Box 5 Empirical evaluation of the effect of Central Bank interventions on the exchange rate of the króna 1998-2001

GARCH models are commonly used to evaluate the effect that central bank interventions in foreign exchange markets have on exchange rates. Such models enable evaluation of the impact of intervention both on the exchange rate level and on its volatility (see, e.g. Brandner, Grech and Stix, 2001, and Kim and Sheen, 2002).

Such a model for the period from the beginning of 1998 to the end of 2001 was used to evaluate the impact of the Central Bank of Iceland's interventions on the exchange rate of the króna. Since foreign exchange trading in its current form did not begin until mid 1997, the beginning of 1998 was chosen as a starting point to allow some experience of the new trading format to have been built up. It was decided to complete the evaluation at the end of 2001 since no direct interventions were made in 2002. The Bank's only transactions that year were in connection with its preannounced program to buy back foreign currency which, as discussed in the main article, are not defined as conventional interventions. Accordingly, two trades by the Bank in December 2001 are not included in the empirical evaluation either.

The following EGARCH model was evaluated using daily data from January 1, 1998 to December 31, 2001 (1,363 observations):

$$\begin{aligned}\Delta \log s_t &= (\alpha_0 + \alpha_1 VIK_t + \alpha_2 FLOT_t + \alpha_3 HOL_t) \\ &+ \delta(\log s_{t-1} - \log s^T)(1 - FLOT_t) \\ &+ [(\beta_{00} + \beta_{01} VIK_t + \beta_{02} FLOT_t) \\ &+ \beta_1 CUM_{t-1} + \beta_2 SIZE_{t-1}] \times INT_{t-1} + \varepsilon_t \sqrt{h_t}\end{aligned}$$

$$\begin{aligned}\log h_t &= (\omega_0 + \omega_1 VIK_t + \omega_2 FLOT_t + \omega_3 HOL_t) \\ &+ \theta\left|\log s_{t-1} - \log s^T\right|(1 - FLOT_t) \\ &+ \gamma_1\left|\varepsilon_{t-1}/\sqrt{h_{t-1}}\right| + \gamma_2(\varepsilon_{t-1}/\sqrt{h_{t-1}}) + \gamma_3 \log h_{t-1} \\ &+ [(\lambda_{00} + \lambda_{01} VIK_t + \lambda_{02} FLOT_t) \\ &+ \lambda_1 CUM_{t-1} + \lambda_2 SIZE_{t-1}] \times \left|INT_{t-1}\right|\end{aligned}$$

where $\Delta\log s_t$ is the percentage change in the exchange rate index on day t (based on the registered exchange rate for the day), VIK_t is a dummy variable which takes the value 0 until the fixed exchange rate bands were widened to ±9% on February 14, 2000 and 1 afterwards, $FLOT_t$ is a dummy variable which takes the value 0 until the fixed exchange rate bands were abolished on March 27, 2001 and 1 afterwards, HOL_t is a dummy variable which takes the value 1 on the first trading day following a holiday, s^T is the central parity of the fixed exchange rate (115.01), INT_t is the Central Bank's intervention on day t in b.kr. (purchases of foreign currency), CUM_t is a dummy variable which is set to 1 if an intervention on day t follows interventions in the same direction on the preceding two days (i.e. interventions in the same direction for three consecutive days) but otherwise to 0, $SIZE_t$ is a dummy value set to 1 if the size of the intervention on day t exceeds the average amount of interventions over the period (approximately 600 m.kr.) but otherwise to 0, and ε_t is an $N(0,1)$ random variable. In order to avoid a simultaneous bias problem interventions only enter lagged. Thus the model does not capture the short-lived impact of interventions (i.e. that die out within the same day that the intervention is performed). However, it can be argued that the longer lasting effects are of primary importance.

