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Does Inflation Targeting Affect the Dispersion of Inflation Expectations?*

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Abstract

In this paper we examine the effect of having an inflation targeting framework on the dispersion of inflation forecasts from professional forecasters. We use a panel data set of 26 countries -including 14 inflation targeters- with monthly information from the last 16 years. We find that the dispersion of long-run inflation expectations is lower in targeting regimes after controlling for country-specific effects, time-specific effects, initial dispersion, the level and the variance of inflation, disinflation periods, and global inflation. When we differentiate between developed and developing countries, we find different dynamics for each group. In particular, the mentioned effect of inflation targeting seems to be present only on the developing countries.

Keywords: Monetary Policy, Survey Data, Panel Data.
JEL Classification: E31, E52, E58, C23

Resumen

En este documento examinamos el efecto de tener un esquema de objetivos de inflación sobre la dispersión de pronósticos de inflación de pronosticadores profesionales. Usamos un panel de 26 países, incluyendo 14 con objetivos de inflación, con información mensual de los últimos 16 años. Encontramos que la dispersión de las expectativas de inflación de largo plazo es menor en regímenes de objetivos de inflación después de controlar por efectos-fijos por país, efectos-fijos en el tiempo, la dispersión inicial, el nivel y la varianza de la inflación, periodos de desinflación e inflación global. Cuando diferenciamos entre países desarrollados y países en desarrollo, encontramos diferentes dinámicas para cada grupo. En particular, el mencionado efecto parece estar presente únicamente en países en desarrollo.

Keywords: Política Monetaria, Encuestas, Datos de Panel.

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Inflation targeting (IT) is a monetary policy strategy that has been gaining popularity around the world. Three main benefits, all interrelated, have been associated with inflation targeting. First, that it successfully lowers inflation and makes it less volatile.[1] Second, that it reduces the real costs of disinflations.[2] Finally, that it anchors long-run inflation expectations at or very close to the inflation target.[3] Of these, the effect on inflation expectations is, in principle, straightforward, since a key aspect that separates inflation targeting from other sensible monetary policies is the public announcement of a numerical target, and the subsequent referral to it in central bank communications. In fact, it is possible that the impact of inflation targeting on inflation and on other macroeconomic variables may come through its effect on inflation expectations and on the expectations formation process: e.g., inflation targeting could coordinate expectations and, in this way, become the nominal anchor of the economy; or it could be thought of as a commitment mechanism that improves the signal-to-noise ratio in the economy, helping people to make a better-informed allocation of resources. For this reason, and in contrast to other investigations that concentrate on the effects of IT on inflation or on macroeconomic variables, we concentrate on the effect of IT on inflation expectations.

By making the inflation target explicit, IT provides a focal point that may anchor inflation expectations. If the central bank does not announce a target and if the performance of the central bank is not evaluated based on a number or a range, then people in the economy need not have the same expectation about the future stance of monetary policy and, therefore, inflation expectations need not be anchored. Indeed, Gürkaynak et al. (2006), using inflation expectations extracted from market instruments, provide evidence that expectations in Canada, the U.K., and Sweden, all IT countries, seem to be less sensitive to macroeconomic news than inflation expectations in the United States, a non-IT.

Inflation targeting may not only affect the level of inflation expectations, but also the dispersion of these expectations across economic agents. As an example, take two otherwise identical countries with monetary policies conducive to low and stable inflation, but one with an explicit inflation target (the IT country) and the other with an implicit one. The potential benefit for the IT country is that the target becomes a focal point for the coordination of expectations among agents. In contrast, in the country with an implicit target, economic agents have to estimate the target in order to form their inflation expectations and, therefore, need not have the same inflation expectation. As a result, the dispersion of

[1] Bernanke et al. (1999), Gonçalves and Salles (forthcoming), Johnson (2002), Levin et al., (2004), Mishkin and Schmidt-Hebbel, (forthcoming), and Vega and Winkelried (2005).

[2] Gonçalves and Salles (forthcoming), Mishkin and Schmidt-Hebbel, (2007).

[3] Bernanke et al. (1999), Gonçalves and Salles (forthcoming), Gürkaynak et al. (2006), Johnson (2002), Levin et al. (2004), Mishkin and Schmidt-Hebbel (2007), and Vega and Winkelried (2005).

inflation expectations would be larger in the non-IT country.

The importance of heterogeneity in inflation expectations for macroeconomic analysis has been emphasized by Lucas (1972) and Phelps (1970). More recently, Mankiw, Reis and Wolfers (2004, p. 2) go as far as suggesting that "... disagreement [about inflation expectations] may be a key to macroeconomic dynamics.". In this paper we study how the choice of a particular monetary policy scheme, inflation targeting, affects this heterogeneity.

We use a simple macroeconomic model to show that, under IT, the optimal long-run inflation forecast is the target.[4] Since this would be true for each forecaster, under IT the dispersion across forecasters (i.e., the disagreement about inflation expectations) should decrease, eventually collapsing around the target. We test this implication using survey data, collected by the firm *Consensus Economics*, on inflation forecasts from professional forecasters.[5] We have data per-forecaster for 26 countries, of which 12 are industrial countries, 7 are from Latin America and 7 are from the Asian Pacific Region. From the 26 countries, 14 have implemented IT. The data is monthly, with forecast horizons of up to 24 months, and spans the last 16 years.[6]

Yet, presenting convincing empirical evidence on the effects of inflation targeting has proven a difficult task for at least two reasons. First, for what now is a considerable amount of time, favorable conditions worldwide have helped tame inflation around the world (Bernanke, 2004; Cecchetti, et al., 2006; Rogoff, 2003).[7] Among these conditions we have central banks becoming autonomous, fiscal policies more favorable to low inflation (e.g., debt renegotiations and low fiscal deficits), and openness to global trade (e.g., more competitive goods and labor markets). Therefore, in recent times inflation has been under control in most countries. This makes it difficult to identify the specific contribution of inflation targeting since, if these conditions are not controlled for, their effects could be erroneously attributed to inflation targeting.[8] Second, in particular in emerging countries, IT coincides for some periods with disinflation programs –i.e., a restrictive monetary policy for long periods of time–, as well as with other actions such as fiscal retrenchment. Again, if these are not taken into account,

[4] As shown in the next section, this result holds if the central bank is an inflation targeter, if there is perfect and symmetric information, and if the agents in the economy have confidence in the central bank.

[5] Our choice of countries is determined by the availability of forecasts per-forecaster in the data from *Asian Consensus Forecasts*, *Consensus Forecasts* and *Latin American Consensus Forecasts.* The data is an unbalanced panel as detailed in the inflation forecasts section.

