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Exchange Rate Pass-Through and Relative Prices: An Industry-Level Empirical Investigation

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Abstract

In this paper we explore the extent of exchange rate pass-through for the USA, UK and Japan using a post-Bretton Woods industry-level dataset. We investigate how different channels of exchange rate pass-through affect domestic and import prices. Our analysis is suggestive of two channels of transmission and we find considerable variation in the extent of pass-through across industries and countries.

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1. Introduction

In this paper, we address the issue of exchange rate pass-through at industry-level prices. The exchange rate pass-through is the percentage change in local currency import prices resulting from a one percent change in the nominal exchange rate. The ongoing debate in the literature over the extent of pass-through has important policy implications.[1] One strand of the literature argues that exchange rate pass-through has, at best, a minimal effect on local currency prices. This happens due to either pricing to market (PTM, see Krugman (1987)) or local currency pricing (LCP, see Devereux (1997)). Under these pricing mechanisms, firms either price discriminate (PTM) or set a different price in foreign currency for sales to foreign households (LCP), leading to low pass-through. As a result, changes in the nominal exchange rate may not be fully passed through to goods prices, and, therefore, consumer prices may not be very responsive to such changes. This implies less "expenditure-switching", i.e., a change in the exchange rate might not lead to much substitution between domestically-produced goods and imports. From a domestic monetary policy perspective, a small nominal exchange rate transmission to import prices may mean a lower expenditure-switching in response to changes in domestic monetary policy, implying that monetary policy is more effective in dealing with real shocks. The low pass-through evidence also makes a fixed exchange rate regime preferable, because a sudden shortage in the supply of foreign goods due to some exogenous shock will lead to large and undesirable currency depreciation under a flexible-rate regime. Previous empirical research reported that prices are indeed sticky in consumers' currencies.[2] New open economy macroeconomics models use the low pass-through evidence from earlier studies in supporting the assumption of nominal price rigidity in buyers' or consumers' currency.

Another strand of the literature, however, argues that exchange rate pass-through has considerable effects on local currency prices. The main argument here is based on producer currency pricing (PCP) models, which assume that importables are priced in exporters' or producers' or sellers' currencies. Given this, currency depreciation in the destination country will lead to higher import prices in that country. Under producer currency pricing, with only the prices of imported goods changing because of high pass-through, there is a change in relative prices. As a result, we would expect high "expenditure-switching" to follow from a nominal exchange rate change, contrary to the local currency pricing or pricing to market-type models. From a domestic monetary

[1] Lane (2001) provides an excellent survey of the growing literature on new open economy macro models involving monetary policy.

[2] Existing studies provide evidence of low pass-through towards consumer prices. New theoretical models that support a fixed exchange rate regime based on the assumption of domestic price rigidity are surveyed by Engel (2002). We selectively mention Mussa (1986), Rogers and Jenkins (1995), Engel (1993, 1999, 2000), Engel and Rogers (1996, 2001) and Parsley and Wei (2001). A number of past studies also investigate the extent of pass-through at industry-level prices. Dornbusch (1987) uses disaggregated industry-level prices to investigate the strategic interactions among domestic producers and producers of import-competing goods to explain low pass-through to import prices, in accordance with the pricing to market argument of Krugman (1987). See Yang (1997) and references therein for a review of these studies. For pass-through studies showing evidence of pricing to market in import prices, see Goldberg and Knetter (1997) and Campa and Goldberg (2002).

policy perspective, evidence that supports a producer currency pricing mechanism would imply that monetary policy is ineffective in dealing with real shocks. Apart from its role in expenditure-switching, exchange rate pass-through can also affect the prediction and control of inflation. Ball (1999) incorporates the degree of pass-through in the monetary policy rule to control inflation. McCarthy (2000) addresses this issue by incorporating a distribution chain of pricing and finds that exchange rates have a modest effect on domestic inflation while import prices have a stronger effect.

In a number of influential new open economy macroeconomics papers, Obstfeld and Rogoff (1995, 1998) show that changes in consumer prices in the short-run can be explained with changes in nominal exchange rates assuming producer currency pricing-type models. Obstfeld (2002) and Obstfeld and Rogoff (2000) also use producer currency pricing and provide some evidence showing that a nominal exchange rate depreciation drives down relative export prices and increases relative import prices. These studies suggest that exporters largely invoice in home currency and, therefore, changes in the nominal exchange rate have significant short-run effects on international competitiveness. In their investigation of German, Japanese and US automobile exports to seven industrial-country destinations, Gagnon and Knetter (1995) find that pricing to market is greater in the long-run than in short-run, which is consistent with invoicing in the exporters currency. Therefore, the pass-through to export prices is not zero, implying that local currency pricing towards export prices may not be true. Proponents of producer currency pricing use similar evidence to suggest price stickiness in sellers' or exporters' currency. To address issues regarding price stickiness in terms of buyers' or sellers' currency, Obstfeld (2001) and Obstfeld and Rogoff (2000) build hybrid theoretical models incorporating producer currency pricing to import prices and local currency pricing or pricing to market to domestic prices from the perspective of a firm. These models generate expenditure-switching similar to the traditional Mundell-Fleming-Dornbusch models, contradicting the local currency pricing or pricing to market oriented studies.

Engel (2002), Obstfeld (2002) and Lane (2001) call for a detailed empirical investigation of the extent of pass-through. In this paper we do this by investigating the extent of pass-through at the industry-level. Our contribution to the relevant empirical literature can be summarized as follows. First, unlike the existing studies which focus exclusively on either long-run or short-run pass-through effects, we investigate the extent of pass-through in both the short and the long-run using industry-level monthly data for import prices, domestic prices (which includes consumer and producer prices) and export prices simultaneously. Second, we identify different channels of pass-through involving prices of both imported and domestically-produced goods. One channel of exchange rate pass-through goes through prices of imported goods at the point of entry. The other channel involves the prices of domestically-produced goods through adjustments in foreign and domestic markups. Third, we provide additional evidence in support of the results reported in Obstfeld and Rogoff (1995, 1998) that suggest that changes in consumer prices in the short-run can be explained by changes in nominal exchange rates as in producer currency pricing models.

We carry out the empirical analysis in two parts. In the first part of the study, following the suggestion by Obstfeld (2001, 2002), we empirically explore different pass-through channels to prices of imported and domestically-produced goods using a monthly industry-level dataset for USA, UK and Japan. Based on markup adjustments by domestic importers and foreign exporters, we show that there is a difference in pass-through to different prices in the short-run. Our empirical approach is based on a “triangular” system of equations. This system clearly identifies different pass-through channels and estimates a number of effects: direct short and long-run responses of prices of domestically-produced (consumer and producer) goods and prices of imports to exchange rate changes; the “carry-over” effect from import prices to domestic prices, as well as the “carry-over” effect from import prices to producer prices. The triangularity of the system is based on the observation that one expects no immediate short-run feedback from prices of domestically-produced (consumer and producer) goods to import prices and no feedback from consumer prices to producer prices. Using a comprehensive econometric methodology that starts by investigating probabilistic properties of the data, we build a vector-autoregressive-with-exogenous-variables (VARX) model. We test the proposed “no-feedback” effect and obtain results that support the triangular arrangement for nineteen out of thirty-four industries in the sample. We also find that there is considerable similarity across industries regarding the no past-feedback. For example, in USA and UK, results from industrial prices of beverages and tobacco, chemicals and machinery and transport equipments show that there is no lagged feedback from consumer price indexes (CPI) or domestically-produced goods prices to current prices of imported goods. Similarly, results from subcategories of manufactures industry from both of these countries support this claim. According to Goldberg and Knetter (1997), the markup adjustment following an exchange rate change generally occurs within a year. Thus, in the short-run, there may be a change in relative prices. We find evidence of relative price changes in industry-level import and consumer prices in the short-run. Out of thirty-four industries from three countries (USA, UK and Japan) in the sample, relative prices change for forty-two percent of the cases.[3]

In the second part of the study, we analyze industry-level export price movements after an unexpected exchange rate shock and check whether there is evidence to indicate export price stickiness in terms of either the sellers’ or buyers’ currency. Though the exchange rate pass-through effect is primarily associated with import and consumer prices, it is useful to consider the pricing practices of exporters whose products enter as imports to the destination country.[4] Accordingly, we explore movements in export prices by first investigating the correlation between industry-level relative export prices and the nominal exchange rate (as in Obstfeld, 2002). The results show high correlations in most

[3] In a recent study Shambaugh (2003) relies on the methodology of Blanchard and Quah (1989) to generate long-run shocks in the exchange rate and prices. He finds that import prices are set in the producers’ currency with lower CPI pass-through reflecting margin changes in the supply chain. This provides some support to the idea of pass-through separation as proposed by Obstfeld (2002). However, unlike ours, Shambaugh’s study does not focus on a detailed industry-level analysis. It also does not consider changes in export prices in response to changes in exchange rates ignoring a possibly important channel.

[4] In this we follow Knetter (1989) (who studies exchange-rate pass-through and pricing-to-market by looking at the prices charged by US and German exporters to importers of a given country) and the literature that followed this seminal contribution.

of the industry-level export prices, providing some support for invoicing in terms of producers' or sellers' or exporters' currency. Second, we use the changes in the logged ratio of export prices and the trade-weighted exchange rate to further corroborate our findings from the first part of the export price analysis.

The results from both parts of our study indicate that exchange rate pass-through for industries in the USA ranges from thirty percent to fifty percent, a finding that is consistent with those of Goldberg and Knetter (1997) and Campa and Goldberg (2002). Within manufacturing and food industries, Japanese food, metal and textiles industries, UK's iron and steel industry and US rubber and furniture industries support earlier results by Campa and Goldberg (2002) in finding negligible pass-through in these industrial categories. However, our results for the US food and machinery and transport equipment industry as well as UK tobacco and non-ferrous metal industry show evidence of a higher extent of pass-through. Results from the Japanese wood industry and the UK pulp and metal ores industries show greater evidence of producer currency pricing, again supporting Campa and Goldberg (2002) findings that lead to the rejection of local currency pricing for these two industry categories.[5]

The rest of the paper is organized as follows. In section 2, we discuss a simple theoretical model and our empirical methodology. In section 3 we present the dataset. In section 4 we present and discuss the results from our empirical analysis. Some concluding remarks are given in section 5. All empirical results are reported in tabular form in the first appendix, data details and information are given in the second appendix. We present some figures in the third appendix.

2. Empirical analysis from industry-level import and export prices

2.1 A simple model for import prices

To analyze different channels of exchange rate pass-through (as proposed by Obstfeld (2001, 2002)) in a simple framework, we focus on the following four prices:

1. Prices of imported goods at the point of entry denominated in local currency (denoted by *imp*)
2. Domestic prices of imported goods as paid by the end-users (denoted by *dig*)
3. Domestic prices of nontradable goods (denoted by *ddg*)
4. Domestic prices, as measured by the CPI (the final price consumers pay).

The *dig* and *ddg* are the constituent parts of CPI. To investigate changes in CPI, we look for changes in either *ddg* or *dig* or in both.

[5] Campa and Goldberg (2002) show that for OECD countries, the Manufacturing and Food import prices reject both PCP and LCP in the short-run. They present, however, evidence on long-run pass-through for Non-manufacturing and Raw Materials import prices. Goldberg and Knetter (1997) report that the median pass-through for OECD Manufacturing import prices hovers around fifty percent over a year period (taken to be the long-run).

Under the local currency pricing (LCP) mechanism, neither the *dig* nor the CPI may change after an exchange rate change. With pricing to market (PTM), there are proportionate and opposite adjustments in the markups charged by sellers after exchange rate changes, resulting in zero or low pass-through. However, with producer currency pricing (PCP), both prices (*dig* and CPI) respond proportionately to changes in the exchange rate. Different channels of exchange rate pass-through can now be hypothesized in the following way:

(1) With an unexpected change in the exchange rate there is pass-through to *imp*. There may be a potential markup adjustment by foreign exporters at this point (in accordance with the PTM argument proposed by Krugman (1987)). The end result will be either higher or lower pass-through to *imp*. This is the first and direct pass-through channel at the point of entry.

If the pass-through to *imp* is fast and of greater magnitude as compared to pass-through to *dig* and CPI, then there would be changes in relative prices. With the transaction cost of the imported good added to the domestic price of the imported good, there may be a difference between *imp* and *dig*. In addition, domestic importers may charge a markup on the imported good (the price of which is denoted by *dig*). With different domestic markup adjustment in *dig* vis-à-vis markup adjustment in *imp* (as described in (1) above), there may be a relative price difference between *dig* and *imp*. Whether CPI changes or not depends on the domestic markup adjustment reflected in *dig*.

If there is domestic wage rigidity (or price rigidity, as proposed in a number of models, see the related discussion in Bergin (2003) and the references cited)[6], *ddg* will not change very fast in response to a domestic monetary shock that affects the exchange rate. The exchange rate change will only affect *imp*.[7]

(2) If there is no markup adjustment by foreign exporters at the entry point, the *imp* will change proportionately with a change in the exchange rate. If the *ddg* responds sluggishly, there would be a difference between *imp* and *ddg*. To maintain the domestic sale of imported goods, domestic importers may adjust the domestic markup in proportion to the *imp* hike. This will be reflected in the *dig*. This is the mechanism emphasized by LCP or PTM. Thus the *ddg* and *dig* remain at the level before the unanticipated shock. As a result, CPI will not change. This is the second and indirect channel of exchange rate pass-through to *dig* and CPI.

