'Exchange Rate Pass Through: The Experience of the United Kingdom.'

By Hugh Metcalf, BSc. MSc.

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Abstract.

The focus of the thesis is on the role of exchange rates in price setting and consequentially nominal price stickiness.

A data set was constructed of individual product lines that were imported to the UK, together with competitive product lines. The empirical results showed that the impact of competitive products is significant and for one of the five products selected the pass through of exchange rates into prices was insignificantly different from zero, one passed a proportion of the exchange rate changes into price adjustments and three adjusted prices in such a way as to reinforce the exchange rate changes.

A multi period pricing model was postulated, drawing on the work of Ball and Mankiw (1994) but extending it to allow exchange rates shocks to impact a firm's costs in both its home country and its export market. This model shows when temporary shocks will not be passed through and provides a rationale why permanent shocks might also not be passed through.

Two further empirical studies were carried on a wider range of products. The first was conducted on imports from major trading partners of the UK. The results were based on aggregated data but showed a very similar picture to the initial product line study. The second study focused on UK exports to the same group of countries using similar products ranges to the import study.

The results again showed a similar picture and further for a majority of individual countries, where there was a significant level of pass through, the sign of the exchange rate pass through changed dependent upon whether the country was importing or exporting. Indicating that a country's responsiveness to exchange rate shocks is an important determinant of firm's pricing decisions. Finally these studies provide further evidence that nominal price stickiness is evident in the UK economy.

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Chapter 1.

Introduction

1.1 The Context of the Study.

The period since 1971, when exchange rates were allowed to float freely has seen large fluctuations in the bilateral exchange rates of all the major economies. This phenomenon has not been matched by equally large changes in the general price levels in those economies, particularly when countries have been experiencing periods of strength of their exchange rates, as shown empirically by Mann (1986), Ohno (1989) and Marston (1990). The law of one price propounds that a good will sell for the same price in different countries once it is expressed in a common currency unit. Consequentially, a strengthening of a country's exchange rate should lead to a fall in that country's general price levels.

This apparent breakdown of the law of one price could be caused by sticky nominal prices, which has long been at the heart of the debate between New Keynesian and New Classical economists. This issue is discussed in Chapter

2, but it also raises the question of why it might be optimal for a firm to pass through less than all of the costs associated with an exchange rate shock.

1.2 Thematic Approaches.

Investigation of the divergence of price levels and the exchange rate was initially tested under the theme of purchasing power parity, where the primary consideration was changes in aggregate price level data and exchange rates over time. Changes in disaggregated traded goods price indices and exchange rates have also been tested and these have been grouped under the heading of the testing of the law of one price. The results of testing both of these approaches have shown that a divergence between exchange rate movements and aggregate price levels does occur.

Another strand of the literature entitled exchange rate pass through has, instead of examining changes in price levels, focused on the adjustment of import prices to exchange rate changes. In testing the elasticity of import prices following a change in the exchange rate, the emphasis of the analysis switches from aggregate economy wide considerations to firm-specific optimal pricing factors. Exchange rate pass through analysis therefore provides the foundational support for the divergence to the law of one price and purchasing power parity that has been noted above, and this approach will be utilised in this thesis.

1.3 The Exchange Rate Pass Through Literature.

The literature primarily considers a profit maximising firm selling a good into its home and an export market. When the firm sets prices, it has to consider whether the markets into which it is selling its products can be segregated, thereby allowing it to price discriminate between the home and foreign markets. In view of the results stated above, that there is evidence of divergence from the law of one price, then it would appear that firms actively price discriminate between their home and export markets. Firms must also consider costs when setting prices, and where they are selling into a foreign market and maximising with respect to the local market price, then one of these costs will be the bilateral exchange rate between the home and the foreign market.

The theoretical models that have been derived in the literature have generally used a one period framework to explain why exchange rate pass through of less than unity can occur. A pass through of unity implies that a firm will pass through all adjustments in the bilateral exchange rate into its price in the foreign market. Reasons such as, the market structure and the elasticity of demand faced by the firm in the export market have been shown to influence the degree of pass through that a firm practices.

One period models do not take account of the future implications of current decisions and some work has been undertaken into the considerations of the dynamic consequences of firm's actions in this area. Two-period models have been developed and these allow consideration of issues such as hysteresis, strategic interactions between firms and also the optimal reaction to temporary and permanent shocks. A detailed, formal review of the exchange rate pass through literature is given in Chapter 2.

The empirical testing of exchange rate pass through, has all been undertaken with either national level or industry level data which generates the problem of aggregation. Additionally most studies undertaken in this area have used a time series approach but many have not considered the time series properties of the data. The results generated may therefore be subject to the problem of spurious regression; this issue and the methodological approaches taken are discussed in Chapter 2

1.4 Motivation for the Study.

The literature to date is able to explain why exchange rate shocks may not be fully passed through into firms' prices. Most work has been undertaken in the context of a one period model which does not permit the reaction to temporary shocks to be analysed. Given the rollercoaster nature of most bilateral exchange rates between the major economies a firm's optimal reaction to permanent and temporary exchange rate shocks is addressed in Chapter 3.

Turning to empirical issues, all of the studies to date suffer from aggregation bias, the assembling and testing of a non-aggregated price data set should produce some interesting results. This issue is addressed in Chapter 4.

Finally, little work has been undertaken on European and in particular UK data, and bearing in mind the debate on whether or not the UK should join the Euro additional empirical evidence of the impact of exchange rates on firms actions must be helpful. This is provided in Chapters 5 and 6.

1.5 Summary of the Thesis.

There is a growing literature that demonstrates that firms often set prices for more than one period. Ball and Mankiw (1994) present a theoretical model that considers a firm's actions when they price for more than one period in a world of constantly rising prices. The model allows the firm to alter prices without cost at the conclusion of its contract period that is taken to be two periods, but the firm can alter price at the end of the first period if it pays an additional charge. This initial model was extended to allow it to be used in an exchange rate pass through environment by allowing the firm to export its goods. The cost function explicitly included exchange rates as an underlying cost of both the home and the export country and therefore the firm's total costs. Using this framework it is possible to show that firms will not pass through temporary exchange rate shocks that last for one period. Additionally they might not pass through exchange rate shocks which last for a limited number of periods, and a minimum bound for the level at which these shocks which will cause the firm to adjust price can be derived. Finally, as this model can demonstrate that there is inertia in nominal prices under the assumptions that are applied, where firms in one economy reacts faster to exchange rate shocks firms in this economy will carry the burden of price adjustment, and this can lead to firms in the other economy experiencing zero exchange rate pass through in the long run. The detailed presentation of the Ball and Mankiw (1994) model and its extension to permit its application to exchange rate pass through are given in Chapter 3. Specifically, the extended model provides a rational for firms to not pass through exchange rate shocks into their export prices. Empirical studies have detected zero pass through but a theoretical explanation of this phenomenon has not previously been presented.

The problem of aggregation bias is incorporated into every empirical study in this area. In addition, studies to date have only focused on the pass through from exporter to the importing countries customs point. This latter point will have a significant impact on the extent of pass through that is detected by empirical studies. Once goods are imported into a country the distributor can decide whether or not to pass through exchange rate induced price changes to the ultimate customer. A significant element in the total pass through equation has therefore been omitted from previous studies. To overcome this it was necessary to find a data set that recorded prices at the product line level. A source of product line data was found that recorded the changes in prices of products monthly. From this, products were selected and were grouped together on the basis that they were competing and at least one of them was an import to the UK. The criteria for selection and the methodology adopted for testing together with the results are presented in Chapter 4.

However, it is implicit under the assumption adopted in the literature, that firms maximise profits only with respect to their own price, that firms do not compete on other potential choice variables. This restricts the sample of goods that can be used, as products must remain unchanged during the sample period. Additionally, the decision process of the consumer will be different when faced with goods that are of significantly different value and to make the results comparable, goods of similar value had to be chosen.

Once the data set had been constructed, it was noted that none of the price series appeared to respond to the related exchange rate movements. However, there was evidence that when relative price ratios of the competing goods were compared with the relevant exchange rate movements, some patterns could be detected. It was further noted that the competitors prices seemed to respond to each other. Of the five groups of products that were tested; one displayed exchange rate pass through that was insignificantly different from zero; one had negative pass through of exchange rate changes; and three displayed positive pass through which amplified rather mitigated the affect of exchange rate shocks. Whilst positive and negative exchange rate pass through has been found and discussed in previous empirical studies, zero pass through has not been addressed in the literature.

This empirical study is the first to consider total pass through of exchange rate changes to the prices consumers are charged. The results offer support to the theoretical model in chapter 3, as four of the five firms were not passing through exchange rate changes to their customers.

As the results found in chapter 4 were from a small sample of products, a panel data approach was adopted to test exchange rate pass through on a large range of products which were imported from the major trading partners of the UK. The results of the panel data study are presented in detail in Chapter 5. The sample population of selected products was sub-divided into five subsets, chosen to highlight how different sub-sectors of the economy reacted. The largest group of results, for both the sample population and the sub-samples, indicates that the level of exchange rate changes that are passed through into prices is insignificantly different from zero. However, there are also a significant number of both positive and negative pass throughs. These results confirm the findings of chapter 4, there is a predominance of firms who shield their customers from the effects of exchange rate changes and are adopting the strategy identified in chapter 3 of not passing through exchange rate adjustments that are considered to be temporary.

Interestingly, almost without exception, each country that was tested displayed only one type of significant pass through, i.e. either positive or negative. This result might be caused by what is termed in the literature as country specific effects, which can be sub-divided between source country effects and destination country effects. The panel data study on imports to the UK in Chapter 5, can be considered as a test of destination country effects for the sample of exporting countries and the wide range of exchange rate pass throughs that were found would reject the hypothesis that the UK exerted a significant destination country effect.

A second panel data study presented in Chapter 6, focused on UK exports to the same group of countries as selected in Chapter 5 and using similar products, and tested whether the UK exerted a source country effect. The results showed a similar picture to that found in Chapter 5, with large numbers of insignificantly different from zero, positive and negative exchange rate pass throughs for both the sample population and the sub-sectors. Accordingly, for this range of products there does not appear to be any source country effect.

In ten of the twenty-two countries that were tested, where there was a significant level of pass through, the sign of the exchange rate pass through found in the import study was the opposite to the sign found in the export study, i.e. countries which passed through price changes in the same direction as exchange rate movements as importers adjusted prices in the opposite direction as exporters. Accordingly, it can be hypothesised that the country effect that is being picked up in this case, appears to be the country which bears the burden of price adjustment following exchange rate shocks, rather than a direct behavioural response of firms which is implied by the country specific effect hypothesis. The results of the two panel studies imply that neither source nor destination country effects are found in the UK.

The conclusions to this thesis are presented in Chapter 7.

Chapter 2.

Review of the Literature

2.1 Introduction.

Sticky nominal prices are at the heart of the debate between New Keynesians and the New Classicist economists. The implication of sluggishness in the response of nominal prices is that purely monetary shocks can generate real effects on the economy. However, the inclusion of a lack of responsiveness into economic theory has been criticised, as the assumption is inconsistent with any reasonable model of micro-economic behaviour. This has led to much theoretical and empirical investigation to help determine the reasonableness or otherwise of its inclusion.

Where nominal price stickiness is included, it has been demonstrated that monetary shocks will have a long run impact on output and consequentially unemployment, price levels and the interest rate. These in turn will impact the exchange rate and therefore the balance of trade. This implies that there are substantial policy implications that arise directly from nominal price sluggishness, including the impact of stabilisation policy on output and the output-inflation relationship. It can also affect the choices of exchange rate regimes, optimal currency areas and international monetary policy co-ordination. Further, if sluggishness is present, a government has the incentive to create unexpected inflation to try and reduce unemployment levels.

If the assumption of nominal sluggishness can be shown to hold, it calls into question, at least in the short run, the law of one price that underlies most international economic models. The law of one price propounds that a good will be sold for the same price in different countries once the price is expressed in a common currency unit. The inherent logic of this law is that arbitrageurs will exploit opportunities to extract profit from the price differentials, net of transport costs and trade taxes, forcing an adjustment to equilibrate prices between the countries. Substantial evidence has been presented, for example by Mann (1986), Dornbusch (1987), Baldwin and Krugman (1986) that even in the long run, unexploited arbitrage opportunities exist.

If the law of one price does not hold, then exchange rate movements may not be passed through in full to the consumer. The degree to which exchange rate changes are reflected in the prices charged by a firm in a foreign market is termed 'exchange rate pass-through'. The definition of exchange rate pass-through is normally taken to be the elasticity of price with respect to changes in the exchange rate. Krugman (1987) in analysing pass through suggested that this was due to firms only charging what the market would bear and termed this 'pricing to market'. Where the market would not bear a change in price in the short run, following an exchange rate change this is evidence that nominal price stickiness is prevalent in the market under review.

If exchange rate changes are not fully reflected in the selling prices of traded goods this will reduce the impact of currency realignments on trade balances, implying for example, that following a depreciation of a country's currency there would not be an automatic increase in the level of the exports. It would also have an effect on the rate of change in prices, the inflationary impact of a currency shock would depend on the extent of exchange rate pass through experienced by the economy. It further raises the issue, at a microeconomic level, of the type of market structure that is characterised by incomplete pass through as a profit maximising strategy for firms. Finally, it raises the issue of what is the optimal profit maximising strategy for a firm, given a market structure, when faced with different perceived exchange rate processes.

Consider a firm which exports a good manufactured in its home country to a third country. If the firm is profit maximising, it will optimise by selling its goods at the price where its marginal cost corresponds to its marginal revenue and the bilateral exchange rate will form part of its objective function. A change in the exchange rate will alter the level of the firm's costs and will shift its marginal cost curve. The extent to which this shift will adjust the price of the good depends on the market conditions. If the firm acts as a price taker, in a market that can be considered to be perfectly competitive, then it will not pass through the exchange rate change if it is the only firm affected by this change. However, if the firm has any degree of monopoly power, it will pass through a proportion of the exchange rate movement and this proportion will depend on the price elasticity of demand faced by the firm in the foreign market.

In the perfectly competitive market, the firm will respond to the exchange rate shock by adjusting the quantity of the good it sells at the market price or it will leave the market dependent upon its average total cost curve. Whereas in the monopolistic market the firm will not only adjust the quantity it sells but will also adjust price and therefore pass through a proportion of the exchange rate shock to its customers.

Accordingly, the analysis of pass through must consider the market form that is prevalent and then determine what other factors must be controlled for, in order to be able to evaluate the effect that exchange rate changes have on the market price of the goods. For example, if the market can be treated as perfectly competitive, but the exchange rate change affects not only the firm under consideration but all market participants, then this will cause a shift in the market supply curve and consequently the price that is taken by all suppliers will adjust. Therefore, even under conditions of perfect competition exchange rate pass through can occur.

Implicit to the previous analysis is that firms choose to set a price in every period and this is the optimal action. However, there are circumstances where this is neither practical nor optimal. This will occur, for example, where a firm has capacity constraints in its productive process and it is costly to alter the quantity of a good that is produced. A similar effect could occur where customers require the firm to set a price for a number of periods, or where it is costly to inform the market of changes in the price of the good. Under these circumstances there are effects that will cause a firm to adjust prices less frequently than every period, however it is not certain whether this delay will cause the extent of the exchange rate pass through to vary in the long run.

Where firms set prices for more than one period, this will induce stickiness in nominal prices. Modelling a multi-period price setting firm permits the underlying process that is governing the movement in the exchange rate to be included. In particular the optimal responses of the firm following a temporary or a permanent exchange rate shock can be derived.

The rest of this chapter will be laid out as follows: section 2.1 derives and discusses exchange rate pass through; section 2.2 extends the pass through analysis to a multi-period environment and introduces temporary and permanent exchange rate shocks; section 2.4 reviews the empirical evidence; and section 2.5 concludes.

2.2 Modelling Approaches to Exchange Rate Pass Through.

Exchange rate pass through is a measure of the extent to which prices in a firm's export market are adjusted following a change in the bilateral exchange rate. For a profit maximising monopolist it can be calculated as follows:

Writing the firm's maximisation problem for the foreign country in period t, as:

$$V_t = (p_t - s_t\phi_t)x_t, \tag{2.1}$$

where: V_t is the firm's profit, p_t is the price, s_t is the bilateral exchange rate, ϕ_t are the firm's constant marginal costs and x_t the firm's output in period t.

If price is the firms only decision variable, differentiating with respect to p_t and setting this equal to zero gives:

$$\frac{dV_t}{dp_t} = (p_t - s_t\phi_t)\frac{dx_t}{dp_t} + x_t = 0, \tag{2.2}$$

or,

$$p_t = \frac{s_t\phi_t}{1 - \frac{1}{\eta_t}}$$

where η_t is the absolute price elasticity of demand.

The extent of a price change following an exchange rate shock is given by:

$$\frac{dp_t}{ds_t} = \frac{\phi_t}{1 - \frac{1}{\eta_t}} \tag{2.3}$$

Accordingly, the exchange rate pass through is a function of the marginal costs of the firm and the price elasticity of demand in the export market.

This approach is taken by Knetter (1989), who derives a model of an exporter selling into a foreign destination. The model assumes that all markets are separable, and if demand, D, in an export market is considered to have the general form:

$$D = f(p)v \tag{2.4}$$

where v is a random variable that may shift demand, and f can be considered as a general demand response function.

Costs for the exporter in relation to any given export market are assumed to be given by:

$$C = C(D)\delta \tag{2.5}$$

where C measures cost in domestic currency units, and δ is a random variable that may shift the cost function.

The demand and cost expression used by Knetter are the functional equivalents of the terms used in (2.1) subject only to the addition of random shift variables on the demand and cost terms. The exchange rate term is included implicitly in the Knetter specification whilst it is treated explicitly in (2.1).

Knetter then states the exporter's profit function in each export market:

$$V = pD - C(D)\delta \tag{2.6}$$

Maximisation with respect to price yields the following first order conditions in each market:

$$p = C'\delta[\frac{\eta}{\eta - 1}] \tag{2.7}$$

where C' is the marginal cost of production and η is the elasticity of demand with respect to the local currency price in the destination market.

Equation (2.7) states that price is a function of the firm's marginal costs, the elasticity of demand in the destination market and the random shift variables. This extends the initial model (2.1) by allowing shift variables to be explicitly included in the firm's optimal price, but (2.7) incorporates the exchange rate into the firm's costs, pass through is not therefore explicitly derived in the paper. However, the pass through in Knetter's paper will be identical to (2.3) with the addition of the shift variables.

A similar approach, but with other demand variables given an explicit role, is taken by Feenstra (1989) in a paper that also considers the size and sign of the exchange rate pass through elasticity. Taking a firm exporting differentiated products, he assumes that demand is now in the form:

$$D = f(p,q,I) \tag{2.8}$$

where q is the composite price of alternative products and I denote expenditure on all varieties of the product.

If costs are assumed to be homogenous of degree one in factor prices and c^* denotes the aggregate of foreign factor prices, then costs can be written as:

$$C(D,c^*) = \phi(c^*)D \tag{2.9}$$

The firm's profit maximisation problem is therefore:

$$\max_p E\{spD(p,q,I) - \phi(D)c^*\} \tag{2.10}$$

where E is the expectations operator. If s^e is taken as the expectation of the exchange rate i.e. $s^e = E(s)$, and assuming that the variables other than the exchange rate are non-random, then the model can be re-written as follows:

$$\max_p \{s^e pD(p,q,I) - \phi(D)c^*\} \tag{2.11}$$

and the related first order condition is:

$$\phi'(D)(\frac{c^*}{s^e}) = p[1 - \frac{1}{\eta}] \equiv r(p,q,I) \tag{2.12}$$

where $r(p,q,I)$ is the marginal revenue. This also leads to the inversion where $p = \pi(c^*/s^e, q, I)$ and π is homogenous of degree one in its arguments, therefore if the arguments are all increased by the same proportion then the optimal import price would increase by the same proportion.

Totally differentiating the first order condition, (2.12) gives the pass through elasticity, φ, and letting $\mu = \frac{c^{\bullet}}{s^{e}}$, then:

$$\varphi = \frac{dp}{d\mu}\frac{\mu}{p} = \frac{1}{([\frac{\phi'' D}{\phi'}]\eta + \frac{r_p p}{r})} \qquad (2.13)$$

Therefore, the pass through elasticity gives the change in export price that is due to a change in the expected exchange rate or a factor price. This can be signed dependant upon the sign of the change in the price elasticity of demand with respect to a change in price; η_p. It is shown that:

if $\eta_p > 0, \phi'' > 0$,, then $0 < \varphi < 1$. (2.14)

but if $\eta_p < 0, \phi'' < 0$, then $\varphi > 1$. (2.15)

Whilst (2.14), is the usual case where the expected change in the exchange rate is less than fully passed through into price and would occur where for example demand is linear and marginal costs are constant or increasing, (2.15) will occur if the elasticity of demand is constant and the marginal costs are declining in output. It is therefore not possible to place a bound on the size of the pass through coefficient.

