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# Modelling Exchange Rate Pass-through in Australia, China and India

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**Abstract:** Exchange rate pass-through (ERPT) has attracted attention of many researchers in the last three decades due to the adoption of flexible exchange rate system by many countries. The objectives of this study are to make a comparative study by exploring the literature relating pass-through for import prices and domestic prices in Australia, China and India. In particular, we test whether the exchange rate pass-through to import prices is complete, estimate the pass-through to CPI to investigate whether there is any association between the pass-through and the average inflation rate across these countries. Using a structural VAR model we test the exchange rate pass-through over the period 1990-2011. The impulse responses indicate that exchange rates have less effect in the rising domestic prices in China and India. This will have important policy implication for the monetary authorities.

***Keywords:*** *Exchange rate pass-through (ERPT), structural VAR model, Australia, China and India*

## 1. INTRODUCTION

Exchange rate pass-through (ERPT) attracts attention of many researchers in the last three decades due to the adoption of flexible exchange rate system by many countries. ERPT refers to the transmission of changes in exchange rate into import (export) prices of specific goods in the destination market currency. ERPT is said to be incomplete if the import (export) prices change by less than one. Whether ERPT is incomplete or pervasive, it is expected that an appreciation of currency reduces import prices and the reverse ensues in case of depreciation (Tivig, 1996; Gagonon and Knetter, 1995; Varangis and Duncun, 1993; Krugman, 1987). Changes in import prices then in turn influence domestic prices of commodities.

Since 1970's, there has been an enormous increase in international investigation of the reasons for less than complete pass-through in the long-run (Campa and Goldberg, 2005; Bailliu and Fujii, 2004; Gagnon and Ihrig, 2004; Bouakez and Rebei, 2008; Choudhri and Hakura, 2006). The rapid growth in the literature on incomplete pass-through has been demonstrated that incomplete pass-through appears to be not only a common, but also a widespread phenomenon. Both theoretical and empirical literature have focused predominantly on large economies, particularly the USA, Japan and Germany, however, for relatively small economies such as Australia and the Asian economies, the empirical research is rather scanty. Moreover, developing countries traditionally experience pass-through of exchange rate changes that is greater and more rapid than high-income countries experience. But developing countries in the 1990s experienced a rapid downward trend in the degree of pass-through and speed of adjustment, more so than did high-income countries. As a consequence, slow and incomplete pass-through is no longer exclusively a luxury of industrial countries.

Moreover, the degree of pass-through is an important issue in determining appropriate monetary policies of a country. A low ERPT provides greater freedom for pursuing an independent monetary policy and to make it easier to implement inflation targeting (Frankel et al., 2005 and Choudhri and Hakura, 2001). However, most of the literature suggests that ERPT is essentially determined by microeconomic factors (e.g., demand elasticities, production cost, market structure etc.) and exogenous to macroeconomic policy (Devereux and Engel, 2001; Goldberg and Knetter, 1997). Taylor (2000) argues that the recently observed declines in the pass-through to aggregate prices are the result of a low inflation environment. In this view, the pass-through depends on the policy regime: a credible low inflation regime will automatically achieve a low pass-through.

The recent empirical literature examines the relationship of the ERPT with monetary and inflationary behaviour. Campa and Goldberg (2001) investigate the relationship based on data for Organisation for Economic Co-operation and Development (OECD) countries and find that although higher inflation and exchange rate volatility are positively related with higher import price pass-through, microeconomic factors related to the composition of imports play a much more important role in determining the pass-through. It should be noted here that the import price pass-through reflects the price behaviour of foreign firms and this behaviour may not be strongly related to the home inflationary environment. Thus evidence on the pass-through to domestic prices (e.g., Consumer price Index (CPI)) would provide a more appropriate test of the Taylor view. Gagnon and Ihrig (2001) explore the relationship between CPI pass-through and inflation stabilisation for eleven industrial countries but they do not find a systematic relation between the pass-through and the monetary behaviour. On the other hand, Nogueira and Le_on-Ledesma (2008) and Shintani et al. (2009) test the hypothesis in the context of nonlinear time-series models and find that inflation appears to drive smooth changes in ERPT regimes. These studies, however, focus on specific nonlinear functional forms and are thus more restrictive.