After all the adjustments have taken place as above, there may still remain a difference between *imp* and *dig* as well as CPI. This may trigger expenditure-switching as argued in Obstfeld (2001, 2002) and Obstfeld and Rogoff (2000).

As this discussion suggests, the speed and extent of markup adjustment drives all the results of high and low pass-through to *imp* and *dig* as well as CPI.

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[6] Domestic wage rigidity leads to domestic price sluggishness as there may be wage contracts signed before the unexpected monetary shock.
[7] This can happen if invoicing contract is signed a period ahead.

The second and indirect channel of pass-through to CPI, as described earlier, calls for looking at the extent of domestic markup adjustments. Since we do not have data for the domestic cost of production at the industry-level at monthly frequency, we devise an indirect way of looking at this effect. Changes in CPI show changes in either *ddg* or *dig* or both. The *dig* reflects adjustment at the second stage when the imported good enters the domestic distribution chain. So the exchange rate change at the entry stage (reflected in *imp*) can indirectly capture the change in *dig* because the second stage adjustment happens only if there is a change in markups at the first stage. Therefore, we take the exchange rate coefficient as a proxy to the adjustment in *dig* based on markups. In addition, if there is any change in the PPI or CPI due to a change in the *dig* (assuming that there is tradable component in production), it is possible to separate out that effect. We denote this potential effect as the "carry-over effect". For some industries, the data allows us to look for this effect.

The above discussion calls for suitably disaggregated data. We do not have access to industry-level domestic prices of the imported goods, yet the data we have include (1) consumer prices (CPI) (which reflect prices of final products or final consumer goods), (2) import prices (IMP) for final goods, intermediate goods as well as crude materials and (3) prices for domestic producers (PPI), which can be categorized in terms of final goods, intermediate goods and crude materials. With this information, we are able to distinguish in terms of end uses, and this allows us a better understanding of the channels of pass-through under investigation.

In our setup, we take the exchange rate to be exogenously determined and focus on the effect of unexpected changes in the exchange rate.[8] Within this framework, we build three different reduced-form systems to capture the effect of changes in the exchange rate on import prices, producer prices, and consumer prices.

The setup we have is designed to analyze various channels that transmit a change in the exchange rate to the prices of final goods as measured by the CPI. The CPI reflects tradable (denoted by *dig*) and nontradable goods (denoted by *ddg*) prices. With a higher proportion of tradables, any change in the exchange rate that affects their prices would lead to a significant change in CPI. Assuming PCP, the effect will be full. On the other hand, under LCP/PTM mechanism, the extent of the CPI change will be closer to zero.

System I: Here we focus on the prices of imported final goods. At the point of entry, retailers pay the price, P_{ri} for imports which possibly include a markup $m_i^* \geq 0$ charged by the exporters. Thus retailers pay the price

$$P_{ri} = \left(1 + m_i^*\right) E P_i^* \tag{1}$$

[8] We do so since we are only interested in the transmission of exchange rate shock and not where and how the shocks are generated. See Adolfson (2001) for a discussion regarding the treatment of the exchange rate as exogenous and omitting "controls" for disaggregated industry-level work.

where E denotes the exchange rate and P_i^* is the foreign currency price of the i-th good imported. Depending on whether m_i^* changes or not, a change in the exchange rate may or may not be reflected in P_{ri}. As pointed out earlier, this is the first channel of short-run exchange rate pass-through. Here foreign exporters can price discriminate among destination markets.

In the home market, retailers have to bear the transport and distribution costs of final goods before selling those to the consumers. Denoting these costs for the i-th good as Ω_{ri}, the total marginal cost that the retailers face is:

$$MC_{ri} = P_{ri}\left(1+\Omega_{ri}\right) \tag{2}$$

Letting the domestic markup charged by the retailer to be γ_i, we have the final price of the i-th good as:

$$P_{ci} = \left(1+\gamma_i\right)MC_{ri} \tag{3}$$

Given (2) and (1), this yields

$$P_{ci} = \left(1+\gamma_i\right)\left(1+\Omega_{ri}\right)\left(1+m_i^*\right)EP_i^* \tag{4}$$

Equation (4) shows the link between E and import prices P_{ci} as mediated by the various markups clearly. An import price increase driven by an exchange rate depreciation (assuming no change in the foreign mark-up) may or may not lead to a proportional increase in consumer prices. This is the second channel of pass-through. The response of domestic prices to changes in the price of imports can be explained by changes in the existing domestic markup, γ_i in the way we have described before.

The foreign and domestic markup adjustments may dampen the transmission of the changes in the exchange rate to import prices and domestic prices. These adjustments can be a reflection of sluggish nominal wage adjustments in the foreign country as well as in the home country.

System II: Here, we concentrate on the case where final consumption goods are produced domestically using tradable and possibly nontradable intermediate inputs. We allow for the possibility that these intermediate inputs themselves have some imported components. Therefore, any change in producer prices of final consumption goods can be explained indirectly by changes in the exchange rate through changes in the prices of domestically produced intermediate inputs as well as changes in the prices of imported intermediate inputs.

To capture the underlying structure of System II in terms of the price adjustments, we look at the following expression. In the case where domestic producers use imported intermediate goods, the price (P_{ni}) they pay at the point of entry once the markup $m_{ni}^* \geq 0$ charged by the exporters' is taken into account, will be given by:

$$P_{ni} = \left(1 + m_{ni}^*\right) EP_i^* \tag{5}$$

In addition to the transaction cost, Ω_{ni}, associated with these imported inputs, the producer also has to cover the labor costs. Let w_i be the wage rate and let l_i denote the unit labor requirement in the production of i-th good. The marginal cost is:

$$MC_{ni} = P_{ni}\left(1 + \Omega_{ni}\right) + w_i l_i \tag{6}$$

If markup charged by the domestic producer is μ_i, we have the producer price of the i-th good as:

$$P_{pi} = \left(1 + \mu_i\right) MC_{ni} \tag{7}$$

Using (6) this yields

$$P_{pi} = \left(1 + \mu_i\right)\left[w_i l_i + \left(1 + \Omega_{ni}\right)\left(1 + m_{ni}^*\right) EP_i^*\right] \tag{8}$$

We have a similar interpretation in terms of markup adjustments and producer prices change as before.

System III: Here we focus on the prices of producer goods that are produced using imported intermediates. As before, denoting the transaction cost for the i-th good by Ω_{pi}, foreign markup by m_{pi}^* and the domestic markup charged by the producer by ν_i, the producer price of the i-th good will be:

$$P_{pi} = \left(1 + \nu_i\right)\left(1 + \Omega_{pi}\right)\left(1 + m_{pi}^*\right) EP_i^* \tag{9}$$

The various channels through which change in exchange rate is passed through in this system are analogous to the ones described above. What differentiates the three systems is that the pass-through is towards consumer prices in system I and towards producer prices in systems II (final consumption goods) and III (producer goods).

With the above three systems approach, we can identify two different channels of exchange rate pass-through. One channel is at the point of entry and captured by fluctuations in import prices at the point of entry. The other channel is one which transmits changes in the exchange rate to domestic prices (can be consumer or producer prices) through markup adjustments by domestic and foreign agents. To capture these effects empirically, we need properly matched industry-level import prices, consumer prices and producer prices. In addition, as we try to determine the unidirectional causality running from exchange rate fluctuations to different prices, we need to devise a framework that reflects this directionality. Since we propose that different pass-through channels can be differentiated in the short-run, data at the monthly frequency will be an appropriate choice to carry out our empirical analysis.

2.2 Empirical framework: import prices

The conceptual framework expressed above needs to be converted into an econometric framework, which then can be used both for testing the implied triangularity of the system we propose and for estimating short and long-run effects. Our analysis is conducted in percentage changes of prices. Before estimating the three systems described above, we performed standard unit root and cointegration tests for the price levels (in logarithmic forms), but found no strong evidence of cointegration.[9] In what follows we describe the empirical implementation of system I.

Consider a (3×1) vector with CPI inflation, PPI inflation and percentage change in import prices, say $\mathbf{z}_t = \left(y_t, x_{t1}, x_{t2}\right)'$, and redefine the percentage change in the exchange rate as $x_{t3} \equiv w_t$.[10] We assume that $\mathbf{z}_t$ can be adequately modeled by a vector autoregression with an exogenous input variable (VARX) as:

$$\mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t \tag{10}$$

where, $\left\{\mathbf{\Pi}_i\right\}_{i=1}^{p}$ are (3×3) parameter matrices and $\left\{\boldsymbol{\beta}\right\}_{j=1}^{q}$ are (3×1) parameter vectors. $\mathbf{z}_{t-i}$ show the autoregressive or lagged values of CPI inflation, PPI inflation and the percentage change in import prices. Similarly, w_{t-j} contain the lagged values of exchange rate changes in percentage terms. The error vector $\mathbf{u}_t$ is assumed to be multivariate white noise with variance-covariance matrix $\mathbf{\Sigma}$. The model in the above equation will be our broadest, unrestricted model (U-model).[11] The implied triangularity of the conceptual model of the previous section can now be tested using this model. Consider the restrictions implied by the following null hypothesis and corresponding to our first restricted model (R1-model):

$$H_0 : \left\{\pi_{ab}^{i} = 0 \mid \text{for } a > b \text{ and } a,\ b = 1,2,3\right\} \ \forall i \tag{11}$$

[9] These unit root and cointegration test results are not presented here but are available on request from the corresponding author.
[10] All variables are taken as deviations from their respective sample means.
[11] The U-model was estimated using conditional least squares with the orders chosen by the Schwarz (BIC) criterion.

where, π_{ab}^{i} is the (a,b) coefficient of $\mathbf{\Pi}_i$. These restrictions imply absence of feedback from CPI inflation to PPI inflation and from CPI and PPI inflation to growth of import prices; they are immediately testable using a Wald-type test applied to the U-model.

If the above null hypothesis is rejected, we proceed by eliminating the insignificant coefficients from the U-model and by re-estimating the remaining parameters by seemingly unrelated regression (SUR). This is our second restricted model (R2-model), which we then compare to the U-model using a likelihood ratio (LR) test. If the R2-model is rejected in favor of the U-model we use the estimates from the U-model to compute the long-run effects; if the R2-model is not rejected we use its estimates to calculate long-run effects. Similarly, if the null hypothesis of triangularity is not rejected, we proceed by eliminating the insignificant coefficients from the R1-model and re-estimate the remaining parameters using SUR. This constitutes our third restricted model (R3-model), which we then compare to the R1-model using a LR test. Depending on whether the R3-model is rejected or not we use the estimates from either the R1-model or the R3-model to calculate the long-run effects.

To illustrate the computation of the long-run effects, consider the U-model and re-write it using lag operator notation as:

$$\mathbf{\Pi}(L)\mathbf{z}_t = \boldsymbol{\beta}(L)w_t + \mathbf{u}_t \tag{12}$$

where, $\mathbf{\Pi}(L) = \mathbf{I}_3 - \sum_{i=1}^{p}\mathbf{\Pi}_i L^i$ and $\boldsymbol{\beta}(L) = \sum_{j=1}^{q}\boldsymbol{\beta}_j L^j$. When the system is in long-run equilibrium we expect that the variables do not deviate substantially from some fixed values, say $\mathbf{z}^*$, w^* and $\mathbf{u}^* = \mathrm{E}[\mathbf{u}_t] = 0$. Therefore, we have the representation:

$$\mathbf{\Pi}(1)\mathbf{z}^* = \boldsymbol{\beta}(1)w^* \tag{13}$$

from which all long-run effects can be easily computed by summing the estimates of the $\mathbf{\Pi}_i$'s and the $\boldsymbol{\beta}_i$'s. For example, the long-run effects of the exchange rate growth on CPI inflation, PPI inflation and growth of import prices are given by the estimate of the vector $\partial\mathbf{z}^*/\partial w^* = [\mathbf{\Pi}(1)]^{-1}\boldsymbol{\beta}(1)$. Standard errors for the long-run effects were obtained using the Delta method. In the first appendix we report the total short and long-run effects, as well as the carry-over effect.

2.3 Empirical framework: export prices

Let p_t denote the price of export of the home country, p_t^* denote the export price of the foreign country and E denote the nominal exchange rate (in units of home's currency per unit of foreign currency). For the first part of the analysis, we construct home's relative export prices (denoted by REP) vis-à-vis foreign's export prices in the following way:

$$REP = E.\frac{p_t^*}{p_t} \tag{14}$$

We then look at the correlation of monthly changes in logarithm of relative export prices and the nominal exchange rate. If export prices remain fixed in the currencies of the originating countries, the ratio of two prices on the right-hand side of (14) will not vary. Thus, relative export prices *REP* and the exchange rate *E* will be highly correlated. This would lead to high pass-through and count as evidence against the LCP mechanism.

