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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 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.[1]

To our knowledge, CB intervention literature does not explicitly link FX intervention behavior to CB's main targets, which is low inflation and/or output close to its potential. This is striking, as CBs typically do not formulate their FX intervention policy in an *ad hoc* manner (reacting only to information in exchange rate), but rather in line with their monetary policy regime oriented towards achieving the targets. 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 Holub (2004), who proposes the criteria for assessing when FX interventions are consistent 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. If CB interventions are in line with the aforementioned criterion, we label it as consistent with inflation targeting (IT consistency hereafter).[2]

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

[2] See Holub (2004, p. 14) for evidence when CBs likely violated this criterion.

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 from its target and output gap. 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). We also employ monthly data on net inflation, as the inflation target of the Czech National Bank (CNB) has been defined in terms of net inflation during the sample period.[3] Real GDP growth data are available on a quarterly basis (HP filter is used to estimate potential growth).

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[3] 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 Kotlan and Navratil (2003) on inflation targeting design in the Czech Republic.

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:

$$IT_t = \alpha\left(\pi_t - \pi_t^*\right) - \beta\left(y_t - y_t^*\right) \tag{2}$$

where π_t is the yearly net inflation, π_t^* is the inflation target, y_t is actual GDP growth and y_t^* is an estimate of potential growth. α and β is determined by principal components. 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.[4]

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:

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

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.[5] The sign of

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[4] IT_t is interpolated linearly to daily values. Interpolation using different procedures had infinitesimal effect on the results in the section 4.

[5] 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

α_2 and α_3 is expected to be negative, i.e. intervention activity is inversely related to 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)[6].

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

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

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 (1) and (2) by the negative binomial model. Second, we estimate the following equation by OLS:

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and MacDonald (2005). The results, using these alternative specifications, are similar to those presented in this paper and are available on request.

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

$$INT_t = \gamma_0 + \gamma_1(s_{t-1} - s_{t-2}) + \gamma_2(s_{t-1} - s_{t-21}) + \gamma_2(s_{t-1} - s_{t-1}^{MA}) + \gamma_4 IT_t + \gamma_5 INT_{t-1} + \varepsilon_t \qquad (3)$$

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).

Figure 1 – CZK/EUR exchange rate and intervention volumes
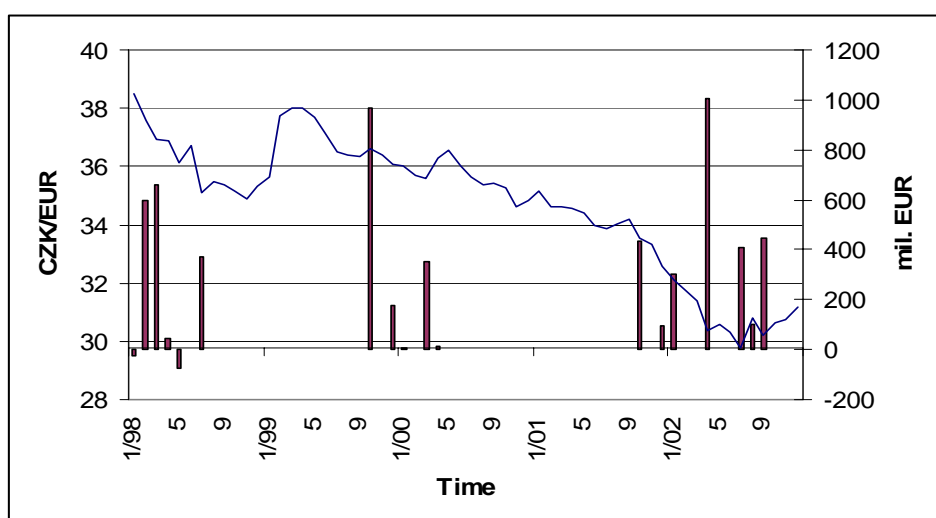
Source: Czech National Bank

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 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 Holub, 2004). The results also suggest that inflation targeting regime is important constraint for FX intervention activity. Concretely, the greater is inflation and output in comparison to their targeted values, the less likely the CNB will intervene against domestic currency appreciation.[7] In addition, there is also evidence that FX intervention activity is persistent, to a certain extent (though intervention volumes are much less persistent).

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.

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

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 is persistent, to a certain extent.

References

Almekinders, G.J., Eijffinger, S.C.W., 1994. Daily Bundesbank and Federal Reserve Interventions: Are They a Reaction to Changes in the Level and Volatility of the DM/$ Rate?, Empirical Economics, 19: 111-130.

Almekinders, G.J., Eijffinger, S.C.W., 1996. A Friction Model of Daily Bundesbank and Federal Reserve Intervention, Journal of Banking and Finance, 20: 1365-1380.

Babetski, I., Egert, B., 2005. Equilibrium Exchange Rates in the Czech Republic: How Good Is Czech BEER?, Finance a uver - Czech Journal of Economics and Finance, 55: 232-252.

Baillie, R.T., W.P. Osterberg, 1997. Why Do Central Banks Intervene?, Journal of International Money and Finance, 16: 909-919.

Crespo-Cuaresma, J., Fidrmuc, Jarko, MacDonald, R., 2005. The Monetary Approach to Exchange Rates in the CEECs, Economics of Transition, 12: 395-416.

Holub, T., 2004. Foreign Exchange Interventions under Inflation Targeting: The Czech Experience, Czech National Bank Research and Policy Note, No.1/2004.

Frenkel, M., Pierdzioch, Ch., Stadtmann, G., 2004. Modelling the Intensity of Foreign Exchange Intervention Activity: an Extension, Economics Letters, 85: 347-351.

Ito, T., Yabu, T., 2006. What Promotes Japan to Intervene in the Forex Market? A New Approach to a Reaction Function, Journal of International Money and Finance, forthcoming.

Kim, S., Sheen, J, 2002. The Determinants of Foreign Exchange Intervention by Central Banks: Evidence from Australia, Journal of International Money and Finance, 21: 619-649.

Kotlan, V., Navratil, D., 2003. Inflation Targeting as a Stabilization Rule: Its Design and Performance in the Czech Republic. Finance a uver - Czech Journal of Economics and Finance, 53: 220-242.

Neely, C.J., 2002. The Temporal Pattern of Trading Rule Returns and Central Bank Intervention: Intervention Does Not Generate Technical Trading Rule Profits, Journal of International Economics, 58: 211-232.

Sarno, L., Taylor, M.P., 2001. Official Intervention in the Foreign Exchange Market: Is It Effective and, If So, How Does It Work?, Journal of Economic Literature, 39: 839-868.