[6] The countries studied are Australia, Argentina, Brazil, Canada, Chile, Colombia, France, Germany, Hong Kong, Indonesia, Italy, Japan, Malaysia, Mexico, the Netherlands, Norway, Peru, Singapore, South Korea, Spain, Sweden, Switzerland, Thailand, the United Kingdom, the United States and Venezuela.

[7] Although in more recent times, high prices of commodities appear to be dominating the global scene.

[8] A related point was made by Ball and Sheridan (2005). They argue that, regardless of the adoption of inflation targeting, countries with high and variable inflation tend to show the largest gains in terms of the behavior of inflation because of a "regression to the mean" effect.

their effects could be attributed to IT. In general, the omission of relevant explanatory variables is likely to bias upwards (in absolute value) the estimate of the effects of inflation targeting. The problem can be alleviated by adequately controlling for omitted variables such as global inflation and disinflation periods, as well as for other variables that are hard to measure or unobservable, such as the degree of central bank independence.

Our main result is that the dispersion of long-run inflation expectations appears to be lower under inflation targeting regimes than in non-inflation targeting ones, after controlling for country-specific events such as the level and the variance of inflation and disinflation periods, and time-specific effects such as global inflation. Thus, we provide evidence that suggests that inflation targeting has helped anchor inflation expectations. When we separate the effects between developed and developing countries, we find that the effect is present in the latter and, in line with Johnson (2002), that there seems to be no effect on the dispersion of long-run expectations in the former.

The paper is organized as follows. Section 1 presents the theoretical model. The data on inflation forecasts is described in section 2, while section 3 contains the empirical results. Finally, a discussion and the implications of the analysis are presented in section 4. The appendix extends the model to the case of a flexible inflation targeter.

1 Theory

In this section we use a simple canonical macroeconomic model to define what anchoring of inflation expectations means under inflation targeting and to derive the implication that we test in the empirical part.

1.1 Inflation targeting

Inflation l periods ahead is given by:

$$\pi_{t+l} = s_t - i_t + \varepsilon_{t+l}, \tag{1}$$

where s_t represents underlying inflationary pressures, i_t is the monetary policy instrument, and ε_{t+l} represents unforecastable shocks (with zero mean). s and ε are assumed to be independent of the monetary policy action, and the difference between them is that s is realized before the choice of the monetary action while ε is realized afterwards. Notice that here l represents the control lag.[9] This equation can be derived from a system with an IS

[9] This equation has been used before, among others, by Bernanke and Woodford (1997).

and a Phillips Curve. In that case, s_t would be a vector with variables from both equations.

The central bank is a strict inflation targeter.[10] The central bank's objective in period t is to choose a sequence of current and future instruments $\{i_\tau\}_{\tau=t}^{\infty}$ to solve:

$$\min_{\{i_\tau\}_{\tau=t}^{\infty}} E\left[\sum_{\tau=t}^{\infty} \delta^{\tau-t}\frac{1}{2}\left(\pi_\tau - \pi^T\right)^2 \mid \Omega_t\right], \tag{2}$$

where δ is a discount factor, π^T is the target, and Ω_t is the central bank's information set. Since in this simple case the instrument (e.g., the overnight rate) in period t will not affect the inflation rate in period t, but will do so until $t+l$, we can find the solution to the optimization problem by assigning the instrument in period t to hit, on an expected basis, the inflation target for period $t+l$, the instrument in $t+1$ to hit the inflation target for period $t+l+1$, and so on (Svensson, 1997). Thus the central bank can find the optimal instrument in period t as the solution to the simple period-by-period problem:

$$\min_{i_t} E\left[\delta^l\frac{1}{2}\left(\pi_{t+l} - \pi^T\right)^2 \mid \Omega_t\right]. \tag{3}$$

The first order condition to solve (3) is:

$$E\left[\pi_{t+l} \mid \Omega_t\right] = \pi^T, \tag{4}$$

where the expectation is evaluated at i_t^*, the optimal instrument.[11] In (4) we can see that the central bank sets its instrument to make the expected value of inflation, conditional on its information set, equal to the target (Svensson's "Inflation Forecast Targeting"). The conditional expected value of inflation is the target of the central bank.

If the central bank knows the equation for the economy (1), then it can use it to form its expectation (to forecast), so that:

$$E\left[\pi_{t+l} \mid \Omega_t\right] = s_t - i_t. \tag{5}$$

Substituting (5) in (4) we get the optimal instrument:

$$i_t^* = s_t - \pi^T. \tag{6}$$

In this economy, the equilibrium is obtained by substituting the optimal instrument (6)

[10] The case of a flexible inflation targeter is presented in the appendix.

[11] We have assumed that integration and differentiation can be interchanged.

in the equation for the economy (1):

$$\pi_{t+l} = \pi^T + \varepsilon_{t+l}, \tag{7}$$

where we can see that observed inflation is not correlated with s_t, and that any dominant characteristic of the vector s_t will not affect inflation. Both are consequences of the central bank acting to offset or reinforce s_t, the underlying inflationary pressures, in order to achieve the target.[12]

We can solve for the agents' rational forecast of inflation in this setup. For the representative agent, if we assume that she chooses her forecast by minimizing Mean Squared Error (MSE), then the problem she solves for each t is:

$$\min_f E\left[(\pi_{t+l} - f_{t+l})^2 \mid I_t\right],$$

where $f_{t+l,t}$ is the forecast of inflation made at t for period $t+l$, and I_t is the agent's information set. The first order condition is:

$$f^*_{t+l} = E\left[\pi_{t+l} \mid I_t\right].$$

This is the typical result that under MSE loss, in effect, the optimal forecast is the expected value conditional on the information known at t.

If we assume that $I_t = \Omega_t$, that is, that there is symmetric information, then the agent can also find the equilibrium (7), and use it to form the optimal forecast:

$$\begin{aligned} f^*_{t+l} &= E\left[\pi_{t+l} \mid I_t\right] \\ &= E\left[\pi^T + \varepsilon_{t+l} \mid I_t\right] \\ &= \pi^T. \end{aligned}$$

Under perfect and symmetric information and full credibility, the optimal forecast for a forecast horizon equal or greater than the control lag is the inflation target. In this model it is possible that, when the agent forms her expectation, actual inflation may not be at the target (deviates from it due to the error term), and despite this the expectation will still be the target. This result reflects the fact that in the model the agent has confidence that the central bank would take the required steps to put inflation back on track.

[12] Firms and individuals enter the economy through s_t. Since we assume that the central bank has perfect information, it observes the behavior of the agents and offsets or reinforces it as needed to achieve the inflation target.

