

Research Report

**Explaining the Exchange Rate
Pass-through in Various Prices for
Mainly Asian Countries**

*A research report submitted in partial fulfillment of the
Requirements of Master of Finance at Massey University*

For: Dr. Martin Berka

By Xuemei Xiang

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Abstract

This paper examines the degree of exchange rate pass-through (ERPT) to four prices in seven main Asian countries. A long period time of database is used to examine the pass-through. Our results are generated from vector autoregressive model (VAR) by applying two different methods of decomposition of variables. Our results show that the response of prices in the short-run is low and the ERPT is higher and close to one in the long-run. Import prices are the most responsive to the exchange rate shock and consumer prices are the least responsive. We find strong statistical evidence that there is a positive relationship between ERPT and inflation, and a weak relationship between (other variables). The result appears to be supportive for Taylor's hypothesis (2000).

1. Introduction

There has been a long interest in investigating the exchange rate pass-through. People became interested in exchange rate pass-through in the late 1960s. Exchange rate pass-through refers to the degree of changes in domestic currency prices of traded goods as the exchange rate changes. Early research hinge on the issue of the prevalence of producer-currency-pricing versus local currency pricing of imports. The researches focus on exchange rate pass-through on both import prices and consumer prices. Since the late 1980s exchange rate pass-through studies focused on different industries, market supply and demand, and product and price discrimination. More recently, the studies turn to focus on a number of macroeconomic variables including inflation and monetary policies to examine exchange rate pass-through in various prices, and there has been a worldwide continuous decline in pass-through of the exchange rates.

Most research in this area is focused on developed countries or large economies and very few on Asian countries. Campa and Goldberg (2002) estimate twenty-five OECD countries. Choudhri, Faruqee and Hakura (2005) examine non-US G7 countries. Campa, Goldberg, and Gonzalez-Minguez (2005) examine European countries. Ihrig, Marazzi and Rothenberg (2006) examine G-7 countries. Only Ito, Sasaki, and Sato (2005), Ca' Zorzi, Hahn and Sánchez (2007) examine a few Asian countries. Although all the studies examine exchange rate pass-through across countries and industrials over time, they appear to provide overall support of Taylor's hypothesis. It is still interesting to examine Asian countries whether exchange rate pass-through result is consistent with Taylor's Hypothesis.

Moreover, it is significant to examine the degree of exchange rate pass-through for forecasting inflation because it is important for monetary authority to adjust monetary

policy in response to changes in inflation. For example, when exchange rate pass-through rates and domestic inflation rate are high, central bank acts to stabilise the domestic inflation rate by tightening monetary policy to offset any inflationary factors.

The first objective of this paper is to estimate the response of different prices to an exchange rate shock for main Asian countries. We use the quarterly data from 1973 to 2006 to test the degree of exchange rate pass-through in both short-run and long-run. The empirical results strongly support the hypothesis of incomplete exchange rate pass-through in the short run across countries. In the long-run, the degree of ERPT is larger than short-run and it nearly reaches full pass-through. Moreover, average ERPT to import prices across countries is apparently higher than that of consumer prices both in 1- and 4-quarters, 52.8% versus 10.4% and 83% versus 36% respectively. By estimating the correlation coefficient between ERPT and the inflation rate, the result shows they are significantly positively correlated. It also supports Taylor's hypothesis that high inflation leads high pass-through.

The second objective of this paper is to investigate how robust of the results by applying generalised ordering of variable in explaining ERPT to import prices and CPI. The results of the alternative model show very similar numbers to those in basic model in terms of import prices and consumer prices both in short-run and long-run. The correlation coefficients between ERPT and average inflation in 1-, 4- and 8-quarters are also consistent with Taylor's hypothesis that ERPT and inflation are positively correlated.

In this paper, we begin with a review of previous literatures. Section 3 describes and analyses the data. Section 4 describes the methodology. Section 5 summarises a number of empirical results. Next section investigates the robustness of applying generalised ordering. Finally, the research is concluded.

2. Literature Review

Initial research in the pass-through relationship was developed by following the estimation of import and export demand and supply elasticities in international trade. However, the measurement of pass-through based solely on elasticities of demand and supply has a number of problems associated with it. The approach does not take the timing of the response of prices to exchange rate changes into account. It also ignores some important elements that behind the supply responses of producers in different countries, such as the details of the industrial organization and of the technology (Menon, 1995). More recently, numerous empirical tests have provided statistical evidence that the transmission of exchange rate was incomplete to various prices. This may be due to market structure (perfect competition and imperfect competition), product differentiation, cross boarder production multinational corporations, and the effects of trade barriers. As a result, pass-through of the exchange rate tends to vary significantly across a broad range of countries and industries.

