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ABSTRACT

This paper investigates the proposition that an exchange rate depreciation will cause import prices to rise by more than a same magnitude appreciation will cause them to fall. This asymmetry proposition is undertaken for 8 countries across the Asia-Pacific using the Johansen and Engle and Granger procedures. The results show that 6 out of 7 countries cannot reject the hypothesis of asymmetry. It is also found that 1 estimate each exhibits absolute PPP, complete asymmetric pass-through and partial symmetric pass-through. Partial asymmetric pass-through occurs in 9 cases and 2 cases exhibit explosive asymmetric pass-through. Malaysia lacked a cointegrating vector.

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I. INTRODUCTION

The start of 1997 witnessed a rather astonishing economic downturn sweep across the economies of the Asia Pacific. Probably the best reflection of the economic crisis was the downward spiral in most of their currencies. This downward spiral not only occurred between the currencies of the Asia-Pacific and those of North America and Europe, but also within the Asia-Pacific itself. For instance, over the twelve month period January 1996 to 1997, the depreciation felt by the major currencies of the Asia-Pacific vis-a-vis the U.S. dollar include the Indonesian Rupiah and Vietnamese Dong by 55%, the Malaysian Ringgit by 34%, the Singapore Dollar by 33%, and the Thai Baht by 27% (IMF, International Financial Statistics, various issues). Other currencies of the Asia-Pacific such as the Japanese Yen, the Australia dollar (AUD) and the New Zealand dollar felt relatively minimal downward movements vis-a-vis the $US, those movements being 3%, 13% and 15% respectively over the same timeframe.

An expected consequence of these dramatic exchange rate swings is adjustments in relative trade prices. This will be reflected in the degree of exchange rate pass-through, which measures the elasticity of domestic currency export or import prices with respect to changes in the exchange rate. In order to explain the concept of pass-through and its predictions, re-consider the 55% depreciation in the Indonesian Rupiah against the $US over the timeframe mentioned previously. The empirical pass-through literature predicts that partial import pass-through is the likely outcome for Indonesia (Menon, 1995). This means that the price of products imported by Indonesia from the U.S. will rise somewhere in the vicinity of 0% to 55% in Rupiah terms. Since the Indonesian economy is relatively small compared to the U.S., then the rise in Rupiah prices is likely to be close to 55%, which is the complete import pass-through case. Let us now consider the case of imports from Australia to Indonesia. Assuming that three-way arbitrage was perfect over the sample timeframe indicated above, then the appreciation of the AUD against the Rupiah was 42%. The pass-through literature predicts that the price of products exported from Australia and bound for Indonesia will rise by between 0% and 42% in Rupiah terms. As Australia is not as large as the U.S. then the final rise in Rupiah import prices is not likely to be at the 42% end of this range but somewhere in between. If Australian/Indonesian import pass-through is 50%, for example, then this means that Rupiah import prices will rise by 21%.

The above hypothetical scenarios are reasonably well supported by the pass-through literature in the case of an exchange rate depreciation. What does this literature predict in the case of an appreciation? The literature at present predicts that at the aggregate level, import prices will decline at the same rate as they went up during the depreciation phase. That is, the present literature predicts that the depreciation phase has a symmetric impact on trade prices to the appreciation phase.[1] It is the primary purpose of this paper to determine if this symmetry between depreciation and appreciation influences on aggregate import prices is consistent with what is experienced in a number of the countries that lie in the Asia-Pacific rim. This investigation is a contribution to the literature for at least three reasons; (i) an examination of the asymmetry hypothesis has not to date been undertaken at the economy level, (ii) the specific way that the asymmetry hypothesis is tested is unique in that it is applied via cointegration-space parameter

[1]This means that if the Rupiah returns to its pre-crisis value against the $U.S., then the Rupiah price of American imports will decline by around 55%. Similarly, a 42% appreciation in the Rupiah against the AUD will cause a 21% reduction in Rupiah import prices.

restrictions in a Vector Autoregression (VAR) framework, and (iii) asymmetry has not been investigated for this set of countries.

The secondary aim of the paper is to examine the incomplete pass-through and Purchasing Power Parity (PPP) hypotheses as these are easily tested within the same framework as asymmetry. This is a contribution to the literature in itself as the way that the asymmetry, PPP, and incomplete pass-through hypotheses are sequenced enables them to be seen as nested hypotheses within a framework that allows for multiple cointegral relationships. Both the primary and secondary aims are examined using the Johansen (1988) and Engle and Granger (1987) procedures, (hereafter denoted the J and EG procedures respectively).

In order to see that the paper is a contribution to the literature, we need to briefly examine what has been done in the asymmetry area. The literature on the asymmetric response of trade prices to exchange rate changes is sparse to say the least. There are six papers, to this author knowledge, that contribute to both the empirical and theoretical literature in the area. The theoretical literature offers three basic explanations for asymmetry; (i) marketing constraints, (ii) production technology switching, and (iii) market share objectives.

Foster and Baldwin's (1986) paper fits into the marketing constraint category. They believe that the asymmetry may come about because foreign exporters fix the ratio of sales to investment in marketing capacity. In order to explain the thrust of their argument, let us assume for expositional simplicity that there is just one exporter who is paid price P^w in her own currency for some product by a group of importers. The importers pay price P^d for the product, which is determined by multiplying their currency price of the exporter's currency, E by P^w. Assume that the importers experience a 10% appreciation in their currency against the exporter's. This 10% decrease in E would normally stimulate importers to buy more of the product. However, if their is insufficient investment in marketing technology then the exporter will not be able to attract extra importers to buy the product. The optimal action for the exporter to take in this case is to increase P^w by 10% in order to keep P^d stable. As the percentage change in P^d is zero in response to a 10% change in E then none of the exchange rate adjustment is passed-through into import prices, which means that import pass-through is zero, $\delta^m = 0$.

If E increases by 10% then a group of the importers who bought the product at the pre-depreciation price will leave the market after the depreciation. This movement out of the market will be unaffected by the marketing investment constraint, which is not binding. The reduction in demand for the importable causes a reduction in the market price, P^w, which we will assume to be 5%. It follows that the net movement in P^d is the sum of a 10% force that is causing it to rise and a 5% force that is causing it to fall, implying a net force upwards of 5%. This implies that of the 10% exchange rate adjustment, 5% is passed-through into higher import prices, and so import pass-through is partial, $\delta^m = 50\%$. It follows that in the case of a 10% depreciation in the importers' currency $\delta^m = 50\%$ but in the case of the same magnitude appreciation $\delta^m = 0\%$.

