The Impact of Exchange Rate Volatility on Import Price Index (Cross Country Analysis)

Majid Feshari

ABSTRACT: The relationship between exchange rate instability and import price index as a proxy for exchange rate pass-through is one of the important issues in international finance literature. Hence, the main objective of this paper is to investigate the impact of monetary regime and exchange rate volatility on the import price index in two groups of countries with the exchange rate anchor versus inflation targeting monetary regime over the period of 1999-2014. For this purpose, 15 and 43 countries have been selected as countries with exchange rate anchor and inflation targeting monetary regime according to IMF classification. The empirical model has been estimated by applying dynamic panel data approach and GMM estimator for these two groups of countries. Empirical findings of this research show that exchange rate volatility has negative effect on the unit value of imports in the two groups of countries. By results of this paper it can be argued that countries with exchange rate anchor monetary regime and high exchange rate volatility, policy makers and monetary authors should adopt credible monetary policies such as inflation targeting to the control of exchange rate fluctuations on import price level.

KEYWORDS: Exchange Rate Volatility, Import Price Index, Monetary Policy, Dynamic Panel Data Approach.
1. INTRODUCTION

The relationship between exchange rate movements and price adjustments of traded goods, which is termed as exchange rate pass-through (ERPT) has long been debated in the field of international economics. Exchange rate pass-through is defined as the percentage change in local currency import prices resulting from a one percent change in exchange rate between exporting and importing countries. In the exchange-rate pass-through literature, pass-through is considered complete when the response is one-for-one and 1 percentage change in the exchange rate results in a 1 percent change in the import price. If pass through is less than complete we have evidence of pricing in the local currency of importers or Pricing to Market (PTM). Incomplete pass through can be due to micro factors such as market structure and product differentiation as well as macroeconomic variables like exchange rate movements, trade openness, monetary policy and trading partner’s production cost.

According to An (2006), McCarthy (2009) and Sowah (2009), exchange rate volatility is one of the main determinants of exchange rate pass-through. The effect of exchange rate volatility on pass-through depends on the whether exchange rate movements are perceived to be transitory or persistent. When exchange rate volatility is high, the cost of price adjustment also rises. If the exchange rate shock is perceived to be transitory, exporters and importers would be more will to adjust their profit margins rather than change prices. However, if the shock is expected to persist, then exporters and importers would be more likely to change prices.

In addition, the exchange rate pass-through is related to monetary regime and inflationary environment. Taylor (2000) argues that in a model with staggered prices and monopolistic competition, low inflationary environment leads to a low exchange rate pass-through to import and domestic prices. Since the 1980s, there has been a growing interest in examining the relationship of the exchange rate pass-through with monetary policy behavior and exchange rate volatility. Several studies have examined the effect of exchange rate volatility and monetary policy on the exchange rate pass-through in developed and developing countries. Devereux and Engel (2001) shows that low exchange rate variability and stable monetary policy has resulted to the low of exchange rate pass-through. Wickremasinghe and Silvapulle (2003) pointed out that there is a positive relationship between exchange rate pass-through and exchange rate volatility for Japan. Kiptui, Ndolo, and Kaminchia (2005) find that an exchange rate shock leads to a sharp increase of import price index in Kenya. Choudhri and Hakura (2006) provided a link between the low inflationary environment and exchange rate pass-through. Kun and Zhanna (2008) concluded that exchange rate volatility has led to the increase of exchange rate pass-through. Nogueira et al (2010) found that exchange rate pass-through has declined with a shift to a low inflationary environment. Byrne et al (2010) showed that exchange rate volatility has a negative effect on the exchange rate pass-through. Aguerre et al (2012) suggested that exchange rate volatility and monetary policy play a crucial role in exchange rate pass-through.