This research presents a comparative study by exploring the literature relating pass-through for import prices as well as domestic prices in relatively small economy like Australia and two largely growing economies China and India. The major reasons for focusing on these economies are: (1) The world economy's center of gravity is shifting rapidly to Asia. The rise of China, and very likely India, is a transformative event for the global economy. Australia regards China and India as major trading partners with both trade and commercial relationship growing rapidly in recent years. (2) In comparison with 1980s, financial markets in these three economies have been developing at a faster rate. Intra-regional direct investment plays a crucial role in the development of these economies. (3) The exchange rates of these three economies have been appreciating against US dollar in recent times, which has been accompanied by rising inflation especially in China and India. (4) The recent global financial crisis has relatively less profound effect on all the three economies. Australia has managed an impressive 18 years of continuous growth since 1992. Even during the financial crisis Australian economy rebound after just one quarter of negative growth. The economy grew by 1.2%

during 2009 - the best performance in the OECD. On the other hand, India and China are two of the world's fastest growing economies, which are also leading the global economic revival. As China and India's average growth rates during 2008-2010 are about 9.5% and 7.5%, respectively.

The objectives of this study are to (i) test whether the exchange rate pass-through to import prices is complete, (ii) estimates the pass-through to CPI to investigate whether there is any association between the pass-through and the average inflation rate across these countries. In particular, we apply the vector autoregressive techniques to assessing the responses of import prices and consumer price indices (CPI) to exchange rate shock with a base line model, and analyse the response of real effective exchange rates to all the concerned variables in terms of impulse response and variance decomposition for the period 1990-2011. This will allow us to empirically assess the relationship between ERPT and inflation and the role of monetary policies in these three economies. This study is especially important for China and India given that these two economies have been experiencing a high inflation for a long period of time, and on the other hand, their currencies have been appreciating since 2005. Moreover, this study will pursue a comparative analysis with Australian economy where the main focus of monetary policy is inflation targeting. Based on the analysis we will be able to evaluate the role of monetary policies in China and India and whether these countries require changing the monetary policy targets. Such a study will undoubtedly contribute to the available vast literature on ERPT relationship, and more importantly, to the debate between the US and China with regard to Chinese trade surplus against the US even when its currency is appreciating.

The remaining part of the paper is organised as follows. Section 2 describes the econometric methodology and data description. Section 3 contains the empirical results and conclusion is in the final section.

## 2. ECONOMETRIC METHODOLOGY AND DATA DESCRIPTION

To examine the pass-through of exchange rate to import prices and domestic prices across Australia, China and India we use a structural VAR model stated in equation (1) as:

$$X_t = \phi + \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + ..... + \Pi_k X_{t-k} + \varepsilon_t \qquad (1)$$

Where $X_t$ denotes vector of endogenous variables, $\varepsilon_t$ is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all right-hand side variables, $\phi$ is a vector of constants and $\Pi$ are matrices of coefficients to be estimated. Identification of the structural shock is achieved by appropriately ordering the variables of interest and applying Cholesky decomposition to the variance matrix of the reduced form residuals $\varepsilon_t$.

The base model estimates six variables i.e., oil price inflation, interest rate, industrial output, import price, exchange rate and CPI for each country over the period 1990-2011. Variables ordered in the base model are to examine the identified shocks contemporaneously affect their corresponding variables and