For the second part of the analysis, the dependent variable is the monthly growth in the ratio of export prices $\Delta y_t = (1-L)\,y_t$. The explanatory variable is the monthly growth of the trade-weighted exchange rate x_{t3}. The model we consider is a regression in monthly percentage changes, namely:

$$\pi(L)\Delta y_t = c + \delta(L)x_{t3} + z_t(\mathbf{v}) \tag{15}$$

where, $\pi(L) = 1 - \sum_{i=1}^{r} \pi_i L^i$ and $\delta(L) = \delta_0 + \sum_{i=1}^{s} \delta_i L^i$ are polynomials in the lag operator and where the term $z_t(\mathbf{v})$ captures the regression error dynamics of the equation and depends on the auxiliary parameter vector $\mathbf{v}$. For example, if the equation includes the first lag of Δy_t and x_{t3} and the regression error follows a seasonal autoregression of orders one and twelve then $\pi(L) = 1 - \pi_1 L$, $\delta(L) = \delta_0 + \delta_1 L$ and $z_t(\mathbf{v}) = u_t$, with $(1-\phi_1 L)(1-\phi_{12} L^{12})u_t = \varepsilon_t$, $\varepsilon_t \sim iid(0, \sigma_\varepsilon^2)$ and $\mathbf{v} = (\phi_1, \phi_{12}, \sigma_\varepsilon^2)'$. If no lagged dynamics of Δy_t and x_{t3} are explicitly included then $\delta^* = \delta_0$ gives us the long-run "equilibrium" effect of a change in monthly relative export prices from a change in the monthly trade-weighted exchange rate. If lagged terms are present, then the long-run effect is computed as $\delta^* = \delta(1)/\pi(1)$, i.e., as the equilibrium solution of the dynamic part of the model. As above, standard errors for the long-run effects are obtained using the Delta method.

3. Data

3.1 Import prices

Our choice of data is guided by two considerations: (1) we need to have industry-level price data for imported goods, as well as matching industry-level price data for intermediate goods (if available, as pointed out in System II) and matching price data for final goods (can be for producers goods, as pointed out in System III or for final consumers goods, as pointed out in System I); (2) we concentrate on three of the largest active economies, USA, UK and Japan, that are involved in heavy trading across three different regions. It is important that these countries do have the required data. We have access to perfectly matching industry-level price data for fourteen US industries, thirteen UK industries and seven Japanese industries (and not for all SITC industries). The data frequency we use is guided by the question we try to answer in this study: whether there is evidence of short-run pass through at the SITC level industrial manufacturing goods data.

The data for the US comes from the Bureau of Labor Statistics web site. Import prices are taken using the SITC classification with the corresponding producer prices (PPI) being taken both from industry-level and commodity-level classifications. We use the CPI for urban consumers.[12] For import prices from Food and Beverages, Mineral Fuels and Lubricants and Textiles industries, we use the corresponding CPI for these industries. In every case of our data for the USA, the end point is December, 2002. However, the starting point varies across industries.[13] The data for trade-weighted exchange rate for the USA come from the Federal Reserve Bank of St. Louise web site. For import prices, the base year is 2000 and for consumer and producer prices the base year is between 1982 to1984; for conformity and comparability we change the base year to 1995. The analysis is carried out for fourteen industries in US, including broad as well as subcategories of SITC level industries.[14]

For the UK, the data for SITC level import prices and producer prices (PPI) come from the National Statistics Online. The trade-weighted exchange rate data is available from the Bank of England's web site.

For Japan, the wholesale price index (WPI)[15], domestic producer price index (PPI), import prices (IMP) and trade-weighted exchange rates are obtained from the Bank of Japan web site. Our sample ranges from January, 1971 to December, 2002 and we have seven broad SITC industries for our study.

3.2 Export prices

For the USA, SITC level data for export prices are again obtained from the web site of the Bureau of Labor Statistics. We examine sixteen industries including subcategories of broad SITC level industries. Most of the monthly data start from January, 1993 and we include observations until December 2002 in our analysis. The reported base year for all prices is 2000 but for conformity we changed the base year to 1995.

For the UK, we take SITC level export prices, including prices for some subcategories, for sixteen industries. The reported base in this case is 1995 = 100. The sample span is from January 1983 to December 2002.

Japanese export prices are taken from the Bank of Japan web site. The data correspond to six industries from January 1983 to December 2002. As in the case of the US, we have also converted the base year from 2000 to 1995.

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[12] We use CPI as a measure of retail prices for these industries in order to match the corresponding import price data for these industries.
[13] This is due to the monthly industry-level data availability for all the matching imported goods, intermediate goods as well as final goods.
[14] Details about the import data are provided in tabular form in Appendix 2.
[15] We use this as a measure of retail prices as described in our System I earlier. Now this index is replaced by the corporate goods index in the source web site.

In examining relative price ratios across countries we require exact industry matching. However, this is not possible for all industries in all three countries. As a result, we have a smaller number of export price ratios, especially when Japan is involved. For the USA and Japan and UK and Japan country pairs we only have five relative prices, whereas, for the USA and UK pair we have fifteen relative export prices.

4. Empirical results

4.1 Summary of results involving import prices

The empirical evidence for the extent of pass-through transmission and relative price changes across countries and industries is mixed. We cannot offer conclusive support either for absolute LCP/PTM (where the extent of pass-through is precisely nil or zero) or for absolute PCP (where the pass-through extent is exactly one). For the present analysis, we consider a cut-off value of twenty percent evidence in support of PCP. This cutoff value is guided by two considerations. First, it is a plausible value given the average monthly change across industries and countries. Second, a cutoff of twenty percent is consistent for a short-run analysis: Campa and Goldberg (1997) and Obstfeld (2002), among others, suggest that the pass-through extent hovers around fifty percent in the long-run. Therefore, from a short-run perspective, choosing a less than fifty percent cutoff appears economically plausible.[16] Overall, about sixty-four percent of the sampled industries appear to lend support to PCP. We choose less than fifteen percent exchange rate pass-through effect for the industries that lend support to LCP/PTM. As a result, almost sixty-two percent of the sampled industries show LCP/PTM evidence. In addition, fifty-three percent of all industries support the no feedback assumption ("triangularity" of the systems), indicating that there is no lagged effect of previous producer or consumer prices on the current import prices. The results from our systems estimation show that, in the short-run, about eighty-three percent of the industries show evidence in favor of PCP to import prices and sixty-four percent provide support for LCP in the domestic prices. Overall, there are high and significant relative prices changes in forty-two percent of the sampled cases. For the long-run results, there is empirical support for relative price changes for forty-two percent of the sampled industries. Taking all industries for all countries, tobacco prices in UK and Machinery and equipment prices in Japan show the highest and lowest extent of short-run and long-run pass-through and relative price change respectively. We find that there is no significant extent of pass-through to the US industries, a result that conforms to earlier studies for the US.

4.1.1 Results from impulse response analysis

To provide some additional, ex-ante, check for the presence of lagged feedback, we performed generalized impulse response analysis (Pesaran and Shin (1998)) involving the endogenous variables in our systems (the commodity prices). Some figures with impulse responses are given in Appendix 3. Our results show considerable support for the proposed no-feedback hypothesis for a number of industries in three countries. In the UK,

[16] Replication of a part of our analysis with a fifty percent cutoff yields results mostly consistent with LCP evidence and not PCP. It is apparent that the choice of the cutoff value is data and country specific.

nine out of thirteen industries show that an innovation in import prices will generate responses in producer prices only, implying that past producer prices and wholesale prices have no significant impact on import prices. For the US, the producer price data do not reflect imported components prices, so the innovation shocks in imports have no impact on producer prices. A majority of US industrial prices (measured by producer price index), except for the Chemicals industry, also support ex-ante “triangularity”. But, consumer prices for three industries in the US, CPI for Food and Beverages, CPI for Mineral fuel and CPI for Apparels, show evidence against the no-feedback argument, as they affect the import prices contemporaneously. For Japan, the impulse responses do not support absence of feedback for all industries. The figures in Appendix 3 show impulse response for three representative industries, Chemical in Japan, Metal-working machinery in the US and Organic chemical in the UK. The first one does not support “triangularity” from the unrestricted VAR while the later two provide evidence of no-feedback, thus supporting “triangularity” from the unrestricted VAR.

4.1.2 Results from System I: industries in Japan and USA

Our estimation results are given in Table 1 while the specification testing results are given in Table 2. Looking at Table 2 first, for all the seven industries in Japan and three industries in USA, we reject the hypothesis of no-feedback from CPI inflation to PPI inflation as well as from CPI and PPI inflation to growth of import prices. As a result, estimation for these ten industries is carried using the R2-model. Short-run results give us the direct effects of exchange rate depreciation on import prices (denoted by IMP_{SR}), the indirect effect on WPI for Japan or on CPI for USA, (denoted by WPI_{SR}) and the carry-over effect from import prices to either wholesale prices or CPI (denoted by COE_{SR}).[17]

In the short-run, for three out of ten industries, there is no evidence of carry-over effect. For the rest of the industries, however, there are significant carry-over effects. Evidence of higher level of relative price changes is supported by at least sixty percent of the tabulated cases, with Mineral fuel and lubricants industry in USA providing the highest magnitude of relative price change. As described earlier, this happens due to PCP for import prices in all of these industries and LCP for wholesale prices or CPI for fifty percent of the results corroborated by low carry-over effect in forty percent of the cases.

In the long-run we find evidence in favor of PCP for sixty percent of industries while forty percent of them support LCP towards domestic prices. A higher level of relative price change is found for these latter industries. Negative coefficients in the tables can be explained by the higher extent of export price declines compared to exchange rate depreciation. We have verified this from the data on export prices and these results are available on request.

[17] Therefore, for these two countries, results under WPI_{SR} and WPI_{LR} denote short-run and long-run calculations from retail industry-level prices interaction with trade-weighted exchange rate and import prices.

4.1.3 Results from System II: industries in UK

Tables 3 and 4 report the estimation and specification testing results from system II (involving intermediate imported inputs). Due to data availability we have done the analysis for the UK. In this case, the long-run and short-run coefficients are calculated from the unrestricted model (U-model) for Chemicals and Organic chemicals industry and from the R2-model for Machinery and Electrical equipment industry. Results from both the industries generate low level of exchange rate pass-through to domestic producer prices for intermediate goods and low carry-over effect in the short as well as in the long run. These findings, therefore, suggest a potentially high relative price change conditional on the extent of PCP for imported goods prices. However, both industries show negative coefficients for the imported goods prices. As a result, the magnitudes of export price declines in both of these industries are much higher than the extent of exchange rate depreciation. Therefore, we do not get the relative price change.

4.1.4 Results from System III: industries in UK and USA

Estimation and model testing results for system III are presented in Tables 5 to 8. This is a two equation system as described earlier. The first equation in the system looks at the exchange rate pass-through effect to import prices in the short-run (denoted by IMP_{SR}). The second equation reflects the direct transmission from import prices change to producer prices in the short-run, measured in terms of COE_{SR} and indirect transmission from import-competing goods prices change in the short-run, captured by the markup adjustment, and measured by PPI_{SR}. Tables 5 and 6 summarize UK findings and USA results[18] are reported in Tables 7 and 8.

Looking at Table 6 in four out of thirteen industries, the R2-model is used to calculate both short and long-run effects. The remaining industries support the R3-model, showing that the null hypothesis of "triangularity" is not rejected. Therefore, the short and long-run coefficients of pass-through for these industries are calculated from R3-model, except for Organic chemicals' industry as the LR test supports the R1-model.

From the estimation results at Table 5, evidence from three industrial prices (Pulp, Wood and Medicinal products) show that there is no carry-over effect from import prices to producer prices both in the short and long-run. Seventy percent of remaining industries, however, report significant carry-over effect in the short-run. We get the highest carry-over effect in Iron and steel industry with a magnitude of fifty seven percent. In the short-run, forty-six percent of the sampled industries support high exchange rate pass-through to import prices. Tobacco reports the highest (more than one hundred percent) and Iron and steel shows the lowest (close to fifteen percent) pass-through effects in the short-run. As noted earlier, negative coefficients can be explained through the greater increase in export prices of these industrial products than the extent of exchange rate depreciation. As compared to pass-through towards import prices, the pass-through magnitude to

[18] We also compared our results using industry-specific exchange rates (provided by Goldberg (2004)) and trade-weighted exchange rates for USA, but found no significant differences in the outcomes. Therefore, we do not report these results in the text.

producer prices is less in four out of thirteen industries in the short-run. These four industries, Tobacco, Metal ores, Plastics and Iron and steel, therefore, support the higher extent of pass-through in the short-run, though the effect declines for Iron and steel and Plastics' prices because of higher magnitude of carry-over effect. The results are similar for the long-run calculations also. In all, we get mixed support for high relative price change.

