Inflation Targeting, exchange rate pass-through and "Fear of Floating"

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Abstract

The paper presents evidence on exchange rate pass-through and the "Fear of Floating" hypothesis before and after Inflation Targeting for a set of developed and emerging market economies. We use a structural VAR model to estimate the effect of depreciations on prices. The results support the view of the previous literature that the pass-through is higher for emerging than for developed economies, and that it has decreased after the adoption of Inflation Targeting. We then use several different methodologies to examine the existence of "Fear of Floating" practices. We observe a drastic reduction in direct foreign exchange market intervention after the adoption of Inflation Targeting. As the exchange rate pass-through still matters for the attainment of the inflation targets, "Fear of Floating" seems to play only a minor role for most economies in our sample.

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1. Introduction

Exchange rate smoothing is a necessity under Inflation Targeting (IT), as a high pass-through may influence the Central Bank's ability of attaining the inflation targets [Schmidt-Hebbel and Werner (2002), Eichengreen (2002), Ball and Reyes (2004a), Mishkin (2004)]. However, interventions in the foreign exchange market can also be a symptom of what is known in the literature as "Fear of Floating", following Calvo and Reinhart (2002). In this sense, it is important to note the difference between occasional interventions in the foreign exchange market and deliberate exchange rate targeting. The first one is related to the exchange rate pass-through and its effects on inflation, while the second one is pure "Fear of Floating". The problem of targeting the exchange rate is that it may not be consistent with the inflation target in the long-run [Mishkin and Schmidt-Hebbel (2001), Fischer (2004) and Mishkin (2004)]. This discussion has led to the emergence of propositions of how to correctly classify a country's policy as "Fear of Floating" or IT.[1]

Exchange rate pass-through means that changes in imports prices are translated into higher domestic prices. There is a vast literature on this [Dornbusch (1987), Fischer (1989), Klein (1990), Freenstra and Kendal (1994), Goldberg and Knetter (1997), Amitrano et al. (1997) and others], and the importance given to this issue has increased after the advent of IT. Many authors, such as Goldfajn and Werlang (2000) and Schmidt-Hebbel and Tapia (2002) have shown that the pass-through is higher for emerging than for developed economies.[2] The problem of having a high pass-through effect is that it implies a greater difficulty for their attainment of the inflation targets, as noted by Fraga et al. (2003).[3] Various studies have shown that the pass-through effect has decreased in recent years, as Taylor (2000), Campa

[1] See, for example, Ball and Reyes (2004a) and Ball and Reyes (2004b).
[2] This conclusion is challenged by Ca'Zorzi et al (2006). Their findings suggest that for emerging markets with moderate inflation rates, pass-through is similar to that of the US economy.
[3] The main reason for a higher pass-through effect in emerging markets lies on the lack of credibility of their Central Banks, which leads to a general belief among agents that temporary exchange rate shocks are indeed permanent [Eichengreen (2002)].

and Goldberg (2002) and Choudhri and Hakura (2006). Nevertheless, as discussed in Nogueira (2006), this reduction of the pass-through does not mean that it is no longer existent.

The objective of this paper is to present empirical evidence regarding the pass-through effect and "Fear of Floating" practices in a set of developed and emerging market economies that adopted IT. An important aspect is that the paper analyzes these two related issues before and after the adoption of the regime change, hence helping understanding the impact of this switch in monetary policy regime. We use a structural VAR model to test if the pass-through effect has indeed decreased in recent years. We also check for the reaction of international reserves and interest rates to changes in the exchange rate to show how IT has affected the foreign exchange market intervention suggested in the "Fear of Floating" literature. The structural VAR model allows us to isolate primitive shocks to exchange rate and inflation and analyse the response of inflation and of monetary policy to exchange rate shocks before and after Inflation Targeting. We also compare our results with those obtained from applying the methodology developed by Calvo and Reinhart (2002) and the modified version proposed by Ball and Reyes (2004b) to distinguish "floaters" from "dirty-floaters".

We conclude that the pass-through has indeed decreased substantially after the adoption of IT, as discussed in the literature. However, our results reinforce the argument of Nogueira (2006) that it does not mean that the pass-through is no longer existent and imposes no problem for the IT countries. Following this finding we conclude that the Central Banks may choose to smooth short-run exchange rate movements to attain its target inflation rate. This does not mean that the Central Banks do not allow the currency to adjust to a new long-run equilibrium following a shock, but that it will not let this movement interfere with their attainment of the inflation targets. We show that interventions in the foreign exchange market are much milder than before the regime change. In fact, the results suggest that that the adoption of IT meant a strong movement towards greater exchange rate flexibility. Following

this, we argue that for most countries possible interventions in the foreign exchange market should not be seen as "Fear of Floating" practices but potentially as a required policy for the attainment of the inflation targets.

The paper is organized as follows. Section 2 briefly discusses the literature on exchange rate pass-through and "Fear of Floating" in IT open-economies. Section 3 applies two basic methodologies to test for exchange rate flexibility and the "Fear of Floating" hypothesis. Section 4 presents evidence on the pass-through effect and interventions in the foreign exchange market. Section 5 concludes.

2. Fear of Floating and Inflation Targeting in open-economies

The debate on exchange rate arrangements in IT countries is often addressed as "Fear of Floating", following Calvo (2001) and Calvo and Reinhart (2002). They looked at monthly changes in exchange rate, international reserves and interest rates for a set of developed and emerging market economies, and concluded that many countries that claim to be "free-floaters" are indeed "dirty-floaters".

Ball and Reyes (2004a) consider that a country exhibits "Fear of Floating" when it claims to be pursuing a policy goal that is independent from the exchange rate, but keeps intervening in the foreign exchange market without any clear link with the policy goal. The reasons for a country to "fear" floating exchange rates may be the existence of a large debt in foreign currency; high exchange rate pass-through; adverse affects on competitiveness; and balance sheet effects. Eichengreen (2002) suggests that another reason is that exchange rate flexibility may increase uncertainty and reduce the access of emerging economies to international financial markets.

The main critique to the "Fear of Floating" approach, as pointed out by Edwards (2002), is related to the fact that it assumes that interventions in the exchange rate are always wrong, which is not necessarily the case under IT.

According to Ball (2000) Central Banks should react to exchange rate movements since they affect domestic inflation through an identifiable channel that is separate from domestic demand or supply shocks. In this sense, Eichengreen (2002) and Mishkin (2004) argue that when a monetary authority that has an inflation target increases interest rates to fight exchange rate movements it should not be concluded that it necessarily cares about exchange rate, but it should be considered that it may just care about inflation and everything that affects it[4]. In fact, Agenor (2002) has shown that the absence of such interventions can be destabilizing under this regime. Baqueiro et al. (2003) address this problem saying that many times the monetary authority's "Fear of Inflation" is mistaken as "Fear of Floating".

The exchange rate pass-through can be defined as the change in local currency domestic prices resulting from 1 percent change in the exchange rate. According to Campa and Goldberg (2002), pass-through studies consider the extent to which exchange rate movements are passed into traded goods prices, versus absorbed in producer profit margins. Most of the studies on this issue focus on changes in import prices following exchange rate movements. Campa and Goldberg (2002) have explained that the basic procedure of this literature is to estimate a local currency imports prices equation that captures movements of the exchange rate, dollar prices of imports and domestic demand of the destination market (normally real GDP). Ganapolsky and Vilan (2005) observe that this economic literature supports the hypothesis of partial pass-through, which means that only a portion of the exchange rate movements are translated into higher domestic prices[5].

[4] According to Mishkin (2000), as IT regimes have no explicit target for the nominal exchange rate they may be called "flexible" regimes, even when some interventions occur.

[5] For example, Campa and Goldberg (2002) have analysed the pass-through from exchange rate depreciation to imports prices, and have found an average short-run pass-through of 60 percent for OECD countries between

There is wide recognition in the literature that the pass-through, at the macroeconomic level, is determined mainly by the inflation level, the output gap and the credibility of the monetary authority [Amitrano et al. (1997), Goldfajn and Werlang (2000), Taylor (2000), Choudhri and Hakura (2006), Nogueira (2006), Garcia and Restrepo (2001) and Baqueiro et al. (2003)]. The output gap affects the pass-through by reducing the firm's power to increase prices, as increasing sales firms find it easier to pass-through increases in costs to final prices [Goldfajn and Werlang (2000)]. The inflation level affects the persistence of costs changes, which is positively correlated with the pass-through [Taylor (2000)][6]. This view, as expressed by Campa and Goldberg (2002) is that the pass-through of costs into mark-ups is endogenous to a country's inflation performance, generating a virtuous circle where low inflation variability leads to reduced mark-ups, less inflationary implications of monetary expansions, and continued low mark-ups. Finally, credible monetary authorities are expected to act according to the inflation stability objective, which keeps low inflation expectations even in the advent of a large depreciation.

Many economists have shown that the pass-through is higher for emerging than for developed economies, and that it has reduced in recent years. The reasons presented to explain this reduction are often related to the determinants of the pass-through: low inflation level [Amitrano et al. (1997), Taylor (2000), Choudhri and Hakura (2001), Baqueiro et al. (2003), Gagnon and Ihrig (2004) and Bailliw and Fujii (2004)], negative output gap [Garcia and Restrepo (2001) and Fraga et al. (2003)] and credibility gains [Mishkin and Savastano (2001)].

