The impact of central bank independence on the performance of inflation targeting regimes*

Sami Alpanda[a], Adam Honig[b]*

[a]*Canadian Economic Analysis Department, Bank of Canada, Ottawa, Ontario, Canada K1A 0G9*
[b]*Department of Economics, Amherst College, Amherst, Massachusetts 01002*

October 2013

Abstract
This paper examines the effects of inflation targeting on inflation in both advanced and emerging economies. We do not detect significant effects in advanced economies and only find small benefits in emerging economies, in line with previous studies. However, when we differentiate the impact of inflation targeting based on the degree of central bank independence, we find large effects in emerging economies with low central bank independence. Our results therefore suggest that central bank independence is not a prerequisite for countries to experience significant declines in inflation following the adoption of inflation targeting. Furthermore, we provide evidence that one channel through which inflation targeting lowers inflation more in countries with low central bank independence is the reduction of budget deficits following the adoption of an inflation target.

JEL Classification: E52; E58
Keyword(s): inflation targeting; central bank independence

---

* Corresponding author: 315 Converse Hall, Amherst College, Amherst, MA 01002-5000. Phone: (413) 542-5032. Fax: (413) 542-2090. *Email*: ahonig@amherst.edu. The views expressed in this paper are solely those of the authors. No responsibility for them should be attributed to the Bank of Canada.

---

1. Introduction

A growing number of countries have adopted inflation targeting (IT) as a monetary policy strategy. This trend began in the early 1990s with a handful of advanced economies. By the mid-1990s, several more industrial countries followed suit, and by the late 1990s and early 2000s, central banks in emerging economies began adopting IT. By 2006, the count was 8 advanced economies and 13 emerging market countries (Batini and Laxton, 2007). Central banks that implemented this new monetary policy framework did so because of the perceived benefits. These include achieving lower inflation and inflation variability, while retaining enough flexibility to respond to macroeconomic shocks and the ability to stabilize output. Emerging market countries in particular were searching for a nominal anchor that did not have the instability associated with fixed exchange rate regimes.

As the number of countries that have adopted IT has grown, so too has the literature attempting to determine empirically the effects of IT on average inflation, inflation volatility, average growth, and growth volatility. Early studies focused on industrial countries (c.f. Ball and Sheridan, 2005) and, in general, found only weak evidence that IT improves macroeconomic performance. More recent studies include emerging economies and tend to find stronger evidence of positive effects (Batini and Laxton, 2007; Gonçalves and Salles, 2008; Lin and Ye, 2009; Mishkin and Schmidt-Hebbel, 2007). However, Brito and Bystedt (2010), using the GMM systems estimator as opposed to the commonly used difference-in-differences estimator employed in Ball and Sheridan (2005), obtain somewhat different results. They find weaker support for the effect of IT on average inflation, inflation volatility, and growth volatility and provide evidence that average growth is lower under IT. Surveying the literature, Ball (2010)

states that the evidence of beneficial effects of IT in emerging economies, while stronger than in advanced countries, is not yet conclusive.

In this paper, we attempt to explain the lack of strong evidence by arguing that not all emerging economies are the same and that IT may work better in some than others. In particular, central banks differ in their degree of central bank independence (CBI), and this may interact with an IT regime to produce different macroeconomic outcomes. It is possible, therefore, that when this distinction is not made, conclusive results for the effects of IT in a subset of countries are weakened by the inclusion of countries for which IT has no effect.

There are opposing views on whether CBI makes an IT regime more or less effective. On the one hand, central bank autonomy may be a precondition for successful IT (Mishkin, 2000; 2004; Eichengreen et al., 1999; Freedman and Ötker-Robe, 2010). For example, IT might not work in achieving low inflation if central banks can be pressured by politicians to lower unemployment or to monetize large fiscal deficits. Similarly, low CBI may imply that other preconditions are missing as well. These include priority of the inflation target as the objective of monetary policy, absence of fiscal dominance, limited liability dollarization, financial development, and effective central bank communication, transparency, and accountability (Batini and Laxton, 2007; Freedman and Ötker-Robe, 2010).[1] In this case, IT should be less effective in low CBI environments. We refer to this as the "precondition effect."

However, there is disagreement about whether these preconditions are in fact prerequisites for successful IT as opposed to simply desirable features to have in place. Certainly most would agree that these elements make any monetary regime more successful. Furthermore, the argument has been made that IT may promote the development of some of these features (Batini and Laxton, 2007; Freedman and Ötker-Robe, 2009; Mishkin, 1999). Therefore, IT may

[1] We discuss later other preconditions that CBI may be correlated with but is less likely to have a causal effect on.

be more successful relative to other monetary regimes when these elements are lacking and there is ample room for improvement. To the extent that these elements are lacking in countries with low CBI, we might expect to see larger effects of IT in low CBI countries. We refer to this as the "improvement effect" of low CBI. In contrast, when these features are already present, there may be little for IT to improve upon.

As another example of this effect, low CBI may imply weak central bank credibility and unanchored inflation expectations, suggesting that IT can have a large impact (Bernanke et al., 1999; Mishkin, 1999; Svensson, 1997), whereas if a central bank has credibility, it does not need the credibility and anchoring of inflation expectations that comes with IT (Ball, 2010; Gonçalves and Salles, 2008). Again, we would expect to see stronger effects of IT in countries without independent central banks.

The net effect of low CBI on the effectiveness of IT thus depends on the relative strength of the precondition and improvement effects.[2] By analyzing empirically the effect of CBI on the performance of IT regimes, we hope to shed light on this debate. To preview our results, we do not find evidence of beneficial effects of IT in advanced countries or emerging countries with high levels of CBI. We do, however, detect large benefits in emerging countries with low levels of CBI. These results cast doubt on the view that CBI is a necessary condition for effective IT. Quite the contrary, IT is only effective when the central bank is not independent, suggesting that the improvement effect is more important than the precondition effect. The policy implication, therefore, is that emerging economies should not wait for greater CBI before adopting IT as a monetary policy strategy.

[2] A more neutral third view argues that CBI and other mentioned preconditions are important for any successful monetary policy strategy and do not disproportionately favor or hinder an IT regime; therefore the absence of these conditions should not stand in the way of adopting IT (Carare et al., 2002; IMF, 2006; Truman, 2003).

We then investigate the channels through which low CBI in emerging economies increases IT's effectiveness in reducing inflation. In particular, we consider several dimensions along which low CBI countries have more room to improve upon relative to high CBI countries following the adoption of IT. For example, IT adoption may bring about a greater *de facto* or *de jure* increase in CBI for low CBI countries as politicians become more vested in their commitment to low inflation (Mishkin, 1999; Batini and Laxton, 2007). Related to this, and perhaps more importantly, IT may bring about greater fiscal discipline and a reduction of budget deficits in low CBI countries, since the continuation of deficit-financing through money creation would jeopardize the achievement of the inflation target (IMF, 2006). IT may also result in the reduction of liability dollarization, strengthening the potency of monetary policy and its ability to lower inflation (Mishkin, 2003). In addition, IT has been accompanied by reforms that promote financial development. Finally, IT is associated with rapid improvements in the technical infrastructure of the adopting central banks (Batini and Laxton, 2007) and their increased communication, transparency and accountability (Mishkin and Schmidt-Hebbel, 2001).

Although we cannot separately identify all these channels due to data limitations, we find evidence that points to the decline in budget deficits as an important channel. In particular, there is a significant decline in budget deficits in low CBI countries after adopting IT, more so than in high CBI countries, and when we control for the role of budget deficits in the benchmark regression, we no longer find that IT is more effective in low CBI countries. In contrast, we do not find evidence that liability dollarization and financial development serve as important channels through which low CBI improves IT's inflation performance.

The rest of the paper is organized as follows: Section 2 introduces the data and the benchmark regression equation that we use to test for the effect of IT on inflation and the role of

CBI. Section 3 presents the results and robustness checks. Section 4 analyzes the potential channels through which CBI alters IT's impact on inflation performance. Section 5 concludes.