In case of the USA, "triangularity" is accepted from the R1-model and then R3-model is used for estimation in ten out of eleven industries in our sample (see Table 8 for reference). For Chemicals, however, the R2-model is taken as the null hypothesis of "triangularity" is rejected from the first step. Long and short-run coefficients are estimated from R2-model for Chemicals and from R3-model for all other industries, except for the Metal-working machinery industry.

The estimation results from Table 7 show no carry-over effects in case of Meat, Rubber and Non-metallic minerals industries both in the short and long-run. There are no pass-through effects (both in short-run and long-run) to producer prices for Fruit, Inorganic chemicals and Electrical machinery industry either. This is perfectly consistent with the data for US PPI, as the imported components are excluded in the US PPI calculation. In our analysis, for forty-six percent of cases in the short-run, we get positive pass-through towards import prices with the highest magnitude of fifty-three percentage points (for Fruit). The producer price pass-through coefficients are very low in the short-run for almost thirty-six percent of sampled industries with the extent varying between two to nine percent. To generate rapid relative price change, a higher level of pass-through to import prices is needed. This effect is present for almost forty-six percentage of sampled industries with the effect significant and most prominent in the Metal-working machinery industry (thirty percent). Relatively low pass-through to Furnitures, which is a part of broad SITC category, Miscellaneous manufactured articles, provide some support to Yang (1997)'s earlier findings for manufacturing industry in USA. Across industry comparisons from the table show considerable variations between manufacturing industries and food and beverages industries. These results are in line with Knetter (1993), which shows substantial variations in pass-through coefficients across industries.

4.2 Results from analysis of export prices

In Table 9 we compare the correlations of exchange rates and relative export competitiveness for Japanese, US and UK industry-level products. Looking at the correlation results on the relative export competitiveness of Japan vis-à-vis USA (denoted by Japan-US), General machinery and equipment price generates the highest and Chemicals the lowest correlation (see Figures 4 and 5 after Appendix 2). The results also point to the fact that there is considerable heterogeneity regarding currency invoicing across industries. These findings are consistent with earlier conclusions from Klitgaard (1999), which reports that for electrical machinery and transportation equipment industry, there is considerable pass-through effect. For these two industries, the effect of yen depreciation pass-through to the foreign consumers is higher, which indirectly support the argument of invoicing in domestic currency. For the five industry comparison for these two countries, the average correlation is 0.76, which is almost equal to the overall aggregate finding for the Japan and USA case in Obstfeld and Rogoff (2000).

Comparing US exports vis-à-vis UK exports (denoted by US-UK), we find considerable differences in industry-level prices. For instance, results from Meat and Fruit industries (part of SITC category, Food and live animals) and Textile fibers, Crude materials except fuel and Metalliferous ores industries (categories of SITC classification, Crude materials, inedible, except fuels) show low correlations. This may support LCP/PTM type pricing, or invoicing in destination currencies. However, for the remaining industries, the correlations are high, supporting the fact that export prices may be largely invoiced in the exporters' currency. Higher correlations support the fact that, across industry-level export prices, the PCP type of pricing seems prevalent for these two countries. There are significant variations across industries with Miscellaneous Manufactures and Road vehicles showing the highest extent of PCP. We have presented the figures for Miscellaneous Manufactures and Road vehicles industry prices in Figures 6 and 7 in Appendix 3.

For the relative export competitiveness between Japan and the UK (denoted by Japan-UK), the lowest correlation is for Road vehicles and the highest is for General machinery and equipment industry (refer to Figures 8 and 9). For this two-country result, the industry average is 0.67, which is comparable with the aggregate case of Obstfeld and Rogoff (2000) finding.[19] Results across industries identify segments where the PCP is prevalent. Except for Japan and the UK, the Miscellaneous manufactured articles' and Road vehicles industry show some evidence of PCP. For Japan and USA, the correlation is the highest for General machinery and equipment, which is again consistent with earlier findings of Klitgaard (1999).

Estimation results from ratios of export prices are presented in Table 10. The last three columns of the table show coefficient estimates associated with trade-weighted exchange rates. Negative coefficients provide empirical support for the theoretical argument on the absence of zero or low extent of exchange rate pass-through towards relative export prices. Out of the total seventeen industries, we get the desired effect in fifteen industries, thus having almost ninety percent of cases provide some evidence of apparent pass-through. Within the USA and UK comparison, the pass-through extent is the largest in Textile fiber industry (forty-seven percent) and lowest in Road vehicles industry (ten percent). From this two-country analysis, in sixty percent of industries, there is high pass-through towards export prices. Comparison between US-Japan export prices show pass-through for eighty percent of industries with Road vehicles industry experiencing the largest amount (almost sixty-seven percent) of pass-through among all the industries in the sample. The relative price comparison for UK and Japan reports the highest level of pass-through in Miscellaneous Manufacturing industry (nearly thirty-five percent). Eighty percent of the sampled industries here provide significant pass-through. These results, therefore, support Keynesian arguments and establish the validity of PCP mechanism. Our results, overall, are quite similar to that of Obstfeld and Rogoff (2000) and Obstfeld (2002). Within cross-country estimates, Chemicals industry's relative

[19] They find a correlation of 0.76 for the aggregate export price index.

export prices pass-through effects are relatively comparable, as the estimates range from eighteen percentages to twenty-nine percentage points. It shows that producer currency pricing type mechanism is prevalent within these countries as far as setting the export price of this industry. Miscellaneous manufactures' industry estimates also point out the same with the exception of the USA and UK estimate. Except for the US-Japan estimate, the Road vehicles' industry prices from other bilateral country comparisons report the lowest evidence of exchange rate pass-through among all the industries and countries in the analysis. This may be due to higher extent of local currency pricing that is being practiced in the US-UK automobile markets.

4.3 Results from both import and export prices analysis

Our results indicate that the producer currency pricing mechanism is supported by a large number of industrial categories. For the three countries in our study, Japan, USA and UK, Chemicals and sub-categories of chemicals industry as well as Miscellaneous Manufactures industry and sub-categories of miscellaneous manufactures industry show evidence of PCP. In the USA and UK, Beverages and Tobacco industry, Organic Chemicals industry, sub-categories of General Machinery and Equipment industry and Non-ferrous Metals industry also lend partial support for the PCP. In Japan, the Textile Fabrics industry yields evidence in support of PCP as well. This is in line with Obstfeld (2002) that also compares co-movements of the USA and Canadian SITC level export prices and import prices and finds similar results.

5. Concluding remarks

In this paper we investigate the extent of pass-through at the industry-level. We do so by focusing on the extent of pass-through in both the short and the long-run using industry-level monthly data for import prices, domestic prices (which includes consumer and producer prices) and export prices simultaneously. We identify different channels of pass-through involving prices of both imported and domestically-produced goods. One channel of exchange rate pass-through goes through prices of imported goods at the point of entry. The other channel involves the prices of domestically-produced goods through adjustments in foreign and domestic markups.

Our empirical results indicate that exchange rate pass-through for industries in the USA ranges from thirty percent to fifty percent, a finding that is consistent with those of Goldberg and Knetter (1997) and Campa and Goldberg (2002). Within the manufacturing and food sector, Japanese food, metal and textiles industries, UK's iron and steel industry and US rubber and furniture industries support earlier results by Campa and Goldberg (2002) in finding negligible pass-through. However, our results for the US food and machinery and transport equipment industry as well as UK tobacco and non-ferrous metal industry show evidence of a higher extent of pass-through. Results from the Japanese wood industry and the UK pulp and metal ores industries show greater evidence of PCP, again supporting Campa and Goldberg (2002) findings that lead to the rejection of LCP for these two industry categories.

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Appendix 1

Table 1: Estimation Results from System I

For SR : $\mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t$; H_0 : $\left\{ \pi_{ab}^i = 0 \mid \text{for } a > b \text{ and } a,\ b = 1,2,3 \right\}\ \forall i$;

For LR : $\mathbf{\Pi}(L)\mathbf{z}_t = \boldsymbol{\beta}(L) w_t + \mathbf{u}_t$; $\mathbf{\Pi}(1)\mathbf{z}^* = \boldsymbol{\beta}(1) w^*$

Country	Industry	IMP_{SR}	WPI_{SR}	COE_{SR}	IMP_{LR}	WPI_{LR}	COE_{LR}
Japan	Chemi	0.088** (0.044)	0.021*** (0.008)	na	0.123** (0.619)	0.351 (0.755)	na
Japan	Food	0.143*** (0.068)	0.042*** (0.018)	0.171*** (0.032)	0.386* (0.238)	1.251 (6.809)	5.130 (27.860)
Japan	Mach	0.053* (0.031)	0.027*** (0.088)	0.036* (0.020)	0.071* (0.042)	0.022*** (0.007)	0.029** (0.015)
Japan	Metal	0.025 (0.085)	0.032** (0.016)	0.085*** (0.017)	0.051 (0.172)	-0.165 (0.196)	-0.443 (0.477)
Japan	Petrol	-0.221*** (0.100)	-0.124*** (0.040)	0.382*** (0.017)	-0.421*** (0.168)	-0.076*** (0.025)	0.234*** (0.023)
Japan	Textiles	0.071*** (0.028)	0.027* (0.019)	0.048 (0.033)	0.078*** (0.036)	0.019* (0.011)	0.035 (0.023)
Japan	Wood	0.401*** (0.089)	0.221*** (0.052)	0.161*** (0.032)	1.257*** (0.457)	0.904 (1.511)	0.658 (1.010)
USA	Food.	0.354*** (0.124)	-0.082*** (0.026)	na	0.291*** (0.106)	-0.084*** (0.029)	na
USA	Mfl	0.522 (0.385)	0.450*** (0.215)	0.154*** (0.039)	0.522 (0.385)	0.450*** (0.215)	0.154*** (0.039)
USA	Appa.	-0.254*** (0.055)	0.158*** (0.056)	na	-0.256*** (0.062)	0.060*** (0.022)	na

Notes: ***, ** and * shows 99%, 95% and 90% level of significance respectively; standard errors are reported in parentheses; the index SR corresponds to "short-run" effects while the index LR corresponds to "long-run" effects. IMP denotes the sum of the estimated coefficients of the lagged exchange rate growth in the import equation. WPI denotes the sum of the estimated coefficients of the lagged exchange rate growth in the wholesale price equation. COE denotes the sum of the estimated coefficients of lagged import prices in the wholesale price equation. For Japan, "Chemi" stands for Chemicals, "Food" stands for Foodstuffs and feedstuff, "Mach" stands for Machinery and equipment, "Petrol" stands for Petroleum, coal and natural gas, "Textiles" stands for Textiles and "Wood" stands for Wood, lumber and related products prices. For USA, "Food." stands for Beverages and tobacco, "Mfl" stands for Mineral fuels, lubricants and related materials and "Appa." stands for Articles of apparel and clothing accessories.

Table 2: Nested Model Testing for System I

$$\mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t \,;\; H_0 : \left\{ \pi_{ab}^{i} = 0 \mid \text{for } a > b \text{ and } a,\ b = 1,2,3 \right\} \ \forall i$$

Country	Industry	$R1$ is correct	$R2$ is correct	$R3$ is correct
Japan	Chemi	52.788	93.992	na
	p-value	0.002	0.567	na
Japan	Food	54.057	129.918	na
	p-value	0.002	0.002	na
Japan	Mach	46.112	72.193	na
	p-value	0.064	0.999	na
Japan	Metal	70.017	33.745	na
	p-value	0.000	0.999	na
Japan	Petrol	55.121	61.439	na
	p-value	0.001	0.997	na
Japan	Textiles	165.985	115.564	na
	p-value	0.000	0.969	na
Japan	Wood	63.177	69.462	na
	p-value	0.000	0.995	na
USA	Food.	338.499	6.053	na
	p-value	0.000	0.999	na
USA	Mfl	404.010	89.932	na
	p-value	0.000	0.999	na
USA	Appa.	67.792	77.684	na
	p-value	0.000	0.888	na

Notes: For Japan, "Chemi" stands for Chemicals, "Food" stands for Foodstuffs and feedstuff, "Mach" stands for Machinery and equipment, "Petrol" stands for Petroleum, coal and natural gas, "Textiles" stands for Textiles and "Wood" stands for Wood, lumber and related products prices. For USA, "Food." stands for Beverages and tobacco, "Mfl" stands for Mineral fuels, lubricants and related materials and "Appa." stands for Articles of apparel and clothing accessories. "p-value" denotes probability values for corresponding test statistics.