In a paper that can be considered an extension of the previous two papers, Feenstra, Gagnon and Knetter (1996) look at the implication of a firm's market share on pass through under the assumption of that products are differentiated. Given that firms act as Bertrand competitors with competitors prices taken as given, and that income, *I*, is fixed when determining optimal prices, the model is:

$$\underset{p}{\mathrm{Max}}(p - s\phi)D(p, q, I) \qquad (2.16)$$

The output *D* is dependent on prices of all substitutes, *q*, and the good, *p*, and income, *I*.

The first order condition they derive is:

$$p = s\phi[\frac{\eta}{\eta - 1}] \qquad (2.17)$$

and this is identical to (2.3). However, by assuming that each product has a finite reservation price at which demand is zero and that the demand function is well behaved in the neighbourhood of this reservation price, they analyse whether the firm is operating in a market where it commands a small or large market share. In the former case, by assuming that the price of the good of the firm is very close to its reservation price, they show that for a firm which has a very small market share, the pass through elasticity will be approximately half. As this corresponds to the case where the firm faces a linear demand curve this is a very strong result, it is also counter intuitive as a firm with a very small market share would generally be considered as a price taker in the market facing a horizontal demand schedule.

In the case that the firm has a very large market share, considered by assuming that the market for imported goods is equal or nearly equal to the total number of varieties under offer, and where income elasticities are unity, the pass through will approaching unity as the firm approaches a monopolist position.

These papers consider models that are very close in structure to the basic pass through model (2.1) and demonstrate that exchange rate pass through is a function of the price elasticity of demand in the destination market and the firm's costs. The amount of the competition to which the firm is subjected is also shown to play a role in determining the extent of pass through, where market share is taken as a proxy for competitive pressure.

Rather than assume, as the previous authors do, that markets are separable, Dornbusch (1987) permits completely flexible prices and the law of one price to hold. Accordingly, prices in any two countries can be represented, under the assumption that tariffs and transport costs are zero, by the following relationship:

$$p_i = sp_i^* \tag{2.18}$$

where p_i is the price of good i in the home country, p_i^* is the foreign price and s is the bilateral exchange rate. Using a Cournot model with a homogenous good in an oligolopolistic market and a linear demand function, the elasticity of the equilibrium price with respect to the exchange rate, φ, is shown to be,:

$$\varphi = (\frac{n^*}{N})(\frac{s\phi^*}{p_i}) \tag{2.19}$$

where $N \equiv n + n^* + 1$ the n domestic firms and n^* foreign firms in the market and ϕ^* are the costs that foreign firms incur in their home country currency.

The relative number of foreign firms in the market and their ratio of marginal costs to price directly affect the pass through elasticity. As these are both fractions, there will not be a full pass through exchange rate fluctuations and the elasticity term must be less than one. It can also explain, via the relative proportion of foreign firms, why pass-throughs close to zero and unity can occur, even in a market where there are fully flexible prices. This can be contrasted with the result of Feenstra (1989), who showed that the pass through range could extend beyond one by removing the restriction that the goods in the market were homogenous and not assuming that marginal costs were constant.

Dornbusch also considers the case of a sticky price environment by utilising the Dixit-Stiglitz (1977) model. As product differentiation is permitted under this scenario, each firm's maximisation will yield the familiar constant mark-up pricing equation. For a domestic firm this will be:

$$p_i = \frac{1}{z} c,$$

where z is the elasticity of substitution amongst the various consumer choice bundles and for a firm exporting into a foreign market it will be:

$$p_i = \frac{1}{z} sc^*.$$

The relative prices of home and foreign firms depend upon the relative marginal costs in a common currency. In the situation where costs are initially identical, the impact of an exchange rate shock on the industry price and the relative price will depend on the proportion of firms that are subjected to that shock. This implies that domestic firms will not change their home currency price, but exporting firms will pass through exchange rate changes. However, if this model is extended to allow for strategic interaction between firms, the interaction will have the effect of reducing the extent of the pass through. Therefore, the sticky price model with heterogeneous products has the same predictions as the basic model (2.1); firms pass through of exchange rate shocks is mitigated by the extent of competition in the destination market.

The drawback in the analysis provided by these papers is that it is static in nature, which as Kadyali (1997) states, implies that the exchange rate change is expected to be permanent. In a world of floating exchange rates, this is obviously hard to justify. The static model is also subjected to criticism by Ohno (1990) who shows in a simulation exercise that the firm's planning horizon affects the degree of pass through that it uses. Accordingly, the static, one period, framework will be extended to a multi-period environment and the response of a firm to an exchange rate shock will be considered.

2.3 Pass Through in a Multi-period Environment.

When setting price for more than one period, firms have to consider the implications of their actions on the profit that is generated in each subsequent period. Under these circumstances, following a temporary exchange rate shock, it might not be optimal to alter prices in the destination market.

Giovannini (1988) takes an infinite period perspective to price setting, where demand is a function of own price, *p*, the price of substitutes, *q*, and a vector of shift variables, *z*, and there is a corresponding demand function in the foreign market with variables denoted p^*, q^*, z^*. The cost function $C(D + D^*, W)$ is deemed to be an increasing function of total output and of a vector *W* of factor costs.

The expectation of demand at time *t*, with firms pre-setting prices on the information set available at *t-1*, is written ${}_{t-1}E(D_t)$. It is assumed that the exchange rate of the currency in which exports are set is fixed. Firms will maximise future profits, without discounting future income flows, as follows:

$$\underset{p_t^*, p_t}{Max}\ {}_0E\{\sum_{t=1}^{\infty} p_t D_t(p_t, q_t, v_t) + p_t^* D_t^*(\frac{p_t^*}{s_t}, q_t^*, v_t^*) - C(D_t + D_t^*, W_t)\}$$

(2.20)

First order conditions for $t = [1, \infty]$ are:

$${}_{t-1}E\{p_t D_t'(p_t, q_t, v_t) + D_t(p_t, q_t, v_t) - C'(D_t + D_t^*, W_t) D_t'(p_t, q_t, v_t)\} = 0$$

(2.21)

$${}_{t-1}E\{p_t \frac{p_t^*}{s_t} D_t^{*'}(p_t^* / s_t, q_t^*, v_t^*) + D_t^*(p_t^* / s_t, q_t^*, v_t^*)$$
$$- C'(D_t + D_t^*, W_t) D_t^{*'}(\frac{p_t^* / s_t, q_t^*, v_t^*}{s_t})\} = 0$$

(2.22)

and similar conditions can be derived where the export price is quoted in a foreign currency.

However, these conditions show that, in the words of Giovannini, 'Since no actions of the firm at time t has any effect on its future profits (beyond $t+1$), the first order conditions indicate that only the expectations of marginal cost and marginal revenue during period t matter in the firm's decision rules at the beginning of time t: there is no carry over from the past, nor any concern about cost or demand after period t. Indeed these decision rules are identical to those of a myopic firm which maximises profits period by period.' Giovannini (1988) page 49.

Although taking a multi-period approach, the model does not link the profit generated in a period with decisions made in a previous period which implies that the actions of the firm in a period will not have an explicit effect on the profit generated by the firm in future periods These links could include, a supplying firm's adjustment costs or consumer's switching costs. It is therefore not surprising that the optimisation is the same as in the static case and firms would react in the same manner to permanent and temporary shocks.

Froot and Klemperer (1989) explicitly link the performance of the firm between periods by use of an intertemporal market share factor. This device links the price charged by the firm in a period to the profits that could be generated in the subsequent period. Therefore, unlike the Giovannini (1988) paper where this explicit link was not made, pricing decisions have intertemporal consequences and firms will react differently to exchange rate shocks than they would have if there were no intertemporal effect. In particular, Froot and Klemperer (1989) show that there is a different reaction to exchange rate shocks that are perceived as temporary, than to those that are perceived as permanent.

Froot and Klemperer (1989) use a two period model to consider the situation where the actions in the first period have an effect on the profits generated in the second period, by assuming that the market share in the first period, σ, has a positive impact on the firm's sales in the second period. Total profits for the two periods in the foreign market can be written as:

$$\pi^* = s_t \pi_t^*(p^*, q^*, s_t) + \lambda s_{t+1} \pi_{t+1}^*(\sigma^*(p^*, q^*), s_{t+1}) \qquad (2.23)$$

where λ is the firms discount factor for profits generated in the second period. Assuming that the firm has constant marginal costs all of which are incurred in the home country and further assuming that the exchange rate and aggregate price level are given exogenously, then if price is the sole choice variable first order conditions are:

$$\frac{d\pi^*}{dp^*} = s_t \frac{\partial \pi_t^*}{\partial p^*} + \lambda s_{t+1} \frac{\partial \pi_{t+1}^*}{\partial o^*} \frac{\partial o^*}{\partial p^*} \qquad (2.24)$$

As the lower price will increase the firm's market share in the first period, and assuming that a larger market share will increase the firm's second periods profits, firms will choose a lower price level than if market share had no value. The effect of an exchange rate change can be analysed by totally differentiating (2.24).

It is shown that the effect of a temporary appreciation of the currency is for period *t*:

$$\frac{dp^*}{ds_t} = -\phi_t \left(\frac{\partial p^*}{\partial \phi_t}\right) - \lambda s_t \left(\frac{\partial p^*}{\partial s_t}\right) \qquad (2.25)$$

and for a future temporary appreciation of the currency in *t+1*, it is:

$$\frac{dp^*}{ds_{t+1}} = -\phi_{t+1}(\frac{\partial p^*}{\partial \phi_{t+1}}) + \lambda s_{t+1}(\frac{\partial p^*}{\partial s_{t+1}}) \qquad (2.26)$$

where ϕ is the marginal cost for the period.

The effect of a permanent exchange rate change is the sum of (2.25) and (2.26):

$$\frac{dp^*}{ds_t} + \frac{dp^*}{ds_{t+1}} = -\phi_t(\frac{\partial p^*}{\partial \phi_t}) - \phi_{t+1}(\frac{\partial p^*}{\partial \phi_{t+1}}) \qquad (2.27)$$

the currency effects will cancel and accordingly a permanent currency appreciation will lower prices more than a temporary one.

The pass through following a permanent exchange rate shock, is the same as it would be in a one period model. A temporary shock is not treated in the same manner by firms because it also has an impact on the relative value of the profits in each period. Accordingly the pass through following a first period temporary shock will be reduced, whereas it would be increased following a expected second period temporary shock. However, this latter reaction can be seen as a consequence of the model structure. There is no link in the model between the second periods price and a third or subsequent periods profits, this link would have an impact on the second periods pass through and consequently would change the conclusions drawn in the paper.

Gross and Schmitt (1999) build on the Froot and Klemperer (1989) model and show that with switching costs, under a two period pricing scenario, that a change in the exchange rate in the first period has an effect on the price that is charged in the second period. This is because the firm will not only take account of the first periods profit effect but will also consider the demand curve's properties in the second period and maximise the total discounted profit of the entire period. However, this is a model in which prices are fixed for two periods, firms do not have the discretion to amend prices at the end of the first period. This will be explored in Chapter 3.

Whilst the previous papers focused on the demand side, Krugman (1987) uses supply side conditions and considers the case where it is costly to expand or contract a sales force. Under this scenario, a firm will be prepared to accept temporary changes in its optimal profits rather than incur the salesforce cost for what it considers a temporary movement in the exchange rate. Baldwin (1988) also found that this hysteresis played a role in limiting exchange rate pass through when capacity constraints were faced by a firm.

The role played by non-recoverable fixed costs of entry and exit is considered by Dixit (1989), in a competitive industry with established home and foreign firms. In this model when the real exchange rate follows a random walk he concludes that hysteresis can be seen to effect the market by mitigating firms actions at the margin. Accordingly a large enough exchange rate shock, even if it is only temporary, can have permanent effects on the level of imports and the degree of pass through.

It has been demonstrated that when the period for which a firm sets its price is increased, firms will react differently to permanent and temporary exchange rate shocks. Temporary shocks are shown to be either not passed through at all or not passed through fully. Consequently, nominal prices in the destination market will be sticky when firms do not perceive shocks to be permanent.

In conclusion, the analysis of static models has demonstrated that exchange rate pass through of less than unity will occur when a firm is subject to competitive pressures. An extension of the price setting period allows the underlying exchange rate mechanism to be introduced into the model and in particular permits permanent and temporary shocks to be analysed. However multi-period discretionary price setting models have not been considered and these will be examined in Chapter 3.

2.4 Empirical Testing.

2.4.1 Introduction

The empirical testing of the pass through relationship can be split two broad areas; work such as that carried out by Mann (1986), Dornbusch (1987) and Krugman (1987), which looks at how broad indices react and offers evidence of how economies react following exchange rate shocks; and work using disaggregated data sets that investigates how industries pass through exchange rate shocks.

Additionally, it has been found that the country from which goods are exported, which is termed the source country, or the country into which the goods are sold, termed the destination country, can have explanatory effects when specifying the pass through relationship.

This section will review the approaches that have been adopted to test pass through and will then detail and comment on the results that have been reported. Finally, the testing of source and country effects will be reviewed to determine the role these variables have in explaining pass through.

2.4.2 Econometric Modelling Approaches.

The first body of tests to be considered uses a broadly descriptive approach; these include papers by Mann (1986) who plots predicted and actual non-oil imports and exports. The prediction is based on a multilateral exchange rate, a lagged commodity price index and a trade weighted foreign consumer price index. The work provides some evidence that foreign suppliers into the United States used their profit margins to absorb the large fluctuations in the U.S. dollar during the 1980's. Whereas the results on exports indicate that an increase in the value of the dollar caused exporters from the U.S. to price more competitively on international markets.

A similar approach is taken by Dornbusch (1987) who finds an indication of pricing to the American market and also Krugman (1987) who concludes that U.S. import prices fell too little in the period 1980-1984, and that the overall level of pass through in the U. S. market is 0.32 of the real exchange rate movement.

Froot and Klemperer (1989) use in their words 'a crude but informative test' of pass through. Whilst not testing that the time series under review were stationary, by using differenced data they should have reduced the series they test from I(1) non-stationary series, to I(0) i.e. stationary series. The dependent variable they employ is the change in exporters' prices to the

United States and Japan. The independent variables are the expected future depreciation of the U.S.-Japanese exchange rate, which is based on survey data, and the contemporaneous change in the real exchange rate. These are tested over a number of industries, superscripted 'i'.

$$\Delta p_t^{i,UK,US} - \Delta p_t^{i,UK,Ja} = \beta_1 \Delta_t E(\Delta s_{t+1}^{US,Ja}) + \beta_2 \Delta s_t^{US,Ja} + u_t^{i,US,Ja} \qquad (2.28)$$

The coefficient β_1 measures the degree of pricing to market that occurs in response to an expected future depreciation, whereas the coefficient β_2 measures the effect of a permanent depreciation. Static models would predict that β_1 should be zero. $\beta_1 - \beta_2$ gives the pass through from a current depreciation that is expected to be temporary.

The statistically significant estimates of β_1 are always positive which implies that a higher expected dollar depreciation generates an increased price in the U.S. relative to other markets. However in only one of fourteen regressions was the value of β_2 statistically different from zero, which would imply that permanent exchange rate changes are fully passed through.

This paper provides further evidence that pass through is occurring but the limitations in the econometric approach[1] do not permit further inferences to be

[1] If for example, the data series were not uniformly I (1) but contained an I (2) series, the presence of the I (1) series which would remain after differencing leaves the problem of potential spurious regression in the reported results.

drawn from the results. Richard Marston (1990) adopts the same econometric approach when considering Japanese manufacturing companies and also finds evidence that they employ pricing-to-market.

This body of tests can only provide indicative evidence of pass through, which is found to be present. However, the finding by Mann (1986) that lags occur in the price setting process and the evidence of Froot and Klemperer (1989) that temporary shocks have an impact on the price setting process, provides support for the hypothesis that firms do not set price myopically. The theoretical approach discussed above is based on the reaction of firms to exchange rate shocks and the remaining empirical work focuses on this issue.

In a survey, Menon (1995) found that all but 4 of 78 estimates of pass through had been undertaken using Ordinary Least Squares methods without considering the time series properties of the data. In the testing of pass through, asset prices and macroeconomic series are used, and, as a large number of these have been found to be non-stationary, the problem of spurious regression is a substantial possibility. As these issues are not addressed within their papers, the results of authors such as Cowling and Sugden (1989), Ohno (1989), Spitaeller (1980), Kreinin (1977) and Robinson et al (1979) will not be reviewed in detail. However this body of work suggests that there are some important questions to be addressed namely: there is evidence in the paper of Spitaeller (1980) that there is a difference in the response of imports and exports to an exchange rate shock; the timing of the response is important, in particular there appears to be a significant difference between the short run and the long run response of prices Spitaeller (1980) and Robinson et al (1979); and finally there is a difference in the pass through coefficients of between countries, smaller open economies exhibiting a larger degree of pass through than large relatively closed economies Spitaeller (1980), Kreinin (1977) and Robinson et al (1979).

Athukorala and Menon (1994) consider pricing-to-market behaviour by Japanese exporters. The authors note that the variables are mainly I (1), and when they are unable to find existence of any cointegrating relationships their response is to utilise the ordinary least squares method in levels despite working with non-stationary data, as opposed to modelling the differenced stationary variables. They recognise that this might give results that are subject to spurious regression but state that the diagnostic results do not identify this as a potential problem. However, the inability to find cointegrating relationships between the variables lends support for the argument that spurious regression is a problem and their results should therefore be treated with caution.

For series to be cointegrated, their long run properties must be comparable, and they will be linked over time. The difference between the series will be stable even though they may contain stochastic trends. Cointegration therefore implies that there is a long run equilibrium to which the economic system converges over time.

In testing data that is potentially non-stationary, i.e. contains a stochastic trend, it is necessary to transform it initially into a stationary series. The process of transforming the series is accomplished by taking first differences of the series. The number of times a series has to differenced in order to produce a stationary series is called the order of integration of the series. Providing series are integrated of the same order, if when they are regressed together they generate an error term that is stationary, the series are said to be cointegrated and the resulting coefficient estimates will be the long run or equilibrium relationship.

The question of causality must also be addressed. The explanatory variables might not all be exogenous and there might exist further cointegrating relationships between the variables. If a single equation approach is taken, the resulting coefficients on the variables of interest will not be efficient unless they are all weakly exogenous. The method that is usually adopted is to follow Johansen (1988,1991) and set the variables into a Vector Error-Correction Model where each variable is regressed against every other variable in the system and lags of the variables. By testing for the number of cointegrating relationships that exist, a system can be formulated and tested that is efficient and provides estimates of the short and long run coefficients.

In a paper on Swedish machinery exports, Athukorala and Menon (1995), test and find that the series under investigation are I (1), they adopt the Phillips-Hansen (1990) technique. Though noting that the Johansen (1988) technique is theoretically superior, the lack of information on its small-sample properties and the sensitivity of results to choice of lag length, are the reasons given for not adopting it.

An error correction approach is taken. The long run relationship was determined by running the following model under ordinary least squares in logs:

$$p = \alpha + \gamma dp + \beta q + \beta s + (1-\beta)c + u \qquad (2.29)$$

where dp is demand pressure, proxied by an index of new orders.

The error correction model is specified as:

$$\Delta p_t = \alpha + \sum_{j=1}^{n} \phi_{1t} \Delta p_{t-j} + \sum_{j=0}^{n} \phi_{2t} \Delta \zeta_{t-j} - \mu ec_{t-1} + u_t \qquad (2.30)$$

where $\xi = (dp, q, s, c)$,

ec is the error correction term from the long run relationship.

As a consequence of the method adopted consideration was not given to the number of cointegrating vectors that could exist in the system. The authors implicitly assume that there is only one, but do not test to confirm that all of the variables are weakly exogenous. Neither do they address the problem raised by Inder (1993) that the Phillips-Hansen technique does not account for the dynamic adjustment process.

Dwyer and Lam (1995) when modelling imports into the Australia also adopt an error correction model approach. They consider pass through at two stages; the first is the initial import to the docks, and the second is from the docks to the final consumer.

To test first stage pass through they utilise the following model:

$$\begin{aligned}\Delta p_t &= \alpha + \sum_{j=1}^{k-1} a_{1j}\Delta p_{t-j} + \sum_{j=0}^{k-1} a_{2j}\Delta s_{t-j} + \sum_{j=0}^{k-1} a_{3j}\Delta q_{t-j} \\ &\quad + \beta_1 p_{t-1} + \beta_1 s_{t-1} + \beta_1 q_{t-1} + u_t\end{aligned} \tag{2.31}$$

The testing of the second stage pass through is conducted under the same framework. However, they do not report whether they tested the order of integration of the series at either stage, nor do they formally test whether cointegration is present relying on the significance of the error correction term in an unreported error correction model as an indication of the existence of cointegration. Whilst the presence of a significant error correction term is indicative of cointegration, the lack of testing for endogeneity or the number of cointegrating vectors, could lead to inefficient reporting of variables.