1.2 No explicit inflation target

To analyze what would happen in a country that has a sensible monetary policy but without inflation targeting, we can use the model presented before but assuming that the central bank never reveals its inflation target to the public.[13] In such an environment, since the representative agent does not know π^T, she would have to estimate it. The reason is that she knows that her best long-run forecast is the target, but she does not know the actual number. In this scenario, the optimal forecast of the representative agent is:

$$\begin{aligned} f^*_{t+l} &= E\left[\pi_{t+l} \mid I_t\right], \\ &= \widehat{\pi}^T, \end{aligned}$$

where $\widehat{\pi}^T$ is an estimate of the expected mean. If the agent uses least squares to estimate the target, then:

$$\widehat{\pi}^T = T^{-1} \sum_{t=1}^{T} \pi_t.$$

Therefore, the optimal forecast is the simple average of past inflation, which is an unbiased and consistent estimate of the target, given that observed inflation is generated by equation (7). In this setting, the precision of the estimate increases with time (as the standard errors of the estimator decrease with the sample size).

1.3 Implications

The model is very simple, but it shows the effect of IT on the equilibrium process for inflation and on expectations. In particular, under inflation targeting inflation follows a stationary process with mean equal to the target and the optimal forecast is the inflation target for horizons equal to or greater than the control lag.

Following the theoretical considerations, we propose the following:

Definition 1 *Inflation expectations are anchored when individual expectations with a forecast horizon equal to or greater than the central bank's control lag are at or very close to the inflation target, even if inflation at the time at which the expectations are formed is not at or close to the target.*

According to our model, we would expect inflation targeting to anchor expectations. Therefore, at least one implication for inflation expectations for horizons equal or greater than the central bank's control lag arise from the model: *under an inflation targeting regime,*

[13] Thus, in this subsection we take the view that inflation targeting means an explicit target.

the dispersion across agent's long-run inflation expectations should be smaller than in non-targeting regimes. This is the implication that we test. In countries without inflation targeting (i.e., with no explicit inflation target), the need to estimate the target opens the door to dispersion of inflation expectations once we consider several agents in the economy.[14]

Notice that, in countries with monetary policies conducive to low and stable inflation but where the target is not public, the heterogeneity across inflation expectations will not be very large because the estimates will be very close to the target (i.e., the dispersion would only be driven by parameter uncertainty). However, in countries where the implicit inflation target has had a short history, because it changed or was nonexistent in the recent past (e.g., under fiscal dominance), then the estimates may be very different. As an example, take a country where a change in the implicit target has occurred in the past, without informing the public. Heterogeneity would arise because different agents could use different sample windows to estimate the target. At least some agents would be using a sample that was generated with another target (under the past regime) and hence their estimates would be biased. Therefore, we expect that making explicit the target would help the most to reduce the dispersion in those countries with relatively short histories of price stability.[15] Hence, we expect a stronger impact of inflation targeting in less developed countries than in developed ones.

2 Data on Inflation Expectations

We use survey measures of private forecasts to study the behavior of inflation expectations.[16] Our data comes from the firm *Consensus Economics*. The database contains monthly inflation forecasts per-forecaster for 26 economies, taken from the *Consensus Forecasts* publications. Each month, *Consensus Economics* collects the forecasts from a number of financial institutions and professional forecasters from each country. The forecasters report an expected rate of Consumer Price Index inflation for the end of the current and following calendar year, thus the longest forecast horizon is 24 months and the shortest is 1 month.

[14] Disagreement about inflation expectations can be driven by many factors. The one described here, learning, has been surveyed by Evans and Honkapohja (2001). Mankiw, Reis and Wolfers (2003) and Carroll (2003) propose differences in the information sets across agents. Capistrán and Timmermann (2006) use differences in the costs of forecast errors.

[15] The uncertainty about the date of a structural break is one of many possible uncertainties that the agents would face in an environment such as the one described here. Other uncertainties would also generate heterogeneity, for example, data uncertainty, model uncertainty, etc.

[16] Two sources of private sector inflation expectations have been used to study the behavior of inflation expectations: data from surveys of private inflation forecasts (Bernanke et al., 1999; Johnson, 2002, 2003; and Levin et al., 2004) and data from interest-rate differentials (Gürkaynak et al., 2006; and Bernanke et al., 1999).

The average number of forecasters polled varies between countries. The number of individual responses is higher for the industrialized countries, especially Japan, the United Kingdom and the United States, than for other countries.

In contrast to some previous studies that suffer from selection bias by including only developed economies (e.g., Johnson, 2002) or only emerging economies (e.g., Gonçalves and Salles, forthcoming), our sample is chosen according to the availability of inflation forecasts per forecaster so that the targeters and the non-targeters groups contain both, industrialized and emerging economies. We use data for 12 industrial countries: Canada, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States; 7 Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela; and 7 economies from the Asian Pacific region: Australia, Hong Kong, Indonesia, Malaysia, Singapore, South Korea, and Thailand.[17]

The database is an unbalanced panel for two reasons. First, the data starts in different months for different countries. For Canada, France, Germany, Italy, Japan, the United Kingdom and the United States, the inflation forecasts per forecaster are compiled since October 1989, for Norway and Switzerland since June 1998, and for the other industrial countries since January 1995. In the Latin American region data exists on inflation forecasts since March 1993 for Argentina, Brazil, Chile, Mexico and Venezuela and since August 1997 for Colombia and Peru. For the Asian Pacific countries the inflation forecasts are compiled since December 1994. The data ends in November 2006 for all countries. The second reason is that the data on inflation forecasts for Latin America is bimonthly until April 2001.

From the countries in our sample, 14 have adopted IT: Australia in June 1993; Brazil in July 1999; Canada in February 1991; Chile in September 1999; Colombia in September 1999; Mexico in February 2001; Norway in March 2001; Peru in January 2002; Spain in January 1995, although in 1999 enters the European Union and hence drops the IT regime; Sweden in January 1993; Switzerland in January 2000; South Korea in April 1998; Thailand in January 2000; and the U.K. in October 1992.[18] For all the IT countries, except Spain and Sweden, the database contains data before inflation targeting was adopted. Therefore, we can analyze the behavior of expectations in the same country before and after IT, and we

[17] There are 4 countries in the Consensus Forecasts publications which do not appear in our study. New Zealand is excluded because its CPI is calculated quarterly and there are no inflation forecasts for the period before IT. China and Taiwan are excluded because we could not find monthly CPI inflation data for the period that we study. India is excluded because the reported inflation expectations are respect to a fiscal year instead of a calendar year.

