Exchange Rate Pass-Through into Import Prices: Empirical Evidences from Some Southeast Asian Countries

(incomplete draft)

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Abstract

Most of the empirical studies on exchange rate pass-through have focused on industrialized countries, and only a few studies have been done for developing countries. In this paper we estimate exchange rate pass-through for three Southeast Asian countries: Thailand, Singapore and the Philippines. We use quarterly data from 1974:1 to 2000:3 for Thailand and Singapore, and from 1974:1 to 1991:4 for the Philippines. The results of the cointegration analysis show that the long run exchange rate pass-through into import prices in Thailand, Singapore, and the Philippines are 0.647, 0.408, and 1.433, respectively. The results of the error correction model show that, in the short run, exchange rate does not have significant effect on import prices in Thailand and Singapore, but has significant negative effect in Philippines. In Thailand and Singapore, in the short run, import prices are appear to be influenced by foreign price and foreign demand rather than by exchange rate.

I. Introduction

One of the central issues in international economics is exchange rate pass-through, which is broadly defined as the percentage change in domestic prices caused by one percent change in exchange rate. Since the 1980s there have been a large number of empirical studies on exchange rate pass-through. These studies can be broadly categorized into three categories. The first category is the studies that focus on examining exchange rate pass-through into import prices of specific industry (for example, Bernhofen & Xu, 1999; Goldberg, 1995). The second category is the studies that examine exchange rate pass-through into aggregate import prices (for example, Hooper & Mann, 1989; Campa & Goldberg, 2002). Finally, the third category is the studies that examine exchange rate pass-through into Consumer Price Index (CPI) or Wholesale Price Index (WPI) (for example, McCarthy, 2000; Papell, 1994). The growing research on exchange rate pass-through at the industry-specific and aggregate level is partly motivated by the rise in the industrial organization and strategic trade theory. On the other hand, the studies on the exchange rate pass-through into CPI and WPI grow along with the development in the open economy macroeconomics models.

Most of the empirical studies on exchange rate pass-through have focused on the industrialized countries, particularly the US and Japan. A survey by Menon (1995) on 48 studies on exchange rate pass-through finds that most of the research in this area is for the U.S. and Japan. Moreover, Goldberg & Knetter (1997) noted that in the 1980s research on exchange rate pass-through is dominated by the analysis of pass-through to the U.S. In addition to studies on the industrialized countries, a few studies on exchange rate pass-through that have been done for developing countries are, for example, Rana & Dowling (1985), Alba & Papell (1998), Anaya (2000), and Garcia & Restrepo (2001). Using data from 13 countries including some Asian developing countries, Rana & Dowling (1985) examine the effects of exchange rate on inflation. Alba & Papell (1998) use a structural open economy model to estimate the relationship between exchange rate and inflation for three Southeast Asian countries: Malaysia, the Philippines, and Singapore. Anaya (2000) examines the effects of dollarization on the degree of exchange rate pass-through into consumer price index for each of the 13 countries in Latin America. More recently, an

empirical study by Garcia and Restrepo (2001) estimates the exchange rate pass-through into inflation rate in Chile.

The main purpose of this paper is to estimate exchange rate pass-through into import prices in some Southeast Asia countries. The countries are chosen considering data availability. Although this paper also focuses on the Southeast Asian countries, this paper is different from Alba and Papell's (1998) paper. While Alba and Papell's paper focuses on the relationship between exchange rate and inflation based on the open economy macroeconomic model, in this paper we examine pass-through of exchange rate into import prices based on the model derived from Law of One Price. The model used in this paper has been widely used in empirical studies on the exchange rate pass-through, for example, Hooper & Mann (1989), Menon (1996), and Campa & Goldberg (2002).

The second purpose of this paper is to compare exchange rate pass-through in Southeast Asian countries with exchange rate pass-through in some industrialized countries. Imperfect competition models predict that the stability of import prices in local currency prices tends to be higher in the country with more competitor industries[1]. By assuming that the exporting countries face a smaller number of competing firms in Southeast Asian countries than in industrialized countries then exchange rate pass-through in Southeast Asian countries should be larger than those of industrialized countries. To test this hypothesis we estimate exchange rate pass-through of some industrialized countries.

There are two reasons, at least, for the importance of understanding exchange rate pass-through. First, exchange rate pass-through has implications for the optimal monetary policy and international macroeconomics transmission. This is one of the issues in the new open economy macroeconomics model. Using the new open economy macroeconomics framework, the implications of the extent of exchange rate pass-through on the optimal monetary policy and exchange rate regime have been analyzed in several studies[2]. With the new open economy macroeconomics model, for example, the welfare effect of the monetary policy can be very different depending on the degree of exchange

[1] Dornbusch's (1987) model of exchange rate and prices under Cournot oligopoly, for example, suggests that prices in importer's currency for a given change in exchange rate is more stable if the number of foreign firms faced by exporting country is larger.
[2] Obstfeld (2002) provides a survey on this issue.

rate pass-through (Betts and Devereux, 2000; Tille 2000). Secondly, understanding exchange rate pass-through at the industry level gives insight about international market power in that industry (for example, Knetter, 1993; Bernhofen & Xu, 1999). Using the US, the UK, Germany and Japan industry data, Knetter measures the degree of prices discrimination across export destinations based on the degree of exchange rate pass-through across industries. Bernhofen & Xu (1999) provides evidence that incomplete exchange rate pass-through can be attributed to non-competitive conduct by foreign firms.

