Inflation Targeting and Exchange Rate Pass-Through: A Comparative Study in Emerging Markets

Olfa Manai Daboussi[1] and Necibi Thameur[2]

[1]Department of Quantitative Methods and Economies,
Higher Institute of Management of Tunis-University of Tunis, Tunisia

[2]Department of Quantitative Methods and Economies,
Higher School of Digital Economy, University of Manouba, Tunisia

ABSTRACT: This paper examines the degree of Exchange Rate Pass-Through (ERPT) to prices in 6 emerging markets that adopt inflation targeting (IT) framework in Latin America and Asia. To achieve this, we employ a modeling strategy that examines the short-run and the long-run fluctuations of the exchange rates pass-through into prices over the period from 1990:Q1-2012:Q4. The paper also finds robust evidence for a positive relationship between the degree of the ERPT and inflation. We conducted a comparative study between countries with hyperinflation and countries with moderate inflation. Estimations results confirm the presence of a positive link between prices and ERPT in emerging markets adopting inflation targeting strategy, while plausible theoretically, finds only weak empirical support in the absence of implemented of inflation targeting regime. The results show that ERPT has declined after IT framework.

KEYWORDS: Exchange rate pass-through, Inflation targeting, Emerging Markets.

1 INTRODUCTION

Movements of exchange rate pass-through into inflation have been at the center of macroeconomic debates over the past two decades. These debates have broad implications for the conduct of monetary policy, for macroeconomic stability, international transmission of shocks and efforts to contain large imbalances in economics. More recently, exchange pass-through issues play a central role over inflation targeting monetary policies. Many emerging markets have opted to change the focus of their monetary policy from targeting the exchange rate or money supply to targeting inflation.

During the 80s and before the adoption of inflation targeting (IT), these countries have experienced high inflation, which has a negative impact on economic growth and investment. Since the early 1990s, the number of ITers countries has increased because this monetary strategy presented more advantages than disadvantages for countries that have adopted it. The implementation of the inflation targeting strategy has shown that countries that have adopted this strategy have experienced low inflation followed by an economic performance (Mishkin (1998) and Woodford (2009)). Mishkin (2001) showed that inflation targeting has improved the framework for monetary policy and (IT) contributes to reducing the rate of inflation and inflation expectations. Recently, Sek (2008) and Gerlach and Tillmann (2012) concluded that (IT) framework appears to be able to realize a stable macroeconomic situation. In this respect, the success of financial policy under inflation targeting has encouraged many other countries adopting this strategy (Kurihara (2010)).

Indeed, since the introduction of the system of floating exchange rates in emerging economies, the works were sometimes conflicting and representative empirical limits. The extent to which exchange rate movements are passed on to consumer prices is an important issue in monetary economics and exchange rate policy. An important empirical and theoretical study on exchange-rate pass-through (ERPT) into import prices is emerging. (ERPT) is one of the main issues in

economics. Formally, the exchange rate pass-through (ERPT) is the percentage change, in local currency, of import prices resulting from a one percent change in the exchange rate between the exporting and importing countries.

In this respect, theoretical and empirical researches on the exchange rate pass-through to aggregate import prices have attracted a renewed attention. In this context, the focus has shifted to the stability of exchange rate pass-through over time.

Calvo (2001) and Ho and McCauley (2003) showed that high degree of pass-through in emerging countries has an important effect on inflation. They concluded from the empirical results that the degree of pass-through, related to an important degree of openness, is higher in emerging market. Moreover, countries that are characterized by a high degree of openness, their economies are influenced by the fluctuation of exchange rates. In this regard, Ghash (2013) shows that the fluctuation of the exchange rate is very noticeable in countries adopting inflation targeting and volatility of the exchange rate has a significant effect on prices through the change in prices of imported consumer goods. In practice, the degree of pass-through plays an important role in the implementation of the policy of IT. Low exchange rate pass-through can lead to a fairly independent monetary policy, which facilitates the implementation of a policy of inflation targeting (Choudhri and Hakura (2006) and Frankel and al. (2012)). Various studies have shown that ERPT has declined in recent years. Beckmann and al. (2013) confirm that the adoption of inflation targeting strategy decreases the exchange rate pass-through into prices, production and importations. Taylor (2000) and Gagnon and Ihring (2004) showed that the degree of exchange rate pass-through and inflation variability, and average inflation are highly correlated. Gagon and Ihring (2002) claim that, a greater emphasis on inflation stabilization allowed both lower mean inflation and reduced pass-through. Adolfson (2007) and Flamini (2007) show that the effectiveness of monetary policy is often conditioned upon the degree of exchange rate pass-through. According to Adolfson (2007), when the pass-through is incomplete, an implicit response to pass-through via CPI inflation targeting is preferred for the conduct of monetary policy that integrates an explicit exchange target, suggesting that the degree of pass-through may contribute to the improvement of monetary policy and reduce average inflation. While for open adopting inflation targeting countries, the transmission of exchange rate changes to prices is an ambiguous effect. This ambiguity is explained by the role of the central bank to stabilize its objectives, namely price stability.

