Monetary and Fiscal Policies in a Sudden Stop: Is Tighter Brighter?[1]

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This Draft: November 28th, 2007

Abstract

It is not.

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[1] This paper was prepared for the project on *Policy Responses to Sudden Stops in Capital Flows*, sponsored by the InterAmerican Development Bank. We would like to thank very specially our research assistant Pablo Gluzmann (Universidad de La Plata) for his invaluable support. We are also grateful to the participants of the LACEA-LAMES 2007 Annual Meetings in Bogotá, Colombia and of the XXVI Meeting of the Latin American Network of Central Banks and Finance Ministries, IADB, Washington DC for very useful comments on a previous version of the paper.

1. Introduction and Motivation

The design of optimal policy responses to adverse capital account shocks during periods of global capital market turmoil (i.e., skyrocketing bond spreads and a sharp retrenchment in capital inflows or Sudden Stop) has been the source of a lively debate, particularly at the time of the Tequila, the Asian and Russian crises, when IMF policies calling for monetary and fiscal restraint in the face of external crises became strongly questioned. Should a country facing a sudden stop tighten its fiscal and monetary policies? Or conversely, should it relax those policies in order to attenuate the output contraction that typically occurs during these events?

Let us briefly review the main arguments of this debate. On the one hand, the view that monetary and fiscal policies in the aftermath of a sudden stop should become tighter is founded on the need to firmly anchor the system that becomes subject to large shocks in order to restore credibility and avoid potentially unstable dynamics. Stanley Fischer (1998) has been one of the main exponents of this view in the context of the Asian 1997 crisis[2]:

"In weighing this question, it is important to recall that when they approached the IMF, the reserves of Thailand and Korea were perilously low, and the Indonesian rupiah was excessively depreciated. Thus, the first order of business was, and still is, to restore confidence in the currency. To achieve this, countries have to make it more attractive to hold domestic currency, which, in turn, requires increasing interest rates temporarily, even if higher interest costs complicate the situation of weak banks and corporations. … Once confidence is restored, interest rates can return to more normal levels. … Indeed, the reluctance to tighten interest rates forcefully at the beginning has been an important factor in perpetuating the crisis…. At the outset of the crisis, countries needed to firm their fiscal positions, both to make room in their budgets for the future costs of financial restructuring, and --depending on the balance of payments situation -- to reduce the current account deficit."

On the other hand, others have argued that a sudden stop, that would inevitably precipitate a contraction, is precisely the time in which both monetary and fiscal policies are called to be expansionary. The Nobel laureate Joseph Stiglitz has been one of the most vocal critics of the IMF view arguing that this set of policy recommendations worsened the downturns in the countries affected:

"For more than seventy years there has been a standard recipe for a country facing a severe economic downturn. The government must stimulate aggregate demand, either by monetary or fiscal policy – cut taxes, increase expenditures, or loosen monetary policy.(…) The crisis economies of East Asia were clearly threatened with a major downturn and needed stimulation. The IMF pushed exactly the opposite course, with consequences precisely of the kind that one would have predicted." [3]

"While the reforms (financial and capital market liberalization) both exposed the countries of the region to more shocks and worsened their capacity for automatically coping with those shocks, the policy stances advocated by the Washington consensus made matters still worse: an almost single minded focus on the problems of the past, on budget deficits and inflation, meant that as countries saw tax revenues decline as their incomes declined or as they saw expenditures increase as the interest rates they faced rose, they were

[2] See also IMF (1999).

[3] See Stiglitz (2002).

encouraged to cut expenditures and raise taxes, and these procyclical discretionary fiscal policies exacerbated the downturns still further in country after country." [4]

"When the Fund entered East Asia, it forced countries to raise interest rates to what, in conventional terms, would be considered astronomical levels (…) The high interest rates increased the number of firms in distress, and thereby increased the number of banks facing nonperforming loans. This weakened the banks further. The increased distress in the corporate and financial sectors exacerbated the downturn that the contractionary policies were inducing trough the reduction in aggregate demand. The IMF had engineered a simultaneous contraction in aggregate demand and supply. [5]

This discussion has been later taken up in the theoretical literature. For example Braggion, Christiano and Roldos (2004, 2005) tried to reconcile the two views by constructing a model where an initial tightening following by a later loosening is optimal. The argument relies on the need to avoid currency mismatches in the very short run, that can be relaxed in the medium term. Hevia (2007) suggests that a contractionary monetary policy is welfare improving. He mentions that when there is a financial tightening on foreign bonds, the country is required to run a current account surplus. In his model there is a decline in the production of final goods, consumption and investment, and a reallocation of inputs to the tradable sector. The optimal drop in consumption and the rigidity of prices imply that money supply should be tightened. Otherwise an increase in the money supply would induce an increase in consumption, employment and the production of final goods which would reduce welfare, since a sudden stop is a period in which the economy should produce more tradables. Aghion, Bacchetta and Banerjee (2001) also found the same result, particularly due to the negative effect of devaluations on output in an economy with credit constraints, though their analysis focuses on the prevention of a sudden stop rather than at the optimal reaction to it.

Such a contrasting set of views on the same phenomenon leaves the reader at awe. Can a country suffering a sudden stop restore credibility by tightening monetary and fiscal policy and thus minimize the impact on output, or will these policies only make matters worse? The answer to these questions is, at the end of the day, an empirical issue. A decade after the large sudden stops of the 1990s is a good time to make an assessment of what has been learned, as many countries have experimented widely in terms of the different responses to sudden stops, providing a rich array of cases that may allow some preliminary conclusions.

The purpose of this paper is to develop and empirical methodology to contribute to this debate based on the recent experience of emerging economies. The outline is as follows. In Section 2 we discuss the identification of the episodes to be considered. There we argue we should concentrate on episodes of sudden stops that coincide with periods of global capital market turbulence for emerging markets, a phenomenon called "systemic sudden stop" or SSS in Calvo, Izquierdo and Talvi (2006). Concentrating in episodes of SSS allows us on the one hand, to address the issue in the setting in which the policy debate took place. On the other hand, it helps rule out many sudden stop episodes that originate in idiosyncratic factors that may lead to endogeneity concerns once we move to the analysis of

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[4] See Stiglitz (2003).

[5] See Stiglitz (2002).

the impact of fiscal and monetary policies. Section 3, the core of the paper, discusses our characterization of fiscal and monetary policies and provides quantitative measures of the conduct of fiscal and monetary policies throughout the sudden stops. Section 4, provides preliminary albeit suggestive evidence on the relation between the monetary and fiscal policy stance and the behavior of output during SSS. This evidence allows us to infer whether a specific policy stance was more or less conducive to avoid output losses. Section 5 concludes.

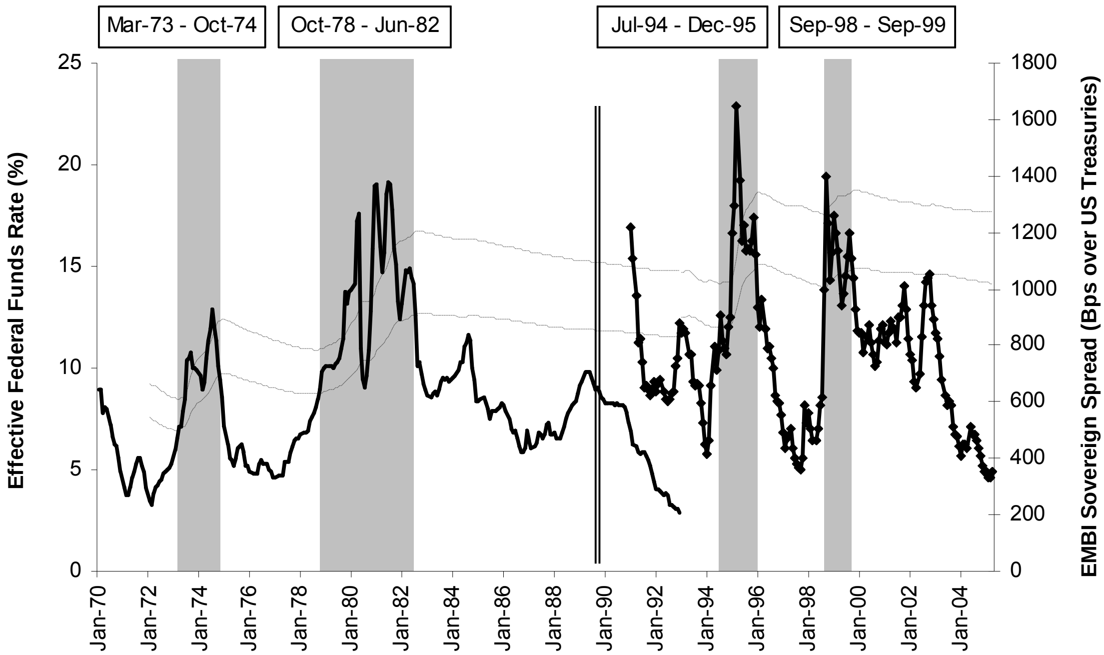
2. Identification of SSS Episodes

In this paper we attempt to analyze the policy reaction to a sudden stop. It seems reasonable then to focus on sudden stop episodes that are, to as large an extent possible, unrelated to country experiences. In fact, if sudden stops were to be characterized simply as a sharp curtailment of the capital account, the number of episodes would be very large. Guidotti *et al* (2004) for example, find 313 episodes since 1974 where the capital account fell by more than 5 percent of GDP from one year to the next. But these span a rich array of cases, from countries where large positive terms of trade shocks led to improvements in the current account, to countries with idiosyncratic crises that strongly affected the evolution of the economy in the short run.

Thus, a natural candidate for the analysis of policy reactions to sudden stops, are sudden stops that largely stem from exogenous financial turmoil. Following Calvo, Izquierdo and Talvi (2006), we refer to these episodes as systemic sudden stops (SSS, hence), i.e., periods of skyrocketing interest rate spreads for emerging markets and capital inflow collapse that affected a large set of emerging countries at approximately the same time, and thus have a systemic component.

In similar fashion to Calvo, Izquierdo and Loo-Kung (2005), we define a SSS window as the union of a *capital-flow window* containing a large fall in capital flows for a given country exceeding two standard deviations from its mean (that starts when the fall in capital flows exceeds one standard deviation, and ends when it is smaller than one standard deviation) that overlaps at any point in time with an *aggregate-spread window* containing a spike in the aggregate Emerging Market Bond Index or EMBI spread exceeding two standard deviations from its mean (which starts when the aggregate EMBI spread exceeds one standard deviation, and ends when it is smaller than one standard deviation). This methodology identifies three systemic crisis during the last two and half decades depicted in Figure 1: the debt crisis that followed the sharp rise in US interest rates in the late seventies and early eighties, the Tequila crisis in1994 and the 1997/98 Asian and Russian crisis.

