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THE RELATIONSHIP BETWEEN EXCHANGE RATE AND INFLATION TARGETING IN EMERGING COUNTRIES

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ABSTRACT

This paper investigates the relationship between exchange rate and inflation targeting regime in six emerging economies which have adopted inflation targeting (IT) regime during the period of 1993M1-2013M7. In this study, we seek to examine how the adoption of inflation targeting influenced exchange rate pass-through (ERPT) and volatility. The empirical evidences suggest that ERPT has declined after IT adoption for both price indexes (consumer and producer prices) for most economies analyzed. Furthermore, our results show that IT regime can reduce exchange rate volatility and inflation volatility in all countries. Thus, the implementation of inflation targeting regime contributes to price stability through the decline of exchange rate pass-through and exchange rate volatility.

Contribution/ Originality: The paper's primary contribution is finding that the inflation targeting regime contributes to price stability through the decline of exchange rate pass-through and exchange rate volatility in emerging countries.

1. INTRODUCTION

Since the early 1990s, an increasing number of countries have chosen to follow the example of New Zealand in the adoption of inflation targeting (IT). According to the IMF, 18 emerging countries have moved away from rigid exchange rate to adopt a combination of inflation targeting and flexible exchange rate regime. This combination is closely related to the "Impossible Trinity" theory. According to this theory, a central bank can only achieve two of the three most desired objectives (pegged exchange rate, independence of the monetary policy and financial integration). However, Calvo and Reinhart (2002) suggest that emerging countries are characterized by the "fear of floating" behavior due to a lack of credibility toward currency value, if their external debt is denominated in foreign currency. So, these countries are reticent to adopt a floating exchange rate regime. Indeed, The relationship between monetary policy and exchange rate has become the center of the policy debates in emerging countries, and has brought new policy issues. In this study, we are interested in exploring the links between inflation targeting regime, exchange rate and price stability. In particular, we try to evaluate the performance of IT regime in contributing to price stability through the pass-through effects and exchange rate movements in six emerging economies that adopted IT regime (Brazil, Hungry, Korea, Philippines, Poland and South Africa). To accomplish this, we will first study the impact of adoption of inflation targeting on the extent of exchange rate pass-through to domestic prices. Then, we will investigate the effect of the adoption of IT regime on exchange rate volatility. Finally, we will study the effect of such policy regime on price stability.

The remainder of the paper is organized as follows: Section 2 briefly discusses the issues of the link between the inflation targeting and exchange rate regimes. Section 3 presents the empirical studies on the effect of inflation targeting on the exchange rate pass-through, exchange rates volatility and price stability. Finally, section 4 concludes.

2. REVIEW OF LITERATURE

Several studies have shown that exchange rate pass-through (ERPT) has decreased in both emerging and developed economies in recent years. In the literature, this decrease is related to a low inflationary environment as proposed by Taylor (2000). He suggests that the establishment of a credible and strong nominal anchor low inflation policy regime leads to a decrease in ERPT. Campa and Goldberg (2005) tested the hypothesis proposed by Taylor (2000) for OCDE countries. Their results show that ERPT decline in countries characterized by low inflation and low exchange rate variability. Choudhri and Hakura (2006) tested also Taylor (2000) hypothesis for 71 countries. They found a positive and significant relation between ERPT and inflation. Gagnon and Ihrig (2004) analyzed the relationship between ERPT and monetary policy for a 20 industrial countries. They argue that exchange rate pass-through to consumer prices decrease in economies with low inflationary environment. More specifically, the ERPT decline in the most countries that adopted inflation targeting regime. Mishkin and Savastano (2001); Eichengreen (2002) and Schmidt-Hebbel and Werner (2002) provide other justifications for the decline in ERPT, they argue that IT regime improves the credibility of monetary policy and keeps inflation expectation anchored. It is also expected to reduce the responsiveness of domestic prices to exchange rate shocks. Thus, the adoption of inflation targeting may lead to lower ERPT.

