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THE NEXUS BETWEEN INFLATION TARGETING AND EXCHANGE RATE VOLATILITY

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Abstract

This study empirically examines the issue on whether countries that target inflation systematically experience higher exchange rate volatility. A major challenge that immediately confronts such analysis is that countries do not choose their monetary regimes in a random fashion. In this paper, an attempt is made to take into account the problem of self-selection in the countries' decision to target inflation via a treatment effect regression that estimates jointly the probability of being an inflation targeter and the outcome equation. The analysis indicates that nominal and real exchange rate volatility are both lower in inflation targeting countries than countries that do not target inflation. More importantly, the analysis also suggest that developing countries that target inflation have lower nominal and real exchange rate volatility than non-inflation targeting developing countries. In the case, of inflation targeting industrial countries, however, it is found to be higher.

Keywords: inflation targeting; treatment effects model; exchange rate volatility; sample selection bias; industrial countries; developing countries

JEL Code: E4, E5, F02, F3, F4

1. Introduction

Since the early 1990s, a steadily growing number of developed and developing countries have opted to follow New Zealand's lead in the adoption of inflation targeting. This increasing popularity of inflation targeting as a framework of monetary policy comes in the face of a widely perceived inability, on the part of these countries, to successfully implement alternative forms of monetary policy strategies. For instance, the apparent instability in money demand in the eighties has rendered money base targeting infeasible for most developed countries. Subsequently, in the nineties, the unwillingness on the part of most developing countries to subordinate an independent monetary policy to the objective of a soft exchange rate peg has made such pegging arrangements fragile in the presence of a liberal regime in capital movements.[2]

It is commonly believed that being a domestically-oriented framework of monetary policy, inflation targeting regards price stability as the primary goal for the central bank. This would imply that inflation targeting mandates a benign neglect of the exchange rate, and if true, the economy has to tolerate substantially higher exchange rate volatility. However, the observation that countries display 'fear of floating' implies that countries, most especially developing countries, have limited abilities to allow volatility in their exchange rates since in the presence of large stocks of unhedged foreign currency denominated debt, exchange rate changes can have deleterious effects on their financial and corporate sectors.[3]

It is surprising, however, that there have been very few studies that examine exchange rate volatility under inflation targeting regime. Perhaps, as a reflection of the domestically-oriented focus of inflation targeting, the domestic macroeconomic performance under inflation targeting has attracted the most attention to date in empirical studies.[4] Two notable exceptions that serve as the closest antecedent to the current work are the studies of Rose (2007) and Lin (forthcoming). Using OLS regressions, Rose (2007) shows that nominal and real exchange rate volatility is typically lower for inflation targeting countries than for non-inflation targeters. By contrast, Lin (forthcoming) addresses the self-selection issue in the countries' policy decision to target inflation. In order to accomplish this, Lin (forthcoming) uses a matching (propensity score) technique and finds significant evidence that both nominal and real exchange rate volatilities are reduced in developing countries that target inflation. However, they are found to be higher for developed countries that target inflation.

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[2] This, of course, acknowledges the fact that other countries such as the euro zone or Panama have opted for harder peg arrangements.

[3] See, for instance, Eichengreen and Hausmann (1999), Hausmann (1999).

[4] The general conclusion coming out of this literature is that inflation targeting is associated with an improvement in overall domestic macroeconomic variables, i.e., lower inflation and volatility, decline in interest rates, and improvement in output volatility (Mishkin and Schmidt-Hebbel, 2007). For a dissenting view see Ball and Sheridan (2005).