Gross and Schmitt (1996) consider exchange rate pass through into the Swiss automobile market. They formally test the order of integration of each of the time series and find that they are either of order one or two, with the exception of Japanese medium sized cars which is I (0). They adopt an error correction modelling approach and use the Engle-Granger (1987) two-step procedure. The long run relationship is specified as:

$$p_t = \alpha + \beta q_t + \gamma_o c_t + \gamma_1 s_t + u_t \tag{2.32}$$

All the variables being in logs.

A differenced equivalent of (2.32) is then tested to consider the short run with the addition of an error correction term. However, consideration is not given to the number of cointegrating vectors, one cointegrating vector being implicitly imposed by the authors. The Engle-Granger two-step procedure is subject to small sample bias and the results are based on a sample of fourteen years. Further, inferences cannot be drawn using standard t-statistics on the significance of the parameters in the long run model.

Swift (1998) models the pass through behaviour of Australian exporters. After testing the time series properties of each of the series and finding them to be of order one, the Johansen maximum likelihood procedure was adopted (Johansen 1988, 1991). Accordingly, he tests what is the appropriate number of cointegrating vectors for the system, which he finds to be one. Restrictions are then placed on the cointegrating vector to determine the appropriate long and short models. The unrestricted model tested was:

$$p = \alpha + \beta s + \gamma q + \psi dp + u \tag{2.33}$$

and a differenced version of this with the addition of an error correction term was utilised for the short run. The test was on the impact of exchange rate changes on Australian export prices and the long run model found the pass through coefficient to be about 0.6. Unfortunately, this model only looks at broad aggregate response and does not consider individual product or industrial markets.

Gross and Schmitt (1999) also use the Johansen maximum likelihood procedures in testing the Swiss automobile industry. The short run parameters were modelled using the following relationship:

where $k = \{1 \ldots n\}$ are the competitors in the market.

$$\Delta p_t = \alpha + \Delta c_t + \Delta s_t + \Delta q_t^k + ec_{t-1} + u_t \qquad (2.34)$$

Accordingly, in the long run the change in price is a function of the change in the firm's costs, the exchange rate and the reaction of competitors' prices. In the short run, the price adjustment also takes into account whether the firm was away from its equilibrium price in the previous period.

In conclusion, the vast majority of the studies have employed methodologies that have severe limitations. Where these limitations are not apparent, for example in the papers by Dwyer and Lam (1995), Swift (1998), the results reported are at the broadest aggregate level and therefore there has only been a limited number of industry level testing that is free of econometric concerns. There is therefore a need for further empirical work to consider the issue of pass through at a disaggregated level, and to provide greater depth to the body of reported results. In particular to focus on the short run and the long run response of prices to exchange rate shocks and consider why there is a difference in the pass through coefficients between countries.

2.4.3 Summary of the Empirical Results using a Time Series Approach.

Mann (1986) takes unit values for U.S. non-oil imports and exports and compares them with the change in exchange rates and a predicted level of import and export prices. It indicates that only 60 percent of exchange rate movements are passed through into U.S. import prices, whilst 75 percent are passed through into U.S. export prices. Additionally there appeared to be a lag in response to exchange rate movements of up to 2 years, which implies that firms use their profit margin to smooth out the effects in the short run.

The pass through coefficients for each of the principal empirical studies that adopts a time series approach is recorded below, together with the name of the author, and the period, country and product group that was investigated. Whilst the theoretical exchange rate pass through coefficient has been shown to take positive values, by the construction of the exchange rate variable in most empirical studies, the positive theoretical value will take a negative empirical value, i.e. for the exchange rate variable only all of the theoretical results are reversed in the empirical discussions, results will be reported in this empirical format.

Author and Study Date	Period of Study	Country of Study	Industry	Pass Through Coefficient	't'-stat.
Marston 1990	1980-1987	Japanese Exports	Small Passenger cars	-0.517	10.6
			Passenger cars	-0.952	12.6
			Small trucks	-0.065	1.68
			Trucks	-0.406	10.4
			Motorcycles	-0.570	7.49
			Tires and Tubes	-1.03	9.69
			Agricultural Tractors	-0.492	4.98
			Construction Tractors	-0.847	9.09
			Colour Televisions	-0.509	6.22
			Tape Recorders	-0.950	7.91
			Tape Decks	-0.588	5.50
			Record Players	-0.0876	6.70
			Amplifiers	-1.11	6.61
			Magnetic recording tape	-0.872	4.96
			Microwave ovens	-0.278	2.94
			Cameras	-0.088	1.49
			Copying Machines	-0.507	4.14
Athukorala and Menon 1994	1980-1992	Japanese Exports	Textiles	-0.860	3.389
			Chemicals	-0.517	8.374
			Metal products	-0.322	2.693
			General Machinery	-0.539	25.60
			Electrical Machinery	-0.451	8.772
			Transport Equipment	-0.395	7.150
			Miscellaneous products	-0.434	8.343
			Total Manufactures	-0.212	3.431
Athukorala and Menon 1995	1977-1990	Swedish Exports	Total Machinery and transport equipment	-0.256	12.80
			Non-electrical	-0.191	5.457

			machinery		
			Electrical machinery	-0.524	7.820
			Transport equipment	-0.170	8.718
			Motor Vehicles	-0.181	8.619
Gross and Schmitt 1996	1977-1991	Swiss Car Market	French Small cars	-0.172	2.20
			German Small cars	-0.100	0.90
			Italian Small Cars	-0.360	3.80
			Japanese Small cars	-0.368	6.50
			Belgian Small cars	0.016	0.20
			French medium cars	-0.634	2.80
			German medium cars	-0.017	0.10
			Italian medium cars	0.292	0.60
			Japanese medium cars	-0.671	4.0
			Belgian medium cars	0.051	0.30

Marston (1990) considered Japanese exporters, finds pass through coefficients that vary from 1.03 for tires and tubes to 0.09 for cameras. This implies that if the exchange rate depreciates by 10% then camera manufacturer would reduce prices by 0.9%, whereas tire and tube manufacturers would reduce prices by 10.3%. This range is obviously very large and implies that there are substantial industry differences. Athukorala and Menon (1994) also consider Japanese companies, whilst the range of responses they find is smaller varying from 0.2 for total manufactures to 0.86 for textiles, this could be due to the higher level of aggregation in their sample. However the mean response from both studies is approximately 0.5, i.e. half of the exchange rate movements are reflected in price changes.

In their study of Swedish exporters, Athukorala and Menon (1995) find a range of responses, from 0.52 for the electrical machinery industry to 0.17 for the transport equipment industry. Whereas the Gross and Schmitt (1996) study of Swiss motor vehicle imports, found pass throughs ranging from positive 0.29 for Italian medium sized cars to negative 0.67 for Japanese medium sized cars.

The number of countries for which long run results have been obtained is small and unfortunately, the results are not directly comparable between the studies. Additionally, there are some concerns in relation to the empirical methods used for most of the studies reported. However, the studies support the conclusion of the earlier more broadly based studies, that pricing to market is prevalent in the countries tested.

In conclusion, the earlier studies offered support to the hypothesis that firms passed through a proportion of exchange rate shocks into export prices. However, the later study by Gross and Schmitt (1996), provides evidence that pass throughs which are insignificantly different from zero are also occurring. This latter phenomenon has not been considered and will be addressed in Chapter 4.

2.4.4 Country Specific Effects.

2.4.4.1 Introduction.

Where country specific effects occur, the behavioural aspects can be used to model the impact of exchange rate fluctuations on bilateral and multilateral trade. It was Mann (1986) who first highlighted that foreign importers into the United States appeared to adjust their profit margins to mitigate the impact of exchange rate changes, whereas this effect could not be found when considering US exporters. This indicates that source and destination country effects have a significant impact on trade with and by US companies.

The studies in this area all focus on the pass-through of exchange rate fluctuations to prices and additionally consider whether a variable to account for country specific effects should be included. There are two variants: source country effects arise when all exports from a country have the same or similar level of pass-through; destination country effects arise when all exports to a particular country exhibit the same or similar levels of pass-through.

Whilst several authors test for country specific effects, there is no formal theoretical underpinnings in any of the papers. One approach taken is, as in Knetter (1989), to add a term in the empirical model to try and capture the effects that are specific to the country. Accordingly, the model tested becomes:

$$p_{it} = \alpha_t + \lambda_i + \beta_i s_{it} + u_{it} \tag{2.35}$$

where λ is the country specific variable.

The other approach, which is used in Knetter (1993), is to test the pass-through coefficients for each country and then run diagnostic tests to determine whether they can be treated as being the same value.

2.4.4.2 Empirical Approach and Discussion of Results.

Knetter (1989) uses a panel data approach in which price is regressed against a constant, a set of time effects and a set of country effects. However, consideration is not given to the time series properties of the data, which as discussed above, have generally found to be integrated of order one and therefore non-stationary, accordingly care must be taken in drawing inferences from the results. The sample period is 1978 to 1986 for US exports and 1977 to 1985 for German exports. The product groups were selected on the basis that there were significant export volumes between the countries.

In Knetter (1989), in each of ten separate destinations, country effects were almost all significantly different from zero. Further, F-tests for the inclusion of country effects in the model are overwhelmingly significant for every industry. It was also found that US exporters adjust their prices in a manner that amplifies the exchange rate effect. This can be compared with ten German export industries where it was found that they tended to stabilise dollar prices in the US market. However, the US market appears to be the only national market where this price stabilisation is seen.

A panel data approach is also adopted in Knetter (1993), this time using differenced data for the period 1973 to 1987. The markets tested are selected industrial groups for German, Japanese, US and UK exporters. Significantly, an F-test of identical pass through of exchange rate across destinations is rejected. Additionally, comparisons of source country behaviour within common industries indicate little evidence of differences in behaviour. This study, which encompasses the sample period of his 1989 paper, rejects the previously reported results and is probably due to using stationary data in the later work.

The 1993 study reports that German, Japanese and UK export industries exhibit more local currency price stabilisation than US industries, but when exact matches of industries between countries can be found then industrial effects seem to dominate. As evidence could not be found that national markets were treated differently, destination specific mark-up adjustments might be the same for all countries. Additionally, the hypothesis of identical export price adjustment behaviour across all industries within a source country can be rejected for the US and the UK but not for Germany or Japan.

Gagnon and Knetter (1994) take a time series approach to the consideration of automobile exports for German, Japanese and US exporters. Whilst adopting the Engle-Yoo three stage procedure to obtain their long run estimates they do not formally consider whether there is a cointegrating relationship between the variables nor the number of cointegrating vectors that are present. The paper notes that there are substantial differences in the extent of pricing-to-market across source countries but evidence is provided that, within the automobile industry, producers from different source countries behave differently. In particular, a comparison of short-run and long-run behaviour indicates that pricing-to-market on exports to the US and Canada is typically greater in the short-run than in the long run whereas this is reversed in respect to other tested destinations. One explanation given for this is the impact of invoicing in respect to home as opposed to export market currency. It was also found that the results should be controlled for are the existence of offshore production facilities, non-tariff barriers and the intensity of competition.

Feenstra, Gagnon and Knetter (1996), find that whilst source and destination country effects are important in some markets they are not important in all markets. This can be compared to Gross and Schmitt (1996), who show that pricing behaviour differs across source countries in the absence of quantity restrictions and after allowing for the location of production facilities. This implies that country specific factors play an important role in the automobile industry, but they conclude that foreign producers are very sensitive to price rivalry and therefore the intensity of competition might be the most important explanatory variable.

In their 1995 paper Gagnon and Knetter note that there are substantial differences in the extent that pricing to market occurs across source countries, whereas Gross and Schmitt (1996) where unable to find similarities in pass through among source countries. However, they do state that their test is at a broad industry classification and a more disaggregated level might produce different results.

In conclusion, whilst there is frequent mention of source and destination country effects in the literature, the empirical testing has a mixed response in locating the extent of country specific effects and determining whether they can be found at a product or industry level. Further work is therefore required, particularly at a disaggregated level of industrial grouping, to provide additional evidence on the existence or otherwise of country specific pass-through effects.

2.5 Conclusions

In the debate on the occurrence of nominal price stickiness, exchange rate pass-through at levels below one hundred percent should intuitively provide evidence of its existence. However as shown by Dornbusch (1987) and Knetter (1989), amongst others, the less than full pass-through of exchange rate changes is perfectly rational and optimal behaviour for firms that are operating in a less than perfectly competitive market.

Theoretical examples of hysteresis, as demonstrated by Dixit (1989), where there are large non-recoverable costs of entry or exit from market, do provide evidence that nominal price sluggishness could occur under prescribed circumstances, which can also include the costly expansion of a sales force or capacity constraints. This rigidity in nominal prices is evidenced by the failure to detect Purchasing Power Parity, even in the long run.

Where prices are set for more than one period, it is shown that firms will react differently to permanent exchange rate shocks than they will to temporary shocks. However, the literature does not comment on the implication of the size or duration of the temporary shock or consider the possibility that firms setting multi-period prices can have the discretion to alter the prices before the end of the pricing period.

The empirical work undertaken to date is limited in the number of countries and product lines that are tested and suffers from a lack of a thorough consideration of the time series properties of the underlying data series and their equilibrium relationships. Additionally, the level of disaggregation that has been achieved in the selection of product groups is also limited with consequent problems such as aggregation bias having to be taken into account. Accordingly, further work with disaggregated data would enhance the literature.

Finally, the results that have been obtained in connection with country specific exchange rate pass-through have been mixed. Some success has been achieved in finding evidence that firms do respond to source country or destination country effects, however all authors working in this area have not found this evidence. Further empirical work is therefore needed to provide a greater pool of results from which more informed conclusions can be drawn.

Chapter 3.

The Implications of Multi-period Pricing on Exchange Rate Pass Through.

3.1 Introduction.

As discussed in Chapter 2, theoretical models of exchange rate pass-through have taken one of two approaches, either they have looked at a static optimisation problem, such as those by Knetter (1989) and Marston (1990), where a profit maximising firm optimises for the current period and the effects of an exchange rate surprise on the optimal price are considered. Alternatively, dynamic elements are introduced into the framework. Froot and Klemperer (1989) use market share as a link between periods, and show that the price the firm will optimally charge is lower than in standard models of international competition. Further, as is also shown in Kasa (1992), responses to permanent exchange rate shocks are passed through into prices whereas temporary shocks are shown to have an ambiguous effect on prices depending on whether the real interest rate[2] or cost[3] effects dominate.

Gross and Schmitt (1999), build on this framework solving a two period oligopoly game, and show that when buyers have switching costs, a change in the exchange rate in the first period does have an effect on the price that is charged in the second period.

As discussed in the previous chapter, neither of these approaches offer an explanation of positive pass through of exchange rate shocks nor of finding that was also made by Gross and Schmitt (1996), that the exchange rate pass through can be insignificantly different from zero. The thrust of the theoretical work to date has identified reasons for a less than full pass through of exchange rate shocks, but has not developed a rationale for the optimal response for a company to be one of not passing through any of the shock into prices.

In addition, it is found when considering product line prices as in chapter 4, that these prices appeared to be fixed for many months. It seems appropriate under these circumstances to develop a model where price setting can be for more than one period, where a period is defined as the minimum time it takes

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[2] The real interest rate effect adjusts the future profit streams for changes in the exchange rate between years and for the firm's discount factor on income in future periods.
[3] The cost effect is the change in optimal price for a given change in the firm's costs.

a firm to react to a shock. In this framework firms will consider the size and duration of the shock when adjusting prices

This multi-period approach addresses one of the problems raised by the empirical studies. Moreover, Carlton (1986), Cecchetti (1986), and Danziger (1987) highlight that firms often set prices for more than one period. More recently, Kashyap (1995) considered the frequency of price changes in U.S. retail catalogues, which are probably an extreme case of price rigidity, and determined that the average number of months between price changes for the products that were tested was 15 months. All of this provides further support to the multi-period framework.

The existing 'multi-period' models only extend to two periods for example Froot and Klemperer (1989), Gross and Schmitt (1999), which does not permit a detailed consideration of the impact of the timing of exchange rate shocks on the firm's pricing response. The question of period lengths has not been discussed in detail and has just been defined as the minimum period that it takes a firm to adjust prices. This is self-evidently firm specific, but for the products that form the sample tested in chapter 4, each would require a minimum period in excess of one month to notify the publisher of the 'price list' which acts as the source of information to the retailer of the product.

In addition, there will be products for which there are extended contractual periods which might run for as long as one year, or where manufacturers have to notify distributors and the public of changes with associated abnormal costs. Accordingly, the ability of firms to react instantaneously to exchange rate shocks is frequently negated and the question of how a firm will react when a shock occurs mid-period must be addressed.

Consider, for example, that a temporary exchange rate shock occurs in month one, the exchange rate alters and then reverts to its expected value before the firm is able to adjust its prices. In this situation the firm will not adjust its price at the first available opportunity; the start of the month two. This is not a trivial situation, the temporary shock could last for several months, but the firm cannot react to it and therefore mitigate the consequential change to its profits.

A theoretical model will therefore be constructed for both two and three periods allowing consideration of the impact that temporary and permanent exchange rate shocks have on a firm's optimal price. It will also enable an analysis to be carried out of whether the timing of these shocks has an impact on a firm's optimal pricing rule. The model will be based on a model by Ball and Mankiw (1994), which showed that under specific assumptions, firms will adjust prices asymmetrically dependant upon whether a demand shock is positive or negative. This asymmetry is demonstrated to be present in a Ball and Mankiw style model which has been extended to allow a firm to export its goods and where the shocks are related to the exchange rate. Finally, the extended model provides a rationale for zero pass through of exchange rate shocks.

The remainder of this chapter is organised as follows: in sections 3.2 and 3.3 a multi-period pricing model is derived based on a model specified by Ball and Mankiw (1994); section 3.4 considers the impact of temporary and permanent exchange rate shocks on this model; section 3.5 extends the model to allow a trend inflation term to be included; 3.6 compares the results of this model to the existing theoretical and empirical literature; and section 3.7 concludes.

3.2 The Ball and Mankiw Model.

To consider multi-period price setting, a simple two-period model will initially be used. The model will build on the framework developed by Ball and Mankiw (1994), in which a firm has a desired price relative to its competitors in a market in which there is a steady inflation rate. The model permits a price adjustment without additional cost every second period, and consequently the firm sets prices for two periods. However, the commitment of the firm to maintain this price is not absolute and it can make an adjustment to the second period price by paying an additional menu cost. This specification contains elements of both time and state dependent price adjustment which, as the authors comment, is realistic to combine as it corresponds to pricing practice in a number of settings including retail and wholesale catalogues.

They consider a single firm whose desired relative price, in logs, is θ. The firm's desired nominal price is $p+\theta$, where p is the log of the aggregate price level. It is assumed that the steady inflation rate, π, is exogenous and accordingly the price level at period t is $p_t = \pi t$. The firm's pricing rule is to observe θ for the first period and then set a price for that period and the following one. If the firm decides to adjust the price in the second period it must pay the menu cost C. It is further assumed that there is no discounting of future income streams and, so that firms will adopt two period pricing, that the menu cost is greater than the loss the firm incurs by not pricing at the optimal price in each period.

If the desired relative price in period nought is zero and it is assumed to remain constant, then the price that the firm will set for the period nought is zero and for period one it will be π. The two-period price will therefore be $\pi/2$ which is the average of the optimal price for each individual period. Following a surprise in period one, the firm's new desired relative price will be θ' and this would generate a potential adjustment to the two-period price. The price entering period one is $\pi/2$ but the *ex post* optimal price is $\theta' + \pi$, the desired adjustment is therefore $\pi/2 + \theta'$.

This will produce an asymmetric response from the firm as the inflation element of the price is a positive number and the absolute value of the potential adjustment must be larger for positive θ' than for negative θ'. Taking the loss function of the firm as the square of the difference in the actual and the desired price plus the menu cost, when it is payable, they show that the firm will not adjust price when:

$$\theta' \in [-\sqrt{C} - \frac{\pi}{2}, \sqrt{C} - \frac{\pi}{2}]$$

As the range is asymmetric with the lower bound larger in absolute value than the upper bound, this will induce stickiness in prices when the firm faces negative shocks, whereas small positive shocks are likely to trigger price adjustments.

3.3 Extension of the Ball and Mankiw (1994) Model to allow for Exchange Rate Pass Through.

Extending the model to include specific functional forms for both the demand and the cost functions and permitting the firm to operate in more than one country, allows the framework to provide intuition into the action of firms when they are faced with changes in the exchange rate after they have adopted a multi-period pricing rule. Initially a simple model will be used, in levels rather than logs, which does not incorporate a trend inflation element and this will be subsequently augmented to make it compatible with the Ball and Mankiw model to determine whether their insights still hold.

