expresses the dependence of the nominal wage $\widehat{w}_t$ on expected price level, technology level, employment level and labour force. In order to find a solution we need to compute change in nominal wage. Solving (3) for a_{t-1} and substituting into (7) and solving for Δw_t, we obtain:

$$\Delta\widehat{w}_t = E_{t-1}\Delta\widehat{p}_t + g - \left(\frac{1-\gamma}{\delta}\right)\widehat{u}_{t-1}, \tag{8}$$

where $\widehat{u}_{t-1}$ is the lagged unemployment rate defined as $\widehat{u}_t = \bar{\ell}_t - \widehat{\ell}_t$.
Putting (2) and (7) into (3) and (7) yields the labor demand:

$$\widehat{\ell}_t^d = \delta\left(\Delta\widehat{p}_t - E_{t-1}\Delta\widehat{p}_t\right) - \gamma\widehat{u}_{t-1} + \delta\epsilon_t^s. \tag{9}$$

Equation (9) states that labor demand depends on past unemployment, inflation surprise and supply shock. Precisely, an increase in unemployment decreases labor demand and a positive supply shock leads to an increase in labor demand. Note that the unemployment rate defined above follows the rule below [5] :

$$\widehat{u}_t = \gamma\widehat{u}_{t-1} - \delta\left(E_{t-1}\pi_t - \pi_t\right) - \delta\epsilon_t^s, \tag{10}$$

[4] Alogoskoufis and Manning (1988), p.464-465, have suggested to modify the insiders objective function by including deviation in real wages and unemployment from their respective targets

[5] Since $\widehat{p}_t - E_{t-1}\widehat{p}_t = \Delta\widehat{p}_t - (E_{t-1}\widehat{p}_t - \widehat{p}_{t-1}) = \pi_t - E_{t-1}\pi_t$, the formulation are equivalent. π_t is the domestic inflation rate.

where π_t stands for the domestic inflation rate.

Equation (10) indicates that the behavior of unemployment is contingent upon tree elements: its own history, inflation surprise and supply shock. Thus if $\gamma = 1$ then unemployment rate has a long memory. In addition, a positive domestic supply shocks brings about a decrease in unemployment. The role of surprise term needs to be explored in details in the next section.

3.2 The aggregate demand relation

In this Section we specify the aggregate demand. The price level p_t is defined as a relation between nominal exchange rate e_t and foreign price level p_t^f:

$$\widehat{p}_t = \widehat{p}_t^f + \widehat{e}_t. \tag{11}$$

Our specification assumes that the system is bombed with permanent shocks in a random walk manner: $\widehat{p}_t^f = \widehat{p}_{t-1}^f + \pi^f + \epsilon_t^p$, where ϵ_t^p captures domestic demand shocks. To complete the model, we introduce equation (12) which represents the conditions for equilibrium in the money market:

$$\widehat{m}_t - \widehat{p}_t = \bar{y}_t - \eta\widehat{i}_t + v_t \qquad \eta > 0, \tag{12}$$

where $\widehat{m}_t$, $\widehat{i}_t$ and v_t are money supply, interest rate and disturbances, respectively, and

$$\overline{y}_t = \alpha\overline{\ell} + \widehat{a}_t. \tag{13}$$

We assume that the disturnances, v_t, follow a random walk process:

$$v_t = v_{t-1} + \epsilon_t^m, \tag{14}$$

where money ϵ_t^m stands for a white noise monetary shock. Uncovered interest rate parity links home nominal interest rates to exchange rate, $\widehat{e}_t$, exchange rate expectation, $E_t\widehat{e}_{t+1}$ and foreign nominal rates, $\widehat{i}_t^f$. Given perfect capital mobility, nominal rate on bonds are set at the beginning of each period as:

$$\widehat{i}_t = E_t\widehat{e}_{t+1} - \widehat{e}_t + \widehat{i}_t^f. \tag{15}$$

We assume that $\widehat{i}_t^f$ follows a random walk process: $\widehat{i}_t^f = \widehat{i}_{t-1}^f + \epsilon_t^i$. World interest rate shock is captured by ϵ_t^i. The equations (2)-(15) can be solved for nominal wage, employment, price level and unemployment rate.

3.3 The law of motion of unemployment

To determine how unemployment behaves in response to structural shocks, we compute the rational expectations' solution to the previous model given the exchange rate regime.