The results of this paper are expected to provide more understanding about exchange rate pass-through in Southeast Asian countries that can be used both for international monetary policy and international trade policy. Using the more up to date data and methodology in estimating the exchange rate pass-through for these countries, we expect to obtain more accurate predictions of the policies related to the exchange rate pass-through.

The remainder of the paper is organized as follows. In section II we provide an overview of the theoretical framework of exchange rate pass-through used in this paper. Section III provides description of the data. In section IV estimation method is described briefly. Estimation results are presented in section V. Finally, section VI provides some conclusion remarks.

II. Theoretical Framework

In this section, we provide an overview of the theoretical relationship between exchange rate and import prices. Exchange rate pass-through is broadly defined as the percentage change in importer currency import prices as a result from one percent change in the exchange rate between exporting and importing countries. One-to-one response of import prices to exchange rate is widely known as “full” or “complete” exchange rate pass-through, while less than one-to-one response of import price to exchange rate is widely known as “limited” or “incomplete” exchange rate pass-through.

Exchange rate movements are transmitted to domestic prices through three channels: (i) prices of imported consumption goods, (ii) prices of imported intermediate goods, and (iii) domestic goods priced in foreign currency. Through imported

consumption goods and domestic goods priced in foreign currency, exchange rate movement affects domestic prices directly. Through imported intermediate goods, exchange rate movement affects domestic price through production cost of the consumption goods.

In this paper, the model we use to estimate the degree of the exchange rate pass-through is derived from Law of One Price (LOP). The model is similar to the model used in many of the literature in this area (for example, Hooper and Mann (1989); Goldberg and Knetter (1997); and Campa and Goldberg (2002)). Consider a representative foreign firm has some degree of control over the price of its goods in importing countries. Suppose this representative firm sets the price of its export to country j in its own currency (PX_t^j) at a markup (l_t^j) over its marginal cost of production (C_t^*), that is,

$$PX_t^j = l_t^j C_t^* \tag{2.1}$$

The import price in the importing currency (PM_t^j) is obtained by multiplying export price of exporting firm (PX_t^j) with the exchange rate of the importing country j (E_t^j), that is,

$$PM_t^j = E_t^j PX_t = E_t^j l_t^j C_t^* \tag{2.2}$$

The markup is assumed to respond to both demand pressure in exporting country (Y_t^*) and competitive pressure in importing country. Competitive pressure in importing country is measured by the gap between the competitors' prices in the importing market (P_t^j) and production cost of exporting firm[3]. Therefore, the markup l_t^j can be represented by

$$l_t^j = \left(\frac{P_t^j}{E_t^j C_t^*} \right)^a Y_t^{*b} \tag{2.3}$$

The value of a is expected between 0 and 1, and the value of ß is expected to be positive. Substituting equation (2.3) into equation (2.1) we get

[3] This method follows Hooper & Mann (1989).

$$PM_t^j = \left(E_t^j C_t^*\right)^{1-a} \left(P_t^j\right)^a Y_t^{*b} \tag{2.4}$$

Taking the logarithmic form of the equation (2.4) and dropping country index j, we get

$$pm_t = (1-a)e_t + (1-a)c_t^* + ap_t + by_t^* \tag{2.5}$$

where lowercase letters denote the logarithmic values of the variables.

In equation (2.5), exchange rate pass-through, defined as the partial elasticity of import price with respect to exchange rate, is (1-α). In the extreme cases, when α=0, the exchange rate pass-through is complete and exporting firm does not face a competition in the importing markets. On the other hand, when α=1, the exchange rate pass-through is zero and exporting firm sets import price equal to competitors' price in the importing market. Incomplete pass-through is characterized by α between 0 and 1.

One of the weakness of this model is that it imposes the restriction that pass-through of exchange rate and foreign cost into import price are the same and there is a unit homogeneity in exchange rate, as well as foreign cost, and competitors' prices. As noted by Bache (2002), however, in practice this restriction does not necessarily hold. Therefore, in estimation we relax these restrictions. Another weakness is that the model is static such that it does not allow import prices to adjust gradually due to the changes in the explanatory variables. Using the more recent econometric model such as VAR and Error Correction Model, the possibility of gradual adjustment can be captured.

III. Data

The main problem in conducting empirical studies on developing countries is data availability. Many developing countries do not have adequate time series data to be used for analysis. For example, quarterly data for GDP, a variable needed in many empirical studies, in most of the Southeast Asian countries are not available in the relatively long series of time. The other problem is reliability of the available data is quite often far from ideal to gain insight on the underlying trend in the variables.

