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Does Inflation Targeting Matter for Emerging Market Economies?

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# Does Inflation Targeting Matter for EMEs?

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## Abstract

This paper presents an empirical assessment of the performance of EMEs that have adopted inflation targets to conduct monetary policy. In contrast to the evidence previously found for industrial economies, we observe that IT has really mattered for EMEs' price stability. Cross-section and panel estimations consistently suggest that IT has significantly contributed to EMEs' disinflation.

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## 1 Introduction

In the more than 15 years since it was first implemented in New Zealand and Chile, Inflation Targeting (IT) has consolidated as an attractive monetary policy option for a wide variety of countries. The literature documenting the successful case study experiences of IT economies is vast, particularly for industrial economies. More recently, the increasing popularity of the regime has led to a growing strand of literature that seeks to assess the relative success of IT *vis-à-vis* other alternative monetary policy frameworks.

In general, most of those studies assessing the success of IT highlight its merits in achieving disinflation and improving the performance of some macroeconomic variables (e.g. expected inflation, interest rates, inflation volatility, sacrifice ratios) but fail to

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demonstrate that the regime has accomplished a superior performance over other monetary policy frameworks (see, for instance, Neumann and von Hagen, 2002; Johnson, 2002; Ball and Sheridan, 2003). This has led to a questioning of whether IT really mattered for the deflationary processes experienced by industrial economies during the 1990s.

Following some of those initial studies, Mishkin (2002), Gertler (2003) and Uhlig (2004) have argued that existing findings might be relying on a biased sample. They warn that the puzzle in those studies is that among industrial economies the group of non-targeter economies followed policies that have many of the same principles and practices adopted by inflation targeters. Indeed, besides pursuing similar long-term inflation goals, both groups put great emphasis on issues such as transparency and accountability. This might be *per se* the reason why studies employing only developed countries (e.g. Johnson, 2002; Ball and Sheridan, 2003) have not been able to establish any comparative success for those industrial economies targeting inflation.

Considering this potential bias, this paper aim is to examine IT regimes employing a sample of countries in which the control (non-targeters) and treatment (targeters) groups have embraced a richer variety of monetary and exchange rate regimes. In particular, we assess whether IT has mattered for disinflation using a sample that contains exclusively Emerging Market Economies (EMEs). To provide a clear methodological benchmark, we initially employ the same Difference-in-Difference model used by Ball and Sheridan (2003)—BS hereafter—to assess IT for a group of industrial economies. Thereafter, we extend that model to control for the influence of other potential variables that are likely to lead to disinflation. More specifically, we attempt to estimate the aggregate effect of IT on EMEs disinflation through ordinary and generalized least squares and the individual effects of IT on each of the countries in the sample employing a fixed effects model and a system of seemingly unrelated regressions.

The rest of this paper proceeds as follows. The next section presents the sample of EMEs chosen and its characteristics. Section 3 analyses the performance of IT using the same cross-sectional model employed by BS for a sample of industrial economies. We extend BS's model to control for other disinflation related factors in a panel analysis. Finally, Section 4 concludes.

## 2 Sample

Our sample comprises the 23 largest EMEs with at least partial statistical information to fulfil the data requirements of our analysis; 11 of these are IT economies. Although

Table 1: Sample's inflation rates and breakpoints

Country	Observations		Averages	
	Before	After	Before	After
	<b><u>ITers</u></b>			
Chile (1991.1)	44	60	21.9	7.3
<i>Israel (1991.4)</i>	47	57	115.0	6.4
Mexico (1999.1)	76	28	46.7	7.3
<i>Brazil (1999.3)</i>	78	26	676.5	8.3
Poland (1999.1)	76	28	82.8	4.5
<i>Peru (1993.4)</i>	55	49	945.7	7.4
Colombia (1999.2)	77	27	23.4	7.2
Korea (1997.4)	71	33	7.4	3.5
Thailand (2000.1)	80	24	5.4	2.2
South Africa (2000.1)	80	24	12.3	5.2
Hungary (2001.3)	61	17	14.6	5.2
	<b><u>Non-ITers</u></b>			
<i>Argentina</i>	61	43	770.9	5.2
Venezuela	61	43	29.7	34.9
Indonesia	61	43	9.3	14.3
Malaysia	61	43	3.7	2.5
Philippines	61	43	13.6	6.0
Singapore	61	43	2.8	0.8
India	61	43	9.5	6.1
Turkey	61	43	59.9	53.6
Egypt	61	43	16.3	5.4
China	61	43	8.7	2.5
Bangladesh	61	38	8.8	4.6
Ecuador	61	43	37.6	29.8

we wanted to include the world largest 25 EMEs (measured by the size of their GDP), countries like Russia and Czech Republic lack the minimum information required to be considered in this evaluation.<sup>1</sup>

Table 1 shows the countries included in the sample and the targeting starting points for our 11 IT countries. For the cross-sectional analysis, the frequency of the data we employ is quarterly. Meanwhile, for the panel analysis the frequency of the information is annual. Data were primarily obtained from the IMF International Financial Statistics (IFS) database.