2. Effects of IT and the Role of CBI

In this section, we introduce our benchmark model and the data used to test for the effects of IT on inflation and the role of CBI. We consider a regression of inflation, *INFL*, on its own lag, an IT dummy variable, *IT*, and several control variables. Our benchmark specification is given by

$$INFL_{i,t} = \beta_1 \cdot INFL_{i,t-1} + \beta_2 \cdot IT_{i,t} + \beta_3 \cdot CBI_{i,t} + \beta_4 \cdot \left(IT_{i,t} * CBI_{i,t}\right)$$
$$+\beta_5 \cdot HIGHINFL_{i,t} + \delta_t + \alpha_i + \varepsilon_{it} \qquad (1)$$

where *i* indexes country and *t* indexes time. We include $INFL_{i,t-1}$ to account for mean reversion as inflation targeting countries tend to start with higher inflation rates and thus are more likely to experience larger drops in their inflation rates. Omitting this variable would bias the estimate of the *IT* coefficient (Ball and Sheridan, 2003). The other explanatory variables include a measure of central bank independence, *CBI*, the interaction of *IT* with *CBI*, and a dummy variable indicating high inflation, *HIGHINFL*. The interaction term *IT*CBI* allows the impact of IT on macroeconomic performance to depend on CBI. As discussed above, CBI can arguably make IT more or less effective depending on the relative strength of the precondition and improvement effects; therefore the coefficient of the interaction term is ambiguous. Finally, δ_t refers to a time effect, and α_i is a country-specific component of the error term. We estimate the model using the GMM systems estimator developed in Arellano and Bover (1995) and Blundell and Bond (1998). We treat *IT* as either predetermined (if inflation affects IT adoption only with a lag) or endogenous (if there is contemporaneous feedback or an omitted variable influences both

inflation and IT adoption). As a robustness test in section 3.1, we calculate the commonly used difference-in-differences estimator employed by Ball and Sheridan (2005) and find very similar results.[3]

2.1 Data and Variables

Data are from the years 1980 to 2006. We take three-year averages of the data, resulting in a sample with 9 periods. This reduces the instrument count, which is quadratic in T, and also provides "a sensible compromise between giving enough time for the sluggish responses of macro variables and separating the IT treatment effects from effects of other events occurring in close proximity" (Brito and Bystedt, 2010, p. 199). The sample includes all countries that adopted IT during the sample period as well as a group of non-targeters.[4] The non-targeters and the pre-adoption periods for the targeters serve as controls. The set of emerging economies, both targeters and non-targeters, is taken from the union of the samples in Batini and Laxton (2007) and Gonçalves and Salles (2008). The only difference is that two of the countries did not have data on CBI, and so we only have 44 emerging economies as opposed to their combined 46. In separate regressions we expand the sample and include advanced economies. The group of 22 advanced economies is taken from Ball (2010).[5] The combined sample therefore consists of 66 countries.

INFL refers to continuously compounded growth in the consumer price index (multiplied by 100). The mean is then calculated for each three-year period. The use of continuous compounding in obtaining percentage changes partially reduces the influence of outliers.

---

[3] Brito and Bystedt (2010) discuss several advantages of system GMM over the difference-in-difference estimator. One important drawback of the latter, which is based on pre and post-IT inflation differences, is that targeters experienced higher average inflation than non-targeters up to the late 1980s but reached the mid 1990s, *before IT adoption*, with *lower* inflation than non-targeters. Not controlling for aggregate time trends would overstate IT's impact in lowering inflation. This issue is discussed in Section 2.2.

[4] See the appendix for a list of countries and data sources.

[5] The only difference is that we do not exclude Greece and Iceland, which were excluded in Ball's sample because they experienced years with annual inflation over 20% since 1984.

The dates of IT adoption for advanced economies are taken from Ball (2010); the dates for emerging economies are from Batini and Laxton (2007). The IT variable assumes the value one during a three-year period if an IT regime was in place in all three years of the period; it is set equal to two thirds or one third if an IT regime was in place for only two years or one year, respectively. We can interpret the coefficient of the IT variable, β_2, as follows: all else equal, an IT country has (minus) β_2 less inflation than a non-targeter (ignoring the interactions term), or equivalently, if a country adopts IT, it will reduce inflation on average by β_2 percentage points.

For the measure of CBI, we consider the CBI indices in Cukierman et al. (1992), which are based on legal aspects of independence (*LEGAL*) and the turnover rate of central bank governors (*TURNOVER*).[6] The indices are generally available until 1989 for both advanced and emerging economies and assume one value per decade.[7] They range from 0 to 1, with higher values indicating greater CBI for the legal index and lower CBI for the turnover index.

The legal index was extended through 2002 for 24 Latin American and Caribbean countries by Jácome and Vázquez (2005), who also added a few new countries to the sample, and through 1999 for advanced countries by Siklos (2008). The turnover index was supplemented with data after 1990 from Crowe and Meade (2007) and Dreher, et al. (2008).

Three points regarding these indicators are worth noting. First, as mentioned above, not all IT countries have a high level of CBI, and there is considerable variation in the value of the CBI variables, which can be exploited to determine the role of CBI. Second, these measures provide additional information about CBI beyond instrument independence. As discussed in Batini and Laxton (2007), most central banks had at least *de jure* instrument independence at the

[6] *TURNOVER* is the average number of changes in the central bank governor per year in each decade. For example, If *TURNOVER* = 0.2, there are 2 changes per decade for an average tenure of 5 years.

[7] To break-up these variables into three-year periods, we create annual observations whose values are constant throughout a decade and then take averages over three-year periods just as we do for the other variables.

time of IT adoption.[8] However, many were lacking in other aspects of CBI that are captured by the legal measure, including freedom of the obligation to purchase government debt, the importance of inflation over other objectives, and a high degree of job security for the central bank governor (Batini and Laxton, 2007). In addition, the turnover measure provides *de facto* information about job security for the governor. Third, a potential problem with the legal measure is that what is written down in law can be vastly different from actual practice. This is particularly true in emerging economies. Similarly, *de jure* instrument independence does not imply *de facto* independence. In fact, Cukierman, et al. (1992) argue the turnover measure is more appropriate for emerging economies than the legal measure, while for advanced countries, the legal measure is more indicative of CBI. These issues are discussed further in Sections 3 and 4.

Finally, following the literature, we include a dummy variable, *HIGHINFL*, indicating high average inflation (>40%) over a three-year period. This controls for macroeconomic dynamics that may differ in high inflation countries (Batini and Laxton, 2007; Brito and Bystedt, 2010; IMF, 2006). Specifically, this variable can serve as a proxy for omitted variables that affect both the choice of IT adoption in high inflation countries as well as the inflation rate. In addition, it controls for other reforms that occur concurrently with IT adoption that are also meant to reduce inflation in high inflation countries. Given that we find stronger effects of IT in low CBI countries with higher initial inflation rates, it is important to proxy for these omitted factors that may be specific to high inflation countries. We also experiment with eliminating high inflation episodes from the sample in Section 3.1.

[8] Instrument independence occurs when the central bank has complete control over the setting of the policy instrument, usually a short-term nominal interest rate, in order to achieve the policy goal. Goal independence under which the central bank sets the policy goal such as the inflation target is uncommon, even in advanced economies (Debelle and Fischer, 1994).

2.2 Summary Statistics

Summary statistics for all observations, advanced countries, and emerging economies are provided in Table 1. The sample period, 1980-2006, is divided into three-year periods. There are 66 countries; 22 are advanced economies, and 44 are emerging countries. Advanced countries comprise 27% of all observations. Advanced economies had an IT regime 15% of the time, while emerging economies had an IT regime 10% of the time. Emerging countries have higher central bank governor turnover rates, although surprisingly, they have slightly higher average levels of legal CBI. This highlights the fact that the legal measure is unlikely to accurately reflect CBI in emerging economies, as Cukierman, et al. (1992) point out. Emerging economies have higher inflation rates and have experienced hyperinflationary episodes as the maximum value of inflation reveals.

Table 2 presents the summary statistics broken up by type of country (advanced or emerging), monetary regime (targeter or non-targeter, as defined by the variable *IT*), and then further by time period (pre-IT vs. post-IT). For the inflation targeting countries, each country's individual IT adoption date was used to break up the sample into the pre-IT and post-IT periods. For advanced (emerging) *non*-targeters, the average IT adoption date for advanced (emerging) countries, 1995 (1999), is used to divide the sample. For advanced countries, the IT period is associated with lower inflation. This improved performance, however, is shared by the non-targeters as well, although the progress is a little smaller. The pattern is similar for emerging economies, although the improvement over time for targeters is considerably larger than for non-targeters. For example, emerging targeters experience a reduction in median inflation of 9.7 percentage points, while non-targeters exhibit a 4.1 percentage point drop. This is reminiscent of previous results in the literature obtained using the difference-in-differences estimator. However,

looking at average inflation before and after IT adoption may be misleading and possibly overstate the beneficial effects of IT. As pointed out by Brito and Bystedt (2010), targeters experienced higher average inflation than non-targeters up to the late 1980s but reached the mid 1990s, *before IT adoption*, with *lower* inflation than non-targeters. This inflation pattern may cause a problem with the difference-in-differences estimator that is based on pre and post-IT inflation differences. Finally, the simple difference in differences calculation reveals that emerging economies, which start out with much higher inflation, experience a much larger drop than advanced economies.