In estimating the model we use quarterly data. The proxies for the variables we use in the model are as follows. Domestic import price (PM) is measured by the index of average import prices in domestic currency. For exchange rate (E) we use average

nominal exchange rate measured in domestic currency per US dollar. The proxy for domestic competitors' price (P) is its Producer Price Index (PPI). As the proxy for the demand pressure in foreign country (Y*), we use foreign industrial production index. Finally, we use foreign PPI as the proxy for foreign marginal cost (C*). All foreign variables are constructed by taking the weighted average of the corresponding variables of the foreign countries where they have significant contribution to domestic import. In this case, we use share of imports values as the weights of each foreign country. Data for PM, E, P, C*, and Y* are obtained from International Financial Statistics CD-ROM and Datastream. The value of imports is obtained from World Import and Export Data, CD-ROM of 1980-1997 released by Center for International Data of UC Davis.

Ideally, to be more representative for Southeast Asian economy, this study covers ASEAN-5 countries, i.e., Indonesia, Malaysia, the Philippines, Singapore and Thailand. All these five countries contribute for more than 90 percent of the total export and import in Southeast Asia. Unfortunately, after exploring data availability from various sources, we can only cover 3 countries, i.e., Thailand, Singapore, and the Philippines. The other two countries, Indonesia and Malaysia, do not have import prices data in domestic currency in the long enough series of time. Data for Thailand and Singapore covers the period from 1974:1 to 2000:3, and data for the Philippines runs from 1974:1 to 1991:4. Although we only use three countries, in average, the share of their total export and import in Southeast Asia during 1974-2000 is still about 60 percent.

IV. Econometrics Methods

Considering that there is a possibility of the long run equilibrium relationship among variables used in this paper, we use Error Correction Model (ECM) to estimate the relationship of the variables. Application of the ECM requires that each series in the equation is not stationary and they have a linear combination that is stationary. In this section, we describe briefly econometric procedure we employ for the unit root test, cointegration test and ECM estimation.

Unit Root Test

A standard unit root test that widely used in empirical studies is Augmented Dickey-Fuller (ADF) test. Suppose we need to test the null hypothesis that the series x_t is characterized by the unit root process. The ADF test statistic is given by the t-ratio of the null hypothesis $a_1=0$ in the regression of

$$\Delta x_t = a_0 + a_1 x_{t-1} + a_2 t + \sum_{i=1}^{p} b_i \Delta x_{t-i} + e_t \tag{4.1}$$

If we fail to reject the null hypothesis then we conclude that the series x_t is a unit root process.

Although the standard ADF test has been widely used, as shown by Perron (1989), in the presence of the structural break this test is biased toward non-rejection of the unit root. The procedure proposed by Perron (1989) for the unit root test in the presence of a structural break can be described as follows. Suppose there is a possible structural break in a series x_t at time T_b. First, data is detrended by estimating either of the following equations

$$x_t = a_0 + a_1 t + a_2 DU_t + \tilde{x}_t \tag{4.2}$$

$$x_t = a_0 + a_1 t + a_2 DU_t + a_3 DT^* + \tilde{x}_t \tag{4.3}$$

$$x_t = a_0 + a_1 t + a_3 DT^* + \tilde{x}_t \tag{4.4}$$

where $DU_t = 1$, if t > T_b and zero otherwise

$DT_t^* = t - T_b$ if t > T_b and zero otherwise

$\tilde{x}_t$ is the residual of the regression

The next step is, to estimate the regression

$$\tilde{x}_t = m\tilde{x}_{t-1} + \sum_{i}^{p} q_i \Delta\tilde{x}_{t-i} + d\sum_{i=1}^{p} d_j D(T_b)_{t-j} + e_t \tag{4.5}$$

or $$\tilde{x}_t = m\tilde{x}_{t-1} + \sum_{i}^{p} q_i \Delta\tilde{x}_{t-i} + e_t \tag{4.6}$$

where $D(T_b)_t = 1$ if $t=T_b+1$ and zero otherwise. Equation (4.5) is estimated for model (4.2) and (4.3), and equation (4.6) is estimated for model (4.4). The test is based on the t-

statistic for the null hypothesis μ=1. If the t-statistic is greater than critical value calculated by Perron (1989) then the hypothesis of a unit root is rejected.

In estimating regressions (4.1), (4.5) and (4.6) we need to choose an appropriate lag length p. One of the methods that can be used to choose the lag length is *general-to-specific sequential t rule*. Suppose we know that p is less than or equal to some known p_{max}. Starting from an autoregression of p_{max}, if the last lag is significant then the lag length is set equal to p_{max}. Otherwise, the lag length is reduced one period and the regression is reestimated and the same test is repeated. If the process is continued until the last length is insignificant, then lag length is set equal to zero. The other procedures that commonly used in choosing the lag length p are based on Akaike Information Criteria (AIC) and Schwartz Bayesian Criteria (SBC) given by

AIC = T ln(sum of squared residuals) + 2n

SBC = T ln(sum of squared residuals) + n ln(T)

where n is the number of parameters estimated, and T is the number of usable observations. The lag length p is chosen based on the lowest value of AIC and/or SBC.