1975 and 1999, and 40 percent for the US. Using a similar methodology Ganapolsky and Vilan (2005) have found a short-run pass-through of 18 percent for the US for the period that spans from 1993M12 to 2004M12.

[6] The idea that low inflation countries have low exchange rate pass-through is the basic explanation given by Amitrano et al. (1997) for the low pass-through levels seen in Europe after the 1992 depreciations.

To explain the importance of monetary authority's response to exchange rate shocks we start describing the composition of the consumer price index[7]:

$$P = P_H^{\alpha} P_T^{(1-\alpha)} \tag{1}$$

Where P is the consumer price level, H represents the non-traded (home) sector, T the traded goods, and α is a bounded parameter that shows the participation of each sector in the composition of the consumer price index.

From equation (1) we can derive an inflation equation for the economy, where π is the general inflation:

$$\pi = \alpha\pi_H + (1-\alpha)\pi_T \tag{2}$$

Assuming relative purchasing power parity and constant world prices, and expressing the exchange rate depreciation as Δe we can rewrite equation (2) as:

$$\pi = \alpha\pi_H + (1-\alpha)\Delta e \tag{3}$$

Equation (3) shows that exchange rate depreciations will have an effect on general inflation that will vary depending on the composition of the consumer price index in terms of traded and non-traded goods. We can now look at the monetary authority response to exchange rate movements in terms of a Taylor-rule:

$$i_t = \theta + \pi_t + \lambda(\pi_t - \pi^*) + \beta(y_t - y^*) \tag{4}$$

Where i_t is the nominal interest rate, y_t is output, y^* is the equilibrium output level and π^* is the inflation target. The constant θ can be understood as the equilibrium real interest

[7] This analysis is based on those found in Reyes (2004) and Ball and Reyes (2004b).

rate. Equation (4) is a traditional Taylor-rule where the central bank reacts to deviations of inflation from the target and also to the output gap. Substituting (3) in (4), yields:

$$i_t = \theta + \pi_t + \lambda[(\alpha\pi_{tH} + (1-\alpha)\Delta e_t) - \pi^*] + \beta(y_t - y^*) \quad (5)$$

It is clear that, although the central bank does not care about the exchange rate level it must respond to its movements as it influences the overall inflation rate, and thus the attainment of the inflation targets[8].

Some authors, such as Ball (2000), advocate the exclusion of short-run exchange rate movements from the inflation target, thus targeting "long-run inflation", a measurement that would remove transitory effects of the exchange rate on prices. A problem with this approach is the difficulty in determining which exchange rate shocks are "transitory" and which are "permanent". In addition to this, as discussed by Agenor (2002), this procedure may lead to a reduction of the policy's transparency to the general public.

As discussed by Gagnon and Ihrig (2004), when a central bank acts aggressively to stabilize the domestic inflation it tightens policy to offset inflationary pressure from imports prices. This policy reaction holds down prices in other sectors so overall inflation remains stable. When agents are more aware of the central bank's intentions they are less likely to pass-through cost increases, including those coming from exchange rate. Hakura (2005) has come to a similar conclusion[9].

In this sense Ball and Reyes (2004a) and Ball and Reyes (2004b) argue that the classification proposed by Calvo and Reinhart (2002) of "Fear of Floating" is not good enough because it does not take into account the fact that many countries now target inflation and, under this regime, some response to exchange rate movements is required. They argue

[8] The term $(1-\alpha)\Delta e_t$ in equation (5) can be defined as the exchange rate pass-through effect. Hence, the greater this effect, the greater the response of the monetary policy to the exchange rate.

[9] Hausmann et al. (2001) have found a significant relationship between exchange rate pass-through and interventions in the foreign exchange market. They argue, however, that this relationship tends to break-down when they control for the ability of countries to borrow in their own currency.

that using Calvo and Reinhart's (2002) metric can actually misclassify targeter regimes as "fear of floaters".

3. IT and Floating Exchange Rates

3.1 Methodology and Data

There are two basic instruments of intervention on the exchange rate: interest rates and international reserves. The international reserves can be used to directly intervene in the foreign exchange market, selling or buying foreign currency and hence controlling the price of foreign currency in terms of the domestic one. The interest rates can be used in a rather indirect manipulation, known in the literature as the "interest rate defence of the currency"[10].

Previous studies on "Fear of Floating" have compared the variability of interest rates, exchange rate and international reserves for countries that claim to follow a free-floating regime. The seminar contribution to this literature was the methodology proposed by Calvo and Reinhart (2002). They present their results in terms of the probability of observing monthly percent changes within a certain range for exchange rate, international reserves and interest rates. The ranges suggested are +/- 2.5 percent changes in exchange rates and international reserves, and 50 basic points change in interest rates. The proposed test can be formalised as following:

$$P[|\Delta e| < x / peg] > P[|\Delta e| < x / float] \quad (5)$$

$$P[|\Delta R| < x / peg] < P[|\Delta R| < x / float] \quad (6)$$

$$P[|\Delta i| < y / peg] < P[|\Delta i| < y / float] \quad (7)$$

Where x is equal to 2.5 percent, y is equal to 50 basic points Δe is the exchange rate depreciation, ΔR is the change in international reserves, and Δi is the change in interest rates.

[10] See for example Flood and Jeanne (2000).

The premise behind their analysis is that under a fixed regime, the variability of exchange rates should be low, while the variability of interest rates and reserves should be high, as they are used to prevent the exchange rate from floating. For a flexible regime, the opposite results should hold.

Ball and Reyes (2004b) suggest some modifications on Calvo and Reinhart's (2002) approach. First, instead of using nominal interest rates they use real interest rates, justifying that the nominal interest rates move in step with inflation, so it is important to break the link between the two before one can analyse whether interest rates are responding to inflation or to exchange rate changes. Second, they change the arbitrary ranges by standard deviations of each series, which is more accommodative to studying country differences[11]. The third modification is the inclusion of the variability of inflation, so as to check if the central bank cares more about stability in inflation or in exchange rate. Their methodology can be formalised as follows:

$$P[|\Delta e| > sd / FF] < P[|\Delta e| > sd / IT] \quad (8)$$

$$P[|\Delta \pi| > sd / FF] > P[|\Delta \pi| > sd / IT] \quad (9)$$

$$P[|\Delta R| > sd / FF] > P[|\Delta R| > sd / IT] \quad (10)$$

$$P[|\Delta r| > sd / FF] \leq P[|\Delta r| > sd / IT] \quad (11)$$

Where sd is the standard deviation of each series, r is the real interest rate, FF stands for "Fear of Floating" and IT for Inflation Targeting. The expected results from Ball and Reye's (2004) approach is that under an IT regime we should see more changes in exchange rate and less changes in inflation and international reserves than under a "Fear of Floating"

[11] This argument can be understood as following: a developed economy may "fear" floating, but the interest rates will rarely change by more than 50 basic points, whereas an emerging market economy, in a much more volatile environment, may be a true floater but consider 50 basic points a small change in interest rates to have the intended effects on output and inflation.

regime. In respect to real interest rates, they believe the probability of high changes should be greater or equal to a "Fear of Floating" regime. It means that there is no clear association between interest rates changes and "Fear of Floating" practices, in a way that further investigation is necessary to classify the country. This investigation is related to the "timing" of the changes. This is done by checking if the probability of large changes in interest rates and international reserves is higher conditional to changes in the inflation gap, or in the exchange rate:

$$P[|\Delta \pi gap| > sd \,/\, |\Delta r| > sd \,/\, IT] > P[|\Delta e| > sd \,/\, |\Delta r| > sd \,/\, IT] \quad (12)$$

$$P[|\Delta \pi gap| > sd \,/\, |\Delta R| > sd \,/\, IT] > P[|\Delta e| > sd \,/\, |\Delta R| > sd \,/\, IT] \quad (13)$$

Where $\Delta\pi$ gap is the difference between the current inflation and the target. Equations (12) and (13) express that conditional on a country adopting Inflation Targeting we expect to see more changes of r and R associated to changes in the inflation gap than to exchange rate.

In this paper we propose the use of both methodologies discussed above not to classify the countries, as in the original papers, but to observe whether or not there is a movement towards greater exchange rate flexibility after the adoption of IT by a set of developed and emerging market economies.

Monthly data was collected for 8 IT countries that may be divided into two groups: the first one comprises developed economies (Canada, United Kingdom and Sweden), and the second one is composed of emerging market economies (Brazil, Czech Republic, Mexico, South Africa and South Korea). The period of analysis corresponds to the interval that spans from 1985M1 to 2004M12 for the developed economies, and 1995M1 to 2004M12 for the emerging market economies. The shorter period of the former countries is in order to exclude

hyperinflation data that may negatively affect the results.[12] The analyses were made in two sub-periods – before and after the adoption of Inflation Targeting.[13]

Data was obtained from the IMF International Financial Statistics. The inflation rate is the rate of growth of Consumer Price Index. Exchange rate depreciation is the change of the national currency per unit of dollar (average of the month). A positive variation means depreciation of the national currency, and a negative variation means appreciation. International reserves data is the monthly change of foreign exchange reserves. The interest rate used is the money market rate. The inflation gap series was constructed subtracting the actual inflation from the monthly target (calculated from the annual inflation target).