[18] Chile, Mexico and Peru adopted a monetary policy scheme with some elements of an IT regime, including an explicit target, in January 1991, February 1999, and January 1994, respectively. However, they only moved to a full-fledged IT regime in the dates presented in the main text. Throughout the paper we use the latter dates, except where we explicitly indicate otherwise.

can also compare the behavior of expectations between countries with and without IT.

We use two measures of dispersion, the interquartile range across forecasters and a coefficient of variation formed by dividing the interquartile range by the absolute value of the median forecast (times 100). Both measures are robust to extreme values in the distributions across forecasters, and the second takes into account the differences in the dispersion of expectations brought about by differences in the levels of inflation across countries and through time. The second measure has the problems that it is indeterminate when the median forecast is zero, and it becomes very large when the absolute value of the median forecast is less than one.[19] We calculate the interquartile range and the median across forecasters using the monthly forecasts for the current and the following year for each country. To clarify how we calculate the two measures, take as an example the November 2006 forecasts for next year's inflation in the United States (forecasts for inflation in 2007 in the United States). The first quartile is 2.10 percent, the median is 2.21 percent, and the third quartile is 2.50 percent. Therefore, the interquartile range for November 2006 is 0.41, and the coefficient of variation is 0.41 divided by the median, 2.10, times 100, for a total of 18.6.

To get some sensibility about the information contained in the data, we compare the distributions of coefficients of variation from periods with IT to those without IT. In order to do this, we divide the coefficients of variation for the following year into two mutually exclusive groups. One group contains observations from non-IT countries and the periods before the adoption of IT on inflation targeting countries. The other group contains observations for IT countries during periods after the implementation of this monetary policy strategy. Figure 1 shows the box-plot of each group. For non-targeting periods, the mean of the distribution is greater and the dispersion is higher than the corresponding moments of the group containing the IT's coefficients of variation. In addition, extreme disagreement (i.e., very large coefficients of variation) only occurs in non-targeting periods.[20] Thus, a simple look at the data shows that, on average, IT may indeed lower the dispersion across long-run inflation expectations.

3 Empirical Results

We use two different estimators in order to test our model's implication that the dispersion across agent's long-run inflation expectations should be smaller in targeting regimes. The first estimator is a "difference-in-differences" estimator, previously used to investigate the

[19] In fact, Hong Kong, Japan and Singapore were dropped from all the analysis that employs the coefficients of variation because inflation was zero or near zero for a number of periods in these countries.

[20] Five observations corresponding to the non-targeting periods are not included in the figure, all of them above 250, with a maximum value of 800.

effects of IT on other variables, such as the level and the variance of inflation, by Ball and Sheridan (2005), Gonçalves and Salles (forthcoming), Mishkin and Schmidt-Hebbel (forthcoming), and Vega and Winkelried (2005). The second estimator is a fixed effects estimator, previously used by Johnson (2002). Both estimators control for omitted variables, unobserved in most cases, that differ from one country to the other but do not change over time within each country (i.e., fixed effects). However, although both estimators are the same when there are only two time periods, they are different when there are more than two time observations for each country, which is our case. In addition to control for fixed-effects, the "diffs-in-diffs" estimator controls for time-fixed effects, i.e., those variables that differ from month to month but do not change across countries within each month, while the fixed-effects estimator does not control, per se, for time-fixed effects when there are more than two time periods.[21] Nevertheless, the fixed effects approach allows us to investigate the effects of disinflation periods and global inflation on the dispersion across forecasters. Since the latter varies through time but not across countries, it allows us to control for time-effects in the fixed effects regression.

3.1 Difference-in-differences estimator

Since the interest is on how IT affects a specific variable, in our case the dispersion of inflation expectations, we calculate the average dispersion across time for the periods before and after the implementation of IT for each of the IT countries, and the averages before and after a particular date for each of the non-targeters. This particular date, as in previous literature, is the average date of IT implementation in those countries with IT, which turns out to be March 1998. Since many measures of economic performance, in particular those related to inflation, have improved in recent years around the world, following this methodology we will compare the change in dispersion in targeting countries with the change in dispersion in non-targeting countries. We implement the difference-in-differences approach through the regression:

$$CV_{final,i} - CV_{initial,i} = \gamma_0 + \gamma_1 DIT_i + \Gamma' Controls_i + \epsilon_i \tag{8}$$

where: $CV_{final,i}$ is the average of the coefficients of variation for country i after the implementation of IT (or after March 1998 for non-targeters), $CV_{initial,i}$ is the average of the coefficients of variation for country i before IT adoption (or before March 1998 for non-targeters), DIT_i is a dummy variable that takes the value of one if country i has inflation

[21] As shown in Ball and Sheridan (2005) and elsewhere, the difference-in-differences approach can control for time invariant unobserved effects, even if they are correlated with the variable used to measure the monetary policy regime (IT or other).

targeting and zero otherwise. $Controls_i$ is a vector of controls. In particular, we control for the initial level of dispersion ($CV_{initial,i}$) in order to avoid a "reversion to the mean" effect, as countries with unusually high dispersions may tend to see the largest gains in the sense that dispersion decreases regardless of whether they adopted IT. We also control for the change in the variance of inflation to take into account the effect that changes in the volatility of inflation could have on the changes in the dispersion of inflation expectations. In addition, we control for the change in the level of inflation in each country. The regression has a number of observations equal to the number of countries analyzed.

Table 1 reports the average dispersions for the difference-in-differences approach using forecasts for the current and the following year. The dispersion does not fall in non-targeting countries but, as expected, it falls in some targeting countries. According to our theory, we expect the results to be present, or stronger, for the forecasts for the following year, as at least some are likely to be for a forecast horizon larger than the central banks' control lag. If we observe the forecasts for the following year, we can see that the coefficient of variation actually falls on average for the countries with inflation targeting (-3.25) compared to the non-targeters group, which sees an increase in the average coefficient of variation (9.74). Even though the change is positive for some targeters, the increase in the dispersion appears smaller than the increase that occurs in non-targeters. Notice that the effect seems to be stronger in developing countries. However, one has to be aware of the possibility of mean reversion, since the coefficient of variation was initially higher in the targeters group. See the case of Brazil for example, which had the greatest fall in the coefficient of variation from the targeters group (-67.53) in our sample, but also had the highest initial coefficient of variation (80.94), supporting the idea that it is important to control for the initial level in the regressions.