Furthermore, several studies have also interested on exchange rate volatility. Some analysts suggest that one of the costs of inflation targeting is the increase in exchange rate volatility as a result of the floating exchange rate regime, which can provoke negative effects especially for emerging economies given their greater financial and real vulnerabilities (Cavoli, 2008). Also, Gali and Monacelli (2005) suggest that the combination of IT and floating exchange rate regime increase the volatility of exchange rate. However, De Gregorio *et al.* (2005) have pointed that exchange rate volatility in Chile is low compared to other countries that adopted floating exchange rates. Hausmann *et al.* (2004) state that the exchange rates volatility in inflation targeting countries is lower than in other countries that adopted flexible exchange rate regime. Yet, Edwards (2006) emphasizes that IT regime has not resulted the increase of the volatility of exchange rate. More recently, Rose (2007) suggests that the volatility of exchange rate is lower for ITers than for non ITers. So, he concludes that IT does not lead the increase of exchange rate volatility.

3. METHODOLOGY

3.1. Exchange Rate Pass-Through

Exchange rate pass-through (ERPT) is generally defined as the percentage change of domestic prices resulting from a 1% change in the exchange rate between domestic and foreign countries. In this section, we investigate whether the pass-through effects have declined after the adoption of inflation targeting regime. For this purpose, we follow the studies of Campa and Goldberg (2005); Gagnon and Ihrig (2004); Edwards (2006) and Prasertnukul *et al.* (2010). Our estimation procedure is based on autoregressive distributed lag (ARDL) model.

The model takes the form below:

$$\Delta \ln P_t = \beta_0 + \beta_1 . \Delta \ln P_t^* + \beta_2 \Delta \ln P_{t-1} + \beta_3 \Delta \ln P_{t-1} \times DFLT + \beta_4 \Delta \ln P_{t-1} \times DIT + \sum_{l=0}^{1} \alpha_l \Delta \ln E_{t-l} + \sum_{i=0}^{1} \gamma_i \Delta \ln E_{t-i} \times DFLT + \sum_{j=0}^{1} \varphi_j \Delta \ln E_{t-j} \times DIT + \sum \psi_k X_k + \varepsilon_t \quad (1)$$

Where P_t is the domestic price index (consumer or producer price index), E_t is the nominal effective exchange rate (NEER), P_t^* is the index of foreign price, and ε is an error term with standard characteristics. The x_i's are the other controls variables designed to detect changes in price levels, include industrial production, oil price, and crises dummy. All data is expressed in logarithms (denoted ln).

In order to study the effect of floating exchange rate and inflation targeting regimes, we build two dummy variables DFLT[1] and DIT[2] into equation to understand whether the adoption of a floating exchange rate and IT regimes have an effect on ERPT. DFLT is a dummy variable that takes the value of one after adopting floating exchange rate regime and zero otherwise. *DIT* is a dummy variable that takes the value of one if the country has adopted inflation targeting, and zero otherwise. Besides, we include the lagged exchange rates and their interaction terms with DIT and DFLT to assess the impact of exchange rates from the past periods on the current price. Furthermore, in equation (1), we incorporate the coefficients of lagged $\Delta \ln P_t$ for two reasons. First, the incorporation of theses coefficients allows us to investigate whether the adoption of IT regime reduces inflationary inertia (Taylor, 2000). Second, it provides an another channel through which IT regime may decline the long-run ERPT (Edwards, 2006).

For the purpose of our analyze, data is divided into three sub-periods – before and after the adoption of floating exchange rate régime, and after the adoption of Inflation Targeting. For the case of Poland and Hungry, the data is divided into sub-period, before and after the adoption of inflation targeting because they have adopted IT regime before adopting floating regime. Besides, for the case of Philippines and South Africa, the dummy DFLT isn't included in the ARDL model because a floating exchange rate regime was adopted there along the period of study.

The extent of ERPT is defined as the coefficients of exchange rate[3]. To calculate the short-run and long-run pass-through, we follow the method used by Edwards (2006) and Gagnon and Ihrig (2004). During the period of pre-floating regime (pre-IT regime[4]), short-run pass-through is given by α_0 and long-run pass-through is $(\sum_{l=0}^{1} a_l)/(1-\beta_2)$. In the post-floating regime period without inflation targeting, the short-run pass-through is $\alpha_0+\gamma_0$ and long-run pass-through is $(\sum_{l=0}^{1} a_l + \sum_{i=0}^{1} \gamma_i)/(1-\beta_2-\beta_3)$. Indeed, in the post-IT period, the short-run pass-through and long-run pass-through are $\alpha_0+\gamma_0+\varphi_0$ and $(\sum_{l=0}^{1} \alpha_l + \sum_{i=0}^{1} \gamma_i + \sum_{j=0}^{1} \varphi_j)/(1-\beta_2-\beta_3-\beta_4)$, respectively. The ARDL model was estimated by ordinary least squares (OLS).