The review of empirical studies on the exchange rate pass-through literature shows that there is no study on the effects of exchange rate volatility and monetary regime on the exchange rate pass-through in countries with different monetary regime and exchange rate arrangements. Hence, for fill out this gap, the main contribution of this paper is to investigate the effects of exchange rate volatility and monetary regime on the import price index in countries with the inflation targeting monetary policy\(^2\) versus exchange rate anchor\(^3\) over the period of 1999-2014.

\(^2\) In inflation targeting regime, monetary policy decisions are guided by the deviation of forecasts for future inflation from the announced inflation target, with the inflation forecast acting (implicitly or explicitly) as the intermediate target of monetary policy. These regimes cover the managed floating with no pre-determined path for the exchange rate and independently floating regime.

\(^3\) In the exchange rate anchor regime, the objective of monetary authority is to buy or sell foreign exchange at given rates to maintain the exchange rate at the certain range. So, the exchange rate serves as the nominal anchor or intermediate target of monetary policy. These regimes consist of exchange rate regimes with no separate legal tender, currency board arrangements, fixed pegs with or without bands, and crawling pegs with or without bands.
The remainder of the paper is organized as follows. In the next section, the review of literature has been reviewed in theoretical framework and empirical studies section and then, empirical model and data collection have been introduced. In section 4, empirical findings have been reported and the final section has been devoted to conclusion and policy implication.

2. LITERATURE REVIEW

The theoretical literature between exchange rate volatility and exchange rate pass-through indicate that the direction of this nexus is not clear. Higher exchange rate volatility is typically associated with lower ERPT (i.e. negative link) in a highly competitive environment because exporters are prepared to let their markup fluctuate seeking to hold or increase market share (Froot and Klemperer, 1989). On the contrary, if exporters seek predominantly to stabilize their profit margins they will tend to maintain fixed the prices in their own currency, i.e. higher ERPT, and so the expected effect is positive (Devereux and Engel, 2002). As noted by Gaulier et al. (2008), this ambiguous nexus reflects a tradeoff in the exporter’s main strategy, namely, to stabilize export volumes or marginal profits. A related argument is whether the volatility shock is perceived as long-lasting or short-lived by exporters; in the latter case, they are more likely to adjust down their profit margins rather than incur the costs associated with frequent price changing (Froot and Klemperer, 1989).

There are theoretical arguments and stylized facts arising from the relationship between the import prices and the exchange rate volatility (Kendall, 1989; Parsley and Cai, 1995; Dhalokia and Raveendra, 2000). Therefore, it is reasonable to assume that the profit margin of exporters depends on the exchange rate volatility. In this case import prices respond to the changes in domestic prices and the exchange rate volatility. By assuming a perfect competitive situation in the domestic market, exporters consider only the changes in exchange rate volatility and domestic prices in their pricing decisions. In addition, the monetary policy is one of the main determinants in exchange rate pass-through. According to Taylor (2000), Hakura (2001), Baiiliu and Fujii (2004) and Sowah (2009) countries with credible monetary regimes such as inflation targeting and low inflationary environment have experienced a lower degree of exchange rate pass-through. So the countries with inflation targeting monetary regime have managed to reduce their inflation rate and have subsequently entered in to a period of relative price stability. The stability of relative prices in these countries has resulted in creating more stable inflation environment and decline in exchange rate pass-through.

Export partner’s production cost is another variable that is include in the empirical estimation of exchange rate pass-through to import prices. Inclusion of this variable provides support for the notion that exporting firms adjust their mark-ups in response to fluctuations in the exchange rate. The export partner’s production cost is used as a proxy for measurement of marginal cost. A rise in the marginal costs in foreign currency should also lead to an increase in import prices through the cost channel as the firms would be looking to recover the cost of production by charging higher prices.