In Table 3, we limit attention to emerging economies and present statistics based on monetary regime, time period, and degree of CBI using *TURNOVER* as a proxy. In particular, we present summary statistics for *TURNOVER* below and above 0.25. As described in the results section, *TURNOVER* = 0.25 corresponds to the cutoff level for which IT's effect on average inflation is significant at the 5% level. It is also close to the mean value for *TURNOVER* of 0.26 (the median is 0.20). For targeters with low turnover/high CBI, average (median) inflation falls by 11.2 (8.2) percentage points after IT adoption, while for non-targeters it falls by 8.4 (3.9) percentage points. For targeters with *TURNOVER* ≥ 0.25, average (median) inflation falls by 55.3 (19.6) percentage points, while for non-targeters it falls by 22.1 (4.8) percentage points. Thus, high turnover/low CBI countries experience larger declines in inflation regardless of monetary regime than high CBI countries. Second, holding CBI constant, targeters improve more over time than non-targeters as the difference-in-differences calculation suggests. Third, the difference in improvement over time between targeters and non-targeters is greater for low CBI countries. With respect to average inflation, therefore, preliminary evidence suggests that IT lowers inflation more, relative to other monetary regimes, in low CBI countries.

Note that a similar pattern is visible for both the budget deficit and *TURNOVER*. In particular, both budget deficits and *TURNOVER* either do not change by much or slightly increase for high CBI countries, regardless of whether they adopt IT or not. For low CBI countries, there is a decline in budget deficits for both targeters and non-targeters, but the average decline for targeters (from 3.2% deficits to 0.1% surplus) is significantly larger than the decline for non-targeters (from 1.1% deficits to 0.8% surplus). This is consistent with the hypothesis that the adoption of IT pushes governments in low CBI countries to increase their fiscal discipline, lowering the need for financing of budget deficits through money creation, and lowering average inflation rates as a result. Similarly, while *TURNOVER* declines by more for targeters than non-targeters, the difference is larger in low CBI countries. In section 4, we propose that the lowering of budget deficits and an improvement in the level of CBI are important channels through which adopting IT is successful in reducing inflation in low CBI countries.

Table 4 presents the sample correlations for the full sample, advanced countries, and emerging economies. IT is correlated with lower average inflation for both advanced and emerging economies. As expected, *LEGAL* and *TURNOVER* are negatively correlated. For advanced countries, however, the sign of the correlation between inflation and *TURNOVER* is unexpectedly negative. As discussed in Cukierman, et al. (1992), *TURNOVER* is not a good measure of CBI for advanced countries, while *LEGAL* is not indicative of CBI in emerging economies. We return to this issue in the results section.

3. Results

Table 5 presents results from the estimation of equation (1) without the CBI indicator as a comparison with previous findings. We do, however, limit the sample to countries that have data on CBI.[9] In panel A, we treat IT (along with the lagged dependent variable) as predetermined although not fully exogenous regressors in the GMM estimation. Therefore we assume that current inflation does not impact IT adoption even though past inflation could. In fact, the summary statistics in Table 2 suggest that higher inflation countries are more likely to adopt IT, suggesting the possibility of feedback, probably with a lag. In panel B, we treat IT as endogenous since there could be contemporaneous feedback, or perhaps an omitted variable could influence both inflation and the adoption of IT. In System GMM, endogenous regressors are instrumented with their lags and with lags of their first differences.[10]

Finally, following the literature, we include a high inflation dummy, *HIGHINF*, which controls for macroeconomic dynamics that may differ in high inflation countries (Batini and Laxton, 2007; Brito and Bystedt, 2010; IMF, 2006). We also experiment with eliminating high inflation episodes from the sample in Section 3.1. This variable is treated as an endogenous variable in all regressions.

The results in Panel A indicate that IT, relative to other monetary regimes, lowers inflation in the full sample by 1.7 percentage points, in advanced countries by 0.34 percentage points (but insignificant), and in emerging economies by 2.0 percentage points (p-value=0.11).

[9] For example, the results for emerging economies are very close to column 5 of Tables 3 and 4 in Brito and Bystedt (2010). The only difference is that two of their countries did not have data on *TURNOVER*. In addition, countries with data on *TURNOVER* did not necessarily have data for all periods, resulting in a further loss of observations. Note that for advanced economies, we limit to data on *LEGAL*, which, as discussed later, is a better measure of CBI for advanced economies. For the full sample, we limit to data on *TURNOVER*, which explains why there are more observations in the full sample than the sum of observations for advanced and emerging economies.

[10] The implementation of this procedure in STATA using the xtabond2 command is outlined in Roodman (2006). We use the "collapse" option of xtabond2 to collapse the instrument set. Otherwise, the instrument count is quadratic in T, which is problematic with a sample period of 9 periods.

The results in Panel B are virtually identical, although the magnitude of the effect of IT is slightly larger. The results for both advanced and emerging economies match the majority of previous studies.

Table 6 presents results from the estimation of equation (1) where we now include CBI and its interaction with IT. We provide results for the full sample, advanced countries, and emerging economies using either *LEGAL* or *TURNOVER* as the measure of CBI. In panel A, we treat IT and CBI as predetermined, while in panel B we treat both as endogenous. To test for the effect of IT, we conduct F-tests to determine whether $\beta_2 + \beta_4 \cdot CBI_{i,t}$ is significantly different than zero for different values of CBI.

Consider the results in Panel A first. For the full sample in specification (1), the results imply that IT has no effect on inflation, regardless of legal independence. For the full sample in specification (2), however, the coefficient of *IT*TURNOVER* is negative and significant, implying that IT is more effective in reducing inflation in countries with higher levels of central bank governor turnover.[11] In particular, the effect of IT on inflation is 36.3 percentage points different in countries with the highest levels of *TURNOVER* compared to those with the lowest, *all else equal*.[12] Further calculations reveal that the effect of IT, $\beta_2 + \beta_4 \cdot TURNOVER_{i,t}$, is significantly negative at the 5% level but only for countries with *TURNOVER* greater than or equal to 0.30, slightly greater than the average for the full sample. The size of the predicted impact on average inflation when *TURNOVER* equals 0.30 is approximately -4.4 percentage points. This effect increases as *TURNOVER* increases to a maximum of -29.9 percentage points for a country with *TURNOVER* equal to one. Thus the effect of IT on average inflation in the

[11] The negative coefficient also implies that greater CBI is less beneficial under IT. This makes sense as IT brings many of the same benefits as CBI, such as a greater emphasis on low inflation.
[12] In fact, when *TURNOVER* is zero, the effect of IT is *positive* and almost significant at the 10% level.

full sample depends on the level of CBI. This effect is evident, however, only when we use *TURNOVER* as our CBI measure. We will explain shortly why this is the case.

For advanced countries, IT does not have a significant effect for all values of *LEGAL* in column (3) and *TURNOVER* in column (4). For emerging economies in specification (5), IT does not significantly impact inflation for any value of *LEGAL*. In addition, the coefficient of *IT*LEGAL* is insignificant, implying that all else equal, legal independence does not alter the impact of IT on inflation. The results in specification (6), however, imply that the effect of IT differs by 57 percentage points in countries with the highest levels of *TURNOVER* relative to those with the lowest, *all else equal* (we discuss these large coefficients and the presence of outliers in Section 3.1). Moreover, the effect of IT, $\beta_2 + \beta_4 \cdot TURNOVER_{i,t}$, is significantly *negative* at the 5% level when *TURNOVER* is greater than or equal to 0.25 (25 countries and 114 observations), which is roughly the average for emerging economies. This is depicted in Figure 1, which presents the marginal effect of IT on inflation in emerging economies for different values of *TURNOVER* and the 95% confidence interval. As discussed in the robustness tests section, we find very similar results using the traditional difference-in-differences estimator. These results suggest that the improvement effect of low CBI dominates the precondition effect so that IT is more effective in low CBI environments.

To summarize, the results in specification (6) imply that IT, by and large, has no significant effect when *TURNOVER* is less than 0.25 but plays an important role in reducing inflation relative to other monetary regimes for the large number of emerging economies with *TURNOVER* above 0.25. The size of the predicted impact on inflation when *TURNOVER* equals 0.25 is -4.0 percentage points. This effect grows as *TURNOVER* increases to a maximum of -46.6 percentage points when *TURNOVER* equals one.

