Policy Switches in Emerging Economies

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Abstract

Motivated by the repeated stabilization programs implemented by emerging economies during the last 30 years, I develop a dynamic stochastic general equilibrium model with Markov-Switching to study fiscal and monetary policies in emerging economies. I estimate the model for Mexico and find strong evidence of policy changes. Two Regimes are identified. The Active Monetary Policy Regime (AMP), in which monetary and fiscal policies respond to inflation and government debt, respectively; and the Active Fiscal Policy Regime (AFP), in which fiscal policy does not respond to government debt and monetary policy does not respond to inflation. AMP holds during short periods of time after macroeconomic crises during the 80s and 90s, and for a long period after 2002. The rest of the periods, AFP is in effect. I find that switches from AFP to AMP have strong stabilization effects at the cost of high output losses. Moreover, credibility in the persistence of the regime change is key to assess the effectiveness of the stabilization program.

Keywords: DSGE Markov-Switching model, Perturbation Methods, Bayesian Estimation, Emerging Markets.

JEL classification: F41, E42, E52.

1. Introduction

During the last 30 years, several emerging economies such as Argentina, Brazil or Mexico, shifted between short periods of price stability and episodes of high inflation,
consumption drops and acceleration of nominal exchange rate growth. In this highly volatile environment, these economies implemented repeated stabilization programs to attack the sources of instability and to control expectations. These stabilization programs encompassed a mix of fiscal and monetary measures capable of affecting these economies’ macroeconomic performance.

The aim of this paper is to study whether variations in the macroeconomic behavior of these economies are associated to policy changes or, instead, to changes in the volatility of exogenous shocks. Distinguishing between these two scenarios is crucial in order to make an appropriate characterization of policy design and the effects of policy shocks. Pursuing these tasks is important for several reasons. First, this environment is not restricted to a particular economy; on the contrary, it is common to several emerging economies. Second, stabilization policies in emerging markets have to deal with extreme macroeconomic conditions, such as hyperinflations and currency crisis; therefore, a correct characterization of policy changes will lead to a better understanding of the effects of policy variations during periods of large distress. Finally, understanding how stabilization policies work in extreme environments may also provide a path of action to developed economies that face periods of macroeconomic crisis, as has recently been observed.

In this paper, I develop a dynamic stochastic general equilibrium model that can address these questions. Specifically, I allow for time-varying fiscal and monetary policy rules and time-varying volatilities, in an otherwise standard small open economy new-Keynesian model. Coefficients in policy rules and volatilities are assumed to change accordingly to independent Markov-Switching processes.

I estimate the model for Mexico and find strong evidence of repeated monetary and fiscal policy changes during the period 1980-2009, as well as several changes in the volatilities of exogenous shocks. In particular, I identify two regimes for the monetary and fiscal policies. In the first one, monetary policy responds strongly to inflation while fiscal policy responds strongly to government-debt-to-output ratio. Following Leeper (1991), this regime is associated to active monetary policy and passive fiscal policy regime (I will refer to this regime as “active monetary policy”). In the second regime, fiscal policy is con-

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1The intuition for referring to this kind of monetary policy as “active monetary policy”, comes from the
ducted independently of government-debt-to-output ratio and monetary policy does not respond strongly to inflation. Also after Leeper (1991), this regime can be associated to active fiscal policy regime and passive monetary policy regime (which for simplicity will be denoted as “active fiscal policy”).

I find that for the period 1980-2000, active monetary policy regime did actually hold only during short periods after macroeconomic crisis. Hence, this regime is associated to the macroeconomic adjustment that starts after macroeconomic turbulence and last for several quarters. More recently, after 2002, I find evidence of active monetary policy regime, even though in this case it did not occur in an environment of macroeconomic distress. During the rest of the sample, active fiscal policy regime is in place.

After characterizing the behavior of fiscal and monetary policies, I analyze the effects of policy changes on macroeconomic performance. I find that the dynamics of output, consumption, inflation and the growth rate of nominal exchanges rate are different across the two regimes. To study their characteristics, I implement impulse responses, counterfactuals and simulation exercises. I find that changes from active fiscal to active monetary policies have strong stabilization effects, inducing, however, strong and persistent output costs.

Not surprisingly, the effectiveness of a change from active fiscal to active monetary policy strongly depends on private sector beliefs about the persistency of the new policy. In particular, I find that if the policy change is perceived as temporary, the effects in terms of stabilization are rather small. On the other hand, if the policy change is perceived as permanent, the stabilization effects are substantially larger and imply almost no additional output costs.

This paper is related to a recent literature that studies fiscal and monetary policy design in emerging economies. Previous studies that address policy determination in emerging markets, such as Mohanty and Klau (2004), Aizenman, Hutchison and Noy (2008) or fact that, under this regime, monetary policy actively fights inflation while fiscal policy accommodates to the endogenous dynamics of government debt.

This regime refers to passive monetary policy/active fiscal policy, because monetary policy passively accommodates to fiscal policy financing requirements, which, in turn, is conducted independently of government debt.
Kaminsky, Reinhart and Vegh (2004) work with vector autoregressions or univariate statistical models with fixed parameters, as well as, more structural approaches such as Batini, Levine and Pearlman (2007), Curdia (2008), Elekdag, Justiniano, and Tchakarov (2006) and Garcia-Cicco (2009). As can be seen, most researchers work under the assumption of time invariant monetary and fiscal policy rules. Considering emerging markets’ recent history, this assumption introduces a significant gap in the literature. This paper, to my best knowledge, is the first one in studying repeated policy changes under rational expectations in small open economies in general, and in particular in emerging economies.

This paper is also related to the literature on “policy temporariness” such as Krugman (1979), Calvo (1987), Calvo and Mendoza (1994), Mendoza and Uribe (2000) and Rebelo and Vegh (2006). This literature studies the distortions introduced by temporary changes in a macroeconomic policy, such as trade policy, exchange rate or tax policy. For instance, in the case of Krugman (1979) the temporariness appears because the new policy is not sustainable given the fundamentals of the economy. Under rational expectations, agents know the policy is not sustainable and, consequently will be abandoned in finite time. After abandonment, the economy is assumed to return to the original equilibrium and remain there forever. Note that, even though questions are similar, the approach of this literature is different from mine. In this paper, as agents know the stochastic distribution of parameters

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3 In particular, Mohanty and Klau (2004), study constant coefficient univariate Taylor rules in emerging markets. They inquire whether monetary rules react to inflation and exchange rate and find strong responses of interest rates to both variables, reflecting “Fear of floating” behavior. However, performing robustness checks, they find evidence of parameter shifts for the case of Korea, Philippines, Thailand, Brazil, Mexico and Poland. On the other hand, Aizenman, Hutchison and Noy (2008) studies interest rate rules using dynamic panels for 16 emerging economies for the period 1989 to 2006. Kaminsky, Reinhart and Vegh (2004), studies how fiscal and monetary policies differ in developed, middle income and low income countries, also using fixed parameter models.

4 Specifically, Batini, et. al (2007) study and rank different monetary policies in open economies with financial frictions. Curdia (2008) study monetary policy in a similar environment, however his main objective is to study monetary policy under sudden stops. Elekdag, Justiniano and Tchakarov (2006) instead estimate a financial friction model for Korean economy to study the importance of financial frictions. Also, Garcia-Cicco (2009) estimates a medium scale new Keynesian model to characterize the monetary policy in Mexico. It is important to mention that in most of these studies, authors are aware that policy changes might be an issue. For instance, Garcia-Cicco (2009) assume fixed policy rules, but time-varying targets.

5 A remarkable exception is Del Negro and Obiols-Homs (2000) that design a VAR model that allows for parameter changes.
in fiscal and monetary policy rules, agents know at any point in time that there is a probability of policy change. Moreover, they know whether the policy change is permanent (in the case there is a absorbent regime) or not, and in this way, the abandonment of the policy change cannot be pinned down.

The model in this paper exhibits a regime in which fiscal policy does not respond strongly to government-debt-to-output ratio. Because of this feature, my paper is also related to the Fiscal Theory of the Price Level. This literature studies the tension between monetary and fiscal policy when fiscal policy is set independently of public sector liabilities.

Empirically, interaction between fiscal and monetary policies have been studied in several papers for a wide set of countries, both big and small economies, developed and, to a lesser extent, developing countries. Regarding developed economies, Melitz (1997) estimates reaction functions for a pool of 19 OECD countries and show that fiscal and monetary policies are closely related. However these results are sensible to the inclusion of U.S. and Germany. Favero (2002) finds that price stabilization coexists with discretionary fiscal policy in the Euro Area. Favero and Monacelli (2003) finds that active fiscal policy was the rule for certain periods of U.S. economy.

Regarding emerging markets, Ramos and Tanner (2002) studies determinacy of fiscal policy for Brazil during the ’90s. Zoli (2005) presents several tests to study whether fiscal policy is active or not, and fiscal and monetary policy interaction for emerging markets and find that Argentina and Brazil can be represented as economies under active fiscal policy regimes during the ’90s while Chile and other emerging markets cannot. Regarding Mexico, evidence is ambiguous, not only depends on the sample period but also on the test he implements. It is important to note, however, this paper also assumes fixed coefficients and has to separate data in subsamples.