The sample covers the period between the first quarter of 1980 and fourth quarter of 2005. Most of the countries in our sample experienced some degree of *de facto* exchange rate flexibility at some point during this period (Levy-Yeyati and Sturzenegger, 2004). In general, during this lapse, the economies in our sample experimented with a variety

<sup>1</sup>Other transition economies like Bangladesh and Hungary are included because they initially have at least partial information to contribute to the analysis.

of monetary and exchange rate regimes that vary from targeting the exchange rate to targeting inflation and from pure floating to hard pegs, respectively.<sup>2</sup>

In a recent paper, Rogoff (2003) suggests that one way of illustrating how the recent global disinflation has transcended narrow interpretations of monetary regimes is to look at inflation performance across different exchange rate arrangements. As we mentioned above, by employing a sample only containing EMEs, in this paper we deal with a large mix of monetary and exchange rate regimes where NITer countries follow policies which are notably different to those followed by ITers.

### 3 Inflation performance and IT

In this section, we start by assessing IT employing the same Difference-in-Difference model used by BS for a sample of industrial economies. Then, we extend that model to a panel analysis to control for other inflation related factors associated with the recent global disinflation experience by the world economy.

#### 3.1 Cross-sectional analysis

Using a sample that comprises 20 OECD industrial economies, BS observed that among them the seven economies that adopted IT in the early 1990s were in principle more effective in achieving price stability. However, they noticed that this was explained by the fact that ITers performed significantly worse before adopting the regime. Once they controlled for the so-called “regression to the mean” effect, there was no evidence that IT improves inflation performance. In this section, we start by replicating BS estimations for our sample of EMEs.

##### 3.1.1 The model

The Difference-in-Difference (DD) model employed by BS can be derived from a “two-way error component” regression model in which the time series dimension is removed by simply differentiating the average of the data ‘before’ and ‘after’ a policy change, and then running the underlying differences equation. Starting from a two-way error component

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<sup>2</sup>We see this diversity of regimes as an advantage for our analysis of IT. As mentioned earlier, one of the critics of Gertler (2003) on Ball and Sheridan’s paper is that, in their sample of 20 OECD countries, NITer countries followed very similar policies to those implemented by the ITers. Under such circumstances, it is then difficult to distinguish the contribution of IT *vis-à-vis* other regimes.

regression model as described by Baltagi (2001),

$$\pi_{it} = \alpha + \beta x_{it} + u_{it}, \quad i = 1, \dots, N, \quad t = 1, \dots, T \quad (1)$$

where  $i$  denotes the  $N$  countries in the sample and the subscript  $t$  denotes time. The dependent variable  $\pi_{it}$  is some macroeconomic variable of interest and the error term is described by  $u_{it} = \mu_i + \lambda_t + \varepsilon_{it}$ , with  $\mu_i$  representing a country specific unobservable effect,  $\lambda_t$  denoting a time specific unobservable effect and  $\varepsilon_{it}$  being the residual stochastic disturbance.

They contract the panel into only two periods by calculating the average of  $y_{it}$  before and after IT to obtain the *pre* and *post* targeting period average levels of  $\pi$  ( $\pi_{i,pre}$  and  $\pi_{i,post}$ , respectively).<sup>3</sup> Then, subtracting the *pre* average period equation from the *post* average period equation we get that

$$\pi_{i,post} - \pi_{i,pre} = (\lambda_{post} - \lambda_{pre}) + \beta(x_{i,post} - x_{i,pre}) + (\varepsilon_{i,post} - \varepsilon_{i,pre}) \quad (2)$$

Considering  $x_{it}$ , for  $t = pre$  or  $post$ , to be a dummy variable that takes the value of 1 if country  $i$  targets inflation in period  $t$  and it is zero otherwise, the DD model is simply reduced to

$$\pi_{i,post} - \pi_{i,pre} = \lambda + \beta x_i + \varepsilon_i \quad (3)$$

where  $\pi_{i,post} - \pi_{i,pre}$  is the effective reduction (or increase) in the average level of  $\pi$ ,  $\lambda = (\lambda_{post} - \lambda_{pre})$  is the intercept,  $x_i = x_{i,pre}$  is just a dummy variable that takes the value of 1 when country  $i$  is targeting inflation and  $\varepsilon_i$  is the remaining stochastic residual. Most importantly, the coefficient  $\beta$  measures the effect of targeting inflation on the behavior of  $y$ , our macroeconomic variable of interest.

