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On the persistence of unemployment in small open economies

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Abstract

The paper attempts to measure the persistence of labour market distortions in general and unemployment in particular to structural shocks in the context of two small open economies (Barbados with a fixed exchange rate regime and Trinidad and Tobago with a flexible exchange rate regime). Using a rational expectations model and performing parameterizations and simulations for the two countries, the paper finds that external and domestic shocks are the main sources of labour market fluctuations in the flexible exchange rate countries. In the fixed exchange rate countries, labour market fluctuations are mainly due to supply shocks. The latter result is similar to those supply responses observed in industrialized countries.

JEL Classification Codes: J51,E24,C15

Keywords: Unemployment persistence, labour market, hysteresis, insider-outsider theory, rational expectations.

1. Introduction

Using a rational expectations model à la Blanchard and Summers(1986) and assuming that the labour market is controlled by insiders¹, this paper theoretically and empirically examines the persistence of unemployment due to various structural shocks in the context of small open economies under two different exchange rate regimes. The paper

specifically deals, at the empirical level, with two Caribbean countries in the period 1974-2010: Barbados with a fixed exchange rate regime and Trinidad and Tobago with a flexible exchange regime.

As pointed out by many authors (for example, Albagli et al. 2004,1), 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 sluggishness with which the labour market seems to adapt to shocks in emerging economies such as the Caribbean economies, the Latin American economies and some European economies.

The low performance of the labour market in the latter economies due mainly to constraints generated by the openness of the 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. As a matter of fact, the countries under study are mainly characterized by persistent and most often high unemployment, at least in the period of interest, explained, among others, by lack of labour market flexibility, itself as a result of stringent labour market regulations and some strength of trade unions.

The analysis of the role of microeconomic rigidities in labour market distortions is not new in the labour literature. Indeed, distortions due mainly to persistence or hysteresis in unemployment have been analysed 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. In a dynamic perspective, adverse shocks that contribute to reduce labour demand change the number of insiders, lower the next periods employment target and affect the nominal wage rate. In other words, membership considerations explain to a great extent 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 considered one explanation of the persistence of unemployment in industrialized countries (see, for example, Blanchard and Summers 1986; Lockwood and Philippopoulos 1994; Blanchard and Wolfers 2000).

The present paper is important to the extent that dealing with the major shocks that drive the path of unemployment (rate) or labour market may reveal useful, at least for the countries of interest, as the impact of these shocks may affect their economic growth as well as their economic integration into the global market.

The paper contributes to the literature in three ways. First, acknowledging that openness of economies is a reality, the paper develops a theoretical framework for analysing external shocks effects in the dynamic model of unemployment. Although Albagli et al. (2004) follow a similar path, the present paper explicitly introduces the behavior of insiders in the model and also distinguishes two exchange rate regimes. Second, it extends the analysis of the sources of the persistence of unemployment to two new emerging countries (Barbados, and Trinidad and Tobago). Precisely, contrary to authors like Blanchard and Summers (1986), aside from domestic shocks we theoretically and empirically analyse the role of external or foreign shocks in explaining labour market

dynamics. Naturally, we distinguish between two exchange rate regimes: fixed and flexible. Third, the paper also simulates the theoretical models to see whether the characteristics of the empirical data match the predictions of the theoretical models.

The remainder of the paper is organized as follows. Section 2 briefly reviews some stylized facts about unemployment in the Caribbean in order to identify shocks that might have affected the labour market. Section 3 deals, at the theoretical level, with the unemployment hysteresis and persistence effects. Section 4 develops a macroeconomic model to explain unemployment persistence. Section 5 contains the empirical results obtained essentially through the calibration of the model for the Caribbean economies (Barbados and Trinidad and Tobago). Section 6 concludes the paper.

2. Unemployment in the Caribbean: some stylized facts

This section focusses on the characteristics of the labour market in the English-speaking Caribbean countries with emphasis on Barbados, Jamaica, and Trinidad and Tobago. The period of interest is 1974-2010. Before proceeding, it is useful to point out that the trend and other characteristics of labour market in general and unemployment in particular may depend on the chosen period, a fact often neglected in many studies.

At the outset, we can point out with Downes (2009,13) 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 2000-2010 an annual population growth

rate (in percent) of 0.30, 0.42, and 0.40 for Barbados, Jamaica and Trinidad and Tobago, respectively, which translated into a stagnant growth of the labour force participation rate of -1.8 percent for Barbados, -2.8 percent for Jamaica and 3.3 percent for Trinidad and Tobago. A direct consequence of this state of affairs is the emergence of an ageing population. Remarkably, female labour participation rate has gained ground compared to male labour participation rate. Despite that, male labour participation rate 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 that of the lower levels. For example, in 2000, only between 5 to 13 percent of the labour force has attained the tertiary level.

On the demand side, the Caribbean economy dominated by sugar plantations has given place to a Caribbean economy 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 percent in 2000, in Jamaica it reached 64.8 percent in 2006 compared to 56 percent in 2000, in Trinidad and Tobago it amounted to 65 percent in 2006 compared to 56.9 percent in 2000. The regression of the agricultural sector is quite striking; nowadays, it only has 5 percent of the labour 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 services, utilities) (see Downes 2009,13). The number of people employed has been on the rise up to recently and so has been the employment rate at least in Jamaica and Trinidad and Tobago. No firm lesson can be drawn from 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 labour legislation. The minimum wage scheme is an example of the labour legislation used in many Caribbean countries.

Unemployment rate, a component of labour market, is of interest in this paper. The objective is to examine in detail its characteristics. Table 1 unveils the following features for the three countries of interest. The average unemployment rate in the period of interest (1974-2010) is at least 14.60 percent. Contrary to our expectations, Trinidad and Tobago's unemployment rate (19.12 percent) is above those for Jamaica (18.40 percent) and Barbados (14.60 percent). The same pattern is observed for the median. The median unemployment rate is impressive: 29.86 percent for Trinidad and Tobago, 21.2 percent for Jamaica and 17.6 percent for Barbados. The unemployment rate standard deviation is as follows: 9.12 percent for Trinidad and Tobago, 5.91 percent for Jamaica and 4.76 percent for Barbados. Note that Trinidad and Tobago's unemployment rate was very high in the 1970s before sensibly decreasing in the 2000s. Although the unemployment rates statistics for the full period are not fully available for the majority of other English-speaking Caribbean countries, on the surface one can state that their situations are not too different from those of the three countries presented above.