3.3.1 Unemployment dynamics under flexible exchange rate

We use the approach develop by Sargent (1987) to solve for linear rational expectations' models[6]. Substituting (11), (13) and (15) into (12), we get:

$$\widehat{e}_t = \frac{1}{1+\eta}\left[\widehat{m}_t - \widehat{p}_t^f - \alpha\bar{\ell} - \widehat{a}_t + \eta\widehat{i}_t^f + v_t + \eta E_t\widehat{e}_{t+1}\right] \quad \Leftrightarrow \quad \left(J - \frac{1+\eta}{\eta}\right)\widehat{e}_{t+1} = \frac{1}{\eta}\widehat{x}_t, \quad (16)$$

with $\widehat{x}_t = \widehat{m}_t - \widehat{p}_t^f - \alpha\bar{\ell} - \widehat{a}_t + \eta\widehat{i}_t^f + v_t$ and J is the forward operator: $J\widehat{e}_t = E_t\widehat{e}_{t+1}$. Using (16) recursively to eliminate the expectation operator on nominal exchange rate, we obtain the no-bubbles solution:

$$\widehat{e}_t = \frac{1}{1+\eta}\sum_{i=0}^{\infty}\left(\frac{\eta}{1+\eta}\right)^i \widehat{x}_{t+1}. \quad (17)$$

The nominal exchange rate depends on the current paths of money supply, foreign price, labour force, technical progress, foreign interest rate[7] (see for instance Walsh (2003)). Using (2), (14) and the law of iterative expectations', we find a solution for (17):

$$\widehat{e}_t = \widehat{x}_t + \frac{\eta}{1+\eta}\left(\mu - g - \pi^f\right), \quad (18)$$

where μ and π^f represent the money growth and the foreign inflation rate, respectively[8]. In order to get $E_{t-1}\Delta\widehat{e}_t$, we apply the expectation operator to equation (18) and we obtain:

$$E_t\Delta\widehat{e}_{t+1} = \mu - g - \pi^f. \quad (19)$$

In the same way, starting from (11) and (18) and apply the expectation operator, we get:

$$E_t\pi_{t+1} = \mu - g. \quad (20)$$

Equation (20) indicates that authorities stabilize inflation if money supply growth is equal to productivity growth. In the same vein, it can be shown that foreign shocks, interest rates shocks, supply shocks and demand shocks would affect nominal exchange rate expectations':

$$\widehat{e}_t - E_{t-1}\widehat{e}_t = \eta\epsilon_t^i + \epsilon_t^m - \epsilon_t^d - \epsilon_s^s. \quad (21)$$

[6] General discussions about this approach can be found in Ulig (1999) and Sargent (1987).

[7] See relation 17.

[8] $\mu = \widehat{m}_t - \widehat{m}_{t-1}$ and $\pi^f = \widehat{p}_t^f - \widehat{p}_{t-1}^f$.

Substituting the solution for $\widehat{e}_t$ given by (18) into (11), we obtain the domestic inflation rate in terms of economic conditions and shocks:

$$\pi_t = \mu - g + \eta\epsilon_t^i - \epsilon^s + \epsilon_t^m. \tag{22}$$

The key question in this work is how do structural shocks affect the unemployment dynamics in a small-open-economy? This answer is obtained by solving (18), (19) and (10). The reduced-form for the unemployment rate dynamics is:

$$\widehat{u}_t = \gamma\widehat{u}_{t-1} - \delta\left(\eta\epsilon_t^i + \epsilon_t^m\right). \tag{23}$$

The autoregressive term γu_{t-1} shows how the persistence of the unemployment rate arises from the insider power in wage setting. If $\gamma < 1$, adverse disturbances like world interest rate shocks, or monetary shocks, have persistent effect ; that is, long lasting effect without permanent ones.

3.3.2 Unemployment dynamics under fixed exchange rate

Under fixed exchange rates system we have $\widehat{e}_t = \overline{\widehat{e}}$. If the system is stable and time consistent credible, then $\widehat{i}_t = \widehat{i}_t^f$ so that, from equation[9] (11) the uncovered interest parity implies that the domestic inflation rate is given by $\pi_t = \pi^f$. Here, unemployment dynamics is easier to compute. Using the previous conditions and equation (10), the unemployment dynamics can be re-expressed as:

$$\widehat{u}_t = \gamma\widehat{u}_{t-1} - \delta\left(\epsilon_t^p + \epsilon_t^s\right). \tag{24}$$

Contrary to flexible exchange rate, productivity and aggregate demand shocks cause an immediate decrease in unemployment.

4 The Extended model: predictions of a New Keynesian macroeconomic model

We extend the discussion by taking into account the New Keynesian Macro-Model. Our theoretical framework is motivated by the fact that small open *developing* economies are affected by international business cycles. For instance, unexpected strong real growth in the US economy might increase exports, output and employment in the Caribbean economies.

[9] With $\Delta\widehat{p}_t^f = \pi^f + \epsilon_t^p$.

The model presented here incorporates several foreign structural shocks. We examine the behavior of the labour market in response to external shocks.

In line with Obsfield and Rogoff (1996), we characterize a set of macroeconomic relations through a system of three equations: the aggregate supply, the IS and the forward looking monetary policy relations .

