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EXCHANGE RATE VOLATILITY, FOREIGN EXCHANGE MARKET INTERVENTION AND ASYMMETRIC PREFERENCES

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ABSTRACT

Policymakers in emerging market economies intervene in currency markets to counter appreciation or depreciation pressure, while also responding to the degree of exchange rate volatility. This paper investigates whether the asymmetric response in terms of foreign exchange intervention depends on the degree of exchange rate volatility. Specifically, we estimate whether the response by policymakers to currency market conditions differs in above or below threshold levels of volatility. We use dynamic threshold panel analysis presented within an asymmetric policy reaction function to investigate the role of exchange rate volatility in foreign exchange intervention. We estimate the model using Generalized Method of Moments (GMM) with monthly data for 23 emerging market economies from 2000 to 2016. We find that the asymmetric aversion to appreciation only holds under below-threshold volatility scenarios, and that the majority of the time, policymakers are simply leaning against exchange rate movements to ensure stable exchange rate conditions. The results confirm that exchange rate volatility impacts the response of policymakers to exchange rate conditions.

Contribution/Originality: This study assesses how exchange rate volatility impacts foreign exchange policy decisions in emerging and developing economies. We provide evidence that prior literature, which did not consider volatility, missed an important policy concern for central banks in these economies when analyzing the existence of asymmetric preference in foreign exchange intervention.

1. INTRODUCTION

Many central banks in emerging markets and developing countries act to influence the value of their currency by intervening in foreign exchange markets to dampen sharp appreciations or depreciations. There has been considerable recent work in this area, which has focused on investigating foreign exchange intervention within the context of an optimal planning structure. Recent variations of these models that have attracted significant attention are structures in which the planner has asymmetric aversion toward one side of the exchange rate movement. Such analyses have been described in Srinivasan *et al.* (2009); Pontines and Ramkishen (2011); Keefe and Shadmani (2018) among others. Their results have provided evidence of an asymmetric aversion against appreciation for most emerging markets and developing countries. This aversion to appreciation has been interpreted as a concern over competitiveness on the global market. When a small export-dependent economy is facing mounting appreciation

pressure relative to its neighbors, it may intervene to counteract that pressure to maintain competitiveness. An asymmetric response against appreciation implies policymakers intervene more significantly during these appreciation periods than during periods of depreciation.

The empirical analysis in these studies generally relies on an asymmetric optimal reaction function in which policymakers intervene in currency markets to counter excessive appreciations or depreciations. However, another important concern to policymakers in these economies is exchange rate volatility. This factor has not been examined in the aforementioned literature. The research presented in this paper investigates whether the reaction of policymakers to exchange rate movements differs depending on the level of volatility in exchange rates. It is the volatility in the exchange rate, rather than the direction of the change, that is of greater concern to policymakers (Mohanty, 2013). Due to less developed financial systems, weaker institutions, higher exchange rate pass-through effects, it is more difficult for emerging market and developing economies to absorb exchange rate shocks that may lead to heightened volatility (Mohanty and Klau, 2004; Edwards, 2006; Ostry *et al.*, 2012). Therefore, to fully understand the effectiveness of foreign exchange intervention, it is necessary to analyze whether the responsiveness to exchange rate movements differs in high versus low volatility periods.

We incorporate the dynamic threshold panel analysis presented in Kremer *et al.* (2013) to the optimal reaction function described in Keefe and Shadmani (2018) to investigate the role of exchange rate volatility in foreign exchange intervention. We estimate the model using Generalized Method of Moments (GMM) with monthly data for 23 emerging market economies from 2000 to 2016. The empirical results confirm the stronger aversion to appreciation as found in Keefe and Shadmani (2018) during the less volatile periods, which occurs only in 16% to 28% of the observations. However, during the more volatile periods, evidence of asymmetric intervention disappears, implying that most policymakers most of the time are simply leaning against exchange rate movements in an attempt to maintain stable exchange rate conditions, rather than demonstrating a consistent aversion to appreciation. The results confirm that exchange rate volatility impacts the response of policymakers to exchange rate conditions. We conduct a sensitivity analysis by using two different measures for volatility. Furthermore, since there are different exchange rate regimes among the countries in the sample and over the period of study, we use dummy variables controlling for the degree of exchange rate management, and the results remain consistent.