However, work addressing the role of the exchange rate within the framework of inflation targeting are very scarce and the theoretical and empirical analyzes are still mixed (Odría and al. (2013)).

To overcome this limitation, it is necessary to use the VAR model justifies by error correction model (VECM). This econometric model provides advantage to generate changes of ERPT in ITers emerging countries.

We are interested in analyzing two basic aspects of this issue:

- Whether ERPT is an important determinant of inflation in the short-run and in the long-run for these countries.
- Whether this effect has indeed decreased after the adoption of IT.

To answer these questions we estimate the short-run and the long-run ERPT after the adoption of IT. We also calculate ERPT for 6 emerging market that adopted IT (Brazil, Mexico, Peru, Thailand, Indonesia and Philippines) in order to compare results and hence to provide some evidence with respect to the hypothesis that ERPT is low for emerging that adopted IT framework. This evidence sheds some light on the relevance of ERPT for emerging markets adopting the IT framework.

The aim of this paper is to present new empirical evidence regarding ERPT in ten emerging markets that adopted IT (see table A in appendix). However, we investigate the effect of ERPT on prices particularly on inflation rates; distinguish between ITers emerging countries in Latin America that experienced hyperinflation and Asian ITers emerging countries with inflation rate moderated.

Thus, we hope to achieve two goals in this work: one is to contribute to the economic literature on the topic; and the other is to have a more reliable yardstick available in order to establish a comparative empirical approach that allows providing robust answers to analyze the relationship between the degree of pass-through and its effect on inflation in some ITers emerging market that experienced hyperinflation in 80 and 90s.

We structure the paper such that section two present empirical analyses and introduces the dataset. In section three gives the estimations results. Finally, we give the conclusion. The paper has additional table in the appendices.

2   EMPIRICAL STUDY

Our aim is to test the variability of (ERPT) over time. For robustness, we seek what are the common characteristics of (ERPT) in emerging countries and what are the factors behind this change.

The contribution of the paper is twofold; first, we estimate time-varying pass through using the VAR approach to account for gradual changes in exchange pass-through into the rate of inflation measured by the consumer price index (IPC). Second, we study the evolution of pass-through. We study the evolution ERPT specific explanations in case of emerging countries in our sample. Empirical estimates will contribute to the improvement of our knowledge of degree of exchange rate pass-through into inflation when the emerging market using inflation targeting framework.

2.1 ECONOMETRIC METHODOLOGY

In this paper, we look at the movements of ERPT for some emerging markets that adopted Inflation Targeting (IT). We consider a new approach to study the variations in the degree of exchange rate pass-through. We estimate the effects of proposed explanatory variables and test their significativity.

To estimate ERPT, it is generally useful to consider an augmented Phillips curve with the following structure:

$$\pi_t = \alpha + \sum_{i=1}^{k} \beta_i \pi_{t-i} + \gamma(y_{t-1} - \bar{y}_{t-1}) + \sum_{i=1}^{k} \theta_i \Delta txc_{t-i} + \varepsilon_i \qquad (1)$$

Where: π_t is the inflation rate that is equal to the logarithmic difference of the CPI, $y_{t-1} - \bar{y}_{t-1}$ is the output GAP, $\bar{y}_{t-1}$ is obtained from the Hodrick-Prescott filter applied to the GDP series and Δtxc_{t-i} is the log change in the exchange rate which is increasing the term of the Phillips curve.

