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Abstract

This paper investigates the impact of inflation targeting (IT) on inflation and economic growth among emerging countries, controlling for common time-variation, country-specific effects and simultaneity. The inclusion of a common time effect weakens the IT negative relation with average inflation, and considerably obviates its damping down effect on the volatilities of inflation and output growth, previously found in the literature. To observe the IT regime's endogeneity helps to recover some of its lowering effect on inflation, but not on the volatilities. More important, the analysis of average output growth shows robust evidence of a negative significant IT impact, making it clear that there is a welfare cost of IT disinflation.

JEL classification: E52; E58
Keywords: Inflation Targeting; Inflation; Output Growth; Emerging Economies

1. Introduction

Recent works like Gonçalves and Salles (2008), Batini and Laxton (2007) and IMF (2006) have brought optimistic evidence about the good performance of inflation targeting (IT) regimes in developing countries, in spite of the concerns by Bernanke and Woodford (2005), Mishkin (2000, 2004), Sims (2005) among others about their institutional maturity and consistency of macroeconomic fundamentals. When compared to the less conclusive evidence of Ball and Sheridan (2005) for developed economies,

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which better fulfill the attributes believed necessary for an efficient IT policy, those findings are striking.

Gonçalves and Salles (2008), denominated GS hereafter, apply Ball and Sheridan (2005) cross-section difference-in-difference OLS approach to test if the adoption of IT impacts on the inflation and economic growth of 36 emerging economies. They show that IT countries lowered the average inflation rates and the real output growth volatility relatively more than non-IT countries. With this evidence, but without analyzing the IT effect on the average output growth, they conclude (on page 318) that "… the often heard claim that Inflation Targeting regimes hinder economic growth is clearly not sustained by the empirical evidence. In sum, data so far suggests that the adoption of IT by emerging economies did contribute towards the attainment of superior outcomes in terms of economic performance".

Applying the same methodology, Batini and Laxton (2007), BL hereafter, are even more positive about IT performance, showing not only that IT adoption reduces the average inflation and the volatility of the real output growth, but also the volatility of inflation. Like GS, BL don't rigorously study the rate of output growth, but their volatility. [1] Based on those, they state (on page 13) that: "Thus there is no evidence that inflation targeters meet their inflation objectives at the expense of real output stabilization."

The above works have in common two flaws. First, related to the econometrics, Ball and Sheridan's (2005) cross-section difference-in-difference ordinary least square approach might not be sharp enough to evaluate the IT policy efficiency, as Gertler (2005) has warned. The adoption of IT is an endogenous choice, taken at different times and by countries with different unobservable characteristics, while the above approach does not account for the potential bias induced by endogeneity, nor control for time and country fixed-effects. Second and most important, as a mater of assessment, to miss the analysis of the levels of output growth seriously vitiates the conclusion that IT does not hinder economic growth, given there is an expected negative relation between inflation and economic activity implied by the Phillips curve.

[1] Batini and Laxton (2007) just present plots of average output growth against output growth volatility (their Figure 2) for pre and pos IT adoption and simply say (on page 9) that "… For real output growth … the pattern is less clear … with little change in average growth."

This paper revisits GS and BL emerging economies sample data using a methodology that tries to isolate the improve in performance exclusive due to the IT adoption from other sources not controlled for by the Ball and Sheridan (2005) approach, like common time-varying effect, country fixed-effects and endogeneity. Instead of averaging the time series observations in a pre and post periods and working with a cross-section, we exploit the time and country-specific dimensions. Similar to Beck and Levine (2004), the data is summarized over many three-year periods, which seems a sensible compromise between separating IT effects from other close events' effects and giving enough time for the sluggish responses of macro variables. Econometrically, we apply the two-step *System GMM* panel estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998) that controls for simultaneity and omitted variable biases. The preference for *System GMM* to *Difference GMM* by Arellano and Bond (1991) is because the former is better instrumented to capture the effects of highly persistent variables than the latter, what is particularly useful in the case of the IT regime variable. While these estimation approaches are suited for micro data, where the number of time periods (T) is small relative to the number of individuals (N), in macro it might be problematic as the number of instruments (a function of T) climbs toward the number of countries (N) in small samples. When instruments are many, they tend to over-fit the instrumented variables and bias the results. In this context, our strategy of summing data up over three-year periods is helpful as far as it allows inputting the information contained in longer time series while holding the number of instruments back. Yet to avoid the over-fitting problem, we also reduce the dimensionality of the instrument matrix by collapsing its columns as in Calderon et al. (2002). Finally, for accurate inference purposes, our two-step standard errors are corrected for finite sample as suggested by Windmeijer (2005).

Besides the GMM panel estimators just described, we present estimates for simple pooled cross-section OLS, pooled OLS including common time-variable effect and including time and country-effects, that better help to understand how the results change as more flexibility is added to the Ball and Sheridan (2005) approach.

Focusing on a panel sample of 46 developing countries during twenty seven years, between 1980 and 2006, we review GS and BL results on average inflation, inflation volatility, output growth volatility and, more revealing, add some new evidence on average real output growth. Sensitivity to differences in the time period, the date of IT adoption according to different authors, and the non-IT control group are also addressed.

Overall, the inclusion of a common time-effect variation weakens the cross-country negative relations of the IT regime with average inflation, and different measures of volatility, and makes the negative relation between IT and real output growth much stronger. After controlling for the omitted variables bias and the dynamic panel bias, the IT relation with inflation is negative, but its significance is impaired by its positive correlation with the inflation error. When treated as endogenous, IT coefficient becomes more negative and significant, as expected, but its significance is not robust to the non-IT control group.

One novel evidence in this paper is that, after controlling for time-effects, country-effects and endogeneities, the IT adoption has a negative significant impact on the average real output growth in emerging countries. We also add that the negative growth-IT relation shows quite stable estimates and seems more robust than the inflation-IT relation. Thus, the evidence on economic growth reduction is relatively stronger than evidence on inflation reduction, clarifying that the IT regimes do seem to hinder economic growth. In case one accepts that IT has been effective in reducing inflation, data so far even strongly suggests that it has a cost in term of lower output growth.

We also show that when measured by the standard-deviation, the volatility of inflation is negatively impacted by the IT regime, but the effect is small and not convincingly significant. When the standard-deviation dependence on levels is taken into account, and the coefficient of variation is used as the volatility measure instead, neither inflation nor growth volatility is reduced by the IT framework.

The article is organized as follows. The methodology applied is described in section 2. Section 3 summarizes the data used. The empirical results are reported and discussed in section 4, and conclusions are in section 5.