Table 3: Estimation Results from System II

$$\text{For } SR: \mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t;\ H_0:\ \left\{\pi_{ab}^{i} = 0 \mid \text{for } a > b \text{ and } a,\ b = 1,2,3\right\}\ \forall i;$$

$$\text{For } LR: \mathbf{\Pi}(L)\mathbf{z}_t = \boldsymbol{\beta}(L) w_t + \mathbf{u}_t;\ \mathbf{\Pi}(1)\mathbf{z}^* = \boldsymbol{\beta}(1) w^*$$

Country	Industry	IMP_{SR}	PPI_{SR}	COE_{SR}	IMP_{LR}	PPI_{LR}	COE_{LR}
UK	Chemi & Org-che	-0.344*** (0.172)	0.054*** (0.083)	0.021** (0.011)	-0.344*** (0.172)	0.054** (0.083)	0.021** (0.011)
UK	Mach & El-mach	-0.461*** (0.101)	0.018** (0.011)	0.028*** (0.012)	-0.571*** (0.140)	0.018** (0.011)	0.029*** (0.012)

Notes: ***, ** and * shows 99%, 95% and 90% level of significance respectively; standard errors are reported in parentheses; the index SR corresponds to "short-run" effects while the index LR corresponds to "long-run" effects. IMP denotes the sum of the estimated coefficients of the lagged exchange rate growth in the import equation. PPI denotes the sum of the estimated coefficients of the lagged exchange rate growth in the producer price equation. COE denotes the sum of the estimated coefficients of lagged import prices in the producer price equation. In the table, "Chemi & Org-che" stands for Chemicals & Organic chemicals industry and "Mach & El-mach" stands for Machinery and transport equipment & Electrical machinery industry.

Table 4: Nested Model Testing for System II

$$\mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t;\ H_0:\ \left\{\pi_{ab}^{i} = 0 \mid \text{for } a > b \text{ and } a,\ b = 1,2,3\right\}\ \forall i$$

Country	Industry	$R1$ is correct	$R2$ is correct	$R3$ is correct
UK	Chemi & Org-che	50.762	139.908	na
	p-value	0.010	0.015	na
UK	Mach & El-mach	74.055	101.359	na
	p-value	0.000	0.236	na

Notes: In the table, "Chemi & Org-che" stands for Chemicals & Organic chemicals industry and "Mach & El-mach" stands for Machinery and transport equipment & Electrical machinery industry. "p-value" denotes probability values for corresponding test statistics.

Table 5: Estimation Results from System III

For $SR: \mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t$; $H_0 : \{\pi_{ab}^i = 0 \mid \text{for } a > b \text{ and } a,\ b = 1,2,3\}\ \forall i$;

For $LR: \mathbf{\Pi}(L)\mathbf{z}_t = \boldsymbol{\beta}(L) w_t + \mathbf{u}_t$; $\mathbf{\Pi}(1)\mathbf{z}^* = \boldsymbol{\beta}(1) w^*$

Country	Industry	IMP_{SR}	PPI_{SR}	COE_{SR}	IMP_{LR}	PPI_{LR}	COE_{LR}
UK	Toba	1.655*** (0.327)	0.522*** (0.135)	-0.354*** (0.055)	1.117*** (0.261)	0.401*** (0.111)	-0.272*** (0.045)
UK	Pulp	0.276*** (0.121)	0.299*** (0.112)	na	0.161*** (0.073)	0.622*** (0.255)	na
UK	Wood	-0.722*** (0.170)	-0.262*** (0.070)	na	-0.722*** (0.170)	-0.394*** (0.071)	na
UK	Metal	0.546* (0.314)	0.324*** (0.112)	-0.145*** (0.052)	0.258* (0.152)	0.487*** (0.180)	-0.218*** (0.087)
UK	Chemi	-0.536*** (0.082)	na	0.036 (0.032)	-0.397*** (0.060)	na	0.075 (0.061)
UK	Org-che	0.215 (0.162)	0.332*** (0.090)	0.163 (0.081)	0.231 (0.203)	0.323*** (0.108)	0.159 (0.082)
UK	Medi.	-0.313*** (0.086)	-0.332*** (0.117)	na	-0.241*** (0.064)	-0.332*** (0.117)	na
UK	Plastics	0.085 (0.065)	-0.079 (0.072)	0.459*** (0.151)	0.187 (0.151)	-0.089 (0.083)	0.518*** (0.131)
UK	Tex-fabs	-0.243*** (0.066)	0.028*** (0.013)	0.086*** (0.026)	-0.359*** (0.113)	0.057*** (0.028)	0.177*** (0.056)
UK	Iron	0.145*** (0.071)	0.131*** (0.063)	0.573*** (0.111)	0.146** (0.073)	0.093*** (0.046)	0.409*** (0.073)
UK	Nonfme	0.251*** (0.079)	0.425*** (0.122)	0.058 (0.049)	0.146*** (0.045)	0.600*** (0.194)	0.082 (0.070)
UK	Mach	-0.487*** (0.123)	0.024*** (0.011)	0.066*** (0.022)	-0.391*** (0.092)	0.024** (0.012)	0.067*** (0.023)
UK	El-mach	-0.479*** (0.109)	0.047*** (0.018)	0.050** (0.027)	-0.511*** (0.122)	0.091*** (0.040)	0.096** (0.049)

Notes: ***, ** and * shows 99%, 95% and 90% level of significance respectively; standard errors are reported in parentheses; the index SR corresponds to "short-run" effects while the index LR corresponds to "long-run" effects. IMP denotes the sum of the estimated coefficients of the lagged exchange rate growth in the import equation. PPI denotes the sum of the estimated coefficients of the lagged exchange rate growth in the producer price equation. COE denotes the sum of the estimated coefficients of lagged import prices in the producer price equation. In the table, "Toba" denotes Tobacco, "Pulp" denotes Pulp and waste paper, "Wood" denotes Wood and cork, "Metal" stands for Metal ores, "Chemi" stands for Chemicals, "Org-che" denotes Organic chemicals, "Medi." denotes Medicinal products, "Plastics" stands for Plastics, "Tex-fabs" denotes Textile fabrics, "Iron" stands for Iron and steel, "Nonfme" stands for Non-ferrous metals, "Mach" denotes Machinery and transport equipment and "El-mach" denotes Electrical machinery.

Table 6: Nested Model Testing for System III

$$\mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t \,; \; H_0 \; : \; \left\{ \pi_{ab}^{i} = 0 \mid \text{for } a > b \text{ and } a,\; b = 1,2,3 \right\} \; \forall i$$

Country	Industry	$R1$ is correct	$R2$ is correct	$R3$ is correct
UK	Toba	51.146	na	50.149
	p-value	0.351	na	0.999
UK	Pulp	64.107	46.194	na
	p-value	0.000	0.464	na
UK	Wood	19.018	na	10.727
	p-value	0.088	na	0.978
UK	Metal	24.510	23.351	na
	p-value	0.017	0.612	na
UK	Chemi	38.741	49.647	na
	p-value	0.003	0.258	na
UK	Org-che	18.275	na	37.008
	p-value	0.107	na	0.012
UK	Medi.	18.946	na	19.563
	p-value	0.395	na	0.994
UK	Plastics	27.529	na	40.591
	p-value	0.069	na	0.237
UK	Tex-fabs	16.874	na	26.804
	p-value	0.531	na	0.838
UK	Iron	24.871	na	39.093
	p-value	0.131	na	0.252
UK	Nonfme	22.944	20.027	na
	p-value	0.028	0.829	na
UK	Mach	11.898	na	39.744
	p-value	0.852	na	0.194
UK	El-mach	32.678	na	45.650
	p-value	0.111	na	0.528

Notes: In the table, “Toba” denotes Tobacco, “Pulp” denotes Pulp and waste paper, “Wood” denotes Wood and cork, “Metal” stands for Metal ores, “Chemi” stands for Chemicals, “Org-che” denotes Organic chemicals, “Medi.” denotes Medicinal products, “Plastics” stands for Plastics, “Tex-fabs” denotes Textile fabrics, “Iron” stands for Iron and steel, “Nonfme” stands for Non-ferrous metals, “Mach” denotes Machinery and transport equipment and “El-mach” denotes Electrical machinery. “p-value” denotes probability values for corresponding test statistics.

Table 7: Estimation Results from System III

For $SR: \mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t$; $H_0: \{\pi_{ab}^i = 0 \mid \text{for } a > b \text{ and } a, b = 1,2,3\} \ \forall i$;

For $LR: \mathbf{\Pi}(L)\mathbf{z}_t = \boldsymbol{\beta}(L) w_t + \mathbf{u}_t$; $\mathbf{\Pi}(1)\mathbf{z}^* = \boldsymbol{\beta}(1) w^*$

Country	Industry	IMP_{SR}	PPI_{SR}	COE_{SR}	IMP_{LR}	PPI_{LR}	COE_{LR}
USA	Meat	-0.316*** (0.174)	-0.133 (0.086)	na	-0.309** (0.173)	-0.174 (0.119)	na
USA	Fruit	0.525 (0.362)	na	0.019*** (0.007)	0.228 (0.158)	na	0.025*** (0.011)
USA	Beve	-0.046* (0.028)	-0.164*** (0.049)	0.319*** (0.100)	-0.033* (0.019)	-0.164*** (0.049)	0.319*** (0.019)
USA	Chemi	0.105*** (0.039)	0.094*** (0.033)	0.237*** (0.116)	0.105*** (0.038)	0.121*** (0.048)	0.306*** (0.130)
USA	Org-che	-0.174* (0.103)	-0.284*** (0.115)	0.535*** (0.212)	-0.161* (0.095)	-0.298*** (0.122)	0.564*** (0.177)
USA	Inor-che	-0.125 (0.124)	na	0.485*** (0.113)	-0.171 (0.165)	na	0.382*** (0.087)
USA	Rubber	0.038 (0.065)	-0.005 (0.028)	na	0.063 (0.113)	-0.014 (0.069)	na
USA	Nm-min	-0.111*** (0.042)	0.028* (0.018)	na	-0.134*** (0.051)	0.035* (0.022)	na
USA	Me-mach	0.303*** (0.098)	0.077*** (0.035)	0.101** (0.047)	0.431*** (0.148)	0.811 (0.165)	1.067 (0.217)
USA	El-mach	-0.118** (0.062)	na	0.078*** (0.023)	-0.189** (0.108)	na	0.145*** (0.049)
USA	Furni	0.100*** (0.043)	0.027*** (0.012)	0.016 (0.027)	0.124*** (0.055)	0.081* (0.050)	0.048 (0.079)

Notes: ***, ** and * shows 99%, 95% and 90% level of significance respectively; standard errors are reported in parentheses; the index SR corresponds to "short-run" effects while the index LR corresponds to "long-run" effects. IMP denotes the sum of the estimated coefficients of the lagged exchange rate growth in the import equation. PPI denotes the sum of the estimated coefficients of the lagged exchange rate growth in the producer price equation. COE denotes the sum of the estimated coefficients of lagged import prices in the producer price equation. In the table, "Meat" stands for Meat and meat preparations, "Fruit" stands for Vegetables, fruit and nuts, fresh or dried, "Beve" stands for Beverages, "Chemi" denotes Chemicals and related products, not essentially specified, "Org-che" stands for Organic chemicals, "Inor-che" stands for Inorganic chemicals, "Rubber" stands for Rubber manufactures, not essentially specified, "Nm-min" stands for Non-metallic mineral manufactures, "Me-mach" denotes Metalworking machinery, "El-mach" stands for Electrical machinery and equipment and "Furni" denotes Furniture and parts thereof.

Table 8: Nested Model Testing for System III

$$\mathbf{z}_t = \sum_{i=1}^{p} \mathbf{\Pi}_i \mathbf{z}_{t-i} + \sum_{j=1}^{q} \boldsymbol{\beta}_j w_{t-j} + \mathbf{u}_t \textbf{;}\ H_0 : \left\{ \pi_{ab}^{i} = 0 \mid \text{for } a > b \text{ and } a,\ b = 1,2,3 \right\} \ \forall i$$

Country	Industry	$R1$ is correct	$R2$ is correct	$R3$ is correct
USA	Meat	21.825	na	21.802
	p-value	0.351	na	0.995
USA	Fruit	13.735	na	41.308
	p-value	0.746	na	0.287
USA	Beve	12.212	na	23.810
	p-value	0.836	na	0.973
USA	Chemi	44.851	66.422	na
	p-value	0.001	0.059	na
USA	Org-che	17.283	na	47.863
	p-value	0.635	na	0.214
USA	Inor-che	21.748	na	18.696
	p-value	0.243	na	0.992
USA	Rubber	21.686	na	27.366
	p-value	0.357	na	0.949
USA	Nm-min	9.220	na	27.155
	p-value	0.980	na	0.983
USA	Me-mach	7.252	na	68.739
	p-value	0.995	na	0.001
USA	El-mach	9.271	na	30.111
	p-value	0.979	na	0.914
USA	Furni	8.299	na	42.688
	p-value	0.989	na	0.398

Notes: In the table, “Meat” stands for Meat and meat preparations, “Fruit” stands for Vegetables, fruit and nuts, fresh or dried, “Beve” stands for Beverages, “Chemi” denotes Chemicals and related products, not essentially specified, “Org-che” stands for Organic chemicals, “Inor-che” stands for Inorganic chemicals, “Rubber” stands for Rubber manufactures, not essentially specified, “Nm-min” stands for Non-metallic mineral manufactures, “Me-mach” denotes Metalworking machinery, “El-mach” stands for Electrical machinery and equipment and “Furni” denotes Furniture and parts thereof. “p-value” denotes probability values for corresponding test statistics.