The production switching reason for asymmetric responses is due to Ware and Winter (1988). They assume there exists a price-taking firm that exports to both a domestic and an export market. The firm can purchase inputs into production from overseas or domestically. In the event of exchange rate changes the firm can alter from where it gets its inputs and the type of production technology that it uses. More specifically, in the event of a change in E that makes imported inputs less expensive, the exporter will switch to a production technology that is more intensive in the imported input, and in the case of a change in E that makes imports more expensive, it will shift to a production technology that is less intensive in the imported input. Let us define $P^D(Q)$ as the inverse import demand curve denominated in the importer's currency, Q as the level of export output, i^m as the level of the imported input, i as the level of the domestic input, P^{im} as the importers price of i^m and P^i as the domestic price of i. If we take the extreme case in which the firm can switch completely from one production regime to another without cost, then the firm's `dual´ profit function is:

$$\pi^D = P^D(Q)Q/E - P^{im}i^m/E \qquad \text{depreciation phase} \qquad (1)$$

$$\pi^A = P^D Q/E - P^i i \qquad \text{appreciation phase} \qquad (2)$$

Let us suppose that the exchange rate appreciates by 10%. In this case the firm's marginal revenue increases by 10% for a given P^d, but marginal costs do not change. The firm will expand output and this causes a drop in P^D. If we assume that P^D decreases by 5% then import pass-through is partial, δ^m = 50%. If the exchange rate depreciates by 10% then the firm's marginal revenue and costs both decrease by 10%. The firm does not alter output and hence there is no change in P^D, so that import pass-through is zero, $\delta^m = 0$. It follows that during the depreciation phase δ^m = 0% and during the appreciation phase δ^m = 50%.

Froot and Klemperer (1989), Marston (1990) and Krugman (1987) analyse the impact of a market share objective in the context of fluctuating exchange rates. Employing the same definitions for P^w, P^d and E used above, the basic argument of these papers is as follows. In the case of a 10% decrease in E the exporter is able to capture gains in market share as P^d diminishes by 10% for a given P^w. In order to obtain maximum gains in market share the exporter will keep P^w constant, thus resulting in P^d declining by 10%, implying complete import pass-through, δ^m = 100%. In the case of an increase in E by 10% the firm attempts to preserve its market share by reducing P^w by 10%, which in turn keeps P^d unchanged. Import pass-through in this situation is zero, δ^m = 0%. It follows that in the case of an appreciation in the importers' currency δ^m = 100%, but in the case of a depreciation δ^m = 0%.

The empirical literature on the asymmetry topic consists of two papers as far as this author is aware; Knetter (1994) and Kanas (1997). Knetter examines the asymmetry hypothesis in the context of trade between Japan and Germany at the 7 digit industry level of aggregation. Knetter estimates for each industry a first difference specification of the form:

$$\Delta P_t^w = \theta_t + \beta_1 \Delta E_{1t}^* + \beta_2 \Delta E_{2t}^* + \varepsilon_t \qquad (3)$$

where ΔE_{1t}^* represents real depreciation episodes, ΔE_{2t}^* represents real appreciation episodes, and θ_t is a time trend variable that attempts to reflect changing marginal costs through time. Since the specification is in first differences then its primary purpose is an examination of short run asymmetry. Knetter finds that the symmetry hypothesis could not be rejected for the vast majority of cases, the exceptions being aluminium foil and middle size cars.

Kanas (1997) examines the asymmetry hypothesis for eight commodity exports from the UK to the US over the period 1981.I to 1985.I. Over this period there existed two major periods of exchange rate adjustment; an episode of continuous real depreciation between 1981.I to 1985.I and an episode of continuous real appreciation between 1985.II to 1988.IV. Kanas regresses export prices on a real exchange rate variable that is split up into two components; EXCH1 is the real exchange rate during the depreciation phase and zero thereafter, while EXCH2 is zero during the depreciation phase and equal to the real exchange rate thereafter. Kanas finds an asymmetric response for six categories out of eight.

The empirical asymmetry investigations to be undertaken in section IV of this paper differs from the above two papers in several respects. Firstly, the degree of aggregation and the countries examined differ. Secondly, long run asymmetry is examined as opposed to short run asymmetry. Thirdly, tests of asymmetry are performed in conjunction with tests of absolute and relative PPP and estimation of the extent of long run pass-through. Fourthly, the long run asymmetry effects are not examined using dummy variables, which restricts an analysis to particular timeframes that contain continuous appreciation or appreciation episodes. Fifthly, the exchange rate argument is the nominal bilateral exchange rate and not the real exchange rate, thus allowing the measurement of the separate influences of the exchange rate and foreign currency trade prices on domestic trade currency prices.

In order to realise the aims of this paper, section II starts off by providing an econometric interpretation of the theory of exchange rate pass-through, PPP and asymmetric responses to exchange rate changes. In section III we relate the theoretical presentation in section II to the empirical specification and methodology. In section IV the results of the empirical investigation are presented and the final section concludes the paper.

II An Econometric Interpretation of Asymmetry, PPP and Pass-through

II.1 The Set-up of the Framework

In this section we shall continue to use the same definitions for P^d, P^w and E used in section II. Let us decompose the logarithm of the exchange rate, e into components that reflect appreciation and depreciation forces in the following way:

$$e_t = e_0 + e_t^A + e_t^D \tag{4}$$

where e_0 is the initial value of the logarithm of the exchange rate series, $e_t^A \equiv \sum_{i=1}^{t} \theta_i (e_i - e_{i-1})$, $\theta_i = 1$ for $e_i < e_{i-1}$ and $\theta_i = 0$ for $e_i > e_{i-1}$, and $e_t^D \equiv \sum_{i=1}^{t} \theta_i^* (e_i - e_{i-1})$, $\theta_i^* = 1$ for $e_i > e_{i-1}$ and $\theta_i^* = 0$ for $e_i < e_{i-1}$. Thus the variable e_t^A represents the accumulated sum of the appreciation episodes and e_t^D the accumulated sum of the depreciation episodes.