2. Methodology

We work with a partial adjustment model:

$$y_{n,t} = \alpha \cdot y_{n,t-1} + \beta \cdot d^{IT}_{n,t} + \gamma \cdot X_{n,t} + \delta_t + \eta_n + \upsilon_{n,t} , \qquad (1)$$

where: $y_{n,t}$ is some macroeconomic performance indicator; subscript $n = 1, 2, \ldots, N$ is for country and $t = 1, 2, \ldots, T$ is for date. The lagged value $y_{n,t-1}$ on the right-hand side is included to capture persistence and mean-reverting dynamics, but reduces the dependent variable sample to *(T-1)* observations as consequence. Among the vector of independent variables $w_{n,t} = \left(y_{n,t-1} , d^{IT}_{n,t} , X_{n,t} \right)$, our focus is going to be on the IT dummy variable $d^{IT}_{n,t}$, equal to 1 if country n is a inflation targeter in period t and 0 if it is not. The vector $X_{n,t}$, with possibly endogenous regressors, accounts for other covariates. The term δ_t allows for time-effects that capture common shocks to all countries, and η_n allows for cross-country fixed-effects. The vector $\theta = (\alpha, \beta, \gamma, \eta)$ of common coefficients has β as main parameter of interest for evaluation of the IT policy regime. For concreteness, we will sometimes refer to $y_{n,t}$ as "average inflation" of country n in period t , but a similar reasoning can be applied to other indicators of macroeconomic performance like real output growth, inflation volatility and output growth volatility.

Ball and Sheridan (2005) model, denominated BS hereafter, can result from the time degeneration of equation (1), which sum up all the data available into $T = 2$ periods, thus turning the *(T-1)-period* dynamic panel (1) into a cross-section:

$$y_{n,\,post} - y_{n,\,pre} = \alpha' \cdot y_{n,\,pre} + \beta \cdot d^{IT}_{n,\,post} + \gamma \cdot X_{n,\,post} + \delta + e_{n,\,post} \qquad \forall n , \qquad (2)$$

where: $y_{n,\,post}$ is country's n post-targeting value of average inflation, $y_{n,\,pre}$ is its pre-targeting value, $\alpha' = (\alpha - 1)$ and $e_{n,\,post} = \left(\eta_n + \upsilon_{n,\,post} \right)$. This cross-section setup gives up the possibility of exploiting the time dimension, and also the cross-country unobserved heterogeneity because η_n cannot be identified from $e_{n,\, post}$.[2]

In both equations (1) and (2), a significant β relates average inflation to the IT policy. For example, a negative significant β means that IT countries should have lower inflation. However, due to the omission of the time-effect variation δ_t and the country-effect variation η_n , equation (2) parameters estimates may be biased.

As Bertrand et al. (2004) point, to ignore the time series information of the data would work well only if all targeters had adopted the regime at the same time. Then, the "*pre*" and "*post*" time windows would coincide for every country, incorporating exactly the same combination of time-effect variation and cancelling out in a between-country comparison. But given IT adoption happened at different times for different economies, "*pre*" and "*post*" are no longer coincident for all IT countries and have to be arbitrarily defined for non-ITs. This meaning the time-effect variation δ_t cannot be ignored in the IT analysis.

Abstracted the common time-variation problem, BS cross-section regression would be useful to investigate between-country variation, which is to ask whether targeters have lower inflation. However, equation (2) also ignores country-specific factors affecting both inflation dynamics and IT adoption, and may erroneously suggest a causal relationship from IT to inflation. To investigate the "within-country" variation, which is to ask whether a country is more likely to have a lower inflation in case it adopts

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[2] In fact, the cross-section equation (2) of BS can result from the time degeneration of two different panel models. Besides equation (1), on which we develop this paper, the interpretation given in the BS's Appendix is that equation (2) could result from time-differencing the model:

$$y_{n,t} = \beta \cdot \sum_{u=1}^{t} d_{n,u}^{IT} + \gamma \cdot \sum_{u=1}^{t-1} - y_{n,u} + \delta'_t + \eta'_n + \upsilon'_{n,t} \ , \qquad \text{(N1)},$$

which does include a time-effect, δ'_t , and country-effects η'_n . However, from time-differenced (N1):

$$y_{n,t} - y_{n,t-1} = \beta \cdot d_{n,t}^{IT} - \gamma \cdot y_{n,t-1} + \left(\delta'_t - \delta'_{t-1}\right) + \Delta\upsilon'_{n,t} \ ,$$

it is straightforward to see that $\left(1-\gamma\right) = \alpha$, $\left(\delta'_t - \delta'_{t-1}\right) = \delta_t$ and $\Delta\upsilon'_{n,t} = \left(\eta_n + \upsilon_{n,t}\right)$, what clarifies (N1) is a particular case of (1) that does not identify the country-effect η_n , the reason why we choose (1), like BL and Mishkin and Schmidt-Hebbel (2007).

the IT framework, it is necessary to controls for country-specific unobserved factors affecting both inflation and IT adoption. This can partially be accomplished by the use of country-effects η_n in equation (1). Although η_n does not control for the time variation of those country-specific unobserved factors, it removes at least their time-invariant part, improving inference on the causal effect.

Equation (1) taken as the true model, another concern is that an OLS estimation approach is biased and does not establish causation of IT on inflation in either equation (2) or (1). The OLS estimates are biased and inconsistent in the highly probable situation where $(\eta_n + \upsilon_{n,t})$ are related to the regressors $w_{n,t}$. The covariance $\mathrm{cov}(y_{n,t-1}, \eta_n)$ is positive and biases the OLS estimator of α upwards. The signs and sizes of the biases in the (β, γ) OLS estimators depend on the combination of $\mathrm{cov}(Z_{n,t}, \eta_{n,})$ and $\mathrm{cov}(Z_{n,t}, \upsilon_{n,t})$ for $Z_{n,t} = (d^{IT}_{n,t}, X_{n,t})$.

In equation (1), the fixed-effect OLS estimation is biased if the transformed independent variables $y^*_{n,t-1} = y_{n,t-1} - (T-1)^{-1}(y_{n,1} + ... + y_{n,T-1})$ and $Z^*_{n,t} = Z_{n,t} - (T-1)^{-1}(Z_{n,2} + ... + X_{n,T})$ are correlated with the transformed error $\upsilon^*_{n,t} = \upsilon_{n,t} - (T-1)^{-1}(\upsilon_{n,2} + ... + \upsilon_{n,T})$. The correlation between $y^*_{n,t-1}$ and $\upsilon^*_{n,t}$ has been shown by Nickell (1981) to be negative, because the terms $y_{n,t-1}$ and $-(T-1)^{-1} y_{n,t}$ in $y^*_{n,t-1}$ respectively correlate with the terms $-(T-1)^{-1}\upsilon_{n,t-1}$ and $\upsilon_{n,t}$ in $\upsilon^*_{n,t}$, resulting in a downward biased estimator of α , known as the dynamic panel bias problem. The biases in the (β, γ) fixed-effect OLS estimators of (1) depends on the covariances $\mathrm{cov}(Z_{n,t}, \upsilon_{n,t-j})$ for all $t \geq 2$ and $j = 0, \ldots, (t - 2)$. Specifically for the inflation-IT relation, because a change in the monetary policy regime seems more probable when inflation performance disappoints (is higher than expected), it is not unreasonable the suspect that $\mathrm{cov}(d^{IT}_{n,t}, \upsilon_{n,t-j}) \geq 0$ for $j = 0, \ldots, (t - 2)$. In fact, Mishkin and Schmidt-Hebbel (2002 and 2007) show evidence on IT regime being caused by previous inflation. This being the case, $\mathrm{cov}(d^{IT}_{n,t}, \upsilon_{n,t}) \geq 0$ would bias the β OLS estimates of (1) and (2) upward, and $\mathrm{cov}(d^{IT}_{n,t}, \upsilon_{n,t-j}) \geq$ for $t \geq 2$ and $j = 1, \ldots, (t - 2)$ would bias OLS estimates of (1) downwards. Besides, the reverse causality effect of inflation on IT, there is also the reasonable concern that both IT adoption and inflation reduction are caused by a third time-varying factor.

