Inflation Targeting, Sudden Stops, and the Cost of Fear of Floating[1]

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Abstract

Sudden stops seem to create the perfect environment for disinflation, especially when central banks defend the exchange rate by increasing interest rates. We propose a variation of the output gap model that incorporates the sudden stop shock. The use of the model in policy analysis shows that fear of floating is pro-cyclical and inflation targeting, counter-cyclical. The model is run for Brazil, Colombia, Korea and Thailand, the inflation targeting countries that have recently had sudden stops. The three policy implications direct attention to the medium and long run. First, the central banks that are targeting inflation should focus on inflation, not during but after the sudden stop. Second, they could complement this medium term view by monitoring a measure of inflation of non traded goods. Third, the monetary authorities could eventually introduce an escape clause to the CPI inflation target under a sharp depreciation.

JEL classification: E3; E58; F3; F41; F42; F47

Contents

I.   Introduction

An increasing number of central banks have made a commitment to maintaining inflation on target. Yet, sudden stops cause large depreciations, which are sizable enough to leave central banks unable to fulfill the commitment. After available international reserves have been spent, central banks face a dilemma: whether or not to increase interest rates. If they increase interest rates, there is a smaller pass-through to inflation but monetary policy is pro-cyclical. If they do not, the pass-through is bigger and monetary policy is not pro-cyclical.

The paper attempts to address the following questions: during a sudden stop, what are the consequences of central bank policy on inflation and output? During a crisis in the capital account of the balance of payments, can a central bank that targets inflation move interest rates counter-cyclically?

We have three objectives in this paper. The first one, to show that policy need not be pro-cyclical if policymakers look beyond the short run. The second one, to state another stylized fact about sudden stops: the behavior of inflation. The third objective is to develop the output gap model that is popular among central banks. We develop the output gap model by incorporating a sudden stop shock, by exploiting the model in policy analysis under a sudden stop, and by using it to rationalize the recent crisis in emerging markets.

Whether a central bank can move interest rates counter-cyclically under a sudden stop is the same question faced by Caballero and Krishnamurthy (2003). In their paper, if I may be permitted an oversimplification, under inflation targeting, the central bank allows the exchange rate to float freely; this decreases the demand for imported investment, which in turn decreases the interest rate. Under fear of floating, the central bank stabilizes the exchange rate. A stable exchange rate increases both the demand for imported investment and the interest rate. They conclude that, inflation targeting is counter-cyclical and fear of floating, pro-cyclical.

Based on different theory, we also obtain the same conclusion, -that inflation targeting is counter-cyclical and fear of floating, pro-cyclical. Inflation targeting is counter-cyclical because in the medium term the sudden stop creates the forces which decrease inflation. If central bank policy looks beyond the short term, the central bank is able to decrease interest rates. In our model fear of floating is pro-cyclical because, as the central bank tightens the stance of monetary policy, it

emphasizes the recessive effect of the increase in bond spreads.

Calvo and Reinhart (2000) show that many floating regimes are floating in name only. In reality, countries move interest rates and international reserves to stabilize the exchange rate. [3] The scope of this paper includes the role of interest rate policy in stabilizing the exchange rate. It does not include other policies available for dealing with a sudden stop such as the management of international reserves, the increase in foreign credit, the development of the local derivatives and securities markets, and foreign liability management operations.

The structure of the paper is as follows: In the second section, the stylized facts of sudden stops are dealt with, especially in regards to the behavior of inflation and to the stance of monetary policy. In sections three to six, the two models that were used are spelled out: the output gap model, and the model for estimating the output gap. In these sections I explain what I mean, in the output gap model, by sudden stop, inflation targeting and fear of floating. In section seven, the central section, a sudden stop is simulated under both inflation targeting and fear of floating and, from this, some of the central conclusions of the paper are obtained. In the

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[3] Goldstein (2002) defends the use of international reserves during a sudden stop under the name of managed floating plus. Allen et. al. (2003), in turn, explain central bank intervention on the grounds that it enables the public sector to insure the balance sheet of the private sector.

last two sections, the policy implications are dealt with, and some conclusions are drawn.

II. Another Stylized Fact: the Behavior of Inflation

A sudden stop is a decrease in capital inflow, with repercussions on higher exchange rates, lower output, disorderly increases in net exports, reserves looses, and increases in bond spreads and interest rates. Calvo (1998), Calvo and Reinhart (1999), Gosh et. al. (2002) and Lahiri and Végh (2002) have shown some of the stylized facts of sudden stops. More recently, Calvo, Izquierdo and Mejía (2003) have shown other empirical facts about sudden stops such as their association with large depreciations specifically in the case of emerging markets, and their tendency "to come in bunches (of countries)."

The 1997-1998 crisis in Asia and the 1998-1999 crisis in Latin America were characterized not only by a decrease in capital inflows, but also by bank runs and by collapses in bank lending, and in real estate prices. These crises were more complex than the mere fall in capital inflow.[4]

In contrast, in June and July 2002 the fall in capital inflows in Brazil and Colombia did not seem to have their origin in financial excesses but in an exogenous event, the increase in the high yield spread in the US. Whatever the variety of

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[4] In the language of Kaminsky (2003), these were "crisis of financial excesses."

currency crisis, whether it is a mere sudden stop in capital inflow or a complex financial crisis, bond spreads seem to have increased in all cases (Figure 1).

What in Kaminsky's terms are "currency crises" are called here the sudden stops of 1997-1999 and 2002 and are captured in the model by an increase in bond spreads. As Figure 1 makes clear, bond spreads increased in the four countries under study in 1997-1999 and in Brazil and Colombia in 2002.

Different studies of sudden stops and currency crises have described the behavior of the exchange rate, output, net exports and other variables. Nothing has been said so far about the primary goal variable of inflation targeting central banks. It is one of our main findings that a sudden stop leads to a sharp, short term increase in inflation due to pass-through and a to smaller but permanent decrease in inflation after a recession. We show the stylized facts of inflation in Figures 2 and 3. This paper will frame this behavior of inflation into the output gap model.

In regards to the behavior of other variables, a sudden stop implies a decrease in the output gap and an increase in net exports. Figures 2, 3 and 4 show the effect of the sudden stop on net exports and on the output gap in Brazil, Colombia, Korea and Thailand.[5]

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[5] Incidentally, a little algebraic work with macroeconomic identities would show that a decrease in the output gap and an increase in net exports imply a sharp decrease in demand or absorption.

What about monetary policy? Recall the fact that Brazil and
Colombia defended somewhat flexible crawling bands in 1998 and
operated under inflation targeting in 2002. During the 1998-
1999 crisis, and using interest rates as an indicator of
monetary policy, Figure 4 indicates that the central banks in
Brazil and Colombia increased interest rates sharply; this
stance is pro-cyclical.

In 2002 Colombia did not increase interest rates; Brazil,
however, did it.[6] The reason for the increase in interest rates
in Brazil must have been not the defense of the exchange rate
but the targeting of inflation: ''The members of the Copom
emphasized that, in spite of the relevance of recent exchange
rate depreciation to the rise in inflation expectations,
monetary policy continues to be calibrated exclusively to
maintain inflation in a trajectory within the targeted range;
therefore, monetary policy does not aim at targeting the
exchange rate level.'' (Minutes of the Copom October 2002).

Rogoff (2003) has recently pointed out that the fall in
inflation around the world is a consequence not only of better
central bank policy, but also of other factors such as
globalization, increased productivity, competition, and
deregulation, among others. We would like to add another factor
to this list. Brazil, Colombia and Thailand adopted inflation
targeting <u>after</u> the sudden stop (Figure 1, Table 1).[7] The large

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[6] Haussman, Paniza and Stein (1999) point to a parallel comparison for the
cases of Mexico and Australia in 1998.

[7] Central banks did not have the modeling tools to asses the effect of the
increase in interest rates on inflation. As noted below, output gap models

decreases in inflation in these and also in other countries
also seem to be a byproduct of the defense of the crawling
bands. Inflation targeting still awaits its toughest proof:
central banks will eventually have to contain demand, and the
strength of political support for price stability will be made
clear.

III. Incorporating the Sudden Stop Shock into the Output Gap Model

Increasingly, central banks use the output gap model for
forecasting and policy analysis. In its many variations, the
output gap model appears in the papers published by McCallum
and Nelson (1999), Svensson (2000), Hargraves (1999), De
Freitas and Kfoury (2000), Beechey, Meredidth, Bharucha,
Cagliarini, Gruen and Thompson (2000), Martinez, Sánchez and
Werner (2001), Gómez and Julio (2000), De Fiore (1998), Ha,
Leung and Shu (2002)), and Coats, Laxton and Rose (2003). The
version in this paper includes the sudden stop shock and its
effect on aggregate demand and the exchange rate.

Diagram 1 depicts the mechanics of the model.[8] Consider a
steady state where inflation is on target, the interest rate is
in equilibrium and the output gap is zero (the three shaded
rectangles). If the inflation forecast increases above the

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in emerging markets were available after the 1998-1999 crisis. In Colombia,
after the 1999 crisis, the autoregressive inflation models then available
showed structural breaks.

[8] Variables are in rectangles, behavioral equations in circles and the shock
in the dashed line circle.

inflation target (see the shaded rectangle in the top right of the diagram), the central bank increases interest rates, which activates the three transmission channels of monetary policy: the aggregate demand channel (gross line), and the direct and indirect exchange rate channels (dashed and dotted lines).

The sudden stop has two immediate effects. First, it causes a short lived increase in inflation through the direct exchange rate channel. Although the pass-through is small, if exchange rate depreciation is large enough, inflation may increase jeopardizing the inflation target. Second, the sudden stop decreases demand.

The most permanent and hence important effect of the sudden stop on inflation and output depends on central bank policy. As we argue throughout this paper, the behavior of inflation and output is different under inflation targeting and fear of floating.