Considering a firm facing a linear demand curve in its foreign market and given that its costs are composed of constant marginal costs, then the profit maximisation problem for the sales in the foreign country for the firm can be written for period t as:

$$Max.\ V_t = (p_t - \phi_t)x_t, \text{ with respect to } p_t. \tag{3.1}$$

where: V_t is the firm's profit, p_t the price, ϕ_t costs and x_t the sales in period t. The assumption of constant marginal costs means that the sales decision in any two markets are independent, provided the markets are segmented.

In the linear demand case, the sales of the firm is given by:

$$x_t = a - bp_t, \tag{3.2}$$

Taking the derivative of the firm's profits with respect to its own price and setting this equal to zero gives:

$$\frac{dV_t}{dp_t} = a - 2bp_t + b\phi_t = 0 \tag{3.3}$$

Noting that the second differential is negative, the optimal price, which generates the maximum profit for period t, will be:

$$p_t^o = \frac{a}{2b} + \frac{\phi_t}{2} \tag{3.4}$$

and substituting $t+1$, for t the optimal price for $t+1$ will be:

$$p_{t+1}^{o} = \frac{a}{2b} + \frac{\phi_{t+1}}{2} \tag{3.5}$$

This is the standard result for a firm setting price for one period. As the firm is optimising based on the response of consumers in its export market it is assumed that it will use the currency of export market in its optimisation routines. Whilst costs of manufacture are assumed to be constant marginal costs, they will have to be converted into the currency of the foreign country and will alter as the bilateral exchange rate fluctuates.

3.3.1 A Two-Period Pricing Model.

Following the Ball and Mankiw pricing rule and setting price for two periods gives a two-period price in the following form:

$$\hat{\hat{p}}_t = \frac{p_t + p_{t+1}}{2} = \frac{2a + b\phi_t + b\phi_{t+1}}{4b} \tag{3.6}$$

It is now possible to consider the case that having set a price for periods t and $t+1$ costs change to $\phi_{t+1}^{'}$ in period $t+1$. If the firm does not change its price then its revised profit for period $t+1$ will be:

$$_{t}\hat{\hat{V}}_{t+1} = (\hat{\hat{p}}_t - \phi_{t+1}^{'})(a - b\hat{\hat{p}}_t) \tag{3.7}$$

The profit in the second period will be the two-period price minus the 'new' costs for period $t+1$ times the original sales figure. This can be compared with the profit the firm would make if it adjusted its price in period $t+1$, which would be:

$${}_{t+1}\hat{\hat{V}}_{t+1} = (p'_{t+1} - \phi'_{t+1})(a - bp'_{t+1}) \tag{3.8}$$

where $p'_{t+1} = \dfrac{a}{2b} + \dfrac{\phi'_{t+1}}{2}$

The profit in the second period will be the revised price for period $t+1$ minus the 'new' costs for period $t+1$ times a new sales figure which reflects the impact of the new price on consumer demand. The firm will adopt a rule that it will adjust its price in period $t+1$ if it will lose more in profits than the cost of passing through the price adjustment, i.e.:

$$\text{Alter price if } {}_{t+1}\hat{\hat{V}}_{t+1} - {}_{t}\hat{\hat{V}}_{t+1} > C \tag{4.9}$$

Where C is the menu cost associated with passing through the price increase.

Solving this in the linear demand case by subtracting (3.7) from (3.8) gives:

$$(p'_{t+1} - \phi'_{t+1})(a - bp'_{t+1}) - (\hat{\hat{p}}_t - \phi'_{t+1})(a - b\,\hat{\hat{p}}_t) > C \tag{3.9'}$$

Substituting in (3.4), (3.5) and (3.6) gives:

$$(p'_{t+1} - \phi'_{t+1})(a - bp'_{t+1}) - (\frac{2a + b\phi_t + b\phi_{t+1}}{4b} - \phi'_{t+1})(a - b[\frac{2a + b\phi_t + b\phi_{t+1}}{4b}]) > C$$

More precisely, when the firm sets the two-period price it does not know the actual value of costs in the future, and therefore using ${}_tE$ as the expectation formed at time t, the two-period price can be written:

$$\hat{\hat{p}}_t = \frac{2a + b\phi_t + b[{}_tE\phi_{t+1}]}{4b} \tag{3.10}$$

Substituting this into the pricing rule (3.9') gives:

$$(p'_{t+1}-\phi'_{t+1})(a-bp'_{t+1})$$
$$-(\frac{2a+b\phi_t+b[{}_tE\phi_{t+1}]}{4b}-\phi'_{t+1})(a-b[\frac{2a+bE\phi_t+b[{}_tE\phi_{t+1}]}{4b}])>C$$

re-arranging, and substituting for new price gives:

$$(\frac{a}{2b}-\frac{\phi'_{t+1}}{2})(\frac{a}{2b}-\frac{b\phi'_{t+1}}{2})$$
$$-(\frac{a}{2b}+\frac{\phi_t}{4}+\frac{{}_tE\phi_{t+1}}{4}-\phi'_{t+1})(\frac{a}{2}-\frac{b\phi_t}{4}-\frac{b{}_tE\phi_{t+1}}{4})>C$$

Which after multiplying out simplifies into:

$$\frac{b}{4}\{[\phi'_{t+1}-(\frac{\phi_t+{}_tE\phi_{t+1}}{2})]^2\}>C. \tag{3.11}$$

If the weighted square of actual costs in $t+1$ minus the mean of the total expected costs is greater than the menu costs the firm will pass through the revised cost into its second period price. So the firm compares the new cost for the second period with the cost that was initially included in the two period price, it then weights this 'error' by the price elasticity in the market. As the square of the error is used, positive errors are as likely to induce changes as negative shocks.

3.3.2 A Three-Period Pricing Model.

The same analysis can be undertaken for a firm that chooses to set its price for three periods.

The three-period price will be:

$$\hat{\hat{\hat{p}}}_t = \frac{p_t + p_{t+1} + p_{t+2}}{3} = \frac{3a + b\phi_t + b\phi_{t+1} + b\phi_{t+2}}{6b} \qquad (4.12)$$

using expectations this becomes:

$$\hat{\hat{\hat{p}}}_t = \frac{3a + b\phi_t + b[{}_tE\phi_{t+1}] + b[{}_tE\phi_{t+2}]}{6b} \qquad (3.13)$$

Considering the case specified above, having set a price for periods *t*, *t+1* and *t+2* costs are different from those expected in periods *t+1*and *t+2*. If the firm does not change its price then its revised profit for period *t+1* will be:

$${}_t\hat{\hat{\hat{V}}}_{t+1} = (\hat{\hat{\hat{p}}}_t - \phi'_{t+1})(a - b\hat{\hat{\hat{p}}}_t) + (\hat{\hat{\hat{p}}}_t - \phi'_{t+2})(a - b\hat{\hat{\hat{p}}}_t) \qquad (3.14)$$

This can be compared with the profit the firm would make if it adjusted its price in period *t+1*, which would be:

$${}_{t+1}\hat{\hat{\hat{V}}}_{t+1} = (\hat{\hat{p}}_{t+1} - \phi'_{t+1})(a - b\hat{\hat{p}}_{t+1}) + (\hat{\hat{p}}_{t+1} - \phi'_{t+2})(a - b\hat{\hat{p}}_{t+1}) \qquad (3.15)$$

and the firm will adopt a rule that it will adjust its price in period *t+1* if it will lose more in profits than the cost of passing through the price adjustment, i.e.:

Alter price if ${}_{t+1}\hat{\hat{\hat{V}}}_{t+1} - {}_t\hat{\hat{\hat{V}}}_{t+1} > C$ (3.16)

Solving this for this example gives:

$$(\hat{\hat{p}}_{t+1} - \phi'_{t+1})(a - b\hat{\hat{p}}_{t+1}) + (\hat{\hat{p}}_{t+1} - \phi'_{t+1})(a - b\hat{\hat{p}}_{t+1}) -$$
$$(\hat{\hat{\hat{p}}}_t - \phi'_{t+1})(a - b\hat{\hat{\hat{p}}}_t) + (\hat{\hat{\hat{p}}}_t - \phi'_{t+1})(a - b\hat{\hat{\hat{p}}}_t) > C$$

Applying expectations at time *t*, the three-period price can be written:

$$\hat{\hat{\hat{p}}}_t = \frac{2a + b\phi_t + b[{}_tE\phi_{t+1}] + b[{}_tE\phi_{t+2}]}{6b} \qquad (3.17)$$

and the two-period price computed at time *t+1*, can be written:

$$\hat{\hat{p}}_{t+1} = \frac{2a + b\phi'_{t+1} + b[_{t+1}E\phi_{t+2}]}{4b} \tag{3.18}$$

substituting these two prices into the pricing rule gives:

$$(\frac{2a + b\phi'_{t+1} + b[_{t+1}E\phi_{t+2}]}{4b} - \phi'_{t+1})(a - b\frac{2a + b\phi'_{t+1} + b[_{t+1}E\phi_{t+2}]}{4b})$$
$$+(\frac{2a + b\phi'_{t+1} + b[_{t+1}E\phi_{t+2}]}{4b} - {}_{t+1}E\phi_{t+2})(a - b\frac{2a + b\phi'_{t+1} + b[_{t+1}E\phi_{t+2}]}{4b})$$
$$-(\frac{2a + b\phi_t + b[_tE\phi_{t+1}] + b[_tE\phi_{t+2}]}{6b} - \phi'_{t+1})$$
$$(a - b\frac{2a + b\phi_t + b[_tE\phi_{t+1}] + b[_tE\phi_{t+2}]}{6b})$$
$$-(\frac{2a + b\phi_t + b[_tE\phi_{t+1}] + b[_tE\phi_{t+2}]}{6b} - {}_{t+1}E\phi_{t+2})$$
$$(a - b\frac{2a + b\phi_t + b[_tE\phi_{t+1}] + b[_tE\phi_{t+2}]}{6b}) > C$$

Which simplifies into:

$$\frac{b}{2}\{[\frac{\phi_{t+1} + {}_{t+1}E\phi_{t+2}}{2} - \frac{\phi_t + {}_tE\phi_{t+1} + {}_tE\phi_{t+2}}{3}]^2\} > C \tag{3.19}$$

This expression the equivalent to the two-period (3.11), the firm compares a weighted square of the average of the revised projected total costs with its initial average costs and if this is greater than its menu costs it adjusts its price.

3.4 Modelling Exchange Rate Shocks.

If the costs are decomposed into a constant marginal cost of manufacture and an exchange rate component, the impact of a change in the bilateral exchange rate on the firm's price can be analysed. Defining the exchange rate s_t, as the number of units of the currency of the home country required to purchase a unit of foreign currency in the export market, a rise in s_t constitutes a nominal depreciation of the home country's currency.

Including s_t, the exchange rate, within the firm's cost function, revises the profit function to:

$$V_t = (p_t - s_t\phi_t)x_t, \tag{3.1'}$$

and the optimal price for period t will be:

$$p_t = \frac{a}{2b} + \frac{s_t\phi_t}{2} \tag{3.2'}$$

and for period $t+1$ the optimal price will be:

$$p_{t+1} = \frac{a}{2b} + \frac{s_{t+1}\phi_{t+1}}{2} \tag{3.3'}$$

and the two-period price will be:

$$\hat{\hat{p}}_t = \frac{p_t + p_{t+1}}{2} = \frac{2a + bs_t\phi_t + bs_{t+1}\phi_{t+1}}{4b} \tag{3.6'}$$

Using expectations this becomes:

$$\hat{\hat{p}}_t = \frac{2a + b[{}_tEs_t\phi_t] + b[{}_tEs_{t+1}\,{}_tE\phi_{t+1}]}{4b} \tag{3.10'}$$

and the three-period price will be:

$$\hat{\hat{\hat{p}}}_t = \frac{p_t + p_{t+1} + p_{t+2}}{3} = \frac{3a + bs_t\phi_t + bs_{t+1}\phi_{t+1} + bs_{t+2}\phi_{t+2}}{6b} \tag{3.12'}$$

Using expectations this becomes:

$$\hat{\hat{\hat{p}}}_t = \frac{3a + b[{}_tEs_t\phi_t] + b[{}_tEs_{t+1}\,{}_tE\phi_{t+1}] + b[{}_tEs_{t+2}\,{}_tE\phi_{t+2}]}{6b} \tag{3.17'}$$

Continuing with the assumption that the costs of manufacture are constant, the cost shock that was considered above will be taken to be an exchange rate shock. This can either be a temporary shock where the exchange rate reverts to its previous level at some point in the future, or a permanent change in the bilateral exchange rate.

3.4.1 Permanent Exchange Rate Shocks.

If a permanent exchange rate shock occurs, then in the two-period price setting model, the change in profits following the shock to be compared with the menu cost is:

$$\frac{b}{4}\{[\phi_{t+1}^{'}-(\frac{\phi_t+{}_tE\phi_{t+1}}{2})]^2\}>C. \qquad (3.11)$$

Setting manufacturing costs as ϕ, and including the exchange rate, this becomes:

$$\frac{b}{4}\{[s_{t+1}\phi-(\frac{s_t\phi+{}_tEs_{t+1}\phi}{2})]^2\}>C. \qquad (3.11')$$

If, when the initial price setting takes place the firm assumes that the exchange rate will not alter over the price setting period,

i.e. ${}_tEs_{t+1} = s_t$, then this simplifies to:

$$\frac{b}{4}\{[s_{t+1}\phi-(\frac{s_t\phi+s_t\phi}{2})]^2\}>C.$$

Setting $s_{t+1}-s_t=\Delta s_{t+1}$

Then this further simplifies to:

$$\frac{b\phi^2}{4}\{\Delta s_{t+1}\}^2 > C \qquad (3.11'')$$

i.e. if the weighted square of the change in the exchange rate is greater than the menu cost a price adjustment will be made. Once again, if there is no change in the exchange rate the left-hand side of the expression (3.11'') reduces to zero. Additionally, as it is the square of the exchange rate change that impacts the price adjustment rule, a positive change to the exchange rate is as equally likely to affect price as a negative change.

If the three-period price setting model is considered, the change in profits following the shock that will be compared with the menu cost is:

$$\frac{b}{2}\{[\frac{\phi_{t+1}+_{t+1}E\phi_{t+2}}{2}-\frac{\phi_t+_tE\phi_{t+1}+_tE\phi_{t+2}}{3}]^2\} > C \qquad (3.19)$$

Setting manufacturing costs as ϕ, and including the exchange rate, this becomes:

$$\frac{b}{2}\{[\frac{s_{t+1}\phi+_{t+1}Es_{t+2}\phi}{2}-\frac{s_t\phi+_tEs_{t+1}\phi+_tEs_{t+2}\phi}{3}]^2\} > C \qquad (3.19')$$

If, when the initial price setting takes place the firm assumes that the exchange rate will not alter over the price setting period,

i.e. ${}_tEs_{t+1} = {}_tEs_{t+2} = s_t$, then following the permanent shock,

${}_{t+1}Es_{t+2} = s_{t+1}$ and the expression simplifies to:

$$\frac{b\phi^2}{2}\{\Delta s_{t+1}\}^2 > C \qquad (3.19'')$$

i.e. if the weighted square of the change in the exchange is greater than the menu cost a price adjustment will be made. Once again, if there is no change in the exchange rate the left-hand side of the expression (3.19'') reduces to zero. Additionally, as it is the square of the exchange rate change that impacts the price adjustment rule, a positive change to the exchange rate is as equally likely to affect price as a negative change.

3.4.2 Temporary Exchange Rate Shocks.

Finally, if the exchange rate shock in the second period is temporary and is reversed in the third period, i.e. ${}_tEs_{t+1} = {}_tEs_{t+2} = s_t$, and ${}_{t+1}Es_{t+2} = s_t$ then

$$\frac{b}{2}\{[\frac{\phi_{t+1} + {}_{t+1}E\phi_{t+2}}{2} - \frac{\phi_t + {}_tE\phi_{t+1} + {}_tE\phi_{t+2}}{3}]^2\} > C \qquad (3.19)$$

Under the same assumptions as above (3.19) simplifies to:

$$\frac{b\phi^2}{8}\{\Delta s_{t+1}\}^2 > C \qquad (3.20)$$

Comparing the outcomes of the three scenarios:

Two-period permanent	$\frac{b\phi^2}{4}\{\Delta s_{t+1}\}^2 > C$	(3.11'')
Three-period permanent	$\frac{b\phi^2}{2}\{\Delta s_{t+1}\}^2 > C$	(3.19'')
Three-period temporary	$\frac{b\phi^2}{8}\{\Delta s_{t+1}\}^2 > C$	(3.20)

Therefore a larger permanent change in exchange rate is needed to cause a price adjustment in the two-period price setting model than in the three period price setting model, which is intuitively correct as the shock will have a longer impact in the three-period model. The temporary exchange rate shock requires the largest change to cause prices to adjust, which again agrees with intuition, as not only is it for a short period but its impact will also be reversed.

3.5 Extension of the Pass Through Model to Incorporate Trend Inflation in Domestic and Export Market.

The model that has been derived in the previous section will now be augmented by a trend inflation term in both the country of manufacture and in the export market. As before, the firm faces a linear demand function in a foreign market but will face costs in both the home country, in which it manufactures and sells, and in a foreign country in which it also sells. Costs are composed of constant marginal cost in both countries but these are subject to a trend level of cost inflation in each country in each period. This latter element is included for compatibility with the Ball and Mankiw model who introduce asymmetries by the inclusion of a positive trend inflation. The firm's maximisation problem for its sales in the foreign country can still be written as (4.1) for t, as:

$Max.\ V_t = (p_t - \phi_t)x_t$, with respect to p_t. (3.1)

Where: V_t is the firm's profit, p_t the price, ϕ_t costs and x_t the output in period t.

In the linear demand case, sales of the firm is given by:

$x_t = a - bp_t$. (3.2)

Costs are:

$$\phi_t = s_t \phi_{ht} + \phi_{ft}, \tag{3.21}$$

Where ϕ_{ht} and ϕ_{ft} are the marginal costs in the home country and the foreign country respectively, and s_t is the exchange rate.

Costs are altered each period by the impact of a trend inflation in each country, denoted by π_h and π_f. Marginal costs, ϕ_f, for the foreign country evolve as follows:

Costs at t $= (1 + \pi_f - \kappa_f \Delta s_t)\phi_f$

Costs at $t+1$ $= (1 + 2\pi_f - \kappa_f \Delta s_{t+1})\phi_f$

Where Δ is the change in the variable up to the specified date, i.e. $\Delta s_{t+1} = s_{t+1} - s_t$, and κ_f is a measure of the impact that any unanticipated change in the exchange rate will have on the firm's costs[4]. Anticipated movements in the exchange rate are captured in the inflation term.

The evolution of costs for the home country can be written as:

Costs at t $= (1 + \pi_h + \kappa_h \Delta s_t)\phi_h$

Costs at $t+1$ $= (1 + 2\pi_h + \kappa_h \Delta s_{t+1})\phi_h$

The term associated with the cost impact of a change in the exchange rate is positive for the home country and negative for the foreign country as it is assumed that a depreciation of the home country's exchange rate will increase

[4] This specification ignores the squared inflation term under the assumption that it will be insignificant.

costs. Since a depreciation of the home country's currency is an appreciation of the foreign country's exchange rate, this should lead to a reduction in costs in the foreign country.[5]

Substituting into (3.3) gives unit costs in period t of:

$$\phi_t = s_t(1+\pi_h+\kappa_h\Delta s_t)\phi_h + (1+\pi_f - \kappa_f\Delta s_t)\phi_f \tag{3.21'}$$

in period t+1 unit costs will be:

$$\phi_{t+1} = s_{t+1}(1+2\pi_h+\kappa_h\Delta s_{t+1})\phi_h + (1+2\pi_f - \kappa_f\Delta s_{t+1})\phi_f \tag{3.21''}$$

Following the analysis of section 3.3 a two-period and a three-period pricing model will now be developed and these models will be subjected to an exchange rate shock.