2. MODEL AND METHODOLOGY

Our estimation is based on monthly data for 23 emerging market economies for the period 2000:01 to 2016:12. The countries in the panel are: Argentina, Bangladesh, Brazil, Chile, Colombia, Czech Republic, Dominican Republic, Guatemala, Hungary, India, Indonesia, Jamaica, Kenya, Mexico, Nigeria, Philippines, Poland, South Korea, South Africa, Sri Lanka, Thailand, Turkey and Vietnam. These countries have been chosen for two reasons. First, each country in the set has shown evidence of a managed floating exchange rate, intervening at times to "lean against the wind". Second, they demonstrate an asymmetry in their response to exchange rate movements as shown in Keefe and Shadmani (2018) for evidence. Data is collected from the IMF International Financial Statistics database.

We follow the empirical model in Keefe and Shadmani (2018) in which the central bank minimizes an asymmetric (non-quadratic) loss function by choosing an optimal level of foreign exchange intervention which results in the following reaction function:[1]

$$R_t = C_1 + C_2 \tilde{e}_t + C_3 \tilde{e}_t^2 + v_t \tag{1}$$

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[1]This aligns with the methodology in Surico (2007); Dijk Teräsvirta and Franses (2002) and Luukkonen Saikkonen and Teräsvirta (1988).

Where R_t represents the change in foreign exchange reserves and serves as a proxy for foreign exchange intervention. This is calculated as $R_t = 100 \times (\Delta \log \; Reserves)$ where we define R_t as percentage change in Official Foreign Exchange Reserves. $\tilde{e}_t$ denotes the percentage change in the exchange rate, so that $\tilde{e}_t < 0$ implies appreciation and $\tilde{e}_t > 0$ implies depreciation. This is calculated as $\tilde{e}_t = 100 \times (\Delta \log e_t)$ where e_t is defined as domestic currency units per unit of foreign currency. C_2 is expected to be negative if the central bank is intervening in foreign exchange markets to curb appreciation/depreciation pressure. C_3 captures the asymmetric response by policymakers. Based on the sign of C_3, we can determine whether the central bank has asymmetric preferences in response to changes in the exchange rate, with positive C_3 representing a stronger aversion to appreciation while a negative C_3 representing a stronger aversion to depreciation.[2]

Because the degree of exchange rate management varies widely across the panel of countries, we control for the exchange rate regime using a dummy variable. We identify periods for each country where the exchange rate is considered to be floating or non-floating (crawling peg, stabilized arrangement, other managed arrangement) using Reinhart and Rogoff (2002); Kocenda and Varga (2018) and the International Monetary Fund (2016). The dummy (D) takes on a value of one for all non-floating periods, zero otherwise, so that we analyze the impact of exchange rate management on the foreign exchange intervention response as follows:

$$R_t = C_1 + C_2 \tilde{e}_t + C_3 \tilde{e}_t^2 + C_4 D + v_t \tag{2}$$

$$R_t = C_1 + C_2 \tilde{e}_t + C_3 \tilde{e}_t^2 + C_4 D + C_5 D \tilde{e}_t + C_6 D \tilde{e}_t^2 + v_t \tag{3}$$

Providing evidence of whether asymmetric responses change depending on the degree of exchange rate management.