Ball and Sheridan (2003) indicate that a problem with this model could arise for some variables of interest if average figures in the pre-targeting period result substantially different for targeter and non-targeter economies. This “regression to the mean” effect implies that for some macroeconomic variables (like, for instance, the inflation level), the pre-targeting period average might be significantly higher for targeters than non-targeters, thus creating an illusion of greater absolute improvement in the post-targeting period simply because initially the targeters were performing worse than the non-targeters.

To eliminate this regression to the mean bias, they simply propose to include the

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<sup>3</sup>An issue that arises when we split the time into the pre and post-targeting period is the definition of a breakpoint for the control group (i.e. the non-ITer emerging markets). We define several alternative breakpoints which are discussed later on.

pre-targeting average value of  $y$  to the model,  $y_{i,pre}$ , as an explanatory variable. The subsequent unbiased model is given by

$$\pi_{i,post} - \pi_{i,pre} = \lambda + \beta_1 x_i + \beta_2 \pi_{i,pre} + \varepsilon_i \quad (4)$$

Including  $\pi_{i,pre}$  on the right-hand side controls for the regression to the mean bias given that the coefficient  $\beta_1$  for the dummy variable, if significant, would show the unbiased effect of targeting inflation on the dependent variable, for some given initial level of  $\pi$ .

### 3.1.2 Estimations

Table 1 shows in parenthesis the targeting starting points for our 11 IT countries. For non-targeters, the break between the post and pre-targeting period is defined as the second quarter of 1995. To define this break point we follow BS and calculate the mid-point quarter between the first ITeR starting point in the sample (i.e. Chile 1991.1) and the last one (i.e. Hungary 2001.3).

Table 1 also presents the annualized average inflation rates for ITers and NITers when the breakpoints for the later group is second quarter of 1995.<sup>4</sup> The table shows that our sample presents considerable cross-country differences in average inflation for targeter and non-targeter EMEs, particularly in the pre-targeting period. Among our cross-sectional observations, Brazil, Peru, Israel and Argentina are four extreme cases with average inflation levels in the pre-targeting period that reach three digits.

This problem with outlier observations is frequently faced in analyses of EMEs inflation data. In fact, when dealing with inflation data, even industrial economies suffer problems of outliers. In BS, countries that have experienced annual inflation rates above 20%, including Greece and Ireland, are excluded from the analysis to avoid such problems.

In terms of the estimations, for the IT regime to be contributing toward lower inflation, a significant negative coefficient associated to the dummy variable would be expected. Table 2 presents the estimates of the DD model using the two different specifications and two different data sets. The two specifications are the DD model presented in equation (3), which we call Model I, and the adjusted version of the same model to correct for regression to the mean effects, which we call Model II, presented in equation (4). The two data sets comprise the averages of inflation with 23 countries (including outliers) and a reduced sample which excludes the four larger outlier countries (i.e. dropping Argentina,

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<sup>4</sup>Notice that Bangladesh and China are omitted from the analysis at this stage because inflation data for these two countries are not available before 1987.

Table 2: DD model estimates

		n=23		n=19	
		Model I	Model II	Model I	Model II
$\alpha$ - Constant		-67.078	13.85	-3.566	7.698
	<i>s.e.</i>	(78.576)	(3.682)	{1.547}	{4.141}
	[p-values]	[0.403]	[0.001]	[0.034]	[0.082]
$\beta_1$ - Dummy		104.503	-7.952	-17.969	-12.619
	<i>s.e.</i>	(113.621)	(5.283)	{9.109}	{4.988}
	[p-values]	[0.368]	[0.148]	[0.065]	[0.022]
$\beta_2$ - x-before			-1.001		-0.619
	<i>s.e.</i>		(0.009)		{0.225}
	[p-values]		[0.000]		[0.014]
Adjusted R <sup>2</sup>		0.01	0.99	0.24	0.71
Koenker LM Test		0.57	0.36	2.83	<b>9.04</b>
Shapiro Wilk (p-value)		<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.24

Note: Standard errors in curly brackets { } are heteroskedasticity robust standard errors

Brazil, Israel and Peru).