Thus, for the above listed, we are driven to a *Difference GMM* estimation strategy of equation (1) that controls for simultaneity and omitted variable bias, like Arellano and Bond (1991). Under the assumptions of: (i) uncorrelated $\upsilon_{n,t}$ and (ii) weakly exogenous regressors $\operatorname{cov}(w_{n,t}, \upsilon_{n,t+k}) = 0$ for $k \geq 1$, this approach consists of differencing (1):

$$\Delta y_{n,t} = \theta \cdot \Delta w_{n,t} + \Delta \delta_t + \Delta \upsilon_{n,t}, \qquad (3)$$

to eliminate the country fixed-effect and to use the following moment conditions on instruments $w_{n,t-s}$:

$$E\left[w_{n,t-s} \cdot \Delta \upsilon_{n,t}\right] = 0 \quad \text{for} \quad \begin{cases} s \geq 1,\ t = 2,...,T, \text{ if } w_{n,t} \text{ is predetermined,} \\ s \geq 2,\ t = 3,...,T, \text{ if } w_{n,t} \text{ is endogenous.} \end{cases} \qquad (4)$$

Given $w_{n,t} = (y_{n,t-1}, Z_{n,t})$, lags $s \geq 2$ for instrument $y_{n,t-s}$ and $s \geq 1$ for instruments $Z_{n,t-s}$ in (4) are indicated because of potential relation with the term $\upsilon_{n,t-1}$ in $\Delta \upsilon_{n,t} = (\upsilon_{n,t} - \upsilon_{n,t-1})$. In case of endogeneity of any $Z_{n,t}$ element, its relation with $\upsilon_{n,t}$ is handled by using lags $s \geq 2$, what makes the instrument $Z_{n,t-2}$ and earlier orthogonal to the terms $\upsilon_{n,t}$ and $\upsilon_{n,t-1}$ in $\Delta \upsilon_{n,t}$. The fact that the regressors are "internally" instrumented by their lags is a convenience of Arellano and Bond design, which particularly suits this application, where the IT-dummy lacks adequate instruments outside the immediate data set.[3]

Using moment conditions (4), we perform two-step GMM estimation. The first-step assumes independent and homoskedastic errors across countries and over time. The

[3] According to Mishkin and Schmidt-Hebbel (2007), on page 8, footnote 12, some determinants of an IT regime, like central bank independence, are not available for time series, while others, such as fiscal balance to GDP, were found to be insignificant in their studies.

residuals obtained in the first-step are then used to construct a consistent variance-covariance matrix for the second-step. However, because the number of years is big relative to N, not to risk over-fit the instrumented variables and bias the results, it is cautious to hold back the number of instruments. This concern motivates our strategy to sum data up over three-year periods, inputting the information contained in a longer time series into a smaller number of periods (shrinks T), and to collapse the columns of the instrument matrix, embodying the moments $E\left[w_{n,t-s} \cdot \Delta\upsilon_{n,t}\right] = 0$ for all t into a single moment condition $E\left[\sum_t w_{n,t-s} \cdot \Delta\upsilon_{n,t}\right] = 0$, as in Calderon et al. (2002). Additionally, we apply Windmeijer's (2005) finite sample correction of the two-step estimator variance-covariance matrix, which would otherwise result in downward biased standard errors, as documented by Arellano and Bond (1991) and Blundell and Bond (1998).

However, because the IT-dummy variable is a persistent process, its past values convey little information about its future changes, and the lagged IT-dummies are weak instruments for the differences of the IT-dummy. On the other hand, its last change conveys reasonable information about its present value. Thus, to increase efficiency, Blundell and Bond (1998) suggest also using the moments:

$$E\left[\Delta w_{n,t-s} \cdot \left(\eta_n + \upsilon_{n,t}\right)\right] = 0 \quad \text{for} \quad \begin{cases} s = 0,\ t = 2,...,T, \text{ if } Z_{n,t} \text{ is predetermined,} \\ s = 1,\ t = 3,...,T, \text{ if } Z_{n,t} \text{ is endogenous;} \end{cases} \qquad (5)$$

where the fixed-effects were expunged from the instruments as indicated in Arellano and Bover (1995), and combining these moment conditions (5) with (4) in a denominated *System-GMM* approach.

This is appropriate if changes in any instrument $\Delta w_{n,t}$ are uncorrelated with the fixed-effect, $E\left[\Delta w_{n,t-s} \cdot \eta_n\right] = 0$ for all w and t. Sufficient conditions for that are: (iii) $E\left[\Delta y_{n,2} \cdot \eta_n\right] = 0$ and (iv) that conditional on the common time-effects, the first moments of $\Delta Z_{n,t}$ be time-invariant, which we advocate to be sensible in section 4. In any way, as these additional moment conditions are over-identifying restrictions, their validity can be tested using standard GMM tests of over-identifying restrictions.

To test that the assumption that the errors terms are not serially correlated, that the instruments are valid ones and that changes in instruments are uncorrelated with the fixed-effect, we respectively report three tests. First, we test whether the error term $\upsilon_{n,t}$ is not serially correlated, which means that $\Delta\upsilon_{n,t}$ is probably first-order correlated, but not second-order correlated. Second, we present the Hansen test of over-identifying restrictions, which tests the overall validity of the instruments by analyzing the sample analog of the moment conditions. And third, the Difference-in-Hansen test for the additional moment conditions implied by $E\left[\Delta w_{n,\,t-s}\cdot\eta_n\right]=0$ is performed. The failure to reject these null hypotheses supports the model.