Monthly data are collected for 6 emerging economies that adopted inflation targeting regime (Brazil, Hungry, Korea, Philippines, Poland and South Africa). The time period runs from 1993 M1 to 2013 M7. For Brazil, the sample spans from 1995M1 to 2013M7.

The data are provided from the IMF International Financial Statistics. We use the CPI index and the PPI index as proxies for non-tradable inflation and domestic tradable inflation, respectively. The US PPI can be considered as a proxy for world inflation. The exchange rate is the nominal effective exchange rate (NEER). A

[1] We follow the standard exchange rate classification from the Annual Report on Exchange Rate Arrangements and Exchange Restrictions published by the International Monetary Fund (IMF) to create the variable DFLT.

[2] We follow IMF to disentangle the data of inflation targeting adoption.

[3] Many studies have imposed the condition of the law of one price (β1= β2). However, this paper does not impose this constraint.

[4] For the case of Hungry and Poland.

decrease in the index means a depreciation of the domestic currency. Oil price index and industrial production index are used as supply and demand shocks respectively. The time series properties of variables are tested by the Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) unit root tests. All variables are non-stationary at level and stationary at first difference (see table A.1 and A.2).

Table 1 and table 2 present the empirical results of ERPT using consumer and producer prices inflation for the ordinary least squares estimation. Table 3 shows the results of the estimates of the short and long-run ERPT to the CPI and the PPI over the periods of the pre-FLT regime (pre-IT regime), post-FLT regime without inflation targeting, and post- inflation targeting[5].

Table-1. Exchange rate pass-through to CPI

	Brazil	**Hungry**	**Korea**	**Philippines**	**Poland**	**South Africa**
ΔlnE_t	-0.020*** (1.76)	-0.120* (-12.85)	-0.003 (-0.10)	-0.018 (-1.01)	-0.048*** (-1.89)	-0.082** (-2.22)
ΔlnE_{-1}	-0.050* (-21.63)	-0.032 (-0.49)	0.007 (0.17)	-0.031* (-1.72)	-0.072* (-2.70)	0.014 (0.83)
ΔlnP^*	0.057* (3.19)	0.098** (2.51)	0.067** (2.41)	-0.005* (-2.74)	0.125** (2.55)	0.100* (3.49)
$\Delta lnCPI_{t-1}$	0.751* (10.78)	0.573* (12.32)	0.425* (4.54)	0.149** (2.41)	0.627* (14.04)	0.257* (10.63)
DFLT × ΔlnEt	0.020 (1.61)	-	-0.078* (-2.37)	-	-	-
DFLT × ΔlnEt-1	**0.055 (1.30)**	-	0.020 (0.36)	-	-	-
DFLT× ΔlnCPIt-1	0.053* (6.20)	-	0.512 (1.60)	-	-	-
DIT × ΔlnEt	0.003 (0.57)	0.008 (0.089)	-0.032 (-1.014)	-0.035 (-1.03)	0.044 (1.24)	0.009** (2.48)
DIT × ΔlnEt-1	0.007 (1.19)	0.003 (0.50)	-0.012 (-0.27)	0.014 (0.44)	0.043 (1.16)	-0.001 (-1.20)
DIT × ΔlnEt-1	-0.113* (5.47)	-0.017* (-5.92)	-0.226** (-2.11)	-0.207*** (1.72)	-0.410* (-2.90)	-0.133* (-11.45)
Constant	0.001* (3.75)	0.003* (5.67)	0.001* (6.10)	0.026* (3.15)	0.002* (4.18)	0.003* (6.50)
R^2	**0.61**	**0.46**	**0.38**	**0.29**	**0.53**	**0.29**

Notes: E_t is the nominal effective exchange rate(NEER), P^*_t is the US PPI, P_{t-1} is a lag of the domestic CPI, DFLT is a dummy for periods with a floating exchange rate regime, and DIT is a dummy for periods with inflation targeting. ( ) t-statistics; */1% significant; **/5% significant; ***/10% significant.