Recently, there has been a significant decline in the degree to which firms pass through changes in costs to prices. Taylor (2000) first identified the decline in pass-through is due to the low inflation environment by using a microeconomic model of price setting. Then he develops an economy-wide model which consistent with the microeconomic model to illustrate how changes in pricing power affect output and inflation dynamics. The study suggests that low inflation leads to low pass-through. A latter study of Choudhri and Hakura (2001) has tested the hypothesis suggested by Taylor (2000). A large database that includes 1979-2000 data for 71 countries is used to estimate the relationship between exchange rate pass-through and the average inflation rate across nations and periods. The study strongly supports a positive and significant association between inflation rates and pass-through estimates. The relation is robust when other macroeconomic variables are controlled for. Therefore,

this result is very important for policy makers in designing monetary policy rules.

Campa and Goldberg (2002) study the exchange rate pass-through into import prices of twenty-five OECD countries. They use quarterly data from 1975 to 1999 to estimate pass-through elasticities. They provide cross-country, panel data and industry-specific evidence on whether PCP or LCP of imports is more prevalent, and on whether exchange rate pass-through rates are endogenous to a country's macroeconomic conditions. There is evidence of incomplete exchange rate pass-through in the short-run-rejecting both PCP and LCP. It demonstrates the prevalence of partial exchange rate pass-through into import prices. Over the long run, the degree of pass-through is close to one. So PCP is more prevalent for many types of imported goods. Although macroeconomic variables like inflation and monetary policy play a significant but limited role in explaining different degrees of pass-through across countries, the most important determinants of changes for OECD countries in pass-through over time are microeconomic and relate to the industry composition of a country's import bundle. The shift in the import composition from industries with high pass-through elasticities to industries with lower pass-through elasticities could deliver changes in the pass-through elasticities on aggregate import prices.

Choudhri, Faruquee and Hakura (2005) examine the degree of exchange rate pass-through to different prices and the performance of a variety of new open economy macroeconomic models in explaining the exchange rate pass-through to these prices for non-US G7 countries. The estimation is based on impulse response analysis of a VAR model. The VAR model is set up with seven endogenous variables which consist with domestic interest rates, the nominal effective exchange rates, import prices, export prices, ppi, cpi and wages. The open economy macroeconomic models represent an interesting combination of features highlighted by different literatures: sticky prices, sticky wages, distribution costs, and a combination of LCP and PCP. Sticky-wage versions perform better than flexible-wage versions. An LCP

model with distribution costs provides a better overall fit to the VAR data than a comparable PCP model. However, both models have problems matching the responses of import and export prices. Therefore, the study finds hybrid models provide a better fit than pure LCP or PCP models.

Moreover, Campa, Goldberg, and Gonzalez-Minguez (2005) present an empirical analysis of exchange rate pass-through to import prices across European countries and product categories over the last fifteen years. They take the introduction of the euro into account more than their previous study of 2002. They test for structural changes in the transmission of exchange rates movements after the introduction of the euro. Their results show that the average pass-through rate to import prices is high in the short run which is around 66%. In the long run, the exchange rate pass-through is higher than short run which is around 80%. There is no strong statistical evidence of a structural break in this transmission except in the case of some manufacturing industries. Industries have been more likely to experience declined rates of exchange rate pass-through to import prices since the euro was introduced.

Ito, Sasaki, and Sato (2005) examine the pass-through effects of exchange rate changes on the domestic prices among the East Asian countries using the conventional pass-through equation and a VAR analysis. They identify structural shocks and examine the pass-through of each shock to domestic inflation. The analysis shows that import prices are the most responsive to exchange rate shocks, Producer Price Index (PPI) is the second and CPI is the least responsive. The results are still consistent with most previous studies such as McCarthy (2000) and Hahn (2003) that investigate the pass-through effects of shocks on prices for developed countries. McCarthy and Hahn attempt to incorporate three types of price variables (import prices, producer prices and consumer prices) in the VAR model. However, Ito, Sasaki, and Sato (2005) incorporate only one price variable in the VAR model. The five endogenous variables in the VAR model include oil prices, money supply, nominal effective exchange rate, the output gap and domestic prices. Overall, their results show that the degree of

exchanger rate pass-through to import prices is quite high and the pass-through to CPI is low.

Ihrig, Marazzi and Rothenberg (2006) examine the exchange rate pass-through to both import prices and consumer prices and the extent to which have experienced declining pass-through rates in the G-7 countries since the late 1970s and 1980s using OLS. The paper estimates them over two 15-year sub-samples, 1975Q1-1989Q4 and 1990Q1-2004Q4. They find that all countries experience a decline in the transmission of exchange rate to import prices. The decline is statistically significant for nearly half of these countries between the two sub-sample periods. The estimates of pass-through to consumer prices except Germany are consistent with other empirical studies such as the study of Gagnon and Ihrig (2004). Furthermore, the latter researchers focus on testing the connection between monetary policy and pass-through. Both the full sample and two sub-samples are tested. They find no statistically significant relationship between estimated exchange rate pass-through and the estimated monetary policy parameters for the full sample. However, there is a statistically significant relationship between them across the two sub-samples.