3. Data

This study reexamines GS and BL samples of emerging market economies for the period 1980-2006, where evidence of IT effectiveness in lowering inflation and macroeconomic volatility were found. As shown in Table 1, the GS sample is composed of 36 emerging economies, including 13 IT countries: Brazil, Chile, Colombia, Czech Republic, Hungary, Israel, Mexico, Peru, Philippines, Poland, South Africa, South Korea, and Thailand. The control group of 23 non-IT countries is composed by: Argentina, Bulgaria China, Costa Rica, Côte d’Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, India, Indonesia, Lebanon, Malaysia, Morocco, Nigeria, Pakistan, Panama, Singapore, Taiwan, Tunisia, Turkey, Uruguay, Venezuela. The BL sample has the same IT treatment group of 13 emerging economies. The difference between the BL and GS control groups is that BL do not include Bulgaria, Panama, Singapore and Taiwan, but additionally contemplate Algeria, Botswana, Croatia, Ghana, Guatemala, Jordan, Russia, Serbia, Tanzania and Ukraine, totaling 42 countries. Aiming at synthesizing the IT effects on inflation and output in emerging economies, we choose to present the current analysis for their union sample of 46 countries and for their intersection sample of 32 economies.[4] The annual inflation and real GDP growth rates used are from the World Economic Outlook (WEO) by the International Monetary Fund (IMF). Among the countries studied, Croatia, Russia and Ukraine series start in 1993, and Serbia series start in 1998, unbalancing the union sample panel.

<Insert Table 1 around here>

The data is difficult to work, because of cross-country heteroskedasticity, exacerbated by the high inflation rates in many countries until the mid-nineties. This fact motivated GS to delete inflation rates above 50% per year, arguing this could bias in favor of the IT dummy. Given we will be working in time series, this procedure is not recommended. BL and IMF (2006) suggest including a threshold dummy for inflation rates higher than a certain ceiling as a control variable $X_{n,t}$ in equation (1), an approach we take. Additionally to prevent that the results be biased by a small number of countries with high inflations, we take the natural logarithm of inflation transforming $Y_{n,t}$ into $y_{n,t} = \ln(1 + Y_{n,t}/100)$. For methodological consistency, we also log-transform the real output growth.

Instead of averaging the data in a pre and post periods and working with a cross-section, we exploit its time and country-specific dimensions, reducing the chances that the results be biased by other events happened close before and after IT adoption, or by country-specific factors affecting both the indicator of macroeconomic performance and the monetary policy regime. Similar to Beck and Levine (2004), the data is summarized over many three-year periods, which we believe is a good compromise between removing overlapping events and giving enough time for the sluggish responses of macro variables. Sensitivity to differences in the definition of the three-year periods and time span is also addressed by presenting results for the years from 1985 to 2005.

[4] Results for GS and BL samples of countries can be provided upon request. As an overlook, BL results are closer to the union sample results, while GS results are closer to the intersection sample results.

The existing literature diverges on when to date the adoption of IT, if with the start of a partial inflation targeting (for example, Corbo, Landerretche and Schmidt-Hebbel (2002); Gonçalves and Salles (2006)), or only when full-fledged targeting is at work (Mishkin (2000); Batini and Laxton (2007); IMF (2006)), as illustrated with GS and BL adoption dates in Table 1.A. Although some robustness exercises with GS IT dating are presented, most of this article works with BL IT adoption dates, a choice we buttress on Mishkin's (2000) point that to be classified as an IT economy, in addition to a public announcement of numerical targets for the future inflation, elements like institutional subordination of other goals, information disclosure and accountability are needed.

4. Results

Tables 2 to 6 present estimates of equation:

$$y_{n,t} = \alpha \cdot y_{n,t-1} + \beta \cdot d_{n,t}^{IT} + \gamma \cdot high_{n,t} + \delta_t + \eta_n + \upsilon_{n,t}\ , \qquad (1')$$

resulting from various estimation methods, for different measures $y_{n,t}$ of macroeconomic performances, where $high_{n,t}$ is a dummy variable equal to 1 if average inflation is bigger than 0.40 per year (in natural logarithm) in period t and 0 otherwise.[5]

The indicator of performance y is the average inflation in Tables 2.A and 4.A and the average real output growth in Tables 2.B and 4.B. Tables 3 and 5 show estimates of equation (1') when y is the volatility of inflation in panels A or the volatility of real output growth in panels B, both measured as the standard-deviation in three-year periods. It seems sensible to keep the dummy variable for high inflation $high_{n,t}$ in the equations of output growth and volatilities of inflation and output growth, given the many possible

[5] Results without the $high_{n,t}$ can be provided upon request and are not qualitatively different with respect to the IT regime effect.

macroeconomic interrelations. For y equal to the coefficient of variation of inflation and output growth, calculated as the difference between the standard deviation and the absolute value of the average, Table 6 displays estimates of a simpler version of equation (1’) without the variable $high_{n,t}$.

<Insert Table 2 around here>

The column 1 of Tables 2 and 3 present estimates of the simple pooled cross-section OLS, that omits δ_t and η_n , with robust standard-errors clustered by country. Although estimated in a multi-period setting, instead of in a cross-section setting like BL and GS, these estimates pretty much reproduce their findings that the IT regime is effective to reduce average inflation (in Table 2.A), the volatility of inflation (in Table 3.A) and the volatility of output growth (in Table 3.B), without a significant cost in terms of lower real output growth (in Table 2.B). The $high_{n,t}$ variable is also significant for all four measures, indicating that in high inflation periods, there is less growth (in Table 2.B) and more macroeconomic volatility (in Table 3).

However, the inclusion of the time-effect variation δ_t in column 2 (TE-OLS) of Tables 2 and 3 considerably modifies the results. Now, the negative impact of IT on inflation (in 2.A) has a negative significant side-effect on output growth (in 2.B), meaning that IT countries grow less. At the same time, the relation between the IT dummy and the volatilities of inflation and output growth are not significant anymore. These results indicate that BL and GS abstraction of the differences in the time span of countries’ pre and post experiences somehow overstated the negative relation between the IT regime and inflation levels or macroeconomic volatility. The inclusion of the common time effect corrects such distortion, weakening these relations and, more revealing, suggests that inflation targeters do pay a cost in terms of reduced economic growth for pursuing lower inflation.

<Insert Table 3 around here>

In column 3 of Tables 2 and 3, we present results for the fixed-effect OLS, with both δ_t and η_n included (CTE-OLS) and robust standard-errors clustered by country. As explained in section 2, the fixed effect OLS estimator of α is biased downward because of the negative correlation between the transformed variables $y^*_{n,t-1}$ and $\upsilon^*_{n,t}$, something noticeable when comparing the lagged variable coefficients in this column with the ones in column 2. The bias in β depends on the opposite effects of $\operatorname{cov}\left(d^{IT}_{n,t}, \upsilon_{n,t}\right)$ and $\operatorname{cov}\left(d^{IT}_{n,t}, \upsilon_{n,t-j}\right)$ for all $t \geq 2$ and $j = 1, \ldots, (t - 2)$, being difficult to predict. However, because $\operatorname{cov}\left(d^{IT}_{n,t}, \upsilon_{n,t}\right)$ also affects the TE-OLS estimator, but $\operatorname{cov}\left(d^{IT}_{n,t}, \upsilon_{n,t-j}\right)$ for $j = 1, \ldots, (t - 2)$ only affects the CTE-OLS estimator, given the estimate of β in column 3 of Table 2.A is much smaller than the one in column 2, it is possible to infer that $\operatorname{cov}\left(d^{IT}_{n,t}, \upsilon_{n,t-j}\right) \geq 0$ for $j = 1, \ldots, (t - 2)$ for the average inflation equation. A similar, but milder, pattern holds for the volatility of inflation in Table 3.A and validates the intuition that IT is positively related to past inflation disappointment. For real output growth, there are no significant changes in the estimates from columns 2 to 3 in Table 2.B and 3.B. These support the reasonable suspicion that IT adoption was mainly driven by inflation concerns and not by output growth concerns.