Let us now consider the dynamic sense of the relationship between the logarithm of the three variables introduced in section II, p_t^d, p_t^w and e_t, and our asymmetry variable e_t^A. There is no necessity to include the depreciation force e_t^D in our considerations since an analysis using both e_t and e_t^A will allow us to form conclusions about the influence of e_t^D. The time series process that describes each of the variables in the set of four is assumed to be embodied within the following general structure:

$$x_{it} = \mu_{it} + \eta_{it} \qquad i= d,w,e, A \qquad (5)$$

$$\mu_{it} = \rho_i\mu_{it-1} + \phi_i\varepsilon_{it} \qquad (6)$$

where $\rho_i \in (-1,1]$, $\varepsilon_{it} \sim IDD(0,\sigma^2_{\varepsilon i})$, $\eta_{it} \sim IDD(0,\sigma^2_{\eta i})$ $\forall i$, ϕ_i are non-zero real numbers that determine the potential long run relations between the variables, and $x_{dt} \equiv p^d_t$, $x_{wt} \equiv p^w_t$, $x_{et} \equiv e_t$ and $x_{At} \equiv e^A_t$. Different assumptions about the ρ_i and $\sigma^2_{\varepsilon i}$ will lead to alternative characterisations of the time series properties of the variables in x_{it}. These assumptions have important implications for how we interpret the dynamic sense of the relationship between the four variables.[2]

Let us suppose that all of the variables follow a trendless unit root process so that $\rho_i = 1$ and $\sigma^2_{\varepsilon i} \neq 0$ $\forall i$. We abstract from the possibility of I(d), d>1 processes, or processes with both a time trend and a unit root, because for the data in this paper it is found that variables are trendless I(1) or I(0) processes. This implies that the moving average representation of each variable i takes the form:

$$x_{it} = \mu_{i0} + \phi_i \sum_{j=1}^{t} \varepsilon_{ij} + \eta_{it} \qquad (7)$$

where the μ_{i0} are initial values. In order to achieve a cointegral relationship between the variables

[2]By construction our asymmetry variable does not revert back to a stable mean, and so it is likely to have in-built non-stationarity if there are a sufficient number of appreciation episodes. This non-stationarity may take a deterministic form, $\sigma^2_{\varepsilon i} = 0$ and $\rho_A = 1$, or a stochastic form, $\sigma^2_{\varepsilon i} \neq 0$ and $\rho_A = 1$.

in (7) we require (i) $\varepsilon_{ij} = \varepsilon_j \ \forall i$ and (ii) the existence of a cointegrating matrix $\mathbf{b}$ of dimension (4xr) such that $\mathbf{b}'\mathbf{f} = 0$, where $\mathbf{f}' = [\phi_d \ \ \phi_w \ \ \phi_e \ \ \phi_A]$. If we assume that r=1 for expositional simplicity, $\mathbf{b}' = [\beta_1 \ \ \beta_2 \ \ \beta_3 \ \ \beta_4]$ and $\mathbf{x}_t' = [p_t^d \ \ p_t^w \ \ e_t \ \ e_t^A]$ then the single cointegral relationship is given by:

$$\mathbf{b}'\mathbf{x}_t = \mathbf{b}'\mathbf{m}_0 + \mathbf{b}'\mathbf{h}_t = w_t \tag{8}$$

where $\mathbf{m}_0' = [\mu_{d0} \ \ \mu_{w0} \ \ \mu_{e0} \ \ \mu_{A0}]$ is a vector of initial conditions and $\mathbf{h}_t' = [\eta_{dt} \ \ \eta_{wt} \ \ \eta_{et} \ \ \eta_{At}]$ is a vector of independent white noise disturbances. Nested within condition (8) are several testable hypotheses related to asymmetry, PPP and exchange rate pass-through. Let us now turn to these nested possibilities.

II.2 A Test of Asymmetry with Cointegration

In order to achieve both a cointegral relationship between the variables and asymmetric responses of import prices we require (i) the existence of a vector $\mathbf{b}'$ that satisfies (8), and (ii) the entry β_4 in $\mathbf{b}'$ is significant in cointegration space. In this case we can write the stochastic form of the long run import price vector normalised on import prices (β_1=1) as:

$$p_t^d + \beta_0 + \beta_2 p_t^w + \beta_3 e_t + \beta_4 e_t^A = u_t \tag{9}$$

where $\beta_0 = -\mathbf{b}'\mathbf{m}_0$ and $u_t = \mathbf{b}'\mathbf{h}_t$. The extent of long run appreciation import pass-through is (β_3 + β_4) and will differ from the extent of long run depreciation import pass-through, β_3.

II.3 A Test of PPP with Cointegration

In order to achieve cointegration as well as absolute PPP we require two conditions over and above the cointegration conditions; (i) $\beta_1 = 1$, $\beta_2 = \beta_3 = -1$, $\beta_4 = 0$ and (ii) $\mathbf{b}'\mathbf{m}_0 = 0$. Absolute PPP also implies the existence of complete import pass-through because the elasticity of p^d with respect to e is unity, however PPP is only a sufficient condition for δ^m=100%.

When does absolute PPP break-down?[3] Absolute PPP can break down either because (i) the variables do not have a common trend, $\varepsilon_{ij} \neq \varepsilon_j \ \forall i$, and/or $\mathbf{b}'\mathbf{f} \neq 0$, (ii) the relationship is not homogeneous, $\mu_{10} \neq \mu_{20} + \mu_{30}$, (iii) pass-through is not complete, $\beta_1 \neq -\beta_2 \neq -\beta_3 = 1$, or (iv) an asymmetry exists $\beta_4 \neq 0$. Categorising the reasons for the break-down in absolute PPP in this way is important because each reason implies a different relationship between the variables. The most important reason for the breakdown is (i) because this means that there is no equilibrium interpretation of the results, irrespective of whether (ii), (iii) or (iv) prevail or not. If cointegration is found then the breakdown in absolute PPP may be a result of reasons (ii), (iii) or (iv) in isolation or in combination. Let us analyse the most interesting of those equilibrium combinations.