[Table 1 about here]

Summing up, the unemployment rate has the following salient features in the English-speaking Caribbean countries. First, over the period of interest (1974-2010), the unemployment rate is on average in the double digit. This is a matter of concern as high unemployment can negatively affect economic growth. Second, in terms of trend, while the three countries have witnessed decreases in unemployment rates from 1974 to 2010, the downward trend in unemployment rate registered by Trinidad and Tobago is quite clear-cut. Clearly, Jamaica and Barbados unemployment rates are characterized by structural changes in the years 1990 and 2007. The above means that unemployment persistence does exist but with different magnitudes. Third, it is often argued that differences in unemployment rates between countries or regions are due to different degrees of labour market rigidity². Labour market rigidity itself can be explained or is highly affected by labour market regulations. In this connection, Rama(1995) in his study established labour market rigidity indices for several countries. Table 2 indicates the English-speaking Caribbean countries are characterized by various degrees of market labour market rigidity with Barbados being relatively the most labour market rigid country. In fact, of eleven Caribbean countries, Barbados occupies the first position with an index of 0.580, Trinidad and Tobago the 5th position with 0.354 and Jamaica the 8th position with 0.278. Note that the labour market regulations measures in the Caribbean are centred around the following: “establishment and protection of workers’ rights, protection of the vulnerable, establishment of minimum compensation for work, assurance of decent working conditions, provision of income security” (Downes et al. 2004, 518). These labour market features are not in general the features of a flexible labour market, that is, a labour market conducive of economic growth.

[Table 2 about here]

3. Unemployment persistence and hysteresis effects

This section briefly introduces unemployment persistence and hysteresis phenomena as well as the relevant literature. Without any loss of generality, one simple representation of unemployment rate dynamics is:

$$u_t = \beta + \gamma u_{t-1} + \varepsilon_t \quad (1)$$

where $\gamma \in [0,1]$, ε_t represents shocks with $E(\varepsilon_t) = 0$ and $Var(\varepsilon_t) = \sigma^2$ and u_t is the unemployment rate defined as the ratio of unemployment (the difference between the labour force and employment) to the labour force.

The behaviour of γ allows us to define statistically persistence and hysteresis. If $0 < \gamma < 1$ then equation (1) is an autoregressive process of order one with the following implication

$$u_t = \gamma^t u_0 + \beta \sum_{i=0}^t \gamma^i + \sum_{i=0}^t \gamma^i \varepsilon_{t-i} \quad (2)$$

where u_0 represents the initial observation of unemployment rate. In general it is assumed to be zero. Exploiting the Wold's theorem, with $u_0 = 0$ it is the case that the solution to equation (1) can also be written as follows:

$$u_t = \beta(1-\gamma)^{-1} + \sum_{i=0}^{\infty} \gamma^i \varepsilon_{t-i} \quad (3)$$

Equation (3) implies that

$$E(u_t) = \frac{\beta}{1-\gamma} = u^* \quad (4)$$

where u^* represents the equilibrium unemployment rate or a weak form of natural rate of unemployment. As can be seen, with $0 < \gamma < 1$ equation (4) states that in the long run unemployment rate converges to its initial position or precisely to its natural rate equilibrium. Equations (2) and (3) indicate a whole range of persistence depending on the value taken by γ . Overall, adverse disturbances or shocks will have lasting or persistent effects without being permanent, that is, the effects gradually fade away over time. The persistence hypothesis or the natural rate of unemployment indicates that unemployment rate is a stationary process, that is, it tends to return to its mean (equilibrium) in the long run after a shock. In such a case, “past unemployment affects the natural rate” (Song and Wu 1997, 236). If $\gamma = 0$ then there is a complete absence of persistent effect of shocks. If $\gamma = 1$ then equation (1) reads as follows:

$$u_t = \beta + u_{t-1} + \varepsilon_t \quad (5)$$

That is, unemployment rate follows a random walk process with drift. Equation (6) below is the solution to equation (5) :

$$u_t = u_0 + \beta t + \sum_{i=0}^{t-1} \varepsilon_{t-i} \quad (6)$$

Equations (5) and (6) characterize the hysteresis phenomenon. As can be deduced, hysteresis can be viewed as the past history of shocks or disturbances which leads to a permanent gap from a deterministic linear trend $u_0 + \beta t$. Thus, unemployment rate has a state dependence on the path followed. Put differently, a temporary disturbance has a permanent effect on unemployment (Blanchard and Summers 1986). This is not the only

meaning of hysteresis in unemployment³. To the best of our knowledge, three theories at the very least explain the hysteresis phenomenon: duration theory which essentially states that the longer the unemployment spell, the harder for the unemployed to find jobs again; insider-outsider theory (see next section) which points out the negative role of insiders in the high persistence of unemployment; and capital stock theory which targets the negative effects of adverse demand shocks on plant capacity (see Romer 2001).

The demarcation line between persistence and hysteresis is often blurred in empirical work as it is not always easy to distinguish between high persistence and hysteresis. For example, it might be the case that $\gamma = 0.98$ and $\gamma = 1$ are statistically indistinguishable in small samples in the context of time series data.

Hysteresis hypothesis can be tested using a univariate or multivariate framework. A look at the literature reveals that recently the univariate framework has become prevalent. In this context, testing for unemployment hysteresis is equivalent to testing for unit root in unemployment rate. An important remark is that the usual tests for unit root (the ADF test, the PP test, the KPSS test, etc.) are not too useful under the following scenarios: the sample size is small in which case the tests will have low power against alternatives; structural break(s) is (are) present in the data in which case the power of tests will be distorted; the relationship is non-linear in which case the power of tests will also be distorted. To boost the power of unit root tests, one often uses panel data instead of time series data with effect of enlarging the sample size. To deal with structural break(s), one utilises appropriate unit root tests such as the Zivot and Andrews test in the context of time series and some modification of panel unit root tests in the context of panel

data. As far as non-linearity is concerned, new tests such as the KSS (Kaetanos-Snell-Shin) test can be of interest.