Figure 1. Timing of Systemic Sudden Stops



For this aggregate shock to matter we also need to focus on countries that are integrated into the world capital market. One possible measure of integration is the ability to place a sizeable amount of international bonds. For this reason, the sample selected for the analysis is composed of countries that are tracked by JP Morgan to construct its global EMBI. The list of countries includes Argentina, Brazil, Bulgaria, Chile, Colombia, Croatia, Czech Republic, the Dominican Republic, Ecuador, El Salvador, Hungary, Indonesia, Ivory Coast, Lebanon, Malaysia, Mexico, Morocco, Nigeria, Panama, Peru, Philippines, Poland, Russia, South Africa, South Korea, Thailand, Tunisia, Turkey, Ukraine, Uruguay, and Venezuela.

In this paper, we will focus on the episodes that occurred in the last 15 years, namely, the Tequila crisis and the Asian and Russian crisis. The reason for this is twofold. On the one hand, because we want to focus on recent episodes, particularly those that were the main object of the intellectual debate considering that financial integration had changed drastically in the early 1990s, at least in comparison to the 1980s. In addition, some of the statistical techniques are quite demanding in terms of data availability and thus difficult to implement for earlier periods.

When focusing on the 1990-2006 period the classification yields 22 episodes of SSS. Table 1 illustrates the behavior of output for each of these SSS episodes. Columns 2 and 3 present the dates corresponding to the output peak and trough during the SSS window.[6]

[6] If either the peak or trough falls within the SSS window, the contraction is classified as belonging to the period of the SSS. If a country experienced a deceleration but not a contraction, the dating was determined using the HP-filtered cyclical component of output.

Column 4 shows the change in output from peak to trough. In the table we have ordered the cases from the largest contraction to the mildest.

Table 1 includes most of the very well known crises throughout the 1990s: the Tequila crisis episodes (Argentina, Mexico and Turkey) and the East Asian and Russian crisis episodes (Indonesia, Malaysia, Thailand, Korea, Ecuador, Argentina and Turkey). As we move down Table 1 we find countries that are less associated to a crisis episode, but that still experienced an output contraction in the aftermath of the Asian and Russian crisis (Brazil, Colombia Chile, Croatia, Philippines, and Peru). Finally, we find countries such as Poland in the aftermath of the Asian and Russian crisis and the Dominican Republic after the Tequila crisis that in spite of experiencing a SSS had no output contraction but only growth deceleration. It is this diversity in the outcomes that will allows us to collect suggestive evidence on the impact of fiscal and monetary policies on output performance during SSS.

Table 1. Systemic Sudden Stop Episodes and Output

	GDP Dates		GDP Variation
Country	Peak	Trough	Peak to trough % change
Argentina 98	Jun-98	Mar-02	-20.9%
Indonesia	Dec-97	Dec-98	-17.3%
Thailand	Sep-96	Sep-98	-15.1%
Morocco	Dec-94	Jun-95	-13.3%
Turkey 93	Dec-93	Jun-94	-12.2%
Malaysia	Dec-97	Sep-98	-11.0%
Russia	Dec-97	Sep-98	-10.1%
Mexico	Dec-94	Jun-95	-9.7%
Korea	Sep-97	Jun-98	-8.5%
Turkey 98	Mar-98	Mar-99	-8.1%
Ecuador	Dec-98	Sep-99	-7.6%
Colombia	Jun-98	Jun-99	-7.1%
Croatia	Dec-97	Jun-99	-5.9%
Argentina 94	Dec-94	Sep-95	-5.6%
Chile	Jun-98	Mar-99	-4.6%
Lebanon	Sep-98	Jun-99	-3.3%
Brazil 95	Mar-95	Sep-95	-2.7%
Peru	Dec-97	Dec-98	-2.4%
Philippines	Dec-97	Jun-98	-2.2%
Brazil 97	Dec-97	Mar-99	-1.7%
Poland	Dec-97	Mar-99	3.2%
Dominican Republic	Mar-94	Sep-95	6.6%
Average			-7.2%

3. Characterization of Fiscal and Monetary Policies

Understanding the implications of different policies for the behavior of output requires measuring fiscal and monetary policy in a way which is exogenous to the output dynamics that we want to analyze. This is not an easy task because fiscal and monetary policies react, quite predictably, to output dynamics. The following subsection discusses the way we have chosen to characterize monetary and fiscal policy during a SSS. In both cases the issue of exogeneity was our most relevant concern.

3.1 Fiscal Policy

If we naively chose to characterize fiscal policy by the behavior of the observed fiscal deficit, we would have to conclude that most countries, when confronted to a SSS, pursued expansionary fiscal policies, therefore leaning against the wind, the standard recipe for a country facing severe contractionary pressures. However this conclusion would be wrong. Since SSS are associated with relatively large contractions in output and therefore fiscal revenues, the fact that the observed fiscal deficit increases is not an indication by any means of an expansionary expenditure policy, but mostly an endogenous response of revenues to the decline in output.

Let us define the observed fiscal balance as:

$$fb_t = r_t - g_t \quad (1)$$

where fb_t, r_t and g_t are the fiscal balance, fiscal revenues and fiscal expenditures in period *t* expressed in percent GDP. Let us also define the observed fiscal impulse I_t as

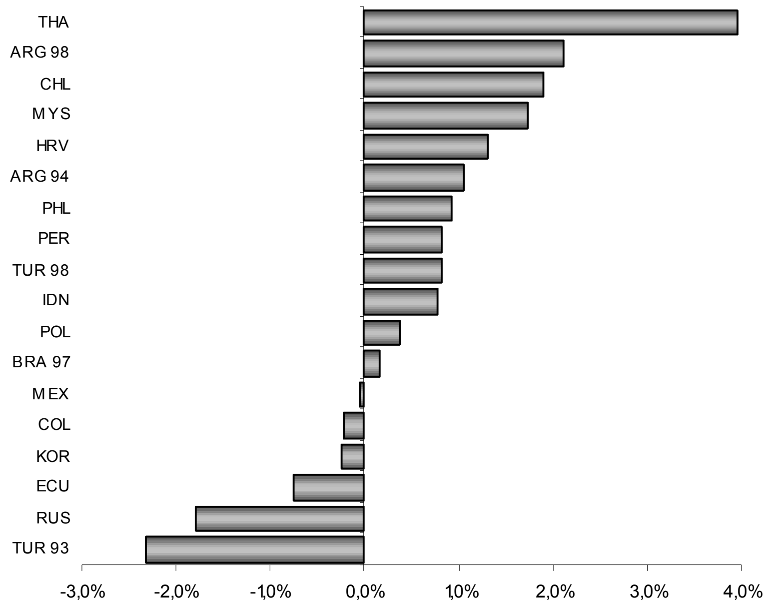
$$I_t = -\Delta fb_t \quad (2)$$

where a positive (negative) value of I_t indicates an expansionary (contractionary) fiscal policy.

The observed fiscal impulses for our episodes are illustrated in Figure 2, which depicts the change in the fiscal deficit from (output) peak to trough shown in Table 1.[7] It shows that the observed fiscal impulse is expansionary in approximately 70 percent of the countries in our sample during periods of SSS. The average size of the fiscal expansion during a SSS is 0.6 percent of GDP.

[7] Due to data availability only 18 out of the 22 SSS episodes were computed.

Figure 2. Observed Fiscal Impulse



However, to appropriately characterize fiscal policy during SSS episodes we need to extract the effect of cyclical fluctuations on fiscal accounts in order to capture discretional components of fiscal policy.

One such way is to compute the structural fiscal balance.[8] Traditional methodologies for computing structural fiscal balances, applied by international organizations such as the OECD, the IMF and the EU, basically apply a three-step procedure. First, estimating potential output and the corresponding output gap (defined as the difference between observed and potential output). This can be conducted basically by two methods: using time-series regression methods or estimating a production function. The second step is to estimate the elasticities of the different components of fiscal accounts to the output gap. Finally, the effect of cyclical components is extracted applying output elasticities to revenues and expenditures and computing the structural fiscal balance.

Although these measures are commonly used in a broad range of countries, they appear unsatisfactory when it comes to analyzing emerging economies, at least for two reasons. In the first place, the standard procedure focuses on output cycles. Nevertheless, in several emerging economies fiscal revenue cycles are also associated with commodity price fluctuations (e.g.: Chile, Mexico, Ecuador and Russia). In the second place, several of the traditional methodologies apply techniques for smoothing fiscal account components that were designed taking into account macroeconomic volatility of developed countries, which are not necessarily well suited to be applied in more volatile environments such as emerging economies.

[8] Hagemann (1999) or Giorno et al (1995), for example, discuss different alternatives to compute structural fiscal balances.

Following Izquierdo, Ottonello and Talvi (2007), rather than constructing a methodology of our own to extract the effect of macroeconomic fluctuations on fiscal accounts for our sample of emerging economies, we "adopted" the methodology currently being applied by Chile since 2001.[9] Chile's Structural Fiscal Rule has been widely praised by academics and market analysts as an example of sound intertemporal fiscal management.

Chile's Structural Fiscal Rule consists of targeting an annual structural surplus (recently changed from 1 percent to 0.5 percent of GDP). The Chilean Fiscal Rule defines the structural balance as the difference between structural fiscal revenues and observed fiscal expenditures. Structural fiscal revenues are defined as the level of revenues that would have been achieved if output were at its potential level and the copper price were at its long run level. Therefore the structural fiscal balance is defined by the Chilean Fiscal Rule as follows:

$$SB_t^{CHLFR} = FB_t - T_t + T_t \left(\frac{Y_t^*}{Y_t} \right)^{\varepsilon} - CS_t \left(P_t^{FOB} - P_t^{REF} \right) \qquad (3)$$

where SB_t^{CHLFR} is period t structural fiscal balance, FB_t is the observed fiscal balance, T_t are actual tax revenues, Y_t^* is potential output, Y_t is the observed level of output, ε is the output elasticity of tax revenues, CS_t are physical sales of CODELCO (Chile's main copper company) in equivalent units of refined copper, P_t^{FOB} is the FOB Price of CODELCO exports that corresponds to the spot price in the Metals Exchange of London, and P_t^{REF} is the reference price or long-term price of copper. Both potential output and the reference price of copper are estimated by two committees of independent experts.

While we cannot directly replicate this rule for other countries we can find a "statistical equivalent" to it. To do so we compute the Lagrange multiplier of the Hodrick-Prescott filter for current revenues in Chile in order to estimate by how much the Chilean authorities smooth their income. The Lagrange multiplier that delivers a surplus/deficit that best matches the structural balance reported by the authorities is the one that provides a statistical equivalent to their complex rules, which are intended to determine the level of sustainable income. Appendix I provides the technical details.

Once the "smoothing" parameter is chosen, the filter is applied to fiscal revenues of the countries included in our sample to compute our measure of structural balance. More precisely, the structural fiscal balance for country i in period t, sb_t^i is defined as follows:

$$sb_t^i = r_t^{*i} - g_t^i \qquad (4)$$

[9] See Marcel et al (2003), García et al (2005).

where r_t^{*i} is the adjusted level of revenues adjusted according to the Chilean Fiscal Rule and g_t^i are total public expenditures for the country *i*, both in percent of GDP.