3.2. Results

The results from Calvo and Reinhart's (2002) "Fear of Floating" analysis are reported in Table 1. In general they show that the adoption of IT meant greater exchange rate flexibility, translated by higher probabilities of high exchange rate changes and lower of monetary instruments changes. This is not equivalent, however, to saying that no intervention in the foreign exchange market takes place after the regime change.

Before Inflation Targeting the probability that the exchange rate in Canada would move within the +/- 2.5 percent range was of 99 percent; after, 94 percent, which is still a very high probability and suggests some control on the exchange rate by the central bank[14]. The change in the probabilities for international reserves and interest rates show a smaller use of these instruments, but international reserves use still seems to be common.

[12] The use of a longer period for Brazil and Mexico would include very high and unstable inflation data. We opted to exclude this period of the others emerging market economies in order to make comparisons between them more appropriate.
[13] The dates of adoption of IT for each country can be seen in the Appendix.
[14] Calvo and Reinhart (2002) suggested that this probability for a "floater" should be below 80 percent, and for a "dirty-floater" should be greater than 90 percent.

Sweden's results are similar to those of Canada, although they show greater exchange rate flexibility, with the probability of the exchange rate moving within the range being less the 70 percent after the regime change. The international reserves use, however, seem to be the same in both periods. Interventions taken place before the regime change can be explained by the commitment of the monetary authority to keep the currency fixed under the European exchange rate arrangement.

The results for the UK show a greater stability of the exchange rate variability after IT, when the probability of monthly changes within the +/- 2.5 percent range reached 87 percent. This result, however, can be due to smaller exchange rate shocks in the second period. International reserves and interest rate's probabilities remained fairly the same in both periods, indicating a possible interventionist policy before and after Inflation Targeting.

Brazil's results show a strong movement towards exchange rate flexibility after the substitution of a dollar-pegged policy by the IT regime. The probability of low monthly changes in exchange rate dropped from 93 to just 49 percent. It is also possible to see an indication of smaller use of interest rates after the regime change. This conclusion does not apply to international reserves, which seems to have a similar pattern of variability in both periods.

South Korea and Czech Republic's results are somewhat similar: both countries had in place a managed exchange rate system before the adoption of the targeter regime, with high probability of the monthly exchange change falling within the +/- 2.5 percent range. Both countries moved towards greater flexibility after IT, with just some indication of small reserves use.

Mexico also had a dollar-pegged policy before IT, and it can be seen through high probability of low monthly changes of the exchange rate, and low probabilities for monetary

policy instruments. The adoption of IT also meant greater flexibility of the exchange rate, but interest rates still seem to respond strongly to exchange rate movements.

Finally, South Africa's results indicate a complete change from a managed exchange rate regime towards a free-floating one. The probability that the monthly exchange change felt within the +/- 2.5 percent range was 83 percent before IT and 43 percent after. The probabilities for interest rates and international reserves also changed according to this conclusion.

Table 2 shows the results for Ball and Reyes's (2004) "Fear of Floating" analysis. The results show the probability of having a monthly change of each variable that is greater than its standard deviation. The conclusions are similar to those found using Calvo and Reinhart's (2002) metric: IT meant greater exchange rate flexibility, but some interventions in the exchange rate still seem to be present. As in our previous analysis it is difficult to find a correct classification for each country according to the metric applied. Although for most of the economies greater exchange rate flexibility is seen after the regime change, more use of interest rates and international reserves is also observed.

Table 3 shows the analysis of the "timing" of the monetary policy instruments used proposed by Ball and Reyes (2004). As discussed in the previous section, it is expected that conditional on a country's adoption of IT, the probability of high monthly changes of real interest rates and international reserves in moments when a wider inflation gap is observed should be higher than the probability of high monthly changes of such instruments when the exchange rate level is changing.

The results, again, are mixed: normally when one instrument (in general real interest rates) is responding more to the inflation gap than to exchange rate we observe the opposite with the other (international reserves in most of the cases). We can get two conclusions from this initial exercise: one, the exchange rate has been freer to float after IT; and two, some

interventions in the foreign exchange market seems to sill occur. In the next section we assess the importance of the pass-through for the attainment of the targets, so we can have a better view of the "Fear of Floating" issue.

4. Exchange rate pass-through and "Fear of Floating" practices

4.1 Methodology

Some studies have tried to analyse the interventions in the foreign exchange rate in a targeter regime looking at impulse responses. Lubik and Schorfheide (2003) have used Bayesian estimates of a DSGE model. Reyes (2003) used a VAR model of interest rates, international reserves and exchange rate to analyse the "Fear of Floating" hypothesis for Canada, Brazil, Mexico and Chile. Ball and Reyes (2004a) also use a VAR model to check for policy responses to exchange rate movements in Mexico, including output gap, inflation gap (inflation minus target), international reserves and real interest rates in their model. However, none of these approaches has addressed the issue of the impact of the adoption of an IT regime.

Following the lead of the literature we use data on inflation, exchange rate, interest rate, international reserves and output growth[15] in order to check the responsiveness of inflation, interest rates and international reserves to exchange rate changes. This is carried out by using a Structural Vector Autoregression (SVAR), and analysing error variance decompositions and impulse response functions[16]. Our analysis is complementary to those cited above because we identify the exchange rate shocks, we look at a larger number of countries, and most importantly we compare the results prior and after the adoption of IT.

[15] We have also tested the model using output gap (obtained using a HP-Filter) instead of output growth. The results are very similar and we have opted to report here just those obtained from using output growth. The reason for this is to avoid using ad-hoc de-trending process to compute the output gap that might eliminate valuable information from the data.

[16] The numbers of lags of the model was determined using Akaike information criteria.

The response of inflation to exchange rate shocks is the basic idea of the pass-through effect, and thus of the role of interventions in the foreign exchange market to the attainment of the inflation targets. Our approach of modelling the pass-through is somewhat similar to those found in Minella et al. (2003) and Ca'Zorzi et al (2006). The first one comprises of estimating a cointegrated Vector Autoregression (VAR) model, in which the endogenous variables are exchange rate, output, inflation, interest rates, and EMBI+ (to capture financial instability). Ca'Zorzi et al (2006) estimated a VAR model including output, oil prices (to capture supply shocks), import prices, CPI inflation, and the exchange rate.

The innovations of the VAR model were orthogonalized using a Choleski decomposition of the covariance matrix. The main importance of orthogonalizing the innovations is in terms of identifying the primitive shocks, as it can be rather misleading to examine a shock to a single variable in isolation if historically it has moved together with the other variables; orthogonalization takes these co-movements into account. The problem with the Choleski procedure is that there is a different factorization for every ordering, and the results can change considerably when the variables ordering is changed. We dealt with this problem by checking the robustness of the results given different variables ordering. The results found were fairly robust to different ordering. The ordering of the variables presented here is: output growth, exchange rate, inflation, international reserves, and interest rate.

The use of a recursive identification scheme implies that the identified shocks contemporaneously affect their corresponding variables and those variables that are ordered at a later stage, but have no impact on those that are ordered before. The first variable in the system is output growth, followed by the exchange rate. With this ordering we implicitly assume a contemporaneous impact of the demand shocks on the exchange rate while also imposing a certain time lag on the impact of exchange rate shocks on output. The price variables are ordered next and are thus contemporaneously affected by the above mentioned

shocks. The interest rate is ordered last, allowing for the monetary policy to react contemporaneously to all variables in the model.

We use the same data of the previous section for the estimations. As a proxy of output growth we have used the rate of growth of the Industrial Production Index, obtained from the IMF International Financial Statistics. Some ADF and KPSS unit-root tests were performed on the data collected and can be seen in Table 4. With the exception of nominal interest rates, all the variables seem to be stationary[17]. Following this we have decided to use the first difference of interest rates instead of its level[18].

4.2 Results

The SVAR estimations results are presented here using variance decomposition and accumulated impulse response functions. We start analysing the pass-through effect. Table 5 shows the accumulated response of inflation following a shock to the exchange rate. This is a measure of the exchange rate pass-through.

In general the results show that the pass-through is indeed higher for emerging than for developed economies, and that it has decreased after the adoption of IT. However, as discussed in Nogueira (2006) the pass-through still seems to be an important variable driving inflation in most of the economies.

Before Inflation Targeting, for Canada 1 percent shock to the exchange rate generated an accumulated response of 0.06 percent inflation, before IT. After the figure is 0.03. For Sweden, 1 percent depreciation leads to 0.02 percent accumulated response of inflation in both periods. UK's results show the inflation response fallen from 0.06 percent before IT, to 0.04 after.

Brazil had the higher pass-through before the adoption of the new regime. The results show that 1 percent exchange rate shock would generate an accumulated response, after 12 months, of 1.31,

[17] The results show inflation for the UK and the Czech Republic to be I(1). Following this finding, we have also estimated the model using the differences of the variables, but the results were basically the same as when we considered them to be stationary. The results reported here consider inflation for these countries as I(0).
[18] We have also estimated the model using the level of interest rates, and the results are qualitatively similar.

which implies a complete pass-through. After the policy change, 1 percent exchange rate shock would lead to a response of inflation of just 0.11 percent. The reason for such a high pass-through before IT is probably linked to the dollar-pegged exchange rate regime of the period between 1995M3 and 1999M2 that was basically used to drive inflation closer to international levels after more than a decade of very high and unstable inflation.