In this paper, the issue of whether countries that target inflation systematically experience higher exchange rate volatility is examined, taking into account at the same time, the problem of self-selection in the countries' decision to target inflation. The analysis conducted in this paper, however, uses an alternative approach in tackling the issue of self-selection bias. A treatment effect regression technique frequently applied in the labour economics literature is employed instead. This technique allows one to estimate jointly the probability of being an inflation targeter and the effect of inflation targeting on real and nominal exchange rate volatilities. Using this empirical approach, I find significant and robust evidence that is consistent with the earlier relevant findings. Indeed, nominal and real exchange rate volatilities are both lower in inflation targeting countries than countries that do not target inflation; and, more importantly, developing countries that target inflation have lower nominal and real exchange volatilities than similar groups of countries that do not target inflation. In the case of inflation targeting industrial countries, however, it is found to be higher. The rest of the paper is organised as follows. Section 2 describes the methodology by proposing the use of a treatment effects framework in order to account for self-selection bias in the decision to target inflation. The results using the treatment effect regression are analysed in Section 3, while Section 4 briefly concludes.

2. Methodology

2.1 The Treatment Problem and Selection Bias

Countries can choose to target inflation (denoted as D_1) or not (denoted as D_0). By convention, we define those countries that choose D_1 as the "treatment group" while those countries that opt for D_0 as the "control group". This binary representation of monetary policy regime choice leads to two potential outcomes which for the purpose of this paper, is defined in terms of an appropriate measure of exchange rate volatility (denoted as *vol*) – vol_0 if D_0 is chosen and vol_1 if D_1 is chosen. From a programme evaluation perspective, we are interested in the difference called the treatment effect ($vol_1 - vol_0$) – what would exchange rate volatility have been had the alternative monetary policy regime been chosen.

However, for a group of countries, we observe only one of these two outcomes (either vol_1 or vol_0 is observed, but not both). To be more precise, exchange rate volatility in countries that have chosen to target inflation if they had instead adopted other monetary policy regimes, are not observable while the exchange rate volatility in those countries that have adopted non-inflation targeting regimes if they had instead targeted inflation are not observable either. Thus, comparing exchange rate volatility between those countries that have chosen to target inflation as their monetary policy regime and those countries that have adopted non-inflation targeting regimes is not straightforward. This obviously raises the question of how to estimate the treatment effect when only one outcome of interest is observed.

If a country's choice of monetary policy regime is random, the simplest approach is to compare the mean outcomes of countries choosing D_1 (treatment group) with those countries choosing D_0 (control group). However, this approach would generate biased estimates of the treatment effect as countries do not choose their monetary policy regimes in a random fashion. One can argue that a number of characteristics of the economic environment where countries operate are likely to make it more attractive for countries to target inflation. Furthermore, some of the characteristics of countries that affect the likelihood of targeting inflation also affect exchange rate volatility which cannot be observed by the researcher. In order to model the endogeneity of the inflation targeting decision, we apply a treatment effects model, to which we next turn to.

2.2 Treatment Effects Model

In order to analyse the conditional effect of inflation targeting on exchange rate volatility, two equations are estimated jointly, the outcome equation and the probability of being an inflation targeter. The empirical specification is given by equations (1)-(3):

$$vol_{i,t} = x_{i,t}\beta + \gamma D_{i,t} + \mu_{i,t} \quad (1)$$

$$D_{i,t} = \begin{cases} 1, & \text{if } D^{*}_{i,t} > 0 \\ 0, & \text{otherwise} \end{cases} \quad (2)$$

$$D^{*}_{i,t} = z_{i,t}\alpha + \varepsilon_{i,t} \quad (3)$$

Equation (1) is the outcome equation which models an appropriate measure of exchange rate volatility for country i at time t ($vol_{i,t}$) as a function of a vector of covariates $x_{i,t}$, including the dummy variable $D_{i,t}$, (the treatment variable) that takes a value of one if country i at time t chooses to target inflation, and zero otherwise. $\mu_{i,t}$ is a random error term, β and γ are parameters to be estimated. The inflation targeting dummy is an endogenous binary variable that depends on the realisation of an unobserved latent variable $D^{*}_{i,t}$, as described in equation (2). This latent variable depends linearly on vector $z_{i,t}$, some of which, but not all, may be the same included in the vector of covariates $x_{i,t}$ in equation (1). α is a vector of parameters to be estimated, $\varepsilon_{i,t}$ is an error term.