More recently, Ca' Zorzi, Hahn and Sánchez (2007) examine the degree of exchange rate pass-through to prices by using VAR model in 12 emerging markets in Asia, Latin America, and Central and Eastern Europe. Quarterly data is used from 1975 to 2004. The baseline model includes six variables: an oil price index, an output variable, an exchange rate, an import price index, a consumer price index and a short-term interest rate. The main result of impulse analysis is the exchange rate pass-through rate is higher for import prices than for consumer prices. In Asia, pass-through to CPI is found to be low both after four and eight quarters. ERPT is very low in the United States both in terms of import and consumer prices. In Japan, ERPT to CPI is found to be very small both after four and eight quarters. More specifically, the pass-through rate to import prices for Japan is higher than in the euro area and the US. Additionally, the results proves that ERPT into both import and consumer prices is not always

higher in emerging countries than in developed countries by comparing the pass-through estimate of advanced with emerging economies. The paper also explores whether there is evidence of a positive correlation between pass-through and inflation. Most countries seem to provide support of Taylor's hypothesis exclude Turkey and Argentina because the two countries have experienced hyperinflation but very low pass-through rate. Finally, the study estimates the relationship between openness and exchange rate pass-through. It finds weak evidence of a statistically significant positive relationship between them. However, the correlation coefficient between pass-through and openness turns positive after controlling for inflation.

Overall, previous literatures can be concluded that the degree of exchange rate pass-through is different across countries and industries. The partial exchange rate pass-through to import prices is prevalent in the short run and the pass-through rate is higher and close to one over the long run. The pass-through rate to import prices is much faster than to CPI. Moreover, there is strong statistical evidence that many countries and industries have experienced a general decline of the exchange rate pass-through over the last three decades. However, most of these studies only focus on developed countries or large economies and very few examine price responses to an exchange rate shock for Asian developing countries. Therefore, this paper is going to investigate the degree of exchange rate pass-through for main Asian countries and analyse the dynamic response of various prices to an exchange rate shock.

3. Data

The research is going to examine the exchange rate pass-through to various prices for seven main Asian countries including Australia, Hong Kong, Korea, Israel, New Zealand, Singapore, and South Africa. These countries are small-economy countries except for Australia. The evidence on the research is based on the impulse response functions derived from a VAR model. The basic VAR model includes data on seven

endogenous and two exogenous variables. The endogenous variables include the interest rate (R), the exchange rate (S), the import price index (P_{im}), the export price index (P_{ex}), the producer price index (P_{ppi}), the consumer price index (P_{cpi}), and the wage index (W). The exogenous variables are the foreign interest rate (R^*) and the foreign consumer price index (P_{cpi}^*).

A set of quarterly data was collected for each country. The sample period ranges from 1973:Q1 to 2006:Q3. All variables are seasonally adjusted at annual rates. The three-month treasury bill rates are used as interest rates. The import and export price indexes are denominated in the US dollars for each sample country. So the exchange rates are used to calculate the import and export price indexes expressed in home currency. The exchange rates are the nominal effective exchange rates which are expressed as foreign currencies per unit of domestic currency. It means that home currency depreciation results from a decrease of the nominal exchange rate. The trade weights acquired from the IMF are used for the series on the foreign interest rate and the foreign price level. The foreign interest rates are constructed by summing up the competitive weight times quarterly domestic interest rate. The foreign CPI is calculated by summing up the competitive weight times quarterly domestic CPI. Finally, all series are in logs except domestic interest rate and foreign interest rate.

Due to data availability, the sample period varies across countries (see the first row in Table 1). Table 1 summarises the average macroeconomic conditions of the sample countries. Average inflation was relatively low in Singapore, Hong Kong and New Zealand. Singapore experienced the lowest average inflation and average interest rate combined with strong real GDP growth among these seven countries, both in terms of value and volatility. Hong Kong and New Zealand also experienced relatively steady development. Australia, Korea and South Africa have higher average inflation and higher average interest rates but lower growth rate of real GDP over the sample period. Nominal effective exchange rate depreciated less than 1% in Hong Kong and Singapore and around 2% in New Zealand. There is nearly no change in Australia.

Korea and South Africa have similar nominal effective exchange rate appreciation around 2.2%. However, Israel stands out in particular. It experienced hyperinflation during last twenty years which is about 39%. The inflation rate was extremely high in 1984 and 1985. It has similar high percentage rate for average inflation and average interest rate both in value and volatility terms. Its nominal effective exchange rate appreciates about 12.7% which is also much larger than other sample countries.

4. Methodology

The standard VAR model is constructed in the following form:

$$Y_t = c + A(L)Y_{t-1} + B(L)Z_t + \varepsilon_t \quad (1)$$

Where Y_t represents the vector of endogenous variables ($R, \Delta \log S, \Delta \log P_{im}, \Delta \log P_{ex}, \Delta \log P_{ppi}, \Delta \log P_{cpi}, \Delta \log W$), Δ represents the first difference operator, Z_t represents the vector of exogenous variables ($R^*, \Delta \log P_{cpi}^*$), c is a vector of constants, $A(L)$ denotes the matrix of autoregressive coefficients of endogenous variables in the lag operator L , $B(L)$ denotes the matrix of autoregressive coefficients of exogenous variables in the lag operator L , and ε_t is a vector of residuals. The nine-variable VAR model is similar to the model developed by Choudhri, Faruqee and Hakura, 2005.