If (ii) is the only reason for the breakdown of absolute PPP then the relationship between the variables is not homogeneous and relative PPP results. The stochastic form of the cointegral relationship in this case is:

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[3]Evidence confirming or denying PPP tends to be mixed, being contingent upon the sample timeframe and the particular countries involved in the investigation. See the survey article by Froot and Rogoff (1995).

$$p_t^d + \beta_0 + p_t^w + e_t = u_t \tag{10}$$

If (ii) and (iv) are the only reasons for the breakdown in absolute PPP then this implies a result of asymmetric complete pass-through. In this case δ^m=1 when the exchange rate depreciates but δ^m=(1 + β_4) when it appreciates. The stochastic form of the cointegral relationship in this case is given by:

$$p_t^d + \beta_0 + p_t^w + e_t + \beta_4 e_t^A = u_t \tag{11}$$

If (ii) and (iii) are the only reasons for the breakdown of absolute PPP then we have a situation of incomplete symmetric pass-through, and the relationship between the variables is not homogeneous. The stochastic form of the cointegral relationship in this case is:

$$p_t^d + \beta_0 + \beta_2 p_t^w + \beta_3 e_t = u_t \tag{12}$$

where the extent of import pass-through is $\delta^m = \beta_3$. We can see from our cointegration condition (8) that this result implies the restriction $\phi_d + \beta_2\phi_w + \beta_3\phi_e = 0$ which says that the extent of import pass-through, β_3 and the foreign price elasticity, β_2 are constrained in their relative values in the long run. The extent of import pass-through can take on a variety of values. If $\delta^m \in (0,1)$ then import pass-through is partial, when $\delta^m \in (0, -\infty)$ then import pass-through is negative, if $\delta^m = 0$ then import pass-through is zero and when $\delta^m \in (1,\infty)$ import pass-through is explosive.

Finally, an interesting case arises when (ii), (iii) and (iv) together are the reasons for the breakdown in absolute PPP. In this case the relationship between the variables is not homogeneous, while depreciation import pass-through is incomplete and different from appreciation import pass-through. The stochastic form of the cointegral relationship is:

$$p_t^d + \beta_0 + \beta_2 p_t^w + \beta_3 e_t + \beta_4 e_t^A = u_t \qquad (13)$$

In this case appreciation import pass-through is $\delta^m=(\beta_4 + \beta_3)$ while depreciation import pass-through is $\delta^m=\beta_3$. The cointegration condition implies the long run constraint $\phi_d + \beta_2\phi_w + \beta_3\phi_e + \beta_4\phi_A = 0$.

In some instances all four variables may not be I(1). Cointegration will still be satisfied as long as there are at least two I(1) variables. Depending on which two variables these are, the constraints needed to satisfy absolute PPP, complete pass-through or incomplete pass-through, with or without asymmetry and homogeneity, will be slightly modified to those indicated above.

II.4 The Determinants of δ^m and the Pass-through Literature

What is the range of δ^m dependent upon? In order to answer this question we need to examine the theoretical literature in the area. There are generally 4 classes of such theoretical studies; (i) the static partial equilibrium class, including papers by Dornbusch (1987), Krugman (1987), and Webber (1995), (ii) the intertemporal class, including authors such as Giovannini (1989), Froot and Klemperer (1989) and Ohno (1990), (iii) the hysteresis class, which includes contributions by Baldwin (1988) and Dixit (1989) and (iv) the macroeconomic class, which features Murphy (1989) and Klein (1990) amongst many others. The first three classes describe different microeconomic determinants of the size and sign of δ^m, such as the degree of substitutability between domestic and foreign variants of a product, the structure of the competition between the foreign and domestic players, the permanency of exchange rate adjustments and the magnitude of exchange rate adjustments. The final class focuses on determinants such as the currency denomination of trade contracts, the size of shocks to money and goods markets, whether exchange rates follow uncovered interest parity, and whether prices are sluggish to adjust to shocks or adjust freely and quickly. The empirical literature on the exchange rate pass-through topic contains three general findings (see the survey article by Menon, 1995). Firstly, larger economies tend to exhibit partial pass-through and smaller economies complete pass-through. This is consistent with expectations given that smaller economies will have less impact on the world price when they react to exchange rate changes compared to larger economies. Secondly, exchange rate changes are passed-through quickly to changes in domestic currency trade prices. A discussion of the reasons for such a time profile of adjustment of trade prices in response to exchange rate changes is neglected in the literature and leaves open room for further investigation of the issue. Thirdly, pass-through will differ considerably depending on the degree of aggregation considered. Once again this result is to be expected given that pass-through is defined to be a function of demand and supply elasticities, and these are likely to differ across industries. These empirical pass-through regularities should be considered in light of the estimates to follow in section III.

III. EMPIRICAL METHODOLOGY

The first step in the estimation methodology requires us to determine if equilibrium relationships exist between our variables, that is, there exists a $\mathbf{b}$ such that $\mathbf{b}'\mathbf{f} = 0$. The second step is to find the appropriate value for r (the columns in $\mathbf{b}$). If $r \geq 1$ then we can perform various hypothesis tests by examining restricted forms of the estimated model. The sequence of the tests is important. The first test in the sequence determines if a constant term is significant in the cointegration space. If the constant is significant then this rules out the possibility of absolute PPP, but the possibility of relative PPP is retained. The second test in the sequence is that of asymmetric import price responses. A finding of asymmetry rules out both forms of PPP. The third test in the sequence is that of complete import pass-through or PPP. Complete import pass-through may be tested in or outside of the presence of asymmetry, and with or without the constant term in the cointegration space. If r=0 then we terminate the investigation as no long run relationships can be found.