The estimation results show that the short and long-run pass-through coefficients are higher for tradable(PPI) than for non-tradable (CPI) in all countries during each sub-periods. These suggest a decrease in the extent of ERPT along the distribution chain. The results are in line with the previous findings (McCarthy, 2000; Hahn, 2003; Edwards, 2006; Faruqee, 2006; Prasertnukul *et al.*, 2010). Besides, we observe in table 2 that the long-run pass-through depends both on the coefficients of $\Delta \ln E_t$ and the inflation inertia presented by the coefficients of $\Delta \ln P_{t-1}$, $\Delta \ln P_{t-1} \times$FLT, $\Delta \ln P_{t-1} \times$DIT. Thus, the long-run ERPT is higher than short-run ERPT in all countries. In addition, we note that CPI and PPI are typified by a marked degree of inflationary inertia which means that inflation inertia significantly influence on inflation. Generally, the inflation inertia is higher for consumer price (or non-tradable) than for producer price (or tradable) in most cases (Edwards, 2006).

[5] Pre-FLT and post-FLT periods : periods before and after the adoption of floating exchange rate régime for Brazil, Korea, Philippines and South Africa. Pre-IT: period before the adoption of inflation targeting regime for Hungry and Poland. Post-IT period after the adoption of inflation targeting regime for all countries.

Table-2. Exchange rate pass-through to PPI

	Brazil	Hungry	Korea	Philippine	Poland	South Africa
ΔlnE$_t$	-0.112* (-6.94)	-0.258* (-11.96)	-0.042** (-1.99)	-0.228* (-4.34)	-0.072* (-2.65)	-0.087* (-28.98)
ΔlnE$_{t-1}$	-0.072 (-0.76)	-0.015 (-0.29)	-0.037 (-0.83)	0.055 (0.97)	-0.059*** (-1.77)	-0.019 (-0.63)
ΔlnP*	0.202* (3.08)	0.143* (2.58)	0.235* (6.60)	0.303* (3.22)	0.150* (3.41)	0.182** (2.41)
ΔlnPPIt-1	0.717* (6.49)	0.423* (5.17)	0.821* (8.05)	0.149*** (1.74)	0.601* (10.73)	0.551* (5.10)
DFLT × ΔlnEt	-0.150* (-9.03)	-	-0.170* (-8.05)	-	-	-
DFLT × ΔlnEt-1	0.033 (0.34)	-	-0.217* (-4.96)	-	-	-
DFLT × ΔlnPPIt-1	-0.309** (2.31)	-	-0.964* (-7.63)	-	-	-
DIT × ΔlnEt	0.161* (9.10)	0.109 (1.06)	0.176* (15.16)	-0.093 (-0.9□)	-0.117 (-1.51)	0.020 (0.55)
DIT × ΔlnEt-1	-0.011 (-0.52)	0.072 (0.62)	-0.202* (-8.24)	-0.097 (-0.99)	0.089 (1.51)	-0.044 (1.18)
DIT × ΔlnPPIt-1	0.212* (4.22)	-0.176* (-9.37)	-0.896* (-15.63)	-0.253*** (-1.97)	-0.287* (-3.52)	-0.082* (-7.10)
Constant	0.002* (4.45)	0.003* (5.39)	0.0004*** (1.86)	0.002* (2.70)	0.001* (4.38)	0.003* (5.53)
R^2	**0.61**	**0.47**	**0.72**	**0.21**	**0.53**	**0.17**

Notes: E_t is the nominal effective exchange rate (NEER), P^*_t is the US PPI, P_{t-1} is a lag of the domestic PPI, DFLT is a dummy for periods with a floating exchange rate regime, and DIT is a dummy for periods with inflation targeting. ( ) t-statistics; */1% significant; **/5% significant; ***/10% significant..