The above model is a generalisation of the Heckman (1979) bivariate selection model to the treatment effects context and can be estimated based on a full information maximum-likelihood (FIML) approach. This is also the approach that I take in this paper. It is assumed in the full information maximum-likelihood estimation that the error terms in both the outcome and the inflation targeting decision equations are jointly normally distributed. In the estimation, I also impose a number of exclusionary restrictions – some variables in vector $z_{i,t}$ are not included in vector $x_{i,t}$. As a robustness check, I also estimated the above model using the instrumental variable treatment procedure suggested by Wooldridge (2002), in order to deal with possible endogeneity problems.

3. Data and Estimation Results

The sample consist of the same set of annual observations of 22 industrial and 52 developing countries that Rose (2007) and Lin (forthcoming) examined over the period 1985 to 2005.[5] The data were drawn from the International Monetary Fund's International Financial Statistics, the World Bank's World Development Indicators and from Reinhart and Rogoff (2004, 2009) for the data on de facto exchange rate flexibility. Following Rose (2007) and Lin (forthcoming), the treatment group consist of ten industrial and thirteen developing countries that have adopted inflation targeting during the period of observation.[6] The control group, on the other hand, consist of all non-targeting major industrial countries and a set of non-targeting developing countries.[7] For exposition purposes, the starting years of inflation targeting for 23 countries as well as the countries that were included in the control group as provided by Rose (2007) are listed in Tables 1 and 2, respectively.[8]

[5] It should be noted that in contrast to Lin (forthcoming), the Rose (2007) study covered the period from 1990 to 2005.

[6] As noted by Lin (forthcoming), the two inflation targeters, Finland and Spain, adopted the euro in 1999. Indonesia, Romania, and Slovak Republic adopted inflation targeting in 2005, but were treated in the sample as non-inflation targeters.

[7] Based on Rose (2007) and Lin (forthcoming), non-targeting developing countries that have a real GDP per capita at least as large as that of the poorest inflation targeting developing country and with a population size at least as big as that of the smallest inflation targeting developing country are included in the control group to ensure that the treatment and control groups are reasonably comparable.

[8] It is to be noted that in Table 1, a default and a conservative starting year for each inflation targeting country is indicated.

Table 1
Inflation Targeting Countries and Starting Years

Industrial Countries	Default Starting Year	Conservative Starting Year
Australia	1993	1994
Canada	1991	1992
Finland	1993	1994
Iceland	2001	2001
New Zealand	1990	1990
Norway	2001	2001
Spain	1995	1995
Sweden	1993	1995
Switzerland	2000	2000
United Kingdom	1992	1992

Developing Countries	Default Starting Year	Conservative Starting Year
Brazil	1999	1999
Chile	1991	1999
Colombia	1999	1999
Czech Republic	1998	1998
Hungary	2001	2001
Israel	1992	1997
Korea	1998	1998
Mexico	1999	2001
Peru	2002	2002
Philippines	2002	2002
Poland	1998	1998
South Africa	2000	2000
Thailand	2000	2000

Source: Rose (2007), Lin (forthcoming).

Table 2
Control Group Countries

Industrial Countries		
Austria	Germany	Japan
Belgium	Greece	Netherlands
Denmark	Ireland	Portugal
France	Italy	United States
Developing Countries		
Algeria	Hong Kong, China	Paraguay
Argentina	Indonesia	Romania
Belarus	Iran	Russia
Bulgaria	Jamaica	Singapore
Cape Verde	Jordan	Slovakia
China	Kazakhstan	Slovenia
Costa Rica	Latvia	Syria
Croatia	Lebanon	Trinidad & Tobago
Dominican Republic	Lithuania	Tunisia
Egypt	Macao, China	Turkey
Estonia	Macedonia	Ukraine
Georgia	Mauritius	Uruguay
Guatemala	Morocco	Venezuela

Source: Rose (2007), Lin (forthcoming).