Thus, the coefficient γ represents the short-run ERPT. However, the long-run ERPT is obtained by the calculated

$$\emptyset = \sum_{i=1}^{k} \theta_i / 1 - \sum_{i=1}^{k} \beta_i.$$

However, it should be noted that in the long-run the entire variable may represent a long-run stationary relationship.

Therefore, the long-run ERPT represented by β_0 is obtained by considering the following equation:

$$cpi = \alpha + \beta_1 y_t + \beta_0 txc_t + \epsilon_t \qquad (2)$$

In this case, the short-run dynamics cannot be shown until a ECM via equation (3) and the impact of short-run ERPT in this case is equal to $\omega = \theta_1 + \varphi\beta_0$.

$$\pi_t = \alpha + \sum_{i=1}^{k} \beta_i \pi_{t-i} + \gamma(y_{t-1} - \bar{y}_{t-1}) + \sum_{i=1}^{k} \theta_i \Delta txc_{t-i} + \varphi ECT_{t-1} + \varepsilon_i \qquad (3)$$

Where: $ECT_{t-1} = cpi - \alpha - \beta_1 y_t - \beta_0 txc_t$

2.2 DATA

The methodology used is as follows, when there is no co-integrating relationship, the analysis focuses on a VAR model in logarithmic difference. But at this work considering that ERPT is shown in terms of the VECM. In the absence of a co-integrating relationship, we add other variables such as the price of oil and IPP and find their theoretical justification on augmented Phillips curve.

According to IMF researchers, 6 of the emerging member countries had adopted IT (with flexible exchange rates) by 2007. The data are quarterly and span the period 1990:1-2012:4. They are obtained from International Financial Statistics. In this regard, we use GDP, IPC (consumer price index) and IPP (production price index) are expressed in logarithm and the nominal exchange rates variable (txc) as a dependent variable. The application of Augmented ADF tests ensures that all variables retained are integrated of order I (1), in this case the Johansen co-integration test is applied. In most cases, the test of the maximum eigen-value confirms the existence of a co-integration relationship within each group of variables at significance level of 1%. The choice of the number of lags is determined using Information Criteria (AIC), Bayesian Information Criteria (BIC) and Hannan-Quinn (HQ), on the criterion of non-autocorrelation of the residuals, the absence of heteroscedasticity (portmanteau test). The results in general show a certain stabilities when changing the number of lags.

3 ESTIMATION RESULTS

In order to achieve our objective of estimating the ERPT on CPI inflation for the ITers emerging markets: Asia and Latin America economies, we presents the econometric test of the variability of ERPT over time. For robustness, we seek what are the common characteristics of ERPT in emerging countries and what are the factors behind this change. We are interested to the dynamic of the long and the short-run of ERPT into inflation.

Results in table 1 suggest that the variation of the exchange rate is transmitted to the inflation with 30% and 35% in (respectively 31.3% in Mexico and 35.25% in Brazil) in the long-run. However, specific estimates in case of ITers Asian countries (Thailand, Philippines) show that the variation of the exchange rate is transmitted to the inflation only 17.58 % to 24.02 % in the long-run, excepted Indonesia the rate is higher (44%).

For the case of Peru, prices respond about 18.19 % for a 1% change in the exchange rate. These results show that ERPT is incomplete and the transmission of the variation in the nominal exchange rates to the real rate is low. According with Taylor (2000) proposition that the decline of pass-through coefficient is caused by a fall in inflation, estimation results of the sign of coefficient corresponds to a decline of both inflation and pass-through. Incomplete ERPT is explained by the low exchange rate mechanism. Monetary authorities do not have enough knowledge to respond quickly to price changes despite implementing inflation targeting framework by their Central Bank. In this context, recent studies suggests that the depreciation of currency should lead to decrease inflation and there is a negative relationship between exchange rate depreciation and inflation for some economies (Mwase (2006), Ca' Zorzi, Hahn and Sánchez (2007)). In this regard, an explanation has been provided by He, Liu and Zhang (2009).

Table 1. Long-run and short-run ERPT and their average in ITers emerging markets

	$\beta2$, txc	Short-run ERPT	On %	On%
Thailand	0.24	0.0169	24.02	1.692
Philippines	0.17	0.05	17.58	0.549
Peru	0.18	0.039	18.19	3.93
Mexico	0.35	-0.14	35.25	-14.09
Indonesia	0.43	-0.043	43.90	-4.30
Brazil	0.31	0.03148	31.13	3.14
Average	0.28 28%	-0.0076 -0.76%		

Source: Author's estimations.