The selection of lag length is very important for precise of the results. The lag length of the VAR is determined by looking at “Lag Length criteria” and “Lag Exclusion tests”. This process is used to identify optimal lag lengths. “*” denotes the selected lag. Firstly, pick the longest lag length and re-estimate VAR with that length. Then estimate the new VAR. Highest p-value shows the lag is insignificant. So eliminate lags that are jointly insignificant from the VAR. Re-estimate VAR and check p-value again. Continue this process until optimal lag lengths are selected.

The main objective of the study is to examine how exchange rate shocks affect various prices over time. Identification of the exchange rate shock is reached by appropriately ordering the seven endogenous variables. Cholesky decomposition method is applied for identification of impulse responses in this study. The method assumes that the shock contemporaneously influences its corresponding variables that come later, but does not contemporaneously influence variables that are ordered before. Primarily, we try to figure out the ordering of variables in this way: wages, import prices, export prices, PPI, CPI, R, S. This is very similar to Ca'Zorzi, Hahn, and Sánchez, 2007. However, the result does not make sense. It cannot explain the various price responses to an exchange rate shock. Additionally, the degree of exchange rate pass-through is not supposed to be zero in quarter 1. Therefore, the study develops two other sensible orderings that almost give identical results which are different from the result of the first ordering. The baseline VAR model follows the ordering of Choudhri, Faruquee and Hakura (2005) which is R, S, import prices, export prices, PPI, CPI, wages. The interest rate is ordered first because all variables are reflected in interest rates. Reserve bank takes all variables into account in economy when setting OCR. The next variable is the exchange rate. It influences everything except wages immediately, but it is not affected back by other variables immediately. Import prices and export prices precede producer prices and consumer prices, but not the other way around. Wages is ordered last because it is the stickiest variable. So it is not affected immediately by any of the variables. This ordering is one of the most sensible orderings for identification of impulse responses. Moreover, we apply a generalised ordering of variables to examine the results.

In the next two sections, we first discuss the results for the exchange rate pass-through to various prices for the seven countries and compare them to those found from other researches. Then we apply generalised ordering of variables to investigate how robust of the results in explaining ERPT in different prices.

5. Empirical results

Dynamic responses of the four prices (import prices, export prices, producer prices, and consumer prices) to an exchange rate shock are derived from the baseline model. Table 2-5 summarise the estimates of the ERPT on the four prices in quarters 1, 4 and 8 to a one-unit exchange rate shock in quarter 1. The degree of ERPT is very different between import prices, export prices, PPI and CPI across countries. In general, the degree of ERPT is found to decline along the pricing chain. Import prices are the most responsive to the exchange rate shock, export prices is the second, PPI follows that and CPI is the least responsive. The result conforms to the previous studies such as Ito, Sasaki and Sato (2005) that examine the pass-through effects for East Asian countries. Additionally, the average degree of ERPT on the four prices across countries is found to be low in the short-run which is less than 53% and high in the long-run which nearly reaches full pass-through.

A number of main results are obtained. First, Table 2 shows the evidence of partial exchange rate pass-through into import prices in the short-run. The response of import prices to an exchange rate shock is dynamic for all sample countries, especially for Israel which has reached full pass-through in quarter 1. We find that average pass-through into import prices is 52.79% in the short run and 83.31% in the long-run. Singapore has relatively low pass-through (9.84% within one quarter and 18.75% within four quarters). Pass-through estimates for Australia, Israel and Korea are larger in the short-run. The pass-through rate is much higher in quarters 4 and 8 except for Korea. The estimate of Korea shows ERPT to import prices turns lower in the long run. Table 3 shows the response of export prices to an exchange rate shock is a little lower than the response of import prices. But it still proves that the degree of pass-through is low in quarter 1 and high in quarters 4 except for Korea.

Second, Table 4 and 5 report the response of producer prices and consumer prices to

an exchange rate shock. The responses of PPI and CPI are quite different from that of import prices. In Israel, the ERPT is much higher than other countries. The response of consumer prices to an exchange rate shock is the slowest for all sample countries. In other words, the consumer price index is affected a little by the exchange rate changes. The short-run pass-through is less than 1% in 3 countries out of 7 countries, and pass-through varies between 1% and 3% in three countries. Israel stands out in particular. The pass-through estimates show Israel has very high pass-through to CPI in quarter 1 and it reaches full pass-through before quarter 4. This result is very different from other literature. It may be explained by hyperinflation during sample period.