An abundant literature on unemployment hysteresis exists for Europe, the United States, and Canada. Gordon (1989) uses the Phillips-type equation to test for unemployment hysteresis for France, Germany, the United Kingdom, Japan and the United States for 1870-1986. For recall, the equation states that inflation depends on its immediate past and the gap between unemployment rate and the natural rate of unemployment. The study is unable to support the full hysteresis hypothesis in these countries in the period of interest. Graafland (1991) uses a four system equations model for The Netherlands for the time period 1960-1987 to describe “the dynamics of wages, employment, long-term unemployment and vacancies.” In particular, the author is interested in explaining the unemployment hysteresis in the period of interest. He is able to uncover duration effects after 1982 in the data. Song and Wu (1997) use panel-based tests for unit root which exploit cross-section restrictions to show that the hypothesis of hysteresis does not hold in 48 contiguous US states over the period 1962-1993. Blanchard and Wolfers (1999) deal with the role of shocks and institutions in the rise of European unemployment from the 1960s up to the 1990s. In fact, they attempt to explain two facts of European unemployment: “the rise in unemployment since the 1960s, and the heterogeneity of individual country experiences.” Using a panel of institutions and shocks for 20 OECD nations since 1960, they find that the interaction between shocks and institutions explains largely the two stylized facts. Leon-Ledesma and MCadam (2003) evaluate unemployment hysteresis situation in many European transition economies using an array

of techniques. They particularly pay attention to the issues of structural change and non-linear dynamics while testing for hysteresis. In addition, they consider the issue of multiple equilibria in unemployment. Overall the unit root hypothesis is rejected after controlling for structural changes and business cycle effects. Camarero et al.(2006) test for unemployment hysteresis in 19 OECD countries covering the period 1956-2001 using stationary panel tests with breaks. They reject the hysteresis hypothesis.

Only a handful of papers deal with the topic of interest for the Caribbean. Downes (1998) conducted an economic analysis of unemployment in Trinidad and Tobago in the time period 1963-1996. Using the ADF and PP tests, he is unable to reject the null hypothesis of unit root, that is, hysteresis hypothesis. This means that a temporary disturbance has a permanent effect on unemployment or better, “the natural rate of unemployment depends on the history of actual unemployment rate” (ibidem 1998). Duration theory coupled with labour market rigidity resulting from labour laws and regulations can explain the situation. It is worth pointing out that as structural breaks are present in the series as acknowledged by the author, the use of the unit root tests which take structural breaks into account might possibly change the conclusion; that is, instead of pure hysteresis one might have simple persistence although most likely a higher one. Craigwell and Warner (2000) deal with the causes of unemployment in Barbados in the time period 1980-1996 using the autoregressive distributed lag framework. They are able to uncover high unemployment persistence explained by high wage levels and high levels of firing and hiring costs. Borda (2000) confirms unemployment hysteresis for Guadeloupe. Craigwell et al. (2011) study the hysteresis phenomenon in the English-

speaking Caribbean using non-linear models for the periods 1975-2010 for Barbados and 1971-2010 for Trinidad and Tobago with quarterly data. They acknowledge that in the Caribbean basin unemployment rates vary between 15 percent and 30 percent. They seem to confirm the hysteresis hypothesis in the two countries of interest. However, they point out that the non-linear model is more appropriate than the linear one. Furthermore, they uncover the “existence of two equilibria of differentiated rates.”

4. Why does unemployment persist? a macroeconomic model

We consider an augmented insider-outsider model with open-economy and stochastic process considerations. The firm maximizes its profits with respect to the labour demand taking the unions wage level as given. The model does not allow for human and physical capital accumulation.

4.1 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 stands for time index. The technology level is precisely captured by

$$A_t = A_{t-1} \bar{G} E_t^S \quad (7)$$

where \bar{G} can be interpreted as technical progress and E is some random variable.

Equation (7) allows to derive \hat{a}_t , the technology level in deviation from the steady state, as follows⁴:

$$\hat{a}_t = \hat{a}_{t-1} + \hat{g} + \varepsilon_t^S \quad (8)$$

where \hat{g} is the technical progress in deviation from the steady state, “^” stands for “in deviation from the steady state”, and ε_t^s is an i.i.d random variable satisfying $E[\varepsilon_t^s] = 0$ and a constant variance. The disturbances here can be considered 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 deviation from the steady state as follows⁵:

$$\hat{\ell}_t^d = -\frac{1}{1-\alpha}(\hat{w}_t - \hat{p}_t - \hat{a}_t) \Leftrightarrow \hat{\ell}_t^d = -\delta(\hat{w}_t - \hat{p}_t - \hat{a}_t) \quad (9)$$

where “ d ” stands for demand, $\delta = (1-\alpha)^{-1}$, \hat{p}_t is price in deviation from the steady state, \hat{w}_t represents nominal wage in deviation from the steady state, and \hat{a}_t is defined as above. As expected, labour demand is a decreasing function in real wage. Nominal wage is set by minimizing a 1-period loss function⁶

$$\min_{\hat{\ell}_t^d} \Omega_t = \frac{1}{2} E_{t-1} \left(\hat{\ell}_t^d - \ell_t^* \right)^2. \quad (10)$$

Equation (10) indicates that insiders accept any wage in order to maintain their status⁷ given ℓ_t^* , the union’s targeted rate of employment. The latter is formed according to the following law:

$$\ell_t^* = \gamma \hat{\ell}_{t-1} + (1-\gamma)\bar{\ell} \quad \gamma \in [0,1] \quad (11)$$

where $\bar{\ell}$ is the size of the labour 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 $\hat{\ell}_t^d = \hat{\ell}_t$. Equation (11) indicates that at each point in time the union’s targeted rate of employment is a weighted sum of the past labour

demand and labour force. Thus if $\gamma = 1$ the labour market exhibits an hysteresis phenomenon, that is, shocks are ever lasting. On the contrary, if $\gamma = 0$ union's policy is independent of history and so shocks are not persistent. This setting is used to introduce rigidity in the labour market that prevents nominal wages from adjusting quickly to equilibrium. The first order condition yields

$$E_{t-1} \left(\ell_t^d - \ell_t^* \right) = 0 \quad (12)$$

Using equations (8), (9), and (11) in equation (12) helps derive the nominal wage setting:

$$\hat{w}_t = E_{t-1} \hat{p}_t + \hat{a}_{t-1} + \hat{g} - \frac{\gamma}{\delta} \hat{\ell}_{t-1}^d - \frac{1-\gamma}{\delta} \bar{\ell}. \quad (13)$$

Equation (13) expresses the dependence of nominal wage \hat{w}_t on expected price level, past technology level, technical progress, past employment level and labour force level. In order to find a solution to the equation we need to compute change in nominal level. Solving equation (9) for \hat{a}_{t-1} and substituting it into equation (13) and solving for $\Delta \hat{w}_t$, we obtain

$$\Delta \hat{w}_t = E_{t-1} \Delta \hat{p}_t + \hat{g} - \left(\frac{1-\gamma}{\delta} \right) \hat{u}_{t-1}, \quad (14)$$

where \hat{u}_{t-1} is the lagged unemployment rate (in deviation to the steady state).