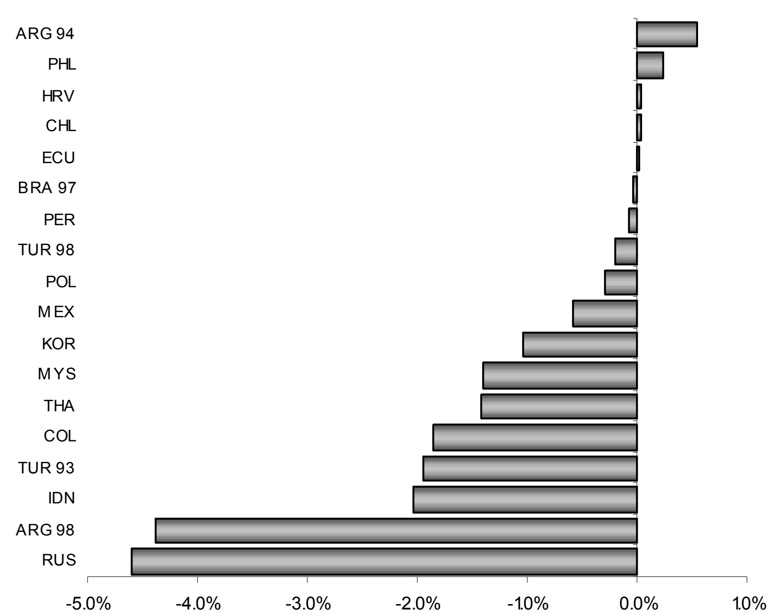
Once obtained the structural fiscal balance, we characterize fiscal policy for country *i* in period *t* through the structural fiscal impulse, defined as follows:

$$I_t^{*i} = -\Delta sb_t^i . \quad (5)$$

Thus, the structural fiscal impulse can be interpreted as the change in fiscal policy in period *t* once the effect of cyclical fluctuations in commodity prices and output is removed. A positive (negative) value of I_t^* indicates an expansionary (contractionary) fiscal policy.

Figure 3 shows the behavior of fiscal policy during SSS, as measured by the structural fiscal impulse from (output) peak to trough shown in Table 1. Contrary to the picture depicted by looking at the observed fiscal impulse in Figure 2, our structural fiscal impulse measure indicates that approximately 70 percent of the countries in our sample followed a contractionary fiscal policy during SSS episodes. The average size of the fiscal contraction during a SSS is 1.1 percent of GDP. It is this measure of fiscal policy that we will contrast with output performance in the section 4 of the paper.

Figure 3. Structural Fiscal Impulse



3.2 Monetary Policy

We now proceed to characterize monetary policy. In times of financial turmoil it is very difficult to extract the discretional component of monetary policy from interest rates. This point has been recently stressed by Calvo (2006), who argued that during SSS interest rates are a very noisy signal. In order to proceed as we did with fiscal policy and capture the discretional components of monetary policy in times of financial turmoil, we plan to measure monetary policy by directly estimating the Central Bank reaction function to movements on inflation, output and the exchange rate immediately prior to the SSS episode, and assume that the Central Bank will react accordingly.

The literature has addressed this in several ways. In recent years there has been an active literature trying to estimate the policy reaction function of central banks, following Taylor's innovative (1993) description of a simple rule by which interest rates were adjusted in response to inflation changes and the output gap. Taylor suggested that a simple equation represented US policy fairly well, namely

$$i_t = \pi_t + 0.5\left(100\left(\frac{Y_t - Y_t^*}{Y_t^*}\right)\right) + 0.5(\pi_t - 2) + 2 \tag{6}$$

where i_t is the federal funds rate, π_t is the rate of inflation over the previous four quarters, Y_t is real GDP and Y_t^* is trend real GDP (which equals 2.2 percent per year from 1984.1 through 1992.3) in period t. Orphanides (2001a, 2001b) criticizes this rule on the basis that the information used by it is unavailable to policy makers at the time of the decision, and thus impossible as a description of actual policies, and suggests an alternative rule based on information available at the time. Clarida, Gali and Gertler (2000) suggest that the Taylor rule has more to do with expectations of inflation and the output gap, and use an IV GMM procedure to estimate it, instrumenting future values of inflation and output on current and lagged information. However, when replicating their analysis we found these estimates to be widely unstable, even when applied to the US.

An alternative is to estimate a structural model. Lubik and Schorfheide (2007) use a Dynamic Stochastic General Equilibrium (DSGE) model and Bayesian techniques to estimate a Taylor rule for a small open economy (following Gali and Monacelli, 2005) that includes the exchange rate in addition to deviations of inflation and output from their steady-states. Lubik and Schorfheide (2007) estimate it for four countries: the UK, Australia, NZ and Canada, but provide a framework that can be applied to any country. This is the route we follow in this paper, estimating a fully hedged DSGE model following Lubik and Schorfheide (2007).

Appendix II provides a description of the model. In a nutshell the new Keynesian models in international finance typically boil down to three equations: a dynamic IS curve, a Philips curve and a policy reaction function. The IS curve is derived from the Euler equation of consumer maximization and aggregate demand matters because the models assume monopolistic competition. The Philips curve originates in the assumption of price rigidities. A very popular choice to model this price rigidity is Calvo's (1983) price staggering mechanism.

In Calvo's model firms are allowed to change prices randomly, but once they can, they do so rationally anticipating the conditions of the economy during the period they thought the price would be relevant. This formulation leads to a very elegant structure. Because change in opportunities appear stochastically and independently across firms, it means that a constant fraction of firms adjust their prices making the price level a smooth variable that changes only over time. Finally, because these models have well defined objective functions they allow for precise statements on welfare, a key step to evaluate policy. Monetary policy, in turn, can be described by an interest rule. With these models, the literature has come full circle, recovering the main tenets of the Mundellian approach, but now derived in coherent fully specified general equilibrium models.

Specifically, Lubik and Schorfheide (2007) estimate a version of a model initially developed by Gali and Monacelli (2005) which in log-linearized form can be described by the following set of equations. An open economy IS-curve:

$$y_t = E_t y_{t+1} - [\tau + \alpha\,(2-\alpha)(1-\tau)](R_t - E_t \pi_{t+1}) - \rho_z z_t - \alpha\,[\tau + \alpha\,(2-\alpha)(1-\tau)]E\Delta q_{t+1} + \alpha\,(2-\alpha)\frac{1-\tau}{\tau} E_t \Delta y^{\bullet}_{t+1} \tag{7}$$

where y_t denotes aggregate output, R_t nominal interest rate, π_t is CPI inflation, z_t is the growth rate of an underlying non-stationary world technology process Z_t, q_t is the terms of trade (as well as the real exchange rate as explained below), defined as the relative price of exports in terms of imports, and y_t^* is exogenous world output. The parameter τ represents the elasticity of intertemporal substitution, α is the import share[10], and ρ_z is the AR coefficient of the world technology. In order to guarantee stationarity of the model, all real variables are expressed in terms of percentage deviations from Z_t.

An open economy Phillips curve:

$$\pi_t = \beta E_t \pi_{t+1} + \alpha\beta E_t \Delta q_{t+1} - \alpha \Delta q_t + \frac{\kappa}{\tau + \alpha(2-\alpha)(1-\tau)}\left(y_t - \overline{y_t}\right) \tag{8}$$

where $\overline{y_t} = -\alpha(2-\alpha)\frac{1-\tau}{\tau} y_t^*$ is potential output in the absence of nominal rigidities. β represents the discount factor while is κ the structural parameter that gives the slope of the Phillips curve.

[10] The equation reduces to the closed economy variant when $\alpha = 0$.

Monetary policy is described by a Taylor-type interest rate rule. We assume that the central bank adjusts the nominal interest rate in response to deviations of inflation, output and exchange rate depreciation from their respective steady-states:

$$R_t = \rho_R R_{t-1} + (1-\rho_R)\left[\psi_1 \pi_t + \psi_2 y_t + \psi_3 \Delta s_t\right] + \varepsilon_t^R \quad (9)$$

where s_t denotes the nominal effective exchange rate, ρ_R captures the partial adjustment of the interest rate to target, while ψ_1, ψ_2 and ψ_3 captures the monetary authorities reaction to inflation, output and exchange rate fluctuations. The exchange rate is introduced via CPI inflation according to:

$$\pi_t = \Delta s_t + (1-\alpha)\Delta q_t + \pi_t^* \quad (10)$$

where π_t^* is a world inflation shock which is treated as an unobservable. Terms of trade, in turn, are assumed to follow a law of motion for their growth rate:

$$\Delta q_t = \rho_q \Delta q_t + \varepsilon_{q,t} . \quad (11)$$

Equations (7) - (11) form a linear rational expectations model. It is assumed that y_t^* and π_t^* evolve according to univariate AR(1) processes with autoregressive coefficients ρ_{y^*} and ρ_{π^*}, respectively. The innovations of the AR(1) processes are denoted by $\varepsilon_{y^*,t}$ and $\varepsilon_{\pi^*,t}$. The model is solved using the method described in Sims (2002) and is estimated using Bayesian methods. Details on estimation methods, data, and choice of priors are described in the Appendix II.

With this methodology we proceed to estimate the Taylor rule of equation (9) for the 18 episodes of our sample.[11] We will focus on the three parameters ψ_1, ψ_2, ψ_3 that we will refer to as "anti inflation" (ψ_1), "output motive" (ψ_2) and "fear of floating" (ψ_3) coefficients respectively, and on the coefficient $(1-\rho_R)$ that we will refer to as "CB reaction" coefficient. The results are contained in Table 2, which shows the estimation by country and the averages for these four coefficients, and for comparison, previous results using the same methodology for New Zealand, Canada, Australia, UK and South Africa. For each country the estimation period comprises the longest period for which we have data and during which the government maintained a relatively homogenous monetary policy framework. To determine this we used Levy Yeyati and Sturzenegger's (2005) exchange rate classification (also presented in Table 2) where we have subsumed the categories of crawling pegs and dirty float into the broader category of managed floats. To illustrate the methodology we can use the case of Argentina that implemented a fixed exchange rate regime in April of 1991. As a result for the Tequila crisis we use the sample 1991:Q2 through 1994:Q4. For Argentina's crisis that starts with the Russian crisis we take the sample 1991:Q2 through 1998:Q2. The initial date of the estimation period for the two

[11] Due to data availability only 18 out of the 22 SSS episodes were computed.

episodes coincides due to the fact that the monetary regime remained unchanged between 1991:Q2 and the end of 2001, so that these samples provide the largest range of data with a homogenous regime prior to each episode.