In the literature, the effect of a sudden stop on the output gap is negative. Uribe (2003) shows that the effect of spreads on output is negative. In an empirical investigation of the financial accelerator, Berganza, Chang and García (2003) show that the exchange rate has an effect on output that is negative. In turn, Calvo and Reihnhart (2000) consider a Keynesian and a liquidity effect to explain an effect of the exchange rate that is also negative.

As for the reasons for this negative effect, take the private sector first. When balance sheets are vulnerable to an exchange

rate depreciation, an increase in the exchange rate decreases net worth. If net worth decreases, demand, and hence output, will likely decrease (Gertler, Gilchrist and Natalucci 2002 and Céspedes, Chang and Velasco 2000).

Second, consider also the government. Does a sudden stop decrease public demand? If the exchange rate depreciates, the debt to GDP ratio will increase. If debt is higher, demand plummets and tax revenue falls. The government is likely to adjust expenditure and pass tax reform. A sudden stop, thus, is likely to decrease public demand.

In this paper, the output gap model includes this negative effect of a sudden stop on demand. Bond spreads were used as proxy for net worth and they were included as an explanatory variable in the aggregate demand equation. Why not capture the negative effect of net worth on aggregate demand with the exchange rate? Because it was important for our purposes to separate the positive effect of the exchange rate on demand through net exports from the negative effect on demand through net worth.[9]

The model consists of six behavioral equations (three estimated, three calibrated) and one identity. Four linking equations close the system.

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[9] In a financially robust economy there would be no reason to split the effect of the exchange rate on net exports and on net worth. This is because the exchange rate would not have a negative effect on net worth. Also, in a financially robust economy there might have been no sudden stop.

The behavioral equations are:

$$p_t = c_1 p_t^e + (1 - c_1 - c_{2t}) p_{t-1} + c_{2t} p_{t-1}^M + c_3 z_{t-1}^y + e_t^p \qquad (1)$$

$$z_t^y = c_4 z_{t-1}^y - c_5 z_{t-1}^r - c_6 z_{t-1}^j + c_{7t} z_{t-1}^q + e_t^y \qquad (2)$$

$$i_t = c_8 i_{t-1} + (1 - c_8)(\bar{r}_t + p_t^4) + c_9(p_{t+6|t} - \bar{p}_{t+6}) \qquad (3)$$

$$x_{t+1} = i_t - i_t^* - j_t \qquad (4)$$

$$p_t^e = c_{10} p_{t-1}^4 + (1 - c_{10}) p_{t+4}^4 + e_t^e \qquad (5)$$

$$p_t^M = (1 - c_{11t}) p_{t-1}^M + c_{11t} x_t + p_t^{US} + e_t^M \qquad (6)$$

The identity and the linking equations are:

$$z_t^j = j_t - \bar{j}_t \qquad (7)$$

$$z_t^q = z_{t-1}^q + q_t - \bar{q}_t \qquad (8)$$

$$\bar{q}_t = x_t + p_t^* - p_t \qquad (9)$$

$$r_t = i_t - p_t^4 \qquad (10)$$

$$p_t^4 = 0.25(p_t + p_{t-1} + p_{t-2} - p_{t-3}) \qquad (11)$$

where p_t is the quarterly inflation at annual rate, p_t^4 is the annual inflation, p_t^M is the import price inflation, $\bar{p}_t$ is the inflation target, $p_{t+6|t}$ is the inflation forecast for six periods ahead , z_t^y is the output gap, z_t^r is the amount that the real interest rate deviates from the long term, x_{t+1} is the expected rate of depreciation, i_t and i_t^* are the domestic and foreign nominal interest rates, j_t is the risk premium, z_t^q is the deviation of the real exchange rate from equilibrium, q_t is the real bilateral exchange rate with the US, and e_t^p , e_t^y , and

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e_t^M are shocks to supply, demand and import price inflation, q_t is the change in the real exchange rate, $\bar{q}_t$ is the change in the long term measure of the exchange rate and p_t^* is US inflation.

The Phillips curve (1) defines the dynamics of inflation. In this equation, inflation is determined by three factors. The first one is inflation expectations. The second one, the pass-through from inflation in the price of imported goods. And the third one, the output gap. We required the coefficients on the nominal variables to add up to one so that in the long term, the natural rate hypothesis would hold.

The aggregate demand (2) is the equation for the output gap. The gap has some persistence, and responds negatively to the interest rate, [10] positively to the exchange rate and negatively to bond spreads.

The reaction function of the central bank (3) depicts the behavior of the policy instrument. The nominal interest rate is a function of three terms. First, there is the lagged interest rate (a smoothing component); second, a term that for zero smoothing enables the equation to be understood either as a feedback mechanism in the nominal or in the real interest rate; and third, a feedback term in the inflation forecast.

It was decided that the reaction function of the central bank should be calibrated for two reasons. First, the construction

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[10] All coefficients are nonnegative

of data on central bank inflation forecasts for the inflation targeting period would result in a sample that would be rather short for estimation. Second, we performed robustness checks on the specification of the reaction function of the central bank with no change in the qualitative implications of the paper. The results were robust to the forecast horizon and to the feedback and smoothing coefficients.

The UIP condition (4) determines the nominal exchange rate. With high capital mobility, the expected rate of depreciation arbitrages the interest rate differential adjusted for a risk premium.

A partial adjustment model (5) defines the first stage of the pass-through. While the first step of the pass-through is Eq. (5), the second step is coefficient c_2 in the Phillips curve. Here, we also required the coefficients to add up to one to ensure super neutrality.

A linear combination of backward and forward looking annual inflation (6) approximates inflation expectations. Given the short length of data for directly measured inflation expectations, our approximation enables the Phillips curve to be estimated for a larger sample.

To model the transfer problem, the model may be extended with equations for exports and imports. Since a decrease in net worth would decrease demand for domestic and imported goods, imports would also depend on net worth. Net worth, again, can be approximated by bond spreads.

Overall, the model connects interest rate policy to inflation through three transmission channels. The aggregate demand channel: $c_5 - c_3$, the direct exchange rate channel: $c_{11} - c_2$, and the indirect exchange rate channel $c_{11} - c_6 - c_3$. The economy responds to interest rate policy, and, as dictated by the policy rule, interest rate policy responds to the economy.

IV. How to Characterize the Shock and the Policy Regimes

Our first question was how to capture a sudden stop in the output gap model. The output gap model does not have an equation for the balance of payments, only an arbitrage condition for the return on capital at home and abroad. It is a model of flows, not stocks. We characterized a sudden stop as a price effect: just as a shortage of supply leads to a price increase, a shift in investor's strategy against high yield increases bond spreads. Decreases in financial flows matching sharp increases in EMBI spreads are shown in Figure 8. [11] [12]

In the model, a sudden stop was characterized as an event that is exogenous. In fact, market sentiment can deteriorate in ways that are completely unrelated to the fundamentals. Some

[11] Perry, Suttle, Fiess (2003) also presented a negative relationship between gross capital inflow and bond spreads.

[12] We define capital inflows as gross amounts. We also exclude the items that have a longer term rationale, foreign direct investment and equity investment. In Asia, bank lending decreased before spreads increased. So, in this region, the graph also excludes bank lending and shows capital inflows as portfolio investment.

commentators claim that in June–July 2002 the emerging market bond spreads increased with the increase in the US high yield.[13] Others emphasize the Wall Street "Lulometro" that was the strength of the then-candidate Lula in the election polls. But both views regard a sudden stop as an exogenous event. In contrast, some currency crises are endogenous to balance sheet vulnerabilities -for example, government or bank over exposure to exchange rate depreciation. But the event that triggers the reversal in capital flows could be regarded as exogenous; Rigobón (2003), for instance, has developed the effect of news in triggering currency crises.

Our second question is how we can characterize fear of floating in a model where the exchange rate floats. Is there a way to model the exchange rate so that it is endogenous to UIP, but still shows fear of floating like behavior? We want the model to reproduce the macro behavior during the period of the rigid crawling bands with an exchange rate that floats. The reason for this is that we want to derive conclusions about policy analysis that can be relevant for the current period of inflation targeting.

Is the solution to include the exchange rate in the reaction function? It could be, but that is not the option we take here. The literature that includes the exchange rate in the reaction function, (Taylor 2000, 2001, Ball 2000) still seems limited to the case of the industrial country, or to the case of an emerging market that is financially robust. The reason is that, in this literature, the exchange rate has an effect on demand

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[13] This view is attributed to Guillermo Calvo.

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that is positive.[14] Furthermore, capturing fear of floating without touching the reaction function would be better on the grounds of simplicity.

How then to characterize fear of floating? It was done by decreasing the inflation target. This device increases the interest rate and stabilizes the exchange rate. Moreover, an attempt to characterize fear of floating without requiring inflation to decrease would be inconsistent with the evidence that inflation fell after the sudden stops.

Hence, a sudden stop under fear of floating was modeled here as an increase in the spread combined with a decrease in the inflation target. Again, as the inflation target decreases, the interest rate increases. The increase in the interest rate keeps the exchange rate from increasing in a way that is consistent with fear of floating. The inflation target was decreased by the number of percentage points that were necessary to roughly stabilize the real exchange rate.[15]

Overall, how is a sudden stop modeled? Under inflation targeting, it is modeled as an exogenous increase in the

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[14] In any event, this literature concludes that in models that include the exchange rate in the reaction function, the variance of inflation and the output gap is somewhat smaller but not in a sense that is quantitatively important.

[15] Despite fear of floating, during the 1998-1999 period, exchange rates overshot and equilibrium exchange rates increased. In contrast, we aimed at a virtual stabilization of the exchange rate. This could be seen as a fear of floating that was too extreme, but our work horse for analysis was the comparison of extremes.

spread. And under fear of floating, it is modeled as an exogenous increase in the spread combined with a decrease in the inflation target. In both cases, the reaction function does not include the exchange rate and the exchange rate is endogenous to UIP.

