Does Inflation Targeting Decrease Exchange Rate Pass-through in Emerging Countries?*

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Abstract

In this paper, we empirically examine the effect of inflation targeting on the exchange rate pass-through to prices in emerging countries. We use a panel VAR that allows us to use a large dataset on twenty-seven emerging countries (fifteen inflation targeters and twelve inflation nontargeters). Our evidence shows that inflation targeting in emerging countries appears to decrease exchange rate pass-through to various prices (import price, producer price and consumer price). Our results also show that the contribution of exchange rate shocks to price fluctuations in emerging targeters declines after adopting inflation targeting.

Keywords: Inflation Targeting, Exchange Rate Pass-Through, panel VAR
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1 Introduction

After New Zealand initiated inflation targeting in 1990, a large number of industrial and emerging countries explicitly adopted an inflation target as their nominal anchor. In the last two decades, ten industrial economies and twenty emerging economies[1] have adopted the full-fledged inflation targeting system for managing monetary policy. Many other emerging countries intend to adopt this monetary framework in the near future. Given the vulnerability of emerging countries to exchange rate shocks, a key element for the success of this strategy depends on its ability to reduce the exchange rate pass-through. Various studies have shown a decrease in exchange rate pass-through in the last two decades: is it related to inflation targeting?

Many studies have provided some evidence that the adoption of inflation targeting is associated with an improvement in overall economic performance (Bernanke and Mishkin, 1997; Svensson, 1997; Mishkin and Schmidt-Hebbel, 2007). Ball and Sheridan (2006), one of the few empirical papers critical of inflation targeting, argue that the implementation of inflation targeting appears to have been irrelevant in industrial countries. Based on OLS cross-section estimation, their results indicate that the reduction in the level and the volatility of inflation in inflation targeting countries simply reflects regression toward the mean, i.e., inflation will fall faster in countries that start with high inflation than in countries with an initial low inflation. Since countries having implemented inflation targeting had generally an initial high level of inflation, the bigger drop in inflation for those countries simply reflects a tendency for this variable to revert to its mean. But their study focused solely on industrial countries and therefore cannot address this issue for emerging countries targeting inflation. Gonçalves and Salles (2008) extended Ball and Sheridan's analysis for a subset of 36 emerging economies and found that, for those countries, results are different. Specifically, emerging countries that have adopted inflation targeting have experienced greater reductions in inflation and in growth volatility, even after controlling for mean reversion.

The present paper contributes to this literature on inflation targeting by analyzing the effect of inflation targeting on exchange rate pass-through in emerging countries. It is based on the hypothesis in Taylor (2000) that argues that exchange rate pass-though is lower in low-inflation environment.

[1] The ten industrial countries targeters are Australia, Canada, Finland, New Zealand, Norway, Spain, Sweden, Switzerland and United Kingdom. Finland and Spain are now in euro area. The twenty emerging countries targeters are Brazil, Chile, Colombia, Czech republic, Ghana, Guatemala, Hungary, Indonesia, Israel, Korea, Mexico, Peru, Philippines, Poland, Romania, Serbia, Slovakia, South Africa, Thailand and Turkey. Slovakia ceased inflation targeting in January 2009 with its ERM II entry

More precisely Taylor's argument is that in low-inflation environment firms expect a deviation of inflation to be less persistent and would therefore pass on less of an exchange rate-induced increase in the price of imported inputs to its selling prices. This hypothesis has been supported by empirical evidence based on the consumer price index (CPI), both for industrialized and emerging countries (Gagnon and Ihrig, 2001; Choudrhi and Hakura, 2006). Since Gonçalves and Salles (2008) show that inflation targeting has helped to reduce inflation in emerging countries, it is interesting to analyze whether the adoption of inflation targeting has lead to a decrease in exchange rate pass-through[2].

This paper tackles this issue by employing panel VAR techniques on data from a subset of twenty-seven emerging economies (fifteen targeters and twelve nontargeters)[3]. The panel VAR approach has two main advantages. First, the VAR approach addresses the endogeneity problem by allowing endogenous interactions between the variables in the system. Second, the asymptotic results are easier to derive for panel data. After a first VAR analysis by only including the consumer price index (CPI), we conduct a second VAR analysis by including two other prices: import price index (IMP) and producer price index (PPI). The use of these two prices indexes (IMP and PPI) in the VAR allows us to directly answer to the Taylor's hypothesis. As argued by Taylor (2000), a decrease in pass-through effect to import prices (producer prices) means that after the adoption of inflation targeting a retailing firm that imports goods (firm that imports its inputs) absorbs a larger fraction of an exchange rate shock through a smaller variation in its selling prices. There are different channels that can explain the incomplete pass-through to consumer prices. First, as highlighted by Campa and Goldberg (2008), exchange rate pass-through into the final consumption prices of

[2]This idea was explored by Mishkin and Schmidt-Hebbel (2007). Mishkin and Schmidt-Hebbel (2007) empirically study the link between inflation targeting and some measures of economic performance including exchange rate pass-through to consumer prices. Using data on twenty-one industrial and emerging inflation-targeting countries (targeters) and thirteen industrial countries without inflation targeting (nontargeters) they employ panel VAR techniques. To test for differences, they adopt the before-and-after approach by comparing impulse response functions in different country samples, depending on whether a country has inflation targeting in place. The results of this analysis show that pass-through effect to consumer prices has been close to zero in industrial inflation targeters before and after inflation targeting and in nontargeters. In emerging inflation targeters, the exchange rate pass-through to consumer prices fell after the countries achieved a stationary target, but remained significantly different from zero. However, these results in Mishkin and Schmidt-Hebbel (2007), using consumer price as the only price, suffer from selection bias as there are no emerging inflation nontargeters in the control group.

[3]In the sequel, "targeters" refers to emerging countries targeting inflation, and "nontargeters" to emerging countries not targeting inflation.

imported goods can reflect the sensitivity of border prices to exchange rates. In the border market, exporters will absorb a larger fraction of exchange rate movements and pass-through into prices at the border will be incomplete. Second, as mentioned by Burstein et al. (2002, 2005), the extent of consumer prices after changes in exchange rate depends on the relative importance of imported inputs being used for domestic production and the presence of distribution costs. The production or distribution channels can dampen the effect of exchange rate shocks and account for incomplete exchange rate pass-through to consumer prices.

Even though impulse responses give information about the size of exchange rate pass-through to domestic prices, they do not show how important exchange rate shocks are in explaining domestic prices fluctuations. Since the implementation of inflation targeting requires flexible exchange rate regime, inflation targeting can lead to a great volatility in exchange rate. Thus, even if inflation targeting leads to a decline in exchange pass through to domestic prices, it can have an ambiguous effect on the contribution of exchange rate shocks to domestic prices fluctuations. Hence, to assess the contribution of exchange rate shocks to domestic prices fluctuations, we also perform a variance decomposition of domestic prices.

The main results of this paper are the following. For targeters countries, the pass-through to consumer, import and producer prices have decreased from a higher level to a new level that remains significantly different from zero, while for nontargeters there is not significant change in the pass-through to domestic prices. The variance decomposition analysis indicates that the contribution of exchange rate shocks to price (particularly import price) fluctuations in targeting countries has decreased after inflation targeting, while the contribution of exchange rate shocks to price fluctuations in nontargeters countries has increased. Since we do not observe a decrease in pass-through for nontargeters and in accordance with Taylor hypothesis, we are led to think that the adoption of inflation targeting is a plausible explanation.

The remainder of the paper is organized as follows. Section 2 presents the econometric methodology. Section 3 describes the data. Section 4 presents the empirical results and their interpretations. Section 5 concludes the study.

2 Methodology

We use panel VAR techniques to estimate impulse response functions. The use of panel VAR techniques has two main advantages. First, the VAR approach addresses the endogeneity problem by allowing endogenous interactions between the variables in the system. Second, the panel techniques tackle the data limitation problem. Indeed, the partition into subsets (before and after) reduces the numbers of time observations. Moreover, for most countries in our sample, there are many missing values.

The econometric model takes the following reduced form:

$$Y_{it} = \Gamma(L)Y_{it} + u_i + \epsilon_{it} \tag{1}$$

where Y_{it} is a vector of stationary variables, $\Gamma(L)$ is a matrix polynomial in the lag operator with $\Gamma(L) = \Gamma_1 L^1 + \Gamma_2 L^2 + \ldots + \Gamma_p L^p$, u_i is a vector of country specific effects and ϵ_{it} is a vector of idiosyncratic errors (zero means, constant variances, individually serially uncorrelated and cross-sectionally uncorrelated). As in Love and Zicchino (2006), each variable in the VAR is time demeaned, i.e., for each time period, we compute the mean of the series across panels and subtract this mean from the series. This procedure eliminates the time specific effects and, thus, mitigates the influence of cross-sectional dependence on panel data (Levin et al. (2002)). In other words, the use of time demeaned series makes the assumption of cross-sectionally uncorrelated errors more acceptable. Mutl (2002) and Huang (2008) have proposed alternative methodologies that account for cross-sectional dependence on panel data.