Methodologically, this paper is related to the “Great moderation” literature that studies policy changes in the U.S. economy. Specifically, it is related to papers that model policy changes as Markov Switching processes such as Sims and Zha (2006), Bianchi (2010),

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5 Importantly, a policy change in my framework is not a surprise given that it is part of agents’ expectations.
David and Leeper (2009) However, these papers study U.S. experience, and hence, work under close economy assumption.

The rest of the paper goes as follows. In Section 2 I motivate my research by reviewing the main features of stabilization programs in several emerging economies. In Section 3 I present the model. In Section 4 I discuss the solution, estimation methods, data and prior distributions. Section 5 presents estimation results. Section 6 studies implications of my findings to monetary and fiscal policies. Section 7 studies the relevance of policy credibility in the success of stabilization policies. Section 9 establishes model comparison to alternative model specifications. Finally, Section 10 concludes.

2. Policy Changes: Evidence from Emerging Markets

Emerging economies implemented repeated stabilization programs during the last 30 years. In this section, I briefly review recent experience of several of these economies. I focus in the experiences of Argentina, Brazil, Ecuador and Mexico. However, this list could be expanded to other emerging and not emerging economies.

2.1. Argentina

Figure 1 presents inflation, nominal exchange rate growth and consumption to output ratio in Argentina, jointly with implementation of stabilization programs, indicated by red vertical lines.

7 A different approach is to assume smooth time-variability of structural parameters. Some examples are Cogley and Sargent (2005), Fernandez-Villaverde and Rubio-Ramirez (2007) or Seoane (2010a), in which parameters are assumed to follow unit root processes for the former one, and autoregressive processes for the later ones. This strategy is also appealing as it does not constraint the economy to follow a finite number of regimes. However, due to computational tractability the type of stochastic processes to be assumes is limited.

8 For instance, early nineties imply a dramatic policy change for several European economies that adopted Euro. Currently, East Europe economies are undergoing policy changes in these direction.
Argentina experienced several episodes of macroeconomic instability and introduced multiple stabilization programs during the 1980s and 1990s. In June 1985, the government introduced “Austral Plan” that lasted until end of 1986. In 1987 and 1988 “Primavera Plan” was introduced in two stages. More recently, “Convertibility Plan”, introduced in 1991, lasted for 10 years and was able to successfully stabilize inflation.

As seen in the picture, macroeconomic dynamics significantly change after early 90s. During the 80s all series exhibit large variability while several stabilization programs were implemented. After 1991 the macroeconomic behavior is remarkably different, associated with the large rigidities imposed by Convertibility Plan.

Austral Plan was designed to induce fiscal and monetary discipline, and in this way affect inertial inflationary behavior and expectations. The program successfully stopped

\footnote{For a detailed characterization of these stabilization programs, see Kiguel (1991) and Fanelli and Frenkel (1989).}
inflation during 1985-1986, but failed to keep stability as rigidities were relaxed.

During 1987-1988, “Primavera Plan” was introduced in 2 stages. These plans were initially successful in stopping price and exchange rate instability, but in the medium run inflation exacerbated, leading to hyperinflationary levels while domestic currency strongly depreciated in 1989.

In early 1990s, “Convertibility Plan” was introduced. Central aspects of the plan were fixed exchange rate regime and financial reform that restricted the capability of Central Government to finance deficits by Central Bank. This was accompanied by major fiscal policy changes such as privatization of public firms and social security system. However, the program was abandoned in 2001 after large period of economic stagnation.\(^{10}\)

2.2. *Brazil*

Figure 2 presents inflation, growth rate of nominal exchange rate and consumption-to-output-ratio for Brazil. As in the previous picture, stabilization programs are denoted by the red vertical lines.

The picture shows a remarkable change in the behavior of the data that occurred after 1994. Before this year, inflation and exchange rate dynamics exhibited larger variability while several stabilization programs were implemented. Since 1986, Brazil introduced 5 stabilization programs. “Cruzado Plan” in 1986 followed by “Bresser Plan” in 1987.\(^ {11}\) In 1989, Brazil introduced “Summer Plan” and during early 90s introduced “Collor Plan”. However, stabilization was attained in 1994 with the “Real Plan”.

Programs implemented during the 80s where based on price, wage and exchange rate controls in order to deal with inertial inflation. However, they failed in controlling inflation in the medium run because of excess demand problems.

In 1990, government implemented ”Collor Plan”. This program was introduced together with liberalization of international trade and prices, and privatizations of public enterprises.

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\(^ {10}\) See Galiani, Heymann and Tommasi (2003).

\(^ {11}\) See Bresser-Pereira (1990).
However, it was "Real Plan" the one that successfully controlled inflation in 1994. The core of the plan was a monetary reform, with the objective of price stabilization. One of the results of the plan was a reduction in government inflationary tax. In order to control exchange rates, Central Bank exchange rate policy included sterilization of foreign currency inflows through open market operations.12

2.3. Ecuador

Probably among the most radical policy changes is the dollarization implemented by Ecuador in 2000. In a dollarized economy, prices are determined in foreign currency (US dollars), transactions are done in foreign currency and, as a consequence, central government loose seigniorage revenues.

In order to make the transition smoother, Central bank of Ecuador fixed exchange rate in January 2000. Soon after that, the Congress approved the “Law for Ecuador Economic Transformation” that modified not only exchange markets but also, financial and monetary aspects in order to established US dollar as the legal currency and to prohibit debt indexation.

2.4. Mexico

In the case of Mexico we observe 3 major stabilization programs implemented since 1980. Figure 4 presents inflation, consumption to output ratio and nominal exchange rate growth together with “Program for immediate economic reorganization” in 1982, “Program for economic solidarity” in 1988 and in 1995 the stabilization program after Tequila Crisis.

As can be seen in the picture, a clear pattern arise; high inflation and nominal exchange rate growth occur together with large variations of consumption to output ratio in the neighborhood of implementation of stabilization programs.
An orthodox stabilization program, “Program for immediate economic reorganization” (PIRE), was introduced in 1982 to constraint demand. Given exogenous shocks, in 1987, macroeconomic situation worsen dramatically and the government introduced the “Pacto de Solidaridad Economica” (PSE). This program included subsidies and government expenditure cuts together with improvements in collecting revenue policies, increases in the tariff of public services and a highly restrictive monetary policy that increased interest rates. The stabilization after this program was maintained by fiscal discipline measures.\textsuperscript{13}

In 1995, Mexico implemented a program to stabilize the economy after 1994 Tequila Crisis that quickly fulfilled its objective. After a short period, during 1996, changes in subsidy policies were introduced in order to stimulate the recovery of the economy and to increase fiscal savings through a recovery of economic activity.

\textsuperscript{13}In the framework of the “Pacto para la Estabilidad y el Crecimiento Economico” (PECE).
2.5. Summary

As can be seen in this section, stabilization programs are recurrent in emerging markets. Moreover, previous pictures provide evidence to think that these programs might have strong effects in the macroeconomic performance of these economies. However, in all four cases, aggregate volatility seem to be larger during the 80s and early 90s, suggesting that also shocks affecting these economies might have been stronger.

Evidence in this section also suggests that in order to study macroeconomic dynamics in emerging economies we have to focus in those small time spawns in which policies do not change, or instead, we have to consider the possibility of changes in policy rules. The first strategy is clearly undesirable if we plan to pursue estimation exercises.

The next section presents the benchmark model that allows for policy and volatility changes that helps to understand the way macroeconomic dynamics, volatility and policy changes are related and, hence, understand the effects of policy changes in these economies.

3. The Model

In this section we present the benchmark model. The model is in the spirit of Gali and Monacelli (2005), Justiniano and Preston (2008) and Monacelli (2005).

I model a small open economy populated by households, domestic firms, government and the rest of the world. Households face incomplete international asset markets, consume, trade government bonds and money. Domestic firms operate in monopolistically competitive markets and set prices accordingly to a Calvo lottery. The Government determines fiscal and monetary policies, in particular, determines primary surplus following a fiscal policy rule and domestic interest rates following a monetary policy rule. Coefficients in the policy rules are allowed to change accordingly to a Markov-Switching process. The rest of the world trade goods and bonds with the domestic economy.

3.1. Households

Households optimization problem is to maximize the discounted value of their lifetime utility. I assume households derive utility form consumption, leisure and real money holdings according to the following function,
Max}_{\{c_t, n_t, B_t, D_t, M_t\}_{t=0}^\infty} \mathbb{E}_0 \left\{ \sum_{t=0}^\infty \beta^t \left[ c_t^{1-\sigma} - \frac{n_t^{1+\varrho}}{1+\varrho} + \frac{m_t^{1-\gamma}}{1-\gamma} \right] \right\},

where, $m_t = M_t/P_t$ are real money holdings, $n_t$ denotes hours worked and $c_t$ is a consumption aggregator given by

$$c_t^{\eta} = (1-\zeta)^{\frac{1}{\epsilon}} c_{h,t}^{\eta} + \zeta^{\frac{1}{\epsilon}} c_{f,t}^{\eta},$$

where $\eta$ denotes the elasticity of substitution between foreign and domestic goods and $(1-\zeta)$ is the home bias. Additionally,

$$c_{h,t} = \left[ \int_0^1 c_{h,t}(j)^{\frac{1}{\epsilon}} \, dj \right]^{\frac{1}{\epsilon}},$$

and

$$c_{f,t} = \left[ \int_0^1 c_{f,t}(j)^{\frac{1}{\epsilon}} \, dj \right]^{\frac{1}{\epsilon}},$$

are the usual Dixit-Stiglitz aggregator. In these expressions, $j$ indexes varieties of consumption goods produced (domestically or abroad) and $\epsilon$ is the elasticity of substitution between producers.