**TABLE 1: UNIT ROOT**

| Panel A: Augmented Dickey Fuller | | | | | | |
|---|---|---|---|---|---|---|
| **Variable** | **Country** | | | | | |
| | **Australia** | | **India** | | **China** | |
| | **Lag** | **Test-Stat** | **Lag** | **Test-Stat** | **Lag** | **Test-Stat** |
| IMP | 15 | -2.71 | 4 | -3.72 | 4 | -3.72 |
| Δ IMP | 4 | -6.98 | 3 | -6.33 | 3 | -6.34 |
| CPI | 7 | -0.96 | 12 | -0.05 | 12 | -1.91 |
| ΔCPI | 6 | -5.01 | 11 | -2.52 | 11 | -4.67 |
| Oilprice | 0 | -13.68 | 0 | -13.68 | 0 | -13.74 |
| ΔOilprice | 9 | -10.36 | 9 | -10.36 | 9 | -10.36 |
| PPI | 1 | -7.34 | 1 | -0.57 | 1 | -4.22 |
| ΔPPI | 2 | -14.11 | 0 | -11.66 | 0 | -5.91 |
| Interest | 2 | -3.99 | 3 | -1.83 | 0 | -1.47 |
| ΔInterest | 2 | -6.89 | 2 | -11.69 | 0 | -14.58 |
| REER | 1 | -2.29 | 0 | -3.83 | 0 | -3.35 |
| ΔREER | 0 | -11.79 | 0 | -15.27 | 0 | -17.43 |
| ExRate | 1 | -1.69 | 1 | -1.92 | 0 | -1.62 |
| Δ ExRate | 0 | -10.97 | 0 | -12.15 | 0 | -15.84 |
| Ind Output | 1 | -4.39 | 13 | -1.04 | 3 | -3.79 |
| ΔInd. Output | 2 | -16.53 | 12 | -3.61 | 2 | -14.02 |
| **PANEL B: Phillips-Perron test statistic** | | | | | | |
| | **Australia** | | **India** | | **China** | |
| | **Bandwidth** | **Test-Stat** | **Bandwidth** | **Test-Stat** | **Bandwidth** | **Test-Stat** |
| IMP | 7 | -2.20 | 9 | -3.03 | 9 | -3.06 |
| Δ IMP | 1 | -8.71 | 5 | -8.80 | 5 | -8.82 |
| CPI | 8 | -0.55 | 0 | 2.09 | 8 | -1.73 |
| ΔCPI | 4 | -10.48 | 1 | -11.58 | 4 | -11.53 |
| Oilprice | 8 | -13.52 | 8 | -13.49 | 8 | -13.58 |
| ΔOilprice | 251 | -190.55 | 250 | -198.19 | 255 | -189.88 |
| PPI | 8 | -12.54 | 5 | -0.21 | 8 | -3.51 |
| ΔPPI | 42 | -76.79 | 3 | -11.80 | 1 | -5.99 |
| Interest | 10 | -4.47 | 11 | -1.93 | 7 | -1.83 |
| ΔInterest | 10 | -15.63 | 15 | -14.84 | 5 | -14.66 |
| REER | 2 | -2.05 | 6 | -3.82 | 1 | -3.33 |
| ΔREER | 5 | -11.61 | 9 | -15.33 | 1 | -17.37 |
| Exchange rate | 6 | -1.51 | 5 | -1.78 | 2 | -1.64 |

Critical value: -3.995189, -3.427902 and -3.137310 are at the 1, 5 and 10 percent level, respectively.

those variables that are ordered at a later stage, but have no impact on those that are ordered before The exchange rate and two price variables are the main focus of the analysis. Oil price inflation and industrial output reflect real sector of the economy whereas interest is included to examine the impact of monetary policy. In the second step, we add producer price index (PPI) in the base line equation placed before CPI. Finally we replace nominal exchange rate with real effective exchange rate for the robustness check.

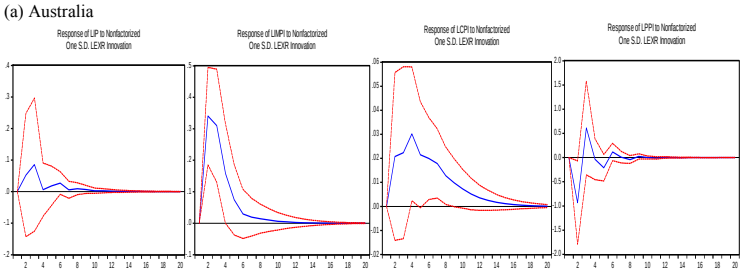
In this study we focus our analysis on three major emerging economies in Asia-Pacific region, Australia, China and India. For each country monthly data is collected from 1990:01 until 2011:03 and from International Financial Statistics, Bank of International Settlements, Reserve Bank of Australia. The oil price data is obtained from Datastream in terms of U.S. dollar. The nominal exchange rate is defined as units of foreign currency per U.S. dollar. United States acts as the base country.