An issue in estimating this model concerns the presence of fixed effects. As fixed effects are correlated with the regressors, due to lags of the dependent variable, we use forward mean differencing (the Helmert procedure), following Love and Zicchino (2006). In this procedure, to remove the fixed effects, all variables in the model are transformed in deviations from forward means. Let $\bar{y}_{it}^m = \sum_{s=t+1}^{T_i} y_{is}^m/(T_i - t)$ denote the means obtained from the future values of y_{it}^m, a variable in the vector $Y_{it} = (y_{it}^1, y_{it}^2, \ldots, y_{it}^M)'$, where T_i denotes the last period of data available for a given country series . Let $\bar{\epsilon}_{it}^m$ denote the same transformation of ϵ_{it}^m, where $\epsilon_{it} = (\epsilon_{it}^1, \epsilon_{it}^2, \ldots, \epsilon_{it}^M)'$. Hence we get:

$$\tilde{y}_{it}^m = \delta_{it}(y_{it}^m - \bar{y}_{it}^m) \tag{2}$$

and

$$\tilde{\epsilon}_{it}^m = \delta_{it}(\epsilon_{it}^m - \bar{\epsilon}_{it}^m) \tag{3}$$

where $\delta_{it} = \sqrt{(T_i - t)/(T_i - t + 1)}$. For the last year of data this transformation cannot be calculated, since there are no future value for the construction of the forward means. The final transformed model is thus given by:

$$\tilde{Y}_{it} = \Gamma(L)\tilde{Y}_{it} + \tilde{\epsilon}_{it} \tag{4}$$

where $\tilde{Y}_{it} = (\tilde{y}^1_{it}, \tilde{y}^2_{it}, \ldots, \tilde{y}^M_{it})'$ and $\tilde{\epsilon}_{it} = (\tilde{\epsilon}^1_{it}, \tilde{\epsilon}^2_{it}, \ldots, \tilde{\epsilon}^M_{it})'$

This transformation is an orthogonal deviation, in which each observation is expressed as a deviation from average future observations. Each observation is weighted so as to standardize the variance. If the original errors are not autocorrelated and are characterized by a constant variance, the transformed errors should exhibit similar properties. Thus, this transformation preserves homoscedasticity and does not induce serial correlation (Arellano and Bover, 1995). Additionally, this technique allows to use the lagged values of regressors as instruments and estimate the coefficients by the generalized method of moment (GMM).

Once all coefficients of the panel VAR are estimated, we compute the impulse response functions (IRFs)[4]. In order to compute the IRFs we use Cholesky decomposition. The assumption behind Cholesky decomposition is that series listed earlier in the VAR order impact the other variables contemporaneously, while series listed later in the VAR order impact those listed earlier only with lag. Consequently, variables listed earlier in the VAR order are considered to be more exogenous. We apply bootstrap methods to construct the confidence intervals of the IRFs. Since we cannot assume independence among the various samples, we also employ bootstrap methods to construct confidence intervals for differences in IRFs rather than simply taking their differences[5].

Following Ito and Sato (2007, 2008)[6], we begin by setting up a 4-variable VAR model, $Y_{it} = (gap_{it}, \Delta m_{it}, \Delta neer_{it}, \Delta cpi_{it})'$, where *gap* denotes the output gap, m, *neer*, *cpi* denote the natural log of money supply, the natural log of the nominal effective exchange rate and the natural log of the consumer price index, respectively. (CPI) and Δ represents the first difference operator. We include the output gap to capture both supply and demand shocks as in Ito and Sato (2007, 2008). Money supply is included to allow for for the effects of monetary policy on inflation.

The response of CPI inflation to changes in exchange rate depends on different channels. First, as highlighted by Campa and Goldberg (2008),

[4]The panel VAR is estimated by using the package provided by Inessa Love. This package is a Stata program for Love (2001) and it is used in Love and Zicchino (2006).

[5]If we assume sample independence, the confidence intervals for differences in IRFs would be narrower.

[6]Ito and Sato (2007) used VAR technique to compare the exchange rate pass-through effects of East Asia and Latin American Countries, while Ito and Sato (2008) applied VAR analysis to exchange rate pass-through in East Asian countries .

exchange rate pass-through into the final consumption prices of imported goods can reflect the response of border prices to exchange rate changes. At the border, the exporter will absorb a larger fraction of exchange rate movement and import prices will respond less than proportional to exchange rate shocks. Second, according to Burstein et al. (2002, 2005), the response of consumer prices to exchange rate shocks depends on the relative importance of imported inputs being used for domestic production and the presence of distribution costs. The production or distribution channels can dampen the effect of exchange rate changes and account for a low pass-through to consumer prices. Then, to directly check the Taylor hypothesis, we also conduct an additional estimation with 6-variable VAR model by including two other prices: the producer price index (PPI) and the import prices (IMP). Following Taylor (2000), a decrease in the pass-through effect on import prices (producer prices) will mean that retail firms that import their commodities (firms that import their inputs) pass-through a lower fraction of an exchange rate shock into their selling prices.

Following Love and Zicchino (2006) and Mishkin and Schmidt-Hebbel (2007), the shocks in the VAR are measured as one standard deviation of the residual of the corresponding equation. This standardization is used in order to allow comparison of dynamic response of different samples. As noted by Lütkepohl (2005, chap. 2, p. 53), the average size of the innovations occurring in a VAR depends on their standard deviations. So, impulse response analysis is more useful when innovations of one standard deviation are considered rather than unit shocks. Such concerns prove valid in our particular case of before-and-after (targeters-and-nontargeters) comparison where the coefficients in the VAR and the variability of shocks can change over period (across targeters and nontargeters) (see Section below).

As discussed above, the order of endogenous variables is central to the identification of structural shocks. Proceeding as in Ito and Sato (2007, 2008), we use the following ordering. The output gap is placed first. Thus, the demand and supply shocks that affect the output gap are assumed to be predetermined. The money supply is ordered second since it seems more reasonable to assume exchange rate responds contemporaneously to monetary policy shocks than vice versa. The nominal effective exchange rate is placed before the domestic prices. So, the nominal effective exchange rate is assumed to respond contemporaneously to supply, demand and monetary policy shocks but not to price shocks, and, the exchange rate shocks are assumed to have a contemporaneous effect only on domestic inflation. Then, for the 4-variable VAR the ordering is: $gap, \Delta m, \Delta neer, \Delta cpi$. In 6-variable VAR it seems appropriate to place import prices ahead of producer and consumer prices and to place consumer prices last in the ordering. Thus, for the

6-variable VAR the ordering is: $gap, \Delta m, \Delta neer, \Delta imp, \Delta ppi, \Delta cpi$.

For robustness, as in Ito and Sato (2007, 2008) we use two alternative orderings: $(\Delta m, \Delta neer, gap, \Delta cpi)$ or $(\Delta m, \Delta neer, gap, \Delta imp, \Delta ppi, \Delta cpi)$ and $(gap, \Delta neer, \Delta m, \Delta cpi)$ or $(gap, \Delta neer, \Delta m, \Delta imp, \Delta ppi, \Delta cpi)$. In the first alternative ordering, output gap is placed the third instead of the first in the ordering. Then, in this ordering, the contemporaneous information of the exchange rate shock and output gap is not ignored in the monetary policy implementation, and the nominal exchange rate shocks is assumed to affect output gap contemporaneously, but not vice versa. In the second alternative ordering, we permute the orderings of money supply and exchange rate from the baseline model so that exchange rate shocks are not affected by monetary policy shock contemporaneously. Results of these alternative orderings are reported in Appendix 3. The use of these alternative orderings does not change our finding.

3 Data

Our quarterly data set consists of twenty-seven emerging economies (fifteen targeters and twelve nontargeters), covering the 1989:Q1-2009:Q1 period. The details and sources of the data used in the empirical estimation are presented in Appendix 2. Using the panel VAR before-and-after strategy already employed by Mishkin and Schmidt-Hebbel (2007), we investigate whether inflation targeting has helped to reduce the exchange rate pass-through to domestic prices in emerging countries.

Some countries in our sample (Argentina and Brazil, for instance) experienced extremely high inflation rates and currency crisis. Following Gonçalves and Salles (2008), to avoid the contamination of our results by the incidence of hyperinflation episodes and currency crisis, we excluded the corresponding periods in the estimation. Since the adverse impact of currency crises is exercised through high inflation, we define hyperinflation episodes and/or currency crisis as the periods when annual inflation was above a 50% threshold (Gonçalves and Salles, 2008).

The output gap is generated by applying the Hodrick-Prescott (HP) filter to eliminate a strong trend in the seasonally adjusted real gross domestic product (GDP). To characterize money supply, we use base money or monetary aggregate M1 depending on theirs availabilities. The nominal effective exchange rate (import-weighted multilateral exchange rate index by country) is used in the VAR to define the pass-through as the impact of the exchange rate changes of trading partners. The nominal effective exchange rate (NEER) is defined so that an increase in the index means depreciation.