$\sigma$ determines the risk aversion of consumer, $\varrho$ denotes the inverse Frisch elasticity and $\gamma$ determines the elasticity of money demand to interest rate. It is assumed that $\sigma > 0$, $\varrho > 0$ and $\gamma > 0$.

Household’s problem is subject to the set of period by period budget constraints,

$$P_t c_t + D_t + e_t B_t + T_t + M_t = D_{t-1} R_{t-1} + e_{t-1} B_{t-1} R_{t-1}^* + W_t n_t + \Pi_t + M_{t-1},$$

where $P_t^{1-\eta} = (1-\zeta) P_{h,t}^{1-\eta} + \zeta P_{f,t}^{1-\eta}$ is the consumption goods price level aggregator, with $P_{h,t}$ being the price of home produced goods and $P_{f,t}$ the price of foreign produced goods. $D_t$ is nominal government debt, issued in domestic currency, $e_t$ is the nominal exchange rate, $B_t$ is foreign debt issued in foreign currency, $R_{t-1}$ is the gross nominal rate of return on domestic bonds, $R_{t-1}^*$ is the gross nominal rate of return on foreign bonds, $\Phi$ is the risk premium, $W_t$ is the nominal wage, $n_t$ denotes hours worked. I assume households own
firms and Π, are their benefits. Finally, T, are nominal transfers from/to the government.

Following Schmitt-Grohe and Uribe (2003) and Justiniano Preston (2010a), risk premium works as a stabilization device,

\[ \Phi_t = \exp\left(\psi\left(\frac{\tilde{B}_t}{B_{ss}}\right)\right), \]

where \(\tilde{B}_t\) is the aggregate level of foreign debt, which is not internalized by the households.

Households choose consumption demand, labor supply and demand of domestic, foreign bonds and money holdings. Setting Lagrange multiplier as \(\beta \frac{\lambda_t}{P_t}\), first order conditions for the households problem are,

\[ \lambda_t = c_t^{-\sigma}, \]

\[ n^e_t = \lambda_t \frac{W_t}{P_t}, \]

\[ \frac{\lambda_t e_t}{P_t} = \beta \mathbb{E}_t \left[ \frac{\lambda_{t+1} e_{t+1} R_t \Phi_{t+1}}{P_{t+1}} \right], \]

\[ \frac{\lambda_t}{P_t} = \beta \mathbb{E}_t \left[ \frac{\lambda_{t+1} P_t}{P_{t+1}} \right], \]

and

\[ m_t^{-\gamma} = \lambda_t - \beta \mathbb{E}_t \left[ \frac{\lambda_{t+1} P_t}{P_{t+1}} \right]. \]

Households’ first order conditions are standard. Note that equations \[3\] and \[4\] combined with \[1\] construct the usual uncovered interest rate parity condition, whereas \[1\] and \[2\] generates the intratemporal allocation condition between labor and leisure.

3.2. Domestic Firms

I assume there is a continuum of domestic firms with monopolistic power that produce different varieties of domestic consumption goods. They operate in perfectly competitive
factor markets and monopolistically competitive product markets. Domestic firms use labor as the only input and rent it at the market rate. I assume that firms produce using labor in a Cobb-Douglas technology,

\[ y_t(j) = z_t F(n_t(j)) - \kappa(j), \]

where \( y_t(j) \) denotes output produced by firm \( j \). \( z_t \) is a stationary TFP shock that will be described later. I assume \( F(n_t(j)) = n_t(j)^\alpha \) and \( \kappa(j) \) is a fixed cost that guarantees zero profits in steady state. The optimal labor demand is a static problem with optimality condition given by,

\[ mc_t(j) = \frac{W_t}{P_{h,t}(j) F(n_t(j))}, \tag{6} \]

where \( mc_t(j) \) is the real marginal cost of firm \( j \) in period \( t \).

I follow Calvo (1983) and assume firms set prices accordingly to a Calvo lottery. Hence, firms will adjust prices at period \( t \) with probability \((1 - \theta)\), but they will not be able to do so with probability \( \theta \). If they can update prices, they will choose it optimally in order to maximize the present discounted value of profits.

A firm that change prices at period \( t \) will face a demand curve in period \( s \) given by,

\[ y_{h,s}(j) = \left( \frac{P_{h,s}(j)}{P_{h,t}(j)} \right)^{-\epsilon} A_s = \left( \frac{P_{h,s}(j)}{P_{h,t}(j)} \right)^{-\epsilon} \left[ c_{h,s} + g_s + c^*_h, s \right], \]

where \( A_t \) is aggregate absorption.

Firm \( j \) dynamic optimization problem is to set prices in order to maximize

\[ \mathbb{E}_{t} \sum_{s=t}^{\infty} \theta_t^{s-t} Q_{s,t} y_{h,s}(j) \left( P_{h,s}(j) - P_{h,s} mc_s(j) \right). \]

Intertemporal first order condition is,

\[ \mathbb{E}_{t} \sum_{s=t}^{\infty} \theta_t^{s-t} Q_{s,t} y_{h,s}(j) P_{h,s} \left[ \frac{\epsilon - 1}{\epsilon} \frac{P_{h,t}(j)}{P_{h,s}} - mc_s \right] = 0. \]

15Fixed cost is constant because the model assumes no growth. If the model has growth, the fixed cost has to grow at the same rate as output growth.
That can be rearranged as

\[ x_t^1 = (\bar{p}_{h,t})^{1-\epsilon} A_t \frac{\epsilon}{\epsilon} + \theta h Q_{t+1} \left( \frac{\bar{p}_{h,t}}{\bar{p}_{h,t+1}} \right)^{1-\epsilon} \pi_{h,t+1} x_{t+1}^1, \]  

(7)

\[ x_t^1 = (\bar{p}_{h,t})^{-\epsilon} A_t mc_{t} + \theta h Q_{t+1} \left( \frac{\bar{p}_{h,t}}{\bar{p}_{h,t+1}} \right)^{-\epsilon} \pi_{h,t+1} x_{t+1}^1. \]  

(8)

3.3. Rest of the World

A key assumption in small open economy models is that domestic economy does not influence rest of the world prices nor quantities. For this reason, it is standard to model the rest of the world by a set of exogenous shocks and a demand function. In particular, it is usually assumed that foreign consumption of domestically produced goods is a function of foreign prices and foreign output, given by,

\[ c_{h,t}^* = \left( \frac{P_{h,t}^*}{P_t^*} \right)^{-\lambda} y_t^*, \]

where \( y_t^* \) is foreign output, \( P_{h,t}^* \) is the price that foreign consumers pay for one unit of domestic goods while \( P_t^* \) is the international consumer price level. \( \lambda \) is the rest of the world elasticity of substitution between foreign and domestic goods. Details on the foreign variables are postponed until we discuss the properties of exogenous shocks.

3.4. Fiscal and Monetary Policies

Government determines monetary and fiscal policy. Consolidated Central Bank and Government budget constraint is given by

\[ x_t = d_{t-1} \frac{R_{t-1}}{\pi_t} - d_t + \frac{m_{t-1}}{\pi_t} - m_t, \]

(9)

where \( x_t \) is the fiscal primary surplus, \( d_t = D_t/P_t \) and \( m_t = M_t/P_t \). For simplicity, I assume that government only demands domestic goods and the ratio of government consumption goods to output is constant. Hence, under this setup, fiscal policy is conducted by lump sum transfers. In particular, I assume government set primary surplus following this feedback rule,

\[ x_t = x_{ss} + \gamma^d (S_t^c) \left[ d_t - \frac{d_{ss}}{y_{ss}} \right] + \gamma^y (S_t^c) \left[ y_t - y_{ss} \right] + \epsilon^f_t, \]  

(10)
Variables indexed with ss are evaluated in steady state. $y_t$ is aggregate output and $\epsilon^f_t$ is a fiscal shock that will be described later. $S^c_t$ is a stochastic process that follows a Markov Switching Process. This variable is known by the agents in the model and evolves accordingly to a transition matrix $P^c$ that will be discussed in the next section.

On the other hand, I assume monetary policy follows a interest rate rule, with feedbacks to inflation and the growth rate of nominal exchange rate,

$$\frac{R_t}{R_{ss}} = \left[ \frac{R_{t-1}}{R_{ss}} \right]^{\rho^f} \left[ \frac{\pi_t}{\pi_{ss}} \right]^{\gamma(\bar{S}^c_t)} \left[ \frac{\xi_t}{\xi_{ss}} \right]^{\gamma(S^c_t)} \exp(\epsilon^m_t),$$

(11)

where $\xi_t$ is the growth rate of nominal exchange rate. $\epsilon^m_t$ is a monetary shock that will be described in the next section.\(^{16}\)

### 3.5. Stochastic Processes

This model has three domestic and three foreign shocks. Foreign disturbances are foreign output shocks, $y^*_t$, foreign inflation shocks, $\pi^*_t$, and foreign interest rate shocks, $r^*_t$. Domestic shocks are exogenous shocks to the total factor productivity $z_t$, monetary, $\epsilon^m_t$ and fiscal policy shocks $\epsilon^f_t$.