We then estimate the Equation 1-3 using the dynamic threshold panel analysis presented in Kremer *et al.* (2013) The objective is to analyze the role of exchange rate volatility thresholds on the reaction function of central banks. The model employs Generalized Method of Moments (GMM) estimators in order to allow for endogeneity, so that the panel threshold model is represented in Equation 4:

$$R_{n,t} = \mu_{n,t} + \beta_1 z_{n,t} I(Vol_{n,t} \leq \rho) + \beta_2 z_{n,t} I(Vol_{n,t} > \rho) + v_{n,t} \tag{4}$$

where subscript $n = 1 \, ..., N$ represents the country and $t = 1 \, ..., T$ represents time. $\mu_{n,t}$ represents the country fixed effects, $z_{n,t}$ represents the explanatory variables based on Equation 1, and the error term, $v_{n,t}$ is i.i.d normal. The indicator function, I, represents the regime defined by the threshold variable, $Vol_{n,t}$, and threshold

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[2] We refer the reader to Keefe and Shadmani (2018) for further details.

level, ρ. We omit the highest and lowest 10% of observations when estimating the volatility threshold, following Enders (2010). We use two estimations for the threshold variable of exchange rate volatility: the standard deviation of $\tilde{e}_{n,t}$ over three months (Vol_3) and over six months (Vol_6). We employ one and two lags of $\tilde{e}_{n,t}$ as instruments ($\tilde{e}_{n,t-1}$ and $\tilde{e}_{n,t-2}$).

3. EMPIRICAL RESULTS

According to the dynamic panel threshold analysis presented in Table 1, there is presence of asymmetric responses to exchange rate movements in below-threshold scenarios. Central banks exhibit an asymmetric response to changes in the exchange rate during periods where exchange rate volatility is below the threshold value of 0.105% and 0.390% for 3-month and 6-month volatility. This aligns with the findings in Keefe and Shadmani (2018) and Pontines and Ramkishen (2011).

Policymakers present a stronger aversion to appreciation than depreciation in the below-threshold scenario, responding more strongly to appreciationary pressure with foreign exchange interventions. Policymakers intervene to counteract the exchange rate movement, indicated by a negative and significant C_2, and they exhibit an asymmetric preference with a positive and significant C_3. Furthermore, the volatility coefficient for Vol_3 is negative and significant, demonstrating that policymakers intervene to ensure liquidity in currency markets as a means of smoothing volatility. Interestingly, the below-threshold scenarios make up only about 16% to 28% of the total observations, showing that although an asymmetric response to appreciation exists as presented in previous literature, it is not the norm.

Controlling for the degree of exchange rate management with the dummy variable D yields consistent results for Vol_3 and Vol_6. Yet, when the dummy is interacted with $\tilde{e}_{n,t}$ and $\tilde{e}_{n,t}^2$, as in Equation 3, the results weaken. During non-floating exchange rate conditions when D is equal to one, C_5 and C_6 are significant only when the threshold variable is Vol_3. This implies central banks with non-floating regimes are leaning against the wind ($C_5 <$ 0) and have stronger aversion to appreciation ($C_6 > 0$), consistent with the previous model. Therefore, the degree of exchange rate management matters. For the threshold variable Vol_6, when the dummy is interacted with $\tilde{e}_{n,t}$ and $\tilde{e}_{n,t}^2$, none of the coefficients are significant in the below-threshold period.

In the above-threshold periods, any presence of asymmetric preferences disappears (C_3 is not significant), indicating that exchange rate volatility plays a role in determining how central banks respond to currency market dynamics. However, C_2 remains negative and significant across the models, showing that policymakers are intervening in currency markets to counteract exchange rate pressures but respond symmetrically to these pressures whether they are appreciations or depreciations.

Table-1. Dynamic threshold panel analysis.