On the empirical aspect, there exist many studies on the estimation of exchange rate pass-through to import prices. For instance, Mann (1989) by using of quarterly data over the period of 1973:1-1988:2 estimated the exchange rate pass-through to import prices in United States. The results of this study reveal that exchange rate fluctuations and marginal production costs have positive and significant effects on the import price index. Goldfajn and Werlang (2000) analyzed the effects of real GDP and exchange rate volatility on the import price index for OECD and non-OECD countries during the 1980-1998. They found that exchange rate volatility and real GDP have positive and significant effect on the import price index. Campa and Goldberg (2001) investigated the main determinants of exchange rate pass-through for twenty three OECD countries over the 1975-2000. The results of this study indicate that exchange rate volatility, real GDP and exporter’s marginal cost have positive effects on the import prices in these countries. Baiiliu and Fujii (2004) using annual data for 11 industrialized countries during
the 1977-2001 found that exchange rate pass-through has declined with a shift to a low-inflation environment brought about by a change in the monetary policy regime. More specifically, the results suggest that pass-through to import, producer, and consumer price indices declined following the inflation stabilization that occurred in many industrialized countries in the early 1990s.

None of previous studies has attempted to look at the impact of monetary regime on the exchange rate pass-through, so the prime objective of this study is to fill out this gap by investigating the effects of monetary regime on the exchange rate pass-through under exchange rate volatility for two categories of countries. The first category consists of the countries with the exchange rate anchor and second group comprise of countries with the inflation targeting monetary regime. In order to examine the responsiveness of import prices to the exchange rate pass-through in presence of the monetary regime and exchange rate volatility in selected countries the defacto exchange rate classification and dynamic panel data approach have been used over the period of 1999-2014.

3. EMPIRICAL MODEL AND DATA COLLECTION

In order to investigate the effects of monetary regime and exchange rate volatility on the import price index in countries with the exchange rate anchor versus inflation targeting monetary regime and according to the economic literature as well as empirical studies by Kim (2007), Kun Sek and Kapsalyamova (2008), Sowah (2009) and Juntila and Korhonen (2012) the dynamic model in terms of logarithm has been specified as follows:

\[ \text{LIP}_t = \beta_1 + \beta_1 \text{LIP}_{t-1} + \beta_2 \text{NEER}_t + \beta_3 \text{Regime} \times \text{LNEER}_t + \beta_4 \text{EX_VOL} \times \text{LNEER}_t + \beta_5 \text{LMC}_t + \varepsilon_t \]  

(1)

In above equation, IP is unit value of imports (as a proxy for import price index); \( \text{LIP}_{t-1} \) represent the first order lag of unit value of imports; \( \text{NEER} \) is nominal effective exchange rate. This variable is defined as the trade weighted average of country’s exchange rate against other currencies. Using the NEER in instead of nominal or real exchange rate allows for some variation in the exchange rate and makes it possible to estimate the degree to which the exchange rate fluctuations get passed through to import price index. On the base of IMF definition for NEER, this variable is expressed as an index of the foreign currency value per unit of domestic currency. Hence, an increase of NEER represents the appreciation of domestic currency. \( \text{Regime} \times \text{LNEER} \) is the cross effects of monetary regime with nominal effective exchange rate in two group countries. Regime is a dummy variable that take value one, if the countries adopt exchange rate anchor or inflation targeting monetary regime between 1999-2014 and zero otherwise. \( \text{EX_VOL} \times \text{LNEER} \) is cross effects of exchange rate volatility with nominal effective exchange rate in two group countries. \( \text{EX_VOL} \) is exchange rate volatility that defined standard deviation of nominal effective exchange rate over there years. According to Barhoumi (2005), Kim (2007) and Sowah (2009) exchange rate volatility has been defined as follows:

\[ \text{LMC} = \text{LIP} - \text{NEER} \]

\[ \text{EX_VOL} = \sigma_{\text{NEER}} \]

\[ \varepsilon_t \]

\[ \text{Regime} \]

4 On the base of IMF monetary regime and exchange rate classification (2009), countries with exchange rate anchor regime consist of 15 countries which Iran is on the fifteen countries in this group. In second group, there are 44 countries with inflation targeting monetary regime and managed float or independently floating exchange rate arrangements.