Table 2 reports the results from the estimation of equation (8), where we have used robust standard errors calculated using White's (1980) correction for heteroskedasticity. The results are divided by forecast horizon, current year and following year, and by the controls included in the regression. The first column corresponding to each horizon reports the results without controls. Inflation targeting does not seem to have an effect in the short-run but, as expected, the effect on the forecasts for next year is significant. The second column, corresponding to each horizon, reports the results using the initial dispersion as control. The results for these regressions also show an insignificant effect of IT for the current year but, in line with our theory, the dummy variable for inflation targeting is significant at 10 percent when forecasts for the following year are used. The control and the constant are also significant in the latter, and these three variables explain 69 percent of the variation in the differences in dispersion.

The estimated effect of inflation targeting on the dispersion of inflation expectations is large. For example, Brazil has an initial level of 80.94 when forecasts for the following year are used. The predicted value for the final level, given that Brazil adopted inflation targeting, is 26.27 (22.42 - 9.10 - 0.84*80.94 + 80.94), a considerable fall. We can also use our results to calculate the counterfactual: the predicted value for the final level of dispersion, had Brazil *not* adopted IT, is 35.37 (22.42 - 0 - 0.84*80.94 + 80.94). So, for Brazil, the adoption of IT reduced the dispersion of inflation expectations by 30 percent of what it would have been without IT. It is also illustrative to present the same calculations for Malaysia, a non-targeter with a large increase in dispersion. The initial level of dispersion for Malaysia is 13.19. The predicted value for the final level, given that it is a non-targeter is 24.53 (compare it to the observed 26.66). Had Malaysia adopted IT, the predicted final level (the counterfactual) would have been much lower, 15.43.

Table 2 also presents the results for the regressions adding as an extra control the change in inflation's variance. The new control is significant at least at 5 percent for both current and following year forecasts, and with the expected sign: if the variance of inflation increases, the dispersion of forecasters is expected to increase as well. As is the case when only one control is used, the dummy for IT is not significant for the forecasts for the current year. However, the effect of IT is significant when forecasts for the following year are considered. In this case, our regression is able to explain almost 90 percent of the variation in the differences in dispersion. The results remain when we use the change in the level of inflation as a control, with a positive sign for the coefficient on the level. We cannot have both the change in the variance and the change in the level as controls due to the high correlation between these variables.

As a robustness check, we performed the estimation of all the regressions dropping Brazil –the targeter with the largest fall in dispersion– and Argentina –the non-targeter with the largest increase. The qualitative results prevail.

3.2 Fixed-effects estimator

The second methodology is a fixed effects estimator applied to the unbalanced panel formed from the monthly observations for each country. The fixed effects estimator controls for any time-invariant characteristics specific to a given country (e.g., the degree of central bank independence, provided it did not change in the sample). The regression in this case is:

$$IR_{it} = (\alpha_0 + \alpha_{1,i}) + \alpha_2 DIT_{it} + \alpha_3 INF_{it} + \alpha_4 DDIS_{it} + \alpha_5 WI_t + \varepsilon_{it}, \tag{9}$$

where: IR_{it} is the interquartile range for country i in period t. DIT_{it} is a dummy variable that takes the value of one if country i has inflation targeting in period t and zero otherwise.

INF_t is the annualized inflation rate in country i in period t. $DDIS_{it}$ is a dummy variable that takes the value of one if that month belongs to a disinflation period, and zero otherwise. Disinflation periods are determined based on the methodology proposed by Ball (1994). A disinflation period is an episode that starts at an inflation peak and ends at an inflation trough, with an annual inflation rate at the trough at least 4 percentage points lower than at the peak for emerging economies and at least 2 percentage points lower for developed ones. Peaks are months in which trend inflation is higher than both, the preceding six months and the subsequent six months and viceversa. Trend inflation is the centered 13 month moving average.[22] Finally, WI_t is the monthly world average inflation as reported in the International Financial Statistics series (IFS) from the International Monetary Fund. This is a time-varying variable that controls for global inflation in order to take into account the shocks that affect inflation, and therefore inflation expectations, across countries. However, since it is the same for all countries within each month, it also captures the effect of other time-specific events.

We estimate regression (9) using fixed-effects and robust standard errors corrected using White (1980)'s method. The results are reported in Table 3. Panel (a) uses the forecasts for the current year to form the interquartile range. Panel (b) presents the estimates using the forecasts for the following calendar year to calculate the dependent variable.

Looking at the results using the forecasts with horizons that are probably below monetary policy's control lag in most countries (forecasts for the current year in panel (a)), we find that IT has the effect of decreasing the dispersion across inflation expectations, but that this effect is not statistically significant when controls are included in the regression. The coefficient on the control for the level of inflation has the expected sign, as an increase in the level of inflation increases the dispersion across forecasters, and is marginally significant (it is significant at 11 percent). The effect of disinflation periods has a negative sign, which means that disinflation periods are associated with smaller coefficients of variation, but is not significant. The control for global inflation has a positive sign, as expected, but is not significant either. According to the t-statistics for each variable, only the level of inflation is

[22] The estimated disinflation periods are as follows: for Argentina, Jan-90 to Jul-96 and Oct-02 to Feb-04. For Brazil, May-90 to Dec-91, Mar-94 to Dec-98 and May-03 to Aug-04. For Canada, Apr-91 to Jul-92 and Jan-03 to Mar-04. For Chile, Jul-90 to Dec-99 and Mar-03 to Apr-04. For Colombia, Mar-91 to Oct-03 and Feb-98 to Aug-02. For Hong Kong, Jan-95 to Dec-99. For Indonesia, Sep-95 to Feb-97, Oct-98 to Feb-00 and Dec-01 to May-04. For Italy, Oct-95 to Nov-97. For Japan, Jan-91 to Aug-95 and Aug-97 to Oct-03. For Malaysia, Aug-98 to Aug-01. For Mexico, Nov-90 to Jun-94, Nov-95 to May-98 and May-99 to May-02. For the Netherlands, Nov-91 to Jan-93 and Jul-01 to Jul-04. For Norway, Dec-00 to May-02. For Peru, Dec-90 to Dec-95, Jul-96 to Sep-99 and May-00 to Mar-02. For South Korea, May-98 to Jul-99. For Spain, Dec-94 to Oct-97. For Sweden, Jan-95 to Dec-96 and Dec-97 to Dec-98. For Thailand, Mar-98 to Oct-99. For United Kingdom, Feb-91 to Aug-94. For Venezuela, Dec-94 to Jul-95, Sep-96 to Jul-01 and Mar-03 to May-06. The countries not mentioned do not have disinflation periods according to the implemented methodology.

able to explain the dispersion of inflation expectations in the short run.