Table 9: Correlations of Exchange Rates and Relative Export Competitiveness

Correlation between $REP = E.\frac{p_t^*}{p_t}$ and E

Industry	US-UK	JAPAN-US	JAPAN-UK
Meat	0.289	na	na
Fruit	0.403	na	na
Beve. and tobacco	0.765	na	na
Crude mate., except fuel	0.369	na	na
Textile fibers	0.264	na	na
Metalliferous ores etc.	0.195	na	na
Chemicals	0.745	0.602	0.605
Organic chemicals	0.505	na	na
Inorganic chemicals	0.572	na	na
Medicinal products etc	0.658	na	na
Uncoated paper	0.681	na	na
Textile fabrics	na	na	0.753
Non-ferrous metals	0.550	na	na
Manu. of metals	na	0.692	na
Machinery and trans.	na	0.977	0.875
Road vehicles	0.500	0.630	0.500
Misc. manufactures	0.825	0.910	0.618

Notes: In the above table, “Meat” denotes Meat and meat preparations, “Fruit” denotes Vegetables, fruit and nuts, fresh or dried, “Beve. and tobacco” denotes Beverages and tobacco, “Crude mate., except fuel” stands for Crude materials, inedible, except fuels, “Textile fibers” denotes Textile fibers and their waste, “Metalliferous ores etc.” denotes Metalliferous ores and metal scrap, “Chemicals” denotes Chemicals and related products, “Organic chemicals” denotes Organic chemicals, “Inorganic chemicals” stands for Inorganic chemicals, “Medicinal products etc” stands for Medicinal and pharmaceutical products, “Uncoated paper” stands for Uncoated paper or paperboard, and linearboard, “Textile fabrics” stands for Textiles, “Non-ferrous metals” denotes Non-ferrous metals, “Manu. of metals” stands for Metals and related products, “Machinery and trans.” denote General machinery and equipment, “Road vehicles’ stands for Road vehicles/Transportation equipment and “Misc. manufactures” denotes Miscellaneous manufactured articles/Other manufacturing industry products.

Table 10: Estimation Results from Relative Export Prices

$$\pi(L)\Delta y_t = c + \delta(L)x_{t3} + z_t(\mathbf{v})$$

Industry	US-UK	US-JAPAN	UK-JAPAN
Meat	-0.637* (0.429)	na	na
Fruit	-0.507* (0.334)	na	na
Beve. and tobacco	-0.243*** (0.081)	na	na
Crude mate., except fuel	0.328*** (0.158)	na	na
Textile fibers	-0.472*** (0.232)	na	na
Metalliferous ores etc.	0.269 (0.244)	na	na
Chemicals	-0.259*** (0.089)	-0.283 (0.211)	-0.179*** (0.073)
Organic chemicals	-0.431*** (0.147)	na	na
Inorganic chemicals	-0.168* (0.112)	na	na
Medicinal products etc.	-0.208** (0.106)	na	na
Uncoated paper	-0.327*** (0.136)	na	na
Textile fabrics	na	na	-0.304*** (0.068)
Non-ferrous metals	-0.203 (0.187)	na	na
Manu. of metals	na	-0.436*** (0.198)	na
Machinery and trans.	na	-0.283*** (0.104)	-0.249*** (0.060)
Road vehicles	-0.095** (0.055)	-0.667*** (0.214)	-0.090 (0.082)
Misc. manufactures	-0.101* (0.064)	-0.374*** (0.178)	-0.347*** (0.092)

Notes: ***, ** and * shows 99%, 95% and 90% level of significance respectively; standard errors are reported in parentheses; all the estimates correspond to the long-run estimates δ^* from equation (15) in the methodology part of the text. In the above table, "Meat" denotes Meat and meat preparations, "Fruit" denotes Vegetables, fruit and nuts, fresh or dried, "Beve. and tobacco" denotes Beverages and tobacco, "Crude mate., except fuel" stands for Crude materials, inedible, except fuels, "Textile fibers" denotes Textile fibers and their waste, "Metalliferous ores etc." denotes Metalliferous ores and metal scrap, "Chemicals" denotes Chemicals and related products, "Organic chemicals" denotes Organic chemicals, "Inorganic chemicals" stands for Inorganic chemicals, "Medicinal products etc" stands for Medicinal and pharmaceutical products, "Uncoated paper" stands for Uncoated paper or paperboard, and linearboard, "Textile fabrics" stands for Textiles, "Non-ferrous metals" denotes Non-ferrous metals, "Manu. of metals" stands for Metals and related products, "Machinery and trans." denote General machinery and equipment, "Road vehicles' stands for Road vehicles/Transportation equipment and "Misc. manufactures" denotes Miscellaneous manufactured articles/Other manufacturing industry products.

Appendix 2

Table 1. SITC Categories for Import Prices in USA

Country	SITC code number for **Import prices**	Full name of the SITC coded industry	Subcategory of SITC category	Denoted as (in table nos. 7 and 8 in appendix 1)
USA	01	Meat and meat preparations	Food and live animals	Meat
USA	05	Vegetables, fruit and nuts, fresh or dried	Food and live animals	Fruit
USA	1	Beverages and Tobacco	Beverages and Tobacco	Food.
USA	11	Beverages	Beverages and Tobacco	Beve
USA	3	Mineral fuels, lubricants and related materials	Mineral fuels, lubricants and related materials	Mfl
USA	5	Chemicals and related products, n.e.s	Chemicals and related products, n.e.s	Chemicals
USA	51	Organic chemicals	Chemicals and related products	Org-che
USA	52	Inorganic chemicals	Chemicals and related products	Inorg-che
USA	62	Rubber manufactures, n.e.s	Manufactured goods classified chiefly by materials	Rubber
USA	66	Non-metallic mineral manufactures	Manufactured goods classified chiefly by materials	Nm-min
USA	73	Metalworking machinery	Machinery and Transport Equipment	Me-mach
USA	77	Electrical machinery and equipment	Machinery and Transport Equipment	El-mach
USA	82	Furniture and parts thereof	Miscellaneous manufactured articles	Furni
USA	84	Articles of apparel and clothing accessories	Miscellaneous manufactured articles	Appa.

Notes: For each of the above import prices, we have taken the corresponding producer prices or consumer prices to carry-out our empirical estimation of exchange rate pass-through effect. Therefore, the corresponding producer or consumer prices either exactly match those SITC codes or sometimes taken as the closest match with the imported products. Please note that this match is made based on the notes available from each of these detailed industry-levels price statistics. For more information, please refer to the Bureau of Labor Statistics web site at http://www.bls.gov.

Table 2. SITC Categories for Import Prices in UK

Country	SITC code number for **Import prices**	Full name of the SITC coded industry	Subcategory of SITC category	Denoted as (in table nos. 3, 4, 5 and 6 in appendix 1)
UK	12	Tobacco	Beverages and Tobacco	Toba
UK	25	Pulp and waste paper	Crude materials	Pulp
UK	24	Wood and cork	Crude materials	Wood
UK	27	Metal ores	Crude materials	Metal
UK	5	Chemicals	Chemicals	Chemi
UK	51	Organic chemicals	Chemicals	Org-che
UK	54	Medicinal products	Chemicals	Medi.
UK	57+58	Plastics	Chemicals	Plastics
UK	65	Textile fabrics	Manufactures	Tex-fabs
UK	67	Iron and steel	Manufactures	Iron
UK	68	Non-ferrous metals	Manufactures	Nonfme
UK	7	Machinery and transport equipment	Machinery and transport equipment	Mach
UK	716+75+76+77	Electrical machinery	Machinery and transport equipment	El-mach

Notes: For each of the above import prices, we have taken the corresponding producer prices to carry-out our empirical estimation of exchange rate pass-through effect. Therefore, the corresponding producer prices either exactly match those SITC codes or sometimes taken as the closest match with the imported products. Please note that this match is made based on the notes available from each of these detailed industry-levels price statistics. For more information, please refer to the National Statistics Online web site at http://www.statistics.gov.uk.

Table 3. Industry Categories for Import Prices in Japan

Country	Full name of the industry for which we are taking **Import prices**	Denoted as (in table nos. 1 and 2 in appendix 1)
Japan	Chemicals	Chemi
Japan	Foodstuffs and feedstuff	Food
Japan	Machinery and equipment	Mach
Japan	Metals and related products	Metal
Japan	Petroleum, coal and natural gas	Petrol
Japan	Textiles	Textiles
Japan	Wood, lumber and related products	Wood

Notes: For each of the above import prices, we have taken the corresponding wholesale prices or producer prices to carry-out our empirical estimation of exchange rate pass-through effect. Therefore, the corresponding wholesale price or producer prices either exactly match those industry codes or sometimes taken as the closest match with the imported products. Please note that this match is made based on the notes available from each of these detailed industry-levels price statistics. For more information, please refer to the Bank of Japan web site at http://www.boj.or.jp/en.

Table 4. SITC Categories for Export Prices in USA and UK

Country	SITC code number for **Export prices**	Full name of the SITC coded industry	Subcategory of SITC category	Denoted as (in table nos. 9 and 10 in appendix 1)
USA+UK	01	Meat and meat preparations	Food and live animals	Meat
USA+UK	05	Vegetables, fruit and nuts, fresh or dried	Food and live animals	Fruit
USA+UK	1	Beverages and tobacco	Beverages and Tobacco	Beve. and Tobacco
USA+UK	2	Crude materials, inedible, except fuels	Crude materials, inedible, except fuels	Crude mate., except fuel
USA+UK	26	Textile fibers and their waste	Crude materials, inedible, except fuels	Textile fibers
USA+UK	28	Metalliferous ores and metal scrap	Crude materials, inedible, except fuels	Metalliferous ores etc.
USA+UK	5	Chemicals and related products, n.e.s	Chemicals and related products, n.e.s	Chemicals
USA+UK	51	Organic chemicals	Chemicals and related products	Organic chemicals
USA+UK	52	Inorganic chemicals	Chemicals and related products	Inorganic chemicals
USA+UK	54	Medicinal and pharmaceutical products	Chemicals and related products	Medicinal products etc.
USA+UK	64	Uncoated paper or paperboard, and linearboard	Manufactured goods classified chiefly by materials	Uncoated paper
USA+UK	68	Nonferrous metals	Manufactured goods classified chiefly by materials	Non-ferrous metals
USA+UK	78	Road vehicles	Machinery and Transport Equipment	Road vehicles
USA+UK	8	Miscellaneous manufactured articles	Miscellaneous manufactured articles	Misc. Manufactures

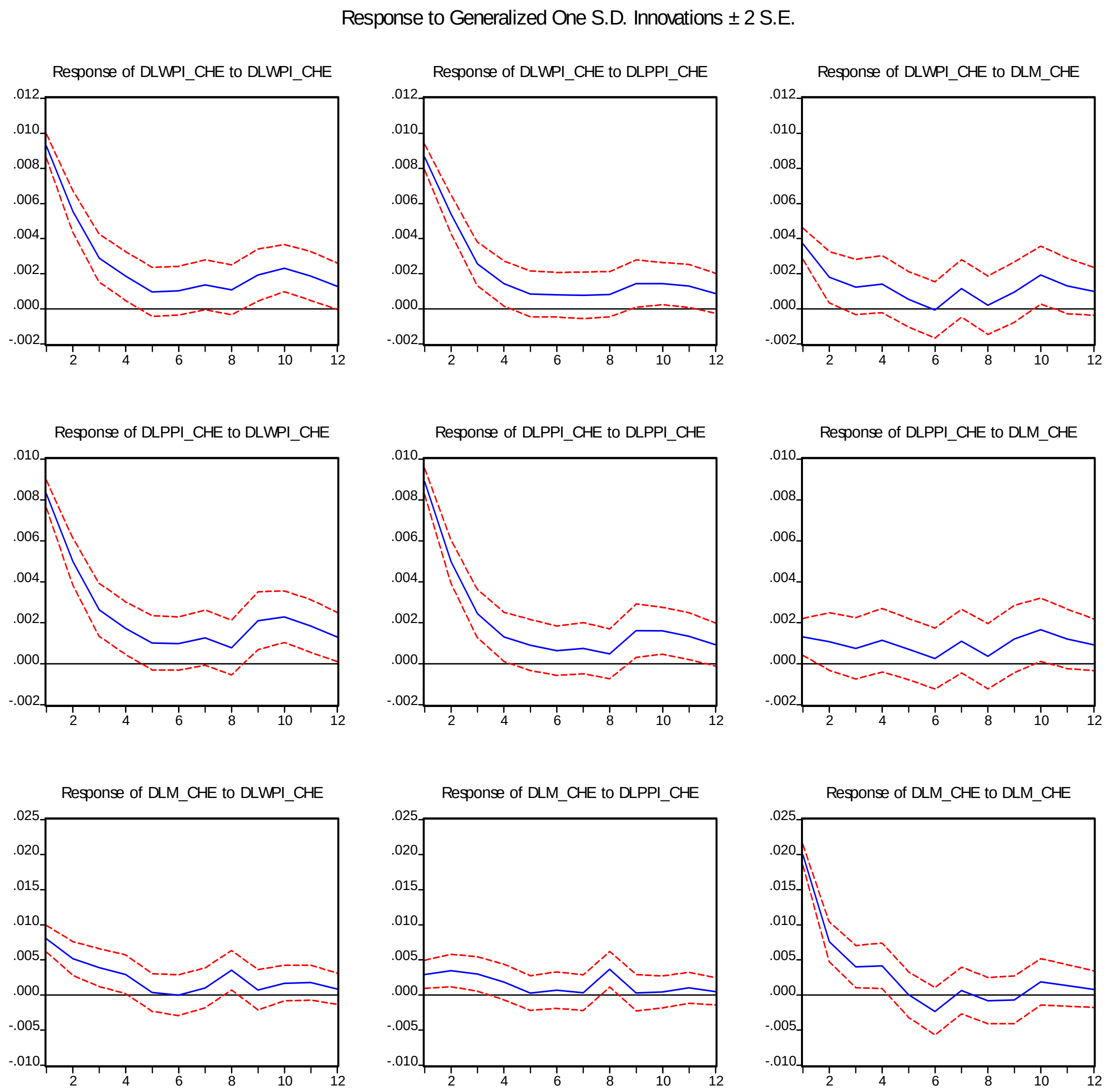
Notes: By USA+UK, we mean that for these two countries, the SITC codes for export prices almost exactly match each other. Based on this information, we have calculated the relative export prices for USA and UK.