Table 2. Monetary Policy Parameter Estimation Results

Country	Exchange Rate Regime (c)	Estimation Period		ψ_1	ψ_2	ψ_3	$(1-\rho_R)$
Australia (a)	Float	1983:Q1	2002:Q4	1.41	0.24	0.07	0.24
Canada (a)	Float / Managed Float	1983:Q1	2002:Q4	1.30	0.23	0.14	0.31
New Zealand (a)	Fix	1988:Q1	2002:Q4	1.69	0.25	0.04	0.37
South Africa (b)	Fix / Managed Float / Float	1983:Q1	2002:Q4	1.11	0.27	0.11	0.27
United Kingdom (a)	Float	1983:Q1	2002:Q4	1.30	0.20	0.13	0.26
Average				*1.36*	*0.24*	*0.10*	*0.29*
Argentina 94	Fix	1991:Q2	1994:Q4	0.17	0.68	4.35	0.59
Argentina 98	Fix	1991:Q2	1998:Q2	0.13	0.21	6.22	0.62
Brazil	Managed Float	1994:Q4	1997:Q4	0.71	0.19	0.25	0.50
Chile	Float	1988:Q3	1998:Q2	1.49	0.17	0.17	0.22
Colombia	Float	1994:Q2	1998:Q2	1.49	0.15	0.23	0.49
Croatia	Managed Float	1994:Q3	1997:Q4	0.67	0.40	1.51	0.57
Ecuador	Float / Managed Float	1990:Q2	1998:Q4	1.15	0.17	0.23	0.75
Indonesia	Managed Float	1994:Q2	1997:Q4	0.75	0.15	0.25	0.95
Korea	Managed Float	1987:Q4	1997:Q3	1.64	0.33	0.72	0.31
Malaysia	Managed Float	1989:Q1	1997:Q4	3.12	0.40	0.15	0.20
Mexico	Fix	1990:Q4	1994:Q4	0.51	0.66	0.34	0.11
Peru	Float	1995:Q1	1997:Q4	1.92	0.53	0.82	0.44
Phillipines	Managed Float	1990:Q4	1997:Q4	1.38	0.29	0.11	0.59
Poland	Float	1995:Q2	1997:Q4	1.18	0.64	0.80	0.16
Russia	Fix	1995:Q2	1997:Q4	0.71	0.68	0.64	0.94
Thailand	Managed Float	1993:Q2	1996:Q3	2.00	0.17	1.04	0.75
Turkey 93	Float	1989:Q2	1993:Q4	1.19	0.17	0.29	0.56
Turkey 98	Float	1989:Q2	1998:Q1	1.77	0.20	0.50	0.87
Average				*1.22*	*0.34*	*1.04*	*0.54*

Source: (a) Lubik and Schorfheide (2007), (b) Ortiz and Sturzenegger (2007),
(c) Levy Yeyati, E. and Sturzenegger, F. (2005)

Notice that we use the framework to estimate the Taylor rule even for those cases in which the monetary regime was characterized by a fixed exchange rate regime, a regime in which, presumably, interest rates are not a policy choice of the Central Bank but are determined endogenously by capital flows. We believe this is correct for a number of reasons. To the extent that interest rates truly react endogenously to the exchange rate, this should be captured by a larger coefficient for ψ_3. Notice that Argentina's convertibility regime indicates exactly this with fear of floating coefficients that are much larger than those of any other episodes in Table 2. The interpretation is that interest rates accommodated themselves to keep the exchange rate fixed, and, when interpreting policy makers objectives, that the Central Bank was willing to allow these adjustments. But fixed exchange rate regimes may not be as clear cut. Occasional devaluations may move the exchange rate, or lack of capital market integration may still allow some leeway in the conduct of monetary policy. In these cases, the estimation of the Taylor rule is a way of assessing how committed the Central Bank was to the fixed regime.

The numbers show some similarities between our sample of EM countries and the control group. The "anti-inflation" coefficient is on average similar in our group of EM countries to the control group, but with a greater dispersion in the former. The same occurs with the "output motive" coefficient. In fact we cannot reject the null hypothesis that the mean of ψ_1 and ψ_2 are equal for both groups of countries at the ten percent level.[12]

What is really "emerging" from our sample of countries, is the "fear of floating" coefficient, ψ_3, which is unambiguously above the control group for all the countries in our sample, and the "CB reaction" coefficient, $(1-\rho_R)$, which is also above our control group for nearly all the countries in the sample. This means that the exchange rate is typically a more relevant concern in our group of EM countries, and that the initial reaction of the Central Bank, for a given value of the shock and the ψ_i parameters, is larger in EM countries.

Now that we know that central banks care about inflation, the output gap and the exchange rate in their reaction function, we analyse how the typical shock during a SSS looks like. To describe the anatomy of the typical shock during a SSS episode we compute the simple average of inflation, output and exchange rate during the (output) peak to trough window for our sample of EM countries. As illustrated in Figure 4, during a SSS the average country faces upward pressures on inflation and the exchange rate and contractionary pressures on output. Therefore, when confronting this type of shock the Central Bank is really faced with a trade-off: the inflation and fear of floating coefficients will lead the Central Bank to tighten monetary policy in response to a SSS, while the output motive will lead the Central Bank to loosen policy.

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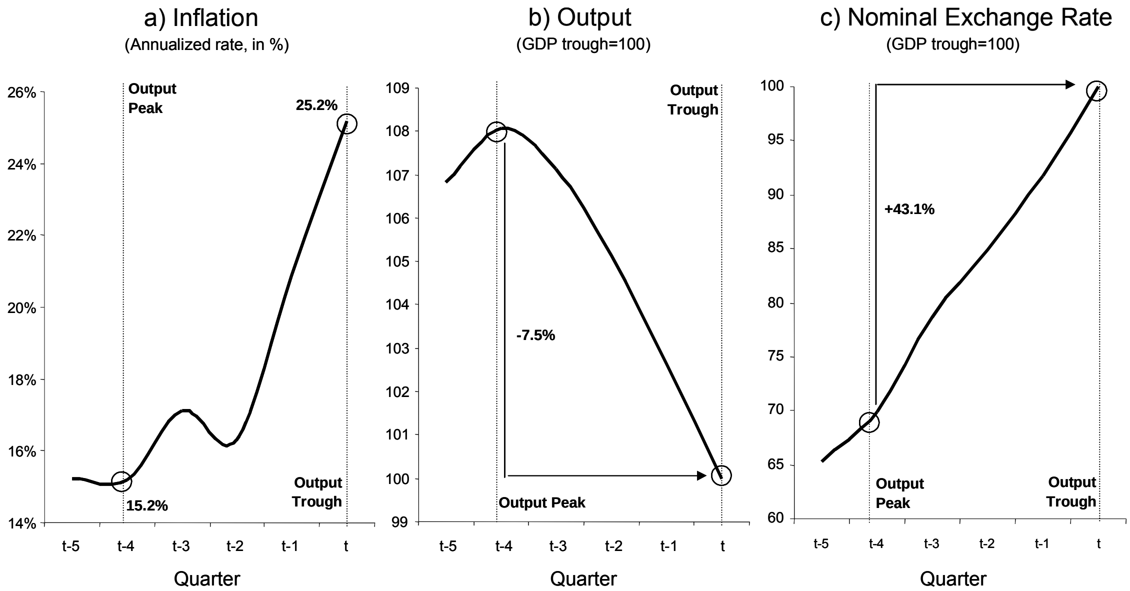
[12] It is interesting to notice that the "output motive" coefficient, ψ_2, is negatively related to the slope of the Phillips curve, the κ parameter on equation (8). This implies that that the larger the possibilities of exploiting the output-inflation trade-off, the larger the Central Bank reaction to the output gap.

Figure 4. Monetary Policy Trade-Offs in a SSS: The Typical Shock



In order to capture the relevant trade-offs central banks face during a SSS, we constructed a set of monetary policy indexes. One of such index is the Monetary Policy Regime index, $T(\pi, S/Y)_t$, which is the ratio between the inflation and fear of floating coefficients (tightening bias) and the output motive coefficient (loosening bias), both computed relative to the sample mean. The Monetary Policy Regime index is given by:

$$T(\pi, S/Y)_t = \left(\frac{\left(\frac{\psi_1}{\overline{\psi_1}}\right) + \left(\frac{\psi_3}{\overline{\psi_3}}\right)}{\left(\frac{\psi_2}{\overline{\psi_2}}\right)} \right) \left(\frac{(1-\rho_R)}{\overline{(1-\rho_R)}} \right), \qquad (12)$$

where $\overline{\psi_1}$, $\overline{\psi_2}$, $\overline{\psi_3}$ and $\overline{(1-\rho_R)}$ are the sample averages. Thus, a county with a higher (lower) Monetary Policy Regime index will tend to react during a SSS by tightening policy more (less) than a country with a lower (higher) Monetary Policy Regime index.

The second way of characterizing monetary policy is by constructing two separate indexes: one which captures the inflation-output trade-off (typical of most developed countries) and the other that captures the exchange rate-output trade-off, typical of EM countries. The Inflation/Output Trade-Off index, $T(\pi/Y)_t$, is given by:

$$T(\pi / Y)_t = \left(\frac{\left(\frac{\psi_1}{\bar{\psi}_1} \right)}{\left(\frac{\psi_2}{\bar{\psi}_2} \right)} \right) \left(\frac{(1 - \rho_R)}{(\overline{1 - \rho_R})} \right), \tag{13}$$

while the Exchange Rate / Output Trade-Off index, $T(S / Y)_t$, is given by

$$T(S / Y)_t = \left(\frac{\left(\frac{\psi_3}{\bar{\psi}_3} \right)}{\left(\frac{\psi_2}{\bar{\psi}_2} \right)} \right) \left(\frac{(1 - \rho_R)}{(\overline{1 - \rho_R})} \right). \tag{14}$$

Thus, a county with a higher (lower) value of these indexes will tend to react during a SSS by tightening policy more (less) than a country with a lower (higher) value of these indexes.

4. The Effects of Fiscal and Monetary Policies during a SSS

We have now completed the main elements that allow us to tackle our exercise. We have identified episodes of SSS in financially integrated emerging economies where a country experiences a sudden collapse in capital flows during a period of systemic capital market turbulence. We have constructed relatively exogenous measures of fiscal and monetary policies. What remains to be seen is whether the fiscal and monetary stance during a SSS episode had a positive or adverse impact on how the economy coped with the SSS.

What effect do we expect from monetary and fiscal policy on output? We share the view put forth by Calvo and Talvi (2005) who argue that the effect of tighter monetary and fiscal policy on output dynamics will depend on whether the sudden stop and lack of access to international credit is systemic or localized. If localized, tight policies might help to restore credibility and regain access to capital markets. In this scenario tightening monetary and fiscal policy would actually be expansionary.

However if the sudden stop is systemic, such as those we analyze in this paper, it is unlikely that the actions of an individual country will help to restore access to capital markets. A SSS thus breaks the link between domestic and international credit markets and the economy starts momentarily operating *de facto* as a financially closed economy. In such a scenario excessively tight monetary and fiscal policies may aggravate the contraction and, undermine credibility.

Specifically regarding fiscal policy it could still be argued that in the presence of Ricardian Equivalence a tightening stance could still have no effects on output, even in a financially closed economy. This of course is due to the fact that the private sector could always fully offset the fiscal contraction. However, empirical evidence suggests that the offset coefficient of fiscal policy is highly dependent on whether a country has access to international credit markets. Using a sample of Latin American countries Gavin and Perotti (1996) have shown that in periods of full access to international financing the offset coefficient is close to one, but drops to 0.4 in periods where countries loose access to the international capital market. It is precisely under these circumstances that tight fiscal policy can bite.

We are now prepared to compute the impact of monetary and fiscal policies on output during a SSS. We do so by running regression between output performance in our SSS window and our policy variables. Since it is unlikely that the effects of monetary and fiscal policy are independent of each other, to avoid confounding the effects, the empirical analysis evaluates the joint effects of both policies on output.