The above steps are undertaken using the cointegrated VAR. The variables employed in the VAR are the four variables introduced in section II. A dummy variable for exchange rate regime changes was also used in an initial investigation, however this proved insignificant in all cases by virtue of the fact that it was not long into the sample timeframe that most currencies moved to more flexible arrangements. The VAR in first difference form is:

$$\Delta \mathbf{x}_t = \mathbf{P}_0 + \mathbf{P}\mathbf{x}_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \mathbf{F}\mathbf{S}_t + \mathbf{u}_t \tag{14}$$

where $\mathbf{x}_t' = [p_t^D \quad p_t^W \quad e_t \quad e_t^A]$, $\mathbf{P}_0$ contains the constant terms which may or may not enter the cointegration space, $\mathbf{S}_t$ is a matrix of centred seasonal dummy variables, $\mathbf{F}$ is a (4x3) matrix of coefficients and $\mathbf{u}_t$ is a (4x1) vector of white noise disturbance terms. As we will indicate again later, the model is restricted in its deterministic components to not include the possibility of quadratic trends in the data generating process and linear trends in the cointegration space. This was deemed to be the case because of theoretical reasons and pre-test results. The (4x4) coefficient matrix $\mathbf{P}$ has an important interpretation. If the four endogenous variables in $\mathbf{x}_t$ are I(1), then cointegration between the variables in $\mathbf{x}_t$ requires the linear relationships $\mathbf{P}\mathbf{x}_{t-1}$ to be I(0). The number of linear relationships that are I(0) is guided by the rank of $\mathbf{P}$, r. If $r \in (0,4)$ then there exists 1, 2 or 3 linear combinations of the terms in $\mathbf{x}_t$ that are I(0). These relationships can be written in the form:

$$\mathbf{P}\mathbf{x}_{t-1} = \mathbf{a}\mathbf{b}'\mathbf{x}_{t-1} \tag{15}$$

where $\mathbf{a}$ is a (4xr) matrix of coefficients that describe the short run adjustments to equilibrium, and $\mathbf{b}$ is the same (4xr) matrix of the coefficients in cointegration space discussed at (8) in section II.2. If r = 0 then all of the variables in the system follow a random walk and do not share the same stochastic trends. If r=4 then this implies that all of the variables in the system are I(0).

In order to conduct hypothesis tests we use the estimated (14) and (15). The null hypothesis for each test can be written in the form H_0: $\mathbf{b} = \mathbf{H}\mathbf{j}$, where $\mathbf{H}$ is some (4 x 4) matrix $\mathbf{H}$ =

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ h_{21} & h_{22} & 0 & 0 \\ h_{31} & 0 & h_{33} & 0 \\ 0 & 0 & 0 & h_{44} \end{bmatrix}$$ and $\mathbf{j}$ is a non-zero (4xr) matrix. The ordering of the variables in the vector $\mathbf{x}_t$ is important in the interpretation of these matrices. In the case of the null of symmetry, contained in **H** are the entries $h_{21} = h_{31} = h_{44} = 0$, $h_{33} = h_{22} = 1$.[4] If this null hypothesis cannot be accepted then this implies that an appreciation will have a different impact on long run import prices than a depreciation.

If the null of symmetry cannot be rejected, and there is no constant term in the cointegration space, then we can proceed to test for absolute PPP. Absolute PPP is tested using $h_{21} = h_{31} = -1$, $h_{22} = h_{33} = h_{44} = 0$. If we are unable to accept this hypothesis then we conclude that long run import pass-through is symmetric and incomplete. If there does exist a constant in the cointegration space then the same **H** matrix tests for relative PPP.

If the null of symmetry cannot be accepted, then this rules out both absolute and relative PPP. However, it is still possible that long run import pass-though is complete in the case of a depreciation or appreciation. In order to determine if import pass-through is complete in the case of asymmetric price adjustment then we employ, $h_{21} = h_{33} = 0$, $h_{22} = h_{44} = 1$, $h_{31} = -1$. If we cannot reject this hypothesis then import prices exhibit asymmetric complete pass-through, otherwise import pass-through is both asymmetric and incomplete

[4]This implies the absolute PPP hypothesis is tested across all r cointegrating vectors. It is also possible to test the hypothesis across just 1 vector, in which case $\mathbf{j}$ becomes (4x1).

The above hypothesis tests are also performed using the first stage of the EG procedure. This procedure estimates a static regression between the four variables under the assumption that r=1, and then tests for stationarity of the residuals from this regression. Hypothesis tests can then be undertaken based on appropriate restrictions of this static regression. In the case of a finding of r=1 in the J procedure then the results of the J and EG procedures should be asymptotically the same. However, since we will be using a sample that is on the small side then this may not be the case.

IV. EMPIRICAL RESULTS[5]

The VAR (14) is estimated and hypothesis tests H_0: $\boldsymbol{\beta} = \mathbf{H}\boldsymbol{\varphi}$ are conducted for the following countries of the Asia Pacific; Korea, Singapore, Malaysia, Australia, Thailand, Japan, Pakistan and the Phillipines. This selection of countries is based on data availability. The sample timeframe is quarterly and extends from 1980:2 to 1997:3 for all countries with the exception of the Phillipines and Malaysia for which the sample timeframes are 1983:1 to 1997:3 and 1987:3 to 1997:3 respectively. Details of data sources and descriptions are given in the appendix.

The lag length, p-1 for the VAR is found using a multivariate adjusted likelihood ratio test due to Sims (1980), and this is supported using the multivariate Akaike Information Criteria (AIC) and the Swartz-Bayesian-Criteria (SBC). The appropriate form of the deterministic component of the

[5]The Johansen procedure is undertaken using the econometrics software CATS in RATS and the Engle and Granger procedure using Shazam.

VAR is found simultaneously with the rank decision using the Pantula (1989) principle. The forms of the deterministic trends that were explored using this principle include (A) no deterministic trends at all, (B) the constant in cointegration space only and (C) the drift term outside the cointegration space. These options were chosen because they were deemed the most relevant based on considering the type of hypothesis tests that will be performed on $\mathbf{b}$ and pre-tests on the variables in levels and first differences. Each option is nested within (14), with (A) implying $\mathbf{P}_0 = \mathbf{0}$, (B) requires restrictions on $\mathbf{P}_0$ and (C) requires $\mathbf{P}_0$ to be unrestricted. The rank of $\mathbf{P}$ is determined using the Johansen Trace test in the J procedure, while Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests of the stationarity of the cointegration regression residuals are used for verifying r=1 in the EG procedure. The lag length for both the ADF and PP tests is determined using univariate forms of the AIC and SBC. Information about whether the cointegation regression in the EG procedure is homogeneous or not is determined by a t-test on the constant term. The Trace, ADF and PP test statistics are presented in table 1 along with the VAR lag length selected, the choice of the deterministic trend in the VAR, and whether the cointegration regression in the EG procedure is homogeneous (H) or not (NH).