Table-3. Short-run and long-run exchange rate pass-through

	Exchange rate pass- through		Pre-FLT/ Pre-IT	Post -FLT	Post-IT
Brazil	Short-run	CPI	0.020	0.020	0.020
		PPI	0.112	0.262	0.101
	Long-run	CPI	0.281	0.357	0.226
		PPI	0.395	0.442	0.265
Hungry	Short-run	CPI	0.120	-	0.120
		PPI	0.258	-	0.258
	Long-run	CPI	0.281	-	0.270
		PPI	0.447	-	0.342
Korea	Short-run	CPI	0.003	0.081	0.081
		PPI	0.042	0.212	0.036
	Long-run	CPI	0.005	0.140	0.101
		PPI	0.234	0.375	0.223
Philippines	Short-run	CPI	-	0.018	0.018
		PPI	-	0.228	0.228
	Long-run	CPI	-	0.057	0.046
		PPI	-	0.267	0.206
Poland	Short-run	CPI	0.048	-	0.048
		PPI	0.072	-	0.072
	Long-run	CPI	0.321	-	0.153
		PPI	0.328	-	0.190
South Africa	Short-run	CPI	-	0.082	0.073
		PPI	-	0.087	0.087
	Long-run	CPI	-	0.110	0.083
		PPI	-	0.193	0.163

Note: Elaboration based on estimations reported in Table 1 and 2.

Besides, our results suggest that the long run and short run ERPT to both the CPI and the PPI have increased after the adoption of floating exchange rate in Korea. The same result is found in Brazil except in short-run pass-through to the CPI.

Furthermore, table 3 shows that the short run ERPT to PPI has declined in the post-IT period in Korea and Brazil. In the case of South Africa, only short run ERPT to the CPI has declined after the adoption of IT regime. The coefficients of $\Delta\ln E_t \times DIT$ have a significant effect on pass-through to both the PPI and CPI. In addition, we observe a decrease of the long run exchange rate pass-through into both consumer and producer prices after the adoption of inflation targeting for all countries. The coefficients of $\Delta\ln P_{t-1} \times DIT$ are negative and statistically significant in equation PPI and CPI. This implies that the degree of inflation inertia has decreased in the post-IT period. We can conclude that IT regime allows the decrease of ERPT. The results found go in line with Edwards (2006); Prasertnukul *et al.* (2010) and Siregar and Goo (2008).

3.2. Exchange Rate Volatility

A floating exchange rate regime constitutes a requirement for a well functioning inflation targeting regime (Mishkin and Savastano, 2001). This requirement can be explained by the theory of the "Impossibility of the Holy Trinity" where capital mobility and independent monetary policy cannot coexist with a pegged exchange rate regime. The link between inflation targeting and floating exchange rate has lead some economists to state that one of the costs of the adoption of IT regime is the higher volatility of exchange rates. There are several ways which have emerged to analyze the effects of inflation targeting on the volatility of exchange rate. Indeed, many studies compare the volatility of exchange rate under inflation targeting with fixed or managed exchange rate regime. However, Edwards suggests that it is not a correct strategy to compare these different monetary policies for the purpose of exchange rate volatility analysis. He presents that the appropriate approach to evaluate the volatility of exchange in inflation targeting regime should be made by controlling the effects of exchange rate regime.

Following Edwards (2006) and Prasertnukul *et al.* (2010) we try to evaluate the relationship between conditional exchange rate volatility and IT adoption for each country in our sample using the generalized autoregressive conditional heteroskedasticity (GARCH) model.

The GARCH model is presented by the following manner for each country:

$$\Delta \ln E_t = \alpha + \sum_{i=1}^{m} \beta_i \Delta \ln E_{t-i} + \sum_{j=1}^{n} \varphi_j x_{j,t} + \varepsilon_t \quad (2)$$

$$\sigma_t^2 = \psi_0 + \sum_{i=1}^{P} \psi_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \delta_j \sigma_{t-j}^2 + \sum_{k=1}^{s} \gamma_k y_{k,t} \quad (3)$$

Where, as mentioned, E_t is the nominal effective exchange rate (NEER); the x_j's are variables that affect changes in the nominal effective exchange rate, the ε_t is a disturbance with the properties of zero mean and conditional variance ${\sigma_t}^2$. The y_k's in equation (3), are control variables that affect exchange rate volatility.