Cointegration Test and Error Correction Model

Given that each variable under the studies follow the unit root process, it is possible that they are cointegrated, that is, they have a linear combination that is stationary. Formally, variables x_{1t}, x_{2t}, …, x_{kt} are said to be cointegrated of order (d,b) if: (i) all x_{1t}, x_{2t},, …, x_{kt} are integrated of order d; and (ii) there exists a vector $ß=(ß_1, ß_2,\ldots, ß_k)$ such that $(ß_1x_{1t}+ ß_2x_{2t}+\ldots+ ß_kx_{kt})$ is integrated of order (d-b) where b>0, (Engel and Granger, 1987).

In this paper, to test the presence of cointegration we employ Johansen's (1991, 1995) procedure described as follows[4]. Consider the VAR representation of the vector $X_t = (x_{1t}, x_{2t}, ..., x_{kt})'$ is given by

$$X_t = \Pi_0 + \Pi_1 X_{t-1} + ...\Pi_p X_{t-p} + e_t \qquad (4.7)$$

[4] Engel and Granger (1987) test for cointegration has important number of defects: (i) the result of the test depends on the variable chosen for normalization; and (ii) no systematic procedure for the separate estimation of the multiple cointegration vectors.

where Π_0 is a (kx1) vector of intercept, Π_i is (kxk) coefficient matrices and $e_1,..e_T$ are IINp (**0,?**). This equation can be transformed into the difference form

$$\Delta X_t = \Pi_0 + \Pi X_{t-p} + \Gamma_1 \Delta X_{t-1} + ... + \Gamma_{p-1} \Delta X_{t-p+1} + e_t \qquad (4.8)$$

where, $\Pi = -(I - \Pi_1 - ... - \Pi_p)$; and

$$\Gamma_i = -(I - \Pi_1 - ... - \Pi_i)$$

Let r represents the rank of matrix ?. If r=0 then equation (4.8) is just a VAR representation of X_t in the differenced variables. If r=k then vector X_t is a stationary process and we can estimate equation (4.7) directly. If 0<r<k then there exist kx r matrices a and ß such that ?= a ß' and ß'X_t is stationary. In this case equation (4.8) can be interpreted as an Error Correction Model. Each column of matrix ß is known as cointegrating vector, and a is the adjustment parameters. If X_t has an error correction representation, estimating X_t as a VAR in the first difference is inappropriate.

The number of distinct cointegrating vectors is determined based on the significance of the characteristic roots of ?. Suppose characteristic roots of ? are $?_1,\ldots,?_k$. The number of significant cointegrating vectors is based on the trace statistics (Q_{trace}) and maximum characteristics roots statistics (Q_{max}) given by

$$Q_{trace} = -T \sum_{i=r-1}^{k} \ln(1 - \hat{l}_i)$$

and

$$Q_{\max} = -T \ln(1 - \hat{l}_{r+1})$$

where $\hat{l}$ is the estimated value of characteristic roots. Trace statistics, Q_{trace}, test the null hypothesis that the number of cointegrating vectors is r against the alternative r+1. The maximum characteristic root statistic test statistic, Q_{max}, test the null hypothesis that the number of cointegrating vectors is less than or equal to r against a general alternative. The critical values for Q_{max} and Q_{trace} is provided by Johansen and Juselius (1990) and Osterwald-Lenum (1992).

V. Estimation Results

The relationship of variables in equation (2.5) is captured as follows. Let ß is a cointegration vector for *pm, e, p, c*, y** and a constant, then the long run relationship between *pm, e, p, c*,* and *y** can be represented in an import price equation

$$pm_t = b_0 + b_1 e_t + b_2 p_t + b_3 p_t^* + b_4 y_t^* \tag{5.1}$$

Given that *pm, e, p, c** and *y** are cointegrated, then the short run dynamic of the model can be captured by an error correction representation in the form

$$\Delta pm_t = a_0 + a_1 v_{t-1} + \sum_{i=1}^{p} g_{1i}\, pm_{t-i} + \sum_{i=1}^{p} g_{2i} \Delta e_{t-i} + \sum_{i=1}^{p} g_{3i} \Delta p_{t-i} + \sum_{i=1}^{p} g_{4i} \Delta c_{t-i}^* + \sum_{i=1}^{p} g_{5i} \Delta y_{t-i}^* + e_t \tag{5.2}$$

where $v_t = pm_t - b_0 - b_1 e_t - b_2 p_t - b_3 p_t^* - b_4 y_t^*$.

Before we estimate the model, we need to do a unit root test for each variable. From the plots of the data presented in Figure 1 through Figure 3, we can see that for each series there is a possibility of structural break. Considering the presence of a structural break in the series, we employ Perron's (1989) procedure for unit root test. For each series, the lag length is determined using *general-to-specific sequential t rule*[5]. The maximum lag length is chosen equal to 8, which is considered a reasonable value for quarterly data. Except for the break point at 1998:1, the break points are chosen based on the inspection of the data visually without any prior information about the events at that break point. The break point at 1998:1 is chosen based on the currency crisis in this area was happened in the third and fourth quarter of the 1997.