Putting equations (2) and (7) into equation (13) yields the following labour demand:

$$\hat{\ell}_t^d = \delta (\Delta \hat{p}_t - E_{t-1} \Delta \hat{p}_t) - \gamma \hat{u}_{t-1} + \delta \varepsilon_t^s \quad (15)$$

Equation (15) states that labour demand depends on inflation surprise, past unemployment rate and supply shock. Precisely, an increase in unemployment rate

decreases labour demand and a positive supply shock leads to an increase in labour demand. Note that the unemployment rate defined above follows the rule below⁸

$$\hat{u}_t = \gamma \hat{u}_{t-1} - \delta (E_{t-1} \pi_t - \pi_t) - \delta \varepsilon_t^s \quad (16)$$

where π_t stands for domestic inflation rate. Equation (16) indicates that the behaviour of unemployment rate is contingent upon three 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 shock brings about a decrease in unemployment. The role of surprise term is explored in detail in the next subsection.

4.2 The aggregate demand relation

In this section we specify the aggregate demand. The price level \hat{p}_t is defined as follows:

$$\hat{p}_t = \hat{p}_t^f + \hat{e}_t \quad (17)$$

where \hat{p}_t^f is the foreign or imported price level, \hat{e}_t stands for the nominal exchange rate and “^” stands for “in deviation to the steady state.” Our specification assumes that the system is “bombarded” with permanent shocks in a random walk manner:

$\hat{p}_t^f = \hat{p}_{t-1}^f + \pi_t^f + \varepsilon_t^f$, where ε_t^f captures foreign shocks. To complete the model, we

introduce equation (18) which represents the condition for equilibrium in the money market:

$$\hat{m}_t - \hat{p}_t = \bar{y}_t - \eta \hat{i}_t + v_t \quad \eta > 0, \quad (18)$$

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

$$\bar{y}_t = \alpha \bar{\ell} + \hat{a}_t, \quad (19)$$

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

$$v_t = v_{t-1} + \varepsilon_t^m \quad (20)$$

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

$$\hat{i}_t = E_t \hat{e}_{t+1} - \hat{e}_t + \hat{i}_t^f. \quad (21)$$

We assume that \hat{i}_t^f follows a random walk process $\hat{i}_t^f = \hat{i}_{t-1}^f + \varepsilon_t^i$. World interest rate shock is captured by ε_t^i . The equations (8)-(21) can be solved for nominal wage, employment, price level and unemployment rate.

4.3 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.

4.3.1 Unemployment dynamics under flexible exchange rates

We use the approach developed by Sargent (1987) to solve for linear rational expectations models⁹. Substituting equations (11), (13), and (15) into equation (12), we get:

$$\hat{e}_t = \frac{1}{1+\eta} [\hat{m}_t - \hat{p}_t^f - \alpha \bar{l} - \hat{a}_t + \eta \hat{i}_t^f + v_t + \eta E_t \hat{e}_{t+1}] \Leftrightarrow \left(J - \frac{1+\eta}{\eta} \right) \hat{e}_t = \frac{1}{\eta} \hat{x}_t, \quad (22)$$

with $\hat{x}_t = \hat{m}_t - \hat{p}_t^f - \alpha \bar{l} - \hat{a}_t + \eta \hat{i}_t^f + v_t$ and J as the forward operator: e.g., $J \hat{e}_t = \hat{e}_{t+1}$.

Equation (22) indicates that the nominal exchange rate depends on the current paths of money supply, foreign price, labour force, technical level, foreign interest rate (see, for instance, Walsh 2003).

Using equation (22) recursively to eliminate the expectation operator on nominal exchange rate, we obtain the no-bubbles solution:

$$\hat{e}_t = \frac{1}{1+\eta} \sum_{i=0}^{\infty} \left(\frac{\eta}{1+\eta} \right)^i \hat{x}_{t+i}. \quad (23)$$

Exploiting equations (8) and (20) and the law of iterative expectations, we find the solution for equation (23):

$$\hat{e}_t = \hat{x}_t + \frac{\eta}{1+\eta} (\hat{\mu} - \hat{g} - \pi_t^f), \quad (24)$$

where $\hat{\mu} = \hat{m}_t - \hat{m}_{t-1}$ represents money growth and other variables are defined as above. In order to get $E_{t-1} \Delta \hat{e}_t$, we apply the expectation operator to equation (24) and we obtain:

$$E_t \Delta \hat{e}_{t+1} = \hat{\mu} - \hat{g} - \pi_t^f. \quad (25)$$

In the same way, using equations (17) and (24) and applying the expectation operator, we obtain:

$$E_t \pi_{t+1} = \hat{\mu} - \hat{g}. \quad (26)$$

Equation (26) indicates that the authorities stabilize inflation if money supply growth is equal to productivity growth or technical progress. In the same vein, it can be shown that foreign shocks, interest rate shocks, supply shocks and demand shocks would affect nominal exchange rate expectations:

$$\hat{e}_t - E_{t-1} \hat{e}_t = \eta \varepsilon_t^i + \varepsilon_t^m - \varepsilon_t^f - \varepsilon_t^s. \quad (27)$$

Substituting the solution for \hat{e}_t given by equation (24) into equation (27), we obtain the domestic inflation rate in terms of economic conditions and shocks:

$$\pi_t = \hat{\mu} - \hat{g} + \eta \varepsilon_t^i + \varepsilon_t^m - \varepsilon_t^s. \quad (28)$$

How do structural shocks affect the unemployment dynamics in a small-open economy? This is the key question of this work. The answer is obtained by solving equations (16), (24) and (25). The reduced form for unemployment rate dynamics is given by

$$\hat{u}_t = \gamma \hat{u}_{t-1} - \delta(\eta \varepsilon_t^i + \varepsilon_t^m). \quad (29)$$

The autoregressive form $\gamma \hat{u}_{t-1}$ 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 being permanent. It is possible to solve equation (29) iteratively. The solution to equation (29) is:

$$\hat{u}_t = \gamma^t \hat{u}_0 - \delta \eta \sum_{k=0}^{t-1} \gamma^k \varepsilon_{t-k}^i - \delta \sum_{k=0}^{t-1} \gamma^k \varepsilon_{t-k}^m. \quad (30)$$

This is a standard autoregressive equation, in which changes in unemployment rate are driven by previous unemployment rate, domestic shocks and external shocks. As equation (30) shows, positive interest rate shocks and positive monetary shocks have a negative influence on unemployment rate. The latter impact is realised through γ , δ and/or η . In fact, an increase in δ and η reinforces the shocks effects as well as their persistence.