As in Edwards (2006) we regress the conditional variance equation on two binary dummy variables *DIT* and *FLT*, to understand whether the adoption of floating exchange rate and inflation targeting regimes has an effect on exchange rate volatility. Recall that DFLT is a dummy variable that takes the value of one after adopting floating exchange rate regime and zero otherwise. *DIT* is a dummy variable that takes the value of one for countries that use inflation targeting , and zero otherwise. As already mentioned, the D*FLT* variable is not included for the Philippines and South Africa because they have floating exchange rate over the whole study period. Following the flexible-price monetary model (Taylor, 1995) we incorporate the inflation differentials (DIFL) and the interest rate differentials (DINT) in the mean equation. In the same equation, we also include a dummy crisis. The inflation differentials is the differential between the domestic price (ln PPI) and foreign price (ln us PPI). The interest rate differentials is the difference between the domestic short-term interest rate and the US federal funds rate. For the short-term interest rates, we use the money market rate for all countries.

As before, we have monthly data for the period that spans from 1993M1 to 2013 M07, with the exception of Brazil where we analyze the period from 1995 M1 to 2013 M07. Besides, as in the previous estimation, all data are collected from the International Financial Statistics(IFS). We identified the order of the GARCH model as follows: GARCH (1,1), GARCH (1,1), GARCH (2,2), GARCH (1,0), GARCH (1,1) and GARCH (1,0) applied to Brazil, Hungary, Korea, the Philippines, Poland and South Africa, respectively, according to the Akaike information criterion (AIC).

The sign of the estimated coefficient of DIT assesses the effect of the adoption of inflation, while the estimated coefficient of DFLT evaluates the effect of floating exchange rate regime. A positive coefficient of DIT means that inflation targeting is associated to higher exchange rate volatility (Mishkin and Savastano, 2001; Gali and Monacelli, 2005). However, a negative coefficient of DIT indicates that the volatility of exchange rate is lower after the adoption of IT regime. In this case, we may conclude that inflation targeting is effective in reducing the exchange rate variability. The coefficient of DFLT is expected to be positive ; it means that floating rates increase exchange rate volatility.

Table-4. GARCH Estimates: Inflation Targeting, Exchange Rate Regime and Nominal Exchange Rate Volatility

country	DIT	DFLT
Brazil GARCH (1,1)	-0.001670* (-2.71)	0.001673* (2.69)
Hungry GARCH (1,1)	-0.000309* (-3.57)	0.000454** (2.03)
Korea GARCH (2,2)	-9.35E-05*** (-1.70)	0.0103633* (14.36)
Philippines GARCH (1,0)	-0.000254** (-2.33)	-
Poland GARCH (1,1)	-0.000352* (-2.79)	3.84E-05* (2.58)
South Africa GARCH (1,0)	-0.000669* (-3.35)	-

Notes: DIT is a dummy for periods with inflation targeting, while DFLT is a dummy for periods with floating exchange rates. ( ) z-statistic ; */1% significant; **/5% significant; ***/10% significant

Table 4 sets out the main results from the GARCH model, which reported the order of the GARCH process and the estimated coefficients for the two dummy variables (DIT, DFLT), along with standard errors in parentheses. First, the estimated coefficient of D*FLT* is significantly positive for Brazil, Poland. We can conclude that floating regime increases the fluctuation of exchange rate. Second, the estimated coefficient of *DIT* is negative and significant for all countries. Thus, adopting inflation targeting allows to reduce conditional exchange rate volatility. We can conclude that the adoption of inflation targeting decreases the conditional volatility derived from the floating exchange rate regime . This result is in line with De Gregorio *et al.* (2005); Edwards (2006) and Rose (2007).

The substantial reduction in the conditional volatility of exchange rate with IT adoption may be due not only to the inflation targeting but also to the exchange rate management which is a frequent practice of emerging countries. On one side, inflation targeting makes monetary policies more credible and predictable, which could help to reduce the effect of unexpected external shocks. On the other side, despite that price stability is the main objective of central bank, they should react to exchange rate movements in order to stabilize the exchange rate. The central bank may intervene on the foreign exchange rate market in order to smooth excessive exchange rate volatility (Sarno and Taylor, 2001). Also, Eichengreen (2002) and Mishkin (2004) state that the monetary authorities increases the interest rates to fight exchange rate movements when adopting inflation targeting regime. Thus, monetary authority should take care of inflation and everything that affects it like exchange rate.