Table 1. Results of the Unit Root Tests

Variables	Thailand		Singapore		Philippines	
	t-statistics	5% critical value	t-statistics	5% critical value	t-statistics	5% critical value
pm	-2.44	-3.69	-3.29	-3.87	-2.27	-3.69
e	-3.36	-3.69	-2.28	-3.68	-2.74	-3.69
p	-2.08	-3.69	-2.74	-3.87	-2.49	-3.69
c*	-3.46	-3.87	-3.48	-3.87	-2.34	-3.94
y*	-2.85	-3.65	-2.78	-3.65	-2.15	-3.65

Note: Critical values are obtained from Perron (1989)

[5] See Hayashi (2000) for details.

The results of the unit root test in Table 1 show that we cannot reject the null hypothesis of the unit root for all variables. These results lead us to test the presence of cointegrations among variables in the model.

In implementing cointegration test, we need to determine the lag length. Based on AIC and SBC criteria we choose lag length of 3, 5, and 3 for Thailand, Singapore and Philippines, respectively. Since we have 5 variables then there is a possibility of 0, 1, 2 , 3, and 4 cointegration vectors. As reported in Table 2, the results of the contegration test indicate that each country has one cointegration vector. The critical values are based on the Osterwald-Lenum's (1992) Table.

Table 2. Cointegration Tests Results

Country	Eigenvalue	Likelihood Ratio	Critical Value		Null Hypothesis
			5%	1%	
Thailand	0.290	70.73	68.52	76.07	r = 0 *
(1974:1-2000:3)	0.143	35.39	47.21	54.46	r = 1
	0.094	19.46	29.68	35.65	r = 2
	0.082	9.33	15.41	20.04	r = 3
	0.005	0.53	3.76	6.65	r = 4
Singapore	0.296	68.55	68.52	76.07	r = 0 *
(1974:1-2000:3)	0.245	33.07	47.21	54.46	r = 1
	0.044	4.73	29.68	35.65	r = 2
	0.001	0.14	15.41	20.04	r = 3
	3.06E-05	0.003	3.76	6.65	r = 4
Philippines	0.536	98.86	68.52	76.07	r = 0 **
(1974:1-1991:4)	0.309	46.65	47.21	54.46	r = 1
	0.147	21.52	29.68	35.65	r = 2
	0.125	10.69	15.41	20.04	r = 3
	0.023	1.59	3.76	6.65	r = 4

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

From cointegration vectors we obtain the long run equilibrium relationships among the variables in the model. By normilizing cointegration vectors with respect to *pm* we get the long run import price equations as follows.

Thailand: $pm = 0.798 + 0.647e + 1.695\,p - 0.139c^{*} - 0.882\,y^{*}$
(2.65) (6.78) (-0.65) (-2.60)

Singapore: $pm = -0.361 + 0.408e - 0.227p + 1.508c^{*} - 0.393\,y^{*}$
(2.39) (-0.43) (2.14) (-1.64)

Philippines: $pm = 14.163 + 1.433e - 1.275\ p + 2.943\ c^{*} + 1.340\ y^{*}$
(2.13) (-1.67) (3.33) (1.96)

From import price equations, the estimates of exchange rate pass-through for Thailand, Singapore and the Philippines are 0.647, 0.408 and 1.433, respectively. For all three countries, the sign of the exchange rate coefficients are consistent with the theory, that is, an increase in domestic import prices is associated with a depreciation of domestic currency. Among the three countries, the Philippines has the highest long run exchange rate pass-through, where it has more than complete pass-through. On the other hand, Thailand and Singapore have incomplete pass-through.

The short run dynamics of the model is captured by coefficients of the error correction term v_t and lag variables in ECM representations. Table 3 shows the estimates of the ECM for each country. From Table 3, we can see that in Thailand only one period lag of foreign price and foreign demand that have significant effect on current import prices and both effects are positive. In Singapore only two period lag of foreign price that has significant effect on import price and the effect is positive. In Thailand and Singapore, exchange rate does not have short run effect on import prices. This can be seen from the coefficient of the error correction terms and the coefficients of the exchange rate, where they cannot be rejected different from zero. In the Philippines, the two period lag of exchange rate has significant negative effect on current import price. One period lag of domestic price is the only significant variable in Philippines that has positive effect on import price in the short run. On the other hand, both foreign variables have significant negative effect.

From these results we can argue that, in the short run, import prices in Thailand and Singapore appear to be influenced by foreign prices and foreign demand rather than by domestic prices and exchange rate. On the other hand, import prices in Philippines in the short run are influenced by exchange rate, domestic price, foreign price and foreign demand.