The estimations based on the full sample initially show that the dummy variable capturing the effect of IT on the rate of inflation is insignificant at the 10% level under both model specifications. Correcting for the regression to the mean bias, by including the pre-targeting level of inflation in model II, results in a strongly significant regression to the mean effect ( $p$ -value 0.000). However, according to the Shapiro–Wilk test, the estimations based on the full sample present problems of non-normality.<sup>5</sup> Since this problem is likely to be encountered in the presence of outliers, we drop from the sample the four countries with the largest inflation averages in the pre-targeting period (i.e. Argentina, Brazil, Israel and Peru). Estimations based on the reduced sample turn out to show a significant IT dummy coefficient at the 5% level and appear to be free from normality problems once that the model control for regression to the mean effect.

Other estimations where we drop the first half of the 1980s or where we employ alternative intermediate breakpoints (e.g. 1993.3 as in BS) provided similar results<sup>6</sup>. Overall, once we control for outlier observations, our results reveal that the EMEs that adopted IT have performed better than the non-targeters in terms of inflation. This result clearly contrasts with Ball and Sheridan’s (2003) conclusion with respect to the effect of IT on average inflation levels for their sample of industrial economies.

<sup>5</sup>Because of our small cross-sectional sample,  $t$ -tests are not asymptotically valid under non-normality.

<sup>6</sup>We chose 1990.1 by calculating for each country in the sample the five quarter moving average inflation rate, then the average across the sample and observing this period as a clear trend change in the average inflation level.



## 3.2 Panel analysis

In this section we re-introduce the time dimension of our sample to explore whether a panel analysis, which considers other inflation determinants, provides evidence to support the results we found using the cross-sectional analysis. In addition to introducing variables commonly associated with inflation performance, like the government primary surplus, GDP growth and worldwide shock variables, we control for the influence of other less traditional factors that the literature has associated with recent disinflation. In particular, we incorporate the impact of two other factors suggested by Rogoff (2003) as determinants of worldwide disinflation: globalization and prudent fiscal policies.

### 3.2.1 The model

The specification of the model departs from equation (1) where, in addition to modelling the behavior of inflation as a function a dummy variable  $T_{it}$ , we control for the effect of country specific factors and world shocks. More precisely, the rate of inflation observed in each period  $t$  and for each country  $i$ ,  $\pi_{i,t}$ , is modelled as

$$\pi_{i,t} = \mu + \delta T_{it} + \beta_1 g_{it} + \beta_2 \Delta y_{it-1} + \beta_3 I_{it} + \gamma_1 P_t^{oil} + \gamma_2 \Delta y_t^{us} + u_{it} \quad (5)$$

where  $g_{it}$  is the government primary surplus as a proportion of GDP,  $\Delta y_{it-1}$  is the first lag of GDP growth,  $I_{it}$  is our proxy for globalization and it is equal to total trade in goods divided by GDP and the variable  $P_t^{oil}$  and  $y_t^{us}$  are shock variables that represent, respectively, the change in the price of oil and the growth rate of output for the US economy.<sup>7</sup> We expect the first lag of GDP growth to have an increasing effect over the rate of inflation at period  $t$ , while the government primary surplus and trade integration (our proxy for globalization) to have a reducing effect. Oil prices and the state of the world economy (measured by rate of growth of the US economy), both variables are expected to have a positive impact on inflation.

### 3.2.2 Estimations

In order to avoid normality problems, for the panel estimations we drop the three largest inflation outlier countries from our sample (Argentina, Brazil, Israel and Peru). Due to

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<sup>7</sup>According to Sumner (2004), it is largely accepted that contemporary globalization is defined by global economic integration in terms of current and capital accounts. Since trade in goods and services has been suggested as a significant factor contributing towards global disinflation (Rogoff, 2003), the estimations presented here focus on examining the influence of trade flows (and increasing competition) on price stability.

Table 3: Aggregate effect of inflation targeting

<b>Variables</b>	<b>OLS*</b>	<b>GLS</b>
Constant ( $\alpha$ )	18.321 [0.074]	12.834 [0.000]
IT dummy ( $T_{it}$ )	-12.362 [0.000]	-6.236 [0.000]
Government primary surplus ( $g_{it}$ )	-2.395 [0.012]	-0.608 [0.000]
Lag of GDP growth ( $y_{it-1}$ )	-0.465 [0.157]	0.118 [0.000]
World trade integration ( $I^w_t$ )	-1.263 [0.671]	-4.689 [0.000]
Change in oil price ( $P_t^{oil}$ )	-0.140 [0.522]	0.151 [0.069]
US GDP growth ( $y^{us}_{it}$ )	1.034 [0.454]	0.473 [0.016]

\* P-values in square brackets calculated using Newey-West standar errors

several missing observations concerning country-specific factors we also exclude Poland, Hungary and Bangladesh from the analysis. In addition, because of some of the country specific factors are not yet available for 2005, the time span of the sample is reduced to 2004.