V. A Model for Potential Output and the Output Gap

There are a myriad of methods to estimate potential output and the output gap. This time we choose to use, for the four countries of this study, a method that is suggestive of ongoing research for a broader set of countries. We set up a model that allows for a time varying growth rate of potential output, a model also that enabled us to split country fluctuations up into idiosyncratic, regional and international components. In building the model for potential output and the output gap, a local linear trend (Harvey 1989, Laxton 1998, Coates, Laxton and Rose 2003), and a DYMIMIC specification (Mody, Sarno and Taylor 2003) were combined. Potential output follows the former, the output gap, the latter. The estimation of potential output and the output gap was carried out simultaneously with the Kalman filter.

The model is:

$$y_t^i = \bar{y}_t^i + z_t^{y,i} \qquad (12)$$

$$\bar{y}_t^i = \bar{y}_{t-1}^i + g_{t-1}^i + e_t^{\bar{Y},i} \qquad (13)$$

$$g_t^i = g_{t-1}^i + e_t^{g,i} \qquad (14)$$

$$z_t^{y,i} = z_t^j + e_t^{z,i} \qquad (15)$$

$$z_t^j = z_t^W + e_t^j \qquad (16)$$

$$z_t^W = e_t^W \qquad (17)$$

where i stands for the country, y_t^i is output $\bar{y}_t^i$ is potential output, g_t^i is the growth rate of potential, and z_t^j, is the regional component of economic activity, and j refers to Latin America and Asia, respectively.

VI. Results of the Estimation

We estimated the model equation by equation because we wanted to acknowledge that the pass-through of import price inflation to CPI inflation has decreased. Hence in the estimation of the Phillips curve we use the Kalman filter and in the estimation of the aggregate demand and import price inflation equations we used OLS.

To deal with the effect of the exchange rate and the spread on the output gap in the estimation, we took into account three factors. First, the exchange rate and the spread are not exogenous to each other. Second, the data seems to be dominated by the huge drop in output and the major devaluation in 1998-1999. So, the estimations tend to pick an effect of the exchange rate on output that is negative. Third, the second consideration does not necessarily mean that the exchange rate did not stimulate net exports. On balance, the exchange rate was dropped from the estimation and the effect on demand through net worth was captured with bond spreads. In the simulations, we calibrated the coefficient of the exchange rate

as it appears in the column corresponding to the real exchange rate in Table 3.

Before the results of the estimation for each equation are discussed, let us deal with the results of the estimation of the long term levels of exchange rates (Figure 6).[16] During a sudden stop, the real exchange rate overshoots and equilibrium levels of the real exchange rate increase.

As to the estimation of the Phillips curve, the heart of the relationship between real and nominal variables, coefficient c_3, is significant. Table 2 shows Kalman filter estimates of the Phillips curve. [17] As the pass-through was unstable, we allowed a time varying pass-through c_{2t}. Table 2 reports the point estimate at the end of the sample, which is the coefficient we use in the simulations.

A result from the estimation of the aggregate demand equation is that the effect of bond spreads on aggregate demand was higher in Asia and output gap persistence in that region was smaller.

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[16] We estimated long term levels for the real exchange rate and the real interest rates and as local linear trends.

[17] The real-nominal relation was significant except in Brazil. Most estimates for Brazil belong to the period 1996-2002 instead of 1990-2002 as is the case in the other countries. This is because the end of the Real Plan constituted a clear regime change. In Brazil, the coefficient c_3 was allowed to be time-varying and to follow a random walk. The variance of the error component of the random walk was calibrated to obtain a reasonable positive coefficient; this procedure, for the particular case of Brazil, amounts to a calibration.

When looking at the estimated coefficients for the equation
dealing with import price inflation, we found similar
coefficients across countries. The results of the estimation of
the equation for import price inflation are presented in Table
4.

As to the estimation of the output gaps, the 1998-1999 crisis
produced higher output gap volatility in Asia. In addition, the
crisis in Latin America took place with a lag (Figure 7).[18]

One other result bears emphasis, the 1998-1999 crisis seems to
have decreased growth of potential output in the four countries
under study, particularly in Colombia (Figure 7). [19] [20] A time
varying growth of potential output is one of the appealing
feature of the local linear trend specification for potential
output.

VII. Simulation of a Sudden Stop in the Output Gap Model

In this section, a sudden stop is simulated under the two
alternative settings for monetary policy. Figures 9 to 12

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[18] As explained above, the four country model was estimated with the Kalman
Filter recursion. A prior step was necessary to investigate the absolute and
relative variances of the residuals that would result in output gap
fluctuations of business cycle frequency.

[19] In the graph, we reported growth of potential output at annual rates.

[20] Growth projections for Thailand are more optimistic than suggested by the
estimated growth of potential output. The local linear trend filter appears
to be influenced by the strong recession in 1998.

compare the sudden stop shock under inflation targeting (solid line) and fear of floating (dotted line) in the four countries.[21] Consider central bank policy as indicated by the stance of interest rates under the two alternatives. Under inflation targeting, interest rates fall; a stance that is counter-cyclical. Under fear of floating, interest rates increase; they are pro-cyclical. Fear of floating keeps the exchange rate from depreciating but emphasizes and prolongs the recession.

Inflation and output under inflation targeting

The sudden stop causes an immediate depreciation. Can the exchange rate depreciation jeopardize the inflation target? Ho and McCauley (2003) would surely answer yes and would hint at the exchange rate as the first suspect. Figures 9 to 12 show that although exchange rate depreciation causes a sharp increase in import price inflation, it leads to a much smaller increase in CPI inflation. The final effect of the exchange rate on CPI inflation is small, but a large enough increase in the exchange rate may eventually jeopardize the inflation target.

Is the increase in inflation under inflation targeting relevant, or in other words, permanent? As the real exchange rate gradually decreases towards equilibrium, depreciation is negative and the pass-through quickly pushes inflation down;

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[21] Rates of interest are presented in annual terms, rates of inflation and depreciation are defined annually. All variables are in deviation from steady state.

even below target. The central bank relaxes its stance. If the stance is loose, economic activity eventually enters a boom, and the boom increases inflation toward target. So, the increase in inflation in the first year does not seem to be permanent.

We claim that under inflation targeting monetary policy can be counter-cyclical. As the exchange rate overshoots, expected depreciation is negative and domestic interest rates may decrease. The data does show some overshooting. However, it cannot be dennied, to say the least, that UIP is subject to considerable additive uncertainty. In addition, what if the prescribed decrease in interest rates stimulated the capital outflow? Counter-cyclical monetary policy is not a straightforward matter. Caballero and Krishnamurthy (2003), and now our paper as well, open up the possibility for a counter-cyclical policy –in theory. In practice, the reservations about the additive uncertainty in UIP (in the case of our paper) and about the role of interest rates in maintaining market confidence, may point to Brainard's (1967) argument for instrument stability.

Inflation and output under fear of floating

Figures 9 to 12 show that fear of floating controls exchange rate pass-through during the first year, but at a cost: a protracted recession. Central bank pro-cyclical policy emphasizes the recessive effect of the decrease in net worth and the increase in bond spreads. A deep and protracted recession changes inflation permanently.

A capital inflow

The model in this paper can also be used to explain inflation, output and policy under a capital inflow. During a capital inflow, the exchange rate appreciates, import price inflation decreases, the output gap increases and inflation tends to increase. Central banks face the opposite dilemma: defending the exchange rate from appreciating amounts to maintaining an expansive monetary stance. Containing inflation requires a tight monetary policy which stimulates the capital inflow.[22]

There are some differences in modeling a capital inflow, however. First, the duration of the shock could be longer since capital inflows are generally persistent. In contrast, sudden stops are big and short lived. Second, compared to a sudden stop, in a capital inflow the size of the change in the spread could be smaller since spreads, like interest rates, have a lower limit.

The cost of fear of floating

Fear of floating decreases inflation, and the decrease in inflation has a cost. The cost is the sacrifice ratio. What then are our estimates of the cost of fear of floating? With the model in Section III, a permanent decrease in inflation of

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[22] For a description of the effects of an increase in capital inflows in the transition economies in Central and Eastern Europe see Lipschitz, Lane and Mourmouras (2002).

one percentage point was simulated. The sacrifice ratio is 2.5, 1.1, 0.8 and 2.6 for Brazil, Colombia, Korea and Thailand.

VIII. Policy Implications of a Sudden Stop

In regards to the policy implications of the paper, we propose that under a sharp devaluation, central banks should focus on inflation <u>after</u> the shock.[23] While depreciation causes inflation in the very short term, monetary policy transmission mechanisms, especially the aggregate demand channel, take about two years to affect inflation sizably. In the face of an unanticipated event such as a sudden stop, the central bank is unable to attain the inflation target in the short term.

Another consideration that must be taken into account in the political economy is the central bank's communication strategy. A central bank that is targeting inflation should emphasize that inflation will go back to target after the first round of effects of the shock. Emphasis on the medium term and the central bank commitment to the long term target could be the primary elements of the communication strategy.

Another policy, proposed by Caballero and Krishnamurthy (2003), is that the central bank could target inflation in the price of non traded goods. We think a central bank that is targeting inflation could complement the medium term alternative with the use of non traded goods inflation in the internal operations of

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[23] A similar proposal, an increased targeting horizon, is attributed to Frederik Mishkin.

the central bank. If the central bank takes the price of non traded goods as the target index, it can ignore almost all open economy aspects,[24] and it is free to focus on output stabilization. The advantage of the use of non traded goods as the target index is that it prevents the central bank from giving excessive attention to the effect of the exchange rate on inflation in the short term, and it enables the central bank to pay due attention to the behavior of inflation in the medium term and to counter-cyclical policy. The disadvantage is that a measure of non traded goods inflation would most likely be produced by the central bank itself and not independently by the statistics department. The cost in transparency, however, does not seem important compared with the significant gains in terms of preventing pro-cyclical policy.