The consumer and producer prices are measured by theirs corresponding indexes (consumer price index (CPI) and producer price index (PPI)). For only Chile and Czech Republic, import price is measured by import price index. For the others countries, due to non-availability of data for long time series of import price index, we use import unit value as an alternative measure of import prices (IMP). Contrary to price index measure, unit value measure has the disadvantage that its variations may be caused by both price and compositional quantity changes. However, thanks to relatively low resource costs, they are used by many countries as surrogates for import price index. Moreover, the bias of unit value measure seem to be negligible when it is used as short-term indicator of inflation (as in our case of quarterly data).

For some countries, scholars disagree on the adoption date of inflation targeting regime. Here we use as the adoption dates of inflation targeting strategy the "default dates" obtained by Rose (2007) that are based on a best judgment of when inflation targeting began.

According to the history of exchange rate arrangements in Reinhart and Rogoff (2004) and Ilzetzki et al. (2011) there is heterogeneity in exchange rate arrangements over time among both targeters and nontargeters. Some targeters (like Chile, Israel and Hungary) have combined inflation targeting with crawling-peg or fixed-band exchange rate regimes. Most targeters have preferred to follow a freely floating exchange rate regime with moderate interventions by the central bank in the foreign exchange market.

Table 1 reports descriptive statistics of different price inflations and variation in NEER. Table 1 shows that the CPI inflation and its volatility have decreased in both targeters and nontargeters. Only in targeters there is a decrease in the level and the volatility of IMP and PPI inflations. Table 1 also shows that the volatility of NEER has decreased over time in targeters countries, while it has increased in nontargeters. However, this change in volatility is taken into account, since as mentioned above the shocks in the VAR are measured as one standard deviation of the residual of the corresponding equation.

4 Empirical Results

This section presents the results of the impulse response functions (IRFs) analysis. Before conducting the VAR estimation, we test for stationarity. We use the Fisher-type test approach testing for panel-data unit roots developed by Maddala and Wu (1999). This test does not require strongly balanced data, and the individual series can have gaps as in our data. Some recent papers (Banerjee et al., 2005, Lyhagen, 2008 and Wagner, 2008) find that, in the

Table 1: Descriptive statistics

	Inflation targerters			
	Before IT		After IT	
Variable	Mean	Std dev.	Mean	Std dev.
CPI inflation	11.32	9.86	4.93	3.44
IMP inflation	10.76	16.08	2.94	12.54
PPI inflation	10.58	13.02	5.86	5.28
NEER variation	8.68	18.23	0.23	9.71
	Inflation nontargerters			
	Before 1999		After 1999	
	Mean	Std dev.	Mean	Std dev.
CPI inflation	7.16	9.20	5.42	5.91
IMP inflation	2.72	9.30	6.33	14.55
PPI inflation	1.94	12.64	7.43	10.13
NEER variation	-2.91	8.23	2.59	13.79

Note: *CPI inflation*, *IMP inflation*, *PPI inflation* and *NEER variation* represent annual change in logarithm of consumer price index, import prices, producer price index and nominal effective exchange rate, respectively.

presence of cross-sectional correlation (particularly in the case of exchange rate due to the common numeraire), the Maddala-Wu test and other similar tests incorrectly reject the null hypothesis of non-stationarity. Therefore, we also implement the test on time demeaned series to deal with cross-sectional dependence. As mentioned by Levin et al. (2002), implementing unit root tests on time demeaned series allows to mitigate the impact of cross-sectional dependence on panel data. Results are reported in Table 2. The three types of domestic prices, the money supply and the nominal exchange rate seem to be non-stationary in level but stationary in first-differences for all countries. The output gap is found to be stationary in level. Previous studies (Ito and Sato, 2007, 2008, Mishkin and Schmidt-Hebbel, 2007) suggest to include in a VAR the output gap in level together with other variables in first-difference. We follow this methodology in our VAR analysis. The model yields similar IRFs when we include more than three lags for targeters. For nontargeters, more than three lags are not accepted for estimating IRFs owing to a nearly singular matrix determinants. Hence, we selected a lag order of two for reasons of parsimony.

We start by discussing the impulse responses of prices (CPI, PPI and IMP) to an exchange rate shock in targeters. To make a comparison, we also discuss the impulse responses of prices to an exchange rate shock in nontargeters.

Table 2: Panel unit root test

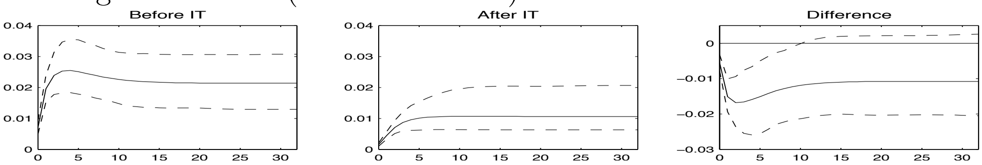
	Test statistics			
Variables	P	Z	L	Pm
Panel unit root test on original series				
g	238.944(0.000)	-7.810(0.000)	-11.176(0.000)	17.796(0.000)
m	71.569(0.055)	-1.076(0.141)	-1.257(0.106)	1.691(0.046)
Δm	97.080(0.000)	-3.817(0.000)	-3.854(0.000)	4.145(0.000)
$neer$	48.549(0.684)	0.274(0.608)	0.191(0.576)	-0.525(0.700)
$\Delta neer$	106.922(0.000)	-4.483(0.000)	-4.586(0.000)	5.092(0.000)
cpi	41.640(0.891)	0.609(0.729)	0.614(0.730)	-1.189(0.882)
Δcpi	104.044(0.000)	-4.408(0.000)	-4.426(0.000)	4.816(0.000)
imp	124.920(0.000)	-0.607(0.272)	-3.188(0.001)	7.492(0.000)
Δimp	119.714(0.000)	-4.645(0.000)	-5.549(0.000)	6.971(0.000)
ppi	58.742(0.186)	-0.282(0.389)	-0.381(0.352)	0.874(0.191)
Δppi	93.660(0.000)	-4.072(0.000)	-4.065(0.000)	4.366(0.000)
Panel unit root test on time demeaned series				
g	304.661(0.000)	-12.136(0.000)	-15.975(0.000)	24.120(0.000)
m	77.912(0.018)	-1.563(0.059)	-1.680(0.048)	2.301(0.011)
Δm	105.352(0.000)	-3.245(0.001)	-3.477(0.000)	4.941(0.000)
$neer$	64.074(0.164)	-0.972(0.166)	-1.074(0.142)	0.969(0.166)
$\Delta neer$	80.019(0.012)	-2.990(0.001)	-2.933(0.002)	2.504(0.006)
cpi	52.971(0.514)	1.247(0.894)	1.015(0.844)	-0.099(0.540)
Δcpi	107.178(0.000)	-4.626(0.000)	-4.698(0.000)	5.117(0.000)
imp	395.803(0.000)	-9.637(0.000)	-19.748(0.000)	34.580(0.000)
Δimp	120.862(0.000)	-4.334(0.000)	-5.340(0.000)	7.086(0.000)
ppi	70.618(0.029)	2.270(0.988)	1.417(0.921)	2.062(0.020)
Δppi	107.747(0.000)	-3.796(0.000)	-4.566(0.000)	5.775(0.000)

Note: The tests are the Fisher-type tests approach testing for panel-data unit roots developed by Maddala and Wu (1999) with the the null hypothesis that all series are non-stationary against the alternative that at least one series in the panel is stationary. The tests are implemented by the STATA command xtunitroot. P, Z, L and Pm represent inverse chi-squared, inverse normal, inverse logit and modified inverse chi-squared, respectively. No lag is used for g. The lag length used in the panel tests is the maximum lag length of individual tests that are chosen based on Schwarz information criterion. 8 (11), 10 (10) , 11 (11), 7 (11), and 10 (10) lags are used for m (Δm), $neer$, ($\Delta neer$), cpi, (Δcpi), imp (Δimp) and ppi (Δppi), respectively. Using higher lag lengths, the results were still found to be the same. For the level of variables (expected g), constant and time trend are included. For the first-difference of variables, only constant is included. P-value are in parenthesis.