Mexico's and Czech Republic's results also show a strong reduction of the pass-through. For the latter country the accumulated response of inflation to a exchange rate shock of 0.19 before IT, and of just 0.02 after; and for the former the figures dropped from 0.45 percent to 0.02 percent.

South Africa's and South Korea's results show a weaker decrease of pass-through effect. In both cases the accumulated response of inflation after 12 months to 1 percent exchange rate shock, before IT, was 0.12 percent. After the regime change it was 0.09 percent for South Africa, and 0.10 percent for South Korea.

Tables 6 and 7 show the percentage of the variance of interest rates that are explained by the variance of inflation and of exchange rate after one, six and twelve months. We expect that, after the regime change, exchange rate variance will not be more important than variance in inflation to explain the variance of interest rates. Table 8 shows the percentage of variance of international reserves that is explained by the variance of exchange rate. In this case we expect a decrease in the importance of the variance of exchange rate to explain the variance of international reserves, indicating a minor role for direct interventions in the foreign exchange market after IT.

We also present the accumulated impulse response functions. While observing the impulse response functions it is important to note that the expected movement of the variables following an intervention in the foreign exchange market is a positive change in interest rates, showing a raise of this instrument to fight the exchange rate depreciation, and a negative change in international reserves, implying that the Central Bank is selling foreign currency to stop the depreciation of the domestic currency.

The analysis of Canada's results show signs of interventions of both instruments on the foreign exchange market before IT, and some intervention after. While the percentage of the variance of interest rate explained by exchange rate depreciation after twelve months fell from 16 percent to just 2 percent, the results for international reserves moved from 6 percent to 7 percent. The percentage of variance of interest rate explained by the variance of inflation was low and quite stable in both periods. In respect to the impulse response functions they show that the responses of the monetary policy instruments to exchange rate shocks have weakened after IT, but remained with the expected movement for interventions. Considering that the estimated pass-through for Canada is very low, and has also decreased after IT, exchange rate smoothing may not be linked solely to inflation control purposes, and some "Fear of Floating" may also be present.

Sweden's results present some weak evidence of intervention in the foreign exchange market. The impulse response functions suggest some international reserves use in both periods. However, before IT the percentage of the variance of international reserves explained by the exchange rate after twelve months is just 2 percent. After the adoption of new regime the percentage found is 4 percent.

The UK's results present evidence of strong interventions before IT, in especial through the use of international reserves. The percentage of the variance of international reserves explained by the exchange rate after 12 months is around 17 percent, and of interest rates is around 4 percent. In both cases the impulse response functions have the expected pattern for interventions. After the adoption of IT there is no such evidence anymore.

Brazil's results are clear in showing interventions in both periods analysed, especially through the use of interest rates. The percentage of the variance of interest rates explained by the variance of the exchange rate after twelve months stayed around 14 percent in both periods, and of international reserves reduced from 7 to 1 percent. The analyses of the

impulse response functions reinforce these conclusions. The response of interest rates to inflation, however, has increased a lot after the regime change, as the percentage of the variance of interest rates explained by the variance of inflation after twelve months changed from just 6 percent to 15 percent. The pass-through estimated before showed a dramatically reduction after IT, though this effect remained quite important in determining the inflation rate. In this sense interventions in the foreign exchange market are likely to be linked more to inflation control purposes than to exchange rate targeting.

The Czech Republic's results suggest an increased level of interventions on the exchange rate after the adoption of IT, especially through the use of the international reserves. After the adoption of the new regime the percentage of the variance of international reserves explained by the exchange rate after twelve months is around 18 percent, whereas before it was around 5 percent. Golinelli and Rovelli (2005) believe the use of international reserves by that country's monetary authority is a sign of "Fear of Floating", which they see as a "disguised" Euro-peg policy. Considering the very low pass-through estimated for the Czech Republic after IT, it is indeed difficult to link interventions to the attainment of the inflation targets, suggesting a possible "Fear of Floating" approach to monetary policy.

Mexico has the strongest policy of intervention of the sample in both periods. Nevertheless, the country does not seem to use international reserves to this end after the regime change. The percentage of the variance of international reserves explained by the variance of the exchange rate after twelve months respectively before and after IT changed from 69 to less than 1 percent. However, the results of interest rates basically stayed the same, changing from 44 to 42 percent, being the most important variable in the explanation of the variance of interest rates. The impulse response functions show that the response of interest rates to exchange rate shocks remained very similar in both periods. In terms of the impacts of the pass-through effect, the results that we have seen before have shown an incredible

reduction of the pass-through effect after the adoption of IT, almost to the point of eliminating it. In this case it is very difficult not to see the Mexican monetary policy as a basic case of "Fear of Floating".

South Africa's results show signs of interest rates use to smooth exchange rate fluctuations in both periods. Before IT the percentage of the variance of interest rates explained by shocks to the exchange rate after 12 months was around 17 percent. After the regime change the figure is around 11 percent. The impulse response functions go in the same direction. At the same time the response of interest rates in respect to inflation has increased. The percentage of the variance of interest rates explained by the variance of inflation, increased from 1 to 15 percent. This conclusion is reinforced by looking at the impulse response functions. The pass-through found for South Africa after IT was lower than before the regime change, but it was still quite high. It means that the pattern of interventions in the foreign exchange market can be consistent with the pass-through level found for South Africa.

Regarding South Korea we can see a strong reduction of interventions on the exchange rate. Before IT the percentage of variance of the interest rate and the international reserves explained by the variance of the exchange rate after twelve months fell from 64 to both of them, to just 6 percent for interest rates and 8 percent for international reserves. The impulse responses also show a milder response of these instruments to exchange rate shocks. Given the pass-through level found before for South Korea, these interventions may not be necessarily symptoms of "Fear of Floating", but just a healthy case of "Fear of Inflation".[19]

The main argument of our analysis is that, given the importance of the pass-through for some economies, exchange rate smoothing may be accepted under IT. When interventions in the foreign exchange market are related to inflation control it is indeed unfair to accuse a country of "Fear of Floating", as it is just a case of "Fear of Inflation" [Baqueiro et al.

[19] This view is opposed by Park (2001) that believes that South Korea's policy after the Asian crisis is basically a "Fear of Floating" approach.

(2003)]. Our analyses of the pass-through have shown that a change in the exchange rate leads to a change in inflation in most country, which is normally greater as time passes. This means that for their Central Banks exchange rate depreciation is a sign of inflation to come; as IT is a forward-looking system, some measures should be taken in the present to avoid this future rise in prices. The results presented in this paper have shown that this is the case for most IT countries.

As general rule Minella et al. (2003) say that the monetary authorities should not move the exchange rate to artificial levels, but should react to curb inflation pressure due to depreciation. Finally, the dynamics of the exchange rate interventions and of the pass-through effect make it very difficult to define whether a country is pursuing a pure inflation target or an exchange rate target. As argued by Ball and Reyes (2004a) it is very difficult to classify a country as practicing IT or "Fear of Floating" as it is not clear where one ends and the other starts. However, the classification of the countries is not the basic idea of this paper, and the analyses are made in a more general way, in order to link the concepts of pass-through, IT and "Fear of Floating". The risk of misclassifying a country policy is that it may put in question the real intentions of the monetary policy and undermine its credibility.

5. Conclusion

We have presented evidence on exchange rate pass-through at the macroeconomic level for a set of developed and emerging market economies, as well as the reaction of their monetary policy to exchange rate shocks. We carry out our analysis comparing the period before and after the adoption of the Inflation Targeting (IT). We ask if this new regime helps reducing the pass-through from exchange rate into national inflation and to what extent the intervention of the Central Bank presents features of "Fear of Floating" or simply reflects "Fear of Inflation".

Our results allow us to draw three main conclusions. First, we support the view from the previous literature that the exchange rate pass-through is higher for emerging than for developed economies, and that it has decreased dramatically after the adoption of IT. This effect, though, did not disappear completely and still appears to be a significant variable driving inflation in many economies. Secondly, that although exchange rate variability increased substantially after IT, most Central Banks kept on reacting to exchange rate changes. Third, the interventions in the foreign exchange market have decreased. Given that exchange rate shocks still have an impact on inflation, this can be interpreted more as "Fear of Inflation" than "Fear of Floating". That is, interest rate reaction to exchange rate shocks may simply be reflecting the fact that the Central Bank is reacting to exchange rate movements since they affect domestic inflation.

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Table 1: Calvo and Reinhart (2002) "Fear of Floating" analysis

	Before Inflation Targeting			After Inflation Targeting		
	Ex. rates	Reserves	Int. rates	Ex. rates	Reserves	Int. rates
Canada	0.99	0.22	0.67	0.94	0.47	0.86
Sweden	0.75	0.35	0.60	0.69	0.36	0.97
UK	0.59	0.57	0.62	0.87	0.63	0.69
Brazil	0.93	0.47	0.23	0.49	0.48	0.69
Czech Rep.	0.81	0.39	0.72	0.63	0.66	0.91
Mexico	0.94	0.33	0.14	0.81	0.75	0.38
S. Africa	0.83	0.25	0.52	0.43	0.75	0.85
S. Korea	0.92	0.47	0.39	0.71	0.58	0.85

Notes: The numbers are the probabilities of changes confined within the bounds presented in equations (5) to (7).