Both nominal and real measures of multilateral (effective) exchange rates were used to arrive at a measure of exchange rate volatility. Natural logarithms of the effective exchange rates were taken and the standard deviations were computed for each country over an interval of 12 monthly observations for each year. As earlier stated, the dependent variable in the outcome equation (1) is the standard deviation of nominal (real) effective exchange rates. In specifying the outcome equation, the following covariates were included: per capita GDP growth as a measure of the level of development; ratio of trade to GDP as an index of openness to trade; log of GDP taken as a measure of the country's economic size; and the ratio of current account to GDP as an index to capture the degree of external sustainability. One can then view the inclusion of the first three variables as standard optimal currency area (OCA) variables typically encountered in empirical studies of exchange rate volatility across countries.[9]

In specifying the treatment equation (3) on the probability of being an inflation targeter, I drew on the literature which emphasised that inflation targeting should be adopted only after some preconditions are met.[10] Based on this perspective, the following covariates were included: (i) lagged inflation rate, (ii) broad money growth, and (iii) per capita GDP growth. An index of de facto exchange rate flexibility was also included from Reinhart and Rogoff (2004, 2009) to capture the presence (or not) of an exchange rate anchor.[11] In some specifications I also included the government's fiscal position as a share of GDP.

In Tables 3 to 5, the basic results obtained from the estimation of a number of treatment effect models for exchange rate volatility are summarised. In particular, Table 3 presents the results for the pooled sample of industrial and developing countries while Tables 4 and 5 show the results for the split samples of industrial and developing countries, respectively. Each table contains two panels. The upper panel contains the results for the outcome equation while the lower panel contains the estimates for the treatment equation, or the probability of being an inflation targeter. As pointed out above, the treatment observations correspond to those countries which chose to target inflation, and the control group is comprised of all countries that did not decide to target inflation over the course of the period of analysis. In addition, the first three columns of each table are the results using the volatility of the nominal effective exchange rate; while the last three columns are the results using the volatility of the real effective exchange rate.

The results for the probability of being an inflation targeter are presented in the lower panels of Tables 3-5. Most coefficients are statistically significant at conventional levels and in such cases, the results indicate that the probability of choosing to target inflation is higher for countries with lower (lagged) inflation rate, a weak fiscal position, the absence of a fixed exchange rate anchor, lower

[9] See, for instance, the studies of Bayoumi and Eichengreen (1998), Hausmann et al. (2001) and Devereux and Lane (2003).
[10] See, for instance, Truman (2003) and Lin (forthcoming).
[11] It should be noted at this point that Reinhart and Rogoff's (2004, 2009) index of de facto exchange rate flexibility entails several degrees of flexibility from 1 (less flexible exchange rate regime) to 15 (more flexible exchange rate regime).

broad money growth,[12] and a lower per capita growth. The results from the estimation of the outcome equation that pertains to the volatility of the effective exchange rate are reported in the upper panels of Tables 3-5. Likewise, most of the coefficients are statistically significant at conventional levels. The results indicate that lower per capita GDP growth, bigger countries, a low openness to trade, and a strong current account position have tended to exhibit a higher degree of exchange rate volatility.[13]

More importantly for the stated objective of this paper, as shown in Table 3 which pertains to the complete sample examined in this paper, the coefficient of the inflation targeting treatment variable is always significantly negative, indicating that inflation targeting countries have experienced a lower degree of nominal (real) effective exchange rate volatility than countries that adopted non-inflation targeting monetary regimes.[14] On further investigation of whether the effects of inflation targeting on exchange rate volatility have different effects on industrial and developing countries, one result was prominent and striking – the coefficient of the inflation targeting treatment variable is always significant but have opposite signs in the two country groups.[15]

To be more exact, as reported in Table 4, the coefficient of the inflation targeting treatment variable in industrial countries, is always significantly positive which indicates that inflation targeting industrial countries have experienced a higher degree of nominal (real) effective exchange rate volatility than non-inflation targeting industrial countries. This is in contrast to the case of developing countries where the coefficient of the inflation targeting treatment variable is always significantly negative (see Table 5), i.e., inflation targeting developing countries have experienced a lower degree of nominal (real) effective exchange rate volatility than non-inflation targeting developing countries.