4.1 Exchange pass-through to domestic prices in targeters: before and after inflation targeting

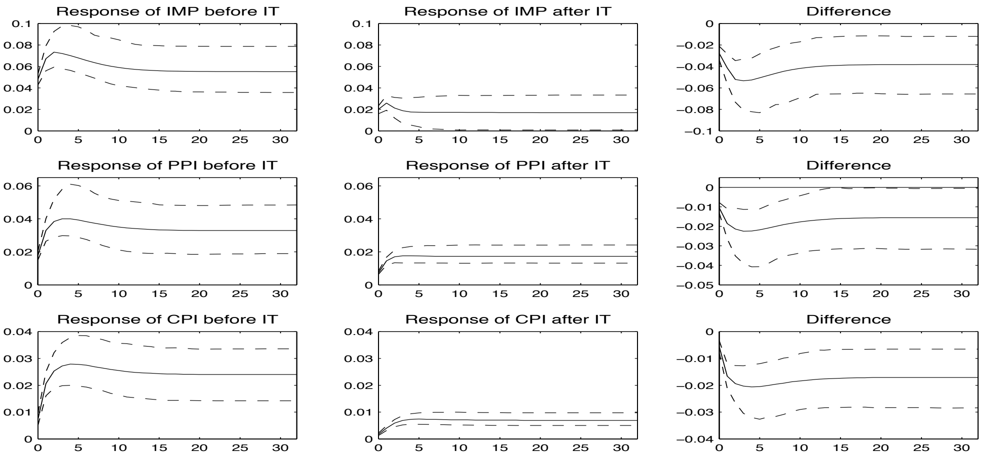
In this subsection we discuss the impulse responses of domestic prices to an exchange rate shock using data on fifteen emerging inflation targeters. The accumulated impulse responses (solid line) are presented over time. These impulse responses for the different targeters samples are reported in Figures 1 and 2. Each figure reports before-and-after comparisons. In these figures the third cell reports the difference between the two preceding responses (the response in the second cell minus the response in the first cell). As mentioned above, we can compare the impulse responses from different samples since the shocks in the VAR are measured as one standard deviation of the residual of the corresponding equation.

Figure 1: Response of CPI inflation in inflation targeters countries to an exchange rate shock (4-variable VAR)



Note: "IT" denotes inflation targeting. Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Figure 2: Response of prices in inflation targeters countries to an exchange rate shock (6-variable VAR)



Note: "IT" denotes inflation targeting. Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Figure 1 reports the dynamic response of CPI inflation to an exchange rate shock using the 4-variable VAR. The first two cells of Figure 1 show that, in targeting countries before and after inflation targeting, the exchange rate pass-through to consumer prices is significantly different from zero during all periods after the shock. Particularly, the long run pass-through is significantly different from zero. However, the third cell of Figure 1 shows that the exchange rate pass-through to consumer prices has decreased after inflation targeting. As reflected by the confidence intervals, the decrease in exchange rate pass-through to consumer prices is statistically different from zero during ten quarters after the shock.

As discussed above, the response of consumer prices to changes in exchange rate depends on the sensitivity of border prices to exchange rates, the extent of imported inputs being used for domestic production and the presence of distribution costs. In order to take into account the border, production and distribution channels, we estimate a 6-variable VAR that includes two other prices: the producer prices (PPI) and the import prices (IMP). This estimation helps us to directly check the hypothesis made by Taylor who argues that in a low-inflation environment firms expect a deviation of inflation to be less persistent and would therefore less adjust its selling prices in response to an exchange rate-induced increase in the price of imported inputs. Figure 2 reports the dynamic responses of the three prices (CPI, IMP, PPI) to an exchange rate shock using the 6-variable VAR. Figure 2 shows that the decline in pass-through to consumer prices in targeters is attributable to the decline in pass-through effect along the price chain. The pass-through to all three prices significantly falls in targeters after adopting inflation targeting to levels that are significantly different from zero during all periods after the shock. Notice that the slight difference between the short run pass-through to consumer price obtained from 4-VAR and that obtained from 6-VAR can caused by the fact that the two VAR are not estimated on the same sample. Indeed, for many countries there are relatively many missing values on import and producer prices.

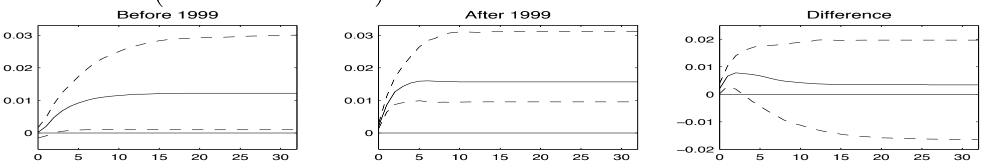
By comparing the exchange rate pass-through along the price chain, the results show that the (short run) pass-through declines along the price chain. This finding is consistent with those of previous results such as McCarthy (2000), Hahn (2003), Faruqee (2006) and Ito and Sato (2007, 2008).

In summary, we obtain evidence that, after the adoption of inflation targeting, the (long run) pass-through to all three prices has decreased from a higher level to a new level that remains significantly different from zero.

4.2 Comparison between targeters and nontargeters

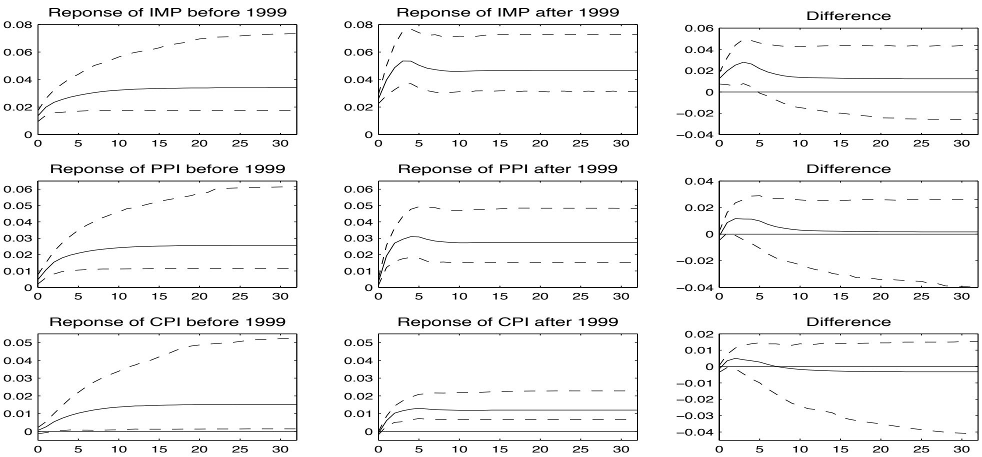
In the previous subsection, we have obtained evidence that after inflation targeting the exchange rate pass-through to all the three domestic prices (CPI, IMP, PPI) have decreased. A comparison with emerging nontargeters conveys interesting additional information. Data for twelve nontargeters are used to conduct this comparative analysis. To perform before-and-after comparisons for nontargeters, the demarcation period for nontargeters is set at year 1999, that is around the average of the adoption date of inflation targeting in emerging countries[7].

Figure 3: Response of CPI inflation in inflation nontargeters to an exchange rate shock (4-variable VAR)



Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Figure 4: Response of prices in inflation nontargeters countries to an exchange rate shock (6-variable VAR)



Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Figure 3 and 4 report before-and-after comparisons for nontargeters before and after 1999. Figure 3 displays the response of the CPI inflation to an exchange rate shock using the 4-variable VAR, while Figure 4 displays the response of the three prices to an exchange rate shock using the 6-variable VAR[8].

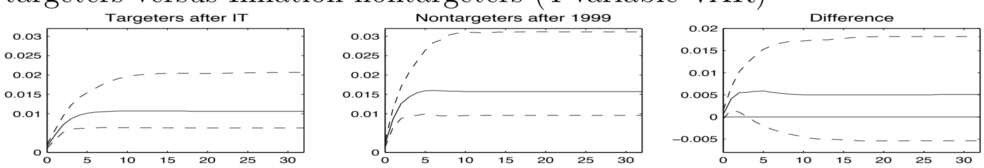
Figure 3 shows that, before 1999, the exchange rate pass-through to consumer prices in nontargeters was significantly different from zero 3 quarters

[7]We also ran estimations using 1998 and 2000 as the demarcation periods. These changes did not substantially affect our results.

[8]China and Uruguay are not included in the 6-variable VAR as no data on import and producer prices are available for these countries.

after the shock, while after 1999, the exchange rate pass-through to consumer prices in nontargeters is significantly different from zero during the all periods after the shock. As reported by the third cell of Figure 3, the pass-trough to the consumer price has increased after 1999 and this increase is significant only during the first three quarters after the shock. Figure 4 also shows that, before 1999, the exchange rate pass-through to the consumer price in nontargeters was significantly different from zero 3 quarters after the shock, while after 1999, the exchange rate pass-through to the consumer price in nontargeters is significantly different from zero during the all periods after the shock. The pass-through to import and producer prices in nontargeters (before and after 1999) are significantly different from zero during all periods after the shock. The third cell in Figure 4) reports that the pass-trough to only import price has increased after 1999 and this increase is significant only during the first five quarters after the shock. Therefore, Figures 3 and 4 show that in nontargeters there is no significant change in the long run pass-through after 1999. As mentioned above, the slight difference between the short run pass-through to consumer price obtained from 4-VAR and that obtained from 6-VAR can be explained by the presence of many missing values on import and producer prices.