4.1 The AS-curve

We adopt the aggregate supply developed by Fuhrer and Moore (1995). This equation is derived from a model of overlapping wage contracts real wages:

$$\pi_t^f = \psi_{AS} + \lambda E_t \pi_{t+1}^f + (1-\lambda)\,\pi_{t-1}^f + \theta\left(\frac{\widehat{y}_t^f + \widehat{y}_{t-1}^f}{2}\right) + \epsilon_t^{AS}, \tag{25}$$

where ψ_{AS} is a constant. π_t^f and y_t^f are foreign inflation rate and foreign output (for instance the US Output) respectively. ϵ_t^{AS} captures the Aggregate Supply shock, assumed to be independently and identically distributed with variance σ_{AS}^2. E_t is the Rational expectations' operator conditional on the information available at time t. In the remainder of this Section, superscript f captures foreign variables (the US economy).

4.2 The IS-curve

The IS equation is derived from the representative individual utility maximization. We included an external level of habit in the utility function, which is:

$$U_t\left(C_t^f\right) = \frac{\left(\frac{C_t^f}{\left(C_{t-1}^f\right)^h}\right)^{1-\sigma} - 1}{1-\sigma}, \tag{26}$$

where h measures how strong is the habit level is and σ is the inverse of the elasticity of substitution. The utility function depends on the consumption ratio in the current period, C_t^f over previous period consumption, C_{t-1}^f. The external habit is not considered as an argument to maximize household's utility function. The budget constraint is :

$$C_t^f + B_t^f \leq \frac{P_{t-1}^f}{P_t^f} R_t^f + W_t^f. \tag{27}$$

where P_t^f is the foreign price level. The previous equation implies that consumption, C_t^f cannot exceed the household endowment coming from labor income, W_t^f, and the real value of the asset holdings at the beginning of the period $\frac{P^f_{t-1}}{P^f_t}R^f_t$. The representative household solves the infinite period dynamic problem by maximizing his expected discounted utility function subject to the budget constraint (27). The Euler condition is :

$$1 = E_t\left(\varphi\frac{U'(C^f_{t+1})}{U'(C^f_t)}\frac{P^f_t}{P^f_{t+1}}R^f_t\right) \tag{28}$$

where φ is the discounted factor. Equation (28) is the standard consumption Euler equation. By an appropriate approximation, the Euler condition can be rewritten as:

$$\widehat{c}^f_t = \psi_{IS} + \vartheta E_t\widehat{c}^f_{t+1} + (1-\vartheta)\,\widehat{c}^f_{t-1} - \rho\left(\widehat{i}^f_t - E_t\widehat{\pi}^f_{t+1}\right). \tag{29}$$

Equation (29) is the monetary transmission mechanism in the IS curve. Since there is no investment and government expenditures, we have the following long run equilibrium condition: $\widehat{c}_t = \widehat{y}_t$. Equation (29) becomes:

$$\widehat{y}^f_t = \psi_{IS} + \vartheta E_t\widehat{y}^f_{t+1} + (1-\vartheta)\,\widehat{y}^f_{t-1} - \rho\left(\widehat{i}^f_t - E_t\widehat{\pi}^f_{t+1}\right) + \epsilon^{IS}_t, \tag{30}$$

where ψ_{IS} is the constant and ϵ^{IS}_t is the foreign aggregate demand shock, independently and identically distributed with variance σ^2_{IS}. Equation (30) is referred to as the dynamic *IS* equation.

4.3 The monetary rule

The monetary rule is set according to the reaction function proposed by Clarida, Gali and Gertler (2000). This function has two parts. The first one reflects the tendency of the central bank to smooth interest rates:

$$\widehat{i}^f_t = \varsigma\widehat{i}^f_{t-1} + (1-\varsigma)\,\widehat{i*}^f_t + \epsilon^{MP}_t. \tag{31}$$

The second one, $\widehat{i*}^f_t$, represents the Taylor Rule:

$$\widehat{i*}^f_t = \widehat{\bar{i*}}^f + \omega\left(E_t\pi^f_{t+1} - \widehat{\bar{\pi}}^f\right) + \kappa\widehat{y}^f_t, \tag{32}$$

where $\widehat{\bar{\pi}}^f$ is the long run equilibrium level of inflation and $\widehat{\bar{i*}}^f$ is the target nominal interest rate. From (31) and (32) we can derive (33):

$$\widehat{i}^f_t = \psi_{LM} + \varsigma\widehat{i}^f_{t-1} + (1-\varsigma)\left(\omega E_t\pi^f_{t+1} + \kappa\widehat{y}^f_t\right) + \epsilon^{MP}_t, \tag{33}$$

where $\psi_{MP} = (\widehat{\bar{i}^*}^f - \omega\widehat{\bar{\pi}^*}^f)$. The Monetary Policy structural shock is ϵ_t^{MP} . As previously, it is assumed to be independently and identically distributed with variance σ_{MP}^2.