3.5.1 A Two-Period Model.

If a firm is profit maximising with price as its only decision variable, then a one period optimisation of (3.1) gives:

$$\frac{dV_t}{dp_t} = (p_t - \phi_t)\frac{dx_t}{dp_t} + x_t = 0, \tag{3.22}$$

which in the case of a linear demand function, after substituting in (3.2), implies that the optimal price for period t, p_t^{opt} is:

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[5] **The exchange rate is defined as the number of units of home currency that are required to purchase one unit of foreign currency, therefore a depreciation of the home currency leads to an increase in the size of s. The term $k\Delta s$ will be positive in the home country following a depreciation to reflect the increase in the cost of imports into that country. If there is a**

$$p_t^{opt} = \frac{a}{2b} + \frac{\phi_t}{2}. \tag{3.23}$$

Alternatively, if (3.21') is substituted into (3.23) the optimal price is:.

$$p_t^{opt} = \frac{a}{2b} + \frac{s_t(1+\pi_h+\kappa_h \Delta s_t)\phi_h + (1+\pi_f - \kappa_f \Delta s_t)\phi_f}{2} \tag{3.23'}$$

Where the firm is setting price for two periods, following the Ball and Mankiw pricing rule, the firm's price is set after determining the desired optimal price at the beginning of the first period t, and the price will remain in force until the end of period t+1. If discounting is ignored, the optimal two-period price, $\hat{p}_t$ will be the average of the individual periods optimal prices:

$$\hat{p}_t = \frac{p_t^{opt} + p_{t+1}^{opt}}{2}. \tag{3.24}$$

In a multi-period pricing model, a firm must use expectations of the level of variables when setting the period price. Using ${}_tE$, to indicate expectations formed at the beginning of period t, the individual period optimal price for t and $t+1$ and the optimal period price can be written by taking expectations of each of the variables at time t. Where expectations are set for more than one period, they are conditional on the value that the variable takes at the end of the previous period. In forming expectations it is assumed that this is done rationally and model consistently and that firms have all the relevant information required to form them. Therefore:

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currency appreciation the $k\Delta s$ term will be negative to reflect the reduction in the cost of imports.

$$p_t^{opt} = \frac{a}{2b} + \frac{{}_tE[s_t](1+{}_tE[\pi_{ht}]+{}_tE[\kappa_h \Delta s_t])\phi_h}{2} + \frac{(1+{}_tE[\pi_{ft}]-{}_tE[\kappa_f \Delta s_t])\phi_f}{2}$$

(3.25)

$$p_{t+1}^{opt} = \frac{a}{2b} + \frac{{}_tE[s_{t+1}](1+{}_tE[\pi_{ht+1}]+{}_tE[\kappa_h \Delta s_{t+1}])\phi_h}{2} + \frac{(1+{}_tE[\pi_{ft+1}]-{}_tE[\kappa_f \Delta s_{t+1}])\phi_f}{2}$$

(3.26)

In addition, these can be combined following (3.23) to form the two-period price.

$$\hat{p}_t = \frac{a}{2b} + \frac{{}_tE[s_t](1+{}_tE[\pi_{ht}]+{}_tE[\kappa_h \Delta s_t])\phi_h}{4} + \frac{(1+{}_tE[\pi_{ft}]-{}_tE[\kappa_f \Delta s_t])\phi_f}{4} + \frac{{}_tE[s_{t+1}](1+{}_tE[\pi_{ht+1}]+{}_tE[\kappa_h \Delta s_{t+1}])\phi_h}{4} + \frac{(1+{}_tE[\pi_{ft+1}]-{}_tE[\kappa_f \Delta s_{t+1}])\phi_f}{4}$$

(3.27)

If the firm when price setting, expects that inflation will be $\pi_{f,h}$ per period in the respective country and that there will be no movement in the exchange rate then expression (3.27) simplifies to:

$$\hat{p}_t = \frac{a}{2b} + \frac{s_t(1+\pi_h)\phi_h}{4} + \frac{(1+\pi_f)\phi_f}{4} + \frac{s_t(1+2\pi_h)\phi_h}{4} + \frac{(1+2\pi_f)\phi_f}{4}$$

or,

$$\hat{p}_t = \frac{a}{2b} + \frac{s_t\phi_h}{2} + \frac{\phi_f}{2} + \frac{3s_t\pi_h\phi_h}{4} + \frac{3\pi_f\phi_f}{4} \tag{3.28}$$

Under the Ball and Mankiw scenario the optimal period price is $\pi/2$, the difference between this and (3.28) is due to the use of explicit functional forms for demand and costs whereas Ball and Mankiw set costs to zero in period t and use logs rather than numbers. Equation (3.28) is directly comparable with (3.6), the two-period price without inflation, they are both functions of a constant and the average expected costs for the price setting period.

3.5.2 A Three-Period Model.

This model can be extended so that the price setting covers three periods, in this case the firm will set its price based on the information available at the beginning of period t, for periods t, $t+1$ and $t+2$. This extension allows a test to be undertaken to determine whether temporary exchange rate shocks of differing lengths have the same affect on the firm's price adjustment rule.

Once again, it is assumed that the firm does not discount future income streams and therefore the price setting rule will be:

$$\hat{p}_t = \frac{p_t^{opt} + p_{t+1}^{opt} + p_{t+2}^{opt}}{3}. \tag{3.29}$$

and if the optimal prices for each period are used and are combined following (3.11) to form the three-period price:

$$\hat{p}_t = \frac{a}{2b} + \frac{{}_tE[s_t](1+{}_tE[\pi_{ht}]+{}_tE[\kappa_h \Delta s_t])\phi_h}{6} + \frac{(1+{}_tE[\pi_{ft}]-{}_tE[\kappa_f \Delta s_t])\phi_f}{6} +$$
$$\frac{{}_tE[s_{t+1}](1+{}_tE[\pi_{ht+1}]+{}_tE[\kappa_h \Delta s_{t+1}])\phi_h}{6} + \frac{(1+{}_tE[\pi_{ft+1}]-{}_tE[\kappa_f \Delta s_{t+1}])\phi_f}{6} +$$
$$\frac{{}_tE[s_{t+2}](1+{}_tE[\pi_{ht+2}]+{}_tE[\kappa_h \Delta s_{t+2}])\phi_h}{6} + \frac{(1+{}_tE[\pi_{ft+2}]-{}_tE[\kappa_f \Delta s_{t+2}])\phi_f}{6}$$

(3.30)

If the firm when price setting expects that inflation will be $\pi_{h,f}$ per period in the respective country and that there will be no movement in the exchange rate then expression (3.29) simplifies to:

$$\hat{p}_t = \frac{a}{2b} + \frac{s_t(1+\pi_h)\phi_h}{6} + \frac{(1+\pi_f)\phi_f}{6} + \frac{s_t(1+2\pi_h)\phi_h}{6} + \frac{(1+2\pi_f)\phi_f}{6} +$$
$$\frac{s_t(1+3\pi_h)\phi_h}{6} + \frac{(1+3\pi_f)\phi_f}{6}$$

which further simplifies to:

$$\hat{p}_t = \frac{a}{2b} + \frac{s_t\phi_h}{2} + \frac{\phi_f}{2} + s_t\pi_h\phi_h + \pi_f\phi_f \tag{3.31}$$

Once again the multi-period price is a function of a constant and the expected average costs for the price setting period.

3.5.3 Modelling Shocks to the Exchange Rate

If the pricing models are subjected to an unexpected change in the exchange rate in period *t*, i.e. after the new period-price has been set but before the price for period *t+1* may be changed, then the firm will calculate a new optimal price for the outstanding periods and compare the change in profits for those periods with the menu cost C. If the change in profits is greater than C, then the firm will 'put through' the price change, i.e. it will pass through the exchange rate effect.

For a two-period model, the new optimal price for period $t+1$ ($p^{nopt}{}_{t+1}$), following the exchange rate shock is:

$$p_{t+1}^{nopt} = \frac{a}{2b} + \frac{{}_{t+1}E[s_{t+1}](1 + {}_{t+1}E[\pi_{ht+1}] + {}_{t+1}E[\kappa_h \Delta s_{t+1}])\phi_h}{2} + \frac{(1 + {}_{t+1}E[\pi_{ft+1}] - {}_{t+1}E[\kappa_f \Delta s_{t+1}])\phi_f}{2} \tag{3.32}$$

which, if the estimate of trend inflation has not changed simplifies to:

$$p_{t+1}^{nopt} = \frac{a}{2b} + \frac{{}_{t+1}E[s_{t+1}](1 + 2\pi_h + {}_{t+1}E[\kappa_h \Delta s_{t+1}])\phi_h}{2} + \frac{(1 + 2\pi_f - {}_{t+1}E[\kappa_f \Delta s_{t+1}])\phi_f}{2} \tag{3.33}$$

If this is substituted into a change in profit equation (3.9) for period $t+1$ then the firm will once again adjust price if the change in profits caused by not making the adjustment exceeds the menu costs, i.e.:

If $\Delta V_{t+1} > C$ then the firm will adopt the new price.

There are two cases to consider in relation to equation (3.33) first, when the exchange rate change is believed to be temporary and second, when the exchange rate change is believed to be permanent.

3.5.3.1 Temporary Shocks.

A shock is considered to be temporary if it will be reversed in the foreseeable future. In the two-period model developed above, following an inter-period temporary exchange rate change, equation (3.33) will alter to:

$$p_{t+1}^{nopt} = \frac{a}{2b} + \frac{s_t(1+2\pi_h)\phi_h}{2} + \frac{(1+2\pi_f)\phi_f}{2} \tag{3.33'}$$

and if this is compared with the original optimal price for period $t+1$ as given by (3.26) amended by the simplifying assumptions relating to trend inflation and that there is no anticipated change in the exchange rate, then:

$$p_{t+1}^{opt} = \frac{a}{2b} + \frac{s_t(1+2\pi_h)\phi_h}{2} + \frac{(1+2\pi_f)\phi_f}{2} \tag{3.26'}$$

it is the same, which implies that the demand will be the same and therefore the change in profits will be less than C, otherwise the original period price would not have been used.

In this example of a within-period temporary exchange rate change there will once again be no pass through of exchange rate changes.

For a firm using a three-period pricing model, if there is a temporary change to the exchange rate in period t which occurs after the price for the period has been enacted but before the company decides whether to make a change in the period price for period $t+1$ or $t+2$. Then it is possible to consider two different scenarios; in the first, the temporary exchange rate change lasts for one period and in the second it lasts for two periods.

Considering the first scenario, the new optimal prices for *t+1* and *t+2* if the inflation rate has not altered, are:

$$p_{t+1}^{nopt} = \frac{a}{2b} + \frac{s_t(1+2\pi_h)\phi_h}{2} + \frac{(1+2\pi_f)\phi_f}{2} \tag{3.34}$$

$$p_{t+2}^{nopt} = \frac{a}{2b} + \frac{s_t(1+3\pi_h)\phi_h}{2} + \frac{(1+3\pi_f)\phi_f}{2} \tag{3.35}$$

these are identical to the originating equations and accordingly changes will not be made to the period price when there is a one period temporary shock to the exchange rate. This confirms the finding in the two-period model that a within-period temporary shock, which occurs after the firm has set the price, does not cause the firm to adjust the multi-period price.

Considering the second scenario, where the temporary shock last for two periods, the revised optimal period price will become:

$$\hat{p}_{t+1} = \frac{a}{2b} + \frac{s_{t+1}(1+2\pi_h+\kappa_h \Delta s_{t+1})\phi_h}{4} + \frac{(1+2\pi_f-\kappa_f \Delta s_{t+1})\phi_f}{4} + \frac{s_t(1+3\pi_h+\kappa_h \Delta s_t)\phi_h}{4} + \frac{(1+3\pi_f-\kappa_f \Delta s_t)\phi_f}{4} \tag{3.36}$$

the original period price was:

$$\hat{p}_t = \frac{a}{2b} + \frac{s_t\phi_h}{2} + \frac{\phi_f}{2} + s_t\pi_h\phi_h + \pi_f\phi_f \tag{3.13}$$

subtracting (3.13) from (3.36) gives:

$$\Delta \hat{p}_t = \frac{s_{t+1}(1+2\pi_h)\phi_h}{4} - \frac{s_t(1+\pi_h)\phi_h}{4} + \frac{\pi_f \phi_f}{4} \qquad (3.37)$$

and if this produces a change in profits greater than C an adjustment in the period price will be made.

It is possible to specify a minimum bound that defines the level of price change, that by construction of the model, must impact profits by an amount that is less than the firm's menu cost. The affect on the firm's profits, caused by charging an average price rather than each individual period's optimal price, must be less than the menu cost of adjusting it, C; otherwise, the firm would not opt to charge the average price. The difference between the average price and the optimal prices is the lower limit of a price change that the firm would pass through, as below this a firm would not find it profitable to adjust its price and therefore it defines the minimum bound for a price change. It is the sum of the absolute value of the price differences in each period that can be computed by taking the difference between the average price and the optimal price in each individual period.

The minimum bound for the price adjustment in a three-period model is:

$$MB = s_t \pi_h \phi_h + \pi_f \phi_f \qquad (3.38)$$

A price difference that is less than this minimum bound will not generate an alteration to the firm's price. It is calculated by taking the difference between the optimal price calculated for the each individual period and the three-period optimal price, i.e. if the optimal price for each individual period is calculated under the assumption of the three-period model, then:

$$p_t^o = \frac{a}{2b} + \frac{s_t\phi_h}{2} + \frac{\phi_f}{2} + \frac{s_t\pi_h\phi_h}{2} + \frac{\pi_f\phi_f}{2} \tag{3.39}$$

$$p_{t+1}^o = \frac{a}{2b} + \frac{s_t\phi_h}{2} + \frac{\phi_f}{2} + s_t\pi_h\phi_h + \pi_f\phi_f \tag{3.40}$$

$$p_{t+2}^o = \frac{a}{2b} + \frac{s_t\phi_h}{2} + \frac{\phi_f}{2} + \frac{3s_t\pi_h\phi_h}{2} + \frac{3\pi_f\phi_f}{2} \tag{3.41}$$

subtracting each one individually from the three-period price:

$$\hat{p}_t = \frac{a}{2b} + \frac{s_t\phi_h}{2} + \frac{\phi_f}{2} + s_t\pi_h\phi_h + \pi_f\phi_f \tag{3.13}$$

and adding the absolute values of the differences gives the minimum bound expression (3.38) above.

To calculate whether the potential price changes as denoted by (3.20), generated by the exchange rate shock, will be passed through by the firm, it is subtracted from the minimum bound expression (3.38) and if the result is positive a price adjustment will not be made.

i.e. there will be no price change if:

$$s_t\pi_h\phi_h + \pi_f\phi_f > \frac{s_{t+1}(1+2\pi_h)\phi_h}{4} - \frac{s_t(1+\pi_h)\phi_h}{4} + \frac{\pi_f\phi_f}{4}$$

Which simplifies to:

$$3s_t\pi_h\phi_h + 3\pi_f\phi_f > \Delta s_{t+1}(1+2\pi_h)\phi_h \tag{3.42}$$

i.e. there will not be a price change if the inflation effect that is built into the model for the final period is greater than the effect of the exchange rate shock on the firm's home costs for the second period. Accordingly, following a temporary exchange rate shock, the effect that this will have on the firm's second period costs must be greater than the maximum amount of inflation that is built into the model before the firm will change its price.

If the outcomes of a temporary shock when the model contains a trend inflation term are compared to the initial model, a within-period temporary shock is treated in the same manner, the firm does not adjust its multi-period price. For a longer duration temporary shock, the firm is once again less likely to pass through the shock than if the shock had been permanent.

3.5.3.2 Permanent Shocks.

Following a permanent change in the exchange rate in the two-period model, equation (3.33) will become:

$$p_{t+1}^{nopt} = \frac{a}{2b} + \frac{s_{t+1}(1+2\pi_h + \kappa_h \Delta s_{t+1})\phi_h}{2} + \frac{(1+2\pi_f - \kappa_f \Delta s_{t+1})\phi_f}{2} \qquad (3.33'')$$

The minimum bound for the two-period model calculated using the same method as the three-period model, is:

$$MB = \frac{s_t \pi_h \phi_h + \pi_f \phi_f}{2} \qquad (3.43)$$

To consider whether the revised optimal prices caused by the exchange rate shock will generate a price adjustment, the minimum bound expression (3.43) can be compared with the difference in the new optimal price for *t+1* and the existing optimal two-period price. This difference is found by deducting (3.28) from (3.33''):

$$\Delta \hat{p}_t = \frac{\Delta s_{t+1}}{2}\{(1+2\pi_h + s_{t+1}k_h)\phi_h - k_f\phi_f\} + \frac{s_t\pi_h\phi_h + \pi_f\phi_f}{4} \qquad (3.44)$$

if the minimum bound expression is greater than this then no price change will be made. Therefore, a price adjustment will not be made if:

$$\frac{s_t\pi_h\phi_h + \pi_f\phi_f}{2} > \Delta s_{t+1}\{(1+2\pi_h + s_{t+1}k_h)\phi_h - k_f\phi_f\} \qquad (3.45)$$

i.e. the effect of the exchange rate shock on the firm's second period home costs and that part of the firm's foreign costs that are affected by the shock must be greater than the minimum bound before a price adjustment will be made. Therefore, the net effect of the permanent exchange rate shock on the firm's costs must exceed the second period's inflation effect that was not incorporated into the original average price before the firm will alter its price.

If the three-period model is considered, then equation (3.19) will change to:

$$\begin{aligned}\hat{p}_{t+1} = \frac{a}{2b} + \frac{s_{t+1}(1+2\pi_h + \kappa_h\Delta s_{t+1})\phi_h}{4} + \frac{(1+2\pi_f - \kappa_f\Delta s_{t+1})\phi_f}{4} + \\ \frac{s_{t+1}(1+3\pi_h + \kappa_h\Delta s_{t+1})\phi_h}{4} + \frac{(1+3\pi_f - \kappa_f\Delta s_{t+1})\phi_f}{4}\end{aligned} \qquad (3.46)$$

the original period price was:

$$\hat{p}_t = \frac{a}{2b} + \frac{s_t\phi_h}{2} + \frac{\phi_f}{2} + s_t\pi_h\phi_h + \pi_f\phi_f \qquad (3.31)$$

subtracting (3.31) from (3.46) gives:

$$\frac{\Delta s_{t+1}\{(2+5\pi_h + 2s_{t+1}k_h)\phi_h - 2k_f\phi_f\}}{4} + \frac{s_t\pi_h\phi_h}{4} + \frac{\pi_f\phi_f}{4} \qquad (3.47)$$

The minimum bound for the three-period model is:

$$MB = s_t \pi_h \phi_h + \pi_f \phi_f \tag{3.38}$$

Comparing (3.38) and (3.47) shows that a price adjustment will not be made if:

$$s_t \pi_h \phi_h + \pi_f \phi_t > \frac{\Delta s_{t+1}\{(2 + 5\pi_h + 2s_{t+1}k_h)\phi_h - 2k_f \phi_f\}}{4} + \frac{s_t \pi_h \phi_h}{4} + \frac{\pi_f \phi_f}{4}$$

This can be simplified to:

$$\frac{3s_t \pi_h \phi_h}{2} + \frac{3\pi_f \phi_f}{2} > \Delta s_{t+1}\{(1 + 5/2\pi_h + s_{t+1}k_h)\phi_h - k_f \phi_f\} \tag{3.48}$$

i.e. the effect of the exchange rate shock on the firm's costs in the final two periods must be greater than the inflation effect in the final period for a price change to be enacted. There is therefore a smaller hurdle to be cleared to put through a price change following a permanent shock than a temporary shock.

The intuition behind the Ball and Mankiw result is that in a world of rising prices, where a firm has opted for a lower than optimal price in the second period, exchange rate shocks that would increase the firm's second period price are more likely to cause a price adjustment than shocks that would decrease the second period price. This intuition still holds, and the minimum bound can be interpreted as giving the limits of a change to the period price that would generate a price adjustment.

Additionally, as in the simple model, the longer the price setting period, the more likely the firm is to pass through the effect of the shock into its price.

3.6 Comparison of the Theoretical Findings.

3.6.1 Contrast with Previous Theoretical Approaches.

The static approach that has been adopted by the majority of researchers in this area has the implicit assumption that the firm is able to adjust price instantaneously. This assumption is not valid in the majority of consumer related markets and is also inappropriate where the firm is dealing with a foreign distributor where the contract is for a fixed term or where the firm faces high menu costs in relation to the adjustment of price. In each of the above cases, firms will utilise a multi-period pricing strategy.

The other theoretical avenue that has been explored by Froot and Klemperer (1989) and Gross and Schmitt (1999) is a two-period fixed price model. This approach forces the firm to consider the implications of its current actions on future profitability but it does not permit the firm the flexibility to make pricing adjustments in later periods.

The multi-period pricing model that has been derived above allows firms to set a price for as many future periods as contractual or other market considerations require, thereby overcoming the problems of the static framework. It also encompasses the static model by allowing the firm to alter prices, subject to the payment of a menu cost, in any of the future periods. This latter element also addresses the flexibility problem in the fixed price two period models. The optimal price setting period for the firm is therefore a function of the costs, including trend inflation,[6] that is foreseen and the menu costs suffered by the firm.

Static models are able to explain a range of exchange rate pass throughs by considering the number of foreign firms in the market and also the ratio of marginal costs to price (Dornbusch 1987). However, they offer very limited explanations of zero pass through, which is only optimal in a market characterised by perfect competition. They are also unable to differentiate between the response of a firm to a temporary or a permanent shock.

The fixed price two period models do allow a theoretical consideration of the permanent and temporary shocks. In the model developed by Froot and Klemperer (1989) it is found that permanent exchange rate changes are passed through in a manner that is similar to the static model. Temporary exchange rate changes are passed through in an ambiguous way dependent upon the effect of interest rates and exchange rates on the firm' future profits.

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[6] The function could substitute any expected increase in the firm's costs for trend inflation.