5 The defacto exchange rate classification has been reported by IMF after the 1999, for this reason, the period of this study has limited to the period of 1999-2014.
\[ EX_{VOL} = \sum_{i=1}^{T} \left( \frac{NEER_{i,t+3} - NEER_{i,t}}{NEER_{i,t}} \right)^2 \] (2)

In above formula, T and NEER are number of periods and nominal effective exchange rate for country i. MC is marginal cost of export partner’s. To measure exporting partner’s production cost, we follow Campa and Goldberg (2001), Sowah (2009) and Ceglowski (2010) methodology and construct a proxy as follows:

\[ MC = \left( \frac{NEER_{j,t}}{REER_{j,t}} \right) \times P^j_t \] (3)

In this formula, NEER and REER are the nominal and real effective exchange rate for importing country j respectively, and P^j is the consumer price index in importing country j.

As mentioned in review of literature, the expected sign of coefficients are:

\[ \beta_1, \beta_2, \beta_3, \beta_4 < 0 \quad \text{and} \quad \beta_5 \text{ for countries with the exchange rate anchor monetary regime should be negative and in second group is expected to be positive.} \]

For investigation of monetary regime and exchange rate volatility effects on the import prices in two group countries, the empirical model has been estimated by dynamic panel data approach\(^6\). Dynamic panel-data method developed by Arellano and Bond (1991) based on work by Anderson and Hsiao (1981) and Holtz-Eakin, Newey, and Rosen (1988). Their approach involves taking the first difference of equation (1) to remove the individual effects.

Although the model in first differences form is still characterized by a correlation between the lagged dependent variable and the disturbance term, Anderson and Hsiao demonstrated that, without the individual effects, there is a simple instrumental variables estimator available. They thus proposed instrumenting for the lagged dependent variable with either the lag of the level or the first difference of the dependent variable; both of these instruments are suitable, given that they are uncorrelated with the disturbance term but correlated with the lagged dependent variable.

Their methodology also relies on the assumption that there is no second-order correlation in the first-differenced error terms. Using this instrument matrix, Arellano and Bond (1991) derive a GMM estimator as well as two specification tests for this estimator that can be used to test the validity of the instruments (Sargan test of over-identifying restrictions) and test of second-order autocorrelation in the first-differenced residuals. The dynamic panel data can be written as follow equation:

\[ y_{it} = \alpha y_{i(t-1)} + x_{i1 \times T} \beta + \eta_i + \nu_{it}, \] (2)

Together with the assumption

\[ E(\nu_{it} | x_{i1}, \ldots, x_{iT}, \eta_i) = 0 \quad (t = 1, \ldots, T) \] (3)

An equation of this type might also contain lags of x and/or additional lags of y, but equation (2) capture the essential feature of the model that we wish to discuss. Namely, a dynamic effect of x on y for which the speed of adjustment is governed by the coefficient of lagged y.

Assumption (3) implies that x is uncorrelated to past, present and future values of \( \nu \), and hence it is a strictly exogenous variable. It does not rule out correlation between x and the individual effect \( \eta \). Lagged y will be correlated by construction with \( \eta \) and with lagged \( \nu \), but it may also be correlated with contemporaneous \( \nu \) if \( \nu \) is serially correlated, which is not ruled out by (3).

\(^6\) As discussed by Arellano and Bond (1991), the dynamic panel data approach is suitable method for estimation of model when the time dimension of the panel is small.
Thus, lagged \( y \) is effectively an endogenous explanatory variable in equation (2) with respect to both \( \eta \) and \( v \).

The data set for all variables of model has been collected from World Bank indicators (WDI) and international financial statistics (IFS) CD-ROM over the period of 1999-2014.

### 4. Empirical Findings

This section presents the results of model estimation by AB approach for two group countries. At first, the results for countries with the exchange rate anchor monetary regime are reported in Table 1.