Besides these shocks, volatility and policy rule coefficients change according to two independent regimes, $S^v_t$ and $S^c_t$.

I assume that TFP and foreign shocks follow mean reverting autoregressive processes of order one. Denoting $\epsilon^j_t$ to the innovation of shock $i$ in period $t$, I assume $\epsilon^v_t \sim N(0, \sigma^v(S^v_t))$, $\epsilon^m_t \sim N(0, \sigma^m(S^v_t))$, $\epsilon^f_t \sim N(0, \sigma^f(S^c_t))$, $\epsilon^*_t \sim N(0, \sigma^*(S^c_t))$, $\epsilon^y_t \sim N(0, \sigma^y(S^c_t))$, $\epsilon^\pi_t \sim N(0, \sigma^\pi(S^c_t))$.

Regarding $S^v_t$ and $S^c_t$, for the benchmark case, I assume they are independent and that each of them can take two values. Hence transition matrices are given by,

$$P^v = \begin{bmatrix} p^v_{(1,1)} & p^v_{(1,2)} \\ p^v_{(2,1)} & p^v_{(2,2)} \end{bmatrix},$$

\(^{16}\)Note that the smoothing parameter of the interest rate rule does not depend on time. Even though this might be interesting for some questions, in order to study how responsive monetary policy is, it does not seem to be crucial. Moreover, ideally, there would be no reason to assume that it should changes in the same way the rest of the parameters in the rule changes.
and

\[ P^c = \begin{bmatrix} p^c_{1,1} & p^c_{1,2} \\ p^c_{2,1} & p^c_{2,2} \end{bmatrix}. \]

Given the independence assumption, the model exhibits a 4 Regime Markov Switching which transition matrix is given by \( P = P^c \otimes P^v. \)

4. Solution and Estimation

In this section, I briefly discuss the solution method, estimation strategy and describe the data definition and sources. Given that I will implement a Bayesian estimation, this section also discusses prior distributions.

4.1. Perturbation in Markov Switching models

In this paper I use first order perturbation solution method as in Foerster, Rubio-Ramirez, Waggoner and Zha (2010). This solution method is an application of perturbation methods to Markov Switching problems. The advantage of this solution method over alternative methods such as the one developed by Chow (2010) or Farmer, Waggoner and Zha (2006) is that it allows me to introduce Markov-Switching from the primitives of the model.

If we denote \( Y_t \) the vector of non-predetermined variables and \( X_t \) the vector of predetermined endogenous variables, the solution by using first order perturbation has the following form,

\[
Y_t = g_x(i)X_t + g_{\epsilon}(i)\epsilon_t + g_{\chi}(i),
\]

\[
X_{t+1} = h_x(i)X_t + h_{\epsilon}(i)\epsilon_t + h_{\chi}(i),
\]

where \( h_x(i), g_x(i), h_{\epsilon}(i), g_{\epsilon}(i), h_{\chi}(i) \) and \( g_{\chi}(i) \) are coefficient matrices of the linear solution for regime \( i \), \( \epsilon_t \) are structural shocks and \( \chi \) is the perturbation parameter.

The last term is important because if different regimes have different steady state, first order solution is not certainty equivalent. Those terms are zero if all regimes have the same steady state. This is the case of the current paper, given that, as seen in the previous
section, Markov Switching affects only policy rules and volatilities, which terms are set to zero in steady state.\footnote{The non-stochastic steady state is calculated by setting all continuous and Markov-Switching shocks to zero.}

Once a solution is constructed, it is key to check whether the solution is unique.\footnote{The solution we find with this method is in the set of MSV solutions and the unicity of MSV solution does not imply unicity in a more general class of solutions. See the discussion in Davig and Leeper (2007), Farmer, Waggoner and Zha (2008) and Bianchi (2010).} The solution is unique only if the eigenvalues of the following $T$ matrix are all less than one in absolute terms, for all possible $T$,

\[
T = \begin{bmatrix}
p(1, 1)(h_x(1) \otimes h_x(1)) & p(1, 2)(h_x(2) \otimes h_x(2)) & \cdots & p(1, n)(h_x(n) \otimes h_x(n)) \\
p(2, 1)(h_x(1) \otimes h_x(1)) & p(2, 2)(h_x(2) \otimes h_x(2)) & \cdots & p(1, n)(h_x(n) \otimes h_x(n)) \\
\vdots & \vdots & \ddots & \vdots \\
p(n, 1)(h_x(1) \otimes h_x(1)) & p(n, 2)(h_x(2) \otimes h_x(2)) & \cdots & p(n, n)(h_x(n) \otimes h_x(n))
\end{bmatrix},
\]

where $p(i, j)$ is the probability of switching from regime $i$ to regime $j$.

Checking for determinacy is straightforward. However, this step might be time consuming depending on the number of regimes, predetermined and non-predetermined variables.

\subsection{Estimation Strategy}

In this paper, I estimate the model using Bayesian Methods. In particular, I use a Random Walk Metropolis-Hastings algorithm\footnote{Details and pseudo-codes can be found in An and Schorfheide (2007).} which requires the evaluation of the posterior density $L(\Upsilon|Y)p(\Upsilon)$, where $\Upsilon$ denotes the vector of parameters to be estimated, $Y$ the vector of observables, $L(\Upsilon|Y)$ is the likelihood function and $p(\Upsilon)$ is the prior function, priors are standard densities described in the next section.

Initial condition and search direction for McMc are determined through a maximization of the posterior mode using Simulated Annealing minimization routines.\footnote{See Moller-Andreasen (2010).}

To evaluate the likelihood function $L(\Upsilon|Y)$ I solve the model for a set of proposal parameters and discard the draw if there is no equilibrium or multiple equilibriums. If
unique equilibrium exist, I evaluate the likelihood using Kim’s Filter as in Kim and Nelson (1999).

Kim’s Filter is a generalization of Kalman Filter that takes care of different regimes. If we estimate a model without Markov-Switching, we would just rely on the Kalman Filter in order to evaluate the likelihood. In standard Kalman Filter, we want to forecast the unobserved states at time $t$ by using the vector of observations available up to $t - 1$. However, in the Markov Switching case, there will be no unique forecast, as it will depend on which regime is the economy at each period $t$. Hence, it is required to condition on each particular regime also. As pointed out in Kim and Nelson (1999), at each new iteration, the filter has to condition on the total number of regimes, hence if $n$ is the number of regimes, in $t = 1$ we will have $n$ forecasts of the state vector, in $t = 2$ we have $n^2$ forecasts, and so on. For this reason, an approximation is required. Kim’s Filter works by collapsing the forecasts into $n$ forecast at each time. Intuitively, the way the filter works is by keeping the $n$ forecasts that are more likely to have happened.

4.3. Data

I construct a dataset of 9 variables for Mexico covering the period 1980Q1 to 2009Q4 at quarterly frequency. The dataset contains monetary, fiscal and national account variables. As the model does not have trend, I use linearly detrended output. The remaining real variables are expressed as ratios with respect to output, consumption to output ratio, primary surplus to output ratio, government debt to output ratio.

Additionally, I include a domestic nominal interest rate\footnote{I use the interest rate at which the Central Bank make advances to banks and financial intermediaries.}, consumer price index inflation, the growth rate of nominal exchange rate, international nominal interest rate and international consumer price index inflation rate.

Primary surplus and government debt are from Central Bank of Mexico while domestic nominal interest rate, consumer price index, output and consumption that are from OECD. Nominal exchange rate is from IFS.

Data is nominal in original sources and I deflate it using consumer price index. Given that the model does not have capital, my definition of output does not include investment.
International nominal interest rate and international consumer price index inflation rate are U.S. 3 months T-Bill rate and U.S. consumer inflation rate from FRED at St. Louis FED, respectively.

4.4. Priors and Calibration

In this paper, a small set of parameters is fixed. I calibrate $\zeta$ to 0.28, which is the average share of imports to output for the sample period. A small number of parameters are set to match certain steady state values in the model to their data counterpart.\footnote{Sample averages for the period 1980Q1-2009Q4.} In particular, I set inflation in steady state to match the average in the data of 6%, steady state terms of trade is set to 0.59, government debt to output ratio is equal to 32% and trade balance to output ratio is 0.57%. Also, $R_{ss}$ is equal to the sample average 1.07.

Priors for autocorrelations of stochastic processes and smoothing parameter of interest rate rule, $\rho_i$, are assumed to be $Beta(0.57, 0.23)$, for $i = r^*, z, y^*, r, \pi^*$, which, as can be seen, imply a mild autocorrelation. Prior for the transition matrices are such that the diagonal elements are assumed to be $Beta(0.9, 0.06)$\footnote{Note that we do not need to impose priors for the probability of moving from regime $i$ to regime $j$, given that this probability is equal to $(1 - \rho_{(1,1)})$.}.

Finally, priors for volatilities are assumed to be the same for all variables and across regimes, $\sigma^2(S_v^j = j)$, are $Gamma(0.25, 0.11)$ for $i = r^*, z, y^*, \pi^*, m, f$ and $j = 1, 2$.

