E C O N O M I C S B U L L E T I N

Modelling Central Bank Intervention Activity under Inflation Targeting

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Abstract

Using daily data from the Czech Republic in 1/1/1998-31/12/2002, we find that foreign exchange intervention activity is determined by the degree of exchange rate misalignment and lagged intervention. Additionally, inflation targeting regime is a binding constraint of intervention activity.

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1. Introduction

Several studies have recently analyzed the determinants of central bank's foreign exchange (FX) intervention[1] activity under flexible exchange rates (Almekinders and Eijffinger, 1994, 1996; Baillie and Osterberg, 1997; Neely, 2002; Kim and Sheen, 2002; Frenkel, Pierdzioch and Stadtmann, 2004; and Ito and Yabu, 2006). Typically, they find that central bank (CB hereafter) intervenes in the FX market, when the exchange rate is largely misaligned and/or excessively volatile.[2]

The literature on the determinants of CB intervention rarely explicitly links FX intervention behavior to CB's monetary policy regime. This is striking, as CBs typically do not formulate their FX intervention policy in an *ad hoc* manner (reacting merely to information in exchange rate), but rather consider the overall economic outlook and the consequences of FX intervention for price stability.[3]

In this paper, we focus on assessing how monetary policy regime (inflation targeting in our case) affects CB's FX intervention activity. We build on anecdotal evidence by Geršl and Holub (2006), who propose the criteria for assessing FX interventions consistency with the inflation targeting regime. The criterion we analyze in this paper is simply that the CB should tighten the monetary conditions when inflation and output forecast is heading above its targeted value and vice versa (Geršl and Holub, 2006, label it as target consistent). If CB interventions are in line with the aforementioned criterion, we label it as consistent with inflation targeting (IT consistency hereafter).

As a result, this paper aims to bridge the gap in evidence on the linkages between FX intervention activity and inflation targeting regime using the daily data from the Czech Republic. First, we construct a simple indicator of "IT consistency" based on deviation of inflation and output from its target levels. Second, we estimate the determinants of FX intervention activity employing the measures of exchange rate misalignment and volatility and IT consistency.

The paper is structured as follows. Data and empirical methodology are described in section 2. Results are presented in section 3. Conclusion follows in section 4.

2. Data and Methodology

The sample period runs from 1/1/1998 to 31/12/2002. We use daily data on actual FX interventions and CZK/EUR exchange rate (prior to 1999 CZK/EUR is retrieved from CZK/DEM and irrevocable fixing rate of DEM/EUR).[4] We also employ monthly data on net inflation, as the inflation target of the Czech National Bank (CNB) has been

[1] We define interventions as sales or purchases of foreign currency by the central bank intended to influence the level or volatility of exchange rate.

[2] See Sarno and Taylor (2001) for comprehensive survey of FX intervention literature.

[3] Note that the most closely related literature to ours is on signaling effect of FX interventions. More specifically, Lewis (1995) finds that monetary variables such as interest rates help to forecast FX interventions and Kaminsky and Lewis (1996) analyze whether FX interventions signal future monetary policy actions. Our approach differs here from this stream of literature, as we narrow our interest to linking FX interventions activity to inflation targeting regime rather than monetary variables in general.

[4] This is motivated by the fact that FX interventions have been conducted vis-à-vis DEM until 1999.

defined in terms of net inflation during the sample period.[5] Real GDP growth data are available on a quarterly basis (HP filter is used to estimate potential growth).

As mentioned above, we define the inflation targeting consistency variable (IT_t) using the difference between net inflation and inflation target and output gap estimate as follows:

$$IT_t = \alpha\left(\pi_t - \pi_t^*\right) + \beta\left(y_t - y_t^*\right) \tag{1}$$

where π_t is the yearly net inflation, π_t^* is the net inflation target, y_t is actual GDP growth and y_t^* is an estimate of potential growth. We estimate α and β by principal components. This is simply motivated for the ease of exposition in the empirical part, as we then obtain single parameter showing whether the considerations about inflation targeting regime have served as important constraint for the FX intervention activity. Alternatively, we also allow α and β to be estimated within the equation on the FX intervention determinants in (3).[6] Additionally, the rationale for using the current values of inflation and output gap instead of its forecasts is uncertainty in future developments in an economy undergoing massive structural changes during the sample period.[7]