<table>
<thead>
<tr>
<th>Intercept and Explanatory Variables</th>
<th>Coefficient</th>
<th>Z-value</th>
<th>Probability Value (PV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( C )</td>
<td>0.11</td>
<td>0.11</td>
<td>0.91</td>
</tr>
<tr>
<td>( LIP_{t-1} )</td>
<td>0.59</td>
<td>17.32</td>
<td>0.000</td>
</tr>
<tr>
<td>( LNEER )</td>
<td>-0.26</td>
<td>-2.36</td>
<td>0.018</td>
</tr>
<tr>
<td>( \text{Re} \text{gime} * LNEER )</td>
<td>-0.017</td>
<td>-2.93</td>
<td>0.003</td>
</tr>
<tr>
<td>( \text{EX_VOL} * LNEER )</td>
<td>-0.06</td>
<td>-3.61</td>
<td>0.000</td>
</tr>
<tr>
<td>( LMC )</td>
<td>0.66</td>
<td>5.89</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Sargan Statistics : \( \chi^2 (28) = 13.05 \) PV(0.99), Observations: 142, Countries: 15

Source: Authors Computations

The results of Table 1 show that nominal effective has negative and significant effect on the domestic price index in first group countries. In other words, an increase of domestic currency against foreign currencies is accompanied with the decrease of demand for domestic produced goods and consequently domestic price level will also decrease. The first order lag of unit value of imports has a positive effect on the unit value level in current period. This result indicates that with increase of import prices in before period, per unit value of imports in these countries will increase. In addition, the cross effect of monetary regime with nominal effective exchange rate has negative effect on the exchange rate pass-through. Hence with adoption of exchange rate anchor monetary regime in these countries, it is expected that the exchange rate pass-through increased. The cross effects of exchange rate volatility with the nominal effective exchange rate has also negative and significant effect on the per unit value of imports. Therefore, with increase of exchange rate volatility, cost of price adjustment also rises and consequently import price index will also increase. The elasticity of import price index with respect to export partner’s marginal cost is estimated at about 0.66 and one percent increase of marginal cost in exporting partner’s has resulted to the 0.66 percent increase in import price level. According to the results of model estimation in countries with exchange rate anchor monetary regime, we can conclude that the degree of exchange rate pass-through in presence of monetary regime and exchange rate volatility is estimated in about of -0.34. Hence, the adoption of exchange rate anchor monetary regime and increase of exchange rate volatility has intensified the exchange rate pass-through to import prices in these countries. Moreover, the value of Sargan statistics with \( \chi^2 \) distribution is 13.05 which indicate that the instrumental variable of model\(^7\) is valid and uncorrelated with the error term. In next stage, the order of autocorrelation in first differenced error term is tested by AB statistics. The results of this test has presented in

\(^7\) In empirical model, the second order lag of LIP is considered as an instrument variable.
Table 2:

Table 2. Arellano-Bond test for order of autocorrelation in first-differenced errors

<table>
<thead>
<tr>
<th>Order</th>
<th>Z-value</th>
<th>Probability Value (PV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-2.40</td>
<td>0.016</td>
</tr>
<tr>
<td>2</td>
<td>-0.11</td>
<td>0.91</td>
</tr>
</tbody>
</table>

Source: Authors Computations

According to Table 2, we can argue that the order of autocorrelation in first-differenced errors is one. This result supports the use of AB method to eliminate the country fixed effects.

In next section, the results of model estimation for countries with inflation targeting monetary regime has presented in Table 3.

Table 3. The Estimation Results for Countries with Inflation Targeting Monetary Regime

<table>
<thead>
<tr>
<th>Intercept and Explanatory Variables</th>
<th>Coefficient</th>
<th>Z-value</th>
<th>Probability Value (PV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.31</td>
<td>-5.38</td>
<td>0.000</td>
</tr>
<tr>
<td>$LIP_{t-1}$</td>
<td>0.79</td>
<td>193.86</td>
<td>0.000</td>
</tr>
<tr>
<td>$LNEER$</td>
<td>-0.1</td>
<td>-7.82</td>
<td>0.000</td>
</tr>
<tr>
<td>Re$gime^{*}LNEER$</td>
<td>0.007</td>
<td>20.10</td>
<td>0.000</td>
</tr>
<tr>
<td>EX$_VOL^{*}LNEER$</td>
<td>-0.07</td>
<td>-27.76</td>
<td>0.000</td>
</tr>
<tr>
<td>$LMC$</td>
<td>0.38</td>
<td>24.03</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Sargan Statistics: $\chi^2(34) = 42.13$ PV(0.16), Observations: 375, Countries: 43