For preference and technology parameters I assume the following prior distributions,
Table 1: Priors for preference and technological parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\eta$</td>
<td>Gamma(2.4, 0.2)</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Beta(0.8, 0.025)</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Gamma(0.75, 0.2)</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>Beta(0.44, 0.11)</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Normal(0.03, 0.05)</td>
</tr>
<tr>
<td>$\epsilon$</td>
<td>Normal(4, 0.1)</td>
</tr>
<tr>
<td>$\varrho$</td>
<td>Gamma(0.6, 0.35)</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>Gamma(0.22, 0.21)</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Gamma(1.2, 0.69)</td>
</tr>
</tbody>
</table>

As can be seen priors are standard probability distributions. The mean of these distributions are in line with previous studies in the open economy literature. For instance, Justiniano and Preston (2010a) finds $\sigma = 0.88$ for Canada, which is included in the 95% confidence band, usual findings for $\theta$ are in the order of 0.6 to 0.8. Davig and Leeper (2005) calibrate $\gamma = 2.6$ while priors for $\gamma$ imply a 95% confidence band that includes 0.25 to 2.8. Frisch elasticity is in the range of recent estimates as the 95% Confidence band range from 0.12 to 1.5. $\alpha$ is in line with estimates by Bergoeing, Kehoe, Kehoe and Soto (2007), $\psi$ is such that on average, the risk premium is of 300 basic points, as observed on the EMBI++ and in line with Garcia-Cicco (2008). $\epsilon$ generates a mark-up of 1.3 which is in line with other studies and micro studies for OECD economies as in Martins et. al ( ). Elasticity of substitution between home and foreign goods in the rest of the world, $\lambda$, is in line with Yalke et. al (2010) that estimates it to 0.3 for US. Additionally, note that for all parameters standard deviations of the probability distributions of priors are high in terms of the magnitude of those parameters.

It remains to discuss prior distributions for policy parameters, which are presented in the following table,
Table 2: Policy Rules Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Distribution Regime 1</th>
<th>Distribution Regime 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma_\pi$</td>
<td>Gamma(0.44,0.41)</td>
<td>Gamma(2,0.89)</td>
</tr>
<tr>
<td>$\gamma_\xi$</td>
<td>Beta(0.28, 0.15)</td>
<td>Beta(0.28,0.15)</td>
</tr>
<tr>
<td>$\gamma_d$</td>
<td>Beta(0.025,0.023)</td>
<td>Beta(0.28,0.15)</td>
</tr>
<tr>
<td>$\gamma_y$</td>
<td>Normal(-0.5,0.5)</td>
<td>Normal(-0.5,0.5)</td>
</tr>
</tbody>
</table>

As can be seen priors under Regime 1 and Regime 2 are different. In particular, I assume that priors under Regime 1 are such that both monetary and fiscal policies are less responsive to inflation and government debt than under Regime 2. In particular, the response of monetary policy to inflation under regime 1 is in line with findings in Zoli (2005) for the non-inflation targeting period of Mexico whereas the one for regime 2 is the same as in Garcia-Cicco (2008). Also response to growth rate of nominal exchange rate is in line with Justiniano and Preston (2010a).

Note, however, prior distributions regarding these parameters are very loose. For instance, 95% confidence band for $\gamma_\pi$ ranges from 0.01 to 1.6 for $S_t = 1$ and from 0.6 to 4 for $S_t = 2$. On the other hand, for $\gamma_d$ they range from 0.0006 to 0.09 and 0.04 to 0.65. Even though they might seem small, they include a large set of values for which both fiscal and monetary policies might be aggressively responding to endogenous variables or not.

Additionally, if we evaluate the model in the mean of the priors distributions, both regimes imply that monetary policy responds strongly to inflation. I assume the prior functions to have this feature in order to match the strategy followed by previous papers in this literature, i.e. new Keynesian models in small open economies assume that monetary policy responds strongly to inflation because they need it to find determinate solution.\textsuperscript{24}

\textsuperscript{24}Given that there is no previous literature to base this priors, I implement several robustness exercises by relaxing priors for $\gamma_\pi(S_t = 1)$, and my findings do not change.
5. Estimation Results

In this section and the next one, I study the main estimation results of the benchmark model. I start by discussing posterior distributions of structural parameters and the features of policy parameters and volatilities. In the next section, I study the main characteristics of monetary and fiscal policies during 1980Q1-2009Q4.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>95 % Credible Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \eta )</td>
<td>2</td>
<td>[1.9 ,2.1]</td>
</tr>
<tr>
<td>( \theta )</td>
<td>0.61</td>
<td>[0.59 ,0.62]</td>
</tr>
<tr>
<td>( \sigma )</td>
<td>0.86</td>
<td>[0.78 ,0.94]</td>
</tr>
<tr>
<td>( \alpha )</td>
<td>0.45</td>
<td>[0.39 ,0.51]</td>
</tr>
<tr>
<td>( \psi )</td>
<td>0.054</td>
<td>[0.046 ,0.063]</td>
</tr>
<tr>
<td>( \epsilon )</td>
<td>3.8</td>
<td>[3.7 ,3.9]</td>
</tr>
<tr>
<td>( \rho_f )</td>
<td>0.61</td>
<td>[0.58 ,0.65]</td>
</tr>
<tr>
<td>( \rho_z )</td>
<td>0.97</td>
<td>[0.96 ,0.98]</td>
</tr>
<tr>
<td>( \rho_y^* )</td>
<td>0.77</td>
<td>[0.73 ,0.81]</td>
</tr>
<tr>
<td>( \rho_r^* )</td>
<td>0.99</td>
<td>[0.99 ,0.99]</td>
</tr>
<tr>
<td>( \rho^\pi^* )</td>
<td>0.98</td>
<td>[0.98 ,0.98]</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>13</td>
<td>[11 ,14]</td>
</tr>
<tr>
<td>( \lambda )</td>
<td>0.27</td>
<td>[0.21 ,0.34]</td>
</tr>
<tr>
<td>( \varrho )</td>
<td>0.15</td>
<td>[0.094 ,0.2]</td>
</tr>
</tbody>
</table>

Note: Computed using 500,000 draws of McMc.

Given the calibrated parameters discussed in previous section, Table 3 presents the mean of the posterior distribution and 95% credible set for preference and technology parameters.

As shown in the table, Mexican economy exhibit a low degree of price stickiness, \( \theta = 0.61 \), that implies on average a price duration of about two quarters. Hence, prices are
reseted every six months, this is one quarter less than Justiniano and Preston (2006) findings for Canada. This finding is reasonable given Mexican economy has been significantly more inflationary than Canadian economy during similar time span. The mean of the posterior distribution for \( \alpha \) is 0.45, this value is similar to standard calibrations as in Mendoza (1995), in which labor share also for Mexico goes from 0.3 to 0.43 depending on the sector. Also, Bergoeing, Kehoe, Kehoe and Soto (2007) finds evidence of \( \alpha = 0.42 \) for Mexico in a single sector model. Regarding \( \epsilon \), the posterior mean is slightly smaller than standard calibrations, which assume it around 6 in order to generate a markup of 1.2, however, this is mainly done for developed economies. The point estimate in this paper generates a markup of 1.3. Note additionally, that interest rate smoothing component of the interest rate rule is \( \rho^r = 0.61 \).

In Table 4 I present posterior means and credible sets for interest rate rule and fiscal rule coefficients for the two regimes,

<table>
<thead>
<tr>
<th>Regime 1 (AFP)</th>
<th>Post. Mean</th>
<th>95 %</th>
<th>Regime 2 (AMP)</th>
<th>Post. Mean</th>
<th>95 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \gamma^\pi(S^\pi_1 = 1) )</td>
<td>0.012</td>
<td>[0.0025, 0.022]</td>
<td>( \gamma^\pi(S^\pi_1 = 2) )</td>
<td>0.4</td>
<td>[0.37, 0.44]</td>
</tr>
<tr>
<td>( \gamma^\xi(S^\xi_1 = 1) )</td>
<td>0.36</td>
<td>[0.32, 0.39]</td>
<td>( \gamma^\xi(S^\xi_1 = 2) )</td>
<td>0.03</td>
<td>[0.014, 0.045]</td>
</tr>
<tr>
<td>( \gamma^d(S^d_1 = 1) )</td>
<td>3.7e-005</td>
<td>[9.2e-006, 6.4e-005]</td>
<td>( \gamma^d(S^d_1 = 2) )</td>
<td>0.11</td>
<td>[0.081, 0.14]</td>
</tr>
<tr>
<td>( \gamma^y(S^y_1 = 1) )</td>
<td>0.23</td>
<td>[0.21, 0.24]</td>
<td>( \gamma^y(S^y_1 = 2) )</td>
<td>0.19</td>
<td>[0.18, 0.21]</td>
</tr>
</tbody>
</table>

Note: Computed using 500,000 draws of McMc.

As can be seen in the table, under Regime 1 monetary policy is not responsive to inflation. However, it responds significantly to the nominal exchange rate growth. On the other hand, in this same regime, fiscal policy does not respond to debt accumulation. Note, on the other hand, that under Regime 2, monetary policy responds in a strong way to inflation, but the response to the growth rate of nominal exchange rate is mild, while fiscal policy responds strongly to debt accumulation.

In order to show that monetary policy does not respond aggressively under Regime 1, but it does under Regime 2, we need to calculate the “Activism Parameter”. In this model,
the activism parameter is given by,

$$a(S_t^c) = \frac{\gamma^\pi(S_t^c) + \gamma^\xi(S_t^c)}{1 - \rho^r}$$

In a model without Markov-Switching, if activism parameter is less than 1 it means that monetary policy does not react strongly enough to eradicate sunspots, in this case we would have an indeterminate equilibrium if the model has no fiscal policy rule, or a determinate equilibrium if induced by fiscal policy. On the other hand, if the parameter is larger than 1, monetary policy responds strongly enough to control inflationary expectations, which, in a model without Markov-Switching, we would need fiscal policy to accommodate to monetary policy for an equilibrium to exist.