Table 2: Ball and Reyes (2004) "Fear of Floating" analysis

	Before Inflation Targeting				After Inflation Targeting			
	Ex. rates	Reserves	Inflation	Real rates	Ex. rates	Reserves	Inflation	Real rates
Canada	0.35	0.14	0.50	0.19	0.32	0.22	0.33	0.11
Sweden	0.38	0.32	0.27	0.08	0.35	0.17	0.22	0.11
UK	0.26	0.13	0.28	0.25	0.21	0.23	0.45	0.19
Brazil	0.06	0.15	0.38	0.06	0.30	0.21	0.56	0.24
Czech R.	0.22	0.25	0.28	0.05	0.33	0.24	0.29	0.18
Mexico	0.08	0.12	0.65	0.08	0.37	0.23	0.72	0.30
S. Africa	0.18	0.20	0.46	0.20	0.24	0.15	0.39	0.15
S. Korea	0.08	0.22	0.35	0.24	0.25	0.33	0.31	0.10

Notes: The numbers are the probabilities of changes that exceed the bounds presented in equations (8) to (11).

Table 3: Ball and Reyes (2004) response of monetary policy instruments

	Real interest rates		International reserves	
	Inflation gap	Ex. rate	Inflation gap	Ex. rate
Canada	0.18	0.17	0.18	0.25
Sweden	0.20	0.11	0.13	0.25
UK	0.18	0.19	0.20	0.19
Brazil	0.19	0.10	0.19	0.20
Czech Rep.	0.22	0.26	0.16	0.15
Mexico	0.29	0.42	0.19	0.19
S. Africa	0.25	0.14	0.13	0.21
S. Korea	0.12	0.10	0.32	0.52

Notes: The numbers are the probabilities of changes that exceed the bounds presented in equations (12) and (13).

Table 4: Unit root tests

Variables	Tests	Brazil	Canada	UK	Mexico	Czech	Sweden	Africa	Korea
Inflation	ADF	-3.06** (12)	-2.91** (12)	-2.731 (12)	-2.82* (07)	-2.053 (12)	-4.96** (04)	-3.77** (07)	-2.478 (12)
	KPSS	0.30** (04)	2.749 (04)	1.940 (04)	1.635 (04)	1.140 (12)	3.191 (04)	0.32** (04)	0.22** (04)
Output	ADF	-5.21** (05)	-8.05** (03)	-6.39** (04)	-8.69** (00)	-9.66** (01)	-10.11** (04)	-8.06** (02)	-4.72 (02)
	KPSS	0.22** (04)	0.13** (03)	0.15** (04)	0.28** (00)	0.33** (01)	0.04** (04)	0.05** (02)	0.07** (02)
Ex. rate	ADF	-5.79** (02)	-3.70** (09)	-11.8** (01)	-2.95** (08)	-6.23** (01)	-11.14** (01)	-5.80** (01)	-6.05** (02)
	KPSS	0.12** (02)	0.30** (04)	0.28** (01)	0.466 (04)	0.582 (03)	0.41* (01)	0.656 (01)	0.16** (02)
Reserves	ADF	-10.2** (00)	-5.27** (08)	-3.98** (06)	-3.36** (12)	-3.54** (07)	-4.11** (12)	-9.73** (00)	-4.44** (05)
	KPSS	0.09** (00)	0.06** (04)	0.19** (04)	0.543 (04)	0.15** (04)	0.15** (04)	0.08** (00)	0.08** (04)
Int. rate	ADF	-2.61* (09)	-1.307 (04)	-1.655 (02)	-1.658 (09)	-0.231 (03)	-0.178 (09)	-1.01 (02)	-0.890 (08)
	KPSS	1.343 (04)	4.868 (04)	7.521 (02)	2.217 (04)	2.751 (03)	4.902 (03)	2.428 (02)	2.033 (04)

Notes: ** indicates the rejection of the null of a unit root at the 5% confidence level and * indicates rejection of the null of a unit root at the 10% confidence level for the ADF test, and acceptance of the null of stationarity for the KPSS test. The numbers in parenthesis are the number of lags.

Table 5: Accumulated response of inflation to 1% shock to exchange rate

	Canada	Sweden	UK	Brazil	Czech R	Mexico	S. Africa	S. Korea
Before IT	0.06	0.02	0.06	1.30	0.19**	0.45**	0.12**	0.12**
After IT	0.03**	0.02**	0.04	0.11**	0.02	0.02	0.09**	0.10**

Notes: The numbers represent the accumulated response of inflation after 12 months to 1% depreciation shock. ** indicates significance at the 10% level.

Table 6: Error variance decomposition of interest rates in respect to exchange rate

Countries	Period	1 Month	6 Months	12 Months
Canada	Before IT	13.63	15.65	15.65
	After IT	0.99	1.78	1.78
Sweden	Before IT	1.77	5.03	5.03
	After IT	0.57	0.72	0.73
UK	Before IT	3.96	3.97	3.97
	After IT	0.08	1.31	1.31
Brazil	Before IT	15.86	14.41	14.03
	After IT	0.50	12.91	13.71
Czech Republic	Before IT	0.39	0.78	0.78
	After IT	0.48	1.43	1.43
Mexico	Before IT	55.79	44.32	44.28
	After IT	40.03	41.61	41.61
South Africa	Before IT	12.90	17.25	17.25
	After IT	3.91	10.38	10.69
South Korea	Before IT	16.80	63.86	63.82
	After IT	0.37	5.74	5.74

Notes: The numbers represent the percentage of the variance of interest rates that is explained by the variance of exchange rate after 1, 6 and 12 months.

Table 7: Error variance decomposition of interest rates in respect to inflation

Countries	Period	1 Month	6 Months	12 Months
Canada	Before IT	0.33	2.29	2.29
	After IT	0.06	1.60	1.60
Sweden	Before IT	2.04	1.92	1.92
	After IT	0.89	1.37	1.37
UK	Before IT	0.13	0.24	0.24
	After IT	1.01	1.04	1.04
Brazil	Before IT	0.62	5.14	5.95
	After IT	3.25	14.65	14.99
Czech Republic	Before IT	15.99	12.06	12.04
	After IT	6.10	6.22	6.22
Mexico	Before IT	0.74	7.89	7.89
	After IT	0.02	0.07	0.07
South Africa	Before IT	0.35	0.63	0.63
	After IT	18.32	15.41	15.28
South Korea	Before IT	0.87	3.13	3.16
	After IT	3.54	3.88	3.88

Notes: The numbers represent the percentage of the variance of interest rates that is explained by the variance of inflation after 1, 6 and 12 months.

Table 8: Error variance decomposition of international reserves in respect to ex. rate

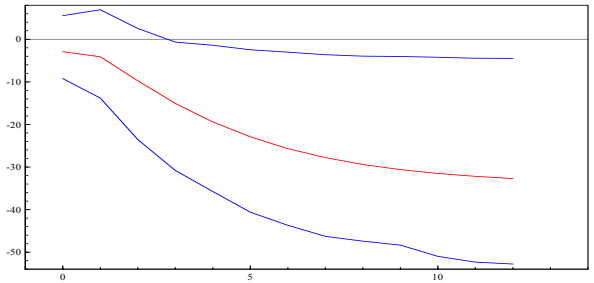
Countries	Period	1 Month	6 Months	12 Months
Canada	Before IT	7.06	5.93	5.93
	After IT	7.45	7.21	7.21
Sweden	Before IT	1.68	1.82	1.82
	After IT	3.26	4.32	4.32
UK	Before IT	17.24	17.65	17.65
	After IT	0.05	0.08	0.08
Brazil	Before IT	4.24	5.87	6.83
	After IT	0.03	0.51	0.51
Czech Republic	Before IT	2.56	4.98	4.98
	After IT	17.65	17.82	17.82
Mexico	Before IT	65.88	68.88	68.97
	After IT	0.02	0.77	0.79
South Africa	Before IT	1.94	5.57	5.57
	After IT	0.12	0.81	0.86
South Korea	Before IT	7.24	63.57	63.82
	After IT	4.62	8.19	8.22

Notes: The numbers represent the percentage of the variance of international reserves that are explained by the variance of exchange rate after 1, 6 and 12 months.