Tabel 3. Estimates of Error Correction Models

Country	lag	Variables						Summary Statistics
		v	?pm	?e	?p	?c*	?y*	
Thailand (1974:1-2000:3)	1	0.125 (1.36)	-0.040 (-0.22)	0.263 (1.54)	-0.028 (-0.08)	1.120 (2.28)	0.596 (2.17)	Adj-R^2: 0.387 SS Resid: 0.132 F-stat.: 3.159
	2		-0.028 (-0.15)	-0.107 (-0.60)	0.447 (1.26)	-0.608 (-1.06)	-0.298 (-1.09)	
	3		-0.169 (-0.93)	-0.114 (-0.66)	-0.184 (-0.57)	0.549 (1.08)	0.460 (1.77)	
Singapore (1974:1-2000:3)	1	-0.011 (-0.12)	0.424 (1.50)	-0.087 (-0.69)	-0.160 (-0.71)	0.002 (0.01)	0.289 (1.35)	Adj-R^2: 0.193 SS Resid: 0.034 F-stat.: 1.852
	2		-0.233 (-0.75)	-0.153 (-1.27)	-0.184 (-0.75)	0.945 (2.14)	-0.105 (-0.52)	
	3		0.163 (0.54)	0.024 (0.21)	-0.131 (-0.55)	-0.409 (-0.90)	0.074 (0.37)	
	4		-0.053 (-0.18)	-0.168 (-1.50)	-0.144 (-0.62)	0.504 (1.09)	0.029 (0.14)	
	5		-0.080 (-0.29)	0.014 (0.12)	-0.165 (-0.76)	-0.165 (-0.40)	0.011 (0.06)	
Philippines (1974:1-1991:4)	1	-0.320 (-4.42)	-0.189 (-1.37)	-0.128 (-0.38)	1.234 (3.01)	1.452 (1.61)	-1.718 (-2.56)	Adj-R^2: 0.535 SS Resid: 0.224 F-stat.: 5.535
	2		0.144 (0.93)	-1.445 (-3.73)	0.310 (0.64)	-2.322 (-2.28)	0.291 (0.45)	
	3		0.214 (1.62)	0.366 (0.95)	-0.599 (-1.57)	0.782 (0.82)	-1.030 (-1.89)	

Since the Philippines data is only covering the period of 1974:1-1991:4, for the comparison reason, we perform cointegration tests and ECM estimations for Thailand and Singapore using data from 1974:1 to 1991:4. The results of the cointegration tests provided in Table 4 show that, using data from 1974:1 to 1991:4, each of Thailand and Singapore has one cointegration vector.

The long run equilibrium of the import price equation for Thailand and Singapore using data during the period of 1974:1-2000:3 are as follows.

Thailand: $pm = 0.883 + \underset{(2.91)}{0.391}e + \underset{(5.03)}{1.586}p - \underset{(-0.55)}{0.165}c^* - \underset{(-2.06)}{0.523}y^*$

Singapore: $pm = 1.002 + 0.270e + 1.418p - 0.675c^{*} + 0.431039y^{*}$
(4.25) (14.25) (-4.64) (6.90)

Compare to the long run exchange rate pass-through using full sample, we obtain lower exchange rate pass-through for both Thailand and Singapore, that is, 0.391 and 0.270 respectively. Thus, using the same period of data, 1974:1-1991:1, the difference between exchange rate pass-through of the Philippines and those of Thailand and Singapore are even larger.

Table 4. Cointegration Tests Results for Thailand and Singapore, 1974:1-1991:4

Country	Eigenvalue	Likelihood Ratio	Critical Value		Null Hypothesis
			5%	1%	
Thailand	0.420	77.19	68.52	76.07	r = 0 **
	0.315	40.18	47.21	54.46	r = 1
	0.107	14.43	29.68	35.65	r = 2
	0.093	6.76	15.41	20.04	r = 3
	0.001	0.10	3.76	6.65	r = 4
Singapore	0.386	75.58	68.52	76.07	r = 0 *
	0.333	42.37	47.21	54.46	r = 1
	0.168	14.78	29.68	35.65	r = 2
	0.027	2.245	15.41	20.04	r = 3
	0.005	0.37	3.76	6.65	r = 4

*(**) denotes rejection of the hypothesis at 5%(1%) significance level

Using data from 1974:1 to 1991:4, the results of the short run dynamic of the model for Thailand and Singapore are provided in Table 5. The short run dynamic of the model in Thailand does not change much if we compare to the short run dynamic using data from 1974:1-2000:3. Still, foreign price and foreign demand have significant positive effects on import price. On the other hand, the three period lag of domestic price has significant negative effect on import price. In Singapore, both domestic price and foreign demand have significant positive effect on import price. However, the effects of foreign price are mix, that is, its two period lag has significant positive effect while its three period lag has significant negative effect.

Table 5. ECM Estimates for Thailand and Singapore, 1974:1-1991:4

Country	lag	Variables						Summary Statistics
		v	?pm	?e	?p	?c*	?y*	
Thailand	1	-0.131 (-1.33)	-0.074 (-0.46)	0.194 (1.36)	-0.242 (-0.92)	1.346 (4.28)	0.263 (1.48)	Adj-R^2: 0.429 SS Resid: 0.025 F-stat.: 4.149
	2		0.169 (1.10)	-0.203 (-1.43)	0.452 (1.77)	-0.599 (-1.53)	-0.109 (-0.61)	
	3		0.075 (0.55)	0.101 (0.67)	-0.640 (-2.64)	0.270 (0.78)	0.617 (3.68)	
Singapore	1	0.893 (4.24)	-1.247 (-2.27)	0.144 (1.08)	1.697 (3.35)	-0.543 (-1.37)	0.446 (2.08)	Adj-R^2: 0.459 SS Resid: 0.020 F-stat.: 4.350
	2		-0.392 (-0.69)	0.033 (0.26)	0.068 (0.13)	0.917 (2.06)	-0.254 (-1.09)	
	3		-0.628 (-1.13)	0.173 (1.36)	0.873 (1.70)	-0.984 (-2.47)	0.322 (1.67)	

VI. Conclusion

Based on the Law of One Price (LOP), in this paper we estimate exchange rate pass-through into import prices in some Southeast Asian countries. Using quarterly data of import price, exchange rate, domestic PPI, foreign PPI and foreign industrial production we estimate the model for Thailand, Singapore and the Philippines. Data for Thailand and Singapore cover the period from 1974:1 to 2000:3, and data for the Philippines cover the period of 1974:1-1991:4.

The results of the unit root tests show that all variables in the model follow the unit root process. For each country, cointegration tests show that pm, e, p, c* and y* are cointegrated of order one. From cointegration vectors we find the long run exchange rate pass-through estimates 0.647, 0.408 and 1.433 for Thailand, Singapore and the Philippines, respectively. By using data from 1974:1 to 1991:4, the long run exchange rates pass-through in Thailand and Singapore fall to 0.391 and 0.270, respectively.

From estimation results of the error correction model we find that, in the short run, foreign price and foreign demand have significant effect on import prices in Thailand and the effects are positive. In Singapore, only foreign price has significant effect on the

import prices in the short run and the effect is positive. Both in Thailand and Singapore, exchange rate does not have significant effect on import prices in the short run. In the Philippines, in the short run, exchange rate, foreign price, and foreign demand have significant negative effect on import prices, and only domestic price that has significant positive effect.

The results presented here have not reached the second purpose of this paper, that is, to compare the exchange rate pass-through of Southeast Asian countries with the exchange rate pass-through of some industrialized countries. Therefore, to complete this paper we will estimate exchange rate pass-through of several industrialized countries. In this case, we will choose industrialized countries that have quite similar trading partners with those of Southeast Asian countries.

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Figure 1. Thailand Data, 1974:1-2000:3

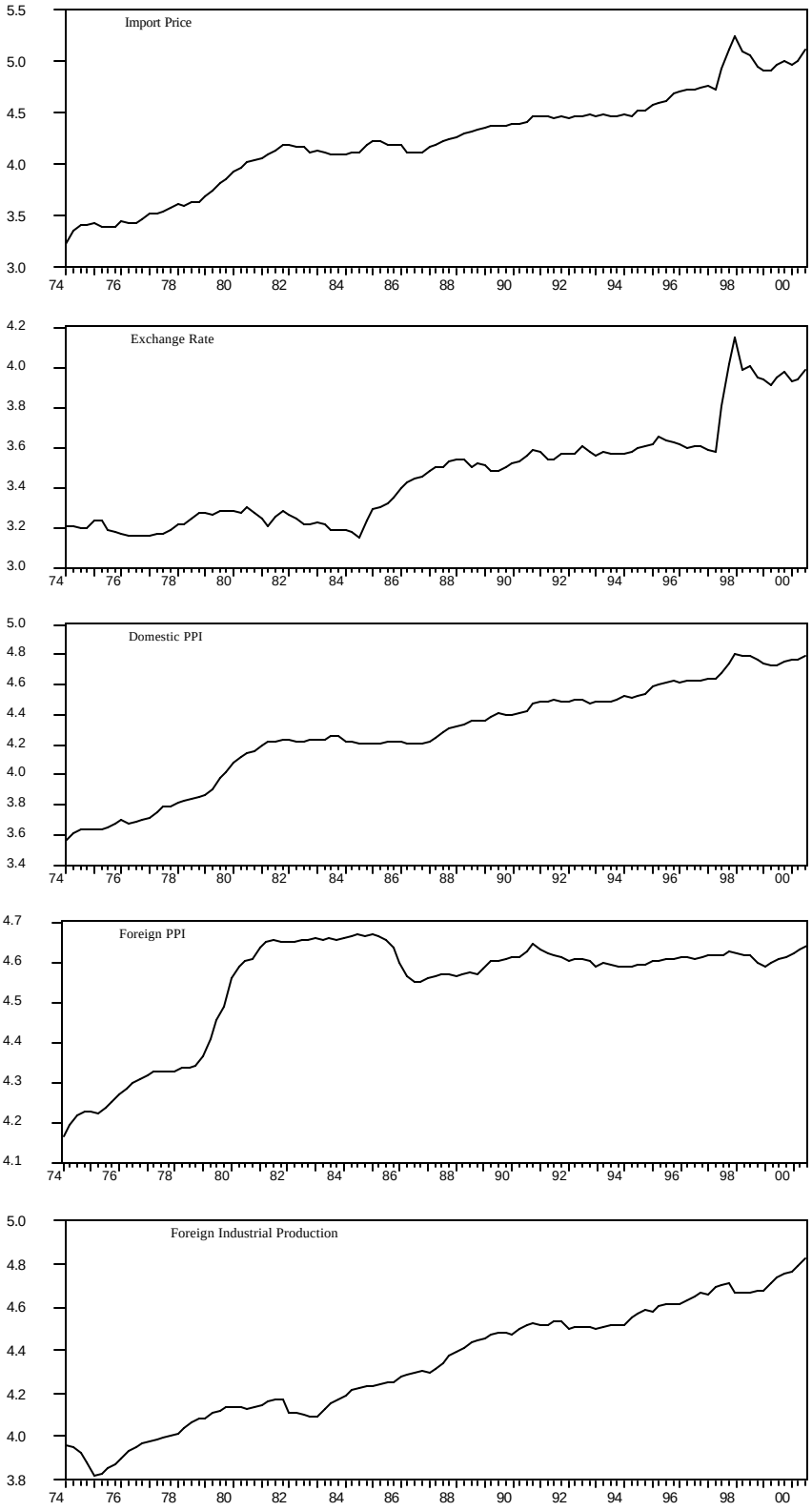

Figure 2. Singapore Data, 1974:1-2000:3

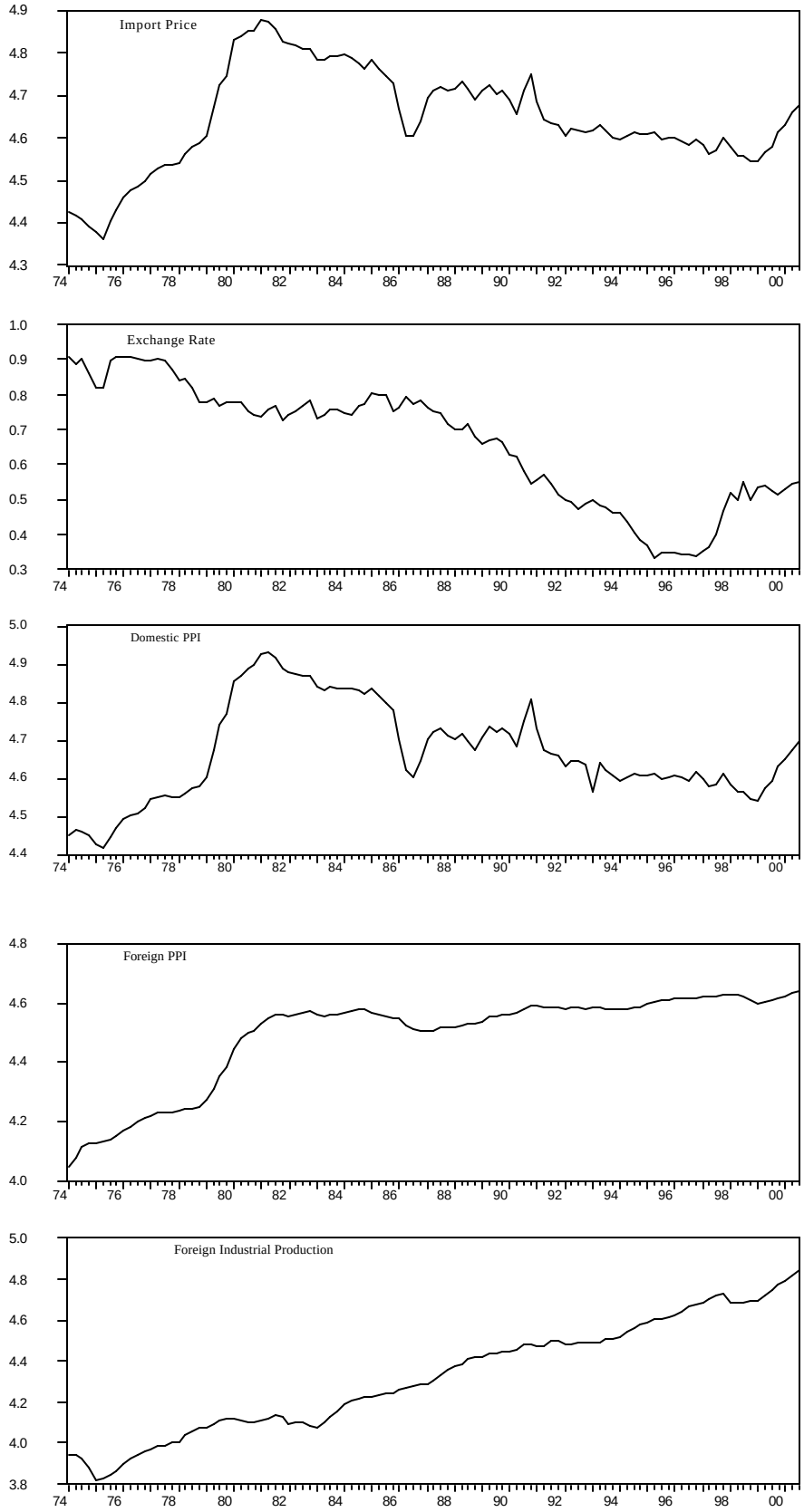

Figure 3. Philippines Data, 1974:1-2000:3