Figure 5: Activism Parameter for Regime 1 and Regime 2

![Figure 5: Activism Parameter for Regime 1 and Regime 2](image)

Note: Posterior distributions computed using 500,000 McMc draws.

In the case of DSGE Markov-Switching model, we can characterize monetary policy in the same way, but the conditions for uniqueness and existence are not the same as shown by Davig and Leeper (2007). Figure 5 presents the posterior distribution of activism.

\[25\text{Intuitively, in an economy without fiscal policy rule you could have small deviations from the so called}\]

26
parameter during Regime 1 and Regime 2.

Note that the previous picture indicates that under Regime 2, monetary policy is actively conducted, in the sense that responds strongly enough nominal disturbances, whereas under Regime 1 it is not. Following Leeper (1991), Regime 1 is such that fiscal policy is actively conducted while monetary policy passively accommodates to it. I will denote this regime as “active fiscal policy regime”. On the other hand, under Regime 2, monetary policy responds actively to nominal disturbances while fiscal policy accommodates to monetary policy, hence in the spirit of Leeper (1991), this regime is active monetary policy with passive fiscal policy regime. I will denote this Regime as “active monetary policy regime”.

Table 5 presents transition probabilities for Regime 1 and Regime 2. Note that the table indicates that active fiscal policy regime is more persistent than the active monetary policy regime,

<table>
<thead>
<tr>
<th>Transition Probability</th>
<th>Posterior Mean</th>
<th>95% Credible Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_{1,1}^c$</td>
<td>0.97</td>
<td>[0.96 ,0.98]</td>
</tr>
<tr>
<td>$p_{2,2}^c$</td>
<td>0.95</td>
<td>[0.94 ,0.96]</td>
</tr>
</tbody>
</table>

Note: Computed using 500,000 draws of McMc.

This result should not be underestimated. Previous work assumes that monetary policy responds in a strong way to nominal disturbances for any period $t$. The reason of this assumption is that previous studies impose time independent feedback rules and do not consider the case in which fiscal policy does not respond to government debt\textsuperscript{26}. In this way, in order to solve for a determinate equilibrium, authors have to assume that monetary

\textsuperscript{26}Just recently we can study this kind of models, as tools for solving time varying policy rules with Markov switching models are relatively new.
policy responds in a strong way to inflation and depreciation rates for every period. Under that assumption we would actually miss a regime in which monetary policy’s objective is not to pin down expectations, but instead, to accommodate to fiscal policy financing requirements.\footnote{This finding is in line with evidence found by Zoli (2005) for Mexico and other emerging economies.}

The model also assumes an independent Markov-Switching Process for volatilities of domestic and foreign shocks. Table \ref{table:volatilities} presents posterior means and credible sets of posterior distribution of variances for both regimes.
Table 7: Transition Probabilities for Volatilities

<table>
<thead>
<tr>
<th>Transition Probability</th>
<th>Posterior Mean</th>
<th>95% Credible Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_{v,1}$</td>
<td>0.63</td>
<td>[0.57, 0.69]</td>
</tr>
<tr>
<td>$p_{v,2}$</td>
<td>0.82</td>
<td>[0.78, 0.85]</td>
</tr>
</tbody>
</table>

Note: Computed using 500,000 draws of McMc.

As can be seen, the regime with higher domestic volatility, Regime 1, is the less persistent one with a probability of staying in the same regime of 63%. Note, however, the probability of staying in the same regime under regime 2 is 82%, even though higher, there is still 18% probability of changing regimes. Hence, volatility regimes are not as persistent as policy rules’ coefficients regimes.

6. Characterizing Fiscal and Monetary Policies

In this section, I study the model implications’ about monetary and fiscal policy regimes. First, I study the probability of changing regimes during the last 30 years, which will allow me to identify the periods of strong and weak responses of monetary policy. Second, I perform variance decomposition exercise. Third, I study which is the impact and persistency of monetary and fiscal policy shocks.

6.1. Regime Probabilities

Figure 6 presents inflation, together with the probability of being in the active fiscal policy regime and the probability of high volatility regime (Volatility Regime 1),

29
As can be seen in the figure, before 2000, probability of active monetary policy regime is high only during a few quarters after the end of severe macroeconomic disturbances. In particular, in early 80s after late seventies inflationary process, after 1982 ”Debt Crisis”, during 1988 after a large period of macroeconomic instabilities originated in 1985 and 1986 foreign shocks, and after 1995 ”Tequila” financial and political crisis.

Fiscal and monetary policies changed quite often starting in 1980s. At the key of these reforms there was the change of revenue system, in particular value added taxation (VAT) was introduced. “Program for immediate economic reorganization” after 1982 included privatization of government firms and mainly orthodox measures to constraint demand.

The adjustment period during 1987/1988 encompassed policy changes that were articulated around the “Pact for economic solidarity”. Building blocks of this program were reduction on public employment, reduction of subsidies and privatization of government firms and the use of the resources generated by them to reduce the level of fiscal debt. On the revenue side, indexation of fiscal system was introduced in order to fight the depreciation of fiscal resources. After 1991 the tightening on government expenditures was relaxed, especially to finance social development programs (education, health, etc.).
At the end of 1994 beginning of 1995, a new stabilization program was required. This program included fiscal and monetary policy reforms. On the fiscal side, there was a suspension of government investment projects and an increase of VAT. On the other hand, monetary policy was conducted to control prices together with a flexibilization of exchange rate regime.

In 1996 most of the adjustment policies started to be abandoned or relaxed in order to boost the recovery of the real economy. Subsidies and tax incentives were introduced.

After Mexico stabilization post-1995 crisis, estimates in this section find evidence of high probability of active fiscal policy regime until 2001. The increase in the probability of active monetary policy regime after that year, coincides with changes in the way Central Bank of Mexico conducted monetary policy recently.

Regarding volatilities, note that high volatility regimes is in effect almost all the periods between 1980-1990, and during the Tequila crisis in 1994-1995. These high volatility periods are associated to crisis episodes. As can be seen probability of high volatility increases again during U.S. recent crisis. However, regarding this last episode it is important to point out that the behavior of inflation does not seem to be affected as it was in early episodes, this finding might correspond to the fact that active monetary policy was on effect during the recent episode.

6.2. Variance Decomposition

In this section, I study the contribution of each structural shock to the volatility of output, inflation and nominal exchange rate growth, conditional on different combinations of coefficient and volatility regimes. Table 6.2 presents the results for all possible regime combinations,
<table>
<thead>
<tr>
<th>Table 8: Variance Decomposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFP</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td><strong>Active Fiscal Policy and High Volatility Regime</strong></td>
</tr>
<tr>
<td>Output</td>
</tr>
<tr>
<td>Inflation</td>
</tr>
<tr>
<td>Nom. Exc. Rate Growth</td>
</tr>
<tr>
<td><strong>Active Monetary Policy and High Volatility Regime</strong></td>
</tr>
<tr>
<td>Output</td>
</tr>
<tr>
<td>Inflation</td>
</tr>
<tr>
<td>Nom. Exc. Rate Growth</td>
</tr>
<tr>
<td><strong>Active Fiscal Policy and Low Volatility Regime</strong></td>
</tr>
<tr>
<td>Output</td>
</tr>
<tr>
<td>Inflation</td>
</tr>
<tr>
<td>Nom. Exc. Rate Growth</td>
</tr>
<tr>
<td><strong>Active Monetary Policy and Low Volatility Regime</strong></td>
</tr>
<tr>
<td>Output</td>
</tr>
<tr>
<td>Inflation</td>
</tr>
<tr>
<td>Nom. Exc. Rate Growth</td>
</tr>
</tbody>
</table>

Note: Theoretical variance decompositions conditioning on each regime.

This exercise is important because it provides insights on the relative importance of domestic and foreign shocks conditional on the macroeconomic environment, i.e. whether the economy is in high or low volatility or active monetary or fiscal policy. Moreover, this section will be important to understand the role of policy shocks in aggregate variability. Importantly, the model will characterize the role of the shocks after taking into account policy changes.
As can be seen in the table, foreign shocks have substantial contribution to the volatility of these three variables. In particular foreign inflation has substantial effect in domestic inflation and nominal depreciation rate in many of the regimes. Shocks to foreign demand are also important, whereas foreign interest rate has a minor share in aggregate variability.

Additionally, TFP shocks have a major importance in explaining the variability of output in all the regimes. It has, however, smaller effect in the variability of inflation and depreciation rate.

Importantly, note that monetary policy shocks represent strong contribution to the variability of these variables in high volatility regimes, specifically monetary policy explains a large share of the variability of inflation and nominal exchange rate growth, and has a substantial effect in output variability. This results imply a smaller variability induced by monetary policy than the one found in previous studies that do not allow for policy changes, such as Garcia-Cicco (2008). Fiscal policy shocks, instead, have a small effect in the variability of these variables.

6.3. The effects of policy shocks

Previous section discussed which share of observed variability is due to fiscal and monetary policy shocks. In order to fully characterize fiscal and monetary policies conditional on each regime, in this section I study how policy shocks affect dynamics of the model under different policy arrangements.