Finally, the coefficient of *LEGAL* by itself is insignificant in all three samples. The coefficient of *TURNOVER* by itself has the predicted positive sign and is significant in the full sample and for emerging economies, implying that low CBI is associated with higher inflation. Notice, however, that for the full sample and emerging economies, the coefficients of *TURNOVER* and *IT*TURNOVER* are roughly equal in magnitude but have opposite signs. This indicates that IT is able to neutralize the effects of low CBI on inflation.

As mentioned above, we find evidence that IT lowers inflation relative to other regimes in the full sample when we use *TURNOVER* as our CBI variable, but not when we use *LEGAL*. *LEGAL* has no effect for advanced countries, which do not seem to benefit from IT. It also has no effect for emerging economies, even though many do benefit from IT, presumably because legal measures of independence are less accurate in emerging countries (Cukierman, et al., 1992). Meanwhile, *TURNOVER* has a strong effect in emerging economies but a smaller and statistically weaker (although still significant) effect in the full sample. The drop in the magnitude and the significance with the full sample can be explained by the fact that some advanced countries have higher turnover rates than developing countries, but still do not experience beneficial effects of IT. Cukierman, et al. (1992) argue that this measure is less indicative of CBI for advanced countries than the legal measure. In the full sample, the effect of *TURNOVER*, although weaker, is still significant. The reason is that advanced countries have lower turnover rates on average and smaller effects of IT than emerging economies, while emerging economies with high turnover rates experience larger reductions in inflation than those with low turnover rates.[13]

[13] This explanation is similar to the one provided in Cukierman, et al. (1992) for why *TURNOVER* is significant in explaining average inflation for developing countries and for the whole sample, even though it is not significant for industrial countries.

The results in Panel B are very similar. The effect of *IT* is insignificant for all values of *LEGAL* for the full sample, advanced economies, and emerging economies. For advanced economies, the effect of IT is also insignificant for all values of *TURNOVER*. The only difference is that for the full sample, the effect of IT is never significant even for higher values of *TURNOVER*, although it becomes very close to significant (p-value = 0.11). Finally, for emerging economies, although the coefficient of *IT***TURNOVER* is insignificant, it is still the case that the overall effect of *IT*, $\beta_2 + \beta_4 \cdot TURNOVER_{i,t}$, is negative and significant for values of *TURNOVER* >= 0.27. To be clear, consider two countries, one with *TURNOVER*=0 and the other with *TURNOVER*=1. The difference in the benefits of IT for the two countries, $\beta_4 = 36.83$, is not statistically significant. However, the effect of IT when *TURNOVER*=1, $\beta_2 + \beta_4 \cdot 1 = 5.37 - 36.83 = -31.5$, is significantly less than 0. Thus Panel B confirms the result that IT is effective but only in emerging economies with lower levels of CBI.

3.1 Robustness Tests for Emerging Economies

We conduct several tests to check the robustness of our results. In what follows, we focus exclusively on emerging economies since we do not find significant effects of IT in advanced economies. We also limit attention to *TURNOVER* as a measure of CBI since, as previously discussed, we find no evidence that IT impacts inflation using *LEGAL*, which is unlikely to accurately reflect CBI for emerging economies. Therefore, we are checking the robustness of the results of column (6) in Table 6.

First, instead of using GMM, we calculate the difference-in-difference estimator that has been commonly used in the literature (Ball and Sheridan, 2005; Batini and Laxton, 2007;

Mishkin and Schmidt-Hebbel, 2007). Amending their model to incorporate CBI and allow for different effects of IT depending on the level of CBI, we estimate the following regression[14]:

$$\overline{INFL}_{i,POST} - \overline{INFL}_{i,PRE} = \beta_0 + \beta_1 \cdot \overline{INFL}_{i,PRE} + \beta_2 \cdot IT_{i,POST} + \beta_3 \cdot \overline{TURNOVER}_{i,POST}$$
$$+\beta_4 \cdot \left(IT_{i,POST} * \overline{TURNOVER}_{i,POST}\right) + \varepsilon_i \qquad (2)$$

The results are presented in Table 7. The effect of IT differs by 18 percentage points in countries with the highest levels of *TURNOVER* relative to those with the lowest, *all else equal*. Moreover, the effect of IT, $\beta_2 + \beta_4 \cdot TURNOVER_{i,t}$, is significantly *negative* at the 5% level when *TURNOVER* is greater than or equal to 0.17. The size of the predicted impact on inflation when *TURNOVER* equals 0.17 is -3.2 percentage points. This effect grows as *TURNOVER* increases to a maximum of -18.3 percentage points when *TURNOVER* equals one. Thus we find again that IT has much larger effects in emerging economies with low CBI.

As a second robustness test, we consider the effects of high inflation observations. The large coefficients of *IT*, *TURNOVER*, and *IT*TURNOVER* in column (6) of Table 6 suggest that high inflation observations may be influential in driving the results, despite including the high inflation dummy. In Table 8, we present results omitting observations with inflation greater than 150%, 100%, and 40% (so that the high inflation dummy indicating inflation greater than 40% drops out). Omitting inflation greater than 150% (100%) (40%) results in a loss of (12) (23) (56) observations. In Panel A, the results are, by and large, similar but less significant than those reported in Table 6. In particular, in column (1) where we restrict to inflation less than 150%, the coefficient of *IT*TURNOVER* is still significant. In addition, the overall effect of IT, $\beta_2 + \beta_4 \cdot TURNOVER_{i,t}$, is significant at the 5% level for *TURNOVER* greater than or equal to 0.34. In

[14] The break point for non-targeters is set to the average IT adoption date for the developing country targeters, 1999.

terms of the magnitude of the effect, IT lowers inflation by 4.4 percentage points when *TURNOVER* equals 0.34, and this effect grows to 18.8% when *TURNOVER* equals one.

In column (2) where we restrict to inflation less than 100%, the coefficient of *IT*TURNOVER* is not significant, although we still find that the overall effect of IT, $\beta_2 + \beta_4 \cdot TURNOVER_{i,t}$, is negative and significant at the 5% level for *TURNOVER* greater than or equal to 0.27. The size of the predicted impact on inflation when *TURNOVER* equals 0.27 is -1.6 percentage points. This effect grows as *TURNOVER* increases to a maximum of -8.6 percentage points when *TURNOVER* equals one.

When we restrict to inflation less than 40% in column (3), the coefficient of *IT*TURNOVER* is positive but insignificant. Moreover, the impact of IT, $\beta_2 + \beta_4 \cdot TURNOVER_{i,t}$, is small and insignificant for all values of *TURNOVER*. This suggests that high inflation observations were influential in driving the results. This is not surprising given that we find in our benchmark regression the strongest effects of IT in low CBI countries that have much higher inflation rates before IT adoption. As discussed later, these high inflation rates are most likely the result of monetizing fiscal deficits, which is more likely to occur in low CBI environments. Eliminating these episodes therefore removes from the sample the observations in which IT is most effective. Therefore, finding weak effects of IT in low inflation countries provides further support for the view that IT is more successful in low CBI countries. In Section 4, we argue that it is the ability of IT to reduce budget deficits and the need for debt monetization that makes IT more effective in low CBI countries with initially large deficits.

The results are very similar in Panel B where IT and CBI are treated as endogenous. The results in column (1) are virtually identical. In column (2) where we restrict to inflation less than 100%, the coefficient of *IT*TURNOVER* is again not significant, although we still find that the

overall effect of IT, $\beta_2 + \beta_4 \cdot TURNOVER_{i,t}$, is negative and significant (at the 10% level) for *TURNOVER* greater than or equal to .27. The size of the predicted impact on inflation when *TURNOVER* equals 0.27 is -1.5 percentage points. This effect grows as *TURNOVER* increases to a maximum of -2.9 percentage points when *TURNOVER* equals one. In column (3) the coefficient of *IT*TURNOVER* is again positive but insignificant, and the impact of IT is small and insignificant for all values of *TURNOVER*.[15]

4. Channels

In this section we investigate the channels through which low CBI in emerging economies increases IT's effectiveness relative to other monetary regimes. We argue that low CBI may imply that certain factors that make monetary policy more effective are missing. Because the adoption of IT can promote the development of some of these factors (Batini and Laxton, 2007; Freedman and Ötker-Robe, 2009; Mishkin, 1999), there is more room for improvement in low CBI environments. Thus IT may have greater impact when CBI is low as a result of the improvement effect.[16]

[15] Finally, in unreported regressions we conduct a number of additional robustness tests. We again find that IT lowers inflation in emerging economies but only for low CBI/high *TURNOVER* countries. The results are available upon request. First, lagged inflation and *TURNOVER* are positively correlated. Although we include lagged inflation as a regressor, we omit the interaction term $IT*INFL_{t-1}$ in the benchmark regression. This may cause a downward bias on the coefficient estimate of *IT*TURNOVER*, since the adoption of IT may be more effective in lowering inflation when lagged inflation rates are high (i.e. the coefficient of $IT*INFL_{t-1}$ is negative). We therefore include $IT*INFL_{t-1}$ as an additional regressor. Second, instead of breaking the sample into three-year periods, we divide the sample into two-year and four-year periods (note that the 27 year sample period does not divide evenly into 4 years or 2 years; however, the choice of break point did not affect the results). Third, we linearly interpolate *TURNOVER* between the decade values. Fourth, we use alternative starting dates for IT adoption from Gonçalves and Salles (2008), which slightly differ from Batini and Laxton (2007) who only classify a country as having adopted IT after full subordination of other goals to the inflation target (Mishkin, 2000). Fifth, we eliminate fixed exchange rate regimes for the sample and alternatively controlled for the exchange rate regime.