The structural model of labour market contains 6 linear rational expectations' equations: technology level (2), wage setting (7), exchange rate dynamics (for flexible exchange regime) (16), foreign inflation rate dynamics (25) and foreign IS curve (30), foreign monetary policy (30). Using the Ulig (1997) general method, we compute analytical and numerical solutions to the optimization problem by taking into account the exchange rate regime[10].

5 Empirical results

This Section is devoted to the computation of the responses of some key variables of labour market to structural disturbances. We solve the equilibrium model by taking into account the rational expectations' hypothesis and perform the parameterization for both basis and extended models. We then simulate the model for Barbados (fixed exchange rate regime) and Jamaica and Trinidad and Tobago, both with flexible exchange rate regime.

5.1 Calibration

Following the business cycle literature, we set the elasticity of the production function with respect to the employment at $\frac{1}{3}$. The Degree of persistence is allowed to vary from completely persistent to completely *hysteretic* such as $\gamma \in [0, 1]$. Labour market parameters of both basic model and extended models are reported in the table 1 and 2 (see Appendix A.2).

To calibrate the sources of the stochastic volatility, we assume that US interest rate is the driving force describing the world (nominal) interest rate. For the monetary policy rule and other parameters, we follow the benchmark model adopted by Allegret and Sand-Zantman (2006) and Cho and Moreno (2006) (for the US economy).

5.2 Some preliminary Results

Several results emerge. First, under a flexible exchange rate regime, unemployment and wage have smaller fluctuations when countries are hit by structural shocks whereas the price level, the nominal and the real exchange rates have larger fluctuations (as shown in Appendix B). Second, under a fixed exchange rate regime, labour market tends to fluctuate more whereas

[10]see Cooley (1995) for detailed discussions on several techniques.

the price level, the nominal wage and the real exchange rates have smaller fluctuations. These observations are consistent with many other studies (more particularly Mussa (1986)).

6 Conclusion

We theoretically and numerically examine the link between structural shocks and labour market variables. To do so, we solve dynamic stochastic small open-economy. The model combines nominal wage rigidity under different exchange rate regimes. The numerical solutions are compared with the actual empirical regularities.

The main sources of labour market fluctuations in the flexible exchange rate countries are foreign and the domestic demand shocks. In the fixed exchange rate countries, labour market fluctuations are mainly due to supply shocks. These results are fairly similar to those supply responses observed by industrialized countries.

References

Allegret, J., Sand-Zatman, A., 2006. Disentangling Business Cycles and Macroeconomic Policy in Mercosur: a Var and Unobserved Components Model approaches. OFCE Working Paper, 2006-15.

Anderson, G., Moore, G., 1985. A Linear Algebric Procedure for Solving Linear Perfect Foresight Models. Economics Letters, 17.

Blanchard, O., Kahn, C., 1980. The Solution of Linear Difference Models Under Rational Expectations. Econometrica 48, 1305-1311.

Blanchard O., Gali J., 2008. Labor Markets and Monetary Policy: A New-Keynesian Model with Unemployment, NBER Working Paper 13897.

Blanchard, O., Summers, L., 1986. Hysteresis and the European Unemployment Problem, NBER Macroeconomics Annual. Edited by Stanley Fischer, 15-78.

Blanchard, O., Wolfers, J., 2000. The role of shocks and institutions in the rise of European unemployment: the aggregate evidence, Economic Journal 110, C1-C33.

Cho, S., Moreno, A., 2006. A Small-Sample Study of the New-Keynesian Macro Model. Journal of Money, Credit and Banking, vol.38, 6.

Clarida, R., Gali, J., 1994. Sources of Real Exchange Rate Fluctuations: How Important are Nominal Shocks?. Carnegie-Rochester Conference Series on Public Policy 41:, 1-56.

Clarida,, R., Gali J., Gertler, M., 2000. Monetary Policy Rules and Macroeconomic Stability: Evidence and some Theory, Quarterly Journal of Economics, 115, 147-80.

Downes, A., 2009, Flexible labour markets, workers'protection and active labour market policies in the Caribbean, United Nations ECLAC, n86, July 2009, 43 p.

Fuhrer, C., Moore, G., 1995. Inflation Persistence. Quarterly Journal of Economics 440, 127-159.

Gali, J., 2008. Monetary Policy, Inflation and the business Cycle. An Introduction to the New Keynesian Framework, Princeton University Press.

Heckman, J., Pagès, C., 2000. The Cost of Job Security Regulation: Evidence from Latin-American Labor Markets. Inter-American Development Bank Working Paper 430.

Lindbeck, A., Snower, D., 1986. Wage-Setting, Unemployment and Insider- Outsider Relations. American Economic Review 76, 235-239.

Lockwood, B. Philippopoulos, A., 1994. Insider Power, Unemployment Dynamics, and Multiple Inflation Equilibria. Economica 61, 59-77.