However, our estimations in table 2 show that there is some evidence of co-integration between all variables of model. On the short-run dynamics, all the coefficients of error correction terms are negative. This confirms that the dynamic system converges to a long-run equilibrium (see table 2).

Table 2. Long-run ERPT into CPI inflation in ITers emerging markets

Periods		C	β_0, GDP	β_1, oil	β_2, txc	β_2, IPP	CointEqua
1995Q1→ 2010Q4	Brazil	3.075	-1.729 (57.62)		-0.311 (17.65)		-0.149 (-5.074)
1990Q1→ 2012Q4	Mexico	1.956	0.076 (0.734)	0.059 (9.07)	-0.352 (5.569)	-1.195 (16.58)	-0.310 (-7.807)
1990Q1→2 011Q4	Peru	-1.881	-0.488 (-11.56)		-0.1819 (-3.907)		-0.1142 (-17.78)
1993Q1→ 2011Q4	Thailand	-2.160	-0.221 (-4.261)		-0.240 (-3.225)		-0.020 (-0.843)
1995Q1→ 2011Q4	Indonesia	5.228	-1.225 (-11.85)		-0.439 (-2.01)		-0.199 (-2.731)
1995Q1→ 2011Q4	Phillipines	1.579	-1.146 (-12.54)		-0.175 (-1.965)		-0.119 (-4.217)

Source: Author's estimations.
Numbers in parenthesis are t-student.
CointEqua: error-correction parameter

Flowing, comparing the results in table 1 and table 2, in this sample, it is clear that the long-run ERPT is higher than the short-run ERPT, as expected. In all countries, the average of short-run ERPT is (-0.16 %). This result show a 100% increase in the exchange rates leads to a decrease of 0.16 % inflation one quarter later.

Among the 6 countries studied, only Indonesia and Mexico have a negative short-run ERPT (- 4.3 % and -14.09 %) respectively. Thailand, Philippines, Peru and Brazil marked a positive short-run ERPT (see table 3). These results are same to Choudhri and Hakura (2006) and Ca'Zorzi, Hahn and Sanchez (2006) study for emerging markets. Furthermore, they show that ERPT has declined for both regions after IT for most emerging markets economies analyzed. However, ERPT still seems to be an issue for the achievement of the inflation targets.

The results show that ERPT has decreased after the adoption of IT for most of emerging markets sample. Nevertheless, the reduction of ERPT after the adoption of IT in the emerging economies analyzed (Latin America and Asia) is justified by the important role of the monetary policy change.

For the two groups ITers economies, the contemporaneous impact of the exchange rate on inflation in the long-run is positive suggesting that the depreciation of exchange rate would lead to decrease in inflation after the implemented in inflation targeting framework during 2000s' (see table A in appendix).

Moreover, the results confirm that the literature on this issue acknowledges the importance of the inflation environment and the monetary policy credibility in determining ERPT (Eichengreen (2002) and Schmidt-Hebbel and Werner (2002). In this regard, when inflation is lowered and stabilized, the economists can explain this by the importance of the institutional role of the Central Bank to counter inflation which justifies the gains on credibility of monetary policy facing decrease of the ERPT (He, Liu and Zhang (2009)).