4.3.2 Unemployment dynamics under fixed exchange rates

Under fixed exchange rate systems we have $\hat{e}_t = \bar{e}$. If the system is stable and time consistent credible, then $\hat{i}_t = \hat{i}_t^f$ so that from equation (17)¹⁰ the uncovered interest parity implies that the domestic inflation rate is given by $\pi_t = \pi_t^f$. Here, the unemployment dynamics is easy to compute. Using the previous conditions and equation (16), the unemployment dynamics can be re-expressed as:

$$\hat{u}_t = \gamma \hat{u}_{t-1} - \delta(\varepsilon_t^f + \varepsilon_t^s). \quad (31)$$

According to equation (31) productivity shock (ε_t^s) and external demand shock (ε_t^f) decrease unemployment rate. By iterating equation (31) we obtain:

$$\hat{u}_t = \gamma^t \hat{u}_0 - \delta \sum_{k=0}^{t-1} \gamma^k \varepsilon_{t-k}^f - \delta \sum_{k=0}^{t-1} \gamma^k \varepsilon_{t-k}^s. \quad (32)$$

In the long run, unemployment rate depends on the past history of shocks. Contrary to the flexible exchange rate system, we see that foreign and supply shocks have similar impact on unemployment rate. The persistence of shocks comes from the assumption of labour market rigidity. If $\gamma < 1$, unemployment follows a gradual path to its equilibrium level, with a persistence that reflects the degree of union's power.

It is interesting to analyse the labour market dynamics when the system is hit by some disturbances. Equations (30) and (32) are essential to understand the propagation of shocks to the labour market. In the following section, empirical results based on simulations of the previous models will be examined.

5. Empirical Results

This section is devoted to the computation of the responses of some key variables of labour market (output, real wage and unemployment) to structural disturbances.

Equations (8),(13),(15) and (17) for flexible exchange rate regimes and (15), (17), (20), (21) and (31) for fixed exchange rate regimes form a linear rational expectations system

$\hat{y}_t, \hat{l}_t, \pi_t, \hat{p}_t^f, \hat{a}_t, \hat{u}_t, \hat{e}_t$ that is driven by the vector of shocks $\varepsilon_t^f, \varepsilon_t^i, \varepsilon_t^m$ and ε_t^s . First, we solve the equilibrium model by taking into account the rational expectations hypothesis and perform the parameterization for the model. We simulate the model using Dynare software developed mainly by Juillard (1996). We first perform a static exercise assessing the steady state implications of economic changes in the model.

The calibration exercise aims at illustrating the qualitative properties of the model.

Precisely, the ultimate aim of the exercise is to gain a better understanding of the role of wage rigidity in the transmission of external shocks to labour market. We simulate the model for Barbados, and Trinidad and Tobago¹¹. The most important source of data is CIAfactbook 11. A way of looking at the dynamic properties of the model is by studying the impulse response functions. Basically, we are interested in observing how the labour market responds to a shock to, for example, one of the errors terms.

For recall, while Barbados is under a fixed exchange rate regime, Trinidad and Tobago experiences a flexible exchange rate regime. The parameters values (see Tables 3 and 4) are chosen or derived to replicate the steady state of the US and the Caribbean economies and are standard in the literature.

[Table 3 about here]

[Table 4 about here]

We point out that some parameters values are borrowed from the business cycle literature. From data, the elasticity of the output with respect to the employment is 0.928 and 0.234 for Barbados and Trinidad and Tobago, respectively. The degree of persistence is allowed to vary from completely non persistent to completely hysteretic such as $\gamma \in [0,1]$. In the baseline calibration, we normalize the Caribbean labour force to one ($\bar{\ell} = 1$). To calibrate the sources of the stochastic volatility, we assume that the US interest rate is the driving force describing the world nominal interest rate. The Central Bank (i.e., the Federal Reserve Bank) is assumed to follow the following Taylor policy rule:

$$\hat{i}_t^f = \psi + \varsigma \hat{i}_{t-1}^f + (1 - \varsigma)(\omega E_t \pi_{t+1}^f + \kappa \hat{y}_t^f) + \varepsilon_t^i. \quad (33)$$

For the calibration of the US monetary policy rule parameters, we follow the benchmark adopted by Cho and Moreno (2006) who estimated this kind of shocks with the generalized method of moments. To analyse the prediction of the model we limit the analysis only to the case of domestic productivity shocks, external shocks and interest rate shocks.

5.1. Response for Barbados

We show the dynamic response of the main variables under fixed exchange rate system for Barbados. Each figure below represents the response of a given variable to one standard deviation innovation with Y axis capturing the response in appropriate unit and X axis the time (years, here).

5.1.1 External demand shocks

Figure 1a shows the output response to external demand shocks (ε_t^f). As can be seen, external demand shocks seem to have an evenly significant impact on output. Precisely, the figure indicates that external demand shocks affect supply of goods and services uniformly in both runs (short run and long run). As far as real wage is concerned, figure 1b indicates the real wage response to the shocks is rather gradual with the smallest impact felt in the earlier years and the biggest in the late years. According to figure 1c, in the short and long runs, external demand shocks have a negative effect on unemployment rate. However, in absolute value the effect tends to decrease substantially in the long run. The impulse response functions clearly reveal that the adjustment of unemployment rate is not the counterpart of that of real wage. Overall, the results seem to confirm on the one hand, the rigidity of real wage and the persistence of unemployment(rate) and on the other hand, the neutrality of demand shocks over the long-run dynamics of labour market and good markets.

[Figure 1 about here]

5.1.2 Productivity Shocks.

The comparison of figure 1 and figure 2 reveals that the effects of productivity shocks and those of external demand shocks on output, real wage and unemployment have the same profiles (see equations (31) and (32)). Summing up, the analysis suggests that taking into account external demand shocks as well as productivity shocks, in addition to contractual characteristics of salary bargaining, largely explains the persistence of unemployment in the Barbadian economy.