Generally, we link FX intervention activity to its lagged value (to address the persistence of interventions), exchange rate developments and the IT consistency. In line with Ito and Yabu (2006), we first estimate the following probit model:

$$P\left(INT_t = 1\right) = \Phi\left(\alpha_0 + \alpha_1\left(s_{t-1} - s_{t-2}\right) + \alpha_2\left(s_{t-1} - s_{t-21}\right) + \alpha_3\left(s_{t-1} - s_{t-1}^{MA}\right)\right) \tag{2}$$

INT_t denotes a binary variable taking value of one, when the CNB intervenes in day *t*; zero otherwise. s_t is the CZK/EUR exchange rate. s_t^{MA} represents the moving average of s_t using 365 days window. As a result, α_1, α_2 and α_3 capture the short-term, medium-term and long-term movements of exchange rate, respectively.[8] The sign of α_2 and α_3 is expected to be negative, i.e. intervention activity is inversely related to

[5] CNB started targeting inflation in 1998. Except inflation developments, the bank reaction function includes also output gap. Given the openness of Czech economy, the CNB may also react to exchange rate developments in case they seriously jeopardize the inflation prospects. See Geršl and Holub (2006) on inflation targeting design in the Czech Republic.

[6] These results are available upon request.

[7] As macroeconomic variables are not available at the daily frequency, we assume least squares learning about the state of economy and thus interpolate IT_t linearly to daily values. The rationale for the exercise is as follows. CBs typically produce forecasts on a quarterly basis and in the meantime collect new information and analyze it to what extent it shifts the outlook from the last forecast. It is vital to note that different interpolation procedures such as quadratic match procedure had infinitesimal effect on the results presented in the section 4.

[8] Alternatively, we estimate short-term exchange rate volatility using a GARCH model of and take the estimates of medium-term exchange rate misalignment from Babetskii and Egert (2005) and Crespo-Cuaresma, Fidrmuc and MacDonald (2005). The results, using these alternative specifications, are similar to those presented in this paper and are also available upon request.

the deviation of the exchange rate from its last month value or its moving average. The sign of α_1 is unconstrained (see Sarno and Taylor, 2001), though we expect it to be positive, as the CNB sells the domestic currency, when the currency appreciates. It is noteworthy that the CNB conducted intervention almost only against the appreciation of domestic currency (CNB intervened in 89 days selling the CZK, only 4 days buying the CZK out of 1242 sample days)[9].

To investigate if the inflation targeting regime served as important constraint of CNB's FX intervention activity, we next estimate regression of the form:

$$P(INT_t = 1) = \Phi\left(\beta_0 + \beta_1\left(s_{t-1} - s_{t-2}\right) + \beta_2\left(s_{t-1} - s_{t-21}\right) + \beta_3\left(s_{t-1} - s_{t-1}^{MA}\right) + \beta_4 IT_t\right) \qquad (3)$$

Given our definition of IT_t, we expect $\beta_4 < 0$; i.e. CNB is less likely to intervene against the appreciation of currency, when the difference between the inflation and its target rises (analogously for output gap).

To address the sensitivity of results, we proceed in two steps. First, following Frenkel et al. (2004), we define INT_t as the number of consecutive intervention days. Using this alternative indicator, we estimate the identical set of FX intervention determinants as in (2) and (3) by the negative binomial model. Second, we estimate the following equation by OLS:

$$INT_t = \gamma_0 + \gamma_1\left(s_{t-1} - s_{t-2}\right) + \gamma_2\left(s_{t-1} - s_{t-21}\right) + \gamma_2\left(s_{t-1} - s_{t-1}^{MA}\right) + \gamma_4 IT_t + \gamma_5 INT_{t-1} + \varepsilon_t \qquad (4)$$

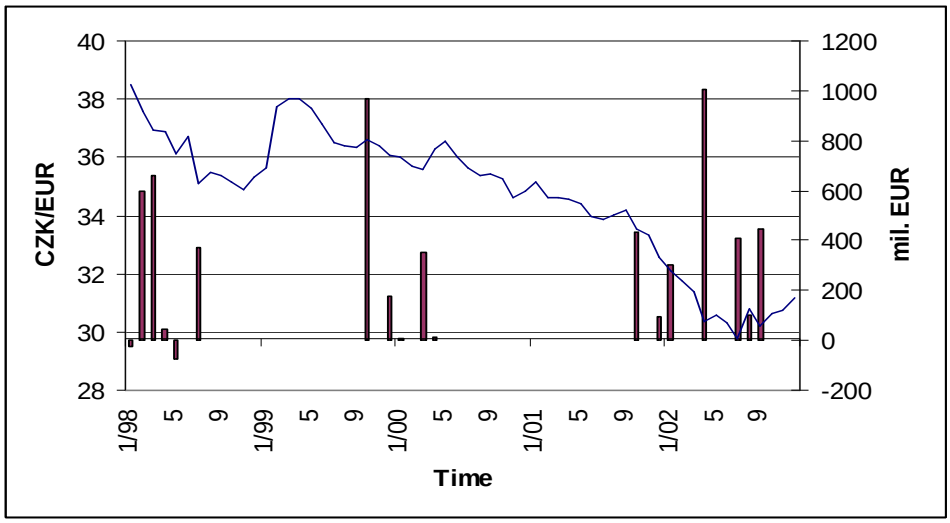
INT_t is defined as in the equation (1) and alternatively using the actual daily FX intervention volume.

4. Results

The monthly intervention volumes and exchange rate developments are presented in Figure 1. As apparent from Figure, there has been three major intervention episodes associated primarily with the sharp CZK/EUR appreciation (the first half of 1998, end of 1999, and mid 2002).

[9] Given the fact that the intervention has been primarily oriented against appreciation of CZK, we do not opt for the ordered probit model.

Figure 1 – CZK/EUR exchange rate and intervention volumes



Source: Czech National Bank

Note: The left scale measures the CZK/EUR exchange rate; the right scale measures the monthly FX intervention volume in the millions of euro.

Table 1 – Estimation Results

	Neg. Binomial		Probit		OLS - indicator		OLS - volume	
$s_{t-1} - s_{t-2}$	1.00	1.08*	0.66	0.67	0.07	0.08	0.63	0.68
	(0.62)	(0.59)	(0.44)	(0.43)	(0.06)	(0.06)	(0.59)	(0.59)
$s_{t-1} - s_{t-21}$	-1.26***	-0.85***	-0.58***	-0.41***	-0.05***	-0.24**	-0.20***	-0.18***
	(0.21)	(0.18)	(0.10)	(0.10)	(0.01)	(0.10)	(0.06)	(0.06)
$s_{t-1} - s_{t-1}^{MA}$	-0.17***	-0.30***	-0.08*	-0.13***	-0.01	-0.01	-0.01	-0.01
	(0.07)	(0.09)	(0.04)	(0.04)	(0.01)	(0.01)	(0.02)	(0.02)
IT_t		-0.61***		-0.36***	-0.05***	-0.03***	-0.07*	-0.07*
		(0.14)		(0.06)	(0.01)	(0.01)	(0.04)	(0.04)
INT_{t-1}						0.52***		0.08**
						(0.05)		(0.03)
No. of obs.	1262	1262	1262	1262	1262	1262	1262	1262
R-sqr.	0.08	0.11	0.07	0.14	0.07	0.33	0.02	0.03

Note: McFadden's R-squared for the negative binomial and probit model. Intervention volume is in the billions of CZK. Robust standard errors in parenthesis. ***, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively.

Table 1 reports our results on the determinants of FX intervention activity. Typically, the CNB does not react to day-to-day exchange rate volatility and rather has been concerned with the medium to long-term exchange rate developments. This is in line with the official bank statements expressing that intervention have been conducted only when the CZK/EUR appreciated excessively (see Geršl and Holub, 2006). The results also suggest that inflation targeting regime is important constraint for FX

intervention activity. More specifically, the more inflation and output is above their targeted values, the less likely the CNB will intervene against domestic currency appreciation.[10] Therefore, our results comply with Geršl and Holub (2006), who argue that most of CNB's FX interventions appear to be target consistent. In addition, there is also evidence for clustering of FX intervention activity (though intervention volumes are much less 'persistent').

5. Conclusions

In this paper, we study the determinants of FX intervention activity of the Czech National Bank. The novelty of our approach is the examination of the role of inflation targeting regime on this activity. Subject to various sensitivity tests, we find that inflation targeting regime is important constraint for the central bank interventions. Besides, central bank reacts to the medium-term exchange rate misalignment. We also find that intervention activity occurs in clusters.

[10] The results using a monthly lag of IT to address the potential endogeneity are similar and available on request.

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