In sum, we observe the behavior of inflation on a sample comprising 6 ITers and 10 non-ITers during 25 years for a total of 400 observations. As with the DD model, our main source of data is the International Financial Statistics database from the IMF.

We start by estimating (5) by OLS, pooling time series and cross section observations. Tests of heteroscedasticity and autocorrelation reveal that both problems coexist in the initial estimations. Therefore, we re-estimate the model and report Newey–West standard errors, which are robust to heteroscedasticity and first-degree autocorrelation. Following these estimations, the results in Table 3 show that the IT dummy that captures the aggregate effect of IT is negative and significant at the 1% level. The government primary surplus, which controls for the effect of prudent fiscal policies on the reduction of inflation, also presents the expected sign and is significant at the 5% level. The ratio of total trade (i.e. import plus exports) to output, our proxy for globalization, presents the negative expected sign but it is insignificant at the 10% level. The first lag of GDP is the only country specific variable in the model that is not just insignificant but also presents the unanticipated sign. Finally, the coefficients for those variables included in the model to capture the effect of world shocks, US GDP growth and oil prices, both are clearly insignificant.

As an alternative to OLS, we estimate (5) as a system of equations through GLS. The advantage of this approach is that instead of relying on robust standard errors we can allow the disturbances to have a heteroscedastic and at the same time autocorrelated structure. Moreover, given the characteristics of our data, we can allow the residuals to be cross-sectionally correlated. We would expect that in a globally integrated financial environment like the one confronted by EMEs—where propagation of shocks through contagion spread from one country to another—residuals would be contemporaneously correlated.

In order to test for contemporaneous correlation of the residuals, we use the errors obtained from the OLS estimations to compute the Breusch–Pagan LM test of cross-sectional independence. The null hypothesis of this test is that all countries are independent of each other, while under the alternative hypothesis the residuals of at least two of the countries in the sample are contemporaneously correlated. The resulting test statistic is distributed as a  $\chi^2$  with  $N(N - 1)/2$  degrees of freedom (see Greene, 2000). The value of the Breusch–Pagan statistic is  $344.01 > \chi_{0.99}^2(120) = 159$ , which clearly suggests that the null has to be rejected.

In summary, the system of regression equations estimated through GLS present the following characteristics:

$$E(\varepsilon_{it}, \varepsilon_{it}) = \sigma_i^2 \quad (6)$$

$$E(\varepsilon_{it}, \varepsilon_{it-1}) = \rho_i \quad (7)$$

$$E(\varepsilon_{it}, \varepsilon_{jt}) = \sigma_{ij}^2 \quad (8)$$

where (6) suggests that the residual are heteroscedastic, (7) that are autocorrelated and (8) that they are cross-sectionally correlated.

Table 3 also presents the results for the estimation of the model as a system of equations through GLS. Allowing for cross-sectional correlation improves the significance of most of the coefficients of the model. The IT dummy remains significant at the 1% level. In fact, all the other country specific variables of the model become significant at the 1% level and present the expected sign, including the coefficients for the lag of GDP and world trade, which were not significant, and in the case of the former presented the wrong sign, when estimated by OLS. The only variables that are not significant at the 1% level following the estimation through GLS are the shock variables: US GDP growth and oil prices; however, they are both significant at the 10% and 5% level respectively. Overall, the panel analysis confirms the results found through the cross-sectional estimations, even accounting for other disinflation related factors, IT has matter for EMEs price stability.

## 4 Conclusion

This paper has attempted to investigate the effect of IT on price stability employing a sample comprised by EMEs. Our findings clearly contrast with those of Ball and Sheridan (2003) for their sample of industrial economies. Cross-section and panel estimations consistently suggest that IT has mattered for EMEs disinflation. Controlling for other relevant disinflation related factors only confirms the influence of IT on price stability.

We conclude that IT really mattered for EMEs disinflation. Nevertheless, there is no reason to believe that this would not change in the future. For emerging and industrial economies, the experience with IT has been analyzed mainly under periods of relative macroeconomic stability. Little is known about the properties of this regime for periods of instability. Certainly, the attributes of the regime under periods of macroeconomic distress must be of great concern for EMEs.

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