Table 1: Trace and Residual Unit Root Tests

The results of table 1 show that for the J procedure there is no constant in the cointegration space for the majority of findings (options A and C). This is in direct contrast to the EG procedure in which 6 out of 8 cointegration regressions find the constant term significant. The rank decisions are shared between a finding of 1 (four cases) and a finding of 2 (three cases), with the exception of Malaysia in which case there is a finding of no cointegration between the variables. In the case of the EG procedure each country was found to have at least one long run vector with the exception of Malaysia. The Malaysian investigation is discontinued by virtue of the lack of cointegration.

Pre-tests of the time series properties of the variables of the model are now performed. We test for two unit roots using the univariate ADF and PP F-type (ϕ_3) tests, and we test for stationarity within the J framework. The J stationarity tests are undertaken by appropriate zero restrictions within the $\mathbf{b}$ vector(s). Since the null hypothesis of this test is that of stationarity, then the chi-squared distribution is the relevant sampling distribution. The ADF and PP tests are well known and follow their own empirical distributions. The stationarity test results are presented in the second column of table 2 and show that we are unable to reject the null hypothesis of stationarity for 4 variables, while the remaining variables appear to be non-stationary. The ADF and PP test statistics are presented in the third and fourth columns of table 2 and indicate that all of the remaining variables are stationary in first differences.

Table 2: Johansen Stationarity Tests and ADF, PP Tests for Multiple Unit Roots

The results of tests of the asymmetry hypothesis are given in table 3. The test statistic for the J procedure is distributed chi-squared and for the EG procedure it is t-distributed. Critical values at the 5% level are given in parentheses.

Table 3: Tests for Asymmetry

The results in table 3 show that in 6 out of 7 cases for both the J and EG procedures, the hypothesis of an asymmetric response of long run import prices to a depreciation and an appreciation cannot be rejected at the 5% level. The two exceptional cases are Singapore for the J procedure and Japan for the EG procedure. This means that for Korea, Australia, the Phillipines, Thailand and Pakistan there is evidence to support the hypothesis that the movement of exchange rates back to their pre-crisis values will not return import prices back to their pre-crisis levels, *ceteris paribus*.

After considering the evidence in tables 1 through to 3 there are only two cases for a continued investigation of absolute PPP, and that is for Japan in the case of the EG procedure and Singapore in the case of the J procedure. There is no possibility of further investigations of relative PPP. All other countries have been ruled out for possible absolute PPP investigations by virtue of them failing the asymmetry criterion or in the case of the Phillipines (for both J and EG procedures), Korea (EG), Thailand (EG) and Pakistan (EG) both asymmetry and non-homogeneity.

The estimates of the parameters in a long run cointegrating vector normalised on P^d are given in table 4 below. Both the Japan J procedure specification and the Singapore EG procedure specification have the e^A variable removed from the long run cointegration space. Prior to estimation using the J procedure, tests were undertaken for weak exogeneity. Weak exogeneity was found in 5 out of 7 countries, and so a partial system was estimated for each. A partial system is one in which the cointegrated VAR is estimated under the assumption that some (weakly exogenous) variables do not respond to deviations from equilibrium. The estimation of such a conditional system often improves the statistical properties of the model. In the case where two cointegrating vectors are found in the J procedure, the specification that is selected as representing the import price relationship has theoretically expected signs and greatest number of significant coefficients. The terms in parentheses represent the chi-squared test statistic for exclusion from the cointegration space in the case of the J estimates, and t-statistics in the case of the EG estimates. The estimate of the extent of depreciation pass-through is given in column 3, and adding these estimates to those in column 4 yields the extent of appreciation pass-through. Omitted from table 4 for brevity reasons are the results of a battery of diagnostic tests. Tests conducted on the error-correction system for the J procedure include LM tests for first and fourth order serial correlation, ARCH tests, and the multivariate Ljung-Box test for white noise residuals. Tests for constancy of the β parameters are also conducted. All estimated models appear to have an absence of serial correlation and conditional heteroskedasticity, however in two cases that are indicated below there are problems of parameter constancy.

Table 4: Parameter Estimates of β' for Long Run Import Prices

Table 4 shows a variety of results. Firstly, in the estimate of long run exchange rate pass-through in the case of a depreciation, the standard outcome $\delta^m \in (0,1)$ is realised in the vast majority of cases (9 estimates out of 14). All estimates of the long run coefficient on e_t are significant at the 5% level for both procedures, with the J estimate for Japan the exception, which is significant at around the 19% level. The estimates of partial pass-through are in the middle to low range, 19% to 51%, except in the case of Singapore (83% and 88%). The difference in the long run estimates between the procedures fluctuates. Asymptotically, the estimates from both the EG and J procedure should be identical in the case of a single cointegrating vector, however given a finite, small to medium sized sample is used in this study then we should expect some differences. In the case of Singapore the estimates differ by only 5%, for Australia the difference is only 6%, and in the case of Pakistan the estimates are different by only 9%. However, for the Phillipines we have a discrepancy of 180% and for Thailand the difference is 234%. In both these cases tests for constancy of the parameters within the cointegration space could not be accepted, and so the estimates for both the Phillipines and Thailand are not reliable. These differentials in estimates do not appear to be a result of the choice of the number of cointegrating vectors as for both the close and substantially different cases there are a mixture of rank decisions.

The coefficient associated with the appreciation asymmetry variable was found to be negative in all significant cases. Given that all coefficients on e_t are found to be positive, then the asymmetry is tending to work in the direction expected by the marketing constraints theory. Let us take two examples from our estimates. In the case of Australia, a 100% depreciation in the Australian dollar will increase import prices by around 21% (using the EG procedure estimate) however a 100% appreciation will reduce import prices by only 4%. In the case of Singapore, a 100% depreciation will causes import prices to rise by 83% but the same magnitude appreciation will causes import prices to fall by only 66%.

In general, the long run pass-through elasticities are expected to vary widely across countries. This follows from the fact that pass-through is a function of a diverse array of determinants as outlined in section II.4. It is difficult to isolate any one reason for the difference in long run pass-through estimates across countries. The differences appear to be a complex combination of the factors mentioned in section II.4, and this is reflected in the fact that one of the main determinants of pass-through, the size of an economy, tends to explain some results but not others. For instance, probably the smallest economy in the group, Singapore, has the highest level of stable pass-through, which is to be expected, however the largest economy, Japan, although having an expected low degree of pass-through, has a higher extent of partial pass-through than smaller economies Australia (for the EG procedure) and Korea (for the J procedure).