[16] Most of the channels we consider here are likely to be directly affected by both IT adoption and the level of CBI. Note, however, that a channel does not have to be directly affected by IT. For example, if CBI affects variable X, which is unaffected by IT directly but makes IT more effective in reducing inflation, then X is still a channel through which CBI alters IT's effectiveness. In contrast, if IT lowers inflation through variable Y but CBI has no effect on Y, then while Y is a channel through which IT lowers inflation, it is not a channel through which CBI moderates IT's effectiveness, which is the focus of this paper.

First, IT may promote greater CBI itself. In particular, by emphasizing the ability of the central bank to control inflation in the long run and its inability to affect long run growth, IT can reduce political pressure on central banks to pursue expansionary policies (Mishkin, 1999). Thus IT can reduce central bank governor turnover. Similarly, legal autonomy in some cases was granted concurrently with the adoption of IT (Batini and Laxton, 2007). For example, many IT countries have passed legislation giving the central bank the authority to set interest rates (Freedman, and Ötker-Robe, 2010). Given that the scope for improved CBI is greater when CBI is initially low, low CBI may allow IT to have greater impact on monetary policy performance. In fact, as reported in the summary statistics in Table 3, average *TURNOVER* declines from 0.47 to 0.39 in low CBI countries following IT adoption, whereas it is largely unchanged for other countries. Our regression already accounts for this channel since we include the interaction term *IT*CBI*. However, we cannot isolate the effect of this channel to determine its magnitude.

Second, and related to CBI, is the importance of fiscal discipline, which contributes to the credibility of any monetary policy framework by reducing the need to finance budget deficits through money creation. Again, IT may have benefits in this area as well, adding support for fiscal sustainability by highlighting the inconsistency of a low inflation target and lack of fiscal discipline (IMF, 2006). Similarly, involving fiscal policymakers in setting the inflation rate may help constrain fiscal policy (Mishkin, 2000). Furthermore, low CBI is likely to provide an environment where public finances can get out of control as it is easier to rely on monetization. Therefore, IT's added benefit is likely to be greater when CBI is low. The summary statistics from Table 3 support this claim; low CBI countries experience larger drops in their budget deficits after IT adoption. When we include in the regression budget deficit (% of GDP) by itself and interacted with IT, the coefficient of *IT*TURNOVER* becomes smaller and insignificant (p-

value = .34 and 0.49 in panel A and B, respectively).[17] This suggests that lower budget deficits is a channel through which IT is better able to reduce inflation in low CBI countries.[18]

Finally, we control for a number of additional channels such as liability dollarization, financial market development, central bank credibility. The inclusion of variables that control for these channels (as well as their interaction with *IT*) did not affect our results, suggesting that these are not channels through which CBI affects IT performance.[19,20,21] Due to lack of data, however, we are unable to control for other potential channels such as technical infrastructure and central bank communication, transparency, and accountability.[22,23,24]

---

[17] The coefficient of *budget deficit* is positive as expected and significant at the 10% level. The coefficient of *IT*budget deficit* is negative as expected (there is more room to improve upon when budget deficits are large) and almost significant at the 10% level.

[18] One concern is that IT may be picking up the effects of other factors that improve fiscal deficits and therefore IT may not have a causal effect on budget deficits. For example, as discussed above, the adoption of IT might occur simultaneously with improvements in CBI, which could also reduce budget deficits. However, we have already included CBI in the regression so that the effect of CBI on inflation through budget deficits is already accounted for. Furthermore, as argued above, IT can promote CBI, and so CBI may one of the channels through which IT impacts budget deficits. As a second example, the adoption of IT could also occur at the same time as more general institutional improvements, which again might impact fiscal deficits. To control for this possibility, we included a measure of institutional quality that averages indices of corruption, law and order, and bureaucratic quality. The inclusion of this variable did not change the results. Finally, *HIGHINFL* can serve as a proxy for omitted variables that affect both the choice of IT adoption in high inflation countries as well as budget deficits and the inflation rate. In addition, it controls for other reforms in high inflation countries, which occur concurrently with IT adoption, that are also meant to reduce inflation through a lowering of fiscal deficits.

[19] Extensive liability dollarization alters the transmission of monetary policy and creates difficulties in implementing IT (Mishkin, 2003). In particular, a reduction in interest rates meant to stimulate aggregate demand could have the opposite effect if it depreciates the exchange rate. Both IT and CBI may impact the level of dollarization as credible monetary policy may reduce the need to denominate loans in dollars (IMF, 2006). Therefore, to the extent that low CBI increases liability dollarization, there may be more room for dollarization to fall after the adoption of IT.

[20] Incomplete financial markets affect the success of IT by limiting the ability of the central bank to affect interest rates faced by households and firms (IMF, 2006). For this reason, IT adoption has in some cases been accompanied by prudential regulation and supervision to strengthen the financial system. To the extent that financial reforms occur more in IT countries, IT can have greater success relative to other frameworks, especially when the financial system is initially underdeveloped. Furthermore, greater CBI may promote financial system development by delivering low and stable inflation. Therefore, IT's added benefit is likely to be larger when CBI is low.

[21] Low CBI may imply weak central bank credibility and unanchored inflation expectations, suggesting that IT can have a large impact (Bernanke et al., 1999; Mishkin, 1999; Svensson, 1997), whereas if a central bank already has enough credibility, it may not require the additional credibility and anchoring of inflation expectations that comes with IT (Ball, 2010; Gonçalves and Salles, 2008). Again, we would expect to see stronger effects of IT in countries without independent central banks. We use lagged inflation to account for credibility and inflation expectations. Therefore, to control for this channel, we include $IT*INFL_{t-1}$.

[22] Note that we have to pay careful attention to whether CBI in fact has a *causal* effect on these variables so that CBI affects IT performance through these particular channels. In that case, excluding these variables from the regression would not cause omitted variable bias; we merely would not be able to separately quantify the magnitude of these

5. Conclusion

Our first goal in this paper is to expand the analysis of the benefits of IT. Recent studies tend to find more evidence in emerging than in advanced economies that IT lowers inflation, although the results are not conclusive. We add to the literature by analyzing the role of CBI in amplifying the effects of IT in emerging economies. In theory, the effect of CBI is ambiguous. Low CBI may strengthen the impact of IT as a result of the improvement effect; i.e. that IT may bring about greater fiscal or institutional changes in low CBI countries, which substantially improve macroeconomic conditions. However, if CBI is itself a precondition for successful IT or promotes other preconditions, then low CBI should dampen the beneficial impact of IT. We find larger benefits of IT in low CBI countries but no significant effects in high CBI countries, suggesting that the improvement effect is more important. Our results also provide an explanation for the somewhat muted impact of IT found in previous studies that do not differentiate the effect of IT based on CBI.

Second, we attempt to identify the channels through which IT lowers inflation more in low CBI countries. We find evidence that IT is effective by promoting fiscal discipline and strengthening CBI itself, areas where there is greater room for improvement in low CBI countries.

---

particular channels. In contrast, in the case where CBI is just *correlated* with these variables, there is nothing special about low CBI. If these variables alter IT's effectiveness, then their exclusion would cause omitted variable bias in our estimate of *IT*CBI*.

[23] There is evidence that IT has been associated with rapid improvements in technical infrastructure, which refers to the ability of the central bank to make forecasts as well as data availability (Batini and Laxton, 2007). For example, the central bank must be able to forecast and model inflation. Again, IT may therefore be more effective when this infrastructure is not initially in place. To the extent that low CBI is correlated with a weak technical infrastructure, we would expect to observe a greater impact of IT in low CBI countries, even though no causal channel may exist.

[24] IT has been argued to promote central bank communication, transparency, and accountability (Mishkin and Schmidt-Hebbel, 2001) and may therefore have greater impact when these elements are at first missing. Certainly CBI could be correlated with these features. However, an argument could be made that low CBI could weaken these elements, particularly accountability, suggesting a causal channel from low CBI to improved IT effectiveness.