Figure 7 presents impulse response functions for a set of endogenous variables after one standard deviation monetary policy shock under volatility regime 1, both for active monetary policy and active fiscal policy regimes.
As can be seen from the previous picture, monetary policy shocks have qualitatively similar effects on most endogenous variables conditional on each regime. A tightening in the monetary policy is recessive both during active monetary policy and active fiscal policy regimes. Under both regimes, it generates different responses of the fiscal surplus. The reason of this difference is that a positive shock to interest rate reduces private demand for money and increases private demand for government bonds, hence, under active monetary policy regimes, fiscal surplus has to adjusts for the increasing demand for bonds by increasing surplus.

Figure 8 presents impulse response functions after one standard deviation fiscal policy shock under active fiscal and monetary policy regimes,
Figure 8: Impulse Responses to Fiscal Policy Shock

Note: one standard deviation shock to $\epsilon_f^t$ in the high volatility regime. AFP is in red line and AMP is in blue line.

In this case, in line with the results on variance decomposition, the effects of fiscal policy shocks are quantitatively smaller than the monetary policy shock. However, in this case, the response of variables are very different under active monetary or active fiscal policy regimes.

Note that in this model, a fiscal adjustment has a recessive and deflationary effect which affects interest rate downwards through interest rate rule. The dynamic effect is a quick recovery of output and an increase in consumption motivated by the reduction in inflation and the expansive effect of monetary loosening.

7. Policy changes and credibility

This section studies which are the effects of policy changes and how does credibility affect the outcome of a stabilization policy. In this section, I do this using simulations exercises. In the following section I will study the most recent stabilization episodes using the actual structure of shocks via counterfactual exercises.
As we saw in the previous section, the main sources of inflation are monetary shocks in the high volatility regime, and foreign inflation shocks in the low volatility regime, hence I focus in these two cases. The exercise will evaluate a policy change under these two inflationary environments.

7.1. Simulations

In this section, I perform two exercises, specifically I simulate inflationary environments originated from different sources. I start by simulating an inflationary environment from a negative monetary policy shock and I show that policy changes in this case have a mild effect; the reason is that the inflationary effect of this shock is not persistent. Then, I simulate an inflationary environment from a foreign inflation shock. I find that a policy change has strong effects in the dynamics of the endogenous variables given that this shock generates a highly persistent inflationary environment.

Let’s start with a negative monetary shock that generates inflation at \( t = 0 \) and assume the economy is in an active fiscal policy regime, then introduce a policy change from active fiscal to active monetary policy, at period \( t = 2 \).

Figure 9: Policy Change after monetary policy shock.

Note: Red line represents the dynamics without policy change, blue line represents the dynamics with policy change at \( t = 2 \).

\(^{28}\) I implement the policy change at period 2 because, as we saw in the previous section, a monetary policy shock has large effects on impact but not persistent effects.
Figure 9 presents the dynamics of nominal exchange rate growth, inflation and output that follow after this shock.

Note that there are substantial effects from this policy change, even though inflation is not very persistent. However, the largest effect occurs before the fifth quarter. The reason is that monetary policy shocks generate small inflationary persistence. It is important to point out that dynamics in the short run are significantly affected. As can be seen, a policy change reduces the variability of the three variables as convergence to steady state is faster than the no policy change dynamics. Moreover, a policy change generates substantial output loss and inflation drop in the short run.

The next picture presents the same exercise but altering the credibility of the agents about the persistency of the policy change.

Figure 10: Policy Change after monetary policy shock under alternative credibility environments.

Note: Red line represents dynamics with actual credibility, blue line represents the dynamics when policy change is perceived as permanent, green line represents the dynamics when policy change is perceived as transitory.

In this picture I present results dynamics after a negative monetary policy shock at $t = 0$ followed by a change from active fiscal to active monetary policy at period $t = 2$ under three alternative transition matrices.

The “benchmark” dynamics characterizes the paths of variables when agents in the model think that transition probabilities of the Markov matrices are equal to the ones estimated in previous section. The “transitory” dynamics present the results of same exercise when agents perceive that the policy change is going to last only one period and
after that the economy will stay forever in the active fiscal policy regime, i.e. they think \( p^c(S_{t+1}^c = 1|S_t^c = 1) = 1 \) and \( p^c(S_{t+1}^c = 2|S_t^c = 1) = 0 \). On the other hand, the “permanent” dynamics are the results of the same exercise when agents perceive the policy change is permanent, i.e. \( p^c(S_{t+1}^c = 2|S_t^c = 2) = 1 \).

As we observed in the previous figure, dynamics under different assumptions are similar. Whether agents believe that the policy change is only one period, it has no major implications as compared to the case in which they think the change is permanent. The reason is that most of the effect of a policy change occurs in the first period of implementation. Next exercise will show that results are significantly different when persistent inflationary shocks occur.

During low volatility regimes, foreign inflation shocks are, instead, the ones that explain the largest share of inflation. Moreover, this variable has a strong effect also during high volatility regimes. Now, I repeat the previous exercise but starting from a foreign inflation shock, hence, I simulate a positive foreign inflation shock that generates inflationary environment at \( t = 0 \) and assume the economy is in an active fiscal policy regime. Introduce a policy change from active fiscal to active monetary policy, at period \( t = 3 \). Figure 11 presents some endogenous dynamics,

![Figure 11: Policy Change after foreign inflation shock.](image)

Note: Red line represents dynamics without policy change, blue line represents the dynamics with policy change at \( t = 3 \).

As can be seen in the picture, in this case a change from active fiscal to active monetary policy after a foreign inflation shock generates a major effect in the dynamics of these
variables; this is so because the foreign inflation shock has persistent effect in the dynamics of inflation and exchange rate. First, reductions in inflation and depreciation rates are immediate. Additionally, there are major, and persistent, output costs associated to the policy change.

Note that inflation and growth rate of exchange rate exhibit a large initial adjustment. This occurs because of the interest rate rule. These series have to accommodate strongly so the new rule hold because of the smoothing component of the rule. If the smoothing component were zero, no overshooting would be required. This adjustment, additionally, tigers the stabilization/recessive mechanism by inducing an increase in real interest rate that motivates output drop and the subsequent adjustment.

Next figure presents the results from alternative beliefs about persistence of the regime change. Recall that if agents perceive the policy change as transitory, they think \( p_c(S_{t+1}^c = 1|S_t^c = 1) = 1 \) and \( p_c(S_{t+1}^c = 2|S_t^c = 1) = 0 \). Additionally, if dynamics are perceived as "permanent", agents think \( p_c(S_{t+1}^c = 2|S_t^c = 2) = 1 \).

Figure 12: Impulse Responses to Foreign Inflation Shock under alternative credibility environments.

![Figure 12: Impulse Responses to Foreign Inflation Shock under alternative credibility environments.](image)

Note: Red line represents dynamics with actual credibility, blue line represents the dynamics when policy change is perceived as permanent, green line represents the dynamics when policy change is perceived as transitory.

As can be seen from the previous picture, credibility about the policy has major effects in this case in which inflationary shock is persistent. Note that if the policy is perceived as permanent, stabilization of prices and exchange rate growth are immediate and at almost not additional output losses, compared to the benchmark case. On the other hand, if agents
perceive the policy change as completely transitory, the policy change is not effective.

8. Counterfactual Stabilization

The previous section shows that Mexican economy switched repeatedly between Active Monetary Policy and Active Fiscal Policy regimes and between periods of high and low domestic and foreign volatilities. In this section, I explore two questions, first I study the effect of policy changes in the stabilization episodes observed during 1988, after implementation of Program for Economic Solidarity, and after 1994 Tequila Crisis, the two major stabilization programs in the last 30 years. This first exercise sheds light on what drove stabilization, whether they are due to actual policy changes or, instead, changes in the volatility of shocks. Second, I study the role of credibility about the persistency of the policy change.

8.1. Good Luck vs Good Policy

Did changes in macroeconomic behavior that occurred after 1988 and 1995 associated to policy changes or changes in volatilities? In this section, I study this question by running counterfactual exercises. Figure 13 presents counterfactual exercises around 1988 stabilization program.
Counterfactuals in top panel pictures in the figure [13] represents what would have happened if no stabilization program would have been applied in 1988. As can be seen, if no stabilization program would have been applied, inflation and growth rate of nominal exchange rate would have been significantly larger during the whole 1988. After that period, these series over adjust compared to observed series. Hence, two main features comes from this picture, policy change is important for stabilization, but at least in part stabilization is not only due to policy changes. Additionally, active monetary policy regime reduce volatility of these series during the stabilization period.

To complete the exercise, bottom panel pictures in the figure presents observed series in red and the counterfactuals of what would have happened if the economy would have exhibit low domestic and high foreign volatility during 1988-1990, in blue. As can be seen, most of the stabilization observed in inflation remains regardless volatility changes, in particular the large stabilization during 1988’s first quarter. Note, on the other hand, the
The volatility of observed and counterfactual series for inflation do not exhibit major differences. Note that these pictures do not replace high volatility by low volatility, but instead, changes high domestic volatility by high foreign volatility shock.

Figure 14 repeat the exercise for the 1995 stabilization program after Tequila crisis.