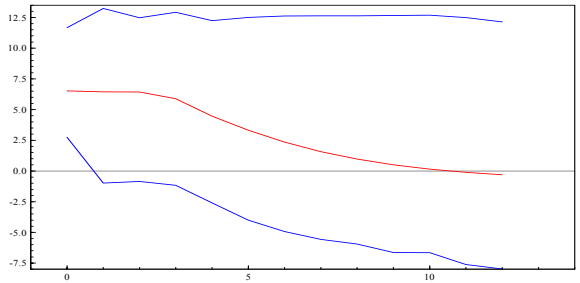
Accumulated Impulse response functions

Brazil before Inflation Targeting

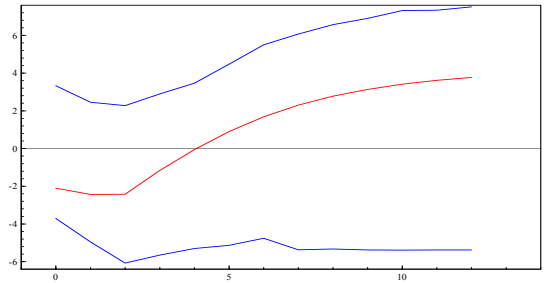
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

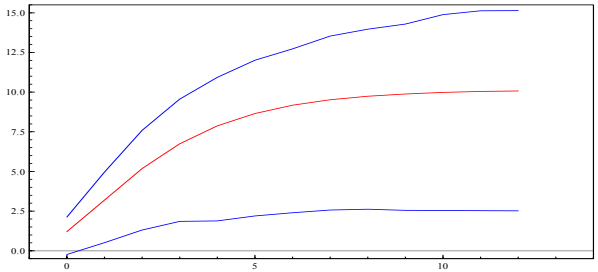


Reserves to a shock to exchange rate

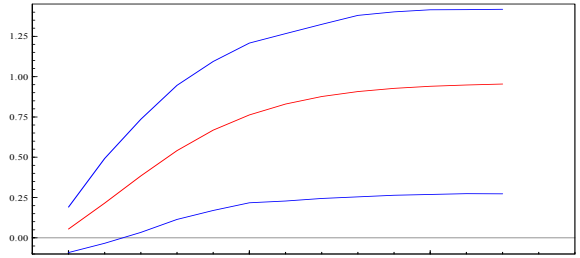


Brazil after Inflation Targeting

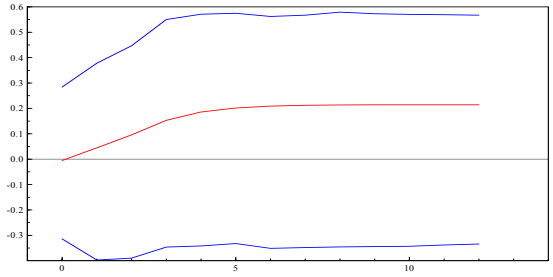
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

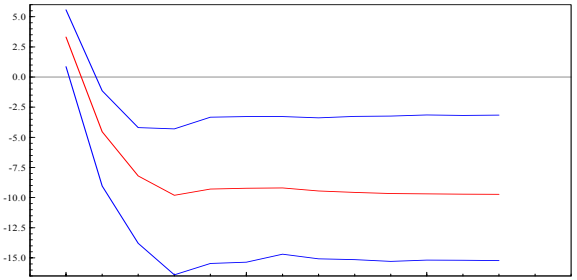


Reserves to a shock to exchange rate

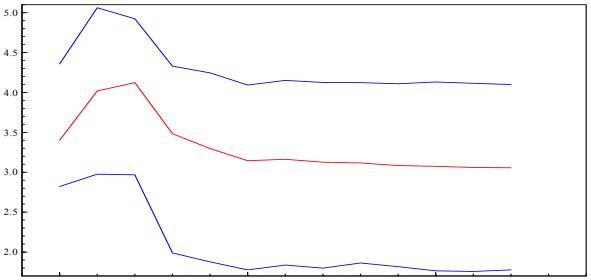


Mexico before Inflation Targeting

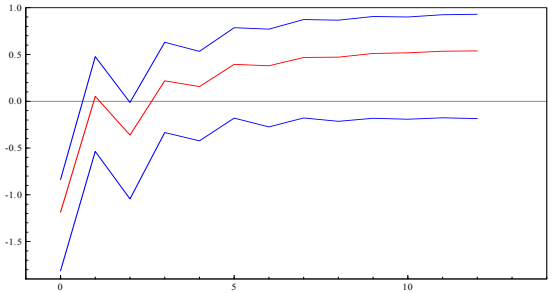
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

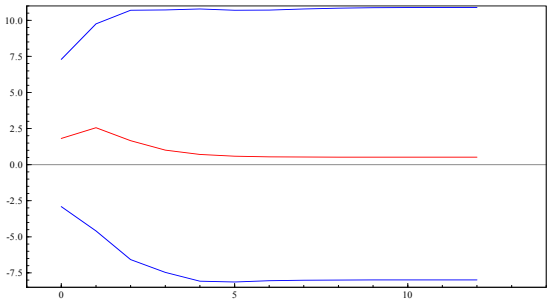


Reserves to a shock to exchange rate

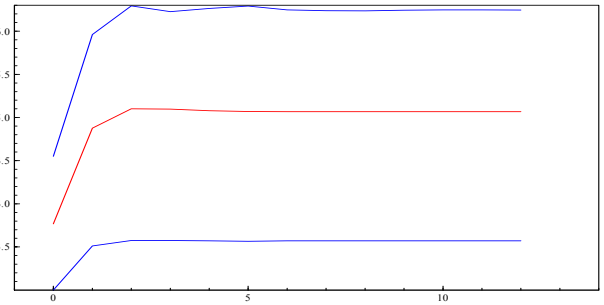


Mexico after Inflation Targeting

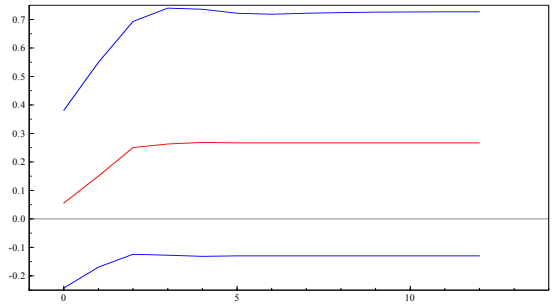
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

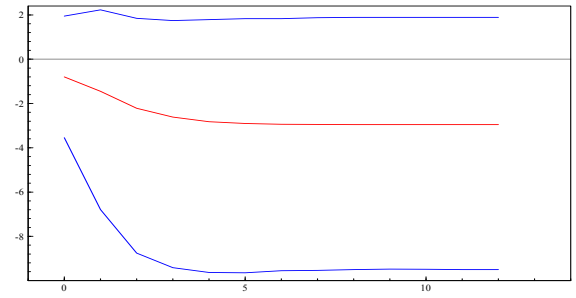


Reserves to a shock to exchange rate

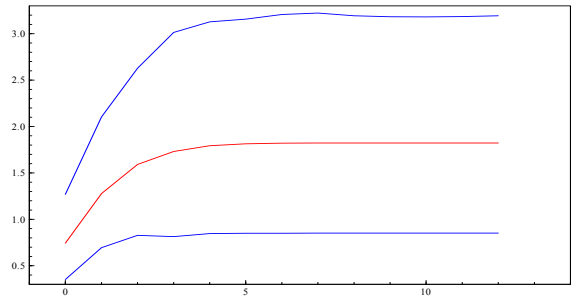


South Africa before Inflation Targeting

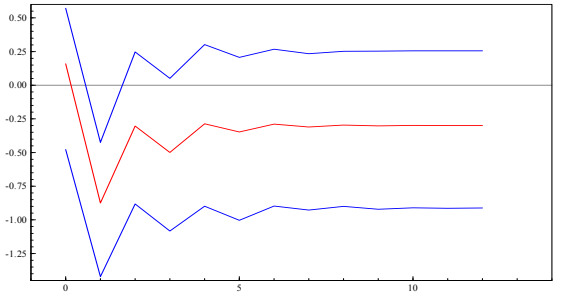
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

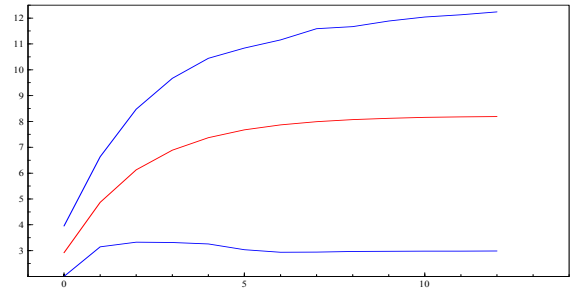


Reserves to a shock to exchange rate

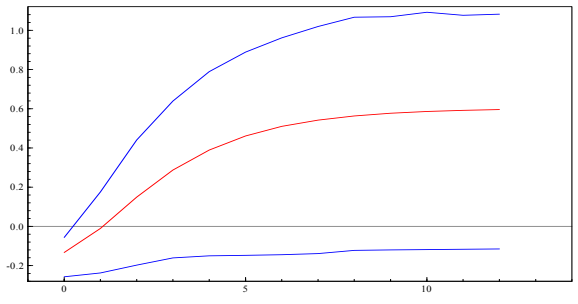


South Africa after Inflation Targeting

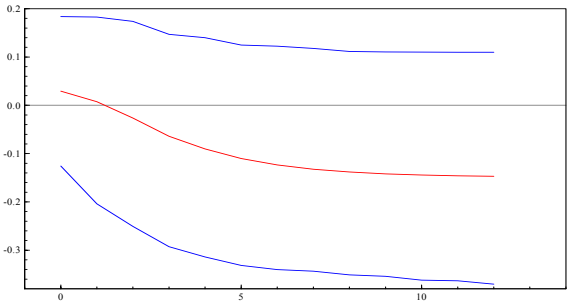
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