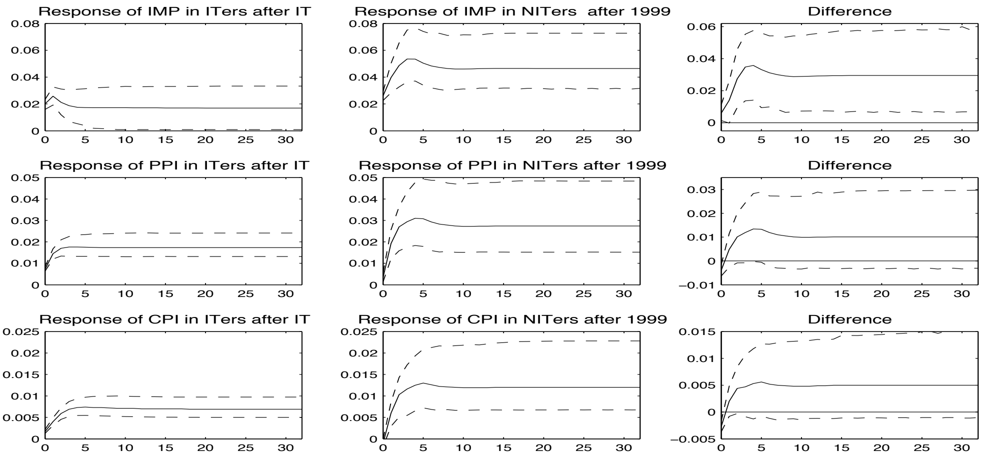
Figure 5: Response of CPI inflation to an exchange rate shock: Inflation targeters versus Inflation nontargeters (4-variable VAR)



Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Figures 5 and 6 report comparisons across the two samples of countries: targeters after adopting inflation targeting are compared to nontargeters after 1999. Figures 5 compares the response of consumer prices to an exchange rate shock using the 4-variable VAR, while Figure 6 compares the responses of the three types of prices to an exchange rate shock using the 6-variable VAR. Figure 5 shows that exchange pass-through to consumer price five quarter after the shock is the same for targeters after inflation targeting and nontargeters after 1999. Figure 6 indicates that exchange pass-through to consumer and producer prices two quarters after the shock in targeters after having adopted inflation targeting are the same than that in nontargeters after 1999, while exchange pass-through to import price during all periods after the shock in targeters after inflation targeting is significantly smaller

Figure 6: Response of prices to an exchange rate shock: Inflation targeters (ITers) versus Inflation nontargeters (NITers) (6-variable VAR)



Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

than that in nontargeters after 1999. Therefore, Figures 5 and 6 show that the long run pass-through to consumer and producer prices are the same in targeters after inflation targeting and in nontargeters after 1999, while the long run pass-through to import price is higher in nontargeters after 1999 than in targeters after inflation targeting.

We can infer two claims from these comparisons. First, for emerging targeters, the long run pass-through to all the three prices have decreased from a higher level to a new level that remains significantly different from zero, while for nontargeters there is no significant change in the long run pass-through. Second, by comparing inflation targeters after adopting inflation targeting to nontargeters after 1999, the long pass-through to consumer and producer are rather close among the two groups of targeters and nontargeters, while the long run pass-through to import price is higher in nontargeters after 1999 than in targeters after inflation targeting.

Since we do not observe a decrease in pass-through for non targeting emerging countries, we are led to think that the adoption of inflation targeting is a plausible explanation. Our evidence supports the view that when initial credibility of emerging markets' central banks is low, practicing inflation targeting makes their monetary policy more credible, and thus leads to a lower inflation environment. More specifically, in accordance with the argument made by Taylor, inflation targeting by implementing low inflation environment in emerging countries induces input-importing firms as well as retailing firms to pass-through less of the exchange rate depreciation in the form of higher prices (producer prices and import prices). Hence exchange rate fluctuations lead to smaller exchange rate pass-through to domestic producer and import prices.

However, we do not claim to have provided a causal link between inflation targeting adoption and the decrease in pass-through. Both phenomena could also be linked to a common factor, yet undisclosed. Campa and Goldberg (2010) discuss specific reasons (the sensitivity to exchange rates of distribution margins, the extent of imported inputs use in different categories of consumption goods, and on their role in consumption of nontradable, home-produced tradable, and imported goods) why a decrease in pass-through can happen over time.

4.3 Variance decomposition

Even though impulse responses give information about the size of exchange rate pass-through to domestic prices, they do not show how important exchange rate shocks are in explaining domestic prices fluctuations. To assess the importance of exchange rate shocks for domestic prices fluctuations, we perform a variance decomposition. We begin by examining the importance of exchange rate shocks for consumer prices by using the 4-variable VAR (Table 3). Table 3 indicates that exchange rate shocks are more important in explaining consumer price fluctuations in targeters. The results contained in Table 3 also show that the contribution of exchange rate shocks to consumer price fluctuations does not change significantly in targeting countries after they adopted inflation targeting, while it increases in nontargeting countries after 1999. For targeters, the contribution of exchange rate shocks to consumer price fluctuations (after 20 quarters) is 26.23% before inflation targeting against 25.87% after inflation targeting. For nontargers, exchange rate shocks explain 6.13% of consumer price variability (after 20 quarters) before 1999, and this percentage is 36.30% after 1999.

Table 3: Percentage of CPI inflation forecast variance attributed to exchange rate shocks (4-variable VAR)

	Inflation targerters		Inflation nontargerters	
Horizon	Before IT	After IT	Before 1999	After 1999
1	9.58	5.14	0.02	4.99
4	26.51	25.32	5.08	36.45
8	26.21	25.91	6.04	36.30
20	26.23	25.87	6.13	36.30

Note: "IT" denotes inflation targeting.

Table 4 displays the contribution of exchange rate shocks in explaining the fluctuations of all three types of prices using the 6-variable VAR. For

Table 4: Percentage of prices forecast variance attributed to exchange rate shocks in inflation targerters (6-variable VAR)

	Inflation targerters		Inflation nontargerters	
Horizon	Before IT	After IT	Before 1999	After 1999
	Import prices		Import prices	
1	57.48	14.96	18.20	35.88
4	57.69	13.59	20.05	34.55
8	56.89	13.44	19.78	34.29
20	56.81	13.44	19.77	34.29
	Producer prices		Producer prices	
1	36.92	23.94	4.64	2.50
4	45.24	34.88	13.57	32.18
8	44.33	34.73	13.75	31.67
20	44.28	34.73	13.79	31.68
	Consumer prices		Consumer prices	
1	10.30	8.23	0.16	0.91
4	29.15	23.66	5.12	35.55
8	28.67	23.37	6.24	35.03
20	28.68	23.30	6.44	35.02

Note: "IT" denotes inflation targeting.

targeters, the contribution of exchange rate shocks to price fluctuations decrease after inflation targeting, the decrease being more pronounced for import and producer prices. For targeters before inflation targeting exchange shocks explain 56.81%, 44.28% and 28.68% of the variance of import prices, producer prices and consumer prices (after 20 quarters), respectively. After the adoption of inflation targeting, these percentages are 13.44%, 34.73% and 23.30%, respectively. In nontargeters, the contribution of exchange rate shocks to the domestic prices fluctuations increase after 1999. For nontargeters before 1999, exchange rate shocks explain 19.77%, 13.79% and 6.44% of the variance of import prices, producer prices and consumer prices (after 20 quarters), respectively. After 1999, these contributions are 34.29%, 31.68% and 35.02%, respectively.

In sum, the variance decomposition analysis indicates that the contribution of exchange rate shocks to the fluctuations in prices (particularly import prices) in targeters decrease after inflation targeting. The variance decomposition analysis also shows that the contribution of exchange rate shocks to price fluctuations in nontargeters increase after 1999. Hence the variance decomposition analysis corroborates the decline in exchange rate pass-through in targeters after adopting inflation targeting.

5 Conclusion

In this paper, we empirically examine the effect of the adoption of an inflation targeting strategy on the exchange rate pass-through to prices in emerging countries. To conduct this empirical study, we used panel VAR techniques using data on twenty-seven emerging countries (fifteen inflation targeters and twelve inflation nontargeters). We adopted the before-and-after approach by comparing impulse response functions in different country subsamples depending on the adoption of inflation targeting.

Our results show that, for targeters countries, the pass-through to consumer, import and producer prices has decreased from a higher level to a new level that remains significantly different from zero, while for nontargeters there is no significant change in the pass-through.

The variance decomposition corroborates these results. The variance decomposition analysis indicates that the contribution of exchange rate shocks to prices (particularly import prices) fluctuations in targeting countries has decreased after inflation targeting, while the contribution of exchange rate shocks to prices fluctuations in nontargeting countries has increased.

Since we observe a decrease in the pass-through for targeting countries and an increase in pass-through for nontargeting countries, the adoption of inflation targeting seem to be a plausible explanation. According to Taylor hypothesis, inflation targeting by implementing low inflation environment can lead to a decrease in exchange rate pass-through. Therefore, our evidence suggests that countries experiencing high exchange rate pass-through because of high inflation will benefit from the adoption of inflation targeting.