The reasons for the symmetric partial pass-through in the case of Singapore and Japan, according to the theories presented in section I, may be the lack of marketing constraints in the tradeable sectors of those economies, difficulties encountered in switching production technology from import intensive to domestic factor intensive production in the event of exchange rate changes, and a move towards non-price means of preserving market share in the event of exchange rate adjustments. In the latter case, Japanese and Singapore firms may be able to preserve market share in the event of exchange rate adjustments, even though trade prices are free to adjust in both upward and downward directions, by producing superior brand names that are able to attract strong customer loyalty.

In the case of testing absolute PPP for Japan an F test yields a test statistic that is equal to F=385.2. This compares to a 5% critical value of 2.75 and thus we are unable to accept the absolute PPP hypothesis. For Singapore a chi-squared test is used, yielding a test statistic χ^2=6.55 with p-value 0.04. In this case we are unable to reject the absolute PPP hypothesis. It follows that out of 14 cases we have found 1 case to support absolute PPP at the 4% level.

In table 5 are the test statistics for incomplete pass-through hypotheses in the case of asymmetry. A chi-squared test is employed in the J procedure and an F test in the EG procedure. The Phillipines EG procedure estimate is the only case that is not able to reject complete pass-through at the 5% level.

Table 5: Incomplete Pass-through Tests with Asymmetry

V CONCLUSION

This study has examined the asymmetry of depreciation and appreciation influences on import prices across 8 Asia Pacific countries. It has also examined Purchasing Power Parity as well as incomplete pass-through hypotheses. The results of the empirical analysis confirm the fear that many of the stronger Asian currencies that have bounced back after the economic crisis will not transmit the same reduction in import prices as the increase in import prices felt during the crisis. More specifically, 5 out of 7 countries for which an equilibrium import price relationship is found indicate unambiguous support for the asymmetry hypothesis. In 2 out of 7 cases there is ambiguous support for the hypothesis. In some cases, the effect of the asymmetry can be quite strong and indeed result in minimal downward pressure on import prices during appreciation phases. The results show little support for PPP, with 1 out of 14 estimates indicating that the hypothesis cannot be rejected. There is equally little support for the complete, asymmetric pass-through hypothesis, with 1 out of 14 cases. The partial asymmetric pass-through case is overwhelmingly supported in 9 of the 14 estimates.

DATA APPENDIX

The entire data set was obtained from the International Monetary Fund’s data base, International Financial Statistics on CD-Rom. The data for the domestic currency price of imports, P^d is the domestic currency import unit values index with base year 1990=100. The world price variable,

P^w is the U.S. dollar price index of world import unit values with base year 1990. E is the domestic currency price of $U.S. at the end of each quarter.

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REFERENCES

Baldwin, R., 1988, Hysteresis in import prices: the beachhead effect, The American Economic Review 78, 4, 773-785.

Branson, W.H., 1989, Comment on exchange rate pass-through in the 1980's: the case of U.S. imports of manufactures, Brookings Papers on Economic Activity 1, 15-69.

Dickey, D.A. and W.A. Fuller, 1981, Likelihood ratio tests for autoregressive time series with unit root, Econometrica 55, 1057-72.

Dixit, A., 1989, Hysteresis, import penetration and exchange rate pass-through, The Quarterly Journal of Economics CIV, 2, 45-69.

Doldado, J., Jenkinson, T. and S. Sosvilla-Rivero, 1990, Cointegration and unit roots, Journal of Economic Surveys 4, 249-73.

Dornbusch, R., 1987, Exchange rates and prices, The American Economic Review 77, 1, 93-100.

Engle, R.E. and C.W.J. Granger, 1987, Cointegration and error-correction: representation, estimation and testing, Econometrica 55, 251-76.

Engle, R.F. and B.S. Yoo, 1987, Forecasting and testing in cointegrated systems, Journal of Econometrics 35, 143-159.

Foster, H. Baldwin, R., 1986, Marketing bottlenecks and the relationship between exchange rates and prices, MIT Mimeo, October.

Froot, K.A. Klemperer, P.D., 1989, Exchange rate pass-through when market share matters, American Economic Review 79, 637-654.

Froot, K.A. and K. Rogoff, 1995, Perspectives on PPP and the long run real exchange rates, Chapter 32 in Grossman, G., and Rogoff K., (Eds.): Handbook of International Economics, North Holland, Amsterdam.

Giovannini, A., 1988 Exchange rates and traded good prices, Journal of International Economics 24, 45-68.

Johansen, S., 1988, Statistical analysis of cointegrating vectors, Journal of Economic Dynamics and Control 12, 231-54.

Kanas, A., 1997, Is economic exposure asymmetric between long run depreciations and appreciations? Testing using cointegration analysis, Journal of Multinational Financial management 7, 27-42.

Klein, M.W., 1990, Macroeconomic aspects of exchange rate pass-through, Journal of International Money and Finance 9, 376-387.

Knetter, M., 1994, Is export price adjustment asymmetric? Evaluating the market shares and bottlenecks hypotheses, Journal of International Money and Finance 13, 55-70.

Krugman, P., 1987, Pricing to market when the exchange rate changes, in Arndt, S.W., and Richardson, J.D., (Eds.) Real Financial Linkages Among Open Economies, MIT Press, Cambridge.

Marston, R., 1990, Pricing to market in Japanese manufacturing, Journal of International Economics 29, 217-236.

Menon, J., 1995, Exchange rate pass-through, Journal of Economic Surveys 9, 2, 197-231.

Murphy, R.G., 1989, Import pricing and the trade balance in a popular model of exchange rate determination, Journal of International Money and Finance 8, 345-357.

Ohno, K., 1990, Exchange rate fluctuations, pass-through and market share, IMF Staff Papers, 37, 2.

Osterwald-Lenum, M., 1992, A note with quantiles of the asymptotic distribution of the maximum likelihood cointegration rank test statistics, Oxford Bulletin of Economics and Statistics 54, 461-71.

Pantula, S.G., 1989, Testing for unit roots in time series data, econometric Theory 5, 256-271.