The multi-period pricing model also allows the theoretical consideration of permanent and temporary shocks. The result of a within-period temporary shock is distinctly different from the other models. Under this framework, firms will not pass through the exchange rate adjustments. The response to multi-period temporary shocks and permanent shocks is as in the Froot and Klemperer (1989) ambiguous. However, the ambiguity in this model is a reflection of the size of the menu costs that firms face when adjusting prices. Additionally, the model permits firms to explicitly take into account the effect of the exchange rate shock on its underlying costs in each country.

The Ball and Mankiw model that has been followed uses a trend rate of inflation to motivate the need for a firm to adopt an average price; if costs were not rising, there would be no need for this type of pricing rule. The results that are generated by the model do not require a trend level of inflation only that firms expect that the overall costs of production will change during the period for which it is optimal to set price. For the period that has been empirically tested in the literature, this does not seem to be an unreasonable requirement.

Finally, if discounting of future income streams was incorporated into the model, the qualitative findings would remain the same. The effect would be to reduce the impact of costs that are borne in later periods. Consequently, a larger exchange rate shock would be required to generate pass through.

3.6.2 Discussion of Previous Empirical Results.

The use of a multi-period pricing model that explicitly considers the impact on a firm's prices of exchange rate shocks, permits a different perspective to be placed on the results of pass through studies.

The Gross and Schmitt (1996) results of the Swiss car market are analysed by exporting country, and sub-analysed by car size. These results can be summarised as follows: French and Japanese exporters display significant negative pass through for both small and medium sized cars, whilst German and Belgium exporters display pass through that is insignificantly different from zero. Italian exporters of the small cars have significant negative pass through whereas for medium sized cars they display insignificant pass through.

Whilst the French and Japanese exporters pass through a proportion of the exchange rate shocks, this is not the case with the German and Belgium exporters. This latter finding indicates that the exchange rate shocks were insufficiently large to induce price changes for the latter two countries exporters and would imply that they considered the shocks to be temporary.

It is seen in Chapter 4 that there was a lack of variability in the price series that were examined. One econometric method that could be applied to try and compensate for a lack of variability is the use of a panel data study that will aggregate many individual series thereby inducing much greater underlying variability into the data generating process. Whilst using this technique will change the focus from the individual firm to groups of firms from the same country, as an exchange rate shock will have a similar impact on each of the constituent firms, the averaging effect should not change the validity of the exchange rate pass through coefficient. Accordingly, this approach will be used to test exchange rate pass through empirically in chapters 5 and 6.

3.7 Conclusions.

It has been shown that firms frequently set prices for more than one period, for example Kashyap (1995), Carlton (1986), and Cecchetti (1985, 1986). This chapter has therefore considered how an exporting firm which adopts a multi-period pricing strategy responds to an exchange rate shock.

This model demonstrates that a firm will not adjust price if it is faced with a one period temporary exchange rate shock. If the temporary shock lasts for more than one period then the firm will adjust price if the effect of the shock is greater than the associated menu costs of adjusting price. This is also the case when the exchange rate shock is permanent. In deciding whether to adjust price the firm not only compares the impact of the shock on the home country costs but also considers the impact of the shock on its costs in the foreign export market. Where the overall profit gain from adjusting prices is greater than the menu cost of adopting them the firm will adjust.

The model also shows that where the exchange rate shock is temporary, the size of the shock that is required to generate a price adjustment is larger than the case where the shock is permanent.

Additionally in this environment, the asymmetric pricing response found by Ball and Mankiw is replicated, firms are more likely to pass through exchange rate shocks that cause increases to the optimal price than those that would generate price reductions.

The finding that firms maintain prices for long periods questions the inferences that can be drawn from empirical studies; pass through that is insignificantly different from zero could be caused by temporary exchange rate shocks or could be due to the lack of variability in the dependent variable invalidating the results. This requires further analysis and a panel data study will be used to provide a further empirical insight.

Chapter 4

Exchange Rate Pass Through in the UK: A Consideration of Time Series Issues and an Analysis of Selected Imports 1987 to 1996

4.1 Introduction.

As discussed in chapter 2, whilst many empirical studies have been conducted, few consider the time series properties of the underlying variables. Additionally, with the exception of Dwyer and Lam (1995) none of the studies consider the pass through of exchange rate shocks from the foreign based manufacturer through to the ultimate consumer, they only test pass through to the first point of entry into the export market. This chapter will focus on the time series issues of exchange rate pass through and by using product line data, instead of aggregated data, will specifically address the extent to which exchange rate changes are passed through to ultimate consumers.

In the course of supplying products to end users, companies make use of a distribution chain. When supplying foreign markets, the chain will generally include a distributor that is based in that market. The price that is recorded by the customs will usually be different to the price charged to the end user, as the distributor will provide services such as transport and marketing which have to be reflected in the price that is charged to the final consumer. Consideration of the change in custom's values, which is the primary source of data for empirical studies, will only take into account 'first stage pass-through' from the manufacturer to the first point of entry into the country. Second stage pass-through, which considers price adjustments from the first point of entry into a country through to the ultimate consumer, will be omitted from the analysis. The full extent of the impact of exchange rate movements on final prices has therefore not been tested, as the foreign based distributor could adjust the final price to counteract or amplify the effects caused by changes in the exchange rate.

The approach taken in this chapter is to select foreign product lines that are sold in the U.K., note the price that is charged to the final consumer, and identify the country in which they are manufactured. A simple graphical comparison of the movements of the prices of these products and the related movements in the associated bilateral exchange rates (see section 4.2.3) shows little apparent correlation between the two series. It also highlights that whilst nominal prices of the products changed infrequently and almost always increased in the period under review, exchange rates changed frequently and moved substantially in both directions. Accordingly, the U.K. based customer is being shielded from the impact of exchange rate changes either by the manufacturer absorbing the changes to their costs or by the U.K. distributor acting to cushion the shocks. For example, whilst the Belgium Franc has appreciated and devalued against the Pound Sterling by more than 20% in the period under review, the price in the U.K. of Duracell batteries, which are manufactured in Belgium, has consistently risen in the period under review.

However, if the price ratio of the home to the foreign manufactured good is graphed and compared with the changes in the bilateral exchange rate, there is evidence that changes in the price ratio do seem to correspond with changes in the exchange rate. This would imply that an exchange rate shock is passed through to consumers in terms of relative price changes.

The literature investigating changes in nominal retail prices of individual products is small. The most recent paper by Kashyap (1995) discusses price changes in US retail catalogues and finds that there is on average fifteen months between price changes. This inflexibility of prices was also found by Carlton (1986) and by Cecchetti (1985, 1986). The studies do not identify the country of origin of the goods that are tested and therefore the data cannot be used to test the extent of exchange rate pass through. But they highlight a very important point that is mirrored in this data set; prices charged to the ultimate consumer do not change frequently.

By identifying that price rigidity is prevalent in the sample, questions about the use of customs' generated industry level price data particularly at the most disaggregated level must be raised, because if this price rigidity is pervasive, the variability that is found within the aggregated series could be conjectured to have more to do with the variation of quality composition of imports rather than variation in the price of the underlying products.

To investigate the initial findings in more detail, the price and exchange rate variables were tested using standard time series techniques following the Johansen method (Johansen, 1988, 1991). The exchange rate variable being defined as the number of units of domestic currency required to purchase a unit of foreign currency, an increase in the value of the exchange rate corresponds to a nominal depreciation of the domestic currency. This approach has been chosen, even though there is a lack of variability in the dependent variable, as the results that are generated can be directly compared with previous studies. Five studies were conducted, (see section 4.5.5) in three of them there is a positive correlation between exchange rate movements and price changes, i.e. firms are adjusting their prices in the long run to amplify the impact caused by the change in the exchange rate. In one of them, there is negative pass through; i.e. the firm adjusted its price to take account of the change in underlying costs following the exchange rate movement. In the final study the firm did not adjust its price to take account of exchange rate movements, i.e. there was zero long run exchange rate pass through.

Other empirical studies have found significant negative pass through in most if not all price series that have been tested, (see section 4.6)[7], but these studies, as detailed in chapter 2, also contain substantial empirical flaws including in many of them, potential spurious regression. Whilst the finding of negative pass through of exchange rate shocks offers support for the static model, the empirical flaws in the studies weaken this support.

The remaining sections of this chapter are laid out as follows: section 4.2 describes the data and its underlying characteristics; in section 4.3 the estimating equations are derived; section 4.4 discusses the estimating procedures; and in section 4.5 the time series properties of the variables and the results are stated; section 4.6 is a critique of past time series work in this area and section 4.7 concludes.

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[7] with the exception of the study by Gross and Schmitt (1996) which found a large number of insignificant pass throughs

4.2 Data Description.

4.2.1 Product and Market Considerations.

Products were selected on the basis that the competition in the market is based on price rather than product specific attributes. This removes the need to include a variable to indicate the quality of the good in the pricing function, but it places a limit on the products that can be selected for testing, as products that change their characteristics during the period under review cannot be selected.

Commercial organisations, due to the sensitivity of the information involved, are rarely prepared to disclose pricing data. To obtain prices, at the appropriate level of detail, it was necessary to find a source that published product level information, including prices, at regular intervals and covering a reasonable range of products. Contact was made with numerous trade and commercial organisations to determine the level of information that was made available to the public and their members. Eventually two sources were found which published information on a wide range of products including individual product descriptions and prices. Additionally, they were published regularly and had been in existence for a number of years.

The selection of products that were to be tested was limited by the following constraints:

a) The price of the product had to be reported throughout the period of testing. As entry into the publications was voluntary, firms could stop advertising prices on products for short periods, or simply delete the product from their listing. This was a major cause of product de-selection from the sample.
b) To confirm that product attributes remained constant, a check was undertaken that neither the product description nor the manufacturers' product code had been changed throughout the period of testing. In certain product areas, there was considerable product innovation; this criterion caused many products to be deselected from the sample.
c) Low value items were selected to ensure that the type of search criteria applied by consumers were broadly similar.
d) The product to be tested had to be manufactured outside of the UK and, to allow for competition effects, there had to be an alternative product that was sold in the UK. The country of manufacture of the selected products was determined by first identifying and then speaking with the UK agent for the product's manufacturer. Information was obtained on the country in which the product was made, and where this was outside of the UK, this determined the bilateral exchange rate that was to be used in the pricing model. Once again, this criterion caused the de-selection of many

products, either because there were no competitive products that provided the necessary information throughout the period under review, or because none of the products in a particular category for which data was available, were manufactured outside of the UK.

e) The product markets had to be free of explicit external controls; this precluded the selection of, for example, pharmaceutical products where resale price maintenance was in force during the period under review.

4.2.2 Data Collection.

There were two sources for the price data: The Chemist and Druggist Monthly Price List and the Grocer Price List. These publications give the manufacturer's recommended retail and wholesale prices each month for a selection of consumer products in the UK. The price for each of the selected products was extracted from either the Chemist and Druggist Monthly Price List or the Grocer Price List, for every month for the period 1 January 1987 to 31 December 1996.

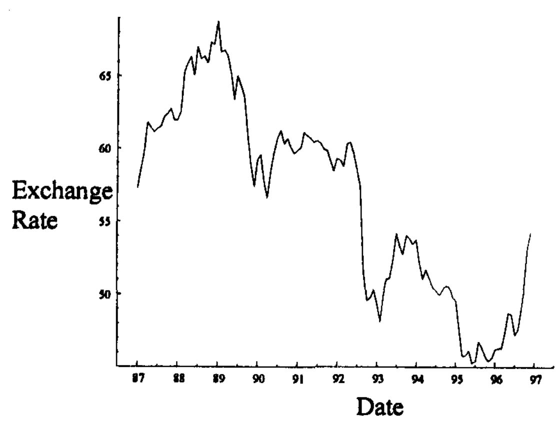
It is acknowledged that changes in underlying costs will affect product prices. The preferred method to determine these would have been to inspect the manufacturer's records for each individual product line. These were not available and a proxy had to be selected to control for a change in the product's underlying costs. The proxy that was chosen was the relevant country price index as movements therein should be broadly reflective of changes in the underlying costs of the manufacturing concern and the data is available at a monthly frequency. Changes in consumer's income will affect their purchasing patterns and to control for this, the index of UK industrial production was selected as a proxy variable that should adjust in line with consumers' incomes and is available monthly. Details of these variables were collected from International Financial Statistics. See appendix 2 to this chapter for further details.

4.2.3 Data Characteristics

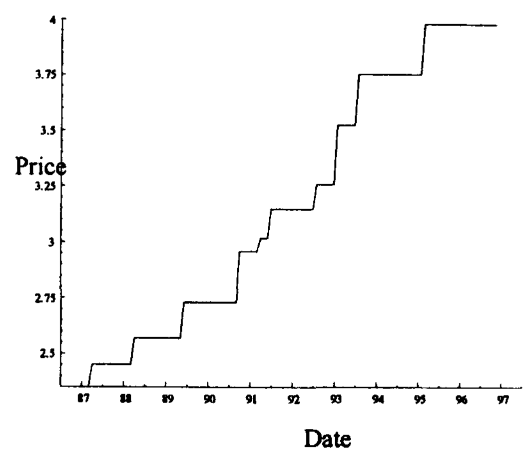
A graphical representation of the raw data for the prices of the selected groups of products and the exchange rate between the country of manufacture of the foreign good and sterling are presented below.