Table 3. ERPT into CPI inflation: Error correction model

	Thailand	Philippines	Peru	Mexico	Indonesia	Brazil
Constant	0.0051	0.0272	0.0282	0.0102	-0.0005	0.0185
	(1.308)	(4.2901)	(18.589)	(5.288)	(-0.033)	(5.277)
π_{t-1}	0.432	0.0247	0.066	0.833	0.1303	0.374
	(2.937)	(0.195)	(2.685)	(5.128)	(0.857)	(0.467)
π_{t-2}	-0.1948	-0.1568	0.0638	-0.367	0.091932	-0.0874
	(-1.203)	(-1.258)	(3.3025)	(-1.915)	(0.5631)	(-0.897)
π_{t-3}	-0.0541	-0.1687	____	0.3715	0.0727	____
	(-0.347)	(-1.399)		(2.035)	[0.461)	
π_{t-5}	-0.207	-0.132	_____	_____	-0.0612	____
	(-1.246)	(-1.077)			(-0.445)	
π_{t-4}	0.1869	_____	0.2144	0.1239	_____	_____
	(1.210)		(1.174)	(0.839)		
Δtxc_{t-1}	0.0119	-0.0155	0.0372	-0.250	-0.1307	-0.0149
	(0.493)	(-0.436)	(2.312)	(-10.768)	(-0.505)	(-1.184)
Δtxc_{t-2}	0.0082	-0.0046	0.0019	0.0097	0.0838	-0.010
	(0.328)	(-0.127)	(0.148)	(0.239)	(0.333)	(-0.843)
Δtxc_{t-3}	0.0121	-0.044	_____	-0.068	0.306	_____
	(0.406)	(-1.194)		(-1.761)	(1.315)	
Δtxc_{t-4}	-0.018	-0.083	_____	-0.030	0.267	_____
	(-0.565)	(-2.209)		(-0.834)	(1.184)	
Δtxc_{t-5}	-0.007	-0.046	_____	_____	0.294	_____
	(-0.225)	(-1.215)			(1.252)	
ECT_{t-1}	-0.02	-0.119	-0.114	-0.310	-0.1998	-0.1491
	(-0.843)	(-4.217)	(-17.78)	(-7.807)	(-2.731)	(-5.074)
Short − run ERPT	0.0169	0.05	0.039	-0.14	-0.043	0.031

Source: Author's estimations.

Numbers in parenthesis are t-student. ERPT = $\omega = \theta_1 + \varphi\beta_0$

4   CONCLUSION

In this work, we presented evidence on (ERPT) for a set of emerging market economies. Our analysis comparing the dynamic of (ERPT) in ITers countries that experienced hyperinflation in 90s (Latin America economies) and others that experienced a moderated inflation (Asian economies).

We examine the (ERPT) of CPI inflation, for selected economies including 6 emerging market adopting inflation targeting by the end of 2007. Using a VECM model to detect long and short-run relationship. We ask if this regime change was followed by a decrease of ERPT into inflation, and therefore the extent to which monetary policy can be restructured to control inflation and achieving goals. Regarding the hypothesis that ERPT is high in emerging markets, we find robust results: it seems that after implemented of inflation targeting regime ERPT is reduced remarkably in countries that experienced hyperinflation. In this regard, we find similar results between our sample emerging markets. In this respect, we find that ERPT into CPI inflation plays an important role in emerging market when the IT is implemented. However, a decrease in (ERPT) decreases inflation. Nevertheless, the role of ERPT is strong for the economies analyzed, and still appears to be a significant variable driving inflation over the short and the long-run.

Empirical results are consistent with economic theory and are robust to the specification of parameters of the model. In this respect, the literature on this issue acknowledges the importance of the inflation environment and the monetary policy credibility in determining ERPT. The problem of having a high ERPT is that it implies that Central Bank has a greater difficulty for attainment of the inflation targets (Fraga, Goldfajn and Minella (2003). In this context, Eichengreen (2002) suggested that the main reason for a higher ERPT in emerging market lies on the lack of credibility of their monetary authorities.

Likewise, the estimation results will help to understand the relationship between the exchange rate and inflation, which could help policy-makers to better guide the adopted monetary policy. From the results above it is possible to observe that ERPT is an important issue under IT framework, as exchange rate movements have serious inflationary implications and our contribution to the economic literature on the topic can invite others emerging market in MENA region like Tunisia, Morocco and Egypt to converge to adopt this monetary regime.

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APPENDIX

Table A. Effective IT adoption dates and average inflation in emerging inflation targeters

	Effective IT adoption date	Pervious anchor	Average inflation 1981-90	Average inflation 1991-02	CPI inflation rate at start of stable targeting
Brazil	1999M6	Exchange rate	699.8	507.4	5.7
Mexico	2001M1	Money supply	69.8	16.5	5.7
Peru	2002M1	Money supply	1,061.7	200.7	-0.1
Thailand	2000M5	Money supply	4.4	4,0	0.8
Indonesia	2005M7	Money supply	11.4	8.41	-------
Philippines	2002M1	Exchange rate And Money supply	14.8	8.1	1.8

Source: Pétursson (2005), IFS and Roger (2009).