3.3. Inflation Volatility

As already known, exchange rate pass-through and exchange rate volatility are considered sources of inflation variability. Following the results found in the previous section, the adoption of inflation targeting seems to contribute to reducing of exchange rate pass-through and volatility. So, we can consider that there is a relationship between price stability and inflation targeting.

Following Prasertnukul *et al.* (2010) we try to study the effect of inflation targeting on inflation volatility for each country for the period that spans from 1993M1 to 2013 M7. We use the generalized autoregressive conditional heteroskedasticity (GARCH) model.

The GARCH model is presented by the following manner for each country:

$$\Delta \ln P_t = \alpha + \sum_{i=1}^{m} \beta_i \, \Delta \ln P_{t-i} + \sum_{j=1}^{n} \varphi_j x_{j,t} + \varepsilon_t \tag{4}$$

$$\sigma_t^2 = \psi_0 + \sum_{i=1}^{P} \psi_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \delta_j \sigma_{t-j}^2 + \sum_{k=1}^{s} \gamma_k y_{k,t} \tag{5}$$

Where P_t is the domestic price (consumer or producer price index); the x_i's are variables that affect changes in inflation. The y_k's in equation (5) are control variables that affect inflation volatility; and the ε_t is a disturbance with the properties of zero mean and conditional variance ${\sigma_t}^2$.

In the variance equation, we include *DIT* and D*FLT* to detect the impact of the floating exchange rate and inflation targeting regimes on inflation volatility. Besides, in the mean equation, we incorporate the nominal effective exchange rate (ln NEER), the foreign price (ln us PPI), the interest rate differentials (DINT) and a crisis dummy.

We identify the order of the GARCH model for the inflation volatility (CPI) as: GARCH (1,1), GARCH (1,0), GARCH (1,0),GARCH (1,0), GARCH (2,2) and GARCH (1,0) for Brazil, Hungry, Korea, the Philippines, and South Africa, respectively. While, we order the GARCH model for inflation volatility (PPI) as follows: GARCH (1,1), GARCH (2,1), GARCH (2,2),GARCH (1,0), GARCH (2,2) and GARCH (1,0) for Brazil, Hungry, Korea, the Philippines, Poland and South Africa, respectively. The order of GARCH models is identified according to the Akaike information criterion (AIC).

Table-5. GARCH Estimates: Inflation Targeting, Exchange Rate Regime and inflation volatility (CPI)

country	CPI	
	DIT	DFLT
Brazil GARCH (1,1)	-1.11E-05* (-4.00)	1.95E-06* (4.26)
Hungry GARCH (1,0)	-2.24E-05* (-3.33)	0.000940*** (1.70)
Korea GARCH (1,0)	-2.79E-06* (-11.44)	9.88E-05* (2.82)
Philippines GARCH (1,0)	-1.74E-05** (-2.20)	-
Poland GARCH (2,2)	-5.70E-05* (-10.27)	4.83E-07* (9.11)
South Africa GARCH (1,0)	-0.001589** (-2.36)	-

Notes: DIT is a dummy for periods with inflation targeting, while DFLT is a dummy for periods with floating exchange rates. ( ) z-statistic ; */1% significant; **/5% significant; ***/10% significant.

Table-6. GARCH Estimates: Inflation Targeting, Exchange Rate Regime and inflation volatility(PPI)

country	PPI	
	DIT	DFLT
Brazil GARCH (1,1)	-0.000502** (-2.17)	0.000473** (2.00)
Hungry GARCH (2,1)	-1.31E-06* (-3.27)	6.82E-06*** (1.73)
Korea GARCH (2,2)	-1.04E-05* (-4.22)	-0.000761*** (-1.96)
Philippines GARCH (1,0)	-4.49E-05* (-3.04)	-
Poland GARCH (2,2)	-2.17E-05* (-2.89)	3.39E-05*** (1.81)
South Africa GARCH (1,0)	-7.76E-05*** (-21.55)	-

Notes: DIT is a dummy for periods with inflation targeting, while FLT is a dummy for periods with floating exchange rates.( ) z-statistic ; */1% significant; **/5% significant; ***/10% significant.