Appendix 1 Countries in the sample

Inflation targeters and adoption date of inflation targeting
Brazil (1999:Q2), Chile (1991:Q1), Colombia (1999:Q3), Czech Republic (1998:Q1), Hungary (2001:Q2, Indonesia (2005:Q3), Israel (1991:Q4), Mexico (1999:Q1), Peru (2002:Q1), Philippines (2002:Q1), Poland (1998:Q3), South Africa (2000:Q1), South Korea (1998:Q2), Thailand (2000:Q2), Turkey (2006:Q1).
Inflation nontargeters
Argentina, Bulgaria, China, Estonia, India, Latvia, Lithuania, Malaysia, Singapore, Taiwan, Uruguay, Venezuela.

Appendix 2 Variable and their sources

Output gap: The output gap is generated by applying the Hodrick-Prescott (HP) filter to eliminate a strong trend in the seasonally adjusted real gross domestic product (GDP). If the original GDP series is not adjusted, series is seasonally adjusted using the Census X-12 method. The quarterly data are collected using Datastream interface. The data sources depending on the countries are the following:
Argentina: GDP volume index (2000=100), International Financial Statistics (IFS) of International Monetary Fund (IMF)
Brazil: GDP volume index (1995=100) (seasonally adjusted), Instituto Brasileiro de Geografia e Estatistica (IBGE) (Brazil).
Bulgaria: GDP volume index, IFS.
Chile: GDP at 2003 prices (seasonally adjusted) Banco Central de Chile
China: GDP at current price (from IFS) divided by CPI.
Colombia: GDP at 2000 prices, National Administrative Department of Statistics (Colombia).
Czech Republic: GDP at 2000 prices, (seasonally adjusted), Organization of Economic Co-operation and Development (OECD).
Estonia: GDP at 2000 prices, Estonia Statistics (Estonia).
Hungary: GDP volume index (2000=100)(seasonally adjusted),OECD.
India: GDP Volume index (2005=100) (seasonally adjusted), OECD.
Indonesia: GDP at 2000 prices (seasonally adjusted), OECD.
Israel: GDP at 2005 prices (seasonally adjusted), Central Bureau of Statistics (Israel).
Latvia: GDP at 2000 prices, Central Statistics Bureau of Latvia (Latvia).
Lithuania: GDP at 2000 prices (seasonally adjusted), Statistics Lithuania (Lithuania).

Malaysia:GDP volume index (2000=100), IFS.
Mexico: GDP volume index (2000=100) (seasonally adjusted), IFS.
Peru: GDP volume index (2000=100), IFS.
Philippines: GDP at 1985 prices (seasonally adjusted), National Statistical Coordination Board (NSCB) (Philippines).
Poland: GDP at 2000 prices (seasonally adjusted),OECD.
Singapore: GDP volume index (2000=100), IFS.
South Africa: GDP at 2000 prices, (seasonally adjusted),IFS.
South Korea: GDP at 2000 prices (seasonally adjusted),OECD, (Quarterly National Accounts).
Taiwan: GDP at 2001 prices, Directorate General of Budget, Accounting and Statistics (DGBAS).
Thailand: GDP at 1988 prices (seasonally adjusted), Office of National Economic and Social Development Board (Thailand).
Turkey: GDP at 1995 prices, Eurostat.
Uruguay: GDP volume index (2005=100) (seasonally adjusted), Banco Central de Uruguay (Uruguay).
Venezuela: GDP at 1997 prices (seasonally adjusted), Banco Central de Venezuela (Venezuela).

Money supply: We use base money or monetary aggregate M1 . If the original series is not adjusted, series is seasonally adjusted using the Census X-12 method. The data sources depending on countries are the following:
Argentina: Base money, IFS.
Brazil: Base money, (seasonally adjusted), IFS.
Bulgaria: Money M1 (Banking Survey), IFS.
Chile: Money M1, IFS.
China: Money Supply, People Bank of China.
Colombia: Money M1 (Banking Survey), IFS.
Czech Republic: Money M1 (Banking Survey), IFS.
Estonia: Money M1 (Banking Survey),(seasonally adjusted), IFS.
Hungary: Monetary Base, IFS.
India: Money M1 (Banking Survey), IFS.
Indonesia: Money M1 (Banking Survey) (seasonally adjusted), IFS.
Israel: Money M1 (seasonally adjusted), IFS.
Latvia: Money M1 (Banking Survey) (seasonally adjusted), IFS.
Lithuania: Money M1 (Banking Survey) (seasonally adjusted), IFS.
Malaysia: Money M1, IFS.
Mexico: Money M1 (Banking Survey) (seasonally adjusted), IFS.
Peru: Money supply, IFS.
Philippines: Money M1 (Banking Survey) (seasonally adjusted), IFS.

Poland: Money M1, (IFS).
Singapore: Money M1 (Banking Survey) (seasonally adjusted), IFS.
South Africa: Money M1, IFS.
South Korea: Money M1 (seasonally adjusted), IFS.
Taiwan: Money supply, Bank Central of China.
Thailand: Money M1 (Banking Survey), IFS.
Turkey: Money M1 (Banking Survey) (seasonally adjusted), IFS.
Uruguay: Money M1 (Banking Survey)(seasonally adjusted), IFS.
Venezuela: Money M1 (Banking Survey)(seasonally adjusted), IFS.

Nominal effective exchange rate: For Brazil, Bulgaria, Chile, China, Colombia, Czech Republic, Hungary, Israel, Malaysia, Mexico, Philippines, Poland, Singapore, South Africa, South Korea, Turkey, Uruguay, Venezuela quarterly data on nominal effective are taken from IFS. For the other countries, monthly data on nominal effective exchange rate taken from Bank of International Settlements (BIS) are used to construct the quarterly nominal effective exchange rate. If the original series is not adjusted, series is seasonally adjusted using the Census X-12 method.

Consumer Prices: For all countries expected China and Tawain the consumer price index (2000=100) is taken from IMF, International Financial Statistics (IFS). For china, the monthly CPI taken from OECD is used to construct the quarterly CPI. For Tawain, the monthly CPI taken from Directorate General of Budget, Accounting and Statistics (DGBAS) is used to construct the quarterly CPI. All series are seasonally adjusted using the Census X-12 method.

Import Prices: The import prices are expressed in home currency. All series are seasonally adjusted using the Census X-12 method. The data sources depending on countries are the following:

Argentina: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Brazil: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Bulgaria: The quarterly series of import price is constructed by dividing the total import value by the total import volume (1995 prices). The import value and the import volume are taken from National Statistics Institute (Bulgaria) and Eurostat, respectively.
Chile: The import price is import price index (2003=100), Banco Central de

Chile (Chile).
Colombia: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Czech Republic: The import price is import price index (2005=100), Czech Statistical of Office.
Estonia: The quarterly series of import price index is constructed by dividing the total import value by the total import volume (2000 prices) Statistics Estonia. The data are taken from Statistics Estonia (Estonia).
Hungary: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
India: The quarterly series of import price is constructed by dividing the total import value by the total import volume (1990 prices). Data are taken from OECD.
Indonesia: The quarterly series of import price index is constructed by dividing the total import value by the total import volume (2000 prices). Data are taken from OECD.
Israel: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Latvia: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Lithuania: The quarterly series of import price is constructed by dividing the total import value by the total import volume (2000 prices). The data are taken from Statistics Lithuania.
Malaysia: The quarterly series of import price is constructed by dividing the total import value by the total import volume (2000 prices). The data are from Department of Statistics (Malaysia).
Mexico: The quarterly import price is constructed by the average monthly import price index (1980=100) taken from Banco de Mexico (Mexico).
Peru: The quarterly import price is constructed by the average monthly import price index (1994=100) taken from Banco Central Reserva (Peru).
Philippines: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Poland: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Singapore: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
South Africa: The import price is the import prices index in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
South Korea: The import price index is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Taiwan: The quarterly import price is constructed by the average monthly

import price index (manufactruing goods) (2001=100) taken from Directorate General of Budget, Accounting and Statistics (DGBAS).
Thailand: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Turkey: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.
Venezuela: The import price is the import unit value in US dollar (2000=100) taken from IFS multiplied by the exchange rate.

Producer Prices: For all countries expected Taiwan and Turkey, the producer prices index are taken form IFS. For Taiwan the quarterly producer prices index are the average monthly output prices index (2006=100) taken from Taiwan Directorate General of Budget, Accounting and Statistics. For Turkey the quarterly data are taken from Turkeys National Institute of Statistics. All series are seasonally adjusted using the Census X-12 method.