## 3. EMPIRICAL ANALYSIS

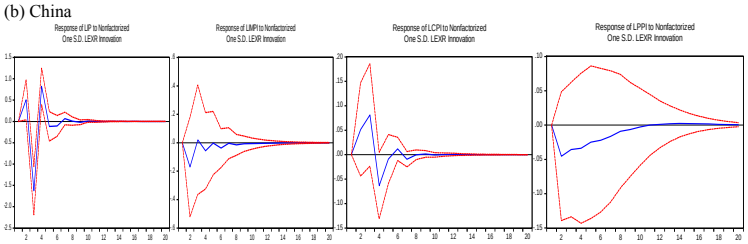
For estimating the degree of responses on price variables we consider the time series properties of the variables and compute the Dicky-Fuller and Phillips Perron tests for unit roots in the variables. Table 1 reports the results for the unit root tests. We select the lag length following Akaike Information Criteria (AIC). We also report the results with the first-differenced series to confirm that all the variables under investigation are I(1). Regression equation for unit root test includes both intercept and trend. From Table 1, we can infer that except oil price and PPI for Australia all variables in levels are non-stationary. Given these properties of the data, VAR model in the first differences of the non-stationary variables considers as an appropriate specification of the models.

Figure 1. Impulse Response Exchange Rate

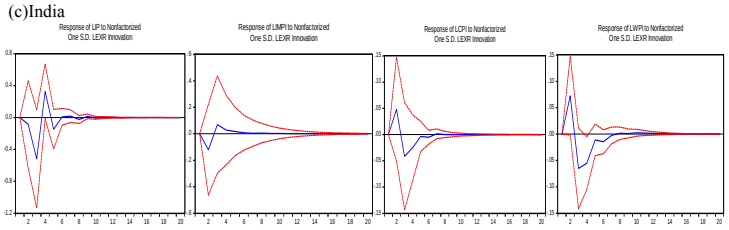
(a) Australia




(b) China




(c)India




### 3.1. Impulse Response

In this subsection we discuss the degree of pass-through from the exchange rate shock to the three price variables, import price, CPI and PPI, in each economy. We first estimate the baseline models, and then analyze the impulse response functions of a variable in response to the shock over a period of 20 months. As the exchange rate is normally defined, an increase in the exchange rate implies a depreciation of the currency of the concerned country. Figure 1 plots the exchange rate shocks and its impact on the three variables estimated by imposing long-run restrictions on the structural VAR model. Due to space limitation, we will report the impulse response of other variables to the exchange rate shock, but make it available upon request. The exchange rate shock is standardized to 1% shocks. The vertical axis in Figure 1 reports the approximate percentage change in the three price variables in response to one standard deviation innovation. The solid line in each graph is the estimated response while the dotted lines denote a one standard deviation confidence band around the estimate. As it can be seen from Figure 1, in contrast to the case of China and India, the response of import price and CPI in Australia to the exchange rate shock is positive and large, which indicates that the exchange rate does matter for domestic inflation in Australia. The response is the largest in IMP, followed by CPI. PPI shows a negative response in the first instance, and then positive but die out quickly. Both IMP and CPI show a similar response pattern, increasing for the first few periods (2 months in case of import price and 6 months in case of CPI) and then decreasing. It takes a year for IMP and 16 months for CPI to restore their initial levels.