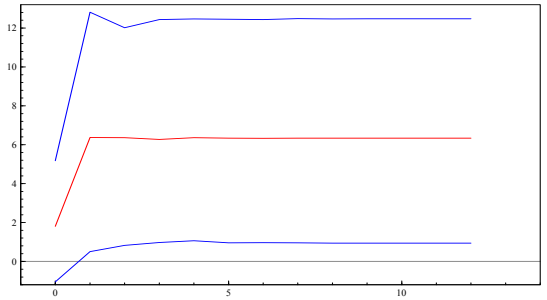


Reserves to a shock to exchange rate

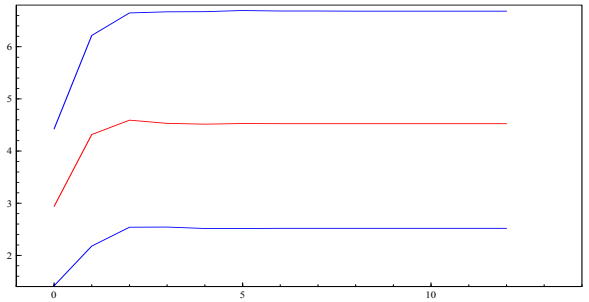


Canada before Inflation Targeting

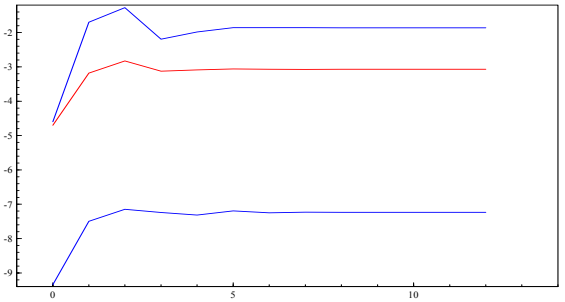
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

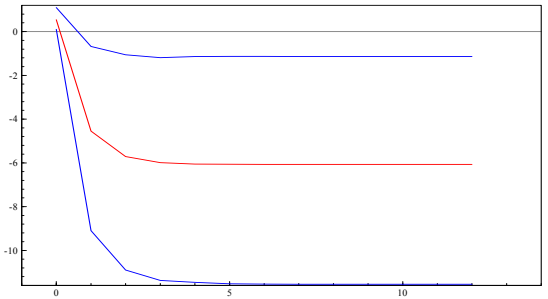


Reserves to a shock to exchange rate

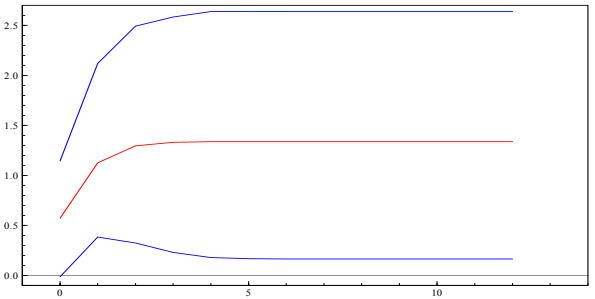


Canada after Inflation Targeting

Interest rate to a shock to inflation



Interest rate to a shock to exchange rate



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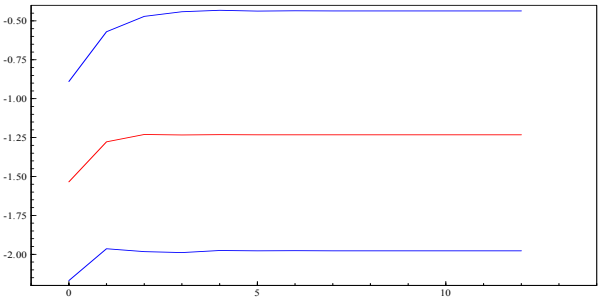
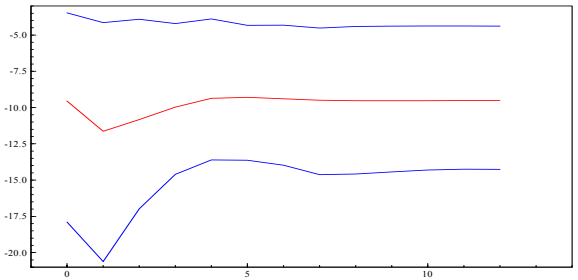
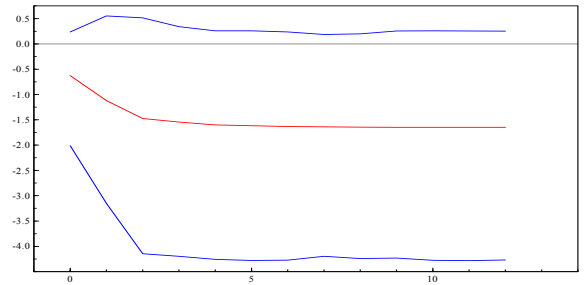


Czech Republic before Inflation Targeting

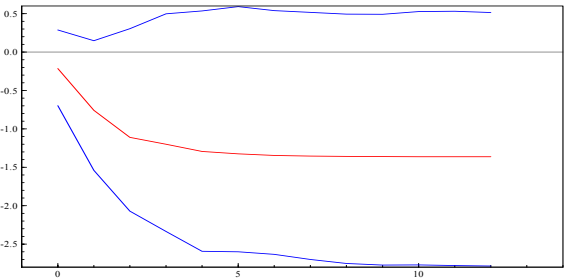
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

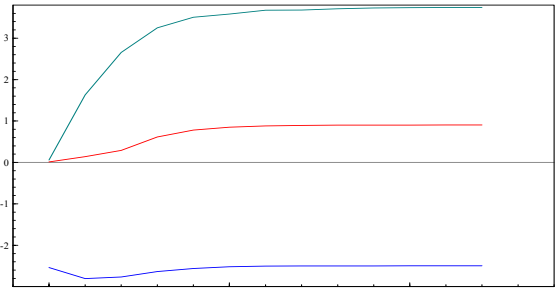


Reserves to a shock to exchange rate

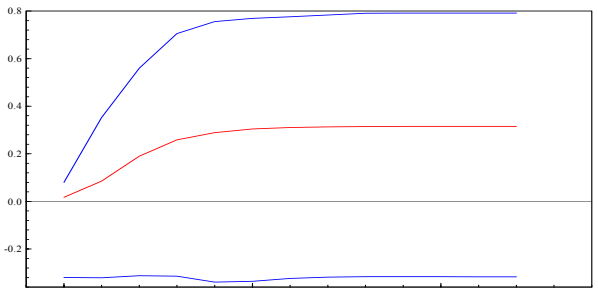


Czech Republic after Inflation Targeting

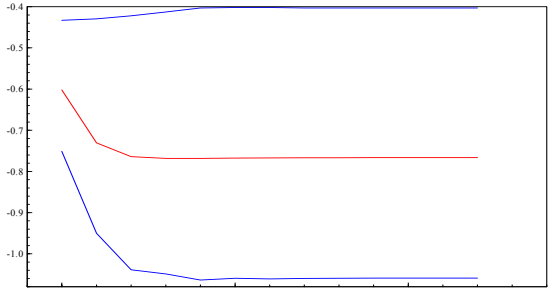
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

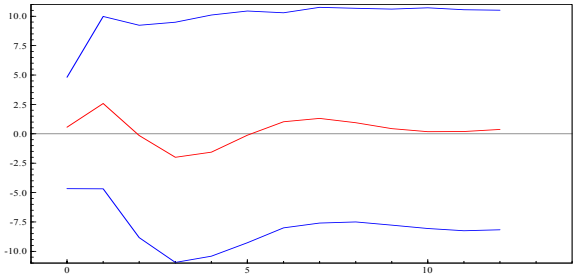


Reserves to a shock to exchange rate

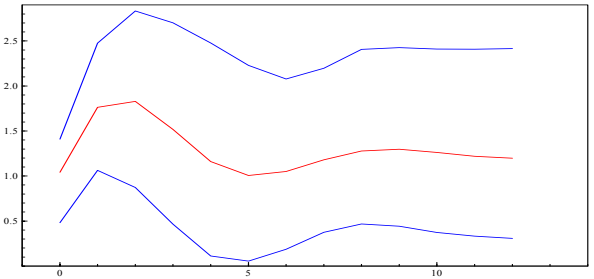


Korea before Inflation Targeting

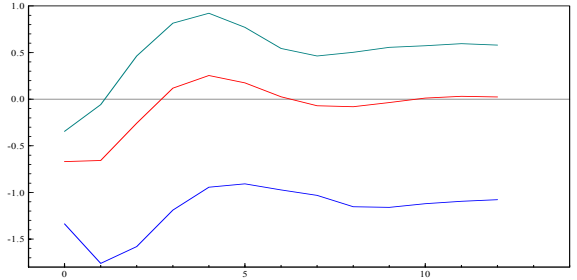
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