[Figure 2 about here]

5.1.3 Interest rate shocks.

The reaction of output to American interest rates shocks (ε_t^i) (see figure 3a) is of a slanted dome-like type with some degree of persistence. Real wage negatively adjusts to the shocks (see figure 3b). The most important reaction is registered in the last years. Figure 3c shows that shocks of American interest rates give rise to persistent effect on unemployment rate. The maximum negative effect is reached few years after the shocks. Nevertheless, the shock effects do not die out after reaching the maximum. Remarkably, the unemployment rate response seems to be the counterpart or the mirror-image of that of output and follows the same path as the real wage response. Without any doubt, these different results underline a certain persistence in the adjustment of labour market.

[Figure 3 about here]

5.2 Response for Trinidad and Tobago

What message can we extract from a flexible exchange rate regime? Figures 4 and 5 contain the elements of response. Indeed, the two types of figures which deal with impulse response functions, show each how unemployment rate, real wage and output react to different shocks under a flexible exchange rate regime (here Trinidad and Tobago). To repeat, as above, each given figure (e.g., figure 4a) represents the response of a given variable to one standard deviation innovation with Y axis capturing the response in appropriate unit and X axis the time.

5.2.1 Domestic monetary shocks

The major impression here is the low persistence of domestic monetary shocks (ε_t^m) effects. Indeed, for example, figure 4a reveals that output (GDP) response to domestic

monetary shocks portrays a low level of persistence, a result largely underlined in the literature --- demand shocks do not have long-run effect. Figure 4b shows that real wage reacts negatively to domestic monetary shocks in the first year before stabilising at -0.4. Unemployment rate (see figure 4c) also negatively reacts to domestic monetary shocks. The impact does not seem to vanish as time passes.

[Figure 4 about here]

5.2.2 Interest rate shocks

Contrary to the case of domestic monetary shocks, here output reacts to the American monetary policy shocks (ε_t^i) in a somewhat slanted dome-like shape (see figure 5a). A slight similar story can be told concerning the unemployment rate under this regime. Indeed, contrary to the response to domestic monetary shocks (see figure 4c), the response of unemployment rate to the American monetary policy shocks is characterized by a slanted inverted dome-like profile, which underlines the strong propagation of external shocks (see figure 5c). The story of real wage reaction to American monetary policy is similar to that of unemployment (see figure 5b). Consequently, the dynamic model is able to generate a certain rigidity on the labour market in response to some shock.

[Figure 5 about here]

6. Conclusion

The paper attempts to measure the persistence of labour market distortions in general and unemployment in particular to structural shocks in the context of small open economies. In this connection, we develop a general dynamic and stochastic equilibrium model for a small open economy according to exchange rate regimes to theoretically and numerically

examine the impact of structural shocks on labour market variables. Concretely, we solve a dynamic stochastic small-open economy rational expectations model. The model assumes that markets are controlled by insiders. Parameterizations and simulations are performed on Barbados, a small open-economy with a fixed exchange rate regime, and Trinidad and Tobago, another small-open economy with a flexible exchange rate regime. The numerical solutions are compared with the actual regularities.

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

Competing interests

The IZA Journal of Labor Economics is committed to the IZA Guiding Principles of Research Integrity. The authors declare that they have observed these principles.

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Endnotes

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).

² Labour market rigidity mainly deals with the question of whether the labour market costs can vary freely in response to shocks or changes in labour demand. In the negative, the labour market is considered rigid otherwise it is flexible.

³ Overall, hysteresis represents “situations where one-time disturbances permanently affect the path of the economy” (Romer 2001, 443).

⁴ 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 $X_t = (x_{1t}, \dots, x_{nt})$. As $\Psi(X) = 0$, the previous relation becomes

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

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

⁵ For recall, the first order of profit maximization is as follows:

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

Using a linear approximation to the previous expression in the neighbourhood of

L_0, A_0, P_0 and W_0 leads to:

$$L_0^{\alpha-1} \left[\frac{A_t - A_0}{A_0} \right] A_0 + (\alpha - 1) A_0 L_0^{\alpha-2} \left[\frac{L_t - L_0}{L_0} \right] L_0 = \frac{1}{P_0 \alpha} \left[\frac{W_t - W_0}{W_0} \right] W_0 - \frac{W_0}{\alpha P_0^2} \left[\frac{P_t - P_0}{P_0} \right] P_0 \quad (a1)$$

In equation (a1), denote by small letters the following quantities:

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

Rewrite equation (a1) with these notations, develop the left-hand side and use the first order condition into the right-hand side to get:

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

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

$$(\alpha - 1) \hat{\ell}_t^d = \hat{w}_t - \hat{p}_t - \hat{a}_t \Leftrightarrow \hat{\ell}_t^d = - \left[\frac{\hat{w}_t - \hat{p}_t - \hat{a}_t}{1 - \alpha} \right] \Leftrightarrow L_t = L_0 \left[1 - \left[\frac{\frac{w_t}{w_0} - \frac{p_t}{p_0} - \frac{A_t}{A_0}}{1 - \alpha} \right] \right]$$

⁶ 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.

⁷ Alogoskoufis and Manning (1988, 464-465) have suggested to modify the insiders' objective function by including deviation in real wages and unemployment from their respective targets.

⁸ Since $\hat{p}_t - E_{t-1} \hat{p}_t = \Delta \hat{p}_t - (E_{t-1} \hat{p}_t - \hat{p}_{t-1}) = \pi_t - E_{t-1} \pi_t$, the formulations are equivalent.

⁹ General discussions about this approach can be found in Uhlig (1999) and Sargent (1987).

¹⁰ With $\Delta \hat{p}_t^f = \pi_t^f + \varepsilon_t^f$.

¹¹ Jamaica is excluded because of missing data for some variables.

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Table 1. Basic statistics of unemployment rate (%): Barbados, Jamaica and Trinidad and Tobago, 1974-2010

	UNEBARB	UNEJAM	UNETRI
Mean	14.60	18.40	19.12
Median	14.50	16.20	19.60
Maximum	24.30	31.10	34.36
Minimum	6.70	9.90	4.50
Std.Dev.	4.76	5.91	9.12
Skewness	0.29	0.42	0.00
Kurtosis	2.14	1.99	1.79
Jarque-Bera	1.67	2.65	2.24
Probability	0.43	0.27	0.33

Source of data: CIA Factbook, 2011

Note: Unebarb: unemployment rate for Barbados; Unejam: unemployment rate for Jamaica; unetri: unemployment rate for Trinidad and Tobago.