On the contrary, the responses of import price for India and China shows the negative and decreasing effects in the initial months and then start increasing but the effects last for about 7 months in China and 5 months in India. The pass-through to import price is the highest in Australia, exceeding 3 percent and larger than that of CPI and PPI. This finding is with our expectation that the degree of the path-through to CPI and PPI should be smaller than that to import price, because the former contains more nontradable components. The pass-through is relatively small in India and China. Our finding confirms that levels of pass-through is high in country with high nominal exchange rate variability.

Overall, the effect of exchange rate pass-through to import price indicates considerable pass-through in all three countries although not complete. On the other hand, pass-through to PPI and CPI is economically moderate. Responses of PPI and CPI show opposite effects in Australia and China. Furthermore, import price and CPI responses are opposite in sign for both China and India.

## 3.2. Variance Decomposition

We now turn to a variance decomposition analysis. Variance decompositions

**Table 2(a). VARIANCE DECOMPOSITION (COUNTRY: AUSTRALIA)**

| | Cholesky Ordering: LOILP LINTER LIP LIMPI LEXR LPPI LCPI | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variance Decomposition** | **Period** | **S.E** | **Oil price** | **Interest rate** | **Industrial output** | **Import price** | **Exchange rate** | **PPI** | **CPI** |
| **Oil price** | 1 | 0.11 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 0.13 | 91.62 | 0.65 | 0.26 | 1.33 | 4.26 | 0.73 | 1.12 |
| | 10 | 0.13 | 91.41 | 0.65 | 0.33 | 1.38 | 4.25 | 0.84 | 1.12 |
| | 20 | 0.13 | 91.41 | 0.66 | 0.33 | 1.38 | 4.26 | 0.83 | 1.12 |
| **Interest rate** | 1 | 0.24 | 0.07 | 99.93 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 0.28 | 0.34 | 79.50 | 2.25 | 7.85 | 8.38 | 0.95 | 0.70 |
| | 10 | 0.29 | 0.34 | 77.89 | 2.21 | 8.43 | 9.31 | 0.95 | 0.85 |
| | 20 | 0.29 | 0.34 | 77.86 | 2.21 | 8.44 | 9.33 | 0.94 | 0.85 |
| **Industrial output** | 1 | 1.47 | 0.04 | 3.05 | 96.91 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 1.71 | 0.25 | 2.49 | 96.34 | 0.29 | 0.36 | 0.087 | 0.15 |
| | 10 | 1.71 | 0.28 | 2.51 | 96.25 | 0.30 | 0.39 | 0.092 | 0.16 |
| | 20 | 1.71 | 0.29 | 2.51 | 96.25 | 0.30 | 0.39 | 0.09 | 0.15 |
| **Import Price** | 1 | 1.15 | 1.76 | 0.85 | 0.41 | 96.95 | 0.00 | 0.00 | 0.00 |
| | 5 | 1.46 | 1.55 | 1.86 | 0.30 | 84.97 | 11.01 | 0.19 | 0.07 |
| | 10 | 1.46 | 1.55 | 1.89 | 0.31 | 84.87 | 11.05 | 0.19 | 0.10 |
| | 20 | 1.46 | 1.55 | 1.89 | 0.31 | 84.87 | 11.05 | 0.19 | 0.10 |
| **Exchange rate** | 1 | 0.02 | 2.56 | 0.03 | 0.02 | 1.03 | 96.38 | 0.00 | 0.00 |
| | 5 | 0.02 | 2.39 | 0.12 | 0.09 | 0.93 | 94.51 | 0.24 | 1.70 |
| | 10 | 0.02 | 2.39 | 0.14 | 0.09 | 0.96 | 94.42 | 0.24 | 1.72 |
| | 20 | 0.02 | 2.39 | 0.15 | 0.09 | 0.96 | 94.41 | 0.24 | 1.72 |
| **PPI** | 1 | 6.46 | 2.01 | 0.20 | 0.05 | 3.68 | 0.00 | 96.04 | 0.00 |
| | 5 | 7.85 | 1.18 | 0.26 | 0.18 | 3.89 | 2.01 | 92.42 | 0.02 |
| | 10 | 7.86 | 1.25 | 0.27 | 0.19 | 3.90 | 2.03 | 92.31 | 0.02 |
| | 20 | 7.86 | 1.25 | 0.27 | 0.19 | 3.90 | 2.03 | 92.31 | 0.02 |
| **CPI** | 1 | 0.26 | 1.38 | 0.02 | 0.01 | 3.27 | 1.20 | 0.01 | 94.09 |
| | 5 | 0.30 | 3.26 | 2.81 | 0.41 | 8.94 | 4.30 | 0.15 | 80.09 |
| | 10 | 0.31 | 3.24 | 3.39 | 0.41 | 9.64 | 5.22 | 0.15 | 77.92 |
| | 20 | 0.31 | 3.23 | 3.41 | 0.40 | 9.66 | 5.27 | 0.15 | 77.85 |