Obstfeld, M., Rogoff, K., 1996. Foundations of International Macroeconomics, MIT Press.

Mendoza E., 1995. The Terms of Trade, The Real Exchange Rate and Economic Fluctuations. International Economic Review, 36(1), 101-37.

Mussa, M., 1986. Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications. Carnegie-Rochester Conference Series on Public Policy, 25, 117-214.

Uhlig, H., 1997. A Toolkit for Analyzing Nonlinear Dynamic Stochastic Model Easily. Center for Economic Research Discussion Paper.

Sargent T., 1987. Dynamic Macroeconomic Theory. Harvard University Press.

Walsh C., 2003. Monetary Theory and Policy. Second Edition, Mit Press.

A Appendix

A.1 Approximation

Let us recall the first order of profit maximization:

$$A_t L_t^{\alpha-1} = \frac{W_t}{\alpha P_t}.$$

Using a linear approximation of the previous expression in a neighbourghood of L_0, A_0, P_0 and W_0:

$$L_0^{\alpha-1}\left[\frac{A_t - A_0}{A_0}\right] A_0 + (\alpha-1)A_0 L_0^{\alpha-2}\left[\frac{L_t - L_0}{L_0}\right] L_0 = \frac{1}{P_0\alpha}\left[\frac{W_t - W_0}{W_0}\right] W_0 - \frac{W_0}{\alpha P_0^2}\left[\frac{P_t - P_0}{P_0}\right] P_0. \quad (34)$$

Let us denote by small letters the following quantities:

$$\widehat{a}_t = \frac{A_t - A_0}{A_0}, \quad \widehat{\ell}_t^d = \frac{L_t - L_0}{L_0}, \quad \widehat{w}_t = \frac{W_t - W_0}{W_0}, \quad \widehat{p}_t = \frac{P_t - P_0}{P_0}.$$

Rewrite (34) with these notations, develop the left hand side and use the first order condition into the right hand side to get :

$$A_0 L_0^{\alpha-1}\widehat{a}_t + (\alpha-1)A_0 L_0^{\alpha-1}\widehat{\ell}_t^d = A_0 L_0^{\alpha-1}\widehat{w}_t - A_0 L_0^{\alpha-1}\widehat{p}_t.$$

Simplify by $A_0 L_0^{\alpha-1}$:

$$(\alpha-1)\widehat{\ell}_t^d = \widehat{w}_t - \widehat{p}_t - \widehat{a}_t \iff \widehat{\ell}_t^d = -\left[\frac{\widehat{w}_t - \widehat{p}_t - \widehat{a}_t}{1-\alpha}\right] \iff L_t = L_0\left[1 - \left[\frac{\frac{W_t}{W_0} - \frac{P_t}{P_0} - \frac{A_t}{A_0}}{1-\alpha}\right]\right].$$

A.2 Behavioural Parameters

Table 1: Parameter values of the basic model for Barbados

α	γ	η	$\bar{\ell}$
0.928	0.962	0.011	1

Table 2: Parameter values of the extended model

λ	θ	ϑ	ς	ω	κ	ρ	σ_{AS}	σ_{IS}	σ_{MP}
0.5586	0.0011	0.4859	0.0045	1.6409	0.6038	0.0045	0.4585	0.0.374	0.7327

Note: Cho and Moreno (2006).