Table 5. Industry Categories for Export Prices in Japan

Country	Full name of the industry for which we are taking **Export prices**	Denoted as (in table nos. 9 and 10 in appendix 1)
Japan	Chemicals and related products	Chemicals
Japan	Textiles	Textile fabrics
Japan	Metals and related products	Manu. of metals
Japan	General machinery and equipment	Machinery and Trans.
Japan	Transportation equipment	Road vehicles
Japan	Other manufacturing industry products	Misc. Manufactures

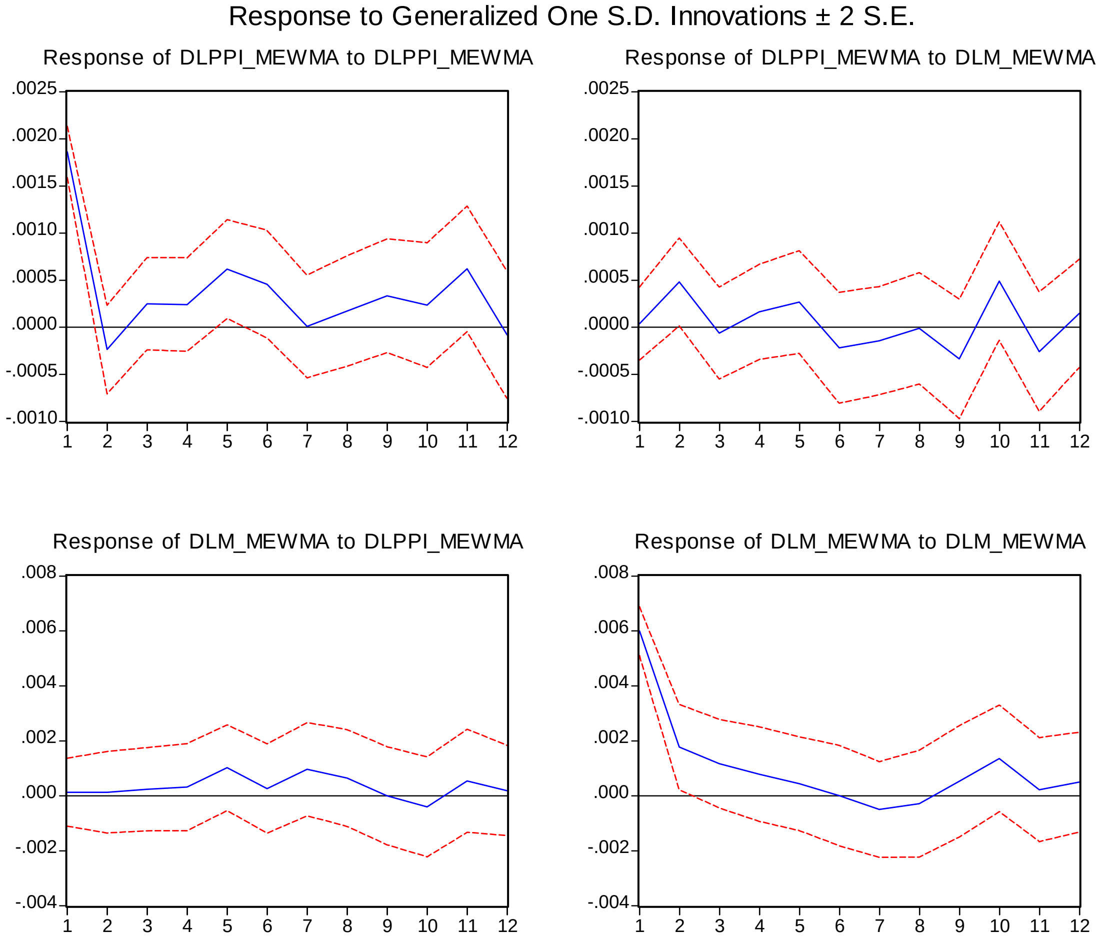
Appendix 3

Figure 1: Impulse Response for Chemical Industry in Japan



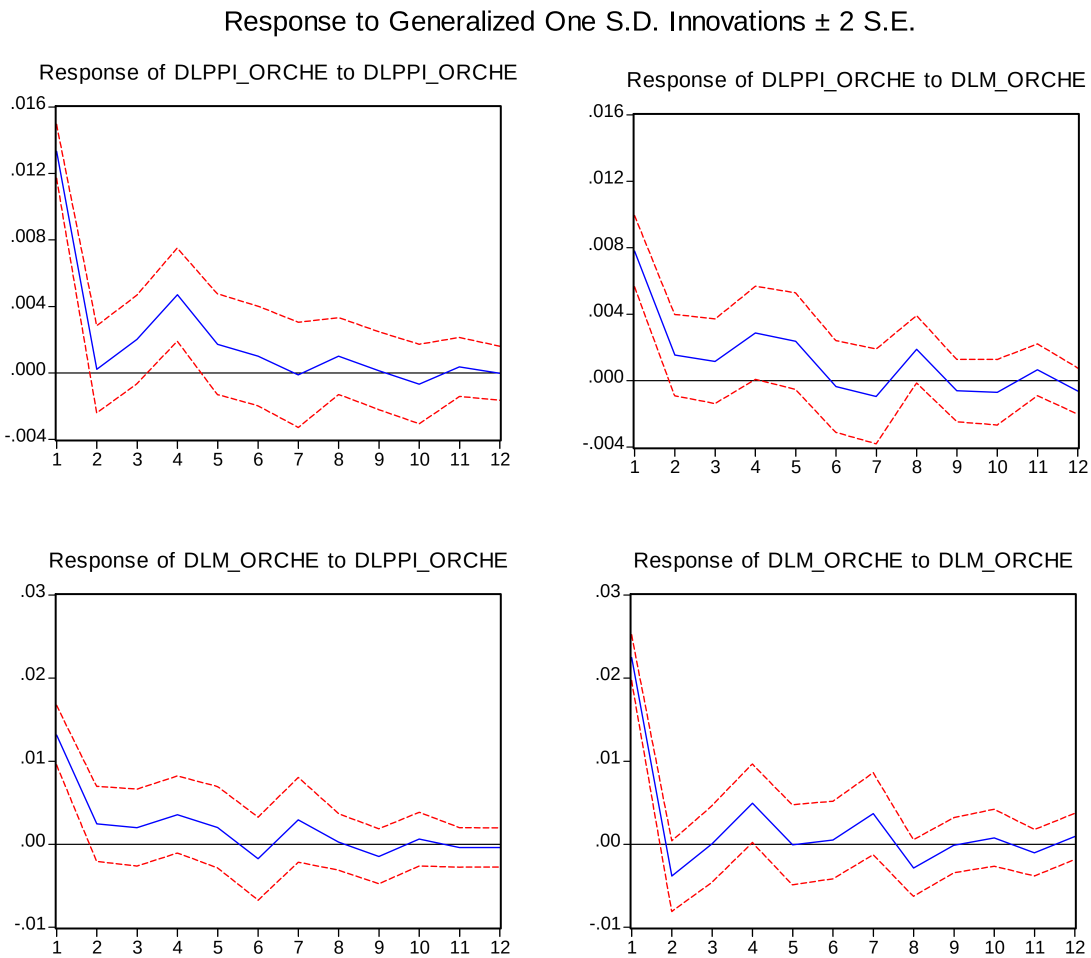
Notes: $DLWPI\_CHE$, $DLPPI\_CHE$ and DLM_CHE stand for percentage change in wholesale prices in chemical industry, percentage change in producer prices in chemical industry and percentage change in import prices in chemical industry for Japan, respectively.

Figure 2: Impulse Response for Metal-working Machinery Industry in USA



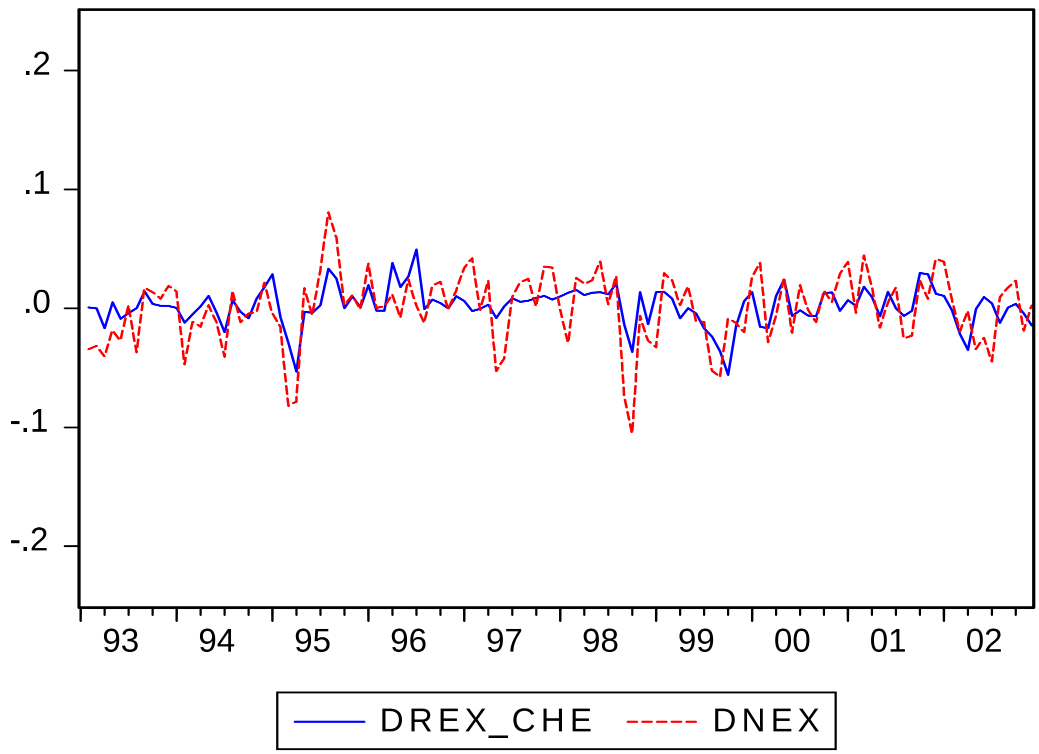
Notes: *DLPPI _ MEWMA* and *DLM _ MEWMA* stand for percentage change in producer prices in metal-working machinery industry and percentage change in of import prices in metal-working machinery industry for USA, respectively.

Figure 3: Impulse Response for Organic Chemical Industry in UK



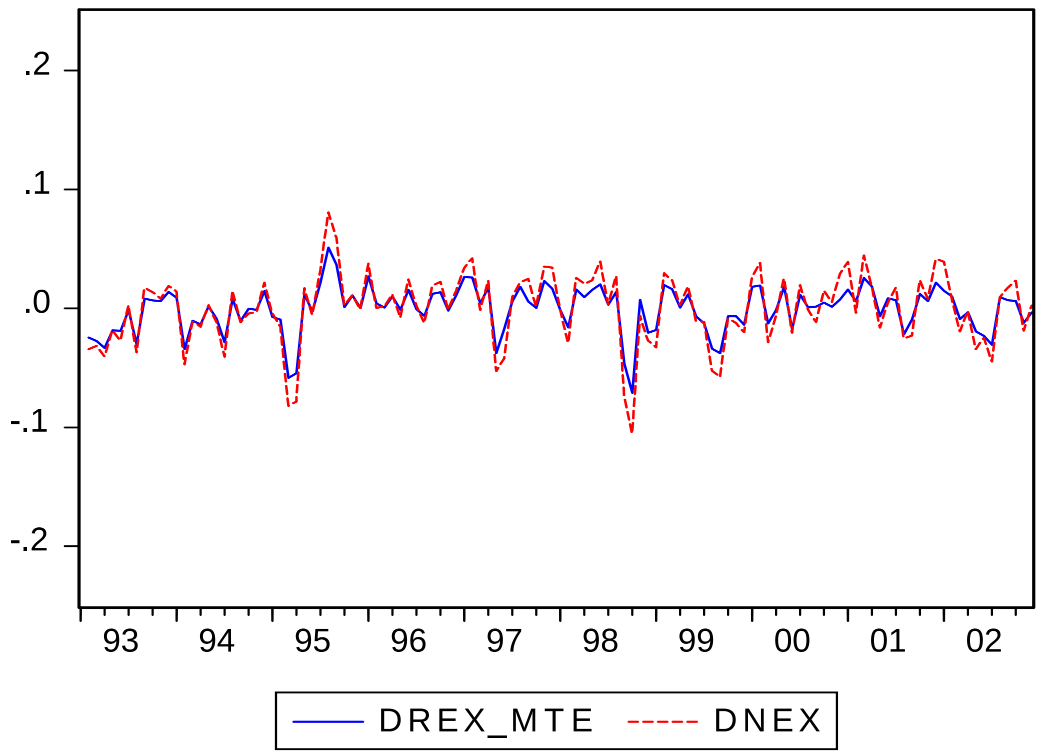
Notes: *DLPPI _ ORCHE* and *DLM _ ORCHE* stand for percentage change in producer prices in organic chemical industry and percentage change in import prices in organic chemical industry for UK, respectively.