Acknowledgements

We are grateful to Ricardo D. Brito and Brianne Bystedt for providing us with their data. We have greatly benefited from comments from an anonymous referee. We also wish to thank seminar participants at Union College and Clark University for helpful comments and discussions.

References

Arellano, Manuel, and Olympia Bover. (1995) "Another Look at the Instrumental Variable Estimation of Error-Components Models." Journal of Econometrics, 68, 29–51.

Ball, L., 2010. "The Performance of Alternative Monetary-Policy Regimes," in Friedman and Woodford, (eds.), *Handbook of Monetary Economics*. Volume 3, 1303-1343.

Ball, L., Sheridan, N., 2005. Does inflation targeting matter? In: Bernanke, B., Woodford, M. (Eds.), The inflation targeting debate. The University of Chicago Press, Chicago, pp. 249–276.

Batini, N., Laxton, D., 2007. Under what conditions can inflation targeting be adopted? The experience of emerging markets. In: Mishkin, F., Schmidt-Hebbel, K. (Eds.), Monetary policy under inflation targeting. Central Bank of Chile, Santiago, pp. 1–38.

Bernanke, B., Laubach, T., Mishkin, F., Posen, A., 1999. Inflation targeting: lessons from the international experience. Princeton University Press, Princeton.

Blundell, Richard, and Stephen Bond. (1998) "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." Journal of Econometrics, 87, 115–43.

Brito, Ricardo D., and Brianne Bystedt. (2010) "Inflation targeting in emerging economies: Panel evidence." Journal of Development Economics, 91, 198-210.

Carare, Alina, and others, 2002, "Establishing Initial Conditions in Support of Inflation Targeting," IMF Working Paper 02/102 (Washington: International Monetary Fund).

Crowe, Christopher, and Ellen E. Meade. (2007) "The Evolution of Central Bank Governance around the World." Journal of Economic Perspectives, 21, 69–90.

Cukierman, Alex, Steven B. Webb, and Bilin Neyapti. (1992) "Measuring the Independence of Central Banks and Its Effect on Policy Outcomes." World Bank Economic Review, 6, 353–98.

Debelle, G. and S. Fischer. 1994. "How Independent Should a Central Bank Be?" In Goals, Guidelines, and Constraints Facing Monetary Policymakers, edited by J.C. Fuhrer. Boston, Mass.: Federal Reserve Bank of Boston.

Dreher, Axel, Jan-Egbert Sturm, and Jakob de Haan. (2008) "Does High Inflation Cause Central Bankers to Lose Their Job? Evidence Based on a New Data Set." European Journal of Political Economy, 24, 778–87.

Eichengreen, B., P. Masson, M. Savastano, and S. Sharma. 1999. "Transition Strategies and Nominal Anchors on the Road to Greater Exchange-Rate Flexibility." In Essays in International Economics, No. 213. International Finance Section, Department of Economics. Princeton, N.J.: Princeton University.

Freedman C., and I. Ötker-Robe. 2010. "Important Elements for Inflation Targeting for Emerging Economies." IMF Working Paper 113.

Gonçalves, C., Salles, J., 2008. Inflation targeting in emerging economies: what do the data say? Journal of Development Economics 85, 312–318.

Honig, A., 2009, Dollarization, Exchange Rate Regimes and Government Quality, Journal of International Money and Finance, March, 2009.

International Monetary Fund (IMF), 2006. Inflation targeting and the IMF. IMF, Washington. March.

Jácome, L. I., and F. Vázquez. 2005. “Any Link between Legal Central Bank Independence and Inflation? Evidence from Latin America and the Caribbean.” IMF Working paper 75.

Lin, S., Ye, H., 2009. Does inflation targeting make a difference in developing countries? Journal of Development Economics 89, 118–123.

Mishkin, F., 1999. International experiences with different monetary policy regimes. Journal of Monetary Economics 43, 579–605.

Mishkin, F., 2000. Inflation targeting in emerging-market countries. American Economic Review Papers and Proceedings 90, 105–109.

Mishkin, F., 2003, “Comments on Fraga, Goldfajn, and Minella, Inflation Targeting in Emerging Market Economies,” mimeo.

Mishkin, F., 2004. Can inflation targeting work in emerging market countries? NBER Working Paper Series, vol. 10646.

Mishkin, F., Schmidt-Hebbel, K., 2002. One decade of inflation targeting in theworld:what do we know and what do we need to know? In: Loayza, N., Soto, R. (Eds.), Inflation Targeting: Design, Performance, Challenges. Central Bank of Chile, Santiago, pp. 171–219.

Mishkin, F., Schmidt-Hebbel, K., 2007. Does inflation targeting make a difference? NBER Working Paper Series, vol. 12876.

Roodman, D. 2006. How to Do xtabond2: An Introduction to "Difference" and "System" GMM in Stata. Working Paper 103. Center for Global Development, Washington.

Siklos, P., 2008. No Single Definition of Central Bank Independence is Right for All Countries. Paolo Baffi Centre Research Paper No. 2008-02

Svensson, L., 1997. Inflation forecast targeting: implementing and monitoring inflation targets. European Economic Review 41, 1111–1146.

Truman, Edwin M., 2003, Inflation Targeting in the World Economy (Washington: Institute for International Economics).

Table 1: Summary Statistics

All Observations - 66 Countries	period obs.[a]	mean	median	s.d.	min.	max.
INFLATION	460	15.07	5.81	32.39	-0.64	317.00
IT	460	0.13	0	0.33	0	1
LEGAL	266	0.43	0.42	0.18	0.10	0.86
TURNOVER	460	0.23	0.20	0.17	0.00	1.00
Advanced - 22 Countries						
INFLATION	126	4.51	2.99	4.92	-0.13	38.08
IT	126	0.15	0	0.34	0	1
LEGAL	126	0.42	0.42	0.16	0.14	0.73
TURNOVER	120	0.16	0.13	0.09	0.00	0.40
Emerging - 44 Countries						
INFLATION	300	20.91	9.20	38.74	-0.60	317.00
IT	300	0.10	0	0.28	0	1
LEGAL	146	0.43	0.42	0.19	0.10	0.86
TURNOVER	300	0.26	0.20	0.19	0.00	1.00

NOTES:

1. Unless otherwise noted, all data are by three year period averages. Growth rates are expressed in percentage terms. The sample period is 1980 to 2006.

2. Variable definitions: *IT* = *Inflation Targeting Dummy*. *LEGAL* = legal measure of CBI (one number per decade with higher numbers indicating greater independence), *TURNOVER* = average number of changes in the central bank governor per year in each decade (one number per decade with higher numbers indicating less CBI).

a. Note that the number of observations for the full sample exceeds the combined observations in the sub-samples. The reason is that to match the sample in the regressions, we limit to observations with data on CBI. For the full sample and for emerging economies, we limit to observations with data on *TURNOVER*, which is a better measure of CBI for emerging economies. For advanced economies, however, we limit to data on *LEGAL*, which is a better measure of CBI for advanced economies. If we had restricted to data on *TURNOVER* for advanced economies, there would be more observations and the sum of observations for both sub-samples would match the number for the full sample.

Table 2: Summary Statistics for *INFLATION* by country type (Advanced vs. Emerging) and monetary regime

Advanced - 22 Countries	period obs.	mean	median	s.d.	min.	max.
targeter: 10 countries[a] pre-IT	42	6.19	4.85	6.20	0.79	38.08
targeter: post-IT	15	1.88	1.80	0.84	0.36	3.34
Difference:		-4.31	-3.05			
non-targeter: 12 countries pre-IT average adoption date	47	5.06	3.21	4.75	0.04	21.88
non-targeter: post-IT average adoption date	22	1.92	1.95	0.88	-0.13	3.68
Difference:		-3.13	-1.26			
Difference-in-Differences:		**-1.18**	**-1.79**			
Emerging - 44 Countries	obs.	mean	median	s.d.	min.	max.
targeter: 13 countries pre-IT	75	33.53	13.10	60.35	1.50	317.00
targeter: post-IT	23	4.03	3.40	2.05	1.00	9.50
Difference:		-29.49	-9.70			
non-targeter: 31 countries pre-IT average adoption date	148	21.94	10.75	31.82	-0.60	254.80
non-targeter: post-IT average adoption date	54	7.77	6.65	6.50	0.40	34.40
Difference:		-14.17	-4.10			
Difference-in-Differences		**-15.33**	**-5.60**			

NOTES:

1. See the notes in Table 1.

a. Two of these countries, Finland and Spain, abandoned IT when they adopted the euro in 1999.