The first equation describes the determination of changes in the exchange rate level of the króna over the period. According to the model, changes in the exchange rate are effected by the previous day's deviation from the central parity of the target bands, ($\log s_{t-1}$ - $\log s^T$), while they were in effect. If the index value exceeds the central parity it should reverse back towards it in the long run, i.e. $\delta < 0$ if this effect is present. Such effects are not present after the króna was floated. Effects of interventions are allowed to vary depending upon their size and persistence and whether they were performed before or after the widening of the target bands in 2000 and their abolition in 2001. For example, the effects of relatively small interventions extending over a single day and performed before the widening of the bands in 2000 is β_{00}, while the impact of a comparable intervention after the floating of the króna is $\beta_{00}+\beta_{01}+\beta_{02}$. Similarly, the impact of an intervention lasting for three consecutive days and exceeding the average amount of interventions after

EGARCH model for the exchange rate index January 1 1998 - December 31 2001

Parameter	*Description*	*Parametric evaluation*	
α_0	Constant in level equation	0.013 (0.006)	**
β_{00}	Impact of interventions on exchange rate level	-0.201 (0.047)	***
β_1	Additional impact of interventions for three consecutive days	0.099 (0.018)	***
β_2	Additional impact of large interventions	0.106 (0.049)	**
ω_0	Constant in volatility equation	-1.719 (0.333)	***
ω_2	Additional volatility after floating of króna	1.086 (0.269)	***
γ_1	Impact of exchange rate changes on volatility	0.412 (0.087)	***
γ_2	Asymmetrical impact of exchange rate changes on volatility	0.194 (0.065)	***
γ_3	Lagged impact of volatility	0.557 (0.103)	***
λ_{01}	Additional impact of interventions after widening of bands	2.234 (0.695)	***
λ_{02}	Additional impact of interventions after floating of króna	-1.032 (0.611)	*
λ_2	Additional impact of large interventions	-0.812 (0.199)	***
log L		-56.929	

Robust Bollerslev and Wooldridge standard errors in parentheses. *** (**) [*] indicate a coefficient estimate significantly different from zero based on the 1% (5%) [10%] critical level.

the floating is $\beta_{00}+\beta_{01}+\beta_{02}+\beta_1+\beta_2$. If the intervention managed to strengthen the króna or reduce its weakening, the sum of the parameters in each case should be positive. Finally, the widening of the target bands in 2000 and their abolition in 2001 is allowed to have a direct effect on the exchange rate index, although such an effect is probably not present. Likewise, average exchange rate changes may be different on the first trading day after a holiday.

The second equation describes the determination of exchange rate volatility which is affected by the same variables as changes in the exchange rate level itself. The EGARCH model allows strengthening and weakening of the exchange rate to have differing effects on volatility. If $\gamma_2 > 0$ a depreciation of the króna increases volatility more than an appreciation. This could reflect, for example, a belief among market participants that the Central Bank was more averse to a depreciation in the exchange rate than to an appreciation. Theoretical models indicate that $\theta < 0$ where the impact of underlying economic factors on the exchange rate within the bands decreases as the exchange rate moves closer to the central parity (see, e.g. Brandner, Grech and Stix, 2001). The króna may also be expected to have become more volatile when the bands were widened and ultimately abolished in 2001. International studies furthermore suggest that exchange rates become more volatile when markets open after holidays, due to the accumulation of information on which trading is then based. The impact of interventions on the volatility of the exchange rate index is interpreted in the same way as their impact on the level itself.

The final model is shown in the table, where insignificant parameters have been eliminated (robust Bollerslev and Wooldridge standard errors are given in parentheses).The final model suggests that the exchange rate of the króna weakens on average on the day after a Central Bank intervention to strengthen it. This implies that the intervention has not succeeded in preventing the króna from depreciating. However, the outcome appears more likely to be successful if the intervention is large or lasts for several days. Impact on the volatility of the króna varies, depending upon whether the intervention was made before or after the widening of the bands and their abolition. Prior to the widening of the bands, large interventions apparently managed to dampen volatility, but after they were widened interventions have increased exchange rate volatility on average, although to a lesser degree after the króna was floated. As before, the impact on volatility remains less if the intervention is relatively large.