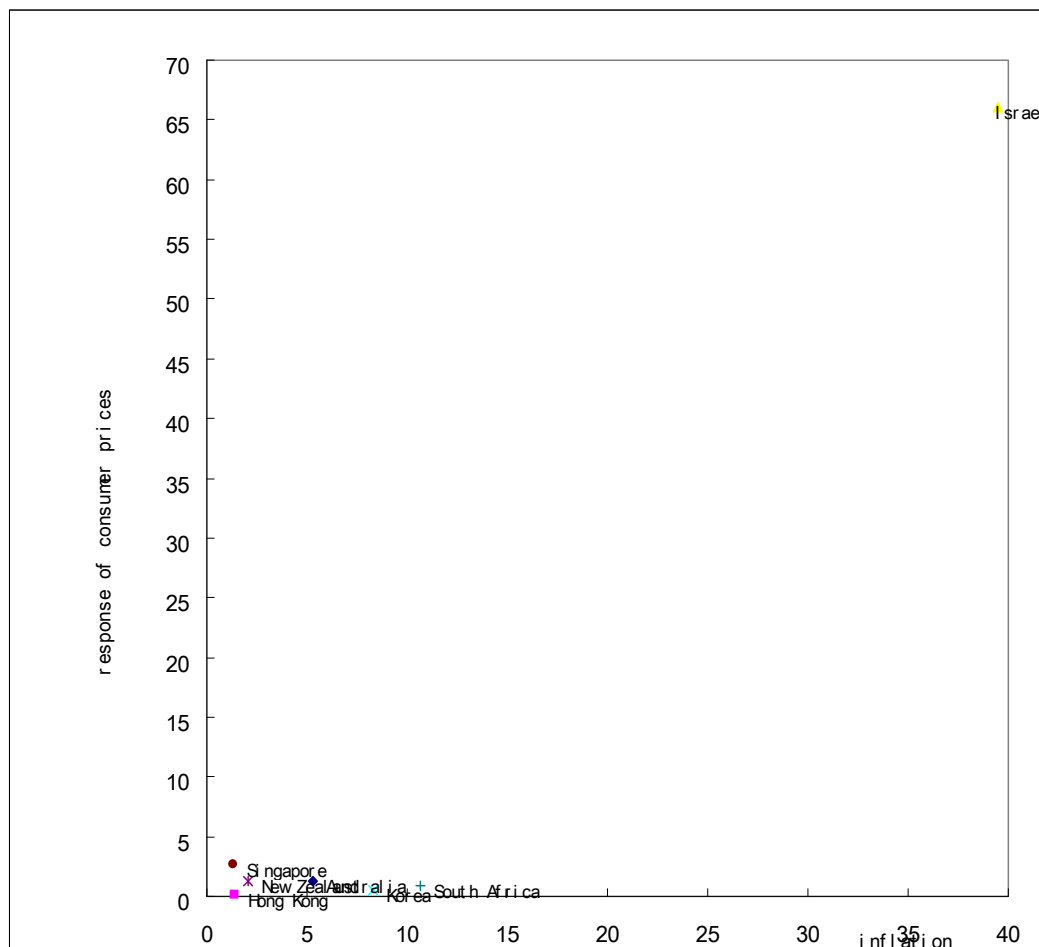
There are a number of reasons why the influence of the exchange rate on CPI is much weaker than those on other prices. Ito, Sasaki, and Sato first mentioned the following factors in 2005. First, the market share of imports in CPI is one important factor. Second, retail goods face more market competitions and substitutable products. Wholesalers and retailers may adjust domestic prices to keep their market share and customers. Third, monetary policy regime still has impact on the pass-through to CPI. The pass-through to CPI may become higher when import prices and wages increase if monetary policy is accommodative, vice versa.

Third, the average ERPT across countries to various prices compared with two previous studies is summarised in Table 6. Although the degree of ERPT is obviously different from the two papers (which two papers? Be specific), our result conforms the principle that pass-through declines among the pricing chain. The average pass-through rate to import prices is much faster than it to consumer prices. Short-run pass-through to various prices is lower than long-run pass-through. However, the average ERPT to various prices is higher than the two papers in all quarters. The difference can be explained by the estimation of different countries. Choudhri and Hakura (2005) examine the ERPT for non-US G7 countries which are developed countries. Ca' Zorzi, Hahn and Sánchez (2007) examine the ERPT in 12 emerging

markets in Asia, Latin America, and Central and Eastern Europe. The result for Ca' Zorzi's estimation in Table 6 is picked up only for Asian countries. All these people have identified Taylor's hypothesis (2000) that low inflation country has low exchange rate pass-through. In my sample countries, 5 out of 7 are developing countries and the rest two countries are small size economy. Table 1 shows developing countries have higher average inflation than developed countries, especially Israel experienced hyperinflation in 1984 and 1985. Therefore, the degree of ERPT for our sample countries is higher than theirs due to the high inflation environment. The relationship between ERPT and inflation will be measured next step.

To identify whether there is evidence of a positive correlation between ERPT and inflation. We begin to illustrate the relationship between ERPT after quarter 1 and inflation for the seven countries (see Figure 1).