Finally, another possible policy would be to introduce an escape clause for CPI inflation targeting under large depreciations. In the model, an escape clause for current inflation would be immaterial since the reaction function targets inflation six quarters ahead. But the political economy argument is that the increase in inflation may tempt the central bank to "do something." So, the escape clause can avoid the output sacrifice associated with fear of floating.

IX. Conclusions

A prominent and recurrent shock to emerging market economies is a sudden stop. Sudden stops increase inflation in the short

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[24] Except that real interest rates are usually defined on overall inflation instead of non traded goods inflation.

term and when combined with fear of floating seem to decrease inflation permanently. Sudden stops trigger an overshooting of the exchange rate and increase the equilibrium exchange rate. After the 1998-1999 sudden stop, growth of potential output seem to have decreased, especially in Colombia.

As for the conduct of monetary policy during a sudden stop, in 1998-1999, Brazil and Colombia managed interest rates pro-cyclically. In 2002 the evidence is mixed: Brazil increased policy rates, Colombia did not. However, in tightening the stance of monetary policy, Brazil must have followed, not the exchange rate, but the inflation target.

The effect of a sudden stop on inflation and output has been explained through the output gap model. The model showed that during a sudden stop, inflation targeting is counter-cyclical, and fear of floating, pro-cyclical. According to the model, under inflation targeting, the recession in the first round of effects is followed by expansion. Under fear of floating, the recession is deeper and longer.

Because the prolonged recession eventually becomes the output loss necessary to decrease inflation, the cost of fear of floating has been identified with the sacrifice ratio. Under fear of floating, by increasing the interest rate, a central bank would prevent inflation from increasing in the short term. This increase in the interest rate would at the same time deepen the recession and decrease inflation permanently. Monetary policy would drive the economy to a permanent output loss and disinflation.

As to the policy implications of the paper, price stability and inflation targeting should not consist of keeping inflation on target at all times, especially under a sudden stop.[25] Under a sudden stop, central banks that are targeting inflation could focus on inflation in the medium term and may monitor a measure of inflation of non traded goods. Eventually in some cases an escape clause for CPI inflation under large depreciations would be welcome.

Inflation targeting, in theory, enables the central bank to implement counter-cyclical policy. It also appears to be a better policy if inflation is in the low single digits: if capital inflow stops when inflation is in the low single digits, fear of floating would add to the inflation outlook a costly downside risk.

References

Allen, Mark, Christoph Rosenberg, Christian Séller, Brad Setser, and Nouriel Roubini (2002). "A Balance Sheet Approach to Financial Crisis." IMF Working Papers 210. December.

Baldacci, Emanuele, Luz de Mello and Gabriela Inchauste (2002). "Financial Crises, Poverty, and Income Distribution, IMF Working Paper 02/4. Washington, International Monetary Fund.

Banco Central do Brasil. Minutes of the 76th Meeting of the Monetary Policy Committe (Copom). October 18, 2002.

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[25] The same argument applies to supply shocks.

Beechey, Meredith, Nargis Bharucha, Adam Cagliarini, David Gruen and Christopher Thompson (2000). "A Small Model of the Australian Macroeconomy." Reserve Bank of Australia, Research Discussion Paper.

Berg, Andrew (1999). The Asia Crisis: Causes, Policy Responses, and Outcomes. IMF Working Paper 138.

Bernanke, Ben, Mark Gertler and Simon Gilchrist (1999). "The Financial Accelarator in a Quatitative Business Cycle Framework.'' Handbook of Macroeconomics. Volume 1. Edited by J.B. Taylor and M. Woodford. Elsevier Science B.V.

Bernanke, Ben, Thomas Lauback, Frederic Mishkin and Adam Posen (1999). Inflation Targeting: Lessons from the International Experience. Princeton University Press. Princeton New Jersey.

Brainard, William (1967). ""Uncertainty and the Effectiveness of Monetary Policy." American Economic Review, 57, no. 2 May.

Caballero, Ricardo and Arvind Krishnamurthy (2003): "Inflation Targeting and Sudden Stops." Mimeo NBER.

Calvo, Guillermo, Alejandro Izquierdo and Luis Fernando Mejía (2003. "On the Empirics of Sudden Stops." Mimeo Interamerican Development Bank.

Calvo, Guillermo and Carmen Reinhart (2000). "Fear of Floating." NBER Working Paper 7993.

Calvo, Guillermo (1998). ''Capital Flows and Capital-Market Crises: The Simple Economics of Sudden Stops''. Journal of applied Economics, vol.1, No.1, pp 35-54.

Calvo, G.A. and Reinhart, C.M. (1999) ''When Capital Inflows Come to a Sudden Stop: Consequences and Policy Options. Mimeo. University of Maryland.

Calvo, G.A. and Végh, C.A.(1999) ''Inflation Stabilization and BoP Crises in Developing Countries''. NBER Working Paper Series 6925.

Céspedes, Luis Felipe, Roberto Chang, and Andrés Velasco (2000) ''Balance Sheets and Exchange Rate Policy'' NBER Working Paper Series 7840.

Céspedes, Luis Felipe, Roberto Chang, and Andrés Velasco (2002) ''IS-LM-BP in the Pampas''. NBER Working Paper Series 9337.

Coats, Warren, Douglas Laxton, and David Rose (2003). The Czech National Bank's Forecasting and Policy Analysis System. Czech National Bank, Prague.

Corsetti, G. (1998) ''What Caused the Asian Currency and Financial Crisis? Part 1: A Macroeconomic Overview''. NBER Working Paper Series 6833.

Chang, R. and Velasco, A. (1998) ''Financial Crises in Emerging Markets: A Canonical Model''. Economic Research Reports. New York University.

Chang, R. and Velasco, A. (2001) ''A Model of Financial Crises in Emerging Markets''. The Quarterly Journal of Economics. Vol. CXVI No.465, May.

De Ferranti, David, Guillermo Perry, Francisco Ferreira and Michael Walton (2003). Inequality in Latin America and the Caribbean, Breaking with History? The World Bank Wahington D.C.

De Fiore, Fiorella (1998). The Transmission of Monetary Policy in Israel. IMF Working Paper 114.

De Freitas Paulo Springer, Marcelo Kfoury Muinhos (2001). A Simple Model for Inflation Targeting in Brazil. Banco do Brasil, Working Paper Series 18.

Gertler, Mark, Simon Gilchrist and Fabio Massimo Natalucci (2001). ''External Contraints on Monetary Policy and the Financial Accelerator. Mimeo.

Ghosh, A., Lane, T., Schulze, G., Bulir, A., Hamann, J. and Mourmouras, A. (2002). "IMF-Supported Programs in Capital Account Crises." Ocasional paper 210.

Goldstein, Morris (2002). Managed Floating Plus: The Great Currency Regime Debate. Institute for International Economics.

Gómez, Javier and Juan Manuel Julio (2000). "Transmission Mechanisms and Inflation Targeting: The Case of Colombia's Disinflation." Borradores Semananes de Economía No. 168. Banco de la República.

Ha, Jiming, Cynthia Leung and Chang Shu (2002). "A Small Macroeconomic Model of Hong Kong." Mimeo. Hong Kong Monetary Authority.

Hargraves, David (1999). ''SDS-SPS: A Small Demand-Side Version of the Forecasting and Policy System Core Model.'' Reserve Bank of New Zealand, Discussion Paper G99/10.

Harvey, Andrew (1989). "Forecasting, Structual Time Series Models and the Kalman Filter." Cambridge University Press, Cambridge, U.K.

Hausmann, Ricardo, Ugo Panizza and Ernesto Stein (1999). ''Why Do Countries Float the Way They Float? Working Paper Inter-American Development Bank.

Ho, Corrinne and Robert McCauley (2003). "Living with Flexible Exchange Rate: Issues and Recent Experience in Inflation Targeting Emerging Market Economies." BIS Working Papers 130. February.

Iwata, Shigeru and Evan Tanner (2003). ''Pick Your Poison: The Exchange Rate Regimes and Capital Account Volatility in Emerging Markets.'' IMF Working Paper No. 03/92.

Kaminsky, Graciela (2003). "Varieties of Curency Crises." Mimeo George Washington University. December.

Lahiri, Amartya and Carlos Végh (2002). ''On the Non-Monotonic Relation Between Interest rates and the Exchange Rate.'' Mimeo UCLA.

Lahiri, Amartya and Carlos Végh (2001). Living with the Fear of Floating: An Optimal Policy Response.'' Mimeo UCLA.

Lane, T., Ghosh, A., Hamann, J., Phillips, S., Schulze-Ghattas, M. and Tsikata, T. (1999) ''IMF-Supported Programs in Indonesia, Korea, and Thailand A Preliminary Assessment''. Ocasional paper 178.

Laxton, Douglas and Paolo Pesenti (2003). ''Monetary Rules for Small, Open, Emerging Economies.'' Mimeo IMF.

Laxton, Douglas, Peter Isard, Hamid Faruqee, Eswar Prasad, and Bart Turtleboom (1998) MULTIMOD Mark III: The Core Dynamics and Steady-state Models, IMF Occasional Paper 164.

Lettau, M., and Ludvigson, S. (2002) ''Time-varying risk premia and the cost of capital: An alternative implication of the Q Theory of investment''. Journal of Monetary Economics 49 pp. 31-66.

Levy-Yeyati, Eduardo, Federico Sturzenegger and Iliana Reggio (2002). On the Endogeneity of Exhcange Rate Regimes. Mimeo.

Lipschitz, Leslie, Timothy Lane and Alex Mourmouras (2002). "Capital Flows to Transition Economies: Master or Servant?, IMF Working Paper 02/11. Washington, International Monetary Fund.

Martínez, Lorenza, Oscar Sánchez, Alejandro Werner (2001). Consideraciones sobre la Conducción de la Política Monetaria y el Mecanismo de Transmisión en México. Banco de México, Documento de Investigación No. 2001-02.