Using the forecasts for the following year (panel (b)), the effect of inflation targeting is significant at 5 percent. As expected, IT reduces the dispersion of inflation expectations in the sample. The effect is large but decreases when we include more controls, although it remains significant. In addition, we can see that during disinflation periods the dispersion across forecasters also decreases. The other controls are significant and with the same signs as when using current year forecasts. In general, it appears that inflation targeting seems to reduce the dispersion of expectations with horizons ranging from one to two years.

We performed a series of robustness checks. The results are qualitatively the same when we estimate regression (9) using the first date of IT implementation (that affects Chile, Mexico and Peru) instead of the second date, but with a smaller effect of inflation targeting. In addition, and as is the case for the difference-in-differences estimator, the qualitative results prevail when we exclude Brazil and Argentina from the sample. We also did the regressions using time-effects instead of the variable global inflation, and the results are robust to this change. As another check, we used an estimate of the conditional variance of inflation using the best AR(12)-GARCH(1,1) model (Bollerslev, 1986) selected by the Schwarz criterion for each country. We used the variable as a control instead of the level of inflation. The results are, again, qualitatively the same. Finally, we estimated the regression with the controls but pooling the data and applying panel-corrected standard errors, including a correction for AR(1) errors for each country. The results remain unaltered, but the coefficients are of a smaller magnitude.[23]

3.3 Effect on developed countries

To our knowledge, the only evidence so far about the effect of IT on the dispersion of inflation expectations is provided by Johnson (2002). Using a panel of 11 developed countries, he reports that the dispersion, measured as the standard deviation across forecasters, falls in the 1990s in all countries, targeters and non-targeters, but that once the effect of the level of inflation, that also falls in all countries, is taken into account: "... there is little or no additional reduction in the dispersion of inflation forecasts associated with the period after the announcement of the inflation targets" (Johnson, 2002, p. 1537). Therefore, it is interesting to see if our result is driven by what happens with developing economies, as would seem the case with other benefits associated with inflation targeting (e.g., Gonçalves and Salles, forthcoming).

In order to separate the results for industrial countries and for emerging economies, we

[23] The results are available from the authors upon request.

use a dummy variable that takes the value of one for industrial countries and zero otherwise, and interact it with the dummy for inflation targeting and with the other independent variables (the controls). We re-estimate equation (9) including the interactions. The results are presented in the last column of panels (a) and (b) of Table 3.

For the current year forecasts none of the interactions is statistically different from zero, indicating that there is not a differentiated effect in the short-run. However, all the interactions are significant for forecasts for the following year, which indicates that the dynamics of the dispersion is very different between developed and developing countries in the long-run. In particular, the coefficient associated with the dummy for inflation targeting, that now captures the effect on developing countries from Latin America and from Asia, is negative, large (i.e., larger than the estimated coefficient using the full sample) and statistically significant. The coefficient on the interaction between industrial countries and the IT dummy has a positive sign. To calculate the total effect of IT on industrial countries we add this coefficient and the one of the IT dummy, and test the hypothesis that the sum is equal to zero. We find that the sum, 0.01, is positive but is not significantly different from zero. Therefore, there appears to be no effect of IT on the dispersion of long-run expectations in developed countries. In addition, the effect of all the other variables increases (in absolute value) or remains the same for developing countries, and decreases (in absolute value) for industrial countries. In particular, the effect of disinflations changes its sign in industrial countries (is 0.06 and it is statistically significant).

Overall, the results from this exercise suggest that: (i) the dynamics of the dispersion of long-run expectations across forecasters is different in developing countries compared to developed countries; (ii) the effect of IT on the dispersion of inflation expectations is driven by what happens in emerging economies; and (ii) IT seems not to affect the dispersion of long-run expectations in developed countries.

4 Discussion and Implications of the Results

In this paper we find that, controlling for other factors, the dispersion of long-run inflation expectations appears to be lower under inflation targeting regimes than in non-inflation targeting ones, which would validate the prediction of our model. This is remarkable given the strong assumptions under which we derived the theoretical results, but it reflects the capacity of inflation targeting to focalize inflation expectations. It is interesting that IT seems to provide a focal point even though some countries have as an inflation target a range and not a point (e.g., Chile and Colombia).

When we separate the effects between developed and developing countries, we find that our result seems to be driven by the latter and, in line with Johnson (2002), that there seems to be no effect of IT on the dispersion of long-run expectations in developed countries. This could be because focalizing inflation expectations is more important in countries which have experienced high and variable inflation in the past, and is less so in countries in which the transition to an inflation targeting regime may have only formalized an implicit target that was already maintaining a relatively low dispersion of inflation expectations. In this respect, it is likely that the cost-benefit ratio of adopting an explicit target would be lower for emerging countries with respect to developed ones, as the benefits of anchoring expectations could be greater than the costs of "tying their hands" with an explicit target (in fact, the discipline may even be beneficial).[24]

The lack of an effect of IT on the dispersion of long-run inflation expectations in developed countries could be related to the use of data from professional forecasters. Given the relative stability of inflation in those countries, professional forecasters may have an homogeneous view about the future developments of inflation in developed countries. Therefore the dispersion may remain almost unaltered when an explicit inflation target is introduced. However, this need not be the case for expectations of other agents, for instance consumers or unions. It still could be the case that the dispersion across inflation expectations for those agents experiences a reduction after the introduction of a focal point such as an explicit inflation target. This is an interesting topic for future research. An effect in developed countries could also be present in forecasts from professional forecasters, but with larger forecast horizons (i.e., more than two years).

We have documented that IT can reduce the dispersion of inflation expectations. This effect can, in turn, affect other macroeconomic variables, illustrating that indeed, the effect on inflation expectations could be the channel through which IT may affect the economy. Perhaps the most important direct effect is that, if the real costs of nominal movements in the economy are related to the dispersion of inflation expectations (Lucas, 1972; Phelps, 1970), having less disperse expectations, for a given level of inflation, may reduce the real costs of disinflations. Less disperse expectations may also reduce the variance in relative prices, which in turn can reduce the level of inflation (Ball and Mankiw, 1995). Firms and individuals may also rely more on expected inflation (the target) to set prices, which could make inflation less persistent (Orphanides and Williams, 2005). In addition, more agents are using the optimal forecast (the target), so the forecast errors and the costs incurred by decisions based on those forecasts may also decrease.

[24] Since the use of an explicit target imposes and extra restriction that the central bank has to fulfill, there is an important trade-off associated with inflation targeting in terms of flexibility. There is another trade-off with respect to the optimal degree of transparency, recently put forward by Walsh (2007).

Finally, the fall in the dispersion of inflation expectations may enhance the effectiveness of the expectations channel of monetary transmission. If this is the case, considering that this mechanism has a smaller control lag than other mechanisms, the central bank has greater flexibility to conduct monetary policy. If the central bank can exert at least some control over inflation expectations, as seems to be the case under IT, then expectations also become a monetary policy instrument.