Figure 1: Pass-through to consumer prices versus average inflation



y-axis: accumulated response of consumer prices to a 1% exchange rate shock after 1-quarter

x-axis: average inflation over the estimation period

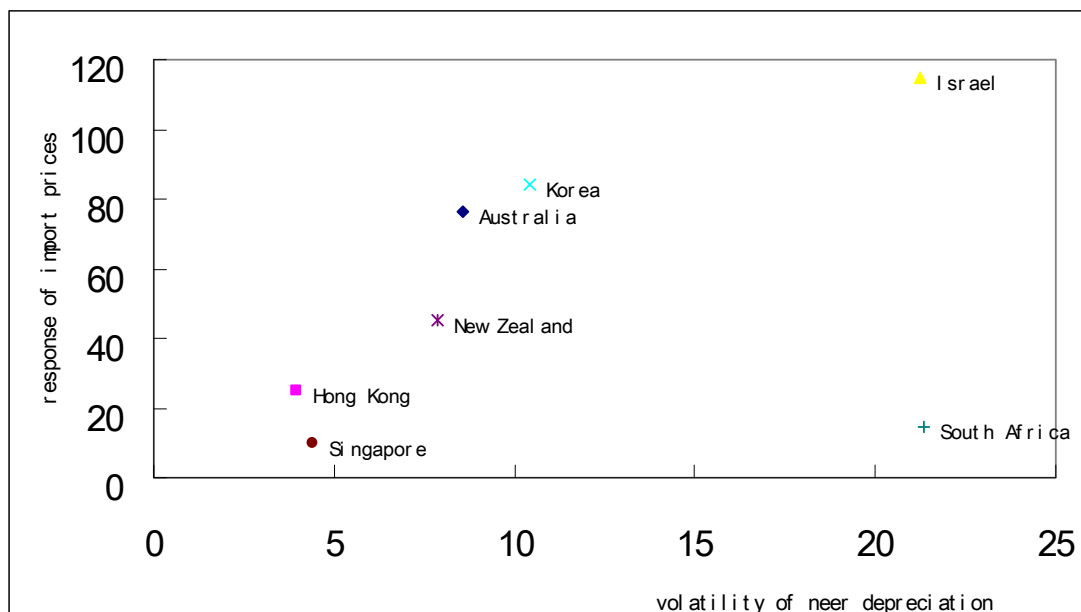
As shown in Figure 1, 3 (Hong Kong, New Zealand and Singapore) out of 7 countries have low average inflation which is less than 5% and experienced low levels of ERPT to CPI which is less than 3%. The other 3 countries (Australia, Korea and South Africa) clearly have higher average inflation which is between 5% and 11%, but they experienced a little lower pass-through compared with the previous 3 countries. Israel combines extremely high average inflation of 39.5% and high consumer prices pass-through of 66%. Overall, these countries seem to provide some support of Taylor's hypothesis. You should note that if you removed Israel, there result would be opposite (negative or insignificant correlation). Therefore, it is not robust in the data.

The correlation coefficients between consumer prices pass-through and a number of

selected variables are reported in Table 7. Pearson correlation coefficient measurement is applied. The result confirms that there is a positive correlation between pass-through and inflation at 1-, 4- and 8-quarters. The correlation coefficient is significant for the selected macroeconomic variables. But the coefficient between pass-through and average nominal effective exchange rate depreciation shows negative numbers because the nominal exchange rate is defined as foreign currencies per unit of domestic currencies. An increase in the nominal exchange rates leads to a decrease in domestic prices of traded goods.

It is also interesting to discuss the relationship between import prices pass-through and average volatility of nominal effective exchange rate depreciation. As shown in Figure 2, two groups of countries can be identified. In the first group, Hong Kong and Singapore experienced less than 25% of import prices pass-through with low volatility of exchange rate depreciation which is less than 5%. In the second group, Korea, Australia and New Zealand have much higher pass-through to import prices with relatively higher exchange rate variability. In Israel, the ERPT to import prices reaches full pass-through in quarter 1. South Africa is clear outlier. It combines very high volatility of exchange rate depreciation with very low pass-through. Devereux, Engel and Storgaard (2004) point out countries with a low volatility of nominal exchange rate and a stable monetary policies would have local currency pricing for transaction invoicing, implying low pass-through. Exchange rate pass-through would be higher for importing countries if the volatility of exchange rate depreciation is large. This hypothesis is supported by my results. Macroeconomic variability plays an important role for currency invoicing if traded goods are differentiated. However, if traded goods are homogenous, the role will be destroyed because consumers may choose domestic similar products instead of imported good unless their goods are priced the same.

**Figure 2: Import prices pass-through versus
average volatility of neer depreciation**



y-axis: accumulated response of import prices to a 1% exchange rate shock after 1-quarter

x-axis: average volatility of near depreciation over the estimation period

6. Robustness

In this section we discuss to what extent the degree of ERPT is sensitive to the choice of decomposition method. We re-estimate the VAR model by applying generalised ordering of the seven endogenous variables. Generalised ordering ignores the specific ordering of the variables and gives average possibility of all orderings. Estimates of pass-through to import prices and consumer prices are reported in Table 8 and 9. The results are very similar to those discussed in the previous section for basic model. Even the degrees of ERPT to import prices and CPI are exactly the same as basic model in 1-, 4-, and 8-quarters in Hong Kong and Israel. In terms of import prices, South Africa is an exception because long-run pass-through is higher than short-run for basic model but alternative model shows opposite result. Import prices

pass-through gets smaller over time in South Africa. In terms of consumer prices, ERPT of alternative model is a little higher than those in basic model except South Africa. Overall, pass-through rates to two prices show similar results in six countries, as well as average pass-through rates in seven countries.