McCallum, Bennett and Edward Nelson (1999). ''Nominal income targeting in an open-economy optimizing model.'' Journal of Monetary Economics 43 (1999) 553-578.

Perry, Guillermo, Phillip Suttle and Norbert Fiess (2003). "Shifts in Financial Markets: Learning to Live with Less External Debt?" World Bank. Presentation application in the web page of the office of the Chief Economist for Latin America and the Caribbean.

Rigobón, Roberto (2003). "News, Contagion and Anticipation." Presented at the 2003 LACEA meeting. Puebla, Mexico.

Rogoff, Kenneth (2003). "Globalization and Global Disinflation." Forthcoming in Federal Reserve Bank of Kansas City, Global Economic Integration: Opportunities and Challenges, 2004.

Rudebusch, Glen and Lars Svensson (1998). "Policy Rules for Inflation Targeting.". NBER Conference on Monetary Policy Rules, January.

Svensson, Lars (2000). ''Open-Economy Inflation Targeting''. Journal of International Economics 50 155-183.

Von Hagen, Jurgen, and Jizhong Zhou (2002). '' De Facto and Official Exchange Rate Regimes in Tranistion Economies. Mimeo Center for European Integration Studies.

Diagram 1. The Output Gap Model
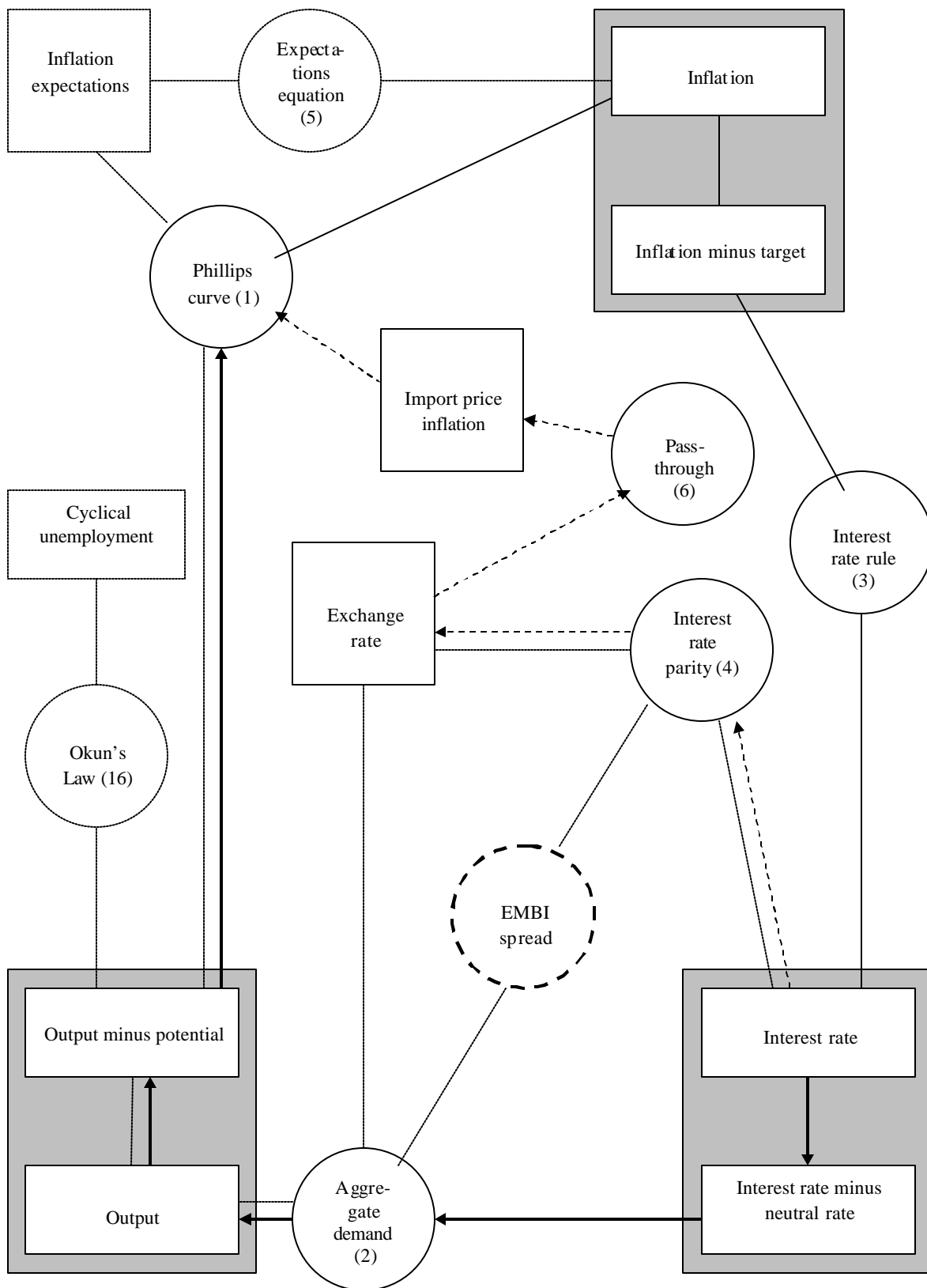
Figure 1. EMBI Spread

Solid line: adoption of inflation targeting. Dotted line: announcement of inflation targeting

Brazil

Colombia
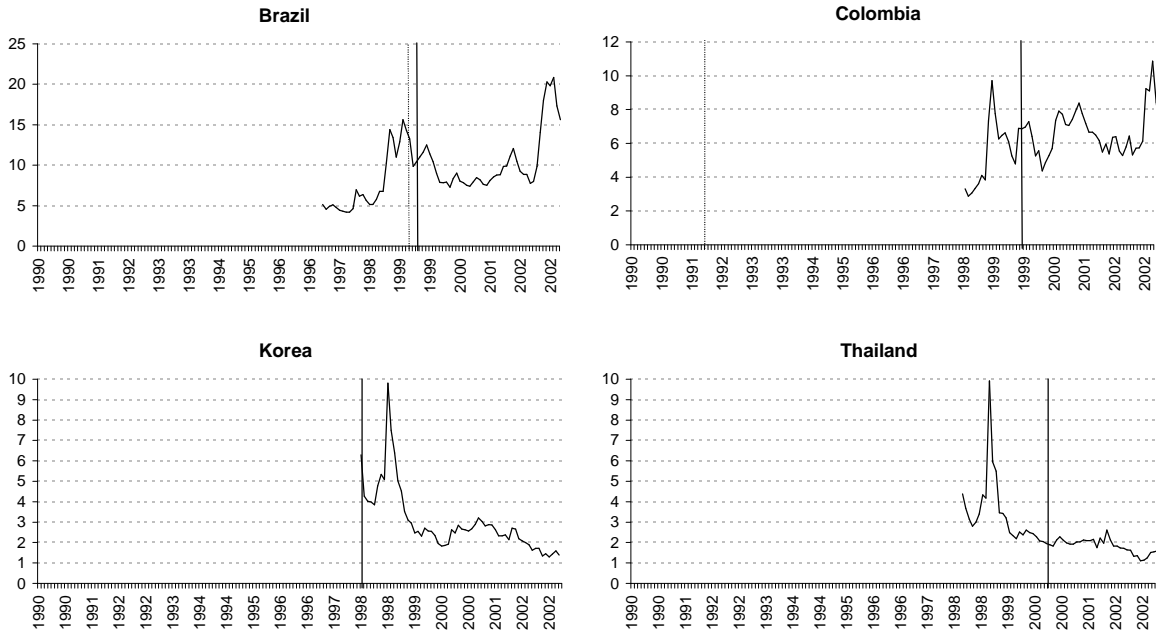
Korea

Thailand

Figure 2. Short term pass-through and long run decrease in inflation in Korea

Output gap

Exchange rate depreciation

Export and import shares

Share of exports in GDP ········ Share of imports in GDP
Current account
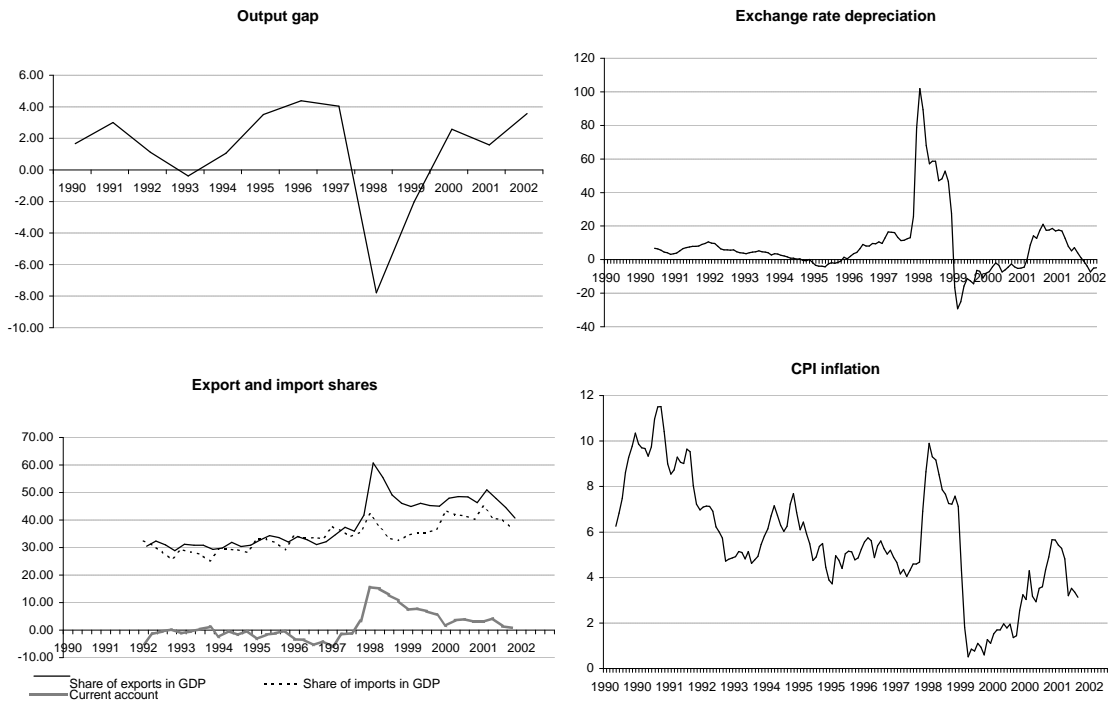
CPI inflation