<Insert Table 4 around here>

In columns 4 of Tables 2 and 3, we use the two-step *Difference-GMM* estimator to fix the dynamic panel bias and to take into account the indisputable endogeneity of $high_{n,t}$, but keep on treating $d^{IT}_{n,t}$ as predetermined. For periods $t \geq 3$, we use the instruments $\left(y_{n,t-2-j}, d^{IT}_{n,t-1-j}, high_{n,t-2-j}\right)$ for $j = 0, 1, \ldots, t\text{-}3$. Given our sample of only 46 countries (N is small), we have to collapse the columns of the instruments matrix to be able explore the information contained in the deeper lags of the regressors while holding back the number of instruments to avoid the over-fit problem.[6] The four measures of economic performance adjust pretty well to the proposed parameterization

[6] Here for example, by collapsing the columns of the instrument matrix, like Calderon et al. (2002), we sum up the information of an otherwise 66 rank instrument matrix into a 23 rank instrument matrix.

(1’). In accordance with the assumptions, there is some evidence of first-order autocorrelation of the residuals, no evidence of second-order autocorrelation, and the Hansen test of over-identifying restrictions does not reject the overall validity of the instruments. Given the TE_LS and CTE_LS estimators of α are likely to be biased in opposite directions, the fact that all estimates of α in column 4 lie between their equivalents in columns 2 and 3 is another evidence of consistency. But in spite of the good model adjustment, its results are disappointing about the effectiveness of the IT policy. The IT coefficient is close to zero and insignificant for the average inflation equation, and becomes positive but insignificant for the measures of average growth and volatilities of inflation and growth.

Given the high persistence of the IT variable, the imprecisely estimated coefficients in column 4 seem a symptom of the past levels of IT being a weak instrument for its present changes. In such situation, Blundell and Bond’s (1998) *System-GMM* is the suitable estimation approach, provided the condition that changes in any instrument are uncorrelated with the fixed-effects. Sufficient conditions for that are: (iii) $E\left[\Delta y_{n,2} \cdot \eta_n\right] = 0$ and, (iv) that conditional on the time-effects, the first moments of $\Delta Z_{n,t}$ be time-invariant.

Because there is nothing special about the first observation in our samples, we might expect the initial condition $E\left[\Delta y_{n,2} \cdot \eta_n\right] = 0$ to be valid.[7] It is thus sufficient that, conditional on time-effects, $E\left[\Delta Z_{n,t} \cdot \eta_n\right] = 0$, which is clearly weaker than requiring the levels of $Z_{n,t}$ be uncorrelated with the country effects. Specifically in the inflation-IT relation, this impose that the IT adoption be unrelated to the country’s inflation fixed-effect $E\left[\Delta d_{n,t}^{IT} \cdot \eta_n\right] = 0$, but allows the IT regime and the country’s inflation fixed-effect to have a time-invariant relation, $E\left[d_{n,t}^{IT} \cdot \eta_n\right] = c$ for all t, where $c \neq 0$ is a constant, as

[7] Our sample starts in 1980 because this is the first year reported for most of emerging economies. For robustness purposes, we also report results for a sample that starts in 1985.

well as the IT adoption to be related to inflation changes $E\left[\Delta d_{n,t}^{IT} \cdot \Delta y_{n,t}\right] \neq 0$.[8] A similar reasoning applies to $high_{n,t}$.

The column 5 in Tables 2 and 3 show the two-step *System GMM* estimates and specification tests, treating $high_{n,t}$ as endogenous and $d_{n,t}^{IT}$ as predetermined. For periods $t \geq 3$, we use the instruments $\left(y_{n,t-2-j}, d_{n,t-1-j}^{IT}, high_{n,t-2-j}\right)$ for *j = 0, 1, …, t-3* with the equation in differences, and the instruments $\left(\Delta y_{n,t-1}, \Delta d_{n,t}^{IT}, \Delta high_{n,t-1}\right)$ with the equations in levels. Like in column 4, there is evidence of first-order autocorrelation and no evidence of second-order autocorrelation. The Hansen test of over-identifying restrictions does not reject the overall validity of the instruments and the estimates of α lie between the TE-OLS and CTE-OLS. Additionally, the Difference-in-Hansen does not reject the validity of the additional moment conditions $E\left[\Delta w_{n,t} \cdot \eta_n\right] = 0$. Relative to the *Difference-GMM*, the IT dummy coefficients become negative and more significant. Although more negative, the impact of IT on inflation (in 2.A) is less significant than its turn down effect on real output growth (in 2.B), indicating that IT does have some cost in terms of lower output growth. The relation between the IT dummy and the volatility of inflation is negative but insignificant, while the volatility of output growth shows a negative significant relation with the IT regime.

Next in column 6, we deal with the possible endogeneity of the IT regime. Although the time- and country-effects are useful in removing the influence of the cross-country invariant and time-invariant determinants of both macroeconomic performance and monetary policy regime, those may not be enough to address the causality of IT on macroeconomic performance. Perhaps, there is also a reverse causality from inflation, and/or output growth to IT. Or there may be a third omitted country-specific time-variable factor that determines both the macroeconomic performance and the monetary policy regime. To handle the consequent endogeneity of IT in such circumstances, we re-estimate column 5 with IT as an endogenous variable instead. This is implemented by

[8] Although theoretical work on IT regime recommends that some pre-conditions be fulfilled for IT adoption , which would imply $E\left[\Delta d_{n,t}^{IT} \cdot \eta_n\right] \neq 0$, IMF (2006) shows that those were not previously accomplished by emerging economies that become inflation targeters, meaning $E\left[\Delta d_{n,t}^{IT} \cdot \eta_n\right] = 0$ at least in this respect.

lagging the $d_{n,t}^{IT}$ instrument once more. Thus, for periods $t \geq 3$, we use the instruments $\left(y_{n,t-2-j}, d_{n,t-2-j}^{IT}, high_{n,t-2-j}\right)$ for $j = 0, 1, \ldots, t\text{-}3$ with the equation in differences, and the instruments $\left(\Delta y_{n,t-1}, \Delta d_{n,t-1}^{IT}, \Delta high_{n,t-1}\right)$ with the equations in levels.

The estimates in columns 6 of Tables 2 and 3 have as good adjustment as the ones in column 5. However, the new β estimates uncover the simultaneity existent between average inflation and IT regime. In Table 2.A, the IT coefficient becomes more negative and significant relative to column 5, indicating that IT is positively influenced by the average inflation error, $\operatorname{cov}\left(d_{n,t}^{IT}, \upsilon_{n,t}\right) > 0$. The β estimates of output growth (in 2.B), inflation volatility (in 3.A) and volatility of output growth (in 3.B) do not change much, clarifying that the main cause of endogeneity bias is the reverse causality from inflation levels to IT.