We also estimate the correlation coefficient between ERPT and average inflation for alternative model (see Table 10). The coefficient is found to be the same as basic model in quarter 1 which is 0.96. The coefficient turns to a little smaller than basic model one year after the exchange rate shock, but it is still significant. Therefore, the coefficient shows positive relationship between ERPT and inflation that supports Taylor's hypothesis. Please also mention the hypothesis of Devereux et al. (2004), and conclude whether you find empirical support for it or not. Add this also to your introduction, abstract and conclusion. You should spend as much time on this hypothesis as you spend on Taylor's (2000) hypothesis.

7. Conclusion

In this paper, we have examined the degree of exchange rate pass-through into import prices, export prices, producer prices and consumer prices in main Asia countries. The degree of ERPT is very different across countries and across time. Generally speaking, the response of prices to an exchange rate shock is found to decline along pricing chain. Import prices response is the fastest. Export prices response is the second. Producer prices response is slower than previous two prices. Consumer prices pass-through is the slowest. The empirical result proves that short-run pass-through is low and incomplete. Long-run pass-through is general higher than short-run and close to one. Israel is an exception, the pass-through rates to import prices and export prices are over one hundred percent in quarter 1. This could be explained on the basis of inflation environment. Israel experienced serious high inflation in 1984 and 1985. The average inflation rate between 1984 and 2006 is still very high. The result identifies Taylor's hypothesis that high inflation leads high pass-through. On the other hand, a

country with lower inflation rate and low inflation volatility leads low pass-through. For example, the average inflation rates in Hong Kong and Singapore are low and pass-through rates are still low. We also have estimated the correlation between ERPT and inflation for sample countries. The results show they are significantly positively correlated.

For future studies, more research should be applied to investigate whether macroeconomic factors or microeconomic factors have impact on the changes in exchange rate pass-through across countries and industries. The changes are very import for monetary authority in controlling for inflation.

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Appendix: Data sources

The data used in this paper covers a maximum sample period between 1973:1 to 2006:3 (see first row of Table 1). For Hong Kong, the sample period starts in 1994:1. The sample periods for Australia, Korea and South Africa are longer. The exact sample for each country, depending on data availability, is described in the first row of Table 1. The corresponding sources are as follows:

Nominal Effective Exchange Rate: We use nominal effective rates from IFS for all sample countries.

Import Price Index: We use import unit values data from IFS as import price index for all countries.

Export Price Index: We use export unit values data from IFS for all countries.

Consumer Price Index: We use CPI data (2000=100) from IFS for all countries but Hong Kong CPI data from Global Financial Data.

Producer Price Index: We use producer or wholesale prices from IFS for all countries.

Interest Rate: We use three-month treasury bill rate from IFS as short-term interest rate for all countries, but three-month treasury bill yield for Hong Kong is from Global Financial Data due to more data availability.

Wage Index: We use wage rates or earnings from IFS for Australia, Hong Kong, Israel, Korea and New Zealand but unit labour cost data for Singapore and South Africa from DataStream.

Real GDP: we use gross domestic production from IMF. The real GDP series for each quarter is constructed by the following equation.

$$GDP_t = 100 * (GDP_t - GDP_{t-1}) / GDP_{t-1}$$

The nominal effective exchange rate (neer) depreciation series for each quarter is constructed by the following formula.

$$neer_t = 100 * (neer_t - neer_{t-1}) / neer_{t-1}$$

The trade weights for our sample countries are collected from IMF. We construct the total competitive weights from world main import and export countries. These countries include Australia, Hong Kong, Korea, New Zealand, Singapore, Peoples Republic of China, Germany, Japan, the United Kingdom, the US, France, Netherlands, Belgium, Sweden and Spain. The foreign interest rates for each sample country are calculated by summing up the competitive weight times quarterly domestic interest rate. The foreign CPI is calculated by summing up the competitive weight times quarterly domestic CPI. The foreign interest rates and foreign CPI are calculated as follows:

$$FR_t = W_{1t} * R_{1t} + W_{2t} * R_{2t} + \dots + W_{nt} * R_{nt}$$

$$FCPI_t = W_{1t} * CPI_{1t} + W_{2t} * CPI_{2t} + \dots + W_{nt} * CPI_t$$

Where FR denotes foreign interests, R denotes domestic interest rates, W denotes corresponding trade weight, and FCPI denotes foreign CPI.