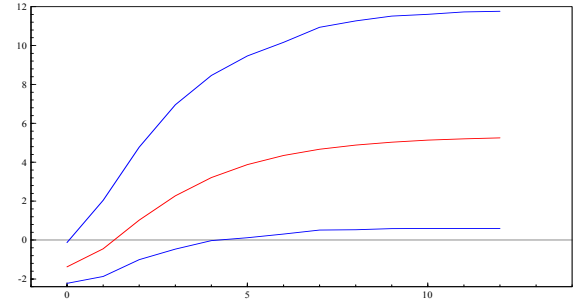


Reserves to a shock to exchange rate

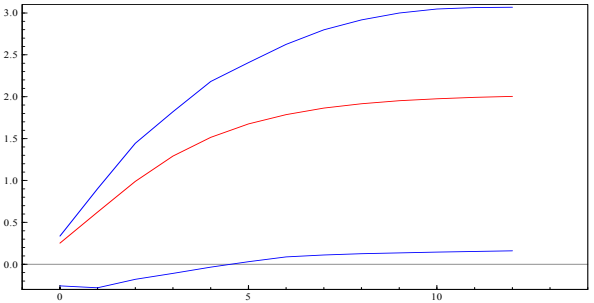


Korea after Inflation Targeting

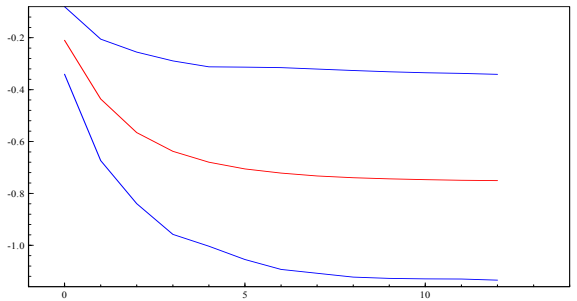
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

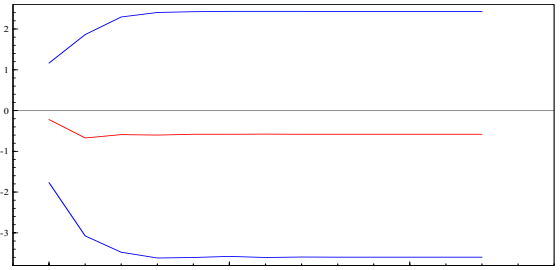


Reserves to a shock to exchange rate

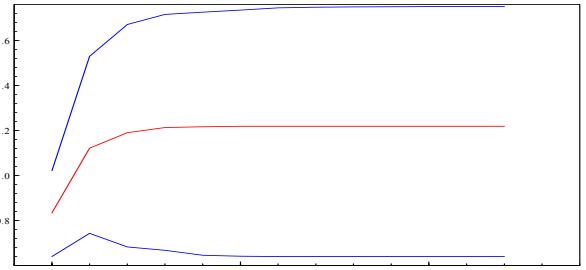


UK before Inflation Targeting

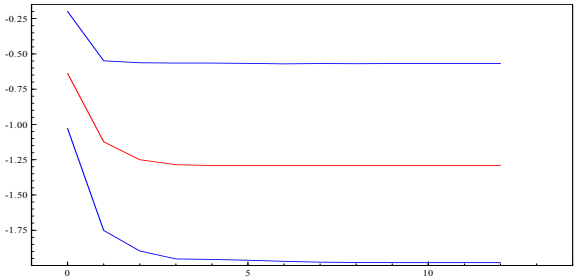
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

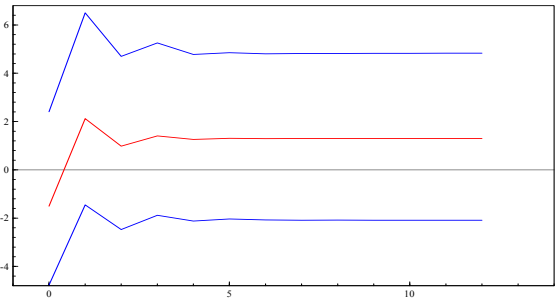


Reserves to a shock to exchange rate

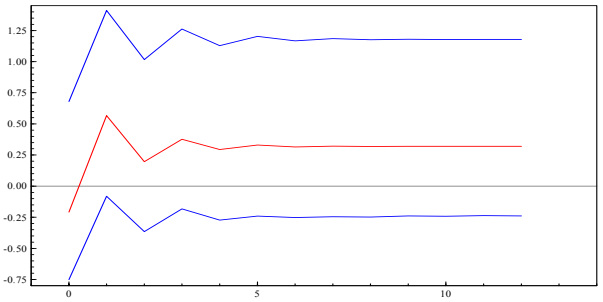


UK after Inflation Targeting

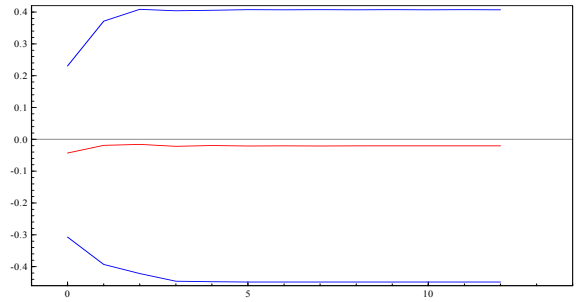
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

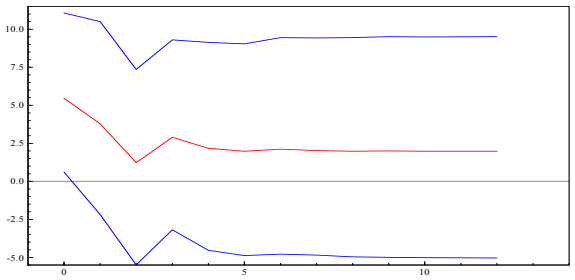


Reserves to a shock to exchange rate

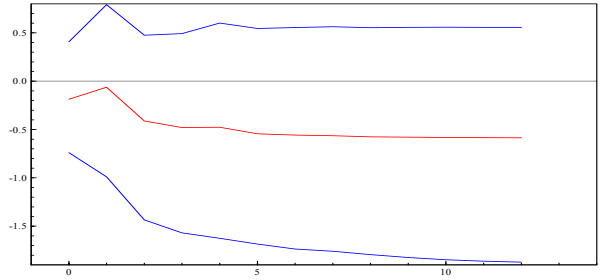


Sweden before Inflation Targeting

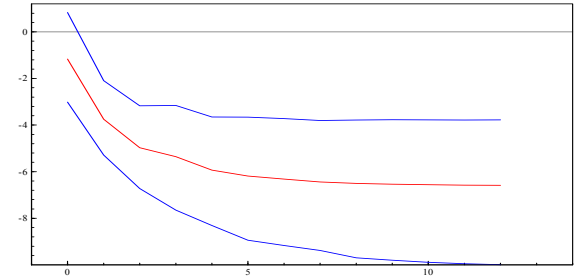
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate

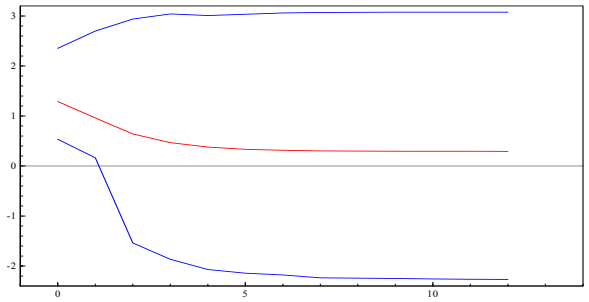


Reserves to a shock to exchange rate

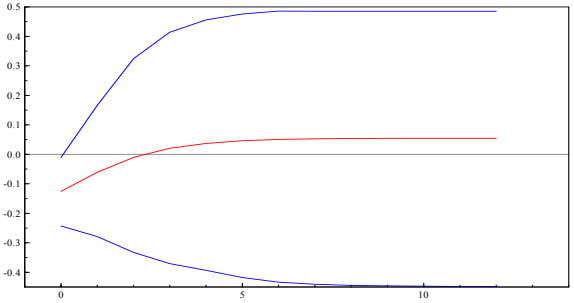


Sweden after Inflation Targeting

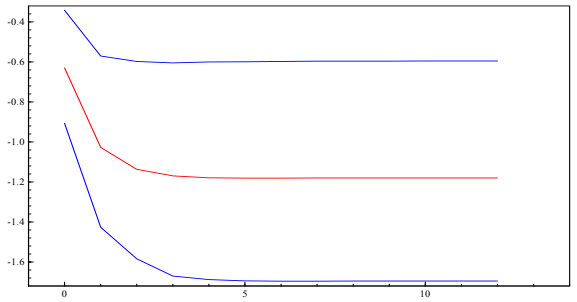
Interest rate to a shock to inflation



Interest rate to a shock to exchange rate



Reserves to a shock to exchange rate



Notes:

1) The graphs show the accumulated impulse responses to 1% shock to a variable.
2) Lines in blue represent the standard errors calculated using bootstrap draws.

Appendix - Date of adoption of the Inflation Targeting regime

Countries	Adoption of Inflation Targeting
Canada	Feb - 1991
United Kingdom	Oct - 1992
Sweden	Jan - 1993
Czech Republic	Jan - 1998
South Korea	Jan - 1998
Mexico	Jan - 1999
Brazil	Jun - 1999
South Africa	Feb - 2000