Figure 3. Short term pass-through and long run decrease in inflation in Thailand

Output gap

Exchange rate depreciation

Export and import shares

Share of exports in GDP   Share of imports in GDP
Current account

CPI inflation
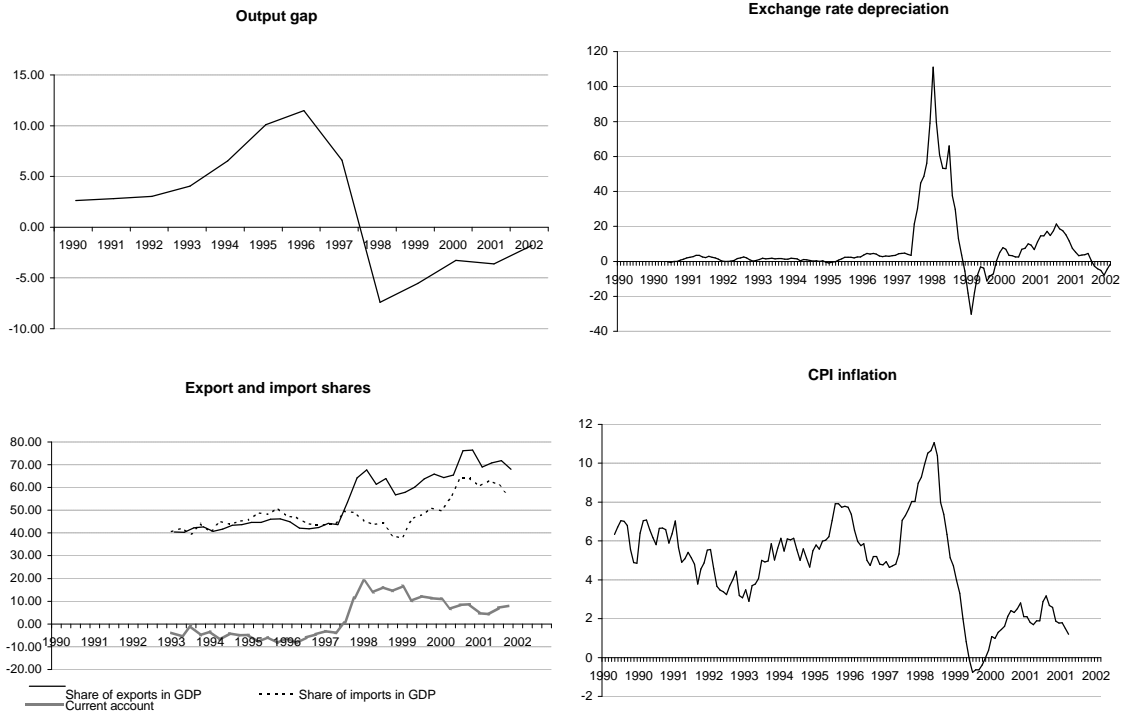
Figure 4. Response of monetary policy to bond sprads and exchange rate depreciation

Brazil

Policy Rate ——— Spread

Brazil

Policy Rate ——— Exchange rate depreciation

Colombia

Policy Rate ——— Spread

Colombia

Policy Rate ——— Exchange rate depreciation
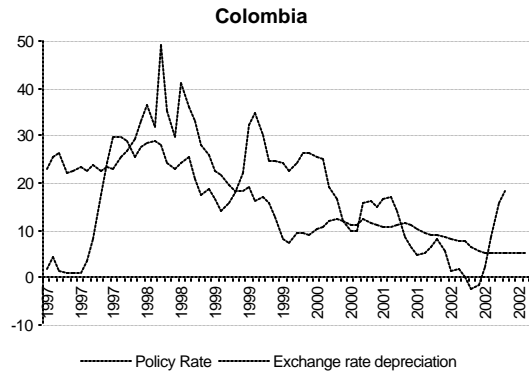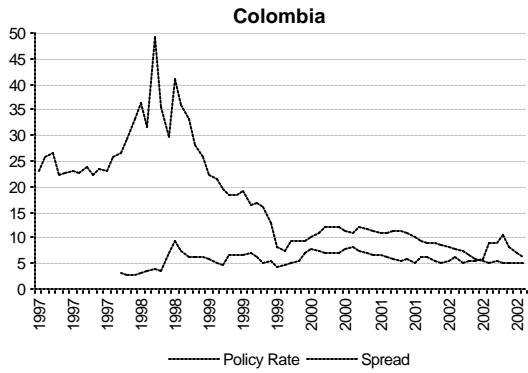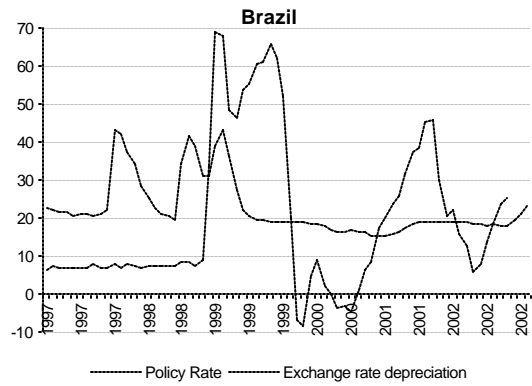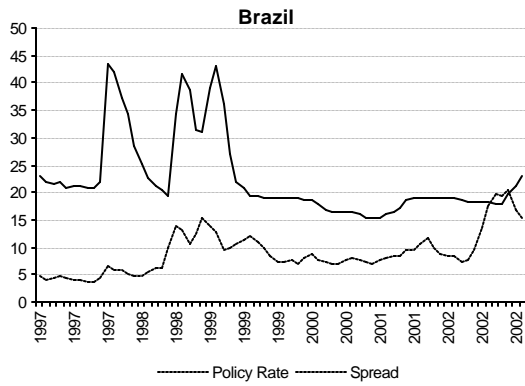
Figure 5. Sudden stops (increase in net exports) and the business cycle

Brazil: output gap
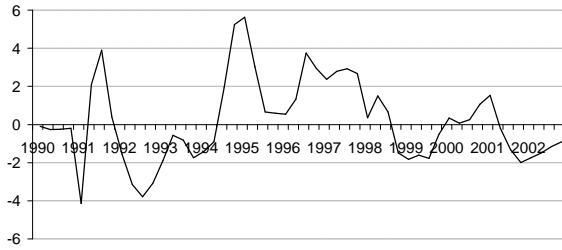
Colombia: output gap
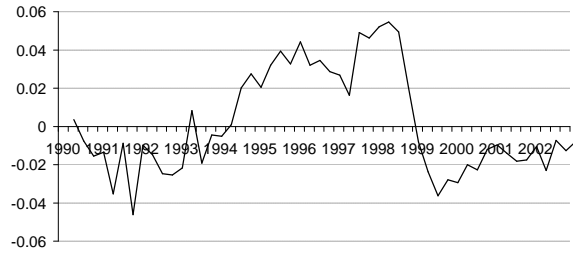
Brazil: Export and import shares

Share of exports in GDP ········· Share of imports in GDP
Current account
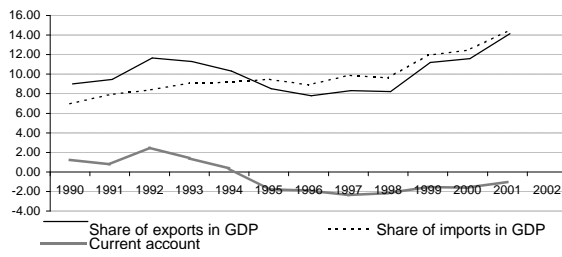
Colombia: Export and import shares

Share of exports in GDP ········· Share of imports in GDP
Current account
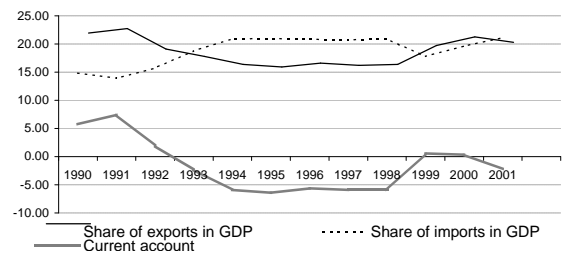
Figure 6. Real exchange rates, real interest rates and long run values
Solid line: observed values, dotted line: long run values