3.1 Robustness Tests

A particularly important question is whether the main results reported in Tables 3, 4 and 5 are robust. A number of robustness checks were conducted to address this issue. First, Rose's (2007) conservative starting years of inflation targeting was used. Second, as in Rose (2007), the period of examination was from 1990 to 2005. Third, the Chinn-Ito (2008) measure of financial openness was included as an additional explanatory variable in the outcome equation. Fourth, the log population was used instead of log gdp as a measure of economic size. Finally, an IV instrumental variable (IV) version of the treatment regression approach was estimated to deal with potential endogeneity. The results for these sets of robustness tests are reported in Table 6.

[12] There is some evidence, however, in the particular case of industrial countries that lower broad money growth actually lowers the probability of choosing to target inflation (see columns 4.1 and 4.2).

[13] It is interesting to note that Devereux and Lane (2003) also arrived at similar conclusions as far as the three OCA variables included in this study.

[14] Rose (2007) also found similar results.

[15] This is also consistent with evidence obtained by Lin (forthcoming).

Table 3
Treatment Effects Regression Results Using the Pooled Sample

	NEER Volatility			REER Volatility		
	spec. 1	spec. 2	spec. 3	spec. 4	spec. 5	spec. 6
			A. Outcome equations			
Per capita GDP growth	-0.004 (6.48)***	-0.006 (9.04)***	-0.007 (7.63)***	-0.004 (8.09)***	-0.004 (7.93)***	-0.004 (7.04)***
Openness	-0.000 (1.00)	-0.000 (0.92)	–	-0.000 (1.94)*	-0.000 (2.08)**	–
Current Account to GDP	–	0.001 (1.32)	0.000 (0.26)	–	0.000 (1.25)***	0.000 (0.44)
Log of GDP	0.003 (16.33)***	0.003 (16.97)***	0.003 (15.71)***	0.003 (16.66)***	0.003 (16.36)***	0.002 (16.18)***
IT Dummy	-0.082 (12.45)***	-0.073 (11.18)***	-0.061 (9.08)***	-0.046 (7.89)***	-0.046 (7.76)***	-0.028 (5.85)***
			B. Treatment equations			
Lagged Inflation rate	-0.071 (8.18)***	-0.070 (7.29)***	-0.143 (10.08)***	-0.070 (6.50)***	-0.069 (6.29)***	-0.170 (7.56)***
Fiscal Surplus/Deficit to GDP	–	–	-0.040 (2.30)**	–	–	-0.057 (2.79)**
Index of exchange rate flexibility	0.019 (2.14)**	0.028 (3.10)***	0.076 (5.57)***	0.031 (3.15)**	0.033 (3.32)***	0.095 (5.76)***
Broad money growth	-0.017 (4.64)***	-0.018 (4.60)***	-0.009 (2.37)**	-0.021 (5.55)***	-0.021 (5.50)***	-0.010 (2.00)**
Per capita GDP growth	0.017 (1.18)	-0.008 (0.47)	-0.035 (1.60)	-0.010 (0.59)	-0.011 (0.64)	-0.045 (1.76)*
N	501	471	251	480	463	251
ath(Rho)	1.077***	0.979***	1.374***	0.678***	0.682***	0.960***
ln sigma	-2.761***	-2.841***	-2.955***	-3.123***	-3.118***	-3.468***
Wald χ^2	439.63	469.56	254.32	469.07	449.44	312.98
Prob > χ^2	0.00	0.00	0.00	0.00	0.00	0.00

NOTES: Absolute value of z statistics in parentheses. All equations were estimated using a maximum likelihood procedure. * significant at 10%, ** significant at 5%, *** significant at 1%.
spec. stands for the treatment effect model specification used.