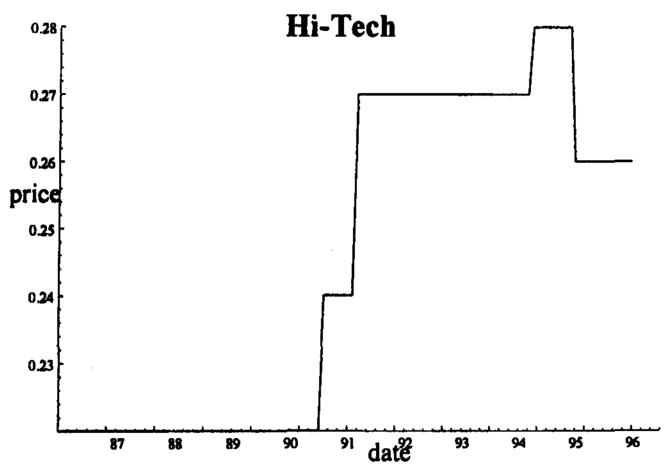
Battery Group

Belgian Franc

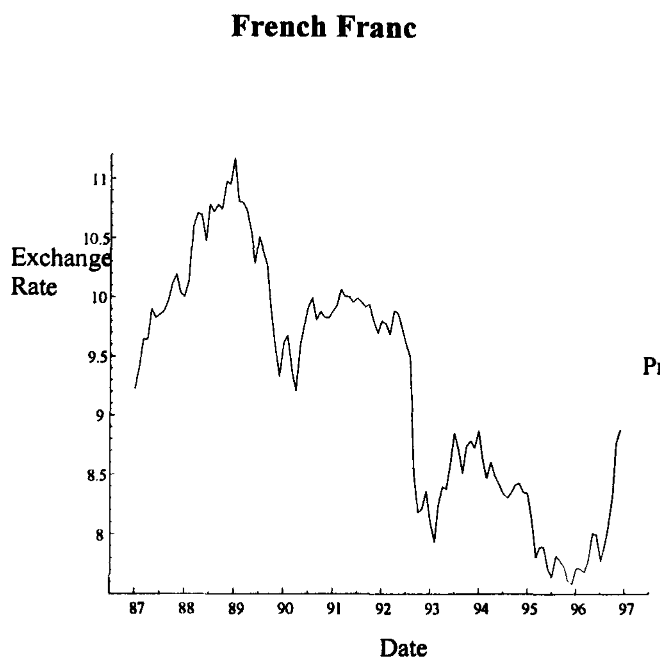


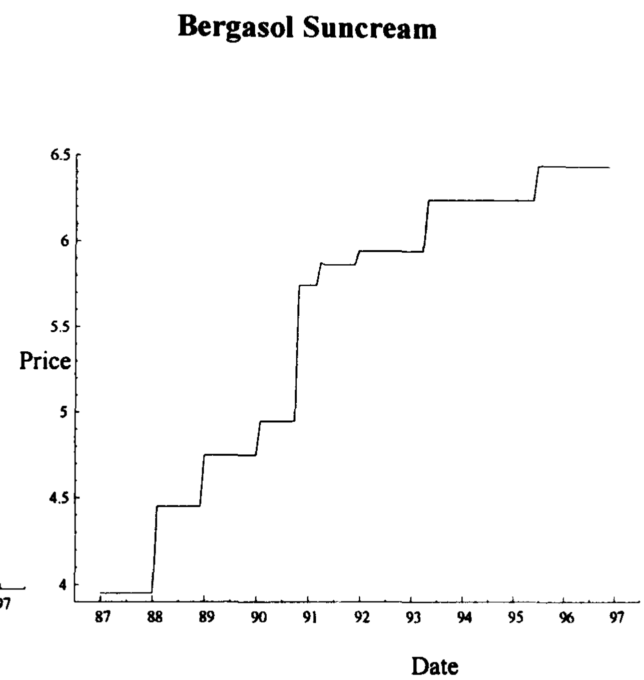
Duracell batteries

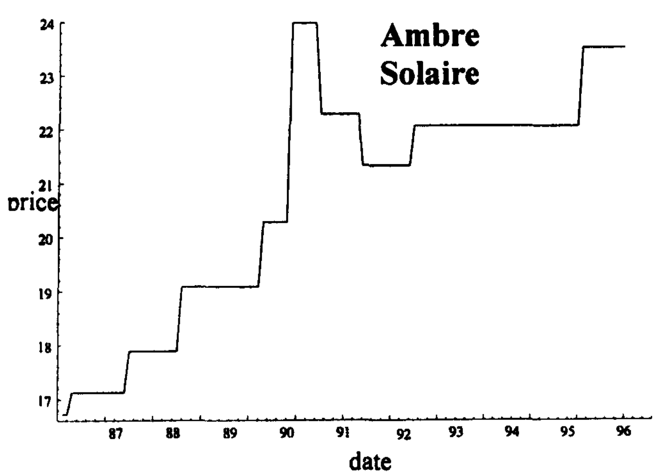




Suncream Group

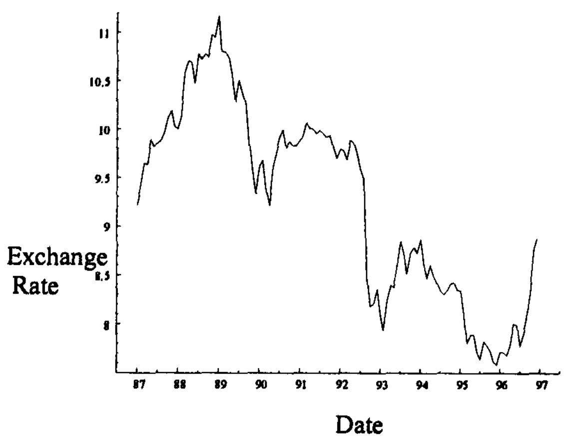




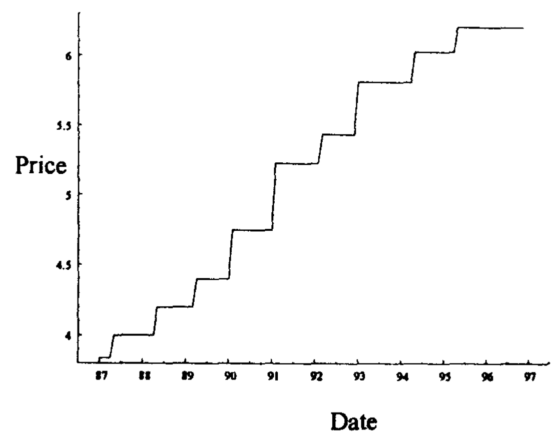


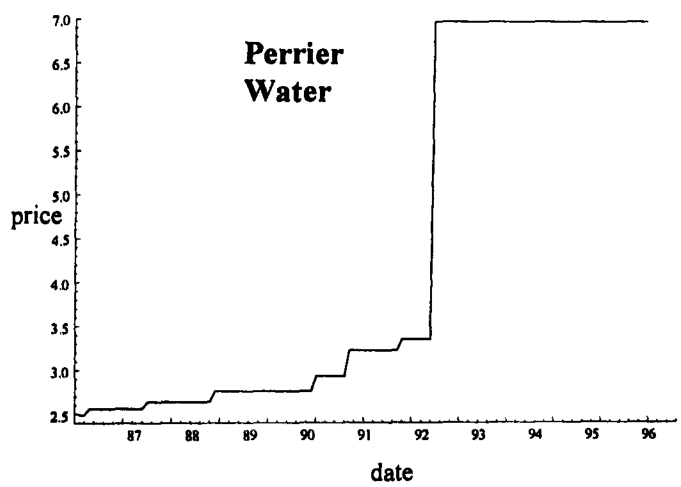
Water Group

French Franc



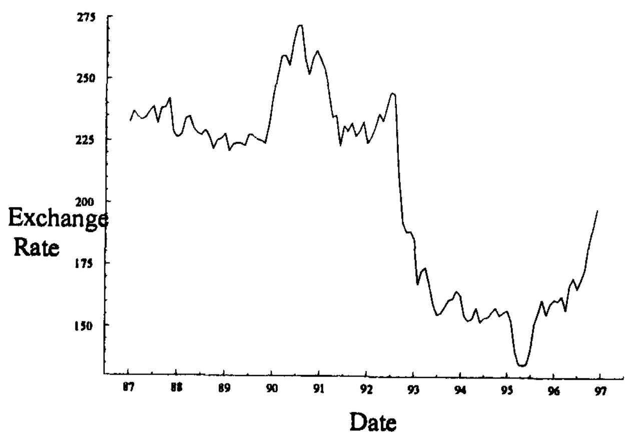
Evian Water



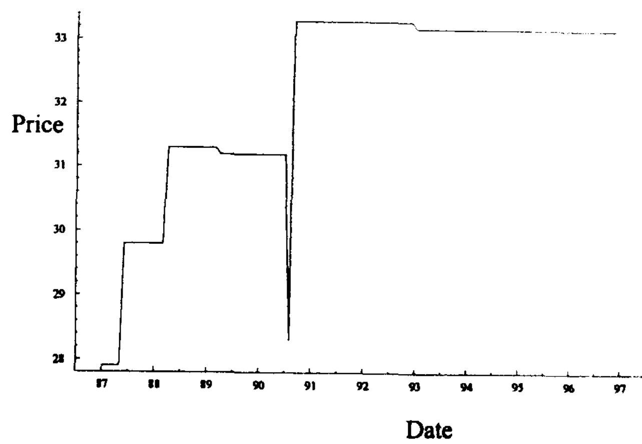


Film Group

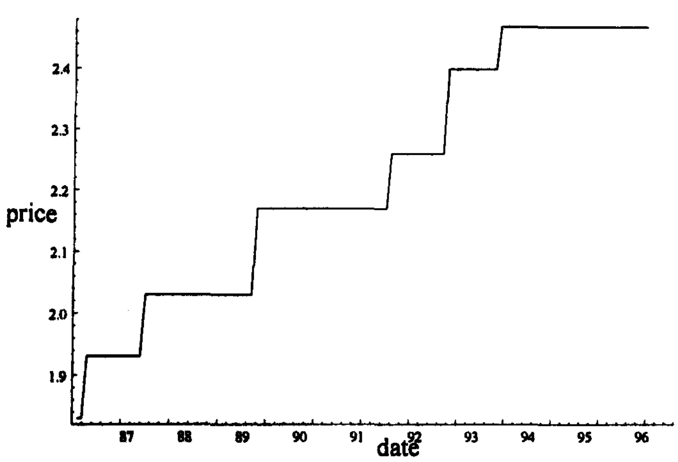
Japanese Yen



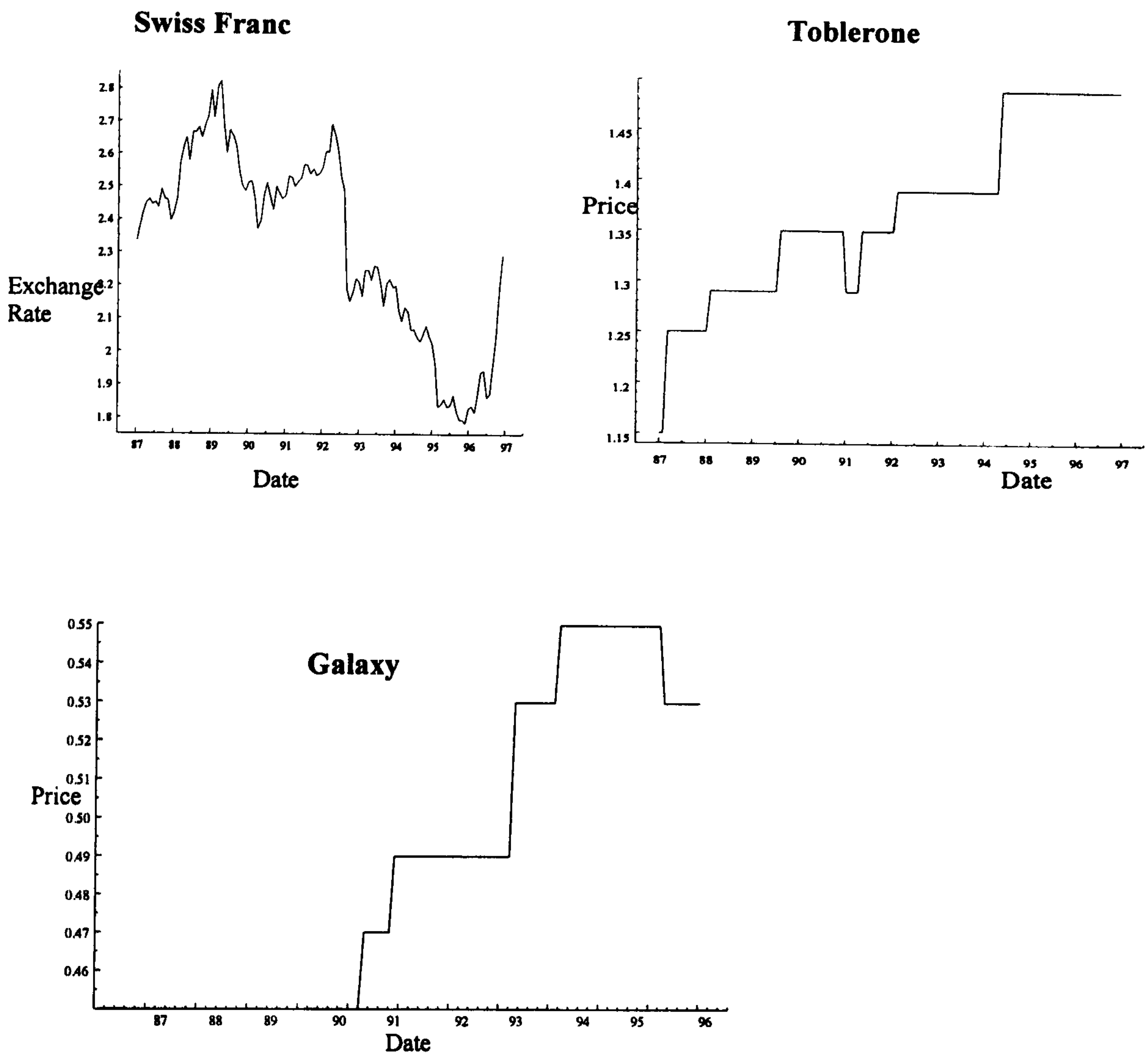
Fuji Film



Kodak film



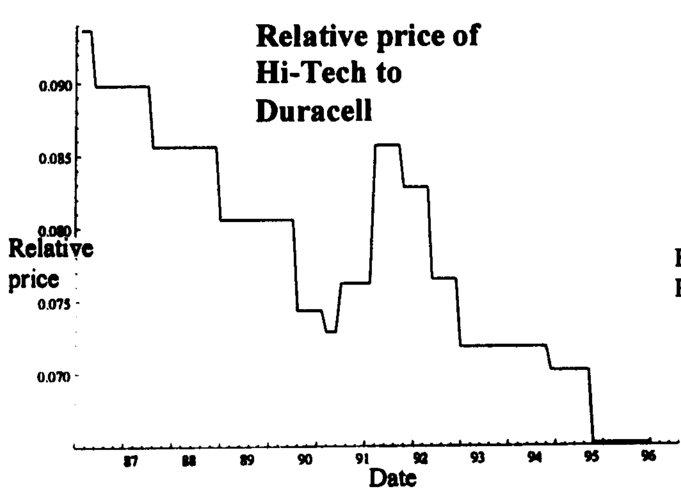
Confectionary Group



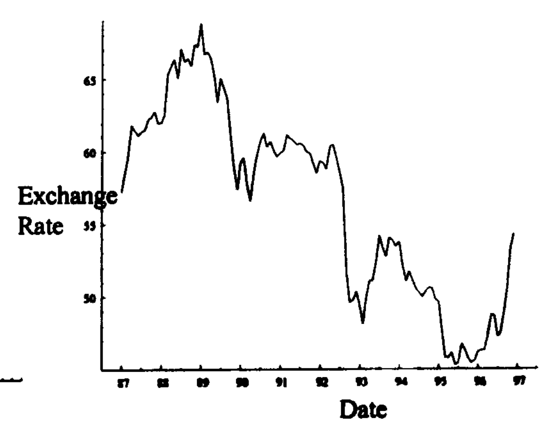
All of the currencies show relatively large positive and negative movements, the product prices, by contrast, display a picture of a rising trend. The *a priori* assumption for the relationship between exchange rates and the price of a good would be a negative response of the price as the firm adjusts its optimal price to reflect the change in its underlying costs brought about by the exchange rate shocks. Other factors will influence the pricing decision of the firm, such as changes in consumers' incomes and changes in other components of the firm's costs, but a review of the raw data without taking these factors into account would indicate that there seems to be little correlation between the movements in exchange rates and prices.

Where the price of a rival good is taken into account when making price change decisions, the ratio of the price of the home produced good to the foreign produced good should indicate the influence of competitive products on the firm's pricing decision. Price ratio and exchange rate graphs are shown below, consideration of these should indicate whether exchange rate changes can be attributed to an adjustment in the ratio of rival company prices.

Ratio of home to foreign price



Belgian Franc per Pound



Between 1987 and 1989 there was an increase in the number of Belgian francs that could be purchased for a pound, this should have led to an decrease in the relative price of Duracell batteries. The graph indicates that there was an decline in the relative price of the home produced good during 1987 to 1990 period which is the opposite effect. Subsequent changes in the exchange rates are also not reflected in the change in the price ratio. Accordingly, the impact of currency shocks does not seem to have the predicted impact on the relative prices of these two goods.

The change in the price of one good can often prompt a change in the price of a rival product. The timing and extent of price changes for both products was therefore investigated and the results are tabled below.

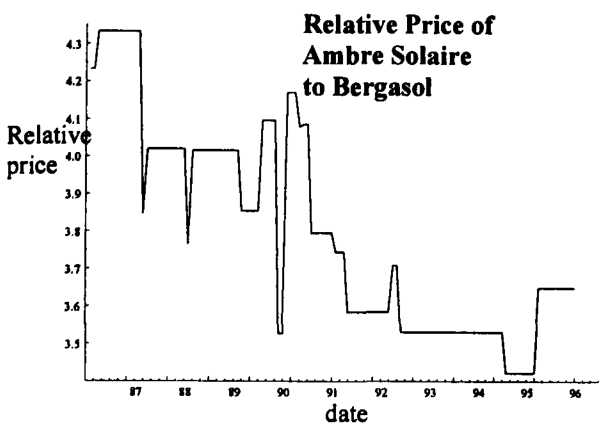
Table of price changes in Duracell and Hi-tech Batteries

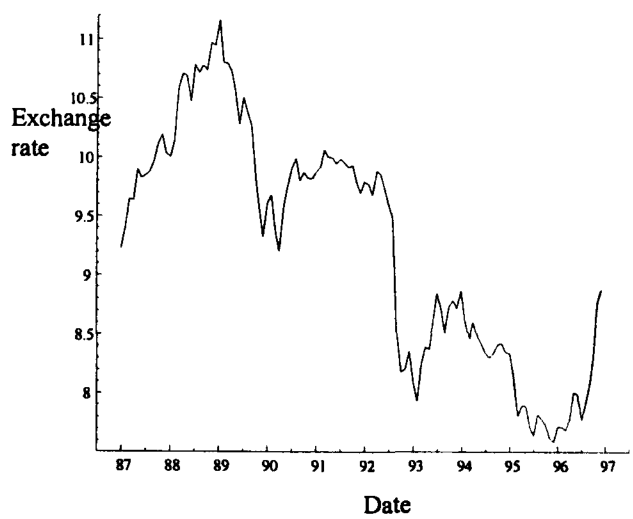
Date	% Price Increase Duracell	% Price Increase Hi-Tech
01/04/87	4.26	
01/04/88	4.90	
01/06/89	6.23	
01/10/90	8.42	
01/04/91	2.03	
01/07/91	4.30	9.09
01/02/92		12.50
01/08/92	3.49	
01/02/93	8.28	
01/08/93	6.52	
01/03/95	6.12	3.70
01/12/95		-7.14

The table highlights that the price changes in rival products does not seem to be a major influence on the pricing policy of the competitor.

The same exercise was then carried out for the Suncream group products:

Ratio of home to foreign price **French franc per Pound**





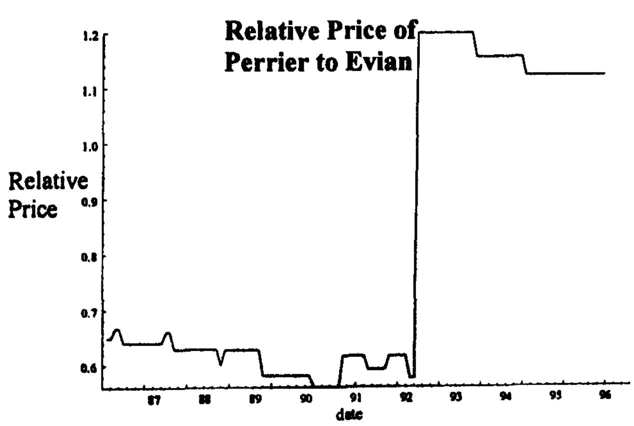
The period of appreciation of the pound against the French franc from 1987 to 1989 is reflected in an initial higher home to foreign good price ratio, although this is reversed later in 1987. Therefore, the higher costs of French exporters were passed through into Bergasol's prices, however the decline in sterling did not result in an increase in the foreign price ratio. Accordingly the signals on this product group are mixed.

The price increases highlight that Bergasol tends to be a price leader but Ambre Solaire, whilst following the price change, does not follow the level of increase, implying that net costs are passed through to the consumer.

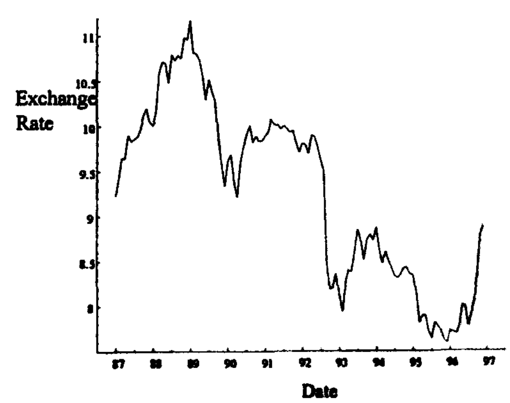
Date	% Price Increase Ambre Solaire	% Price Increase Bergasol
01/03/87	2.39	
01/02/88		12.66
01/03/88	4.50	
01/01/89		6.74
01/02/89	6.65	
01/02/90		4.21
01/07/90	6.29	
01/11/90		16.16
01/01/91	18.29	
01/04/91		2.26
01/05/91		-0.17
01/07/91	-7.13	
01/01/92		1.36
01/04/92	-4.26	
01/03/93	3.47	
01/05/93		5.04
01/07/95		3.20
01/03/96	6.66	

The exercise was then carried out for the Water group products:

Ratio of Foreign to foreign price



French Franc per Pound



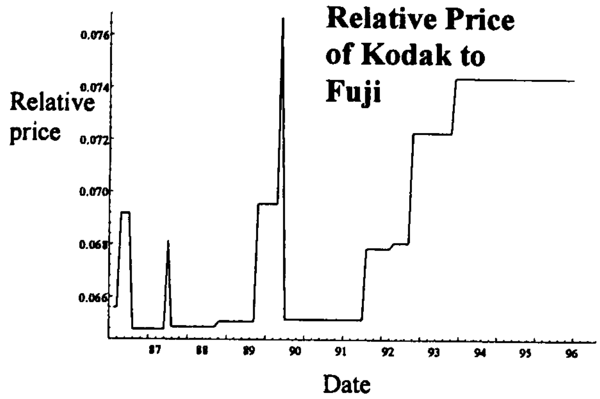
Both of the goods which are investigated in this market are imported from France. The impact of currency movements should have an identical impact on export prices, however the relative price of the goods has shown a substantial change in 1992/3.

Date	% Price Increase Perrier	% Price Increase Evian
01/03/87	2.81	
01/05/87		4.17
01/03/88	3.13	
01/05/88		5.00
01/04/89		4.76
01/05/89	4.55	
01/02/90		7.95
01/02/91	6.16	10.11
01/09/91	9.90	
01/03/92		4.02
01/08/92	4.04	
01/01/93		6.99
01/03/93	108.36	
01/05/94		3.78
01/05/95		2.98

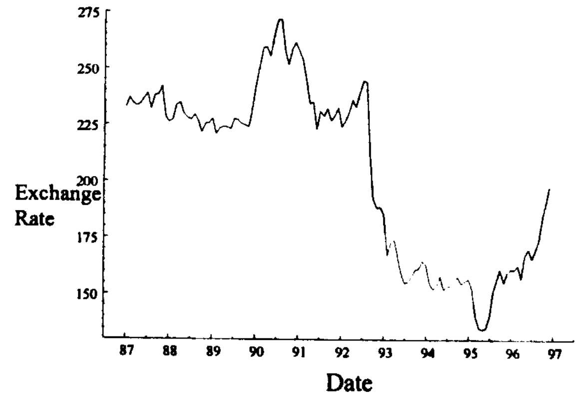
In addition Perrier appears to be the leader in price adjustments in the UK market, although there is no consistency in the level of the changes between the firms.

The exercise was then carried out for the Film group products:

Ratio of home to foreign price



Japanese Yen per Pound



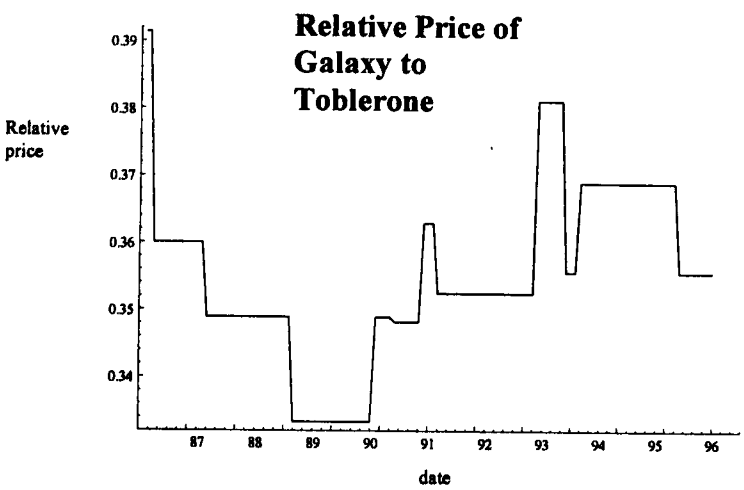
Whilst there was relatively little change in relative prices until 1992, there was then a significant increase in the ratio of the price of the home good to the foreign produced good. This increase in price ratio coincides with an appreciation of the pound with the Japanese Yen. Lower costs to the exporting firm were therefore passed through into the UK market.

Date	% Price Increase Fuji	% Price Increase Kodak
01/03/87		5.46
01/06/87	6.81	
01/03/88		5.18
01/04/88	5.03	
01/04/89	-0.32	
01/08/90	-9.29	
01/09/90	17.67	
01/06/92		4.15
01/01/93	-0.30	
01/06/93		6.19
01/05/94		2.92

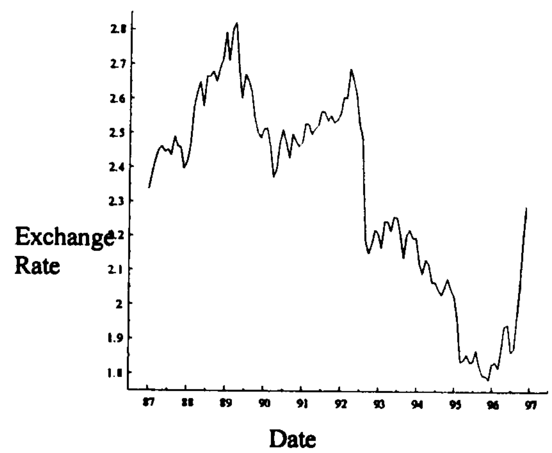
The timing of price changes reveals that there is no apparent co-ordination in this market, further emphasising that exchange rate changes are being passed through to consumers.

The exercise was then carried out for the Confectionary group products:

Ratio of home to foreign price



Swiss Franc per Pound



After an initial rapid decline in the period to 1989, the price ratio of the home to the foreign good showed a consistent increase until 1993 and has then been erratic. This corresponds with a appreciation of sterling until 1989, which resulted in Swiss exporters increasing their relative prices, the subsequent depreciation has seen this trend reversed.