B Appendix

B.1 Impulse responses for Barbados : the basic model

Figure 1: Impulse responses to ϵ_t^s

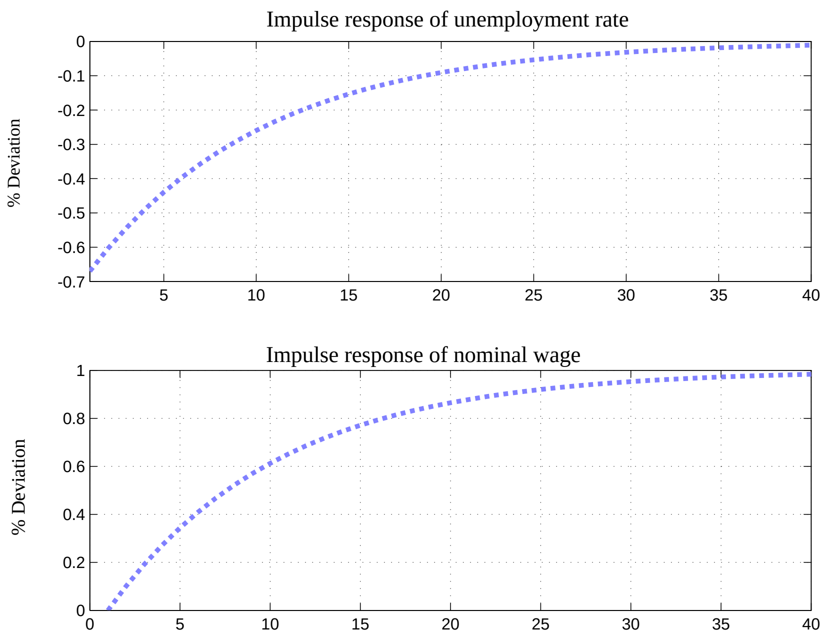
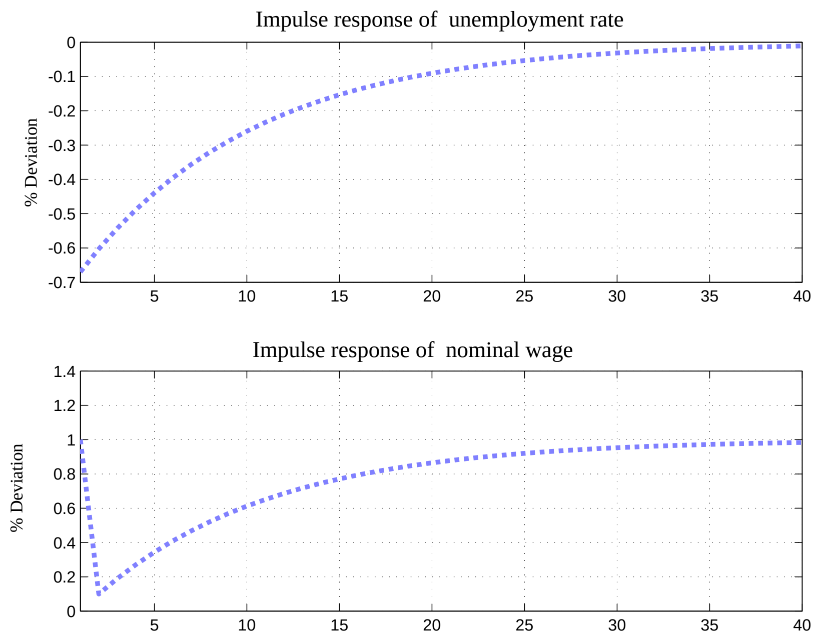