Table 4
Treatment Effects Regression Results Using the Industrial Countries Sample

	NEER Volatility			REER Volatility		
	spec. 1	spec. 2	spec. 3	spec. 4	spec. 5	spec. 6
			A. Outcome equations			
Per capita GDP growth	-0.001 (0.72)	-0.001 (0.82)	0.000 (0.31)	-0.001 (0.56)	-0.001 (0.59)	0.001 (0.47)
Openness	-0.000 (4.65)***	-0.000 (3.84)***	–	-0.000 (2.91)***	-0.000 (2.49)***	–
Current Account to GDP	–	-0.000 (0.55)	-0.000 (1.16)	–	-0.000 (0.21)	-0.000 (1.11)
Log of GDP	0.001 (5.46)***	0.001 (5.07)***	-0.000 (0.19)	0.001 (3.88)***	0.001 (3.72)***	-0.000 (0.41)
IT Dummy	0.028 (4.68)***	0.028 (4.98)***	0.030 (9.03)***	0.034 (7.50)***	0.034 (7.65)***	0.030 (8.00)***
			B. Treatment equations			
Lagged Inflation rate	-0.048 (0.79)	-0.053 (0.88)	-0.038 (0.50)	-0.079 (1.54)	-0.080 (1.56)	-0.039 (0.44)
Fiscal Surplus/Deficit to GDP	–	–	0.003 (0.07)	–	–	0.044 (1.15)
Index of exchange rate flexibility	-0.001 (0.07)	0.001 (0.05)	0.109 (3.98)***	0.009 (0.52)	0.010 (0.56)	0.093 (3.11)***
Broad money growth	0.039 (2.12)**	0.036 (1.98)**	-0.005 (0.36)	0.029 (1.77)*	0.028 (1.63)	-0.005 (0.59)
Per capita GDP growth	0.027 (0.39)	-0.027 (0.40)	0.024 (0.23)	-0.031 (0.47)	-0.031 (0.47)	0.024 (0.22)
N	122	122	55	122	122	55
ath(Rho)	-1.050***	-1.115***	-2.425***	-1.511***	-1.534***	-1.839***
ln sigma	-4.096***	-4.078***	-4.062***	-3.978***	-3.972***	-4.186***
Wald χ^2	318.26	308.94	146.81	259.14	257.86	163.11
Prob > χ^2	0.00	0.00	0.00	0.00	0.00	0.00

NOTES: Absolute value of z statistics in parentheses. All equations were estimated using a maximum likelihood procedure. * significant at 10%, ** significant at 5%, *** significant at 1%.
spec. stands for the treatment effect model specification used.

Table 5
Treatment Effects Regression Results Using the Developing Countries Sample

	NEER Volatility			REER Volatility		
	spec. 1	spec. 2	spec. 3	spec. 4	spec. 5	spec. 6
			A. Outcome equations			
Per capita GDP growth	-0.004 (6.10)***	-0.007 (9.22)***	-0.007 (7.57)***	-0.004 (7.89)***	-0.004 (8.02)***	-0.004 (7.24)***
Openness	-0.000 (1.46)	-0.000 (1.63)	–	-0.000 (2.52)**	-0.000 (2.46)**	–
Current Account to GDP	–	0.001 (2.14)**	0.000 (0.47)	–	0.001 (2.15)**	0.000 (0.82)
Log of GDP	0.003 (13.60)***	0.003 (14.00)***	0.003 (14.42)***	0.003 (14.56)***	0.003 (14.06)***	0.002 (15.37)***
IT Dummy	-0.093 (9.63)***	-0.075 (7.62)***	-0.058 (7.16)***	-0.048 (5.71)***	-0.047 (5.57)***	-0.027 (4.42)***
			B. Treatment equations			
Lagged Inflation rate	-0.046 (4.47)***	-0.081 (4.69)***	-0.119 (6.31)***	-0.057 (4.25)***	-0.109 (5.73)***	-0.173(7.66)***
Fiscal Surplus/Deficit to GDP	–	–	-0.125 (3.65)***	–	–	-0.170 (4.37)***
Index of exchange rate flexibility	0.016 (1.08)	0.059 (2.94)***	0.061 (2.81)***	0.036 (2.09)**	0.080 (3.89)***	0.091 (3.60)***
Broad money growth	-0.032 (5.48)***	-0.043 (5.59)***	-0.041 (5.49)***	-0.031 (5.36)***	-0.042 (5.57)***	-0.055 (5.18)***
Per capita GDP growth	0.022 (1.33)	0.034 (1.61)	-0.007 (0.31)	0.014 (0.74)	-0.049 (2.17)**	0.001 (0.06)
N	379	336	196	358	328	196
ath(Rho)	1.071***	0.948***	1.759***	0.606***	0.700***	1.239***
ln sigma	-2.674***	-2.774***	-2.892**	-3.054***	-3.040***	-3.414***
Wald χ^2	330.86	357.10	220.59	374.15	351.64	263.60
Prob > χ^2	0.00	0.00	0.00	0.00	0.00	0.00