Sims, C., 1980, Macroeconomics and Reality, Econometrica 48, 1-49.

Ware, R., Winter, R., 1988, Forward markets, currency options and the hedging of foreign exchange risks, Journal of International Economics 25, 291-302.

Webber, A.G., 1995, Partial small country import pass-through, currency composition and imported inputs, International Economic Journal 9, 4, 13-30.

Webber, A.G., 1997, Australian commodity export pass-through and feedback causality from commodity prices to the exchange rate, Australian Economic Papers, June, 55-68.

TABLES

Table 1: Trace and Residual Unit Root Tests

Country	VAR Lag Length	Deterministic Component	Trace Statistic[a]	Rank Decision	ADF/PP/H(NH)[b]
Korea	4	A	25.798(26.422)[c]	1	-2.96/-3.32/NH
Australia	2	C	24.554(29.376)	1	-3.03/-4.46/H
Japan	5	A	7.757(12.212)	2	-3.87/-3.83/NH
Phillipines	3	B	34.098(34.795)	1	-3.19/-3.11/NH
Singapore	4	C	22.481(29.376)	1	-3.55/-3.26/NH
Thailand	2	A	6.311(12.212)	2	-3.79/-3.69/NH
Malaysia	1	C	29.379(47.208)	0	-0.05/0.04/NH
Pakistan	6	A	10.463(12.212)	2	-3.25/-4.19/H

[a]95% critical value in parentheses except where indicated otherwise. Critical values are from Osterwald-Lenum (1992).

[b]5% critical value is -2.91.

[c]Accept the null at the 2.5% level.

Table 2: Johansen Stationarity Tests and ADF, PP Tests for Multiple Unit Roots

Variable	Stationarity[a]	2 Unit Roots: ADF[b]	2 Unit Roots: PP[b]
p^{w}	32.58(7.81)	12.519	19.031
p^{Korea}	36.58(7.81)	11.190	9.6025
$p^{Australia}$	30.70(7.81)	7.557	16.838
p^{Japan}	45.87(5.99)	5.832	12.50
$p^{Phillipines}$	25.74(7.81)	5.525	18.196
$p^{Singapore}$	36.11(3.84)	5.8574	12.030
$p^{Thailand}$	7.89(7.81)	5.352	22.803
$p^{Pakistan}$	10.06(7.81)	7.253	27.015
e^{Korea}	5.62(7.81)[c]	-	-
$e^{Australia}$	29.55(7.81)	13.097	22.326
e^{Japan}	18.28(5.99)	5.417	18.804
$e^{Phillipines}$	20.47(7.81)	12.198	22.221
$e^{Singapore}$	5.83(3.84)	5.812	26.616
$e^{Thailand}$	5.51(7.81)[c]	-	-
$e^{Pakistan}$	4.64(7.81)[c]	-	-
e^{AKorea}	21.62(7.81)	7.834	15.537
$e^{AAustralia}$	35.70(7.81)	12.356	26.744
e^{AJapan}	12.24(5.99)	9.841	16.832
$e^{APhillipines}$	25.31(7.81)	5.251	27.438
$e^{ASingapore}$	15.52(5.99)	6.018	19.531
$e^{AThailand}$	10.84(5.99)	5.781	21.416
$e^{APakistan}$	2.02(5.99)[c]	-	-

[a]5% critical value is given in parentheses.

[b]5% critical value is approximately 5.01.

[c]Unable to reject the null of stationarity.

Table 3: Tests for Asymmetry

Country	J	EG
Korea	3.87(3.84)	6.70(2.00)
Australia	15.94(3.84)	2.60(2.00)
Japan	22.79(5.99)	0.90(2.00)[a]
Phillipines	22.19(3.84)	2.21(2.01)
Singapore	1.72(3.84)[a]	4.45(2.00)
Thailand	8.74(5.99)	9.67(2.00)
Pakistan	11.75(5.99)	3.40(2.00)

[a]Unable to accept the asymmetry hypothesis.

Table 4: Parameter Estimates of $\mathbf{b}'$ for Long Run Import Prices[a]

Country	p^w	e	e^A	5% Critical Values
Korea				
J	0.899(4.57)[a]	0.106(8.02)	-0.0001(0.37)	3.84
EG	1.040(20.53)	0.411(8.22)	-0.005(6.70)	2.00
Australia				
J	1.263(25.29)	0.266(13.37)[a]	-0.111(15.94)[a]	3.84
EG	1.078(15.32)	0.207(4.39)	-0.171(2.60)	2.00
Japan				
J	0.613(1.15)	0.199(3.48)	-0.001(22.79)	5.99
EG	1.310(18.27)	0.364(11.63)	-	2.00
Phillipines				
J	1.063(20.44)[a]	3.246(21.74)	-0.173(22.19)	3.84
EG	0.796(5.426)	1.446(5.72)	-0.037(2.21)	2.00
Singapore				
J	0.847(2.68)[a]	0.883(3.86)	-	3.84
EG	0.816(12.29)	0.832(11.01)	-0.165(4.54)	2.00
Thailand				
J	0.275(4.34)	1.277(10.49)	-0.03(8.74)[a]	5.99
EG	1.135(11.77)	3.613(13.06)	-0.079(9.67)	2.00
Pakistan				
J	1.137(7.14)	0.422(7.41)	-0.127(11.75)	5.99
EG	1.127(12.72)	0.512(3.63)	-0.026(3.40)	2.00

[a]Found to be weakly exogenous at the 5% level.

Table 5: Incomplete Pass-through Tests with Asymmetry

Country	Incomplete Pass-through
Korea	
J[a]	24.21(0.00)
EG[b]	138.26(3.99)
Australia	
J	22.4(0.00)
EG	655.47(3.99)
Japan	
J	24.4(0.00)
EG	372.45(3.99)[c]
Phillipines	
J	19.38(0.00)
EG	3.106(4.06)[d]
Singapore	
EG	4.9426(3.99)
Thailand	
J	9.71(0.01)
EG	89.153(3.99)
Pakistan	
J	16.71(0.00)
EG	114.64(3.99)

[a]p value given in parentheses for the J results.
[b]5% critical value given in parentheses for the EG results.
[c]Test statistic computed under the assumption of symmetry.
[d]Complete pass-through cannot be rejected at the 5% level.