**(b)** VARIANCE DECOMPOSITION (COUNTRY: CHINA)

| | Cholesky Ordering: LOILP LINTER LIP LIMPI LEXR LPPI LCPI | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variance Decomposition** | **Period** | **S.E** | **Oil price** | **Interest rate** | **Industrial output** | **Import price** | **Exchange rate** | **PPI** | **CPI** |
| **Oil price** | 1 | 0.11 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 0.13 | 92.42 | 0.10 | 3.99 | 0.17 | 0.15 | 2.83 | 0.31 |
| | 10 | 0.14 | 91.35 | 0.11 | 4.76 | 0.22 | 0.17 | 3.02 | 0.33 |
| | 20 | 0.14 | 91.33 | 0.11 | 4.77 | 0.23 | 0.17 | 3.03 | 0.34 |
| **Interest rate** | 1 | 0.24 | 0.75 | 99.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 0.24 | 4.11 | 89.08 | 2.08 | 0.09 | 0.30 | 1.95 | 2.36 |
| | 10 | 0.24 | 4.11 | 88.97 | 2.09 | 0.10 | 0.36 | 1.97 | 2.36 |
| | 20 | 0.24 | 4.12 | 88.96 | 2.09 | 0.10 | 0.37 | 1.97 | 2.36 |
| **Industrial output** | 1 | 2.94 | 1.63 | 0.22 | 98.14 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 3.75 | 3.32 | 0.34 | 91.35 | 0.87 | 0.07 | 3.14 | 0.89 |
| | 10 | 3.75 | 3.39 | 0.35 | 91.00 | 0.89 | 0.10 | 3.29 | 0.95 |
| | 20 | 3.75 | 3.39 | 0.35 | 90.99 | 0.89 | 0.11 | 3.29 | 0.95 |
| **Import Price** | 1 | 2.74 | 1.19 | 0.01 | 0.03 | 98.76 | 0.00 | 0.00 | 0.00 |
| | 5 | 3.57 | 1.29 | 0.43 | 1.37 | 77.72 | 2.02 | 11.72 | 5.41 |
| | 10 | 3.84 | 2.05 | 0.48 | 2.98 | 67.85 | 2.89 | 17.70 | 6.01 |
| | 20 | 3.86 | 2.12 | 0.55 | 3.03 | 67.53 | 3.01 | 17.67 | 6.06 |
| **Exchange rate** | 1 | 0.017 | 0.79 | 0.24 | 0.30 | 0.33 | 98.32 | 0.00 | 0.00 |
| | 5 | 0.02 | 1.08 | 0.67 | 0.49 | 0.57 | 94.67 | 0.51 | 1.99 |
| | 10 | 0.02 | 1.18 | 0.73 | 0.67 | 0.53 | 93.76 | 0.59 | 2.51 |
| | 20 | 0.02 | 1.21 | 0.75 | 0.71 | 0.54 | 93.51 | 0.63 | 2.61 |
| **PPI** | 1 | 0.63 | 0.19 | 0.56 | 6.94 | 0.02 | 0.45 | 91.81 | 0.00 |
| | 5 | 0.98 | 7.48 | 1.44 | 11.48 | 3.98 | 1.16 | 69.68 | 4.76 |
| | 10 | 1.00 | 7.66 | 1.70 | 11.13 | 6.18 | 1.18 | 67.26 | 4.85 |
| | 20 | 1.01 | 7.65 | 1.70 | 11.14 | 6.19 | 1.18 | 67.26 | 4.87 |
| **CPI** | 1 | 0.57 | 5.84 | 0.28 | 2.02 | 2.06 | 0.13 | 5.44 | 84.20 |
| | 5 | 0.67 | 5.37 | 1.45 | 14.64 | 4.29 | 1.16 | 6.77 | 66.29 |
| | 10 | 0.67 | 5.35 | 1.51 | 14.49 | 4.78 | 1.27 | 6.99 | 65.59 |
| | 20 | 0.83 | 1.48 | 2.55 | 1.37 | 2.71 | 1.01 | 25.19 | 65.65 |