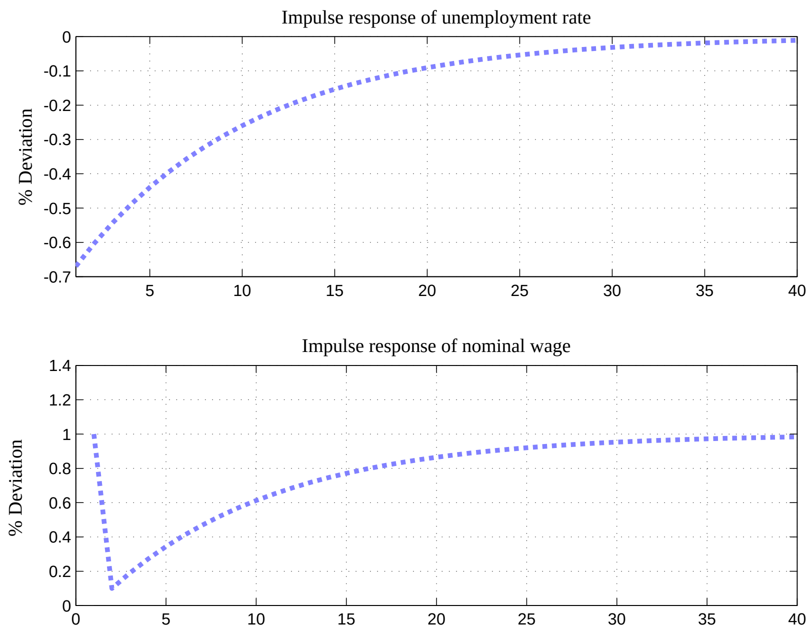
Figure 2: Impulse responses to ϵ_t^p



B.2 Impulse responses for Jamaica : the basic model

Figure 3: Impulse responses to ϵ_t^i

Figure 4: Impulse responses to ϵ_t^m



B.3 Impulse responses for Barbados : the extended model

Figure 5: Impulse responses to ϵ_t^{AS}

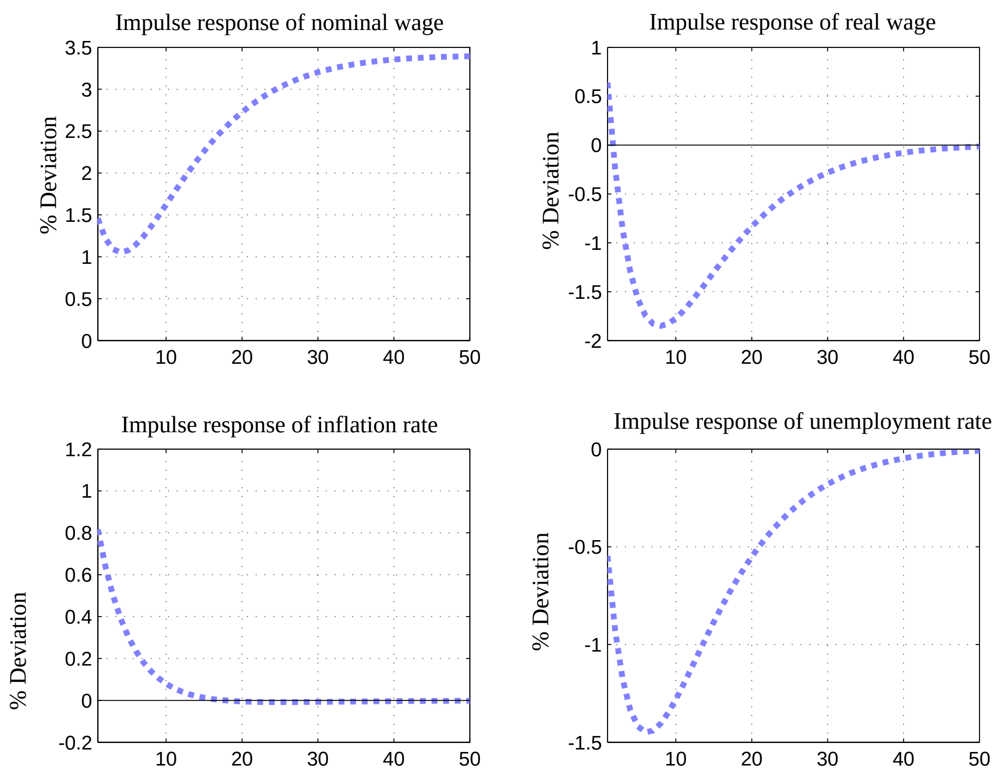


Figure 6: Impulse responses to ϵ_t^{IS}

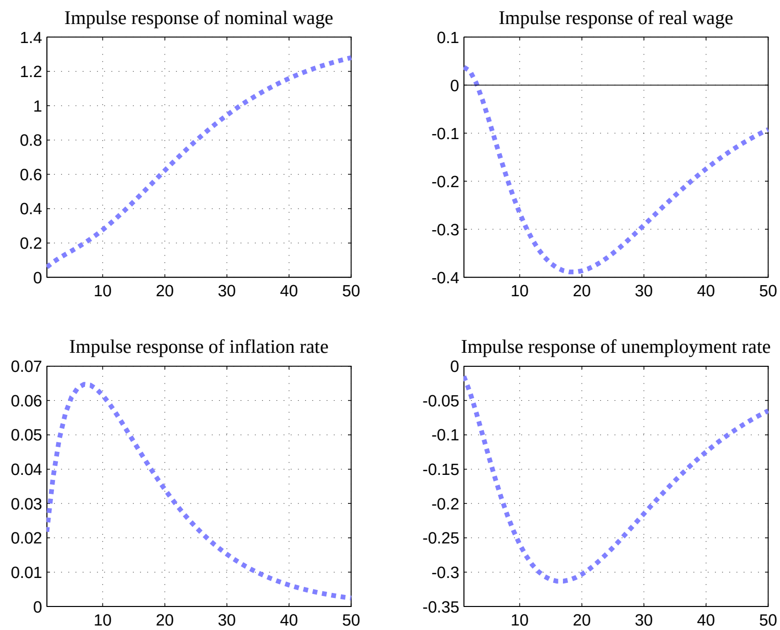
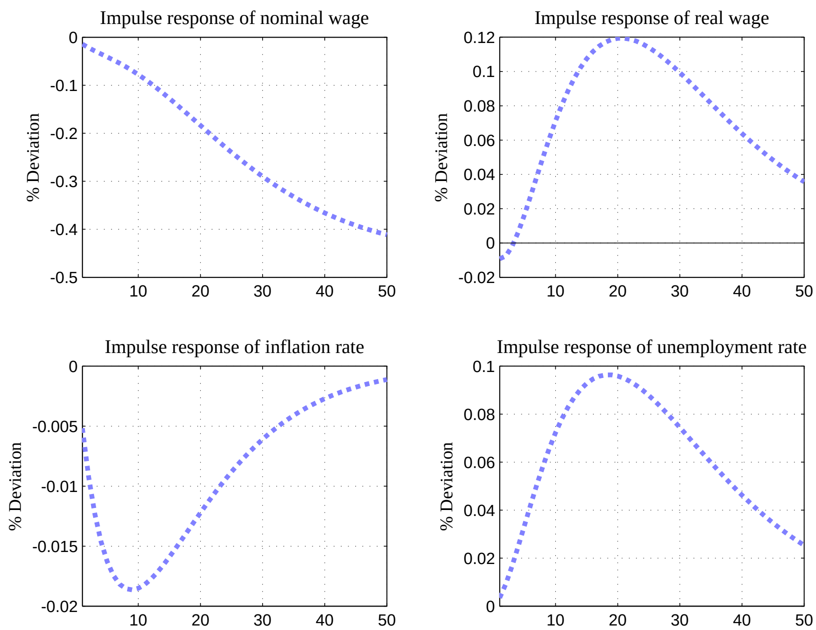