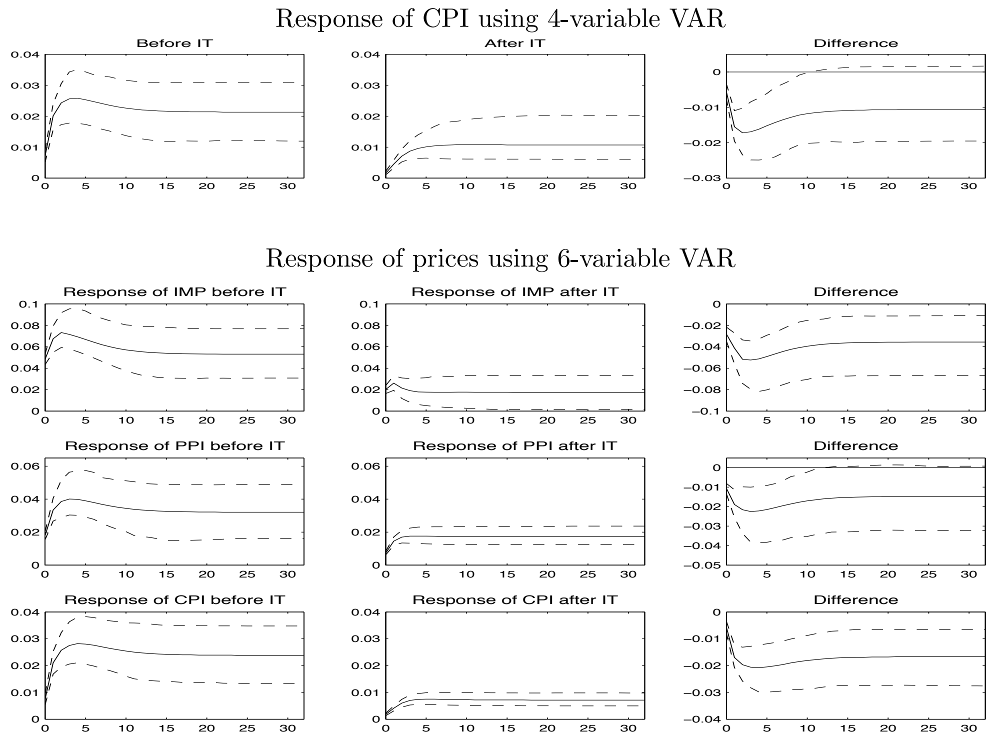
Appendix 3 Sensitive analysis to alternative ordering

This section reports the results using two alternative ordering in VAR:

Alternative ordering 1: $(\Delta m, \Delta neer, gap, \Delta cpi)$ or $(\Delta m, \Delta neer, gap, \Delta imp, \Delta ppi, \Delta cpi)$
Alternative ordering 2: $(gap, \Delta neer, \Delta m, \Delta cpi)$ or $(gap, \Delta neer, \Delta m, \Delta imp, \Delta ppi, \Delta cpi)$

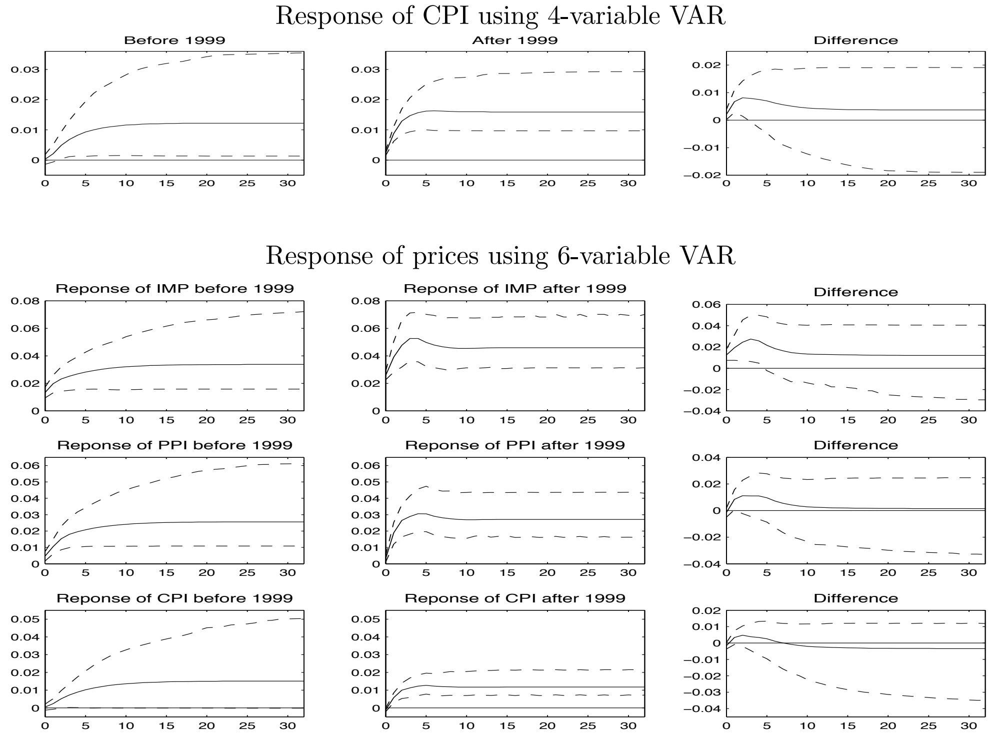
Appendix 3.1 Sensitive analysis to alternative ordering 1

Figure A 1: Response of prices in targeters to an exchange rate shock (alternative ordering 1)



Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Figure A 2: Response of prices in nontargeters to an exchange rate shock (alternative ordering 1)



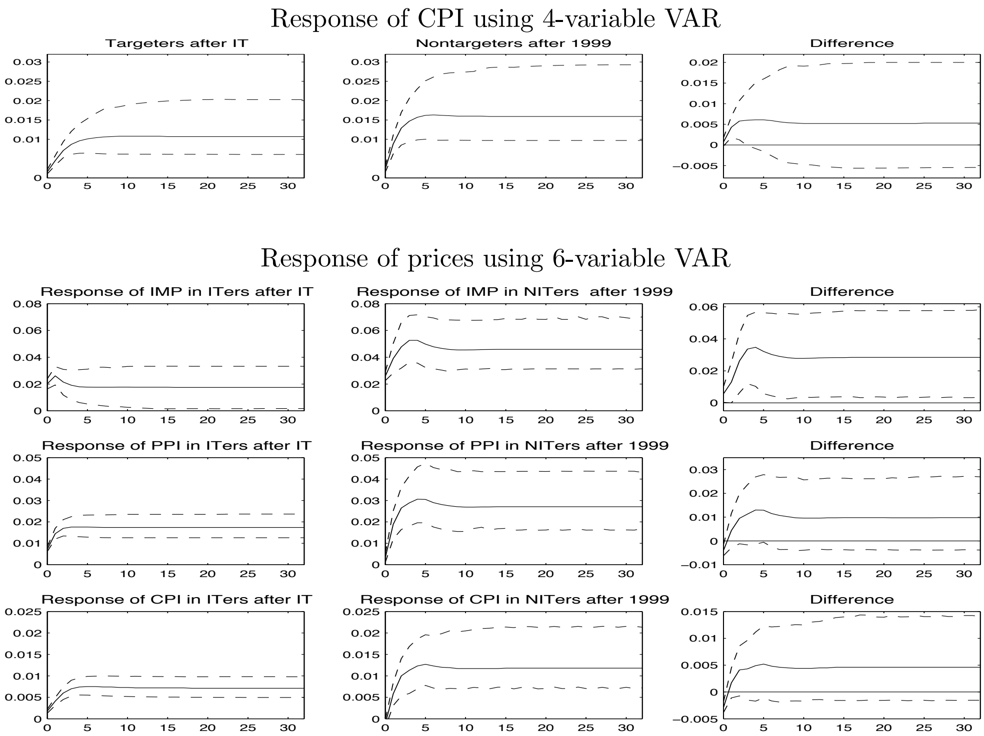
Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Table A 1: Percentage of Prices forecast variance attributed to exchange rate shocks (alternative ordering 1)

Variance decompostion of CPI using 4-variable VAR				
	Inflation targerters		Inflation nontargerters	
Horizon	Before IT	After IT	Before 1999	After 1999
1	10.32	5.18	0.03	5.73
4	27.34	25.44	5.07	38.08
8	27.04	26.07	6.01	37.84
20	27.07	26.03	6.10	37.84
Variance decompostion of prices using 6-variable VAR				
	Inflation targerters		Inflation nontargerters	
Horizon	Before IT	After IT	Before 1999	After 1999
	Import prices		Import prices	
1	58.88	15.19	17.66	35.27
4	58.50	13.81	19.61	33.58
8	57.77	13.66	19.36	33.30
20	57.71	13.66	19.35	33.31
	Producer prices		Producer prices	
1	38.15	24.09	4.56	2.31
4	45.97	35.05	13.48	31.12
8	45.10	34.90	13.66	30.76
20	45.08	34.90	13.70	30.77
	Consumer prices		Consumer prices	
1	11.18	8.40	0.12	1.20
4	30.05	24.17	5.64	34.76
8	29.56	23.91	6.21	34.31
20	29.58	23.84	6.42	34.31

Note: “IT” denotes inflation targeting.