**(c)** VARIANCE DECOMPOSITION (COUNTRY: INDIA)

| | Cholesky Ordering: LOILP LINTER LIP LIMPI LEXR LPPI LCPI | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variance Decomposition** | **Period** | **S.E** | **Oil price** | **Interest rate** | **Industrial output** | **Import price** | **Exchange rate** | **PPI** | **CPI** |
| **Oil price** | 1 | 0.11 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 0.13 | 96.22 | 0.48 | 0.09 | 0.34 | 0.04 | 1.98 | 0.80 |
| | 10 | 0.13 | 96.16 | 0.50 | 0.10 | 0.35 | 0.05 | 1.98 | 0.83 |
| | 20 | 0.13 | 96.16 | 0.50 | 0.10 | 0.35 | 0.05 | 1.98 | 0.83 |
| **Interest rate** | 1 | 0.24 | 0.27 | 99.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 0.25 | 1.20 | 94.43 | 1.58 | 0.05 | 1.55 | 0.68 | 0.49 |
| | 10 | 0.25 | 1.23 | 94.34 | 1.59 | 0.07 | 1.55 | 0.69 | 0.50 |
| | 20 | 0.25 | 1.23 | 94.34 | 1.59 | 0.07 | 1.55 | 0.69 | 0.50 |
| **Industrial output** | 1 | 4.14 | 0.32 | 1.16 | 98.51 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5 | 5.41 | 1.73 | 1.17 | 82.63 | 0.29 | 1.33 | 2.34 | 10.48 |
| | 10 | 5.43 | 1.80 | 1.18 | 82.48 | 0.30 | 1.35 | 2.40 | 10.48 |
| | 20 | 5.43 | 1.80 | 1.18 | 82.47 | 0.31 | 1.34 | 2.40 | 10.47 |
| **Import Price** | 1 | 2.57 | 1.15 | 1.34 | 0.14 | 97.35 | 0.00 | 0.00 | 0.00 |
| | 5 | 3.27 | 0.85 | 1.01 | 0.36 | 88.98 | 0.26 | 7.24 | 1.26 |
| | 10 | 3.34 | 0.84 | 1.21 | 0.37 | 86.90 | 0.29 | 8.50 | 1.85 |
| | 20 | 3.34 | 0.84 | 1.22 | 0.37 | 86.87 | 0.29 | 8.51 | 1.86 |
| **Exchange rate** | 1 | 0.64 | 0.25 | 0.21 | 0.02 | 1.85 | 97.66 | 0.00 | 0.00 |
| | 5 | 0.70 | 0.66 | 2.45 | 1.69 | 6.56 | 86.95 | 1.09 | 0.56 |
| | 10 | 0.71 | 0.67 | 2.49 | 1.70 | 6.68 | 86.43 | 1.32 | 0.67 |
| | 20 | 0.70 | 0.67 | 2.49 | 1.70 | 6.68 | 86.43 | 1.32 | 0.67 |
| **PPI** | 1 | 0.56 | 4.75 | 0.019 | 0.32 | 0.04 | 0.01 | 94.84 | 0.00 |
| | 5 | 0.64 | 5.08 | 1.36 | 2.42 | 2.60 | 3.07 | 82.32 | 3.12 |
| | 10 | 0.64 | 5.02 | 1.45 | 2.39 | 3.57 | 3.07 | 81.33 | 3.14 |
| | 20 | 0.64 | 5.02 | 1.46 | 2.39 | 3.57 | 3.07 | 81.31 | 3.15 |
| **CPI** | 1 | 0.73 | 0.19 | 0.03 | 0.57 | 1.05 | 0.13 | 15.83 | 82.16 |
| | 5 | 0.83 | 1.49 | 2.47 | 1.38 | 1.92 | 0.95 | 25.32 | 66.44 |
| | 10 | 0.83 | 1.48 | 2.54 | 1.37 | 2.70 | 1.01 | 25.19 | 65.67 |
| | 20 | 0.83 | 1.48 | 2.55 | 1.37 | 2.71 | 1.01 | 25.19 | 65.65 |