We first compute as the dependent variable the output performance during SSS described by the peak to trough variations, ΔY_t, presented in Table 1. We then relate our measures of monetary and fiscal policy –described in section 3-- to output performance by performing simple OLS regressions. Since we have two alternative ways of characterizing monetary policy we estimate two alternative models.

The first model (henceforth Model I) includes as independent variables the structural fiscal impulse, I_t^*, and the Monetary Policy Regime index, $T(\pi, S/Y)_t$. The estimation of Model I yields the following results: [13]

$$\Delta Y_t = -0.035 + 1.876 I_t^* - 0.010 T(\pi, S/Y) + \varepsilon_t^I \qquad (15)$$
$$\qquad (2.793) \quad (-2.779)$$

The conclusion is clear: evidence suggests that tighter fiscal and monetary policy during a SSS are associated with a larger output contraction. Both coefficients are significant at the five percent level. As Figure 5a shows, the model does a pretty good job in explaining output contractions, reflected in an adjusted R^2 of 0.61. Moreover, we reject the hypothesis that the coefficients are jointly equal to zero at the 1 percent level. In addition, Figures 5b and 5c show the cross plots between fiscal policy and output and monetary policy and output respectively, after partialling out the effect of other policies.

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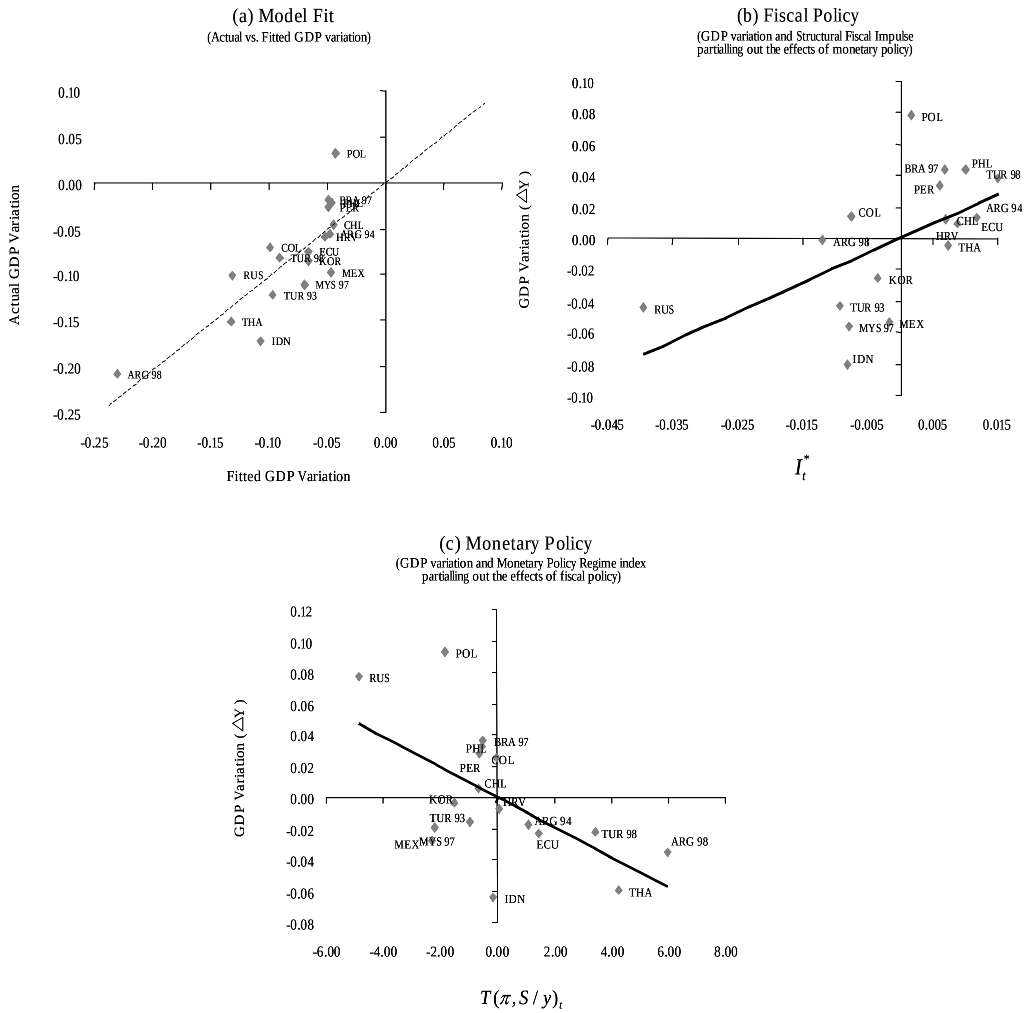
[13] T-statistics between brackets. Regressions results are presented in Appendix III. The results do not vary if the Monetary Policy Regime index were $\left[\frac{\left[\frac{\psi_1}{\overline{\psi_1}}\right]+\left[\frac{\psi_3}{\overline{\psi_3}}\right]}{\left[\frac{\psi_2}{\overline{\psi_2}}\right]}\right]$, which excludes the "CB reaction" coefficient.

Figure 5. Monetary, Fiscal Policy and Output Performance:
Model I Estimations



The model fit also allows quantifying the relevance of flexibility. Figure 5a shows the predicted and actual output drops resulting from the specific policy reaction function of each country. A large group, among our subsample, retained the flexibility required to keep the output effects of SSS below 5%. Another group however, among which Argentina provides the clearest example (but where we could include Indonesia, Thailand, Russia and Turkey) had a policy framework that allowed to anticipate output losses above 10%. These results suggest that retaining flexible fiscal and monetary policies is very significant from a quantitative point of view.

The second model (henceforth Model II) splits the effects of the monetary policy by including as independent variables both the Inflation/Output Trade-Off index, $T(\pi/Y)_t$, and the Exchange Rate/Output Trade-Off index, $T\left(S/Y\right)_t$. The estimation of Model II yields the following results: [14]

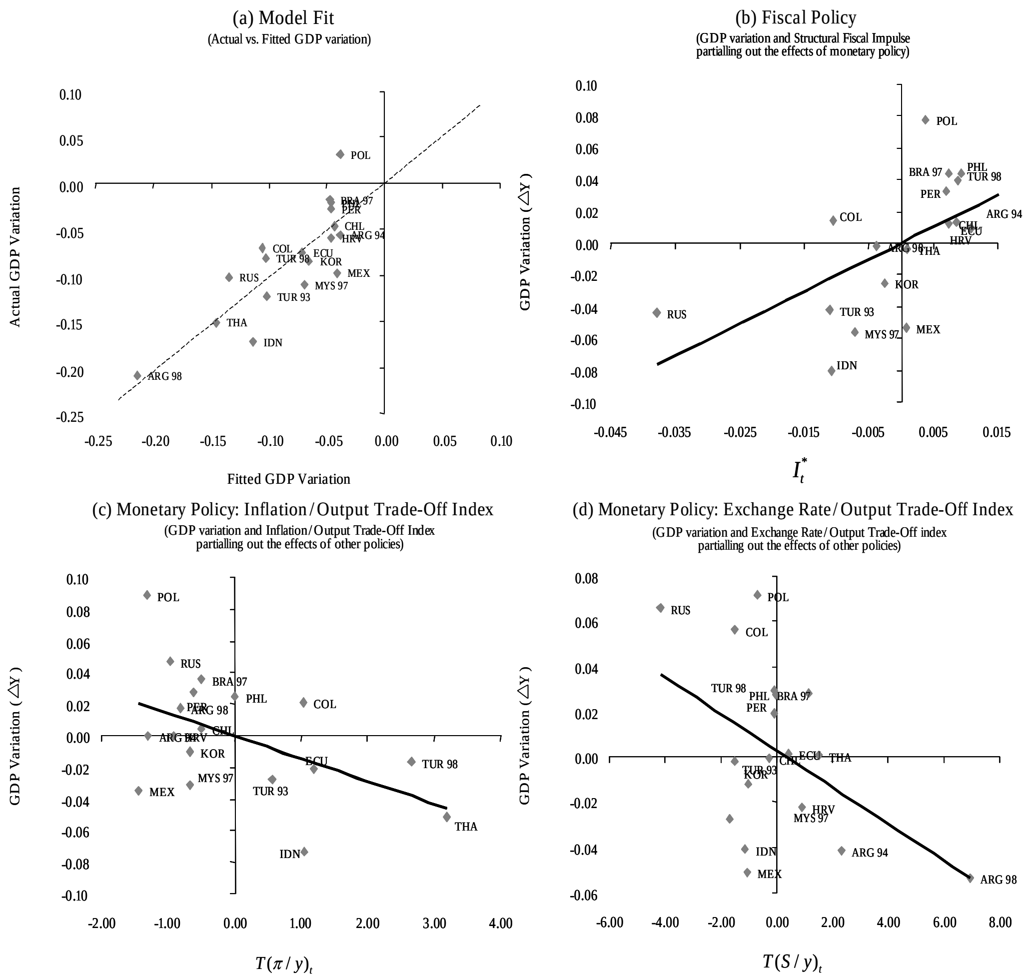
$$\Delta Y_t = -0.029 + 2.033 I_t^* - 0.014 T\left(\pi / Y\right) - 0.008 T\left(S / Y\right) + \varepsilon_t^{II} \qquad (16)$$

(2.887) *(-2.161)* *(-2.052)*

Model II confirms the results for fiscal policy obtained in Model I, the coefficient of the fiscal impulse is positive and significant at the five percent level. Furthermore, both Monetary policy indexes have a negative and significant coefficient, (at the five percent level for Inflation/Output Trade-Off index and at the ten percent level for the Exchange Rate/Output Trade-Off index), implying that tighter policies are associated with a larger output contraction. As illustrated in Figure 6a, the overall fit of the regression for Model II also does a pretty good job in explaining output contraction reflected in an adjusted R^2 of 0.60. Once again, we reject the hypothesis that the coefficients are jointly equal to zero at the 1 percent level. Finally Figure 6b, 6c, and 6d show the effects of fiscal policy and the two monetary policy indices when partialling out the effects of other policies.

[14] T-statistics between brackets. Regressions are presented in Appendix III. The results do not vary if $\left[\frac{\left[\frac{\psi_1}{\psi_1}\right]}{\left[\frac{\psi_2}{\psi_2}\right]}\right]$ and $\left[\frac{\left[\frac{\psi_3}{\psi_3}\right]}{\left[\frac{\psi_2}{\psi_2}\right]}\right]$ were the Inflation/Output Trade-Off index and the Exchange Rate/Output Trade-Off index, respectively .

Figure 6. Monetary, Fiscal Policy and Output Performance:
Model II Estimations



To summarize, although the presence of feedback effects (running from output to fiscal and monetary policy) cannot be completely ignored even when extracting the discretional components of fiscal and monetary policy, our evidence appears to run contrary to the conventional wisdom of the IMF during the crises of the 1990s. If tighter policies bite, financial assistance packages should be made readily available to countries with sound fundamentals facing a liquidity crunch due to systemic capital market turmoil, without any additional conditionality. Forcing these countries to tighten policies under these circumstances could be counterproductive. This is we believe the direction the IMF has been recently moving towards, through attempts to develop of new facilities such as the Reserve Augmentation Line (RAL), and this evidence suggests that is the right way to go.