Figure 7: Impulse responses to ϵ_t^{MP}



B.4 Impulse responses for Jamaica : the extended model

Figure 8: Impulse responses to ϵ_t^{AS}

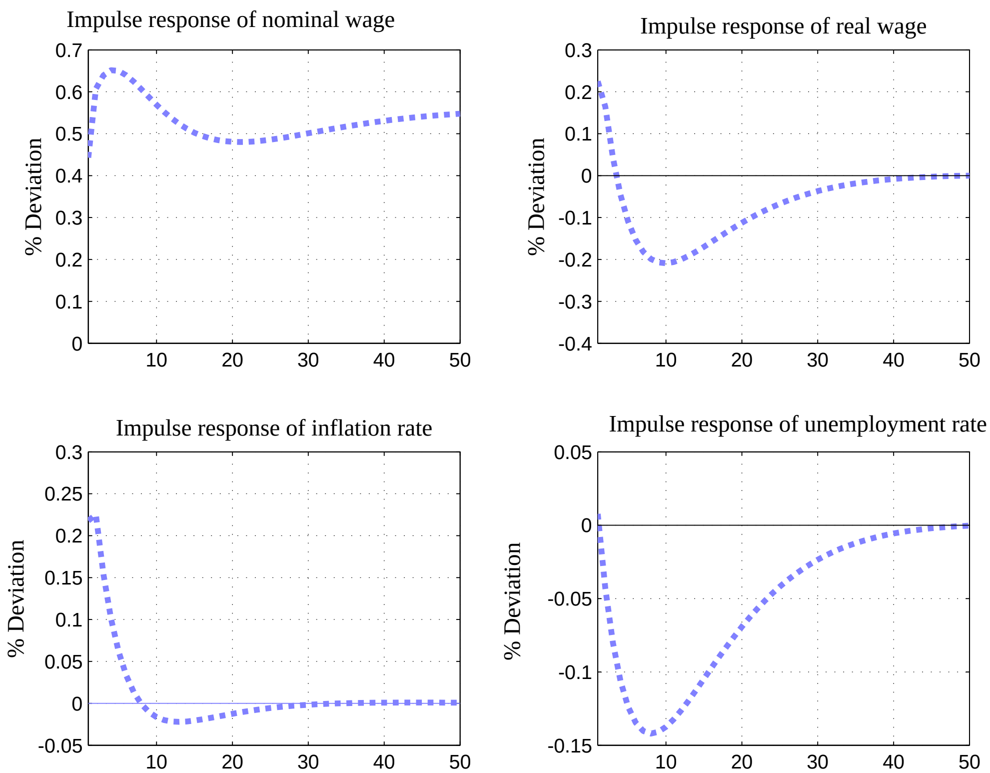


Figure 9: Impulse responses to ϵ_t^{IS}

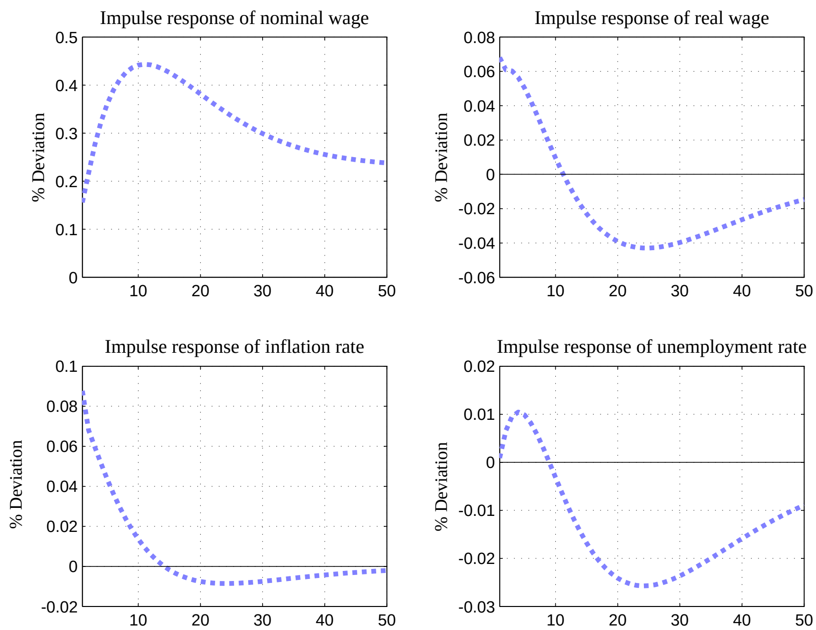


Figure 10: Impulse responses to ϵ_t^{MP}