examine the fluctuations of each price variables are due to the exchange rate shocks or other factors. Table 2 represents the results for all baseline variables at 5 months intervals up to 20 months. It is found that the bulk of the movements in oil price, interest rate, industrial output, exchange rate and CPI were explained by the importance of composite shocks to the self variables and the effects diminish over 5 months and remain persistent after that. For import prices, exchange rate shocks are the next important factor in explaining import price variance in Australia, where the share changes from 0 to 11 percent (Table 2a). The exchange rate shocks account for respectively about 3 percent and 0.3 percent of import price variance in China and India, whereas, PPI and CPI explain import price variance up to 18 and 6 percent respectively overtime in China and 9 and 2 percent, respectively in India.

The results show that the variance of PPI is mainly explained by its own (PPI) shock in all the three economies. In the case of Australia, about 92% (96% in the first stage) is accounted for by the PPI shock, in contrast to about 4% by IMP shock and 2% by exchange rate shock through the horizons. A slightly different pattern is observed for China and India, where oil price, industrial output, exchange rate and CPI are the next most important determinants in the variance of PPI in China and India. In the case of China, industrial output accounts for about 12% of the variation in PPI, followed by oil price for about 8% and import price for about 7%. CPI explains about 5% of the variance in PPI. In India, these variables have a similar explanatory power, each accounting for a share of around 3 to 5 percent of the variations in PPI. It is also noticed that, besides its own (CPI) shock, import price and exchange rate are the two most important determinants of the variations in CPI in Australia, each accounting for about 10% and over 5%, respectively. In contrast, PPI is the second important determinant in the variance of CPI in India and increasingly important in China, accounting for 25% after the initial stage in India and over 25% in the last stage in China. Exchange rate does not have much explanatory power in the variance of CPI. The variance decompositions thus suggest that external factors explain modest portion of the variance of domestic consumer prices in Australia, and Australia's CPI inflation was mainly caused by the import price and the exchange rate pass-through. Whereas, the effect is opposite in China and India where internal factors like PPI and industrial output account for moderate variation in CPI. Thus, this finding is consistent with our casual observation that the external factors tend to have greater influence in more open economy like Australia than India and China.

## 4. CONCLUDING REMARKS

This paper examines pass-through of exchange rate and import prices to producer and consumer prices for three major economies viz. Australia, China and India in the Asia-Pacific region. Using a structural VAR model that incorporate distribution chain, we find that pass-through to aggregate consumer prices is greater in Australia than China and India, however appreciation of Australian dollar increases import price and consumer prices. On the other hand, appreciation of Chinese reminbi and Indian rupee decrease the import price but it has inflationary effect on domestic prices over the period 1990-2011. However, the external factors account for a little variation in domestic prices in these two countries. In contrast, internal factors like industrial production, interest rate and producer prices reflect some influence on consumer prices.

The results have important implications for monetary policy in China and India. Decrease in import price is unable to control high levels of inflation in these two countries. The much of the inflation during the period comes from internal factors. Thus attention should be given on revisit monetary policy target and how it can be restructured to control inflation.

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