Analyzing column 6 estimates deeper, the long-term average difference in inflation between IT and non-IT countries is *-3.71* percent per year (in natural logarithm) in Table 2.A, similar to GS value for the period 1980-2005.[9] The long-run reduction in the volatilities of inflation and output growth, respectively *-0.22* and *-0.46* percent, can be considered small and, in the volatility of growth case, different from the *-1.4* percent got by GS. However, there is a considerable long-term output growth cost of *-1.18* percent to be borne for the IT use.

So far, assuming that IT adoption is not related to the country-fixed effects, we have the evidence that IT framework is effective to reduce inflation levels, with small impacts on volatilities, at the cost of lower output growth. But are these findings for the period 1980-2006 in an unbalanced panel of 46 countries with BL IT adoption dates robust? Tables 4 and 5 present some robustness checks by examining the period 1985-2005 in columns 1 and 2, the use of GS IT adoption dates in columns 3 and 4 and the balanced panel of 32 countries which intersect BL and GS samples in columns 5 and 6.

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[9] For equation (2) during the period 1980-2005, GS report in their Table 2 estimates of $\alpha' = -0.67$ and $\beta = -2.53$, resulting in long-term average difference in inflation between IT and non-IT countries of *-3.78* percent, or *-3.71* percent in natural logarithm. Given methodological and sample differences with the current work described above, such similarity should be partially attributed to simple coincidence. Results for other periods still close, but not this equal.

<Insert Table 5 around here>

In column 1 and 2 of Table 4.A, we again see strong evidence of IT endogeneity in the inflation-IT relation. For the period 1985-2005, the IT regime is effective to reduce the level of inflation at the cost of lower economic growth, respectively in column 2 of Tables 4.A and 4.B. Output growth volatility repeats in column 2 of Table 5.B the same insignificant small sensitivity to IT presented in column 6 of Table 3.B. The change in pattern, relative to the period 1980-2006, happens to inflation volatility that now seems significantly reduced by the IT framework.

The use of GS IT adoption date in columns 3 and 4 results in a pattern very close to the one reported in columns 5 and 6 of Tables 2 and 3, indicating that the results are not sensitive to differences in the IT dating. However, the variation in the non-control group in columns 5 and 6 considerably change the results. When the sample studied is the balanced panel of 32 countries common to BL and GS, the absolute size of the IT effect on the inflation levels is much reduced and its significance annulled. While IT does not seem to significantly affect inflation levels anymore, neither the volatilities of inflation and output growth in column 6 of Table 5, it is still causing a significant negative effect on output growth in column 6 of Table 4.B

Summarizing Tables 4 and 5, the negative side effect of IT regime on average output growth seems more robust than its intended minimization effects on average inflation, inflation volatility and output volatility.

<Insert Table 6 around here>

To finish, because IT has shown to cut down average measures, it is reasonable to wonder whether its negative effects on volatility measures are not due to the standard-deviation being linearly related to the absolute size of the mean. Table 6 tries to address this estimating equation (1’) without the $high_{n,t}$ dummy variable for the coefficients of variation of inflation (in 6.A) and output growth (in 6.B), computed as the difference between the standard-deviation and the absolute average. Columns 1 to 6 show two-step System GMM estimates for three different samples: the union sample during 1980-2006 (in columns 1 and 2), the union sample during 1985-2005, and the intersection sample during 1980-2006. For all samples, reasonably adjusted according to the specification test results, the estimates of the IT impact become positive in general and non-significant, demonstrating that the apparent damping down effect of IT on volatilities of inflation and growth is just a consequence of its negative effect on their respective averages.

5. Conclusion

In this paper, we examined the impact of the IT framework on the level and volatility of emerging countries' inflation and output growth. Different from Batini and Laxton (2007) and Gonçalves and Salles (2008), which used Ball and Sheridan's (2005) cross-section difference-in-difference OLS, we applied the dynamic panel estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998) that controls for simultaneity and omitted variable biases. This instrumental variable estimation better suit the inference purpose on the causal effect of IT on inflation and resulted in considerable qualifications Batini and Laxton (2007) and Gonçalves and Salles (2008) conclusions.

The inclusion of a common time-effect variation weakened the cross-country negative relation of the IT regime with average inflation and measures of volatility, and uncovered a strong negative relation between the IT framework and economic growth.

After controlling for the dynamic panel bias problem and for the endogeneity of the IT regime, there is some evidence that IT reduces inflation, but it is not robust to variations in the non-IT control group. The IT impact on the volatilities of inflation and output were shown small and their significance variable to subtle changes in the instrument set, period of analysis, IT adoption date or non-IT control group. Among the macroeconomic indicators of performance studied, the most robust result was that the IT regime significantly hinders output growth.

In sum, although there is some relation between IT and lower inflation, this relation seems weaker than previously affirmed in the literature. More important, in opposition to the previous views that IT adoption was costless in term of output growth, we showed that there is a negative significant relation between IT adoption and output growth to be taken into account for purposes of evaluation of the IT policy.

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TABLES

Table 1

Authors' Samples and Dates of Inflation Targeting Adoption

1.A - Inflation targeting countries

present in both samples:	Year of inflation targeting adoption, according to:	
	Gonçalves and Salles (2008)	Batini and Laxton (2006)
Brazil	1999	1999
Chile	1991	1999
Colombia	2000	1999
Czech Republic	1998	1998
Hungary	2001	2001
Israel	1992	1997
Mexico	1999	2002
Peru	1994	2002
Philippines	2002	2002
Poland	1999	1999
South Africa	2000	2000
South Korea	1998	1998
Thailand	2000	2000

1.B - Non-inflation targeting countries present in:

both samples:	Gonçalves and Salles only:	Batini and Laxton only:
Argentina	Bulgaria	Algeria
China	Panama	Botswana
Costa Rica	Singapore	Croatia
Côte d'Ivoire	Taiwan	Ghana
Dominican Republic		Guatemala
Ecuador		Jordan
Egypt		Russia
El Salvador		Serbia
India		Tanzania
Indonesia		Ukraine
Lebanon		
Malaysia		
Morocco		
Nigeria		
Pakistan		
Tunisia		
Turkey		
Uruguay		
Venezuela		

Table 2
Estimates of the Inflation Targeting Effects on Inflation and Output Growth (1980-2006)