Brazil: real exchange rate
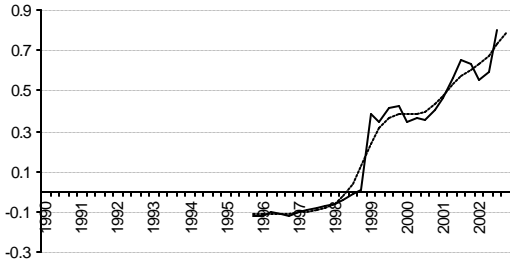
Brazil: real interest rate
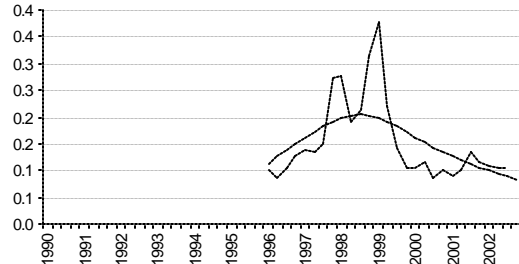
Colombia: real exchange rate
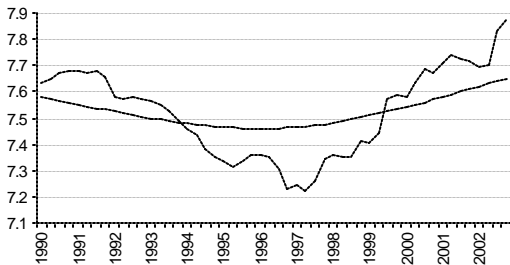
Colombia: real interest rate
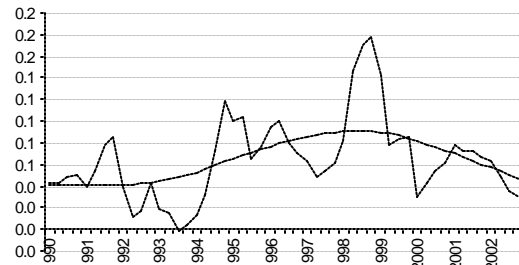
Korea: real exchange rate
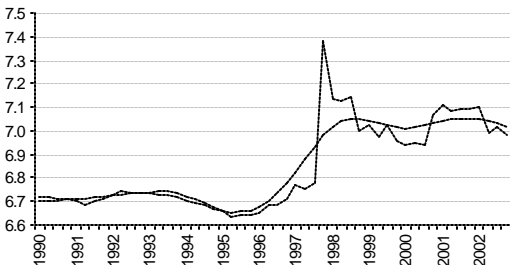
Korea: real interest rate
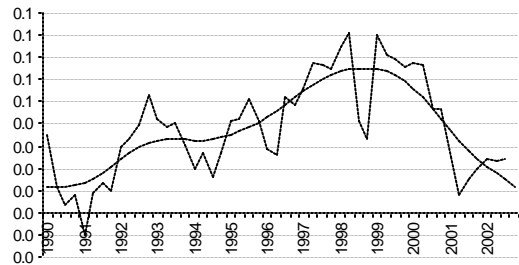
Thailand: real exchange rate
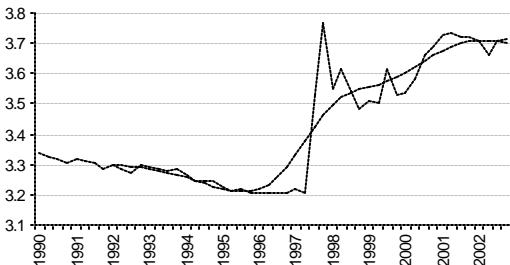
Thailand: real interest rate
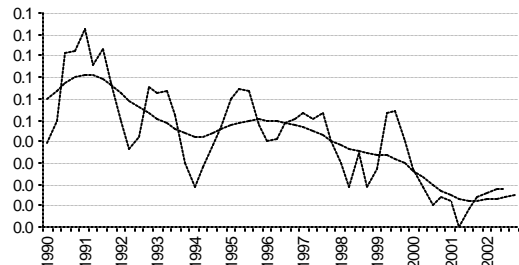
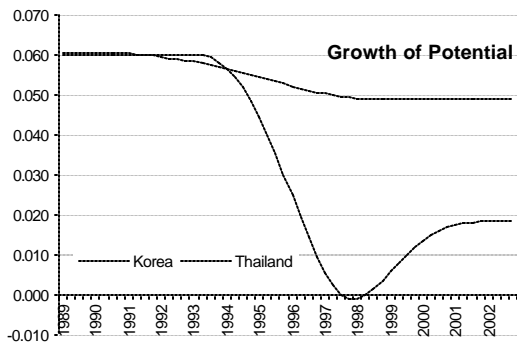**Figure 7. Output Gaps, Regional and Global Components
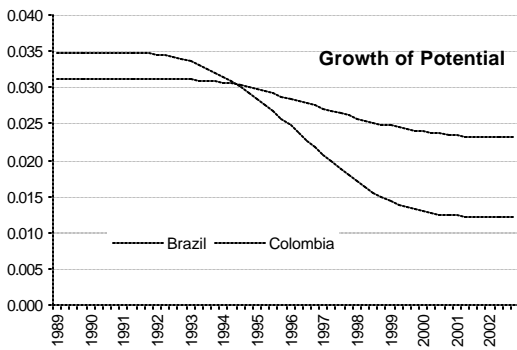and Growth of Pontential Output**
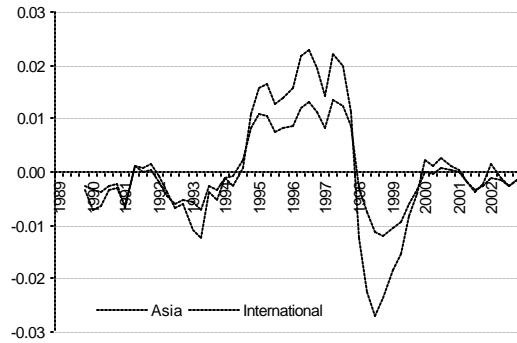
Figure 8. EMBI Spread as Indicator of Sudden Stops

Brazil

Colombia

Korea

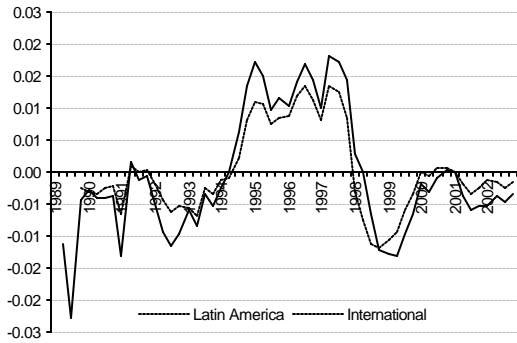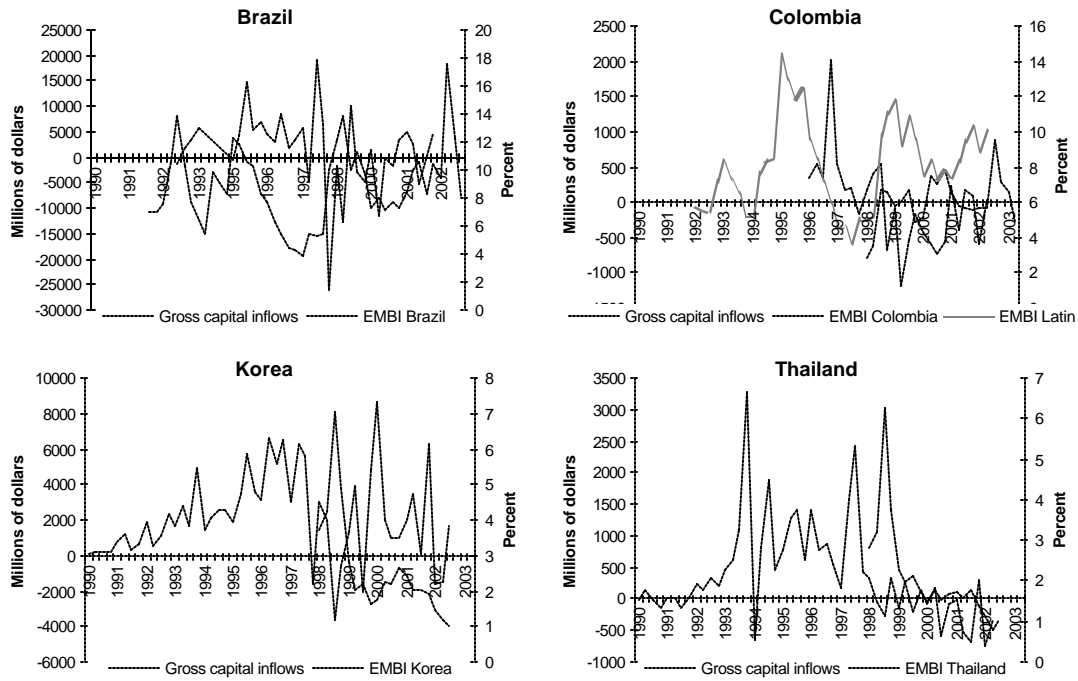**Thailand**

Figure 9. Sudden Stop in Brazil under Inflation Targeting and Fear of Floating

Solid line: Inflation Targeting, dotted line: Fear of Floating

Nominal interest rate

Inflation

Real interest rate

Import price inflation

Output gap

Exchange rate depreciation
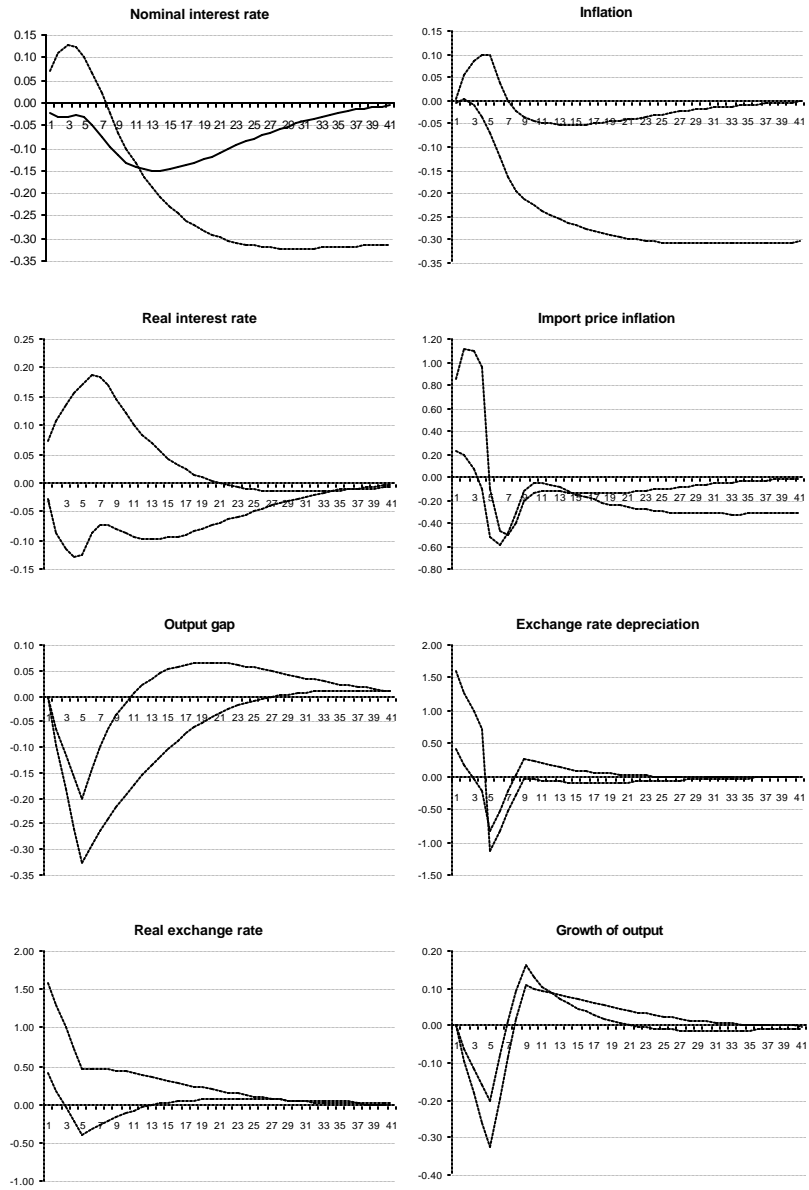
Real exchange rate