Table 2. Labour market rigidity index

Country	Unionization (labour force %)	Labour Market Rigidity (index)	Rank (1=highest value)
Antigua & Barbuda	24	0.380	4
Barbados	31	0.580	1
Belize	13	0.182	11
Dominica	25	0.223	10
Grenada	47	0.328	6
Guyana	32	0.415	3
Jamaica	24	0.278	8
St. Kitts & Nevis	34	0.476	2
St. Lucia	20	0.306	7
St. Vincent & The Grenadines	12	0.251	9
Trinidad & Tobago	28	0.354	5

Source: Rama (1995).

Table 3: Parameters values for the Caribbean countries

	α	γ	η	$\bar{\ell}$
Barbados	0.928	0.962	0.011	1
Trinidad and Tobago	0.324	0.992	0.054	1

Note: authors' calculations (see the different models in the text).

Table 4. Parameters values for monetary rule

	ζ	ω	κ	σ_i
US economy	0.0045	1.6409	0.6038	0.7327

Note: see Cho and Moreno (2006).

Figure 1. Impulse responses to ε_t^f : Barbados

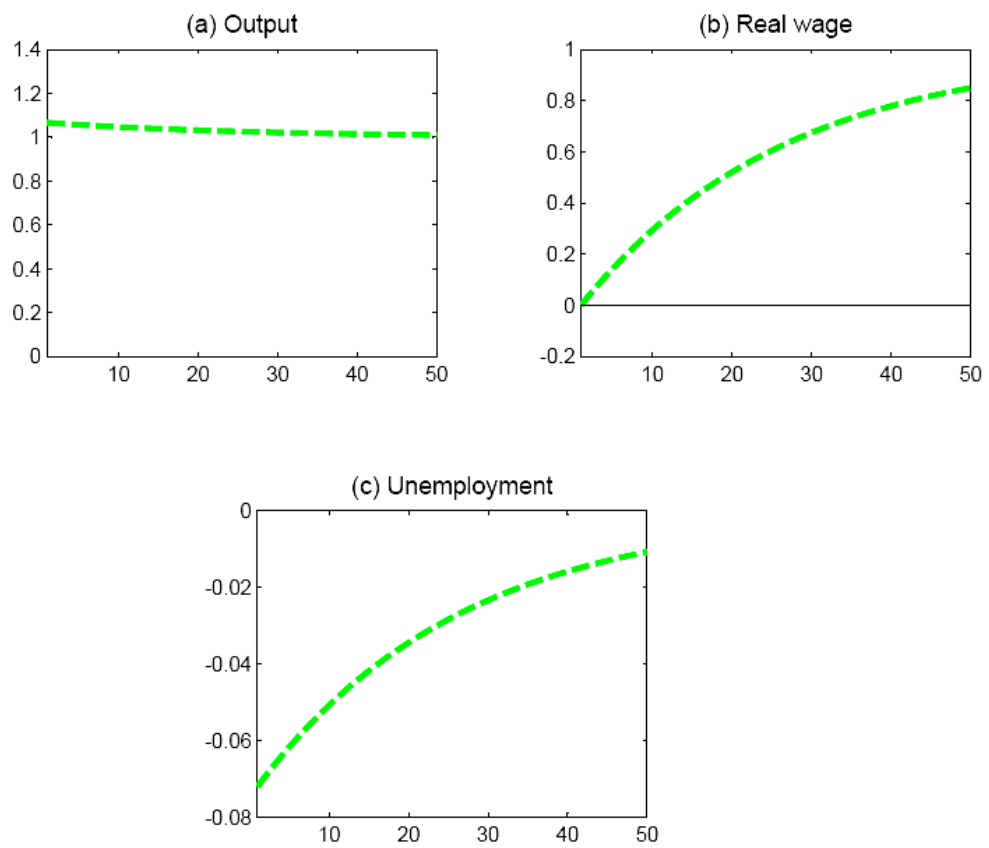


Figure 2. Impulse responses to ε_t^S : Barbados

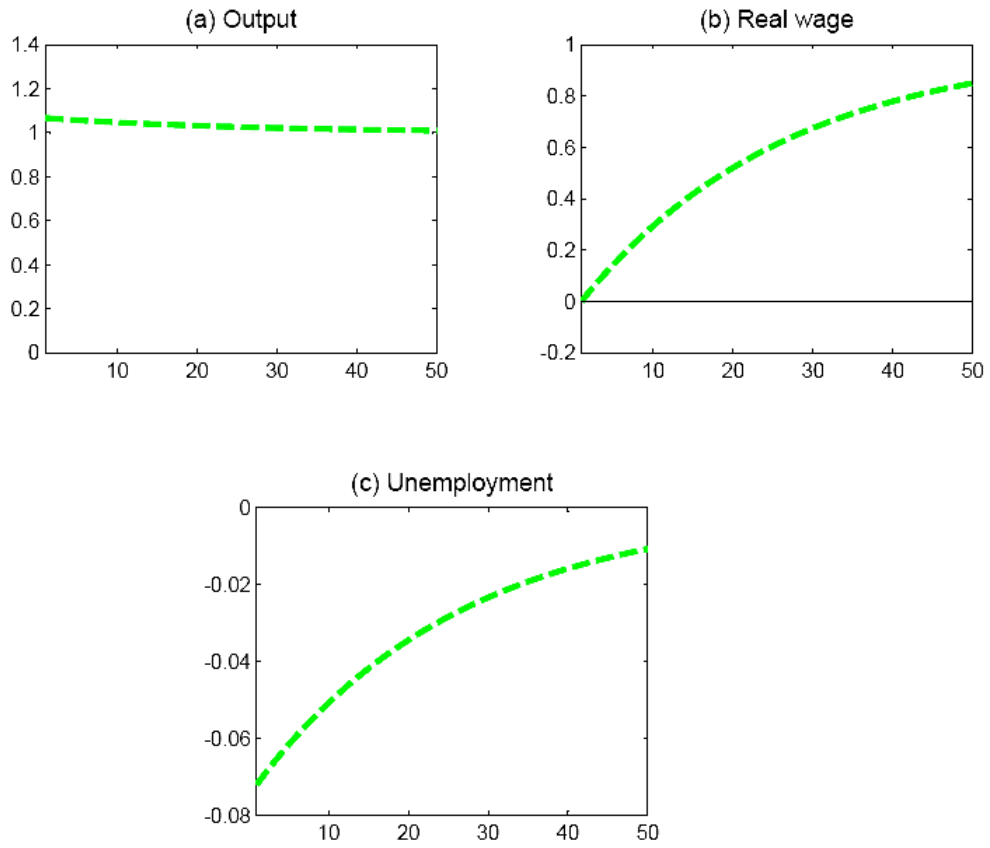


Figure 3. Impulse responses to ε_t^i : Barbados

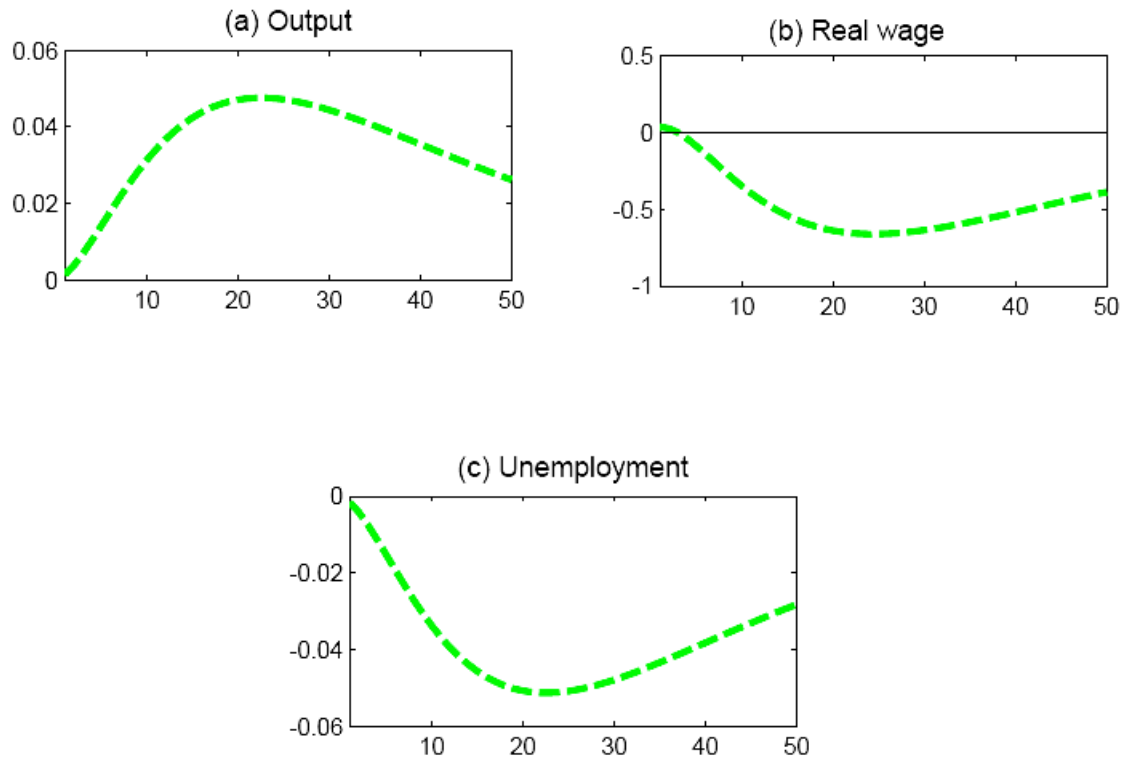


Figure 4. Impulse responses to ε_t^m : Trinidad and Tobago

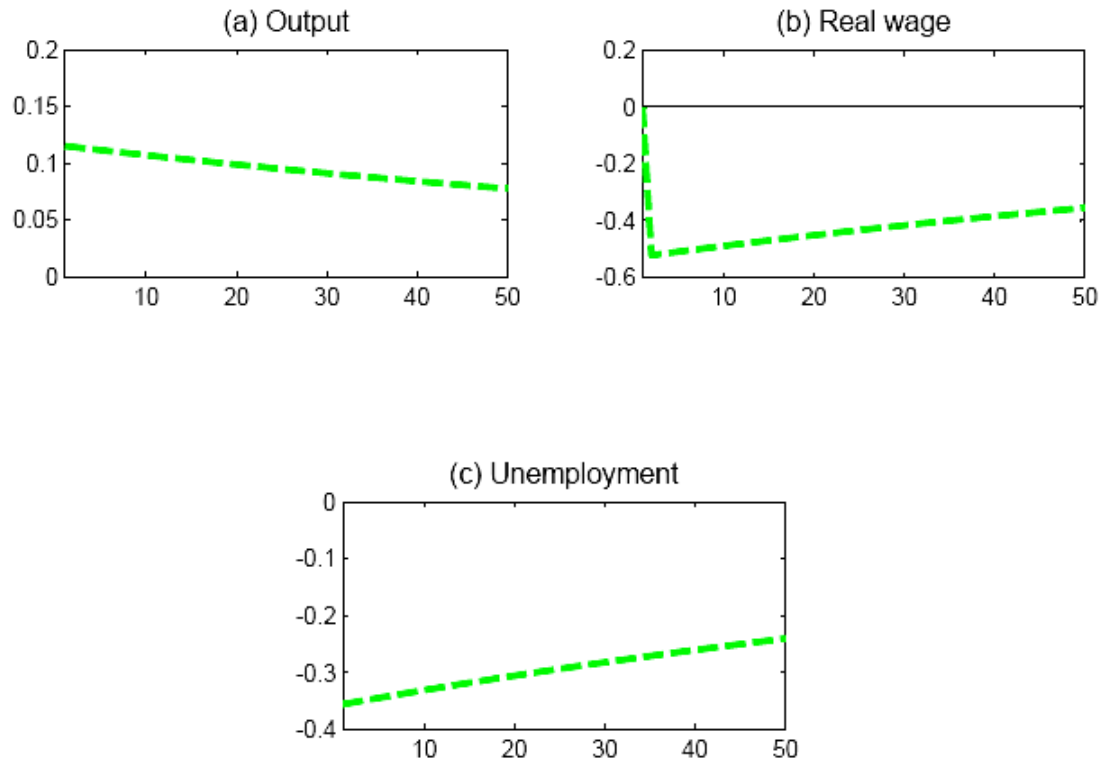


Figure 5. Impulse responses to ε_t^j : Trinidad and Tobago