Table 1

Summary indicators for seven countries over the estimated sample period

in annualised average percentage rates

	Australia	Hong Kong	Israel	Korea	New Zealand	Singapore	South Africa
sample period	75Q1-06Q3	94Q1-06Q2	84Q2-06Q2	74Q1-06Q3	92Q4-06Q3	85Q3-06Q3	75Q1-06Q3
av inflation	5.31	1.40	39.46	8.30	2.08	1.33	10.70
av int.rate(% per annum)	8.84	4.01	39.65	14.16	6.56	2.08	11.84
av growth rate of real GDP	3.26	4.22	4.25	6.94	3.58	6.91	2.32
av neer depreciation	-0.07	0.24	-12.68	-2.17	2.04	0.75	-2.39
sd inflation	4.62	4.55	98.95	7.60	1.10	1.37	4.48
sd neer rate of change	8.59	3.96	21.25	10.41	7.86	4.43	21.32
sd int.rate(% per annum)	3.95	2.24	113.32	6.26	1.46	1.15	4.13

Table 2**Accumulated response of import prices (in %) to a 1% exchange rate shock****Basic model**

	Australia	HongKong	Israel	Korea	New Zealand	Singapore	South Africa	Average
1 quarter	76.40	24.91	114.61	83.91	45.44	9.84	14.40	52.79
4 quarters	82.63	81.23	239.49	25.73	75.55	18.75	59.79	83.31
8 quarters	83.32	106.55	360.63	6.68	87.20	10.43	102.17	108.14

Table 3

Accumulated response of export prices (in %) to a 1% exchange rate shock

Basic model

	Australia	HongKong	Israel	Korea	New Zealand	Singapore	South Africa	Average
1 quarter	56.92	11.34	110.00	63.07	42.27	28.49	9.84	45.99
4 quarters	30.89	53.78	225.62	37.60	79.06	52.04	38.80	73.97
8 quarters	22.23	71.52	346.75	28.50	104.00	43.15	81.60	99.68

Table 4

Accumulated response of producer prices (in %) to a 1% exchange rate shock

Basic model

	Australia	HongKong	Israel	Korea	New Zealand	Singapore	South Africa	Average
1 quarter	4.99	--	71.80	8.68	3.42	21.88	2.06	18.80
4 quarters	10.89	--	188.92	5.50	21.16	59.23	22.41	51.35
8 quarters	9.46	--	312.49	9.37	29.64	55.13	83.76	83.31

Table 5

Accumulated response of consumer prices (in %) to a 1% exchange rate shock

Basic model

	Australia	HongKong	Israel	Korea	New Zealand	Singapore	South Africa	Average
1 quarter	1.33	0.18	66.07	0.49	1.25	2.64	0.95	10.41
4 quarters	3.54	22.00	188.27	3.77	1.69	16.42	19.68	36.48
8 quarters	1.06	41.34	310.34	8.57	2.34	18.45	76.19	65.47

Table 6

The average ERPT to various prices (Basic model) compared with the average ERPT from other studies

	Import	Export	Producer	Consumer
1 quarter (short-run)	prices	prices	prices	prices
this research	52.79	45.99	18.80	10.41
Choudhri & Hakura (2004)	45.00	25.00	1.00	2.00
Ca'Zorzi(2007)	--	--	--	--
4 quarters (long-run)				
this research	83.31	73.97	51.35	36.48
Choudhri & Hakura (2004)	73.00	36.00	13.00	11.00
Ca'Zorzi(2007)	78.36	--	--	23.50
8 quarters (long-run)				
this research	108.14	99.68	83.31	65.47

Choudhri & Hakura (2004)	--	--	--	
Ca'Zorzi(2007)	104.45	--	--	44.67

Table 7

Correlation of exchange-rate pass-through to CPI with selected variables

Basic model

	T=1	T=4	T=8
av inflation	0.96	0.95	0.96
av neer depreciation	-0.94	-0.95	-0.96
sd inflation	1.00	0.99	0.97
sd neer rate of change	0.61	0.62	0.71

Table 8**Accumulated response of import prices (in %) to a 1% exchange rate shock****Alternative model**

	Australia	HongKong	Israel	Korea	New Zealand	Singapore	South Africa	Average
1 quarter	75.73	24.91	114.61	87.97	46.00	11.02	16.64	53.84
4 quarters	78.51	81.23	239.49	35.23	75.41	19.70	8.24	76.83
8 quarters	77.87	106.55	360.63	15.82	85.58	12.09	3.94	94.64

Table 9**Accumulated response of consumer prices (in %) to a 1% exchange rate shock****Alternative model**

	Australia	HongKong	Israel	Korea	New Zealand	Singapore	South Africa	Average
1 quarter	1.64	0.18	66.07	1.35	1.27	2.78	0.10	10.48
4 quarters	4.00	22.00	188.27	8.88	1.93	18.32	5.88	35.61
8 quarters	2.15	41.34	310.34	1.01	2.40	20.91	9.97	55.44

Table 10

Correlation of exchange-rate pass-through to CPI with selected variables

Alternative model

	T=1	T=4	T=8
av inflation	0.96	0.94	0.94
av neer depreciation	-0.94	-0.94	-0.93
sd inflation	1.00	0.99	0.99
sd neer rate of change	0.60	0.56	0.56