5. Concluding Remarks

The 1997 Asian crisis stirred a lively debate on the appropriate monetary and fiscal policy response. The IMF view that monetary and fiscal policy should be unequivocally tightened to restore credibility was severely questioned. In fact, many critics have argued that the tightening stance sponsored by the IMF exacerbated the downturns and that the policies should have been exactly the opposite: to loosen monetary and fiscal policy, the standard recipe for countries facing severe contractionary pressures

This paper attempts to contribute to this debate by studying the fiscal and monetary policy response and their effects on output in a set of 18 external financial crisis episodes occurred since 1990, when the resumption of capital inflows to emerging economies acquired full force. These episodes took place during the three big external financial crises of this period, namely, the 1994 Tequila crisis, the 1997 Asian crisis and the 1998 Russian crisis.

Although our sample is too small to reach any definitive conclusions, it is nonetheless highly suggestive. We find evidence that countries that tightened monetary and fiscal policy during these crises, experienced larger output contractions than countries that followed a looser policy stance.

Does this evidence provide an endorsement for looser policies during an external financial crisis? We think that even if our results are taken as serious evidence that tighter policies do not necessarily lead to brighter outcomes, a note of caution is in order. The way we like to read the results of this paper is as follows: other things being equal, countries that were able or willing to loosen monetary and fiscal policy during the crisis fared better than those that did not. But, does this mean that countries that followed tighter policies would have done better had they followed a looser path? Not necessarily.

For example, there is ample evidence that countries with high levels of liability dollarization, do experience higher fear of floating and are thus more reluctant to let the exchange rate depreciate in a crisis, due to the adverse balance sheet effects.[15] These countries might resist the depreciation through higher interest rates and thus precipitate a more severe contraction relative to a country with no liability dollarization that can allow the exchange rate to depreciate. However, it is unclear that a country in such a situation would have done better by loosening monetary policy and letting the exchange depreciate. With a large degree of liability dollarization it could conceivably have done worse.

Or take another example. Countries that pursued expansionary fiscal policies during a cyclical upturn will be forced into highly procyclical adjustments (i.e., reductions in government spending or increase in tax rates) during the crisis period. Such a procyclical response will trigger a larger contraction relative to a country that pursued more prudent fiscal policies during the expansionary phase, and is now in a position to adopt a countercyclical fiscal policy. However, it is again unclear if a country in this situation would have done better by pursuing more expansionary fiscal policies during the crisis. Those policies could have conceivably casted doubts about the country's solvency, precipitating an even larger contraction.

In summary, the way we read the evidence presented in this paper is that having the flexibility to loosen monetary and fiscal policy during an external financial crisis is

[15] See for example Calvo and Reinhart (2002) and Hausmann, Panizza, and Stein (1999).

beneficial. But flexibility, in fiscal or exchange rate policy, cannot be used under any circumstances. On the contrary, stringent preconditions need to be met to allow the use of this flexibility. For fiscal policy it means sound intertemporal fiscal behavior and low debt levels, for monetary policy itself it means high levels of credibility that keep inflation expectations low in the face of an expansionary move, for exchange rate policy it means low levels of financial dollarization and trade openness. It is toward removing these fundamental obstacles, that preclude countries from using countercyclical monetary and fiscal policy in times of external financial crisis, that policy makers efforts should be aimed at. What this paper shows is that having the flexibility to implement expansionary fiscal and monetary policies during a SSS pays handsomely in terms of smaller recessions and lower volatility of output.

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6. Appendix I. Estimating Fiscal Policy

The Hodrick Prescott (HP) filter chooses the sequence of μ_t that minimizes

$$\sum_{t=1}^{T}\left(y_t-\mu_t\right)^2+\lambda\sum_{t=2}^{T}\left[\left(\mu_{t+1}-\mu_t\right)-\left(\mu_t-\mu_{t-1}\right)\right]^2$$

which implies that if $\lambda=0, \mu_t=y_t$ and if $\lambda\to\infty$, then μ_t approaches to a linear trend.

Let $r_t^{*CHL}\left(\lambda_i,n,T\right)$ denote Chile's fiscal income in percent of GDP adjusted with $\lambda=\lambda_i$ for the period between $T-n$ and T.[16] Define the corresponding structural fiscal balance for the period t, $sb_t^{CHL}\left(\lambda_i,n,T\right)$ as

$$sb_t^{CHL}\left(\lambda_i,n,T\right)=r_t^{*CHL}\left(\lambda_i,n,T\right)-g_t \tag{17}$$

where g_t^i are total public expenditures in percent of GDP. Let $sb_t^{CHL,OBS}$ be the observed structural fiscal balance in period t as reported by the Chilean authorities. Define the error $DC\left(\lambda_i,n,T\right)$ as the quadratic difference between and the fiscal balance computed with this smoothing rule and the observed structural fiscal balance such that

$$DC\left(\lambda_i,n,T\right)=\sum_{t=m}^{p}\left(sb_t^{CHL}\left(\lambda_i,n,T\right)-sb_t^{CHL,OBS}\right)^2 \tag{18}$$

The values of λ, n and T that minimize this difference are the ones used to estimate structural fiscal revenues and structural fiscal balance for all the countries in the sample.

[16] The HP filter is applied to the logarithm of real revenues.

7. Appendix II. Estimating Monetary Policy

7.1 A Simple Structural Open Economy Model

The description of the small open economy model follows Gali and Monacelli (2005) and it is mainly presented to make the paper self-contained. The model economy incorporates the basic microfundations standard in the New Keynesian framework. The model is presented in detail first and then the economy is reduced to the system of 5 equations used for estimation consisting on: (i) a forward-looking open economy IS-equation, (ii) an open economy Phillips curve, (iii) monetary policy described by an interest rate rule, (iv) an equilibrium condition describing the evolution of the nominal exchange rate[17], and (v) an equilibrium relation describing the evolution of the terms of trade.

7.1.1 Households

A representative household chooses a sequence of consumption, C_t, and labor, N_t, to maximize expected lifetime utility

$$E_0 \sum_{t=0}^{\infty} \beta^t U\left(C_t, N_t\right) \tag{19}$$

where $\beta \in \left(0,1\right)$ is the discount factor. Consumption is divided between domestic goods, $C_{H,t}$, and foreign goods, $C_{F,t}$, according to

$$C_t = \left[\left(1-\alpha\right)^{\frac{1}{\eta}} \left(C_{H,t}\right)^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} \left(C_{F,t}\right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{20}$$

where $\left(1-\alpha\right) \in \left[0,1\right]$ is associated to the degree of home bias in preferences, while $\eta > 0$ measures the substitutability between domestic and foreign goods.

Household resources are composed of a portfolio of bonds holdings, D_t, labor income with nominal wage, W_t, and lump-sum transfers, T_t. These resources are divided between one-period discount bonds with unit price $E_t\left\{\phi_{t,t+1}\right\}$ and domestic and foreign goods with prices $P_{H,t}$ and $P_{F,t}$, respectively. Therefore, each period's maximization problem (15) is subject to the sequence of budget constraints

$$P_{H,t}C_{H,t} + P_{F,t}C_{F,t} + E_t\left\{\phi_{t,t+1}D_{t+1}\right\} \le D_t + W_tN_t + T_t \tag{21}$$

[17] In the description below the exchange rate is introduced via the definition of the consumer price index (CPI) under the assumption of purchasing power parity (PPP). An alternative would be to use the uncovered interest parity condition (UIP).

Optimal allocation of expenditures between domestic and imported goods is given by

$$C_{H,t} = (1-\alpha)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C_t \quad , \quad C_{F,t} = \alpha\left(\frac{P_{F,t}}{P_t}\right)^{-\eta} C_t \tag{22}$$

where $P_t = \left[(1-\alpha)\left(P_{H,t}\right)^{1-\eta} + \alpha\left(P_{F,t}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}}$ is the consumer price index (CPI). Total consumption expenditure by domestic households is given by $P_t C_t = P_{H,t} C_{H,t} + P_{F,t} C_{F,t}$.

Following Gali and Monacelli, we specialize the period utility function to take the form

$$U(C,N) = \frac{C^{1-\sigma}}{1-\sigma} - \frac{N^{1+\varphi}}{1+\varphi}$$

where $\tau \equiv \frac{1}{\sigma} > 0$ represents the intertemporal elasticity of substitution in consumption and $\frac{1}{\varphi} > 0$ is elasticity of labor supply with respect to real wages. Then household's labor, consumption and bond holdings optimality conditions imply

$$C_t^{\sigma} N_t^{\varphi} = \frac{W_t}{P_t} \tag{23}$$

and

$$\beta\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\left(\frac{P_t}{P_{t+1}}\right) = \phi_{t,t+1} \tag{24}$$

Taking conditional expectations on both sides of (17) and rearranging we get the Euler condition

$$\beta R_t E_t\left\{\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\left(\frac{P_t}{P_{t+1}}\right)\right\} = 1 \tag{25}$$

where $R_t = \dfrac{1}{E_t\left\{\phi_{t,t+1}\right\}}$ is the gross return on the riskless one-period discount bond, with price $E_t\left\{\phi_{t,t+1}\right\}$, paying off one unit of domestic currency in $t+1$.

Under the assumption of complete securities markets, a first-order condition analogous to (20) must also hold for the representative household in any country.

7.1.2 Firms

The small open economy is inhabited by a continuum of monopolistic competitive firms indexed by $j \in [0,1]$ that operate a CRS technology $Y_{H,t}(j) = Z_t N_t(j)$, where Z is a total factor productivity shifter following the AR(1) process (in logs) $z_t = \rho_z z_{t-1} + \varepsilon_t$. The nominal marginal cost is given by $MC_t^n = \frac{W_t}{Z_t}$, while the real marginal cost is given by $MC_t = \frac{W_t}{P_{H,t} Z_t}$.