Table 5 and 6 provide the results of the GARCH model for each of the six countries. The estimated coefficients of DFLT are positive and significant. This implies that floating exchange rate regime increases the inflation volatility. Therefore, all the coefficients of *DIT* are significantly negative. Thus, we can conclude that inflation targeting seems to contribute to inflation stability.

4. CONCLUSION

Our paper has examined the relationship between exchange rate and inflation targeting in six emerging countries. We assess the effect of the adoption of inflation targeting frameworks on the exchange rate pass-through to domestic inflation, on exchange rate volatility and on inflation stability.

The results found show differences in exchange rate pass-through across price indexes, as this effect seems to be higher for producer prices than for consumer prices. Furthermore, they show that exchange rate pass-through has declined after the adoption of inflation targeting for most of the economies in our sample for both consumer and producer prices. These results go in line with Taylor (2000) suggesting that exchange rate pass-through will be low in countries characterized by low inflationary environment. Besides, the inflation targeting does not increase the volatility of nominal exchange rates associated with the adoption of a floating regime. Furthermore, our results emphasize that IT helped the decline of inflation volatility. So, inflation targeting regime contributes to price stability through the decline of exchange rate pass-through and exchange rate volatility. Thus, to achieve the primary objective of price stability, the central banks should make their monetary policies more accountable and transparent to preserve the credibility of an inflation targeting regime. In addition, the central banks may intervene on the foreign exchange rate market in order to smooth excessive exchange rate volatility.

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APPENDIX

Table-A.1. Augmented Dickey-Fuller Unit Root Test

	ln NEER	Dln NEER	ln PPI	Dln PPI	ln CPI	Dln CPI	ln IPI	Dln IPI	ln OIL	Dln OIL	lnp*	Dlnp*
Brazil	-1.52	-5.46*	-0.45	-3.17**	-2.12	-5.77*	-1.55	-17.55*	-3.37	-12.9*	-2.44	-10.82*
Hungary	-2.79	-11.75*	-2.33	-8.15*	-2.75	-4.52*	-1.63	-3.07**	-3.37	-12.9*	-2.44	-10.82*
Korea	-2.25	-10.76*	-1.18	-8.46*	-2.73	-10.77*	-1.02	-5.13*	-3.37	-12.9*	-2.44	-10.82*
Philippines	-1.58	-10.79*	-2.26	-15.24*	-2.81	-12.53*	-2.34	-5.33*	-3.37	-12.9*	-2.44	-10.82*
Poland	-1.47	-11.79*	-1.078	-12.19*	-2.55	-3.32**	-1.42	-3.42**	-3.37	-12.9*	-2.44	-10.82*
South Africa	-1.44	-12.41*	-1.86	-9.17*	-1.77	-11.52*	-0.76	-9.13*	-3.37	-12.9*	-2.44	-10.82*

Note: ** and *respectively refer to significance at the 1% and 5%.

Table-A.2. Phillips-Perron Unit Root Test

	ln NEER	Dln NEER	ln PPI	Dln PPI	ln CPI	Dln CPI	ln IPI	Dln IPI	ln OIL	Dln OIL	lnp*	Dlnp*
Brazil	-1.60	-4.96*	-0.23	-3.54*	-2.57	-5.71*	-1.48	-17.55*	-2.55	-12.9*	-2.35	-10.96*
Hungry	-2.88	-11.67*	-2.16	-13.86*	-3.002	-9.47*	-2.16	-38.72*	-2.55	-12.9*	-2.35	-10.96*
Korea	-2.29	-9.35*	-1.10	-8.32*	-2.55	-10.78*	-1.55	-25.52*	-2.55	-12.9*	-2.35	-10.96*
Philippines	-1.51	-10.7*	-2.04	-15.52*	-2.79	-12.62*	-2.01	-26.25*	-2.55	-12.9*	-2.35	-10.96*
Poland	-1.63	-11.65*	3.55	-6.81*	3.64	-6.03*	-1.49	-37.84*	-2.55	-12.9*	-2.35	-10.96*
South Africa	-1.35	-12.41*	-1.81	-24.9*	-1.67	-11.77*	-0.82	-11.43*	-2.55	-12.9*	-2.35	-10.96*

Note: * refer to significance at the 1%.