Growth of output

Figure 10. Sudden Stop in Colombia under Inflation Targeting and Fear of Floating
Solid line: Inflation Targeting, dotted line: Fear of Floating

Nominal interest rate

Inflation

Real interest rate

Import price inflation

Output gap

Exchange rate depreciation

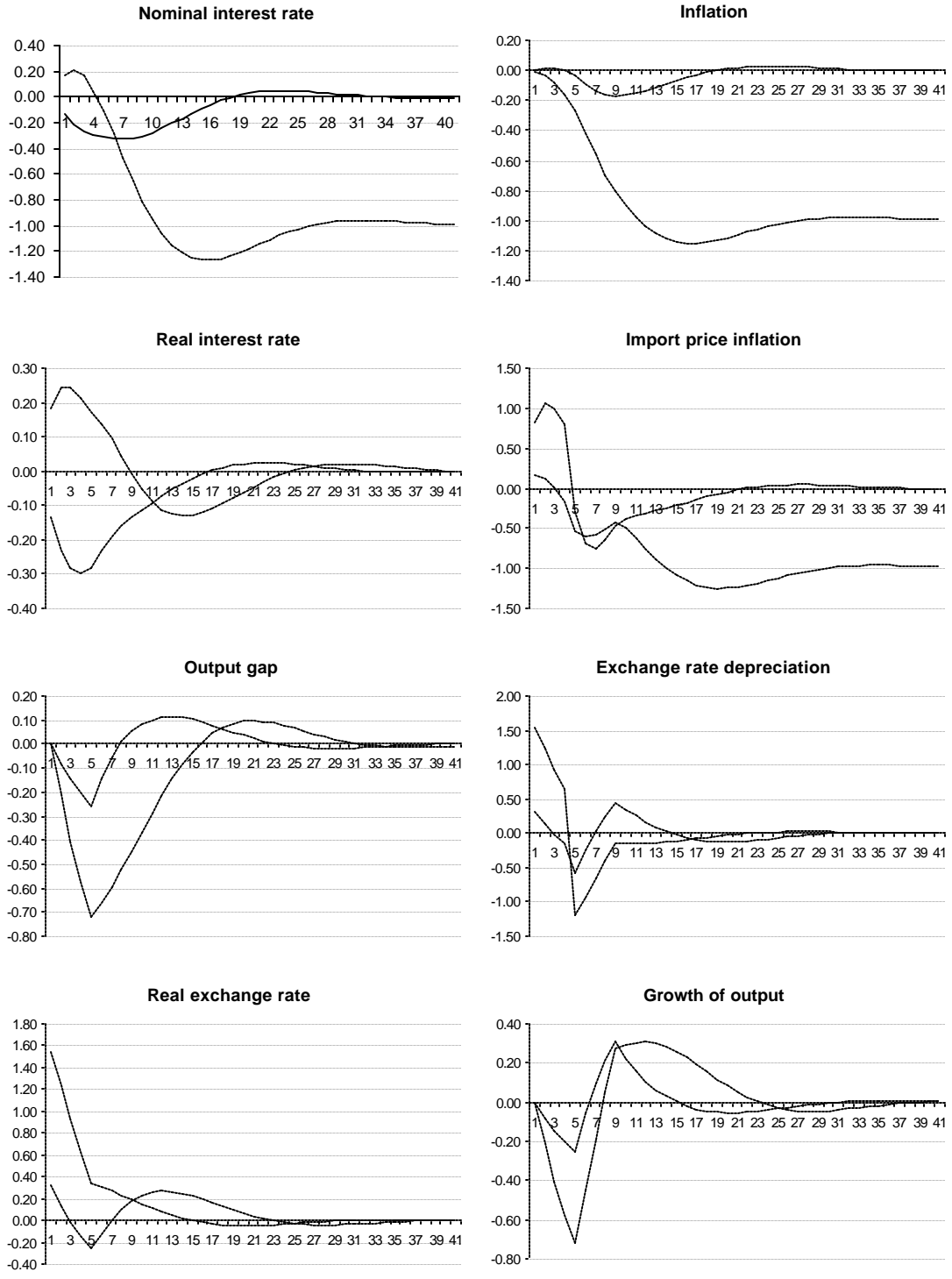**Real exchange rate**

Growth of output

Figure 11. Sudden Stop in Korea under Inflation Targeting and Fear of Floating
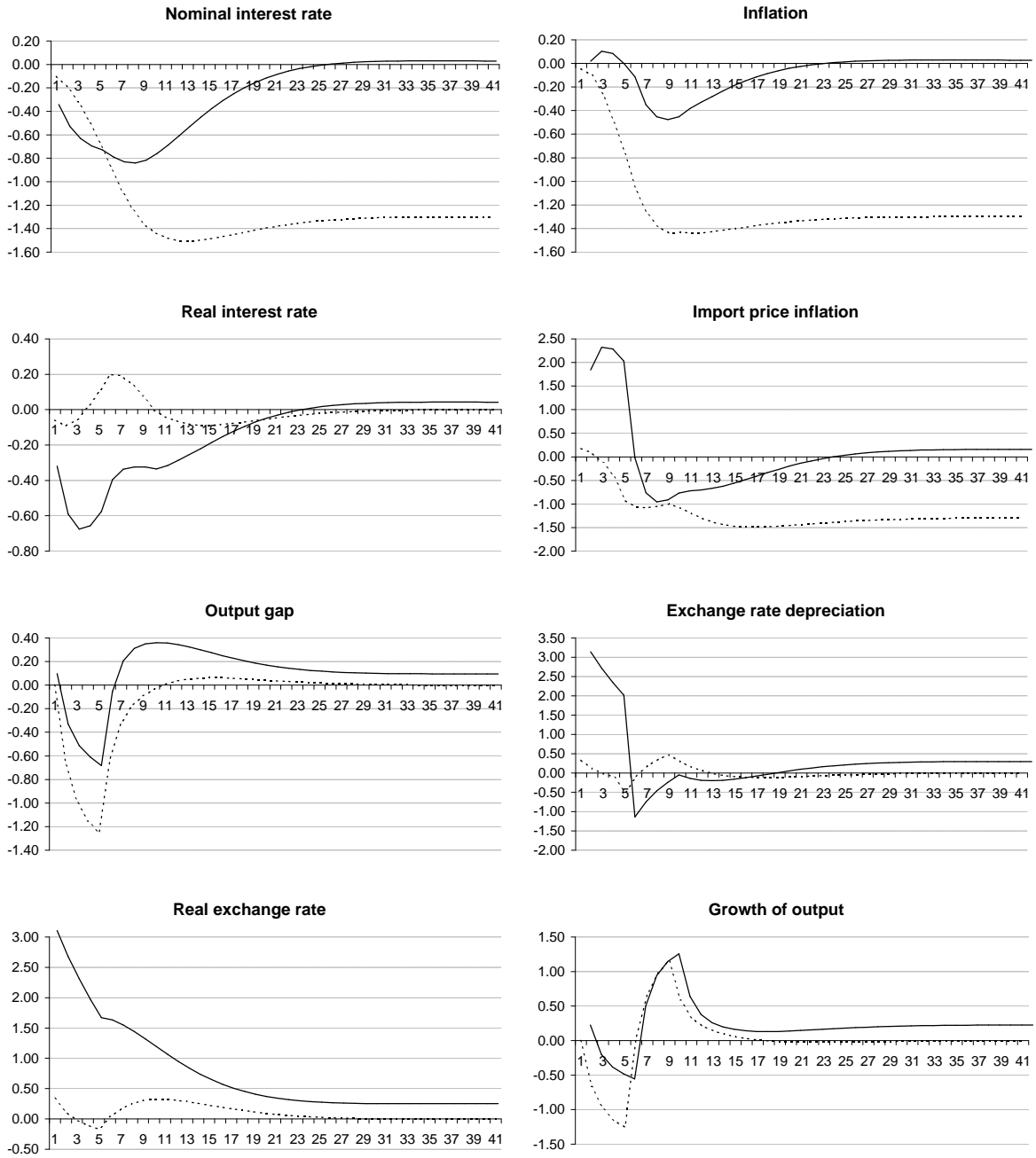Solid line: Inflation Targeting, dotted line: Fear of Floating

Figure 12. Sudden Stop in Thailand under Inflation Targeting and Fear of Floating
Solid line: Inflation Targeting, dotted line: Fear of Floating

Nominal interest rate

Inflation

Real interest rate

Import price inflation

Output gap

Exchange rate depreciation

Real exchange rate

Growth of output