Figure 4: Relative Export Price and Nominal Exchange Rate Correlation for Chemical Industry for USA and Japan



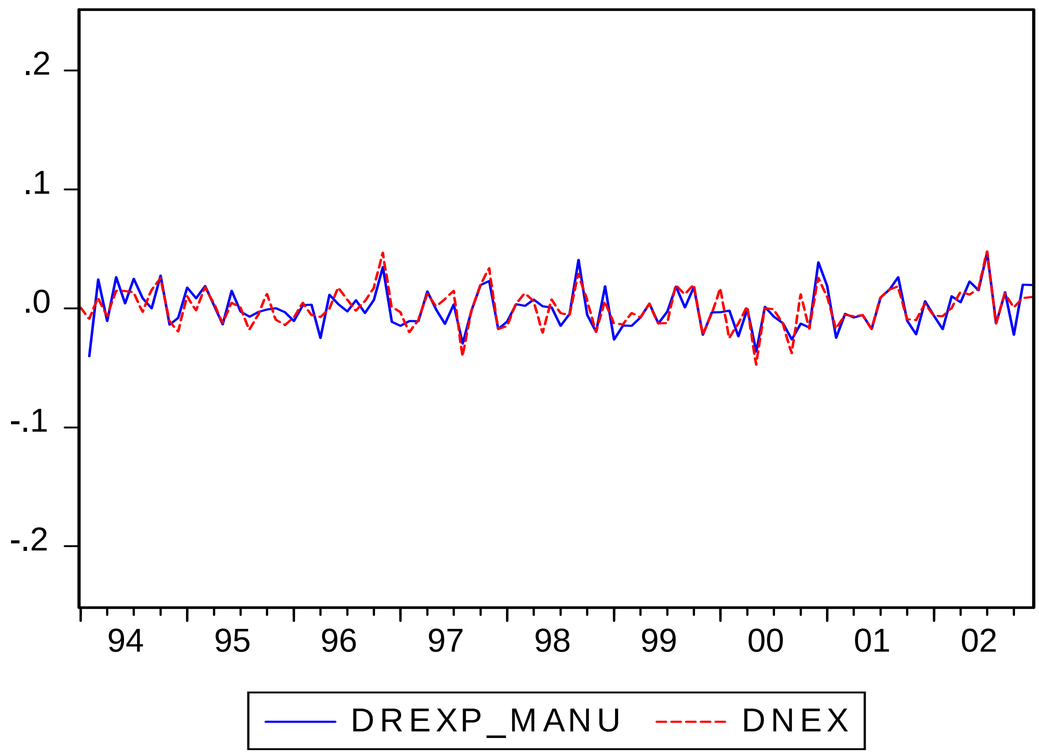
Notes: *DREX _ CHE* and *DNEX* stand for percentage change in relative export prices in chemical industry and percentage change in nominal exchange for USA and Japan, respectively.

Figure 5: Relative Export Price and Nominal Exchange Rate Correlation for Machinery and Transport Industry for USA and Japan



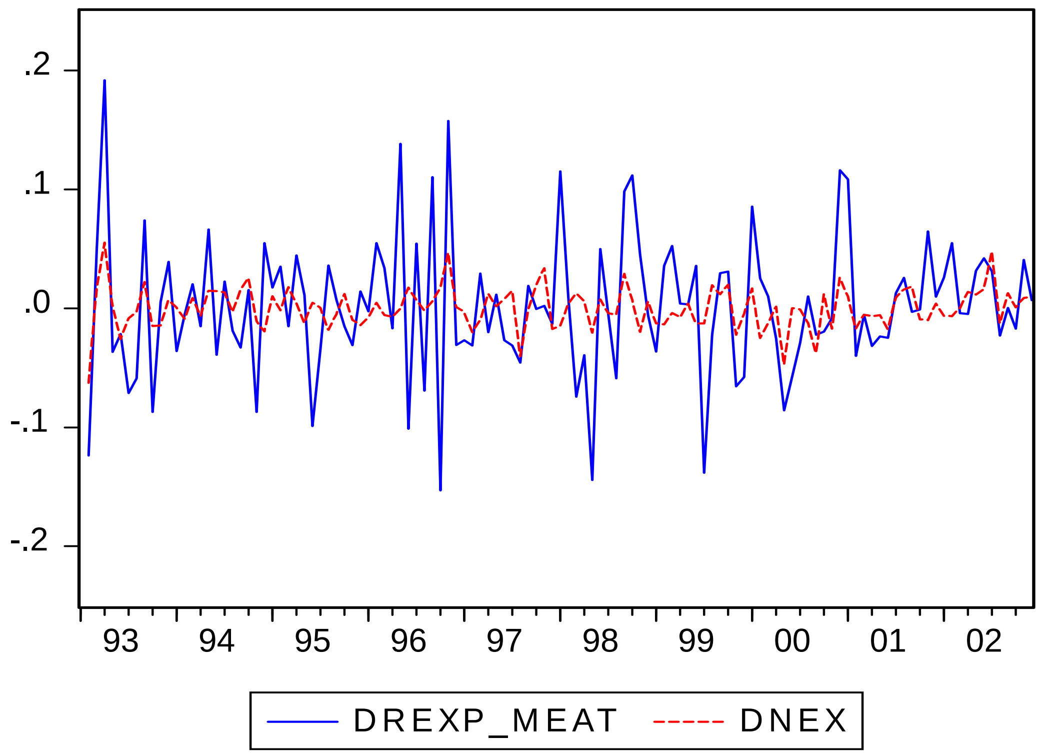
Notes: *DREX _ MTE* and *DNEX* stand for percentage change in relative export prices in machinery and transport industry and percentage change in nominal exchange for USA and Japan, respectively.

Figure 6: Relative Export Price and Nominal Exchange Rate Correlation for Miscellaneous Manufactures Industry for USA and UK



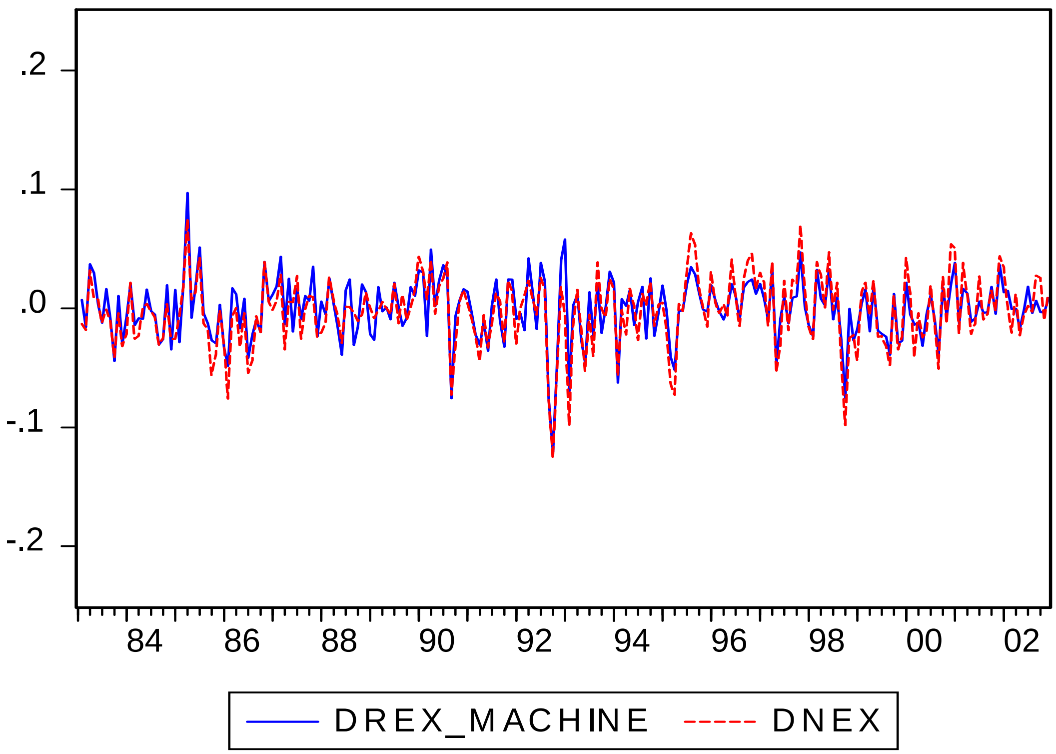
Notes: *DREXP _ MANU* and *DNEX* stand for percentage change in relative export prices in miscellaneous manufactures industry and percentage change in nominal exchange for USA and UK, respectively.

Figure 7: Relative Export Price and Nominal Exchange Rate Correlation for Meat Industry for USA and UK



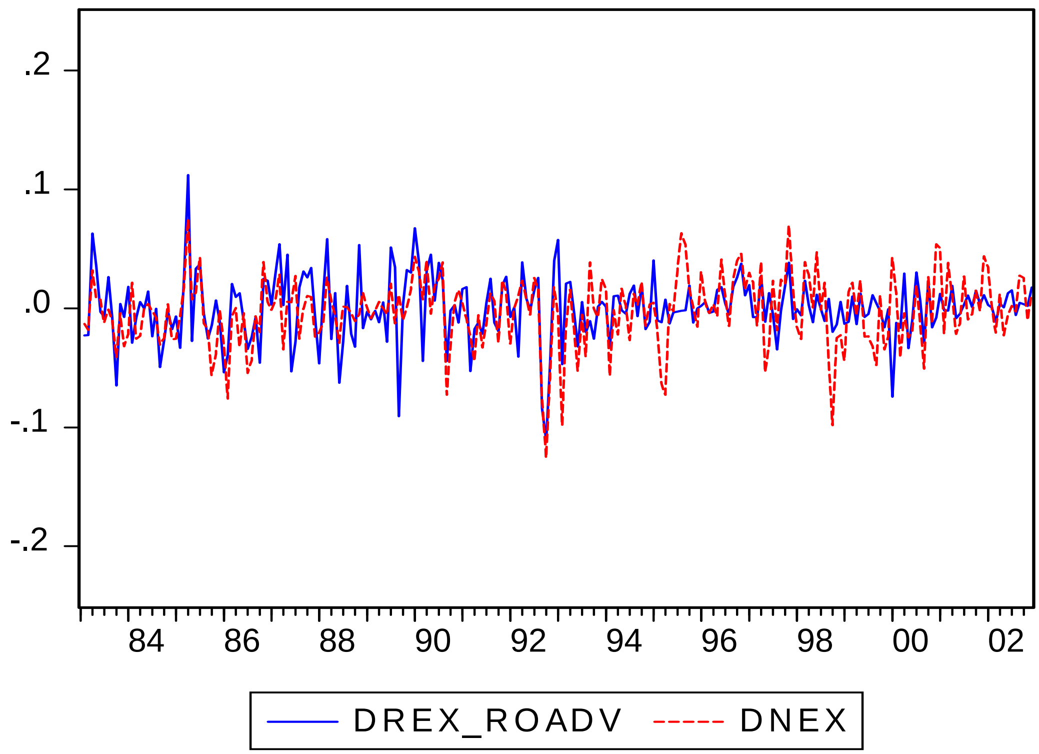
Notes: *DREXP _ MEAT* and *DNEX* stand for growth rate of relative export prices in meat industry and percentage change in nominal exchange for USA and UK, respectively.

Figure 8: Relative Export Price and Nominal Exchange Rate Correlation for Machinery and Transport Industry for Japan and UK



Notes: *DREX _ MACHINE* and *DNEX* stand for growth rate of relative export prices in machinery and transport industry and percentage change in nominal exchange for Japan and UK, respectively.

Figure 9: Relative Export Price and Nominal Exchange Rate Correlation for Road Vehicles Industry for Japan and UK



Notes: *DREX _ ROADV* and *DNEX* stand for growth rate of relative export prices in road vehicles industry and percentage change in nominal exchange for Japan and UK, respectively.