Figure 14: Good Luck versus Good Policy 1995

![Graphs showing inflation and nominal exchange rate growth](image)

Note: Top panel presents counterfactual series obtained by assuming no policy change, whereas bottom panel assumes no volatility changes. Red line are actual series, blue line are counterfactual series and 68% confidence bands are represented by dashed lines.

In contrast to the findings in Figure 13, if no stabilization would have been implemented, inflation would have not decreased after 1995 first quarter. This is associated to an increase in growth rate of nominal exchange rate after that same period.

8.2. Credibility

In this section I study which is the role of credibility in the success of a stabilization program by running two counterfactual exercises.

In the next two pictures, I show counterfactual dynamics by altering the credibility agents have about the persistency of the policy change. As in the previous section, the
"benchmark" series are the actual series. The counterfactual dynamics and 68% error bands for the top panels of Figure 15 are the ones in which agents perceive that the policy change in 1988 will last only one period and after that the economy will stay forever in the active fiscal policy regime. Hence, private sector thinks \( p^c(S_{t+1}^c = 1|S_t^c = 1) = 1 \) and \( p^c(S_{t+1}^c = 2|S_t^c = 1) = 0 \). On the other hand, bottom panel presents counterfactual for the "permanent" dynamics, that is when agents perceive the policy change is permanent, i.e. \( p^c(S_{t+1}^c = 2|S_t^c = 2) = 1 \).

Note: Top panel presents counterfactual series obtained by assuming private sector perceives the policy change as temporary, whereas bottom panel assumes the perception is permanent. Red line are actual series, blue line are counterfactual series and 68% confidence bands are represented by dashed lines.

In contrast, Figure 16 presents the same exercises for the 1995 stabilization program,
I find that if agents perceive the policy as completely transitory, the stabilization effect in terms of inflation and nominal exchange rate growth are diminished, both for the cases of the 1988 and 1995 stabilization programs.

As can be seen both inflation and nominal exchange rate growth are significantly smaller after stabilization programs in 1988. After Tequila crisis, instead, it seems that if policy change is perceived as permanent, it have a substantial effect only on inflation, but small effects on nominal exchange rate growth.

In this section, counterfactual exercise allows us to use the actual structure of shocks implied by the model estimation. The findings of this section are in line with the ones in previous section when we assume different beliefs for the private sector. Credibility in the persistence of the stabilization policies matters for price and exchange rate dynamics.

The previous figures present two extreme cases, when agents believe policy change is not persistent and when agents perceive it is permanent. We find that credibility matters for
stabilization. However, do we need to assume complete lack of credibility in order to find a failure of a stabilization program? Figure 17 describes how the persistence probability of the active monetary policy regime affects average inflation and growth rate of nominal exchange rate in both 1988 and 1995 stabilization episodes.

Figure 17: Credibility

As can be seen in the picture, a large perceived persistence probability, i.e. credibility, is required to lower the average inflation and growth rate of nominal exchange rate. However, these stabilization episodes do not need to be perceived as permanent in order to stabilize the economy, as can be seen significant differences are obtained for transition probabilities of 0.8 or larger.

9. Model Comparison

It remains showing whether data favors the model with policy changes over fixed coefficients models and alternative formulations. I do this in this section by computing
marginal data density of competing models, the benchmark model, a model with only volatility changes and a model with only coefficient changes.


Following previous notation, the marginal density function is defined as

\[ P(Y_T) = \int p(Y_T|\Upsilon)p(\Upsilon)d\Upsilon. \]

This function can be expressed as

\[ P(Y_T)^{-1} = \int \frac{h(\Upsilon)}{p(Y_T|\Upsilon)p(\Upsilon)}p(\Upsilon|Y_T)d\Upsilon, \]

and approximated by

\[ P(Y_T)^{-1} = \frac{1}{M} \sum_{j=1}^{M} \frac{h(\Upsilon^j)}{p(Y_T|\Upsilon^j)p(\Upsilon^j)}. \]

Gelfand and Dey (1994) and Geweke (1999) propose a normal distribution to approximate \( h(\Upsilon) \). However, as discussed in Sims, et. al (2008), standard modified harmonic mean (MHM) approach from Gelfand and Dey (1994) and Geweke (1999) might be a poor approximation in Markov switching models, because the posterior density is usually non-Gaussian. In order to overcome this problem, they propose to compute the marginal posterior using a more general density, the elliptical distribution.

Authors suggest to center the distribution in the posterior mode, \( \hat{\Upsilon} \), and for scaling they propose,

\[ \hat{\Omega} = \frac{1}{M} \sum_{j=1}^{M} (\Upsilon^{(j)} - \hat{\Upsilon})(\Upsilon^{(j)} - \hat{\Upsilon})'. \]

Finally, the elliptical distribution that is centered in \( \hat{\Upsilon} \) with scaling \( \sqrt{\hat{\Omega}} \) has the following form,

\[ g(\Upsilon) = \frac{\Gamma(k/2)f(r)}{2\pi^{k/2}|det(\sqrt{\hat{\Omega}})|^{k/2-1}}. \]
where \( k \) stands for \( \Upsilon \)'s dimension \( r = \sqrt{(\Upsilon^{(j)} - \hat{\Upsilon})\hat{\Omega}^{-1}(\Upsilon^{(j)} - \hat{\Upsilon})} \) and \( f(r) \) is any one dimensional density that is defined for the positive reals.

Following this approach, Table 9 presents marginal data densities for the benchmark model, that allows for changes in policy rules coefficients and volatilities, a version of the same model that only allows for changes in coefficients, and 3 other variants: the benchmark model with the rest of the world modeled as a VAR(1), called "Alternative Model 1", a version in which interest rate rule responds to output, "Alternative Model 2", and a version that allows for higher probability of policy changes during high volatility regime, "Alternative Model 3".

<table>
<thead>
<tr>
<th></th>
<th>p = 0.1</th>
<th>p = 0.5</th>
<th>p = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benchmark Model</td>
<td>2225.1</td>
<td>2228.3</td>
<td>2232</td>
</tr>
<tr>
<td>Alternative Model 1</td>
<td>2140.6</td>
<td>2144.8</td>
<td>2148.2</td>
</tr>
<tr>
<td>Alternative Model 2</td>
<td>2160.1</td>
<td>2165.8</td>
<td>2170.7</td>
</tr>
<tr>
<td>Alternative Model 3</td>
<td>2183.1</td>
<td>2188.6</td>
<td>2192.1</td>
</tr>
<tr>
<td>MS only in volatilities</td>
<td>1843.5</td>
<td>1846.3</td>
<td>1851.5</td>
</tr>
</tbody>
</table>

Note: Log marginal data density, where \( p \) is the fraction of draws used for the approximation.

As can be seen from the previous table, the model with both coefficients and volatility changes do substantially better than both models with constant parameters in policy rules.

In this way, the data supports policy changes in fiscal and monetary policies in emerging markets. Moreover, the table also indicates that the benchmark model slightly outperforms the three alternative specifications.

**10. Conclusions**

In this paper, I provide evidence that supports that, during the last 30 years, emerging economies shifted repeatedly between periods of high macroeconomic volatility, inflation...
and acceleration of exchange rate growth, with periods of price and macroeconomic stability; and that in this environment, these economies implemented several stabilization programs which encompassed a mix of changes in the fiscal and monetary policies.

Motivated by these facts, I develop a dynamic stochastic general equilibrium model that allows fiscal and monetary policy rule coefficients to change accordingly to a Markov-Switching process. The model also allows for volatility changes. Using this model, I inquire how the variations in macroeconomic performance relate to policies and volatility changes.

I estimate the model for Mexico using the last 30 years of data. I find strong evidence of policy changes. In particular, I identify two Regimes. The active monetary policy regime (AMP), in which monetary and fiscal policies respond to inflation and government debt, respectively; and the active fiscal policy regime (AFP), in which fiscal policy does not respond to government debt and monetary policy does not respond to inflation. The active monetary policy regime holds during short periods of time after macroeconomic crises during the 80s and 90s, and for a long period after 2002.

On the other hand, active fiscal policy regime holds during most of the time and is the more persistent one. The importance of these findings is major. Monetary analysis in emerging economies has been conducted under the assumption of a permanent active monetary policy regime. This assumption was required in order to solve the models for a unique equilibrium. However by introducing non-Ricardian fiscal policy and Markov-Switching in the simple New-Keynesian model for open economies, I am able to relax that assumption, and find that during a large part of the sample, we observe the opposite, i.e. fiscal policy is conducted independently of government debt and monetary policy accommodates to fiscal policy requirements.

Then, I study the properties of policy shocks and policy changes. I find that monetary policy shocks generate substantial aggregate variability during high volatility regimes and, in particular, explain a large share of the volatility of inflation and exchange rate growth. On the other hand, fiscal policy shocks have a minor contribution to variability of output, inflation and exchange rates.

Regarding policy changes, I find that changes from active fiscal policy to active monetary policy induce stabilization at the cost of high output looses. However, credibility in
the persistence of the policy change matters. If the agents in the model perceive the policy to be permanent, the benefits from stabilization are substantially larger than the case in which agents think there is a probability of abandonment of the policy. On the other hand, if agents think that stabilization program is not persistent, the benefits from stabilization are undermined.

I study these findings for the stabilizations of 1988 and 1995 and provide evidence that policy changes played a major role in the observed dynamics of inflation and nominal exchange rate growth in both episodes.
References