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Appendix

Flexible inflation targeting

If the central bank is a flexible inflation targeter, then its objective in period t is to choose a sequence of current and future instruments $\{i_\tau\}_{\tau=t}^{\infty}$ to solve:

$$\min_{\{i_\tau\}_{\tau=t}^{\infty}} E\left[\sum_{\tau=t}^{\infty} \delta^{\tau-t}\frac{1}{2}\left[\left(\pi_\tau-\pi^T\right)^2+\lambda y_\tau^2\right] \mid \Omega_t\right],$$

where $\lambda > 0$ is the relative weight on output stabilization, and y_t is the output gap. As is the case for the strict inflation targeter, the central bank can find the optimal instrument in period t as the solution to the simple period-by-period problem:

$$\min_{i_t} E\left[\delta^l\frac{1}{2}\left[\left(\pi_{t+2}-\pi^T\right)^2+\lambda y_{t+1}^2\right] \mid \Omega_t\right],$$

where we have assumed that the control lag for the output gap is smaller than for inflation (Svensson, 1997).

The first order condition, using the notation $E[\cdot \mid \Omega_t] = E_t[\cdot]$ is:

$$E_t[\pi_{t+2}] = \pi^T - \frac{\lambda\frac{\partial y_{t+1}}{\partial i_t}}{\frac{\partial \pi_{t+2}}{\partial i_t}} E_t[y_{t+1}],$$

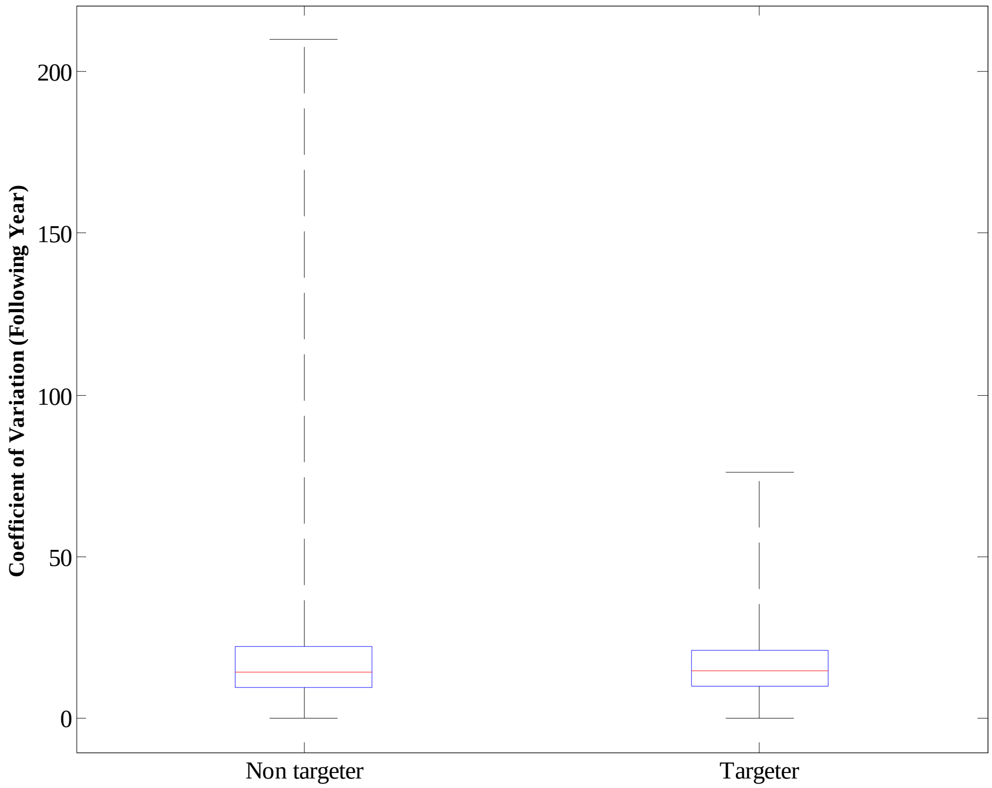
where the expectations are evaluated at i_t^*, the optimal instrument, and we have assumed that integration and differentiation can be interchanged. In this case the central bank sets its instrument to make the conditional expected value of inflation equal to the target only if the expected output gap is equal to zero. Otherwise the inflation forecast should differ from the inflation target in a proportion of the expected output gap. The proportion increases with the weight attached to output in the central bank's loss function and with the marginal effect of the interest rate on the output gap. The proportion decreases with the marginal effect of the interest rate on inflation.

In contrast to the case of a strict inflation targeter ($\lambda = 0$), a flexible targeter has considerations for output and this is reflected in its inflation forecasts. In this case the forecast of the central bank is equal to the target only when the expected output gap is zero. The agents in this economy would need to consider forecasts of the output gap and, typically, estimates of λ in order to calculate their inflation forecasts. These are extra sources of uncertainty and will likely generate some dispersion across forecasters. Yet, this dispersion should still be smaller than the one induced by other sensible monetary policies as, on average, the inflation target is a good forecast of inflation:

$$
\begin{aligned}
E\left[E_t\left[\pi_{t+2}\right]\right] &= E\left[\pi^T - \frac{\lambda \frac{\partial y_{t+1}}{\partial i_t}}{\frac{\partial \pi_{t+2}}{\partial i_t}} E_t\left[y_{t+1}\right]\right], \\
E\left[\pi_{t+2}\right] &= \pi^T - \frac{\lambda \frac{\partial y_{t+1}}{\partial i_t}}{\frac{\partial \pi_{t+2}}{\partial i_t}} 0, \\
&= \pi^T,
\end{aligned}
$$

where the first step follows from the application of the Law of Iterated Expectations, and the second from the fact that the unconditional mean of the output gap is zero.

Figure 1. Box plots of Coefficients of Variation [1/]
(1989:10 - 2006:11) [2/]



1/ Coefficients of variation were calculated as the interquartile range across forecasters divided by the absolute value of the median using monthly forecasts for next year inflation. The box-plot for non-targeters includes data from: Argentina, France, Germany, Indonesia, Italy, Malaysia, the Netherlands, the United States and Venezuela, and data from targeting countries before they implemented inflation targeting. The box-plot for targeters includes data from: Australia, Brazil, Canada, Chile, Colombia, Mexico, Norway, Peru, South Korea, Spain from 1995 to 1999, Sweden, Switzerland, Thailand and United Kingdom, after they implemented inflation targeting..