Source: Authors Computations

The empirical results for countries with inflation targeting indicate that first order lag of per unit value of imports has positive on the import price index in current period. The coefficient of nominal effective exchange rate is negative, which shows that an increase of domestic currency versus foreign currencies causes to increase of demand for imported inputs and finally import price index will increase. In addition, cross effects of monetary regime with nominal effective exchange rate in these countries is positive and significant. Furthermore, with adopt of inflation targeting monetary regime, it is expected that exchange rate pass-through declined. The cross effect of exchange rate with nominal effective exchange rate has negative and significant effect on the exchange rate pass-through. This result shows that, with increase of exchange rate volatility, the cost of price adjustment will increase and finally the price of imported goods tend to increase. The marginal cost in exporting countries has a positive and significant effect on the import price index. So, with increase of marginal cost in export partners, the cost of imports rises and the price level of imports will increase. As overall result, the estimated degree of exchange rate pass-through under the monetary regime and in presence of exchange rate volatility is -0.16, which is less than of exchange rate pass-through in countries with the exchange rate anchor monetary regime. This result suggests that in second group countries, the adoption of inflation targeting monetary regime has led to decrease of exchange rate pass-through.
The results of Sargan test for this model has confirmed the validity of instrument variable. In order to examine of autocorrelation in first differenced error terms, we used the AB test. The result of Arrelano and Bond test has showed in table 4.

Table 4. Arellano-Bond test for order of autocorrelation in first-differenced errors

<table>
<thead>
<tr>
<th>Order</th>
<th>Z-value</th>
<th>Probability Value (PV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-4.54</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>0.19</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Source: Authors Computations

With respect to the results of AB test, we can conclude that there is no autocorrelation between differenced error terms and AB is the suitable method for model estimation.

5. DISCUSSION AND POLICY IMPLICATION

This paper analyzes empirically the effects of monetary regime and exchange rate volatility on the degree of exchange rate pass-through in countries with exchange rate anchor versus inflation targeting monetary regime over the period of 1999-2014. For this purpose, by using of IMF defacto exchange rate classification and dynamic panel data approach, empirical model has been estimated for two groups of countries. The main findings of this study indicate that nominal effective exchange rate and cross effect of exchange rate volatility with nominal effective exchange rate has negative and significant effect on the per unit value of imports in two groups of countries. In addition, the first lags of unit value of imports and marginal cost of exporting countries have positive effects on the import price index. Moreover, cross effects of monetary regime with nominal exchange rate has negative effect in countries with exchange rate anchor regime and positive in the second groups of countries. Cross effects of exchange rate volatility with nominal exchange rate has negative and significant effect on the per unit value of imports in both groups of countries. Hence, with increase of exchange rate volatility, the adjustment of prices will avoidable. The elasticity of import price index due to marginal cost is positive, which indicate that increase in marginal cost of exporting partners causes a proportional increase in import prices in these countries. The results of this paper are consistent with theoretical framework of exchange rate pass-through and empirical studies such as Sowah (2009), Nogueira et al (2010) and Ivohasina (2012).

An important policy implication of this paper is that the dependence of the exchange rate pass-through on the exchange rate volatility and monetary regime should be taken into account in designing monetary policy rules. Hence, in the countries with exchange rate anchor monetary regime and high exchange rate volatility, policy makers and monetary authors should adopt credible monetary policies such as inflation targeting to the control of exchange rate fluctuations on import price level.
REFERENCES:


