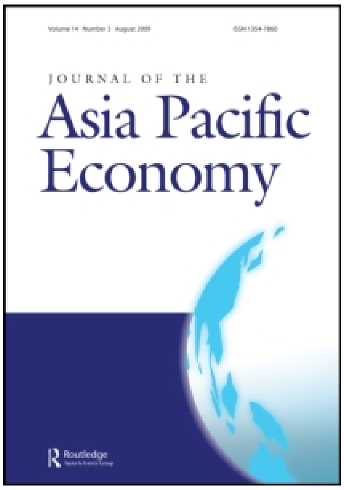

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Amit Ghosh [ab]; Ramkishen S. Rajan [ab]
[a] Department of Economics, Illinois Wesleyan University, Bloomington, Illinois, USA [b] School of Public Policy, George Mason University, Arlington, Virginia, USA

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What is the extent of exchange rate pass-through in Singapore? Has it changed over time?

Amit Ghosh* and Ramkishen S. Rajan

Department of Economics, Illinois Wesleyan University, Bloomington, Illinois, USA; School of Public Policy, George Mason University, Arlington, Virginia, USA

This paper estimates the extent and evolution of exchange rate pass-through into import prices in Singapore for the period 1980 to 2005. Our results indicate that exchange rate pass-through into Singapore's import prices is 25% in the short-run and slightly higher at 29% for the long-run. There is evidence to suggest that the pass-through elasticity has trended downwards from 0.4 in 1983 to around 0.3 by 1987, after which it has remained fairly stable. The paper also examines the macroeconomic determinants of Singapore's exchange rate pass-through.

Keywords: exchange rate pass-through (ERPT); market share; pricing-to-market; Singapore

JEL-Classification: E31, F3, F41

1. Introduction

Exchange rate pass-through (ERPT) is broadly defined as the percentage change in import prices in the importing nation's currency due to a 1% change in the exchange rate between the importing and exporting nation. This paper examines the transmission of exchange rate changes into import prices in Singapore for the period 1980 to 2005. The degree of exchange rate pass-through has important implications for macroeconomic policy and the choice of exchange rate regime (Ghosh and Rajan 2007). Specifically, if ERPT is low, use of any exchange rate based adjustment to improve the trade balance may be rendered less effective.[1] Conversely, low ERPT implies that the economy may be less concerned about the potential inflationary consequences of exchange rate fluctuations.[2] For a detailed survey on the literature on ERPT, see Goldberg and Knetter (1997).

Singapore has operated a forward-looking band-basket-crawl regime since 1981 with a high *de facto* weight being given to the US dollar in the currency basket.[3] In view of this we examine ERPT with the bilateral US dollar exchange rate. At an aggregate level ERPT could be examined for various price indices such as consumer prices (CPI) and import prices. Typically, CPI pass-through is less sensitive to exchange rate changes as CPI includes non-tradables and is also impacted by other factors such as the distribution channel and market structure of retail chains. Therefore, the impact of exchange rate changes on CPI is much more indirect than it is on import prices. As such, the paper concentrates on estimating ERPT into import prices (i.e. 'prices at the border') only. We also examine

*Corresponding author. Email: aghosh@iwu.edu

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how the underlying macro fundamentals of a country might have affected the time-varying ERPT elasticities.

In related literature on ERPT for Singapore Ito *et al.* (2005) examines the extent of ERPT into both aggregate import prices for Singapore as well as seven other East Asian countries during the period 1986:Q1 to 2004:Q2. The authors use a single equation specification and a first-differenced model with a lag of the effective exchange rate up to four periods. They find ERPT into import prices to be insignificant for Singapore. Sasaki (2005) examines the effect of changes in US dollar for selected Asian countries including Singapore for 1973–2000 using a first-differenced model. ERPT elasticity for Singapore is estimated to be about 40%.

The paper is organized as follows. Section 2 develops a simple model to formalize the determinants of ERPT. Section 3 estimates ERPT elasticities for Singapore's import prices using bilateral exchange rate vis-à-vis the US dollar. Section 4 briefly examines whether the ERPT has changed over time. Section 5 investigates whether ERPT is endogenous to certain macro variables, including inflation and monetary and exchange rate volatility. The final section concludes the paper.

2. A simple model of ERPT

Before undertaking the empirics it is useful to help formalize thoughts on the determinants of ERPT (Knetter 1993; Marston 1990). We consider a firm in country A exporting a product i to country B. Firm A is a price maker and sets its own price, P_i. The profit function for A is given by:

$$\pi_A = P_i Q_i - C(Q_i) \tag{1}$$

where $C(Q_i)$ is the total cost function for firm A.

$$\frac{\partial \pi_A}{\partial Q_i} = P_i + Q_i \frac{\mathrm{d}P_i}{\mathrm{d}Q_i} - C'(Q_i) = 0$$

Re-arranging we have,

$$1 + \frac{1}{\varepsilon_i} = \frac{1}{P_i} MC_i^A(Q_i)$$

where

$$\varepsilon_i = \frac{\mathrm{d}Q_i}{\mathrm{d}P_i} \frac{P_i}{Q_i}$$

is the price elasticity of demand for good i in absolute terms and $MC_i^A(Q_i)$ is the marginal cost for firm A.

$$P_i = \left(\frac{\varepsilon_i}{\varepsilon_i + 1}\right) MC_i^A(Q_i). \tag{2}$$

$$P_i^A = \mu MC_i^A(Q_i). \tag{3}$$

with $\mu_i = (\frac{\varepsilon_i}{\varepsilon_i + 1})$ being the markup of price over the marginal cost.

We focus on the price of good *i* in importing nation B. Assuming no impediments to trade, the price of the product should be the same in both nations.

$$P_i^B = P_i^A E_B^A \tag{4}$$

where E_B^A is defined as the number of units of B's currency per unit of A's currency.

Using equation (3) in equation (4), we have:

$$P_i^B = \mu MC_i^A E_B^A \tag{5}$$

Expressing equation (5) in logs we get:

$$\ln P_i^B = \ln \mu + \ln MC_i^A + \ln E_B^A \tag{6}$$

Equation (6) shows that ERPT may be affected by the marginal costs of the exporters and also on the extent of change in mark-ups of the exporters.

3. Empirical model and results

Taking equation (6) as the starting point we examine ERPT into the aggregate import prices of Singapore with regard to the bilateral nominal exchange rate with the US dollar. In order to use an estimating version of equation (6) it is important to control for domestic demand. Thus, our estimating equation is:

$$\ln(imprsg) = \alpha_0 + \alpha_1 \ln(exrt) + \alpha_2 \ln(mpsg) + \alpha_3 \ln(MC^F) \tag{7}$$

where *imprsg* denotes Singapore's import prices; *exrt* denotes Singapore's exchange rate (vis-à-vis the US dollar). A rise in the bilateral exchange rate with the US dollar denotes a depreciation of the Singapore dollar. *mpsg* denotes Singapore's manufacturing production index which is a proxy for domestic demand. A rise in domestic output generally implies an increase in demand for imported goods, thereby raising the import price. Thus, α_2 is expected to be positive. However, a rise in output could also imply less demand for imported goods and a decline in the import prices. So it is plausible that $\alpha_2 < 0$. MC^F represents the control for Singapore's exporter's costs (we discuss proxies for this in the next section). If $\alpha_1 = 0$ there is no ERPT into Singapore's import prices, while if $\alpha_1 = 1$ there is complete ERPT. If the coefficient lies anywhere in between 0 and 1 then there is partial ERPT.

3.1. *Data and controls*

We control for shifts in import demand by using the index of manufacturing production in Singapore, which proxies output.[4] With regard to costs, since most of Singapore's trade is invoiced in US dollars, we follow Marazzi *et al.* (2005) and Campa and Goldberg (2005) by proxying exporter's costs by using the US CPI and PPI. We also use a third proxy for foreign exporters' costs, namely the world CPI, although this variable is a bit suspect as the weights used to compute it.[5] The data span the period 1980Q1–2005Q3 and all data are sourced from the IMF's *International Financial Statistics*.

3.2. *Stationarity tests*

In order to ascertain to what degree the variables share univariate integration properties we start by conducting tests for stationarity in the variables in equation (7) using both the augmented Dickey-Fuller (ADF) test as well as the Phillip-Perron test (Table 1(a)). Both tests fail to reject the null hypothesis of unit root in the variables in their level form, suggesting that they are stationary in their first differenced form. Given that the variables are $I(1)$ we next test for cointegration among the variables in equation (3) using the methodology developed by Johansen and Juselius (1990). Evidence of cointegration among variables rules out the possibility of the estimated relationship being spurious. The Johansen procedure involves identification of the rank of an m by m matrix Π with the following specification:

$$\Delta X_t = \delta + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Pi X_{t-k} + \varepsilon_t \tag{8}$$

X_t is a column vector of the m variables. Γ and Π represent coefficient matrices. Δ is a difference operator. k denotes the lag length. δ is a column of constants. If Π has zero rank, there is no linear combination of the variables, i.e. the variables are non-cointegrated. If the rank r, $0 < r < m$, then the variables in equation (7) are cointegrated.

The results for cointegration for ERPT into import prices using the alternative measures of exporters' costs are shown in Table 1(b). The results indicate the presence of a cointegrating relationship for most cases.

3.3. *Estimated ERPT elasticities*

3.3.1. *Long-run elasticities*

We use the methodology developed by Stock and Watson (1993) to obtain the long-run ERPT elasticities. The dynamic OLS (DOLS) procedure involves regressing any variable with the regressors itself but also the leads and lags of the first differences of the regressors. Stock and Watson (1993) show that it is a robust methodology, particularly for small samples, as it allows for regressing variables integrated of different orders that are co-integrated.

Table 1a. Unit root test results

	ADF stat. levels	5% critical value	ADF stat. 1st difference	5% critical value		P-P stat. levels	5% critical value	P-P stat. 1st difference	5% critical value
limprsg	–0.876	–3.455	–7.847	–3.455	*limpr*	–0.897	–3.454	–7.239	–3.455
lexrt	–0.926	–3.454	–9.414	–3.455	*lexrt*	–1.165	–3.454	–9.482	–3.455
lmpsg	–3.237	–3.458	–5.114	–3.457	*lmpi*	–3.655	–3.454	–13.43	–3.455
lppiusa	–2.821	–3.455	–5.967	–3.455	*lppiusa*	–2.943	–3.454	–5.967	–3.455
lcpiusa	–3.023	–3.455	–6.744	–3.455	*lcpiusa*	–4.282	–3.454	–6.7	–3.455
lcpiworld	–0.431	–3.459	–2.25	–3.459	*lcpiworld*	1.052	–3.454	–3.868	–3.455

limprsg = log of import price index of Singapore; *lexrt* = log of Singapore dollar per unit of USD; *lmpsg* = log of manufacturing production index of Singapore; *lcpiusa* = log of US CPI; *lppiusa* = log of US PPI; *lcpiworld* = log of world CPI; *cr_dum* = A dummy that assume the value of 1 for 1997Q2–1998Q2 and 0 otherwise.
*tests are conducted using trend and intercept.

Table 1b. Cointegration test results

	Trace statistic				Max. Eigenvalue statistic			
	$r = 0$	$r = 1$	$r = 2$	$r = 3$	$r = 0$	$r = 1$	$r = 2$	$r = 3$
Specification 1	87.334	46.054	15.573	7.799	41.280	30.481	7.774	6.014
Specification 2	78.746	42.571	17.223	2.903	36.175	25.348	14.320	2.739
Specification 3	111.266	59.717	29.351	12.900	51.549	30.366	16.450	10.580
5% critical value	69.819	47.856	29.797	15.495	33.877	27.584	21.132	14.265

r denotes the number of co-integrating equations. Each cointegration test is done for the corresponding specification in the subsequent tables. For instance specification 1 here is the cointegration result for estimating equation (1) in Table 2.

Moreover, by including the lagged and lead values of the changes in the regressors it corrects for potential simultaneity bias and small sample bias among the regressors.

The empirical estimating version of equation (7) is given by:

$$\ln(imprsg)_t = B'X_t + \sum_{j=-1}^{j=+1} \eta_j \Delta \ln(exrt)_{t-j} + \sum_{j=-1}^{j=+1} \lambda_j \Delta \ln(mpsg)_{t-j} + \sum_{j=-1}^{j=+1} \gamma_j \Delta \ln(MC^F)_{t-j} + \zeta_t \quad (9)$$

where: $B = [\alpha_0, \alpha_1, \alpha_2, \alpha_3]'$, $X = [(1, \ln(exrt), \ln(mpsg), \ln(MC^F)]$.

We use one period leads and lags of the regressors.[6] We also control for any possible effects of the Asian financial crisis by constructing a dummy that assumes a value of 1 from 1997Q2–1998Q2 and 0 for all other periods.[7]

The results are summarized in Table 2. Specifications 1 to 3 report the exchange rate pass-through estimates using US CPI, PPI and world CPI as proxies for exporters' cost conditions, respectively. ERPT into import prices for Singapore is 37% when using US CPI (Column 1). When we use the US PPI as a proxy for the cost conditions in the US, import price ERPT is 30% (Column 2). The coefficients in both cases are statistically significant at the 1% level. When we use the world CPI to proxy for a cost measure of all exporters selling to Singapore with their exports invoiced in US dollars the ERPT elasticity is much lower at 12%. While there is not much to choose between these specifications, note that the important control variable – namely the proxy for cost – is the correct sign only in the second specification when we use US PPI. For this reason this is our preferred specification.

3.3.2. *Short-run elasticities*

Having estimated the long-run relationship we next consider the short-run elasticities. We do so by employing an error correction model (ECM) to model the short-run dynamics. Given the variables in equation (7) are cointegrated we examine the short-run relationship

Table 2. Dynamic OLS (DOLS) import price pass-through in Singapore: US dollar

	Specification 1	Specification 2	Specification 3
Constant	**5.838***** 0.730	**2.884***** 0.814	**3.940***** 0.115
$(lexrt)_t$	**0.366***** 0.045	**0.293***** 0.072	**0.122**** 0.051
$(lmpsg)_t$	**0.232**** 0.106	**–0.169**** 0.067	**0.409***** 0.053
$(lcpiusa)_t$	**–0.543**** 0.255		
$(lppiusa)_t$		**0.496**** 0.238	
$(lcpiworld)_t$			**–0.274***** 0.030
$\Delta lexrt_{(t)}$	–0.161 0.166	0.166 0.131	–0.058 0.165
$\Delta lexrt_{(t+1)}$	**0.165*** 0.150	**0.260**** 0.128	0.046 0.135
$\Delta lexrt_{(t-1)}$	–0.245 0.126	0.242 0.166	–0.083 0.129
$\Delta lmpsg_{(t)}$	**–0.234**** 0.077	–0.042 0.072	**–0.296***** 0.070
$\Delta lmpsg_{(t+1)}$	–0.060 0.072	**–0.174***** 0.060	0.007 0.056
$\Delta lmpsg_{(t-1)}$	**–0.194**** 0.074	–0.072 0.059	**–0.203***** 0.052
$\Delta lcpiusa_{(t)}$	**2.445**** 1.089		
$\Delta lcpiusa_{(t+1)}$	–0.362 1.123		
$\Delta lcpiusa_{(t-1)}$	1.745 1.174		
$\Delta lppiusa_{(t)}$		**1.313**** 0.531	
$\Delta lppiusa_{(t+1)}$		**0.870**** 0.370	
$\Delta lppiusa_{(t-1)}$		**1.710**** 0.654	
$\Delta lcpiworld_{(t)}$			0.057 0.240
$\Delta lcpiworld_{(t+1)}$			–0.309 0.239
$\Delta lcpiworld_{(t-1)}$			0.190 0.308
cr_dum	**–0.030*** 0.018	–0.024 0.020	–0.022 0.014
Adj. R^2	0.818	0.787	0.884

Terms below coefficient denote standard errors. *, **,*** indicates significance at the 10%, 5%, 1% levels. Bold text denotes the statistically significant co-efficients *limprsg* = log of import price index of Singapore; *lexrt* = log of Singapore dollar per unit of USD; *lmpsg* = log of manufacturing production index of Singapore; *lcpiusa* = log of US CPI; *lppiusa* = log of US PPI; *lcpiworld* = log of world CPI; *cr_dum* = A dummy that assume the value of 1 for 1997Q2–1998Q2 and 0 otherwise. Δ denotes first-differenced operator.

by using an vector error correction specification given by:

$$\begin{aligned}\Delta \ln(imprsg)_t = \beta_0 &+ \sum_{j=1}^{j=k} \phi_j \alpha_1 \Delta \ln(imprsg)_{t-j} + \sum_{j=0}^{j=l} \eta_j \Delta \ln(exrt)_{t-j} \\ &+ \sum_{j=0}^{j=m} \lambda_j \Delta \ln(mpsg)_{t-j} + \sum_{j=0}^{j=n} \gamma_j \Delta \ln(MC^F)_{t-j} \\ &+ \sum_{j=1}^{r} \beta_j [\ln(imprsg)_{t-1} - B' X_{t-1}] + \varepsilon_t \end{aligned} \tag{10}$$

The coefficient of the lagged error correction term is a short-term adjustment coefficient and captures the speed of adjustment from any disequilibrium from the long-run relationships.[8]

The ERPT results are summarized in Table 3. Specifications 1 to 4 are the short-run counterparts to those in Table 2. It appears that the long-run relationship is adjusted by about 15% within the first quarter in the case of bilateral exchange rate changes between the US and Singapore. We fail to reject the null hypothesis of no ERPT, when we use US CPI and world CPI, while for the specification using US PPI the short-run ERPT coefficient is 25%. This is slightly lower than the corresponding long-run ERPT of 30%.

4. Has ERPT been declining over time?

Overall, using our preferred specification (US PPI), the results indicate that exchange rate pass-through into Singapore's import prices is 25% in the short-run and 29% for the long-run. This is broadly consistent with the findings of Sasaki (2005). While these

Table 3. ECM-import price pass-through in Singapore: US dollar

	Specification 1	Specification 2	Specification 3
Constant	**–0.010****	**–0.008*****	**0.005***
	0.005	0.002	0.003
$ECM_{(t-1)}$	**–0.205*****	**–0.153*****	**–0.288*****
	0.059	0.033	0.056
$\Delta(lexrt)_t$	0.113	**0.249*****	0.039
	0.078	0.063	0.100
$\Delta(lmpsg)_t$	**0.044***	–0.005	**0.059****
	0.027	0.026	0.027
$\Delta(cpiusa)_t$	**1.034****		
	0.455		
$\Delta(lppiusa)_t$		1.314	
		0.277	
$\Delta(lcpiworld)_t$			**–0.227****
			0.092
$\Delta limprsg_{(t-1)}$	**0.273****	**0.123*****	**0.335*****
	0.109	0.092	0.122
Adj. R^2	0.268	0.497	0.293
F-stat.	**8.332*****	**20.801*****	**9.305*****

Terms below coefficient denote standard errors. *, **,*** indicates significance at the 10%, 5%, 1% levels.

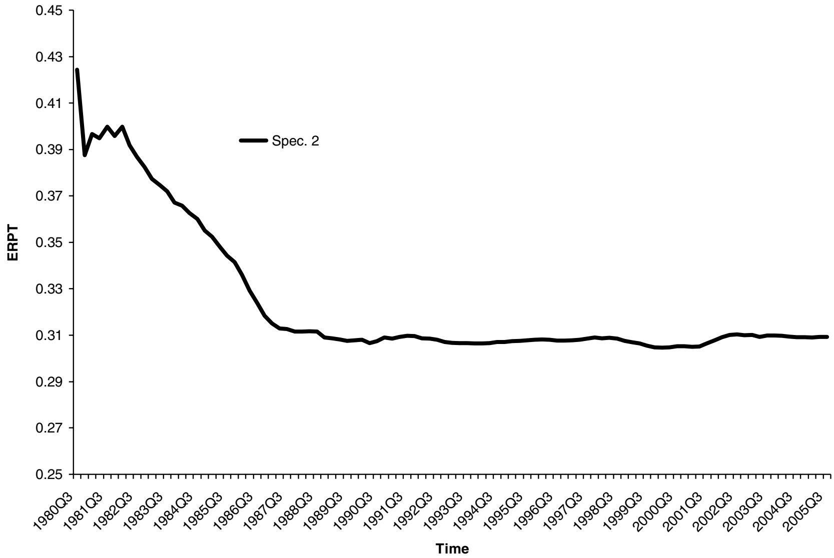

Figure 1. Kalman-filter estimates of USD pass-through into Singapore's import prices.

point estimates are averages over the period, how has ERPT in Singapore evolved over time? Recent literature on ERPT has found declining pass-through since 1980s for the industrialized countries (see Campa and Goldberg 2005). Can the same be said of ERPT in Singapore?

To examine this we undertake Kalman Filter estimations using our preferred specifications (Specification 2). This is a recursive methodology which essentially estimates equation (7) in a state space and then updates the chosen state variable (i.e. the exchange rate term here) in a dynamic model. In the second stage, the ERPT coefficient is specified as a random walk, called the state equation and is estimated dynamically over time. Figure 1 plots these estimates for the period under consideration. The ERPT elasticity has clearly trended downwards from 0.4 in 1983 to around 0.3 by 1987, after which it remained fairly stable. This is consistent with the long run point elasticities estimated previously.

5. Endogeneity of pass-through rates with macroeconomic variables

Having estimated ERPT we next explore its possible determinants. In particular, we are interested in whether ERPT is endogenous to a country's underlying macroeconomic factors?

Following Taylor (2000), it is generally believed that ERPT rates are endogenous to a nation's monetary policy and monetary stability, i.e. the more stable is a country's monetary policy and the lower its inflation the lower will be the extent of ERPT. This thesis has been confirmed by Gagnon and Ihrig (2004) using macro level data for industrial countries, as well as by Choudri and Hakura (2001), Frankel *et al.* (2005) and others. In related work, Devereux and Engel (2001) argue that if exporters set their prices in the currency of the country that has stable monetary policy (i.e. local currency pricing as opposed to producer currency pricing) then ERPT into import prices in local currency terms will be low for countries with low monetary and exchange rate variability. While the impact of monetary policy variability on ERPT is generally accepted, the impact of exchange rate variability is less certain. For instance, Froot and Klemperer (1989) contend that ERPT is low when nominal exchange rate volatility is high and exporters try to preserve market share. They view exchange rate volatility as temporary fluctuations in exchange rates in any one direction. So exporters absorb these shocks in their mark-ups and profit margins. Another factor affecting ERPT could be the degree of openness of a country. A more open economy such as Singapore may face more competition as foreign exporters try to maintain local currency price stability to preserve market share. As such, ERPT elasticity may be inversely related to trade openness.

With this as background, we focus on the endogeneity of ERPT using Specification 2. We test for the role of these macroeconomic variables by regressing the time-varying ERPT elasticities obtained from the Kalman-Filter estimations on money supply growth volatility, lagged inflation rates and its volatility, exchange rate volatility and trade openness.

$$\hat{\alpha}_1^i = \delta' x_t \tag{11}$$

where $\delta = [\delta_0, \delta_1, \delta_2, \delta_3, \delta_4]$, x_t = [money supply growth volatility, lagged inflation rate, inflation rate volatility, exchange rate volatility, trade openness]. For money supply growth we used the percentage rate of change of M2 and for inflation rate we use percentage change of CPI of Singapore. We capture exchange rate volatility by using a moving average standard deviation of the exchange rate series,

$$V = \left[(1/m) \sum_{i=1}^{m} (\log E_{t+i-1} - \log E_{t+i-2})^2 \right]^{1/2}$$

with $m = 4$ is the number of lags and E = exchange rate (using US dollars). We undertake similar volatility measures for monetary growth as well as inflation rate. We measure openness by the ratio of the volume of Singapore's exports and imports to manufacturing production index.[9]

Table 4 presents the results. Since monetary growth appears to be largely endogenous in Singapore, which has an exchange rate centered monetary policy (see Cavoli and Rajan 2007; Khor *et al.* 2004), we tried the regressions with and without monetary growth variability. It is apparent that monetary growth is statistically insignificant and has no

Table 4. Effects of Macroeconomic variables on ERPT Elasticity of US dollar

Constant	**0.342*****	**0.338*****
	0.024	0.023
Money growth volatility	–0.007	
	0.009	
Inflation rate	**0.019***	**0.017***
	0.010	0.009
Inflation rate volatility	**0.172*****	**0.172*****
	0.029	0.029
USD volatility	0.032	0.036
	0.164	0.169
Trade openness	**–0.025****	**–0.024****
	0.011	0.011
Adj. R^2	0.783	0.783

Terms below co-efficient denote standard errors. *, **,*** indicates significance at the 10%, 5%, 1% levels.

obvious impact on the regression. The inflation rate and inflation rate volatility terms are both positive and statistically significant. In other words, higher underlying inflation tends to increase ERPT, while higher macroeconomic variability captured by inflation rate volatility also increases the extent of ERPT.[10] Trade openness too tends to have a negative and statistically significant impact on ERPT at the 10% level. The exchange rate volatility term is economically and statistically insignificant. This is not altogether surprising in view of the possible competing impacts it might have on ERPT as discussed before.

6. Conclusion

This paper has examined the extent of transmission of exchange rate changes into import prices of Singapore using the US dollar bilateral rate. We summarize three important findings in this paper. First, the long-run exchange rate pass-through elasticity into import prices is about 29% and the corresponding short-run elasticity is slightly lower at about 25%. Second, there is evidence to suggest that the ERPT elasticity has trended downwards from 0.4 in 1983 to around 0.3 by 1987, after which it remained fairly stable. Third, there is some evidence that the priors – namely monetary policy stability and low underlying inflation keep ERPT down – find validation in the case of Singapore. There is also some – albeit weak – evidence that higher trade openness tends to lower the extent of ERPT.

There is a growing consensus in the literature on industrial countries that the low ERPT experienced by them in recent years has been largely due to changing commodity composition of trade baskets as opposed to macroeconomic factors per se (Campa and Goldberg 2005, Otani *et al.* 2003 and Marazzi *et al*. 2005). This consequently implies the need to pay more attention to ascertaining ERPT at the disaggregated level of Singapore's trade rather than just at the broad macro level. This is an area of future research.

Acknowledgement

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Notes

1. Of course, there may be other real sector consequences of exchange rate changes for instance, via balance sheet effects. See Rajan and Shen (2006) and Rajan (2007) and references cited within.
2. Low ERPT also has implications for the transmission of shocks. For instance, see Betts and Devereux (2001).
3. See Cavoli and Rajan (2007), and Khor *et al.* (2004) for detailed analyses of Singapore's exchange rate policy. Also see Rajan and Siregar (2002) for a discussion of Singapore's exchange rate regime with an emphasis on the degree of misalignment. Also see Gerlach and Gerlach (2006)
4. Real GDP was not available in quarterly frequency for Singapore.
5. This index is computed using a weighted average of all countries in the world – industrial and developing – although details are not available from the IFS on what weights are attached to each country.
6. We also included higher order lags and leads, but they were statistically insignificant. As such we restrict our analysis to the most parsimonious model specification.
7. The dating corresponds to Khalid and Kawai (2003) who identify July 1997 to June 20, 1997 as the currency crisis period in Asia. We also tried variations in the crisis dates. The results remained unchanged and are available on request.

8. We used a general-to-specific approach and started with current and four period lags of the variables. They were not significant.
9. We use manufacturing production given lack of quarterly data on GDP. The trade ratio for Singapore has risen consistently during the time period under consideration.
10. The results remained largely similar when we used current inflation rate.

References

Betts, C. and Devereux, M., 2001. The international effects of monetary and fiscal policy. *In*: G. Calvo and R. Dornbusch, eds. *Essays in Honor of Robert A. Mundell*. Cambridge: MIT Press, 9–52.

Campa, J.M. and Goldberg, L.S., 2005. Exchange rate pass-through into import prices. *The Review of Economics and Statistics*, 87 (4), 679–690.

Cavoli, T. and Rajan, R.S., 2007. Managing in the middle: characterizing Singapore's exchange rate policy. *Asian Economic Journal*, 21 (3), 321–342.

Choudri, E. and Hakura, D., 2001. *Exchange rate pass-through to domestic prices: does the inflationary environment matter*. Working Paper No. 01/194, International Monetary Fund.

Devereux, M. and Engel, C., 2001. *Endogenous* currency *of price setting in a dynamic open economy model*. Working Paper No. 8559, National Bureau of Economic Research.

Frankel, J., Parsley, D. and Wei, S.J., 2005. *Slow pass-through around the world: a new import for developing countries?* Working Paper No. 116, Center for International Development, Harvard University.

Froot, K. and Klemperer, P., 1989. Exchange rate pass-through when market share matters. *American Economic Review*, 79 (4), 637–654.

Gagnon, J. and Ihrig, J., 2004. *Monetary policy and exchange rate pass-through*. International Finance, Discussion Paper No. 704, Federal Reserve Board.

Gerlach, S. and Gerlach, P.G., 2006. *Monetary policy regimes and macroeconomic outcomes: Hong Kong and Singapore*. Working Paper No. 204, Bank for International Settlements (BIS).

Ghosh, A. and Rajan, R.S., 2007. A survey of exchange rate pass-through in Asia. *Asian-Pacific Economic Literature*, 21 (2), 13–28.

Goldberg, P. and Knetter, M., 1997. Goods prices and exchange rates: what have we learned? *Journal of Economic Literature*, 35 (3), 1243–1292.

Ito, T., Sasaki, Y. and Sato, K., 2005. *Pass-through of exchange rate changes and macroeconomic shocks to domestic inflation in East Asian countries*. Discussion Paper Series, 05-E-020, Research Institute of Economy, Trade and Industry (RIETI), Japan.

Johansen, S. and Juselius, K., 1990. Maximum likelihood estimation and estimation and inference on cointegration with applications to money demand. *Oxford Bulletin of Economics and Statistics*, 52(2), 169–210.

Khalid, A.M. and Kawai, M., 2003. Was financial market contagion the source of economic crisis in Asia? Evidence using a multivariate VAR model. *Journal of Asian Economics*, 14 (1), 131–156.

Khor, H.E., Robinson, E. and Lee, J., 2004. *Managed floating and intermediate exchange rate systems: the Singaporean experience*. Staff Paper No. 37, Monetary Authority of Singapore (MAS).

Knetter, M., 1993. International comparisons of pricing-to-market behavior. *The American Economic Review*, 83(3), 473–486.

Marazzi, M., Sheets, N., Vigfusson, R. and Associates, 2005. *Exchange rate pass-through to U.S. import prices: some new evidence*. International Finance Discussion Papers No. 833, Board of Governors of the Federal Reserve System.

Marston, R., 1990. Pricing to market in Japanese manufacturing. *Journal of International Economics*, 29(3-4), 217–236.

Otani, A., Shiratuka, S. and Shirato, S., 2003. *The decline in the exchange rate pass-through: evidence from Japanese import prices. Monetary and economic studies*. Institute for Monetary and Economic Studies (IMES), Bank of Japan 21, 53–81.

Rajan, R.S., 2007. Managing new style currency crises: the swan diagram revisited. *Journal of International Development*, 19 (5), 583–606.

Rajan, R.S. and Shen, C.H., 2006. Why are crisis-induced devaluations contractionary? Exploring alternative hypotheses' *Journal of Economic Integration*, 21 (3), 526–550.

Rajan, R.S. and Siregar, R., 2002. *The choice of exchange rate regime: currency board (Hong Kong) or monitoring band (Singapore)?* Australian Economic Papers 41, 538–556.
Sasaki, Y.N., 2005. *Pass-through of exchange rates on import prices of east asian countries*. The Society of Economics, Meiji Gakuin University, Keizai Kenyu 132, 23–33.
Stock, J.H. and Watson, M., 1993. A simple estimator of cointegrating vectors in higher ordered systems. *Econometrica*, 61(4), 783–820.
Taylor, J.B., 2000. Low inflation, pass-through, and the pricing power of firms. *European Economic Review*, 44(7), 1389–1408.