To introduce nominal rigidities assume that firms face an à la Calvo (1983) price stickiness with a probability θ of not being able to adjust its price in any given period. Let $\overline{P}_{H,t}(j)$ denote the price set by firm j adjusting its price in time t. When setting a new price in period t firm j seeks to maximize expected profits taking into account that this price will remain unchanged for k periods with probability θ^k, and taking as given the household discount factor $\phi_{t,t+k}$. In a symmetric equilibrium all firms adjusting its price in any given period make the same decision, so we can drop the j subscript. The firm's problem is

$$\max_{\overline{P}_{H,t}} \sum_{k=0}^{\infty} \theta^k E_t \left\{ \phi_{t,t+k} \left[\left(\overline{P}_{H,t} - MC_{t+k}^n \right) Y_{t+k} \right] \right\}$$

subject to the sequence of demand constraints

$$Y_{t+k} \leq \left(\frac{\overline{P}_{H,t}}{P_{H,t+k}} \right)^{-\varepsilon} \left[C_{H,t+k} + C_{H,t+k}^* \right] \equiv Y_{t+k}^d \left(\overline{P}_{H,t} \right)$$

Thus, $\overline{P}_{H,t}$, must satisfy the first order condition

$$\sum_{k=0}^{\infty} \theta^k E_t \left\{ \phi_{t,t+k} \left[\left(\overline{P}_{H,t} - \frac{\varepsilon}{\varepsilon - 1} MC_{t+k}^n \right) Y_{t+k} \right] \right\} = 0 \qquad (26)$$

Using (17) that implies $\phi_{t,t+k} = \beta^k \left(\frac{C_{t+k}}{C_t} \right)^{-\sigma} \left(\frac{P_t}{P_{t+k}} \right)$, we can rewrite the previous condition as

$$\sum_{k=0}^{\infty} (\beta\theta)^k E_t \left\{ (C_{t+k})^{-\sigma} \frac{1}{P_{t+k}} \left[\left(\overline{P}_{H,t} - \frac{\varepsilon}{\varepsilon - 1} MC_{t+k}^n \right) Y_{t+k} \right] \right\} = 0$$

or, in terms of stationary variables,

$$\sum_{k=0}^{\infty}(\beta\theta)^k E_t\left\{(C_{t+k})^{-\sigma}\left(\frac{P_{H,t-1}}{P_{t+k}}\right)\left[\left(\frac{\overline{P}_{H,t}}{P_{H,t-1}}-\frac{\varepsilon}{\varepsilon-1}\Pi^H_{t-1,t+k}MC_{t+k}\right)Y_{t+k}\right]\right\}=0 \quad (27)$$

where $\Pi^H_{t-1,t+k}=\frac{P_{H,t+k}}{P_{H,t-1}}$, and $MC_{t+k}=\frac{MC^n_{t+k}}{P_{H,t+k}}$. Under the assumed price-setting structure, the dynamic of the domestic price index is described by

$$P_{H,t}=\left[\theta\left(P_{H,t-1}\right)^{1-\varepsilon}+(1-\theta)\left(\overline{P}_{H,t}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \quad (28)$$

Combining equations (28) and (27) yields an expression for gross inflation rate for domestically produced goods:

$$\pi_{H,t}=\frac{P_{H,t}}{P_{H,t-1}}=\left(\frac{\varepsilon}{\varepsilon-1}\frac{MC^n_t}{P_{H,t}}\right)^{\frac{(1-\theta)(1-\beta\theta)}{\theta}} E_t\left\{\frac{P_{H,t+1}}{P_{H,t}}\right\}^{\beta} \quad (29)$$

Equation (29) is the optimization-based Phillips curve arising from this environment of time-dependent staggered price setting.

CPI inflation is a composite of domestic and foreign good price inflation. Within a local region of the steady state, CPI inflation, π_t, may be expressed as

$$\pi_t=\frac{P_t}{P_{t-1}}=\left(\frac{P_{H,t}}{P_{H,t-1}}\right)^{(1-\alpha)}\left(\frac{P_{F,t}}{P_{F,t-1}}\right)^{\alpha} \quad (30)$$

7.1.3 Inflation, terms of trade and exchange rate

Inversely to Gali and Monacelli, we define the effective terms of trade as the relative price of exports in terms of imports $Q_t\equiv\frac{P_{H,t}}{P_{F,t}}$. Replacing this in (26) domestic inflation, and CPI inflation are related by

$$\pi_t=\pi_{H,t}\left(\frac{Q_t}{Q_{t-1}}\right)^{-\alpha} \quad (31)$$

Assume that the law of one price holds at all times both for import and export prices, which implies that

$$P_{F,t}=S_tP^*_t$$

where S_t is the nominal effective exchange rate and P_t^* is the world price index.

Combining the previous result with the definition of the terms of trade yields

$$Q_t = \frac{P_{H,t}}{S_t P_t^*} \tag{32}$$

Real exchange rate $RER_t = \frac{P_t}{S_t P_t^*}$ is related to terms of trade by

$$RER_t = \frac{\left(P_{H,t}\right)^{(1-\alpha)} \left(P_{F,t}\right)^{\alpha}}{S_t P_t^*} = \left(\frac{P_{H,t}}{P_{F,t}}\right)^{(1-\alpha)} = Q_t^{(1-\alpha)}$$

Finally, by replacing $P_{H,t}$ from (28) into equation (31) we can get an expression relating CPI inflation with foreign inflation, terms of trade changes and exchange rate changes.

$$\pi_t = \left(\frac{S_t}{S_{t-1}}\right)\left(\frac{Q_t}{Q_{t-1}}\right)^{1-\alpha} \pi_t^* \tag{33}$$

where $\pi_t^* = \frac{P_t^*}{P_{t-1}^*}$ is world inflation.

7.1.4 Monetary policy

Monetary policy is described by an interest rate rule of the form

$$R_t = R_{t-1}^{\rho_R} \left[r\hat{\pi} \left(\frac{\pi_t}{\hat{\pi}}\right)^{\psi_1} \left(\frac{Y_t}{\hat{Y}}\right)^{\psi_2} \left(\frac{\frac{S_t}{S_{t-1}}}{\left(\frac{\hat{S}}{S_{-1}}\right)} \right)^{\psi_3} \right]^{(1-\rho_R)} e^{\varepsilon_{R,t}} \tag{34}$$

where r is the steady-state real interest rate, $\hat{\pi}$ is the target inflation rate, which in equilibrium coincides with the steady-state inflation rate, $\hat{Y}$ is the steady-state output level, $\left(\frac{\hat{S}}{S_{-1}}\right) = 1$ is the steady-state depreciation, ρ_R captures the partial adjustment of the interest rate to target, while ψ_1, ψ_2, and ψ_3 captures the monetary authority's reaction to inflation, output and exchange rate fluctuations.

7.1.5 Equilibrium

World's goods market clearing condition requires that world consumption represented by the index C_t^* is equal to the world output index Y_t^*

$$C_t^* = Y_t^* \tag{35}$$

Domestic goods market clearing requires that domestic production meets domestic demand and exports $C_{H,t}^*$

$$C_{H,t} + C_{H,t}^* = Y_t \tag{36}$$

Domestic economy asset accumulation follows

$$E_t\left\{\phi_{t,t+1}D_{t+1}\right\} - D_t = Y_t - C_{H,t} - \frac{S_t P_t^*}{P_t} C_{F,t} + C_{H,t}^* \tag{37}$$

Finally, bonds market clearing requires that there is no excess demand for bonds

$$D_t + D_t^* = 0 \tag{38}$$

7.1.6 Log-linearization and simplification

The model economy described above can be simplified and log-linearize to yield the system of 5 equations described in the text and that is the basis for estimation. All small letters denote log-deviations from steady-state.

Using the log-linear terms of trade evolution condition

$$\left[\tau + \alpha(2-\alpha)(1-\tau)\right] q_t = y_t^* - y_t \tag{39}$$

and the goods markets clearing conditions (31) and (32) into the Euler equation (25) we get the open economy IS-curve (7). The open economy Phillips curve (8) is obtained by using the CPI inflation condition (27), and the equilibrium real marginal cost into the Phillips curve (25), and log-linearizing. The log-linear version of the interest rate rule (34) is given by (9). In order to study exchange rate policies we log-linearize equation (33) to obtain (10).

Even when the above conditions make use of the equilibrium condition for the terms of trade (39), estimation of the fully structural model turns out to be problematic because the model is very restricted. Therefore a law of motion for their growth rate as in (11) is used.

7.2 Estimation Strategy and Empirical Implementation

7.2.1 Bayesian estimation of the DSGE model

As noted by Lubik and Schorfheide (2007) the monetary policy rule cannot be consistently estimated by ordinary least squares because the regressors are endogenous, that is, $E_t\left\{\varepsilon_{R,t}\middle|\pi_t, y_t, \Delta s_t\right\}\neq 0$. System based methods correct for the endogeneity by adjusting the non-zero conditional expectation of the monetary policy shock. The monetary policy rule is implicitly replaced by the following equation:

$$R_t = E_t\left\{\varepsilon_{R,t}\middle|\pi_t, y_t, \Delta s_t\right\} + \rho_R R_{t-1} + (1-\rho_R)\left[\psi_1\pi_t + \psi_2 y_t + \psi_3\Delta s_t\right] + \left(\varepsilon_{R,t} - E_t\left\{\varepsilon_{R,t}\middle|\pi_t, y_t, \Delta s_t\right\}\right) \tag{36}$$

The likelihood function associated with the DSGE model discussed above is used to generate the correction term $E_t\left\{\varepsilon_{R,t}\middle|\pi_t, y_t, \Delta s_t\right\}$. Potential efficiency gains are exploited by imposing all the rational expectations cross-coefficient restrictions.

The DSGE model presented above is estimated using Bayesian methods[18]. The object of interest is the vector of parameters

$$\theta = \left\{\psi_1, \psi_2, \psi_3, \rho_R, \alpha, \beta, \kappa, \tau, \rho_q, \rho_z, \rho_{y^*}, \rho_{\pi^*}, \sigma_R, \sigma_q, \sigma_z, \sigma_{y^*}, \sigma_{\pi^*}\right\}$$

Given a prior $p(\theta)$, the posterior density of the model parameters, θ, is given by

$$p\left(\theta\middle|Y^T\right) = \frac{L\left(\theta\middle|Y^T\right)p(\theta)}{\int L\left(\theta\middle|Y^T\right)p(\theta)d\theta}$$

where $L\left(\theta\middle|Y^T\right)$ is the likelihood conditional on observed data $Y^T = \{Y_1, \ldots, Y_T\}$. In our case $Y_t = \left[\Delta y_t + z_t, 4\pi_t 4R_t, \Delta s_t, \Delta q_t\right]'$.

The likelihood function is computed under the assumption of normally distributed disturbances by combining the state-space representation implied by the solution of the linear rational expectations model and the Kalman filter. Posterior draws are obtained using Markov Chain Monte Carlo methods. After obtaining an approximation to the mode of the posterior, a Random Walk Metropolis algorithm is used to generate posterior draws. Point

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18 A detailed description of the methods is found in An and Schorfheide (2007). Textbook treatments are available in Canova (2007) and Dejong and Dave (2007).

estimates and measures of uncertainty for θ are obtained from the generated values. In the graphs we have reported the mean and the 90% confidence interval.

Once we have this, inferential exercises are straightforward for example, by studying the propagation and relative importance of structural shocks through impulse response functions and variance decompositions.

7.2.2 Data

The model is estimated using quarterly data on real output growth, inflation, nominal interest rates, exchange rates changes, and terms of trade or real exchange rate changes. Data availability varies across countries and it comes from the IMF's International Financial Statistics and countries' central banks and statistical agencies. Data details are provided in the table below. Output growth rates are computed as natural logarithm (ln) differences of the seasonal adjusted real gross domestic product. Inflation rates are ln differences of the seasonal adjusted consumer price indices, multiplied by 4 to annualize. Nominal interest rates are reported in levels and correspond to the best available proxy for each country's monetary policy instrument. Exchange rates changes are ln differences of domestic currency per US dollar except for Poland and Croatia where we use the DM or Euro. Terms of trade, defined as the relative price of exports in terms of imports, are reported in changes by using the ln differences. When terms of trade data is not available, we use real exchange rate defined as the ratio of domestic price level to foreign prices.