NOTES: Absolute value of z statistics in parentheses. All equations were estimated using a maximum likelihood procedure. * significant at 10%, ** significant at 5%, *** significant at 1%.
spec. stands for the treatment effect model specification used.

Table 6
Robustness Test Results

	NEER Volatility			REER Volatility		
	spec. 1	spec. 2	spec. 3	spec. 4	spec. 5	spec. 6
			A. Pooled Sample			
Use conservative starting years	-0.080 (12.08)***	-0.072 (11.03)***	-0.062 (9.13)***	-0.046 (8.06)***	-0.046 (7.96)***	-0.028 (5.84)***
Use the 1990 to 2005 sample	-0.077 (11.89)***	-0.067 (10.67)***	-0.061 (9.08)***	-0.037 (8.36)***	-0.037 (8.29)***	-0.028 (5.85)***
Adding Chinn-Ito measure of financial openness	-0.076 (10.87)***	-0.073 (10.24)***	-0.055 (7.59)***	-0.034 (5.14)***	-0.041 (5.72)***	-0.016 (3.07)***
Use log population as measure of economic size	-0.080 (11.01)***	-0.068 (10.61)***	-0.058 (8.78)***	-0.042 (6.65)***	-0.041 (7.08)***	-0.026 (5.60)***
Use instrumental variable version of treatment effect regression	-0.068 (3.85)***	-0.047 (3.74)***	-0.037 (3.65)***	-0.040 (3.11)***	-0.024 (2.51)**	-0.015 (2.45)**
			B. Industrial Countries			
Use conservative starting years	0.029 (4.84)***	0.029 (5.23)***	0.031 (7.81)***	0.035 (7.89)***	0.035 (8.15)***	0.031 (8.13)***
Use the 1990 to 2005 sample	0.027 (3.63)***	0.028 (4.27)***	0.030 (9.03)***	0.035 (7.09)***	0.035 (7.45)***	0.030 (8.00)***
Adding Chinn-Ito measure of financial openness	0.028 (4.63)***	0.028 (4.89)***	0.028 (7.65)***	0.034 (7.35)***	0.034 (7.42)***	0.030 (7.66)***
Use log population as measure of economic size	0.029 (5.33)***	0.029 (5.61)***	0.030 (9.07)***	0.035 (8.01)***	0.035 (8.18)***	0.030 (8.00)***
Use instrumental variable version of treatment effect regression	0.011 (3.12)***	0.010 (3.00)***	0.020 (2.50)**	0.011 (3.12)***	0.011 (3.29)***	0.018 (2.65)**
			C. Developing Countries			
Use conservative starting years	-0.087 (8.58)***	-0.075 (7.62)***	-0.058 (7.16)***	-0.048 (5.74)***	-0.047 (5.57)***	-0.027 (4.42)***
Use the 1990 to 2005 sample	-0.086 (9.24)***	-0.069 (7.23)***	-0.058 (7.16)***	-0.038 (5.74)***	-0.033 (4.96)***	-0.027 (4.42)***
Adding Chinn-Ito measure of financial openness	-0.090 (8.96)***	-0.066 (6.42)***	-0.056 (6.56)***	-0.044 (4.97)***	-0.041 (4.57)***	-0.018 (2.73)**
Use log population as measure of economic size	-0.091 (8.41)***	-0.072 (7.36)***	-0.057 (7.08)***	-0.045 (4.82)***	-0.045 (5.29)***	-0.026 (4.34)***
Use instrumental variable version of treatment effect regression	-0.095 (3.37)***	-0.034 (2.17)**	-0.019 (1.60)	-0.036 (1.87)*	-0.014 (1.13)	-0.003 (0.40)