Estimator:	OLS	TE-OLS	CTE-OLS	D-GMM P	S-GMM P	S-GMM E
Regressors:	(1)	(2)	(3)	(4)	(5)	(6)
			2.A - CPI Inflation Equation			
Inflation-targeting	-3.73	-1.74	-10.90	-0.10	-1.86	-3.18
dummy	(0.01)	(0.06)	(0.02)	(0.99)	(0.08)	(0.01)
Lagged inflation	0.23	0.25	0.14	0.16	0.14	0.14
	(0.00)	(0.00)	(0.02)	(0.23)	(0.30)	(0.28)
High inflation dummy	72.70	69.00	71.10	72.00	73.70	76.50
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
AR(1) test				0.07	0.07	0.07
AR(2) test				0.87	0.90	0.90
Hansen J test				0.26	0.27	0.48
Difference-in-Hansen					0.49	0.91
Observations	350	350	350	304	350	350
Instrument columns				23	27	26
R-squared	0.59	0.60	0.51			
			2.B - Real Output Growth Equation			
Inflation-targeting	-0.26	-0.60	-0.28	3.35	-0.85	-1.01
dummy	(0.43)	(0.02)	(0.70)	(0.33)	(0.02)	(0.02)
Lagged output growth	0.14	0.16	-0.02	0.12	0.14	0.15
	(0.30)	(0.27)	(0.85)	(0.52)	(0.41)	(0.40)
High inflation dummy	-3.97	-3.85	-4.25	-1.77	-2.26	-2.17
	(0.01)	(0.01)	(0.01)	(0.44)	(0.18)	(0.20)
AR(1) test				0.14	0.08	0.08
AR(2) test				0.25	0.26	0.27
Hansen J test				0.57	0.26	0.21
Difference-in-Hansen					0.23	0.23
Observations	350	350	350	304	350	350
Instrument columns				23	27	26
R-squared	0.15	0.20	0.18			

Pooled cross-section (OLS) in column (1), including time-variable effect (TE-OLS) in (2), and time and country-effects (CTE-OLS) in (3), with robust standard errors clustered by country in parentheses. (4) uses two-step difference GMM of Arellano and Bond (1991) (D-GMM P). (5) and (6) use two-step system GMM of Arellano and Bover (1995). (5) takes the IT dummy as predetermined (S-GMM P), while (6) assumes it is endogenous (S-GMM E). D-GMM and S-GMM report Windmeijer's (2005) corrected robust standard errors. All columns use Batini and Laxton (2006) IT dating. The sample is an unbalanced panel of 46 emerging countries (all countries in Table 1) with data averaged over 3-year periods between 1980 and 2006. The start date of the dependent variable is 1985 (i.e.: t=1985 and t-1=1982). AR(1), AR(2), Hansen J tests and Difference-in-Hansen report the respective p-values.

Table 3

Estimates of the Inflation Targeting Effect on Macroeconomic Volatility (1980-2006)

Estimator:	OLS	TE-OLS	CTE-OLS	D-GMM P	S-GMM P	S-GMM E
Regressors:	(1)	(2)	(3)	(4)	(5)	(6)
			3.A - Inflation Volatility Equation			
Inflation-targeting	-1.35	-0.60	-1.86	8.42	-0.26	-0.19
dummy	(0.01)	(0.26)	(0.25)	(0.19)	(0.51)	(0.70)
Lagged inflation	0.19	0.20	0.10	0.14	0.15	0.15
volatility	(0.02)	(0.02)	(0.27)	(0.20)	(0.03)	(0.03)
High inflation dummy	28.90	27.50	28.50	35.30	32.20	32.30
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
AR(1) test				0.05	0.04	0.04
AR(2) test				0.52	0.46	0.47
Hansen J test				0.12	0.34	0.29
Difference-in-Hansen					0.23	0.25
Observations	350	350	350	304	350	350
Instrument columns				23	27	26
R-squared	0.41	0.42	0.35			
			3.B - Real Output Growth Volatility Equation			
Inflation-targeting	-0.75	-0.30	0.01	1.50	-0.37	-0.34
dummy	(0.01)	(0.34)	(0.98)	(0.74)	(0.05)	(0.24)
Lagged output growth	0.29	0.30	0.12	0.23	0.27	0.27
volatility	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.00)
High inflation dummy	3.34	3.05	3.10	1.17	1.43	1.39
	(0.03)	(0.03)	(0.10)	(0.38)	(0.14)	(0.16)
AR(1) test				0.03	0.02	0.02
AR(2) test				0.42	0.44	0.44
Hansen J test				0.83	0.86	0.84
Difference-in-Hansen					0.70	0.70
Observations	350	350	350	304	350	350
Instrument columns				23	27	26
R-squared	0.23	0.25	0.15			

Pooled cross-section (OLS) in column (1), including time-variable effect (TE-OLS) in (2), and time and country-effects (CTE-OLS) in (3), with robust standard errors clustered by country in parentheses. (4) uses two-step difference GMM of Arellano and Bond (1991) (D-GMM P). (5) and (6) use two-step system GMM of Arellano and Bover (1995). (5) takes the IT dummy as predetermined (S-GMM P), while (6) assumes it is endogenous (S-GMM E). D-GMM and S-GMM report Windmeijer's (2005) corrected robust standard errors. All columns use Batini and Laxton (2006) IT dating. The sample is an unbalanced panel of 46 emerging countries (all countries in Table 1) with data averaged over 3-year periods between 1980 and 2006. The start date of the dependent variable is 1985 (i.e.: t=1985 and t-1=1982). AR(1), AR(2), Hansen J tests and Difference-in-Hansen report the respective p-values.

Table 4
System GMM Estimates of the Inflation Targeting Effects on Average Inflation and Average Real Output Growth: Robustness Checks

	Union sample				Intersection sample	
Author's IT (period):	BL (1985-2005)		GS (1980-2006)		BL (1980-2006)	
Estimator:	S-GMM P	S-GMM E	S-GMM P	S-GMM E	S-GMM P	S-GMM E
Regressors:	(1)	(2)	(3)	(4)	(5)	(6)
4.A - CPI Inflation Equation						
Inflation-targeting	-0.97	-4.35	-1.76	-3.14	-1.68	-1.09
dummy	(0.41)	(0.01)	(0.07)	(0.01)	(0.24)	(0.65)
Lagged inflation	0.18	0.15	0.15	0.16	0.21	0.21
	(0.21)	(0.29)	(0.28)	(0.24)	(0.09)	(0.10)
High inflation dummy	62.60	77.30	72.30	70.80	102.00	102.00
	(0.32)	(0.20)	(0.00)	(0.00)	(0.00)	(0.00)
AR(1) test	0.48	0.38	0.08	0.08	0.04	0.04
AR(2) test	0.83	0.98	0.82	0.83	0.64	0.62
Hansen J test	0.12	0.27	0.21	0.29	0.26	0.11
Difference-in-Hansen	0.02	0.06	0.62	0.77	0.13	0.01
Observations	266	266	350	350	256	256
Instrument columns	21	20	29	28	27	26
4.B - Real Output Growth Equation						
Inflation-targeting	-1.19	-1.13	-0.86	-1.20	-0.81	-1.05
dummy	(0.02)	(0.02)	(0.02)	(0.01)	(0.11)	(0.04)
Lagged output growth	-0.11	-0.09	0.11	0.12	-0.04	-0.04
	(0.63)	(0.70)	(0.49)	(0.47)	(0.76)	(0.80)
High inflation dummy	-7.35	-6.85	-2.40	-2.68	-2.03	-1.84
	(0.13)	(0.18)	(0.11)	(0.06)	(0.18)	(0.27)
AR(1) test	0.17	0.17	0.11	0.09	0.20	0.21
AR(2) test	0.83	0.89	0.22	0.22	0.20	0.21
Hansen J test	0.17	0.17	0.28	0.25	0.29	0.21
Difference-in-Hansen	0.06	0.10	0.41	0.32	0.35	0.17
Observations	266	266	350	350	256	256
Instrument columns	21	20	29	28	27	26