Table 3: Summary Statistics by monetary regime and CBI

Emerging, *TURNOVER* < 0.25 (high CBI) - 35 countries[a]		period obs.	mean	median	s.d.	min.	max.
targeter: 11 countries	*INFLATION*	44	15.16	11.60	18.76	1.50	128.40
pre-IT	*deficit (% GDP)*	43	2.54	2.12	2.95	-2.09	16.31
	TURNOVER	44	0.14	0.12	0.06	0.00	0.23
targeter:	*INFLATION*	16	3.92	3.45	1.84	1.00	6.90
post-IT	*deficit (% GDP)*	13	3.19	3.30	1.99	0.85	6.29
	TURNOVER	16	0.12	0.10	0.07	0.00	0.20
Difference (*INFLATION*):			-11.24	-8.15			
non-targeter: 24 countries	*INFLATION*	88	15.53	8.70	18.05	-0.60	112.50
pre-IT average adoption date	*deficit (% GDP)*	72	2.16	2.30	3.82	-12.55	10.95
	TURNOVER	88	0.16	0.20	0.06	0.00	0.23
non-targeter:	*INFLATION*	38	7.16	4.85	6.89	0.40	34.40
post-IT average adoption date	*deficit (% GDP)*	21	3.21	2.39	4.07	-2.13	19.60
	TURNOVER	38	0.16	0.20	0.06	0.00	0.20
Difference (*INFLATION*):			-8.37	-3.85			
Difference-in-Differences:			**-2.87**	**-4.30**			
Emerging, *TURNOVER* >= 0.25 (low CBI) - 25 countries							
targeter: 9 countries	*INFLATION*	31	59.60	23.00	85.33	2.70	317.00
pre-IT	*deficit (% GDP)*	30	3.20	2.59	4.13	-4.14	13.50
	TURNOVER	31	0.47	0.40	0.20	0.27	0.90
targeter:	*INFLATION*	7	4.30	3.40	2.63	1.40	9.50
post-IT	*deficit (% GDP)*	7	-0.14	-0.43	2.33	-2.83	3.00
	TURNOVER	7	0.39	0.40	0.09	0.30	0.50
Difference (*INFLATION*):			-55.30	-19.60			
non-targeter: 16 countries	*INFLATION*	60	31.34	14.80	43.49	-0.40	254.80
pre-IT average adoption date	*deficit (% GDP)*	57	1.12	1.32	6.00	-21.36	9.47
	TURNOVER	60	0.42	0.30	0.21	0.27	1.00
non-targeter:	*INFLATION*	16	9.23	10.00	5.37	0.40	17.70
post-IT average adoption date	*deficit (% GDP)*	13	-0.79	-0.86	2.97	-6.23	4.67
	TURNOVER	16	0.44	0.35	0.21	0.30	0.90
Difference (*INFLATION*):			-22.11	-4.80			
Difference-in-Differences:			**-33.19**	**-14.80**			

NOTES:

1, See the notes in Table 1.

a. There are 35 emerging countries that at one point during the sample had *TURNOVER* < 0.25. Similarly, there are 25 countries that at one point had *TURNOVER* >= 0.25. The union of these two groups is 44 countries. Similarly, the union of 11 and 9 is 13 targeters, and the union of 24 and 16 is 31 non-targeters.

Table 4 - Correlation Matrix

All Observations			
	INFLATION	*IT*	*LEGAL*
IT	-0.15		
LEGAL	-0.04	0.17	
TURNOVER	0.41	-0.15	-0.05
Advanced			
	INFLATION	*IT*	*LEGAL*
IT	-0.23		
LEGAL	-0.14	0.21	
TURNOVER	-0.07	-0.22	-0.06
Emerging			
	INFLATION	*IT*	*LEGAL*
IT	-0.15		
LEGAL	-0.07	0.20	
TURNOVER	0.39	-0.09	-0.09

NOTES:

1. See the notes in Table 1.

Table 5: Equation (1) without *CBI* - GMM Estimation

PANEL A: *IT* predetermined

Dependent variable:	Inflation (%)		
	(1) Full Sample	(2) Advanced	(3) Emerging
INFL(-1)	0.13	0.72	0.13
	(0.13)	(0.05)***	(0.17)
IT	-1.72	-0.34	-1.96
	(0.73)**	(0.28)	(1.20)
HIGHINFL	81.85		73.48
	(20.20)***		(21.16)***
Obs.[a], Countries	460, 66	126, 22	300, 44
Instrument Columns	30	20	28
AR(2) test p-value	0.90	0.68	0.91
Hansen J-test p-value	0.77	0.64	0.09

PANEL B: *IT* endogenous

Dependent variable:	Inflation (%)		
	(1) Full Sample	(2) Advanced	(3) Emerging
INFL(-1)	0.13	0.71	0.13
	(0.13)	(0.05)***	(0.16)
IT	-2.14	0.18	-3.42
	(0.75)***	(0.32)	(1.29)**
HIGHINFL	81.69		73.62
	(19.92)***		(19.78)***
Obs.[a], Countries	460, 66	126, 22	300, 44
Instrument Columns	30	20	28
AR(2) test p-value	0.91	0.76	0.91
Hansen J-test p-value	0.72	0.93	0.13

NOTES:

1. See the notes in Table 1.

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

3. Panel regression, 1980-2006, estimated by GMM. Robust standard errors in parentheses.

a. Note that the number of observations for the full sample exceeds the combined observations in the sub-samples. The reason is that for the full sample and for emerging economies, we limit to observations with data on *TURNOVER*, which is a better measure of CBI for emerging economies. For advanced economies, however, we limit to data on *LEGAL*, which is a better measure of CBI for advanced economies. If we had restricted to data on *TURNOVER* for advanced economies, there would be more observations and the sum of observations for both sub-samples would match the number for the full sample.

Table 6: Equation (1) - Average Inflation - GMM Estimation

PANEL A: *IT* and CBI predetermined

Dependent variable:	*INFL* = Inflation (%)					
	(1) Full Sample	(2) Full Sample	(3) Advanced	(4) Advanced	(5) Emerging	(6) Emerging
INFL(-1)	0.20	0.12	0.58	0.61	0.05	0.09
	(0.13)	(0.08)	(0.07)***	(0.05)***	(0.34)	(0.08)
IT	9.87	6.45	-2.40	0.69	-61.62	10.16
	(13.68)	(4.16)	(2.32)	(1.99)	(202.24)	(5.10)*
LEGAL	15.41		-6.92		64.30	
	(27.00)		(12.47)		(88.15)	
TURNOVER		37.16		-1.71		49.61
		(19.35)*		(5.84)		(22.12)**
*IT*LEGAL*	-26.20		4.98		74.75	
	(28.97)		(6.77)		(278.00)	
*IT*TURNOVER*		-36.32		-9.06		-56.71
		(18.49)*		(13.97)		(21.66)**
HIGHINFL	117.60	84.78			109.77	77.86
	(30.48)***	(20.37)***			(25.04)***	(21.50)***
B_2+B_4*TURNOVER[a]		**-4.4** (*TURN*=0.30)**				**-4.0** (*TURN*=0.25)**
Obs., Countries	275, 58	460, 66	126, 22	160, 22	149, 36	300, 44
Instrument Columns	37	45	30	41	33	40
AR(2) test p-value	0.42	0.88	0.65	0.82	0.84	0.99
Hansen J-test p-value	0.08	0.09	0.80	0.99	0.96	0.14

PANEL B: *IT* and CBI endogenous

Dependent variable:	*INFL* = Inflation (%)					
	(1) Full Sample	(2) Full Sample	(3) Advanced	(4) Advanced	(5) Emerging	(6) Emerging
INFL(-1)	0.20	0.11	0.56	0.58	0.19	0.10
	(0.15)	(0.10)	(0.11)***	(0.05)***	(0.61)	(0.10)
IT	27.09	3.55	-4.29	-1.64	49.95	5.37
	(38.31)	(3.68)	(7.15)	(2.98)	(302.95)	(9.48)
LEGAL	24.64		-7.56		38.50	
	(61.90)		(16.02)		(159.57)	
TURNOVER		36.93		2.17		43.44
		(18.80)*		(5.22)		(39.62)
*IT*LEGAL*	-53.67		10.51		-67.79	
	(93.11)		(16.67)		(392.52)	
*IT*TURNOVER*		-22.02		13.68		-36.83
		(16.47)		(23.20)		(37.30)
HIGHINFL	119.69	88.33			108.26	80.54
	(32.35)***	(21.74)***			(38.87)***	(18.91)***
B_2+B_4*TURNOVER[a]						**-4.7** (*TURN*=0.27)**
Instrument Columns	34	42	27	38	30	37
AR(2) test p-value	0.43	0.90	0.51	0.49	0.70	0.92
Hansen J-test p-value	0.10	0.08	0.95	0.99	0.97	0.13

NOTES:

1. See the notes in Table 1.
2. * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Panel regression, 1980-2006, estimated by GMM. Robust standard errors in parentheses.

a. Table gives B_2+B_4**TURNOVER* for the cutoff level of *TURNOVER* at which B_2+B_4*TURNOVER becomes significant.