Below Threshold	Vol_3		Vol_3		Vol_3		Vol_6		Vol_6		Vol_6	
$\tilde{e}_{n,t}$	-2.116	***	-2.185	***	-0.535		-3.343	***	-3.725	***	-4.081	
	(0.827)		(0.897)		(0.659)		(1.673)		(1.735)		(11.831)	
$\tilde{e}_{n,t}^2$	0.290	***	0.295	***	0.158		0.214	***	0.206	***	0.207	
	(0.086)		(0.092)		(0.096)		(0.075)		(0.073)		(0.557)	
$Vol_{n,t}$	-2.740	***	-2.432	***	-2.060	***	-0.328		0.069		0.021	
	(1.011)		(0.942)		(1.009)		(0.837)		(0.815)		(0.486)	
D_{C4}			2.743		3.205				1.447		0.456	
			(3.349)		(3.613)				(1.335)		(1.573)	
D_{C5}					-3.819	*					1.759	
					(2.296)						(11.878)	
D_{C6}					0.192	***					-0.051	
					(0.081)						(0.546)	
Above threshold												
$\tilde{e}_{n,t}$	-0.342	***	-0.340	***	-0.361	**	-0.349	***	-0.348	***	-0.314	***
	(0.152)		(0.151)		(0.172)		(0.151)		(0.152)		(0.174)	
$\tilde{e}_{n,t}^2$	0.004		0.004		0.001		0.005		0.004		0.001	
	(0.006)		(0.006)		(0.008)		(0.006)		(0.006)		(0.008)	
$Vol_{n,t}$	-0.018		-0.013		-0.001		-0.059		-0.047		-0.057	
	(0.069)		(0.070)		(0.075)		(0.076)		(0.078)		(0.081)	
D_{C4}			0.481		0.460				0.795		0.957	***
			(0.427)		(0.426)				(0.432)		(0.484)	
D_{C5}					-0.170						-0.167	
					(0.208)						(0.210)	
D_{C6}					0.009						0.009	
					(0.008)						(0.008)	
No.Obs. below	974		938		974		620		620		620	
No.Obs. above	3442		3478		3442		3796		3796		3796	
Threshold value	0.105		0.107		0.107		0.390		0.390		0.389	

This table presents the results from the dynamic panel threshold analysis. Values in parenthesis represent standard errors. *, **, *** represent significance at the 10, 5, and 1% levels.

Since the above-threshold scenarios represent about 70% to 85% of the observations, this shows that the majority of the time, policymakers are simply responding to lean against exchange rate movements in an attempt to keep exchange rates relatively stable. They react with equal weight to appreciations and depreciations, rather than attempting to counteract appreciations more strongly and significantly than depreciations. This is a critical contribution of our research to the literature. Previous studies on asymmetric foreign exchange intervention found policymakers responding more significantly to appreciations than to depreciations, reflecting a concern to maintain competitiveness on the global market. Our results show that, although this is true some of the time when volatility is below the threshold value, in the majority of scenarios, policymakers are simply responding to keep exchange rates relatively stable.

4. CONCLUSIONS

In this paper, we present evidence that exchange rate volatility plays a significant role in determining the asymmetric preferences for foreign exchange intervention. We show that policymakers maintain their aversion to appreciation when exchange rate volatility is below the threshold value. During above-threshold volatility periods, policymakers abandon their asymmetric preferences, and focus on countering exchange rate movements symmetrically. In other words, they react with equal weight to appreciations and depreciations when volatility is above the threshold value of 0.105% or 0.390% for 3-month and 6-month volatility, respectively. The above-threshold scenario represents the majority of cases for the emerging markets and developing economies in the panel.

Showing that the asymmetric response to appreciation is in reality a special case, and not the norm, is quite important. Previous literature has focused on determining asymmetric foreign exchange intervention without consideration of exchange rate conditions such as volatility. An aversion to appreciation reflects a general concern over maintaining competitiveness vis-a-vis other exporting countries. Since we find that this asymmetric response is not the norm, and in fact most interventions occur to maintain stability in the exchange rate, this reinforces confidence in these economies that interventions are not being used to influence the direction of the exchange rate, specifically tamping down appreciations much more than responding to depreciations. This is particularly important as more and more economies adopt inflation targeting and yet still maintain a de facto managed-floating exchange rate regime. Many see the need to include the exchange rate as part of their monetary response function, since drastic exchange rate movements can destabilize prices in these economies (Jašová *et al.*, 2016).

This research contributes to the literature on the role of exchange rate volatility in determining optimal foreign exchange policy responses in emerging and developing economies. We provide evidence that prior literature, which did not consider volatility, missed an important policy concern for central banks in these economies. Factoring in exchange rate volatility into the response function of central banks reflects the concerns they repeatedly note when conducting foreign exchange intervention: they are more concerned with volatility than the direction of exchange rate movement.

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