Figure A 3: Response of prices to an exchange rate shock targeters versus nontargeters (alternative ordering 1)

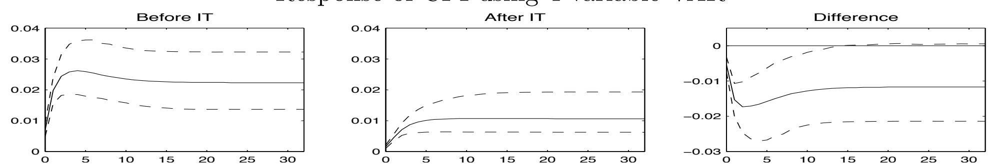


Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

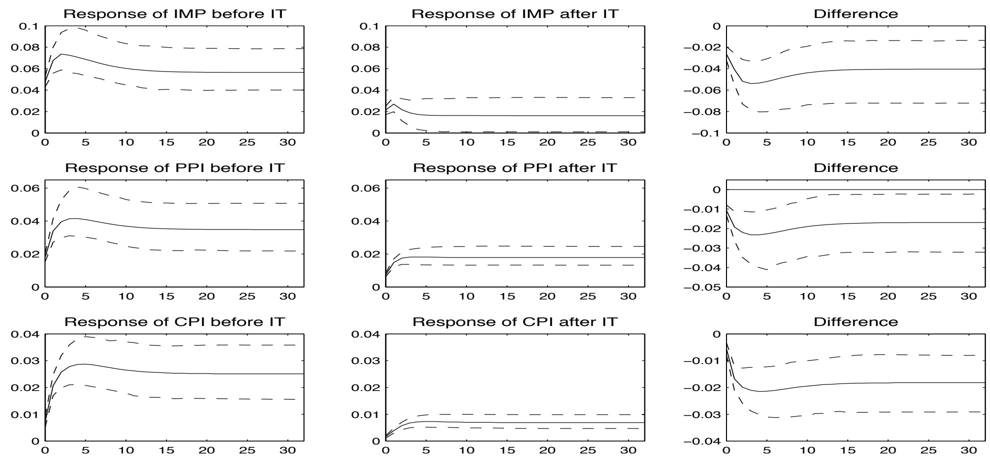
Appendix 3.2 Sensitive analysis to alternative ordering 2

Figure A 4: Response of prices in targeters to an exchange rate shock (alternative ordering 2)

Response of CPI using 4-variable VAR

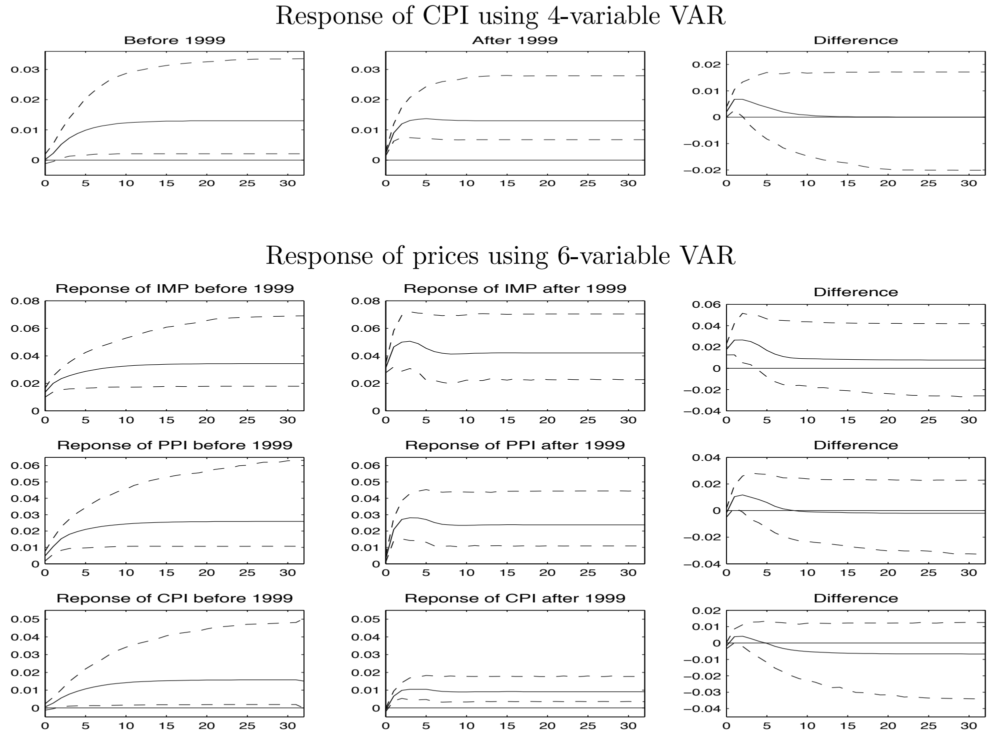


Response of prices using 6-variable VAR



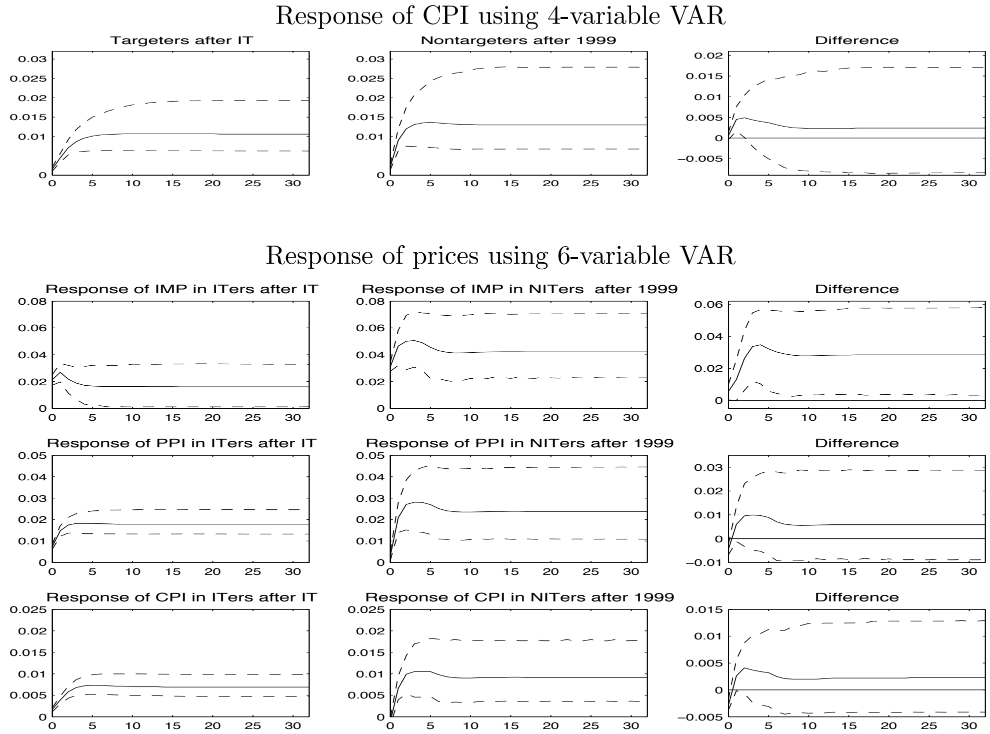
Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Figure A 5: Response of prices in nontargeters to an exchange rate shock (alternative ordering 2)



Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Figure A 6: Response of prices to an exchange rate shock targeters versus nontargeters (alternative ordering 2)



Note: Confidence intervals are computed via Monte Carlo simulation with 5000 replications. Ranges indicated represent 90% confidence intervals.

Table A 2: Percentage of Prices forecast variance attributed to exchange rate shocks (alternative ordering 2)

Variance decompostion of CPI using 4-variable VAR				
	Inflation targerters		Inflation nontargerters	
Horizon	Before IT	After IT	Before 1999	After 1999
1	9.50	5.31	0.03	5.01
4	27.40	25.14	5.85	34.68
8	27.07	25.76	6.89	33.97
20	27.08	25.72	6.99	33.97

Variance decompostion of prices using 6-variable VAR				
	Inflation targerters		Inflation nontargerters	
Horizon	Before IT	After IT	Before 1999	After 1999
	Import prices		Import prices	
1	57.45	17.18	18.30	51.45
4	58.03	15.50	20.13	43.53
8	57.17	15.37	19.90	43.33
20	57.08	15.36	19.89	43.31
	Producer prices		Producer prices	
1	38.44	25.09	4.71	1.94
4	47.87	36.91	13.49	36.11
8	46.86	36.76	13.72	35.46
20	46.78	36.75	13.77	35.44
	Consumer prices		Consumer prices	
1	10.28	7.48	0.20	1.26
4	30.00	22.81	5.60	36.62
8	29.51	22.57	6.77	35.73
20	29.51	22.51	6.98	35.72

Note: “IT” denotes inflation targeting.

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