2/ Although the maximum value for the coefficient of variation encompassed by the whiskers is 250, there are 5 observations for the non-targeters not included in the figure, with a maximum value of 800.

Source: Data from Consensus Forecasts.

Table 1. Coefficients of Variation Data[1/]

Country	IT Adoption Date	Forecasts for Current Year			Forecasts for Following Year		
		Initial cv	Final cv	Change	Initial cv	Final cv	Change
Brazil	Jul-99	32.60	7.69	-24.91	80.94	13.41	-67.53
Chile	Sep-99	4.66	11.35	6.70	10.67	8.05	-2.62
Colombia	Sep-99	5.70	6.66	0.95	9.01	10.43	1.42
Mexico	Feb-01	5.37	6.64	1.27	14.66	12.41	-2.25
Peru	Jan-02	14.35	16.65	2.30	18.94	15.15	-3.79
Canada	Feb-91	3.80	12.73	8.93	8.34	16.95	8.61
Norway	Mar-01	3.62	14.97	11.35	7.98	13.19	5.21
Switzerland	Jan-00	21.89	18.31	-3.59	17.83	26.17	8.33
United Kingdom	Oct-92	4.50	7.93	3.43	15.47	15.73	0.26
Australia	Jun-93	0.17	0.12	-0.05	0.24	0.19	-0.05
Thailand	Jan-00	24.42	20.36	-4.07	21.41	26.49	5.08
South Korea	Apr-98	8.33	14.44	6.11	12.69	21.02	8.33
Targeters Mean	**Mar-98**	**10.78**	**11.49**	**0.70**	**18.18**	**14.93**	**-3.25**
Argentina		34.44	67.52	33.08	28.89	59.16	30.27
Venezuela		11.49	14.55	3.06	27.44	29.70	2.26
France		6.48	11.55	5.07	9.41	13.78	4.36
Germany		5.41	12.51	7.10	11.92	22.75	10.84
Italy		4.13	5.40	1.28	9.74	11.10	1.36
Netherlands		5.71	7.28	1.57	6.05	15.48	9.43
United States		5.99	7.71	1.72	13.03	18.83	5.80
Indonesia		9.46	14.97	5.51	15.73	25.56	9.83
Malaysia		9.69	18.16	8.46	13.19	26.66	13.47
Non-targeters Mean		**10.31**	**17.74**	**7.43**	**15.05**	**24.78**	**9.74**

1/ Spain and Sweden are excluded because the data on inflation forecasts per forecaster is compiled after the implementation of an inflation target. Hong Kong, Japan, and Singapore are excluded due to the many periods in which the median inflation forecast reported was close to zero.

Table 2. "Difference-in-Differences" Regression[1/]

Dependent Variable: Change in Coefficient of Variation [2/]								
	Forecasts for Current Year				Forecasts for Following Year			
c	7.43 **	8.50 **	4.5	4.67	9.74 ***	22.42 ***	6.38	6.05
	(3.29)	(3.74)	(3.44)	(2.87)	(2.88)	(4.42)	(4.53)	(4.60)
dit	-7.14	-6.94	-4.86	-4.89	-13.41 *	-9.10 *	-7.56 **	-7.63 **
	(4.29)	(4.92)	(3.44)	(3.44)	(6.67)	(5.19)	(3.15)	(3.06)
initial cv		-0.1	0.29	0.29		-0.84 ***	0.24	0.28
		(0.52)	(0.42)	(0.42)		(0.20)	(0.41)	(0.40)
change in var			0.16 ***				0.40 ***	
			(0.05)				(0.13)	
change in inf				0.04 ***				0.10 ***
				(0.01)				(0.03)
Number of Observations	21	21	21	21	21	21	21	21
R^2	0.13	0.14	0.53	0.53	0.15	0.69	0.87	0.88

* p < 0.10. ** p<0.05. *** p < 0.01.
1/ Sample of countries as in Table 1.
2/ White heteroskedasticity-consistent standard errors in parentheses.

Table 3. Results from Fixed Effects Estimation for all Countries[1/]

a) Forecasts for Current Year

Dependent Variable: Interquartile Range [/2]				
intercept	0.70 (0.61)	-0.08 (0.85)	0.61 (1.05)	0.05 (0.79)
dit [/3]	-11.34 * (6.92)	-1.62 (1.92)	-2.14 (2.32)	-2.95 (3.88)
inflation		0.15 (0.09)	0.15 (0.09)	0.15 (0.09)
ddis			-2.74 (3.33)	-5.69 (6.59)
dit*d_industrial				2.97 (3.88)
inflation*d_industrial				-0.14 (0.09)
ddis*d_industrial				5.72 (6.59)
worldinf*d_industrial				-0.61 (0.44)
world inflation [4/]	0.73 (0.48)	0.11 (0.09)	0.13 (0.10)	0.61 (0.44)
Number of observations	3678	3665	3665	3665
R^2	0.01	0.30	0.30	0.30

b) Forecasts for Following Year

Dependent Variable: Interquartile Range [2]				
intercept	2.81 **	2.13 **	3.13 **	2.52 **
	(1.12)	(0.86)	(1.31)	(1.13)
dit [3]	-14.39 ***	-5.88 **	-6.63 **	-11.37 **
	(5.02)	(2.47)	(2.81)	(4.97)
inflation		0.13 ***	0.13 ***	0.13 ***
		(0.04)	(0.04)	(0.04)
ddis			-3.95 **	-8.98 **
			(1.96)	(4.22)
dit*d_industrial				11.36 **
				(4.97)
inflation*d_industrial				-0.13 ***
				(0.04)
ddis*d_industrial				9.04 **
				(4.22)
worldinf*d_industrial				-0.62 **
				(0.28)
world inflation [4/]	0.66 ***	0.12 **	0.15 **	0.62 **
	(0.22)	(0.06)	(0.07)	(0.28)
Number of observations	3678	3665	3665	3665
R^2	0.01	0.54	0.54	0.54

* p < 0.10. ** p<0.05. *** p < 0.01.
1/ White heteroskedasticity-consistent standard errors in parentheses.
2/ The countries used are: Argentina, Brazil, Canada, Chile, Colombia, France, Germany, Hong Kong, Indonesia, Italy, Japan, Malaysia, Mexico, the Netherlands, Norway, Peru, Singapore, South Korea, Spain, Sweden, Switzerland, Thailand, the United Kingdom, the United States and Venezuela. Australia is missing because the inflation figures are quarterly.
3/ For Chile, México and Peru, second dates of IT implementation are used. For Chile, the second date is September 1999, for Mexico February 2001 and for Peru, January 2002.
4/ World average inflation rate as reported in the IFS series.