Columns (1) to (4) use the unbalanced panel of 46 countries. (1) and (2) cover the period 1985-2005 with Batini and Laxton (2006) IT dating, and (3) and (4) cover the period 1980-2006 with Gonçalves and Salles (2008) IT dating. Columns (5) and (6) use the balanced panel of 32 emerging countries (countries in the first column of Table 1) during 1980-2006. Data are averaged over 3-year periods. S-GMM P and S-GMM E are two-step system GMMs of Arellano and Bover (1995), with Windmeijer's (2005) corrected robust standard errors, where S-GMM P takes the IT dummy as predetermined, and S-GMM E assumes it is endogenous. AR(1), AR(2), Hansen J tests and Difference-in-Hansen report the respective p-values.

Table 5
System GMM Estimates of the Inflation Targeting Effects on Inflation Volatility and Real Output Growth Volatility: Robustness Check

	Union sample				Intersection sample	
Author's IT (period):	BL (1985-2005)		GS (1980-2006)		BL (1980-2006)	
Estimator:	S-GMM P	S-GMM E	S-GMM P	S-GMM E	S-GMM P	S-GMM E
Regressors:	(1)	(2)	(3)	(4)	(5)	(6)
	5.A - Inflation Volatility Equation					
Inflation-targeting	-0.76	-1.10	-0.54	-0.79	-0.79	-0.40
dummy	(0.06)	(0.08)	(0.13)	(0.13)	(0.23)	(0.65)
Lagged inflation	0.14	0.12	0.16	0.16	0.28	0.27
volatility	(0.26)	(0.26)	(0.03)	(0.02)	(0.01)	(0.01)
High inflation dummy	36.20	40.30	32.50	32.60	29.70	29.50
	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
AR(1) test	0.14	0.13	0.04	0.04	0.03	0.03
AR(2) test	0.18	0.16	0.46	0.46	0.94	0.96
Hansen J test	0.68	0.76	0.46	0.43	0.23	0.22
Difference-in-Hansen	0.49	0.68	0.30	0.27	0.02	0.04
Observations	263	263	350	350	256	256
Instrument columns	21	20	29	28	27	26
	5.B - Real Output Growth Volatility Equation					
Inflation-targeting	-0.64	-0.32	-0.39	-0.26	-0.63	-0.53
dummy	(0.01)	(0.24)	(0.05)	(0.35)	(0.01)	(0.38)
Lagged output growth	0.29	0.30	0.26	0.26	0.29	0.29
volatility	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
High inflation dummy	0.40	0.52	1.02	0.96	1.18	1.06
	(0.71)	(0.58)	(0.28)	(0.32)	(0.25)	(0.32)
AR(1) test	0.00	0.00	0.02	0.02	0.03	0.03
AR(2) test	0.41	0.37	0.44	0.44	0.45	0.46
Hansen J test	0.69	0.76	0.76	0.77	0.92	0.86
Difference-in-Hansen	0.20	0.37	0.22	0.24	0.74	0.71
Observations	262	262	350	350	256	256
Instrument columns	21	20	29	28	27	26

Columns (1) to (4) use the unbalanced panel of 46 countries. (1) and (2) cover the period 1985-2005 with Batini and Laxton (2006) IT dating, and (3) and (4) cover the period 1980-2006 with Gonçalves and Salles (2008) IT dating. Columns (5) and (6) use the balanced panel of 32 emerging countries (countries in the first column of Table 1) during 1980-2006. Data are averaged over 3-year periods. S-GMM P and S-GMM E are two-step system GMMs of Arellano and Bover (1995), with Windmeijer's (2005) corrected robust standard errors, where S-GMM P takes the IT dummy as predetermined, and S-GMM E assumes it is endogenous. AR(1), AR(2), Hansen J tests and Difference-in-Hansen report the respective p-values.

Table 6
System GMM Estimates of the Inflation Targeting Effects on Inflation Coefficient of Variation and Real Output Growth Coefficient of Variation: Robustness Check

	Union sample				Intersection sample	
Period:	1980-2006		1985-2005		1980-2006	
Estimator:	S-GMM P	S-GMM E	S-GMM P	S-GMM E	S-GMM P	S-GMM E
Regressors:	(1)	(2)	(3)	(4)	(5)	(6)
	6.A - Inflation Coefficient of Variation Equation					
Inflation-targeting	0.88	1.52	1.02	1.16	0.09	-1.42
dummy	(0.21)	(0.08)	(0.14)	(0.44)	(0.92)	(0.48)
Lagged inflation	0.44	0.45	0.49	0.47	0.56	0.56
coefficient of variation	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
AR(1) test	0.04	0.04	0.04	0.05	0.05	0.05
AR(2) test	0.65	0.65	0.12	0.12	0.61	0.59
Hansen J test	0.22	0.22	0.41	0.54	0.12	0.06
Difference-in-Hansen	0.66	0.79	0.22	0.47	0.70	0.04
Observations	350	350	263	263	256	256
Instrument columns	19	18	15	14	19	18
	6.B - Real Output Growth Coefficient of Variation Equation					
Inflation-targeting	0.39	0.65	0.22	0.46	-0.02	0.40
dummy	(0.25)	(0.11)	(0.65)	(0.43)	(0.97)	(0.50)
Lagged output growth	0.25	0.25	0.11	0.13	0.23	0.23
coefficient of variation	(0.00)	(0.00)	(0.20)	(0.18)	(0.00)	(0.00)
AR(1) test	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) test	0.38	0.38	0.44	0.37	0.37	0.37
Hansen J test	0.80	0.70	0.46	0.42	0.59	0.49
Difference-in-Hansen	0.67	0.60	0.22	0.31	0.15	0.14
Observations	350	350	262	262	256	256
Instrument columns	19	18	15	14	19	18

Columns 1 to 4 use the unbalanced panel of 46 countries. (1) and (2) cover the period 1980-2006, and (3) and (4) cover the period 1985-2005. Columns 5 and 6 use the balanced panel of 32 emerging countries (countries in the first column of Table 1) during 1980-2006. All columns use Batini and Laxton (2006) IT dating. Data are averaged over 3-year periods. S-GMM P and S-GMM E are two-step system GMMs of Arellano and Bover (1995), with Windmeijer's (2005) corrected robust standard errors, where S-GMM P takes the IT dummy as predetermined, and S-GMM E assumes it is endogenous. AR(1), AR(2), Hansen J tests and Difference-in-Hansen report the respective p-values.