Table 3. Data Sources and Initial Date

Country	GDP	CPI	R	S	TOT	RER	Initial Date
Argentina	SA	IFS	IFS	IFS	M		1990:Q2
Brazil	CB	IFS	CB	IFS	SA		1994:Q4
Chile	CB	IFS	CB	IFS	CB		1989:Q2
Colombia	CB	IFS	IFS	IFS	CB		1994:Q2
Croatia	IFS	IFS	IFS	IFS		IFS	1994:Q3
Ecuador	CB	IFS	IFS	IFS	CB, OC(1)		1990:Q2
Indonesia	JPM	IFS	IFS	IFS		BIS	1994:Q2
Korea	IFS	IFS	IFS	IFS	IFS		1987:Q4
Malaysia	IFS	IFS	IFS	IFS		IFS	1989:Q1
Mexico	CB	IFS	IFS	IFS	CB		1985:Q1
Peru	CB	IFS	IFS	IFS	CB		1995:Q1
Phillipines	IFS	IFS	IFS	IFS		IFS	1988:Q1
Poland	IFS	IFS	IFS	IFS	IFS		1995:Q2
Russia	SA	IFS	IFS	IFS		IFS	1995:Q2
Thailand	IFS	IFS	IFS	IFS	IFS		1993:Q2
Turkey	IFS	IFS	IFS	IFS	IFS		1989:Q2

(1) Based on WTO and IFS, Period 1990-1994

BIS = Bank of International Settelments; CB = Central Bank; IFS = International Financial Statistics; JPM = JP Morgan; M = Ministries; OC = Own calculations; SA = Statistical Agency; WTO = World Trade Organization

7.2.3 Choice of prior

The table below shows the priors for structural parameters used in estimations. For each parameter we report the mean, standard deviation and distribution. We present Lubik and Schorfheide's loose priors for Canada as a basis for comparison and highlight differences with shaded cells. Prior distributions are assumed to be independent. Given the possibility of non-existence or multiplicity of equilibriums, the joint prior distribution used for estimation is truncated at the boundary of determinacy region and prior assigns 5% probability to indeterminacy.

In general, we used loose priors for monetary policy parameters with means near those usually associated with Taylor rules, but with large variance to allow for a wide range of monetary policy regimes. Specifically, in the estimations if $\psi_1 \to \infty$ the Central Bank follows strict inflation targeting, while $\psi_3 \to \infty$ represents a fixed exchange rate regime, and ψ_1 finite and $\psi_3 > 0$ would suggest a managed floating. The priors for the degree of openness, α, were selected based on import shares. Calculations of the ex-post real interest rates and measures of the marginal product of capital as calculated by Casselli and Feyrer (2007) were used in setting the prior for the steady state real interest rate, r. For the rest of the parameters, in general, we kept the priors reported for Canada unless the calculations to set priors suggested that the processes were markedly different.

Table 4. Priors by Country

Loose Priors Lubik and Schorfheide (2007) for Canada

Symbol	Mean	Std. Dev.	Density	Description
ψ_1	1.50	0.60	Gamma	Taylor rule coefficient on inflation
ψ_2	0.75	0.30	Gamma	Taylor rule coefficient on output
ψ_3	0.75	0.30	Gamma	Taylor rule coefficient on currency depreciation
ρ_R	0.00	1.00	Uniform	degree of interest rate smoothing
α	0.20	0.05	Beta	import share
r	2.50	1.00	Gamma	real interest rate
κ	0.50	0.25	Gamma	structural parameter, slope of Phillips curve
τ	0.50	0.20	Beta	elasticity of inter-temporal substitution
ρ_q	0.40	0.20	Beta	AR coefficient of the terms of trade / real exchange rate
ρ_z	0.20	0.05	Beta	AR coefficient of the world technology
ρ_{y^*}	0.90	0.05	Beta	AR coefficient of the world output
ρ_{π^*}	0.80	0.10	Beta	AR coefficient of the world inflation
σ_R	0.50	4.00	InvGamma	standard deviation of nominal interest rate innovation
σ_q	1.50	4.00	InvGamma	standard deviation of terms of trade / real exchange rate innovation
σ_z	1.00	4.00	InvGamma	standard deviation of the world technology innovation
σ_{y^*}	1.50	4.00	InvGamma	standard deviation of the world output innovation
σ_{π^*}	0.55	4.00	InvGamma	standard deviation of the world inflation innovation

Argentina

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	1.00*	1.00*	Gamma
ρ_R	0.00	1.00	Uniform
α	0.10*	0.05	Beta
r	5.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Brazil**

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.50*	Gamma
ψ_2	0.25*	0.13*	Gamma
ψ_3	0.25*	0.13*	Gamma
ρ_R	0.50*	0.20*	Beta*
α	0.10*	0.05	Beta
r	5.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Chile**

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.50*	Gamma
ψ_2	0.25*	0.13*	Gamma
ψ_3	0.25*	0.13*	Gamma
ρ_R	0.50*	0.20*	Beta*
α	0.30*	0.05	Beta
r	4.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.20*	0.11*	Beta
ρ_z	0.22*	0.11*	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.70*	0.11*	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Colombia**

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.50*	Gamma
ψ_2	0.25*	0.13*	Gamma
ψ_3	0.25*	0.13*	Gamma
ρ_R	0.50*	0.20*	Beta
α	0.15*	0.05	Beta
r	4.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

*Values different from Lubik and Schorfheide's loose priors for Canada
**Estimated using tighter monetary policy priors in line with Lubik and Schorfheide benchmark values

Table 4. Priors by Country (Cont.)

Croatia

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.30*	0.05	Beta
r	3.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
$\rho_{rer}^{(*)}$	0.20	0.10	Beta
ρ_z	0.20	0.10	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
$\sigma_{rer}^{(*)}$	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Ecuador**

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.50*	Gamma
ψ_2	0.25*	0.13*	Gamma
ψ_3	0.25*	0.13*	Gamma
ρ_R	0.50*	0.20*	Beta*
α	0.35*	0.07*	Beta
r	10.00*	4.00*	Gamma
κ	1.00*	0.40*	Gamma
τ	0.50	0.20	Beta
ρ_q	0.40	0.20	Beta
ρ_z	0.50*	0.06*	Beta
ρ_{y^*}	0.90	0.08*	Beta
ρ_{π^*}	0.80	0.20*	Beta
σ_R	3.50*	4.00	InvGamma
σ_q	5.00*	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	5.00*	4.00	InvGamma

Indonesia

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.22*	0.05	Beta
r	3.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
$\rho_{rer}^{(*)}$	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
$\sigma_{rer}^{(*)}$	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Korea

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.30*	0.05	Beta
r	4.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Malaysia

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.20	0.05	Beta
r	2.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
$\rho_{rer}^{(*)}$	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
$\sigma_{rer}^{(*)}$	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Mexico

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.24*	0.05	Beta
r	5.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.20*	0.10*	Beta
ρ_z	0.20	0.10*	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Table 4. Priors by Country (Cont.)

Peru

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.18*	0.05	Beta
r	5.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.30*	0.15*	Beta
ρ_z	0.40*	0.10*	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Phillipines

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.50*	Gamma
ψ_3	0.75	0.50*	Gamma
ρ_R	0.00	1.00	Uniform
α	0.30*	0.10*	Beta
r	4.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
$\rho_{rer}^{(*)}$	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
$\sigma_{rer}^{(*)}$	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Poland

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.29*	0.05	Beta
r	5.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.20	0.10	Beta
ρ_z	0.20	0.10	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Russia

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.20	0.05	Beta
r	5.00*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
$\rho_{rer}^{(*)}$	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
$\sigma_{rer}^{(*)}$	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Thailand

Symbol	Mean	Std. Dev.	Density
ψ_1	1.50	0.60	Gamma
ψ_2	0.75	0.30	Gamma
ψ_3	0.75	0.30	Gamma
ρ_R	0.00	1.00	Uniform
α	0.48*	0.10*	Beta
r	3.50*	1.00	Gamma
κ	0.50	0.25	Gamma
τ	0.50	0.20	Beta
ρ_q	0.40	0.20	Beta
ρ_z	0.20	0.05	Beta
ρ_{y^*}	0.90	0.05	Beta
ρ_{π^*}	0.80	0.10	Beta
σ_R	0.50	4.00	InvGamma
σ_q	1.50	4.00	InvGamma
σ_z	1.00	4.00	InvGamma
σ_{y^*}	1.50	4.00	InvGamma
σ_{π^*}	0.55	4.00	InvGamma

Turkey

Symbol	Mean	Std. Dev.	Density
ψ_1	2.00*	1.50*	Gamma
ψ_2	0.25*	0.20*	Gamma
ψ_3	0.33*	0.30*	Gamma
ρ_R	0.50*	0.20*	Beta*
α	0.20	0.05	Beta
r	3.20*	3.00*	Gamma
κ	5.00*	0.60*	Gamma
τ	0.50	0.20	Beta
$\rho_{rer}^{(*)}$	0.40	0.20	Beta
ρ_z	0.40*	0.09*	Beta
ρ_{y^*}	0.90	0.09*	Beta
ρ_{π^*}	0.80	0.20*	Beta
σ_R	9.00*	4.00	InvGamma
$\sigma_{rer}^{(*)}$	4.50*	4.00	InvGamma
σ_z	3.20*	4.00	InvGamma
σ_{y^*}	2.00*	4.00	InvGamma
σ_{π^*}	9.00*	4.00	InvGamma

8. Appendix III. Fiscal Policy, Monetary Policy and Output: Regression Results

Table 5 and 6 presents the results of the regressions between output performance and our measures of monetary and fiscal policy:

Table 5. Model I Estimation Results

Dependent Variable: ΔY
Method: Least Squares
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.035	0.012	-2.830	0.013
I_t^*	1.876	0.672	2.793	0.014
MR_t	-0.010	0.003	-2.779	0.014
R-squared	0.658	Mean dependent var		-0.082
Adjusted R-squared	0.612	S.D. dependent var		0.059
S.E. of regression	0.036	Akaike info criterion		-3.632
Sum squared resid	0.020	Schwarz criterion		-3.484
Log likelihood	35.692	F-statistic		14.431
Durbin-Watson stat	1.172	Prob(F-statistic)		0.000

Table 6. Model II Estimation Results

Dependent Variable: ΔY
Method: Least Squares
Included observations: 18

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.029	0.015	-1.967	0.069
I_t^*	2.033	0.704	2.887	0.012
$T(\pi / Y)_t$	-0.014	0.007	-2.161	0.049
$T(XR / Y)_t$	-0.008	0.004	-2.052	0.059
R-squared	0.674	Mean dependent var		-0.082
Adjusted R-squared	0.604	S.D. dependent var		0.059
S.E. of regression	0.037	Akaike info criterion		-3.570
Sum squared resid	0.019	Schwarz criterion		-3.372
Log likelihood	36.129	F-statistic		9.658
Durbin-Watson stat	1.229	Prob(F-statistic)		0.001

where ΔY is output peak to trough variation; I_t^* is the structural fiscal impulse; $T(\pi, S/Y)_t$ is the Monetary Policy Regime index; $T(\pi / Y)_t$ is the Inflation/Output Trade-Off index and $T(S/Y)_t$; is the Exchange Rate/Output Trade-Off index.