Table 7: Robustness Tests for Emerging Economies - Equation (2), DD Estimation

Dependent variable: *INFL* = average Inflation (%)	
INFL(-1)	-0.96 (0.02)***
IT	-0.10 (2.32)
TURNOVER	13.10 (6.84)*
*IT*TURNOVER*	-18.17 (7.71)**
B_2+B_4*TURNOVER[a]	**-3.2** (*TURN*=0.17)**
Observations	39
R^2	0.98

NOTES:
1. See the notes in Table 1.
2. * significant at 10%; ** significant at 5%; *** significant at 1%.
3. Cross-sectional regression, estimated by OLS. Robust standard errors in parentheses.
a. Table gives B_2+B_4**TURNOVER* for the cutoff level of *TURNOVER* at which B_2+B_4*TURNOVER becomes significant.

Table 8: Robustness Tests for Emerging Economies - removing high inflation observations

PANEL A: *IT* and CBI predetermined

Dependent variable: *INFL* = average Inflation (%)

	(1) *INFL*<150%	(2) *INFL*<100%	(3) *INFL*<40%
INFL(-1)	0.24	0.39	0.35
	(0.12)**	(0.09)***	(0.09)***
IT	3.04	0.98	-2.44
	(2.86)	(2.73)	(1.87)
TURNOVER	16.77	9.27	-1.86
	(12.27)	(8.88)	(7.26)
*IT*TURNOVER*	-21.84	-9.55	3.73
	(12.15)*	(10.22)	(7.44)
HIGHINFL (>40%)	51.82	31.22	
	(14.23)***	(5.15)***	
B_2+B_4*TURNOVER[a]	**-4.4** (*TURN*=0.34)**	**-1.6** (*TURN*=0.27)**	
Obs., Countries	288, 44	277, 44	244, 44
Instrument Columns	40	40	39
AR(2) test p-value	0.07	0.27	0.13
Hansen J-test p-value	0.21	0.34	0.36

PANEL B: *IT* and CBI endogenous

Dependent variable: *INFL* = average Inflation (%)

	(1) *INFL*<150%	(2) *INFL*<100%	(3) *INFL*<40%
INFL(-1)	0.17	0.46	0.34
	(0.12)	(0.11)***	(0.11)***
IT	3.01	-0.93	-4.23
	(3.22)	(3.23)	(2.11)*
TURNOVER	20.85	4.38	-3.69
	(13.45)	(10.65)	(8.86)
*IT*TURNOVER*	-22.72	-1.93	8.66
	(11.92)*	(11.52)	(8.18)
HIGHINFL (>40%)	60.35	26.80	
	(16.20)***	(7.46)***	
B_2+B_4*TURNOVER[a]	**-4.0** (*TURN*=0.31)**	**-1.5* (*TURN*=0.27)**	
Instrument Columns	37	37	37
AR(2) test p-value	0.10	0.27	0.13
Hansen J-test p-value	0.18	0.34	0.36

NOTES:

1. See the notes in Table 1.

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

3. Panel regression, 1980-2006, estimated by GMM. Robust standard errors in parentheses.

a. Table gives B_2+B_4**TURNOVER* for the cutoff level of *TURNOVER* at which B_2+B_4*TURNOVER becomes significant.

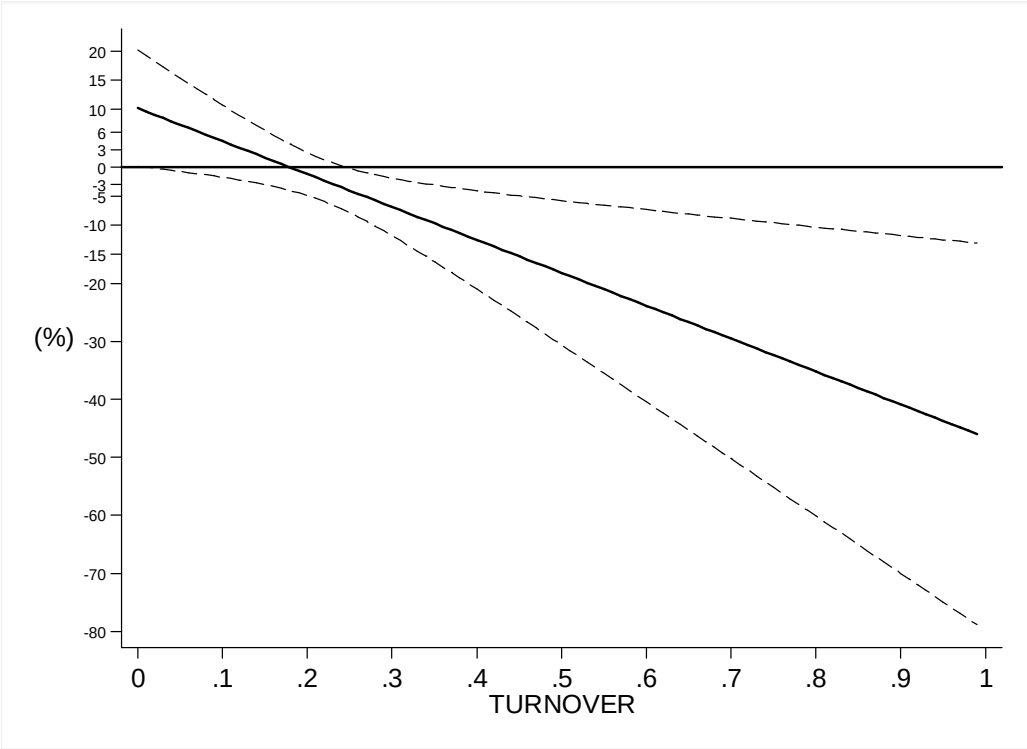

FIG. 1. Marginal Effect of IT on Inflation in Emerging Economies for each level of *TURNOVER* using specification (6a) in Table 6. The dotted lines represent the 95% confidence interval. See the notes in Table 1 for a description of the variables.

Table A1: Variables and Data Sources

Variable	Description and Source
IT	Inflation Targeting regime in place. Source: Ball (2010) and Batini and Laxton (2007).
INFL	Annual percent change in consumer price index. Source: WDI.
TURNOVER	*TURNOVER* is the average number of changes in the central bank governor per year in each decade. For example, if *TURNOVER* = 0.2, there are 2 changes per decade for an average tenure of 5 years. One observation per decade (1950's to 1980's). Source: Cukierman, et al., (1992). Data after 1990 obtained from Crowe and Meade (2007) and Dreher, et al. (2008).
LEGAL	One observation per decade (1950's to 1980's). Source: Cukierman, et al., (1992). Data updated by Jácome and Vázquez (2005) and Siklos (2008).
Budget Surplus (% of GDP)	Central government budget surplus (% of GDP). Source: IFS v80.
Foreign Currency Deposits (% of total deposits)	Source: Honig (2009).
Stocks traded, turnover ratio %	The total value of shares traded during the year divided by the average market capitalization for the year. Average market capitalization is calculated as the average of the end-of-year values for the current year and the previous year. Source: WDI.
Stock market capitalization (% of GDP)	Source: WDI.

Table A2: Countries

Targeters for part of sample period		Non-targeters		
Advanced	Emerging	Advanced	Emerging	
Australia	Brazil	Austria	Algeria	Lebanon
Canada	Chile	Belgium	Argentina	Malaysia
Finland	Colombia	Denmark	Botswana	Morocco
Iceland	Czech Republic	France	Bulgaria	Nigeria
New Zealand	Hungary	Germany	China	Pakistan
Norway	Israel	Greece	Costa Rica	Panama
Spain	Korea	Ireland	Croatia	Russia
Sweden	Mexico	Italy	Dominican Republic	Singapore
Switzerland	Peru	Japan	Ecuador	Taiwan
United Kingdom	Philippines	Netherlands	Egypt	Tanzania
	Poland	Portugal	El Salvador	Tunisia
	South Africa	United States	Ghana	Turkey
	Thailand		Guatemala	Ukraine
			India	Uruguay
			Indonesia	Venezuela
			Jordan	