NOTES: Absolute value of z statistics in parentheses. All equations were estimated using a maximum likelihood procedure. * significant at 10%, ** significant at 5%, *** significant at 1%.
spec. stands for the relevant treatment effect model specification used as indicated in the relevant columns of Tables 3 – 5.

In view of space considerations, Table 6 only reports the estimates and statistical significance of the coefficient of paramount interest in this paper – the inflation targeting treatment variable.[16] Table 6 contains three panels. The upper panel contains the summary of the robustness test results using the pooled sample of industrial and developing countries while the middle and lower panels contain the test results for the split samples of industrial and developing countries, respectively.[17]

All of these robustness checks do not undermine the main results reported in Tables 3, 4 and 5. Out of the 30 reported coefficients presented in each panel of Table 6, the coefficient of the inflation targeting treatment variable was significantly negative in all cases for the complete sample (28 out of the 30 coefficients significant at the 0.01 level, two at the 0.05 level); significantly positive for the industrial country group (28 of the 30 coefficients also significant at the 0.01 level, two at the 0.05 level); and significantly negative in 27 out of the 30 cases for the developing country group (24 significant at the 0.01 level, two at the 0.05 level, and one at the 0.10 level).

4. Conclusion

This paper examined, for a comparative perspective, of how performance in inflation targeting countries compare against a certain 'control group' of non-inflation targeting countries in a dimension outside of what has typically attracted the most attention in the literature. To be precise, the question of whether countries that target inflation systematically experience higher exchange rate volatility was examined. A major challenge that immediately confronts such analysis is that countries do not choose their monetary regimes in a random fashion. The paper tackled this issue of self-selection in the countries' decision to target inflation by using a treatment effect regression, a technique frequently applied in the labour economics literature. Using this method allows one to jointly estimate the probability of being an inflation targeter and the outcome equation that pertains to the variable of interest, i.e., exchange rate volatility.

The estimation using this method yielded significant and robust evidence that are consistent with the earlier relevant findings of Rose (2007) and Lin (forthcoming). Indeed, nominal and real exchange rate volatility are both lower in inflation targeting countries than countries that do not target inflation; and, more importantly, developing countries that target inflation have lower nominal and real exchange volatility than non-inflation targeting developing countries. In the case, however, of inflation targeting industrial countries, it was found to be higher.

These results indicate that 'financially robust' industrial countries that are not typically hampered by balance sheet effects of exchange rate volatility,

[16] Complete results of these robustness tests are available from the author on request.

[17] For the remainder of the variables included in the estimation, refer to the relevant columns (denoted as spec.) in Tables 3-5.

epitomize, on average, the dictum that 'inflation targeters let their exchange rates float'. In the case of inflation targeting developing countries, however, the limited ability of these 'financially vulnerable' countries to tolerate substantially higher exchange rate volatility in practice suggest that the adoption of inflation targeting as a monetary regime has been visibly favourable. As such, the observed absence of a trade-off between the supposed domestically-oriented focus of inflation targeting and exchange rate volatility crucially applies to these particular group of countries. Thus, as a result, this apparent dichotomy between industrial and developing inflation targeting countries may well reflect the increasing appeal of inflation targeting and, more importantly, explain the remarkable durability to date of inflation targeting, i.e., why no country has yet abandoned inflation targeting.

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