Date	% Price Increase Galaxy	% Price Increase Toblerone
01/03/87		8.70
01/02/88		3.20
01/08/89		4.65
01/01/91		-4.44
01/05/91	4.44	4.65
01/11/91	4.26	
01/02/92		2.96
01/11/93	8.16	
01/05/94		7.19
01/08/94	3.77	
01/05/96	-3.64	

The timing of price increases would appear to indicate that manufacturers in this sector pass through cost changes rather than follow the lead of rival companies.

The overall conclusions that can be drawn from the review of the raw data is that whilst companies do not appear to adjust prices to account for changes in exchange rates there is evidence that some relative price ratios are adjusted to reflect currency shocks. Additionally, whilst there is little evidence of price leadership behaviour in any of the groups, there is some pattern of response between firms. Further statistical investigation will be undertaken to consider the responses of firms to exchange rate changes allowing for changes in underlying cost structures and also accounting for responses to competitors in section 4.4.

4.3 Derivation of Estimating Equations.

The theoretical models that have been used to underpin the empirical work to date have been primarily static in nature. This can be defended if the process of exchange rate pass-through can be viewed as the firm's price moving from one long run equilibrium position to another within the firm's optimising period. Under this hypothesis the firm can be considered to be a profit maximiser which optimises for a single period.

If an exporting firm which sells its output x_1 in a foreign market at price p_1, is considered, then its profit for period t can be stated in the local currency as:

$$V_t = [p_{1t} - s_t\phi_{1t}]x_{1t}(p_{1t}, p_{2t}, I_t) \tag{4.1}$$

where V_t is the firm's profit,

p_{1t} the price,

s_t the bilateral exchange rate

ϕ_{1t} the firm's marginal costs (assumed to be independent of the level of x_{1t}).

x_{1t} the firm's output,

p_{2t} the price of a competing good,

I_t the consumers' income.

Assuming the firm is a profit maximiser with price as it's only decision variable, then if the firm optimises for one period:

$$\frac{dV_t}{dp_t} = (p_{1t} - s_t\phi_{1t})\frac{dx_{1t}}{dp_{1t}} + x_{1t}(p_{1t}, p_{2t}, I_t) = 0, \tag{4.2}$$

and this can be re-arranged, following Feenstra (1989) to give:

$$s_t\phi_{1t} = p_{1t}[1 - \frac{1}{\varepsilon_1}] \equiv r[p_{1t}, p_{2t}, I_t], \tag{4.3}$$

where ε_1 is the positive price elasticity of demand $(-\frac{\delta x_1}{\delta p_1}\frac{p_{1t}}{x_{1t}})$, and $r[p_{1t}, p_{2t}, I_t]$ denotes marginal revenue.

Equation (4.3) can then be inverted into the general form:

$$p_{1t} = \pi(p_{2t}, \phi_{1t}, I_t, s_t) \tag{4.4}$$

The pass-through of exchange rate movements into prices is the partial differential of price with respect to exchange rates, i.e.

$$\frac{\delta p_{1t}}{\delta s_t} = \frac{\phi_{1t}}{1 - \dfrac{1}{\varepsilon_1}}$$

which must take a positive value if the firm adopts a profit maximising strategy, (as $\varepsilon_1 > 1$ in the initial equilibrium).

To illustrate the range of possible outcomes, a linear and an iso-elastic demand function were substituted into equation (4.2) to replace the general demand function, the *t* subscript being suppressed to simplify the discussion.

Letting the demand function take the linear form,

$$x_1 = a - b_1 p_1 + b_2 p_2 + c_1 I$$

and substituting this into equation (4.2) gives:

$$0 = a - 2b_1 p_1 + b_2 p_2 + c_1 I + b_1 s \phi_1 \tag{4.2a}$$

which can be re-arranged to give a pricing equation:

$$p_1 = \frac{a + b_2 p_2 + c_1 I}{2b_1} + \frac{s\phi_1}{2}$$

If the demand function takes the iso-elastic form:

$$x_1 = a p_1^{-b_1} p_2^{b_2} I^{c_1}$$

and substituting this into equation (4.2) gives:

$$0 = ap_1^{-b_1} p_2^{b_2} I^{c_1} + b_1 s \phi_1 a p_1^{-b_1 -1} p_2^{b_2} I^{c_1} - b_1 a p_1^{-b_1} p_2^{b_2} I^{c_1} \qquad (4.2b)$$

and this can be re-arranged to give a pricing equation:

$$p_1 = \frac{b_1}{b_1 - 1} s \phi_1$$

the partial derivatives are:

	Linear Demand	Iso-elastic Demand
Exchange rate pass through:	$\frac{\partial p_1}{\partial s} = \frac{\phi_1}{2}$	$\frac{\partial p_1}{\partial s} = \frac{b_1}{b_1 - 1}\phi_1$
Cost pass through:	$\frac{\partial p_1}{\partial \phi_1} = \frac{s}{2}$	$\frac{\partial p_1}{\partial \phi_1} = \frac{b_1}{b_1 - 1} s$
Alternative good price pass through:	$\frac{\partial p_1}{\partial p_2} = \frac{b_2}{2b_1}$	$\frac{\partial p_1}{\partial p_2} = 0$
Consumer income pass through:	$\frac{\partial p_1}{\partial I} = \frac{c_1}{2b_1}$	$\frac{\partial p_1}{\partial I} = 0$

All of the partial derivatives will be positively signed under the linear demand form for a normal good.

Whereas, under an iso-elastic demand form, the exchange rate and cost pass throughs will both be positively signed as b_1 must be greater than 1 to ensure that the price is non-negative, due to the properties of the iso-elastic demand curve, both the alternative good and income pass throughs will be zero.

If the demand function takes a linear form exchange rate pass through will be half of the relevant cost component, whereas under an iso-elastic form exchange rate pass through will vary, and is dependant upon the size of the own price exponent. A similar form of pass through is seen for cost adjustments. Alternative goods price pass through and Consumer income pass through are found to have a positive impact under a linear specification, however changes in alternative goods prices and consumers incomes do not cause any price adjustment under the restrictions of an iso-elastic demand function.

But these results assume that competitors prices are exogenous. It is likely that equilibrium prices, for both p_1 and p_2, are determined endogenously, in which case a change in any exogenous variable will effect the equilibrium values of both prices. The analysis will be extended to consider the case of a duopoly, letting demand take the linear form for firm 1:

$$x_1 = a - b_1 p_1 + b_2 p_2 + c_1 I_1$$

and for firm 2:

$$x_2 = \alpha + \beta_1 p_1 - \beta_2 p_2 + \gamma_1 I_1$$

but allow firm 2 to manufacture the good in the domestic market thereby removing the exchange rate from the cost equation for this firm.

Substituting these functions into equation (4.2) gives for firm 1:

$$0 = a - 2b_1 p_1 + b_2 p_2 + c_1 I + b_1 s\phi_1 \tag{4.2c}$$

and for firm 2:

$$0 = \alpha + \beta_1 p_1 - 2\beta_2 p_2 + \gamma_2 I + \beta_2 \phi_2 \qquad (4.2d)$$

Solving these simultaneously gives the duopoly prices:

$$p_1 = \frac{2\beta_2[a + b_1 s\phi_1 + c_1 I] + b_2[\alpha + \beta_2\phi_2 + \gamma_2 I]}{4b_1\beta_2 - b_2\beta_1}$$

$$p_2 = \frac{2b_1[\alpha + \beta_2\phi_2 + \gamma_2 I] + \beta_1[a + b_1 s\phi_1 + c_1 I]}{4b_1\beta_2 - b_2\beta_1}$$

the denominator will be positive for all positive prices of good 1 and 2[8], as all of the terms in the numerator are positive.

If the demand function takes the iso-elastic form then for firm 1:

$$x_1 = ap_1^{-b_1} p_2^{b_2} I^{c_1}$$

and for firm 2:

$$x_2 = \alpha p_1^{-\beta_1} p_2^{\beta_2} I^{\gamma_2}$$

then solving simultaneously as before gives:

$$p_1 = \frac{b_1}{b_1 - 1} s\phi_1$$

$$p_2 = \frac{\beta_2}{\beta_2 - 1}\phi_2$$

[8] This condition also ensures that the equilibrium is stable.

the partial derivatives are:

	Linear	Iso-elastic
Exchange rate pass through:	$\frac{\partial p_1}{\partial s}=\frac{2\beta_2 b_1\phi_1}{4b_1\beta_2-b_2\beta_1}$ $\frac{\partial p_2}{\partial s}=\frac{\beta_1 b_1\phi_1}{4b_1\beta_2-b_2\beta_1}$	$\frac{\partial p_1}{\partial s}=\frac{b_1}{b_1-1}\phi_1$ $\frac{\partial p_2}{\partial s}=0$
Cost pass through:	$\frac{\partial p_1}{\partial \phi_1}=\frac{2\beta_2 b_1 s}{4b_1\beta_2-b_2\beta_1}$ $\frac{\partial p_1}{\partial \phi_2}=\frac{\beta_2 b_2}{4b_1\beta_2-b_2\beta_1}$ $\frac{\partial p_2}{\partial \phi_1}=\frac{\beta_1 b_1 s}{4b_1\beta_2-b_2\beta_1}$ $\frac{\partial p_2}{\partial \phi_2}=\frac{2\beta_2 b_1}{4b_1\beta_2-b_2\beta_1}$	$\frac{\partial p_1}{\partial \phi_1}=\frac{b_1}{b_1-1}s$ $\frac{\partial p_1}{\partial \phi_2}=0$ $\frac{\partial p_2}{\partial \phi_1}=0$ $\frac{\partial p_2}{\partial \phi_2}=\frac{\beta_2}{\beta_2-1}$
Consumer income pass through:	$\frac{\partial p_1}{\partial I}=\frac{2\beta_2 c_1+b_2\gamma_2}{4b_1\beta_2-b_2\beta_1}$ $\frac{\partial p_2}{\partial I}=\frac{2b_1\gamma_2+\beta_1 c_1}{4b_1\beta_2-b_2\beta_1}$	$\frac{\partial p_1}{\partial I}=0$ $\frac{\partial p_2}{\partial I}=0$

All of the pass throughs will be positively signed under the linear demand form for a normal good, and they correspond with the standard results in this area. In particular the form of exchange rate pass through is identical to cost pass through.

Whereas under an iso-elastic demand form, the exchange rate and cost pass throughs will both be positively signed as b_1 and β_2 must be greater than 1 to ensure that the prices are non-negative, with the exception of firm 2 which manufactures domestically and does not change its price following an exchange rate shock. If firm 2 manufactures in the same country as firm 1 and they both export into the domestic market, the pass through elasticity for firm 2 will be positive. Consumer income pass through will, as in the single firm case, be zero due to the properties of the iso-elastic demand function.

To summarise: for a firm facing a linear demand function, all of pass throughs will be positive; for a firm facing an iso-elastic demand function, all of the pass throughs will also be positive except for changes in consumers' income which are not passed through by any firm. In the case of firms operating as duopolists, the exchange rate pass through of the domestic firm will be positive if the demand is linear but zero where demand is iso-elastic.

4. 4 Estimation Procedure.

The long run relationship will be estimated by parameterising (4.4) with the addition of a dummy term to account for the period of the United Kingdom's membership of the European exchange rate mechanism (*derm*) in the following logarithmic equivalent of the iso-elastic demand function:

$$\ln p_{1t} = v + w \ln p_{2t} + \sigma \ln s_t + \gamma \ln I_t + \chi \ln c_t + \xi derm_t + \mu_t \qquad (4.5)$$

Where v, w, σ, γ, χ, ξ, are the parameters to be estimated, μ_t is a random error and *ln* is the natural logarithm. The *derm* term is included to try and isolate the effect that the UK's entry into and exit from the European exchange rate mechanism might have had on firms' pass through behaviour. The iso-elastic demand form has been utilised as it is the form that is predominantly used in the literature.

One advantage of utilising the logarithmic form is that the parameters of the model represent the partial elasticities of the variables. The parameter σ can therefore be considered as the extent to which exchange rate changes are passed through into the price of the product that is being tested, i.e. the coefficient of exchange rate pass-through, provided that there is no interaction between the variables. To test for this, the estimation procedure will initially start with a system of equations in which each variable modelled as a function of all of the other variables, thereby allowing for interaction between all of the variables.

Although Bleaney (1997) and Marston (1990) show that cost effects can be removed under reasonable assumptions by deflating expression (3.5) by domestic output prices, a measure of costs has been included to test whether this premise holds within the industries being considered. It must be highlighted that the specification used, as is standard in this literature, implicitly assumes that all competition in the market is price competition rather than product attribute enhancement and also that consumer tastes have remained static over the period under review.

The response of the firm when it is away from this long run position will be considered by adopting an equilibrium correction model approach. It is recognised that the theoretical models that underpin the empirical model do not anticipate prices being away from their equilibrium position. Rather prices are assumed to change continuously from one equilibrium position to the next equilibrium position. However, under the assumption that the variables in the models cointegrate, following the Grainger Representation Theorem there must be an error correction model corresponding to the long run solution and this off-equilibrium position will be estimated using the following form:

$$\begin{aligned}\Delta \ln p_t &= V(L)\Delta \ln p_{t-1} + W(L)\Delta \ln q_t + X(L)\Delta \ln s_t + M(L)\Delta \ln I_t \\ &\quad + R(L)\Delta \ln c_t + \Sigma \hat{\mu}_{t-1} + \varpi_t \end{aligned} \qquad (4.6)$$

Where $\hat{\mu}$ is the residual from the long run relationship and *M(L), R(L), V(L), W(L), X(L)* are polynomials in the lag operator and ϖ_t is an error term. Additionally, this model will be run as a system of equations in a manner that corresponds with the approach taken with the long run system.

The existence of cointegration between the variables and corresponding error correction models further questions the predominant one period theoretical models.

4.5 Data Description and Results.

Before considering the long run relationships in detail, it is first necessary to determine the underlying properties of the processes that generate the time series variables. In particular it is necessary to determine whether these series are stationary. If the series that are modelled are not stationary then this can lead to problems of 'spurious regression' (Granger and Newbold 1974).

To determine the stationarity properties of the price series, Augmented Dickey-Fuller (ADF) tests were run to establish whether the series contained a unit root and by differencing the series to identify the level of integration. Following Dickey and Fuller 1979, the series were tested to establish whether they contained a trend by regressing the variable against a lag of itself and a trend dummy. Where the trend was found to be a significant variable in the regression, it was incorporated into the ADF test for unit roots. Where it was not significant then the ADF test was run with a constant but no trend term.

As the data has a monthly frequency an initial lag length of 13 was selected for the ADF test, and the number of lags was then systematically reduced until a significant lag length was found. The resulting lag length was then used for the ADF test of the series in levels and Table 1 below gives the results of these tests. The same procedure was then applied to the first differences of each series.

Table 1.

ADF Statistics[9].

Logged Series	Constant, trend	t-statistic levels	t-statistic first difference
Duracell	c, t	-2.3214	-3.9960**
Hi-tech	c	-1.3739	-10.246**
Bergasol	c	-1.7061	-10.598**
Ambre Solaire	c	-1.8519	-10.500**
Fuji Film	c, t	-3.2605	-10.569**
Kodak Film	c, t	-2.5140	-11.680**
Evian	c, t	+0.9095	-10.896**
Perrier	c	-0.6421	-10.326**
Toblerone	c, t	-3.0786	-6.3631**
Galaxy	c	-1.1011	-10.362**
Belgium price index	c, t	-2.2727	-9.4324**
French price index	c	-2.3862	-2.9304**
Japanese price index	c, t	-1.5869	-7.3994**
Swiss price index	c	-2.4192	-9.4832**
UK Industrial production	c	-0.02802	-4.4177**
French Franc	c, t	-1.4640	-8.5599**
Japanese Yen	c	-1.2526	-4.1409**
Belgian franc	c	-2.4886	-4.3407**
Swiss Franc	c	-1.3158	-8.0842**

From the results of Table 1, it is clear that unit roots cannot be rejected for the series in levels at the 5% significance level, but unit roots are rejected for all

[9] The critical values calculated from MacKinnon tables for variables with a constant and trend at 5% significance is –3.451 and at 1% significance is –4.044. With a constant but without a trend the 5% significance level is –2.888 and at 1% is –3.49. * Indicates rejection of the null hypothesis of non-stationarity at the 5% level and ** for rejection at the 1% level.

series in first differences. This indicates that the series are integrated of order one, I(1).

4.5.1 Modelling Approach.

Having established the level of integration of the series to be tested, the relationship between the I(1) variables that will be modelled must be investigated. The relationship detailed in (4.5) implies that the price of a product is a function of the specified variables but it does not consider that there could be, for example, a strategic pricing policy amongst the rival products. If this occurs then the price of the product could also act as a determinant of the price of the rival product, i.e. there could be endogeneity within the price formation process. Similarly, other variables could also interact with each other.

Following Johansen (1988), a system of equations will be developed that will allow each variable to be a function of all of the other variables to be tested together with lags of those variables. Testing will then be undertaken to determine whether any of these relationships are cointegrated and the order of the system established. Where series are cointegrated, even though they may contain stochastic trends, the linear combination of them will be stationary.

The first step is to test whether any or how many of the relationships that are modelled by the system are cointegrated. The modelling approach adopted is attributable to Johansen, (Johansen 1988). Initially a system was formulated of all the variables and 15 lags of each variable. The likely number of cointegrating vectors in the system were considered by reviewing the trace and max statistics which are likelihood ratio statistics of the correlation between the cointegrating relationships and the stationary part of the model. The lags of variables were then sequentially reduced until the system was found to have at least one cointegrating vector for which stationarity could not be rejected.

The results of this exercise are given in Appendix 1. In several of the models there is an indication, particularly when reviewing the max statistics, that is more than one cointegrating vector in the system. Economic theory usually provides for the prices of rival products to have an impact on one another and accordingly all the series were modelled with two cointegrating vectors, allowing this price interaction to be investigated.

It is necessary to establish the unique long run relationships between the variables in the system. The equilibrium matrices, generally termed Π, which were used to determine the cointegrating relationships are expressed as the product of two matrices, α and β, i.e. $\Pi_1 = \alpha_1\beta_1'$ and $\Pi_2 = \alpha_2\beta_2'$. Where $\alpha_{1,2}$ are matrices of error correction coefficients and can be thought of as speed of adjustment coefficients, and $\beta_{1,2}$ are matrices of cointegration or steady state vectors. Although the initial Π matrices are stationary, any linear combination of the elements of the matrices would also be stationary, however by placing restrictions on the α and β terms, unique long run relationships can be determined.

The strategy adopted in placing restrictions on the α and β matrices was to first exclude from the long run equations given by the β's, those variables which were considered from an economic perspective unlikely to play a role. For example, changes in foreign cost levels are unlikely to influence a domestic manufacturer, and consideration was given to the restrictions that are highlighted by the first order conditions in section 4.3. These exclusions were then augmented by removing those variables that played a statistically insignificant role in the price setting process. Similarly, restrictions were then placed on the speed of adjustment coefficients in the α matrices to determine, by setting these equal to zero, whether they were weakly exogenous to the system. After performing a LR test to confirm that the restrictions on the matrices could be accepted, the resulting unique relationships are reported below.

4.5.2 Empirical Results.

Appendix 2 lists all of the product lines that were selected and the groups into which they were placed. Each of the groups was given a generic name: Batteries; Suntan; Film; Water; Confectionery. These names reflect the type of products being tested in each system. For example in the battery group, Duracell is a battery that is manufactured in Belgium and is sold in the UK; Hi-tech is a rival product in the UK market.

The long run relationships and the relevant standard errors that were derived are recorded below, together with the overall test statistics. These are presented in a two-equation form of the general specification given in (4.5) and correspond to the firms' best response functions:

$$ln\,ap_t = v_1 + w_1\, ln\,bp_t + x_1\, ln\,s_t + m_1\, ln\,I_t + r_1\, ln\,c_t + \xi_1 derm_t + u_{1t}$$

$$ln\,bp_t = v_2 + w_2\, ln\,ap_t + x_2\, ln\,s_t + m_2\, ln\,I_t + r_2\, ln\,c_t + \xi_2 derm_t + u_{2t}$$

i.e. that the price of the imported product in each system, *ap*, that was tested, is a function of a constant term, *v,* the price of rival products, *bp*, the bilateral exchange rate, *s*, consumers' incomes, *I*, costs of manufacture, *c*, and a dummy to account for the period whilst the UK was part of the European exchange rate mechanism, *derm*. The price of the rival product, *bp*, is then expressed as a function of the same variables.

The initials of actual products are prefixed to the pricing term in the equations that follow; a table of these abbreviations is incorporated into table 4 below. The figures in parenthesis are standard errors.

Batteries.

$$\ln durp_t = \underset{(0.07)}{0.56} \ln htp_t + \underset{(0.07)}{0.46} \ln s_t + \underset{(0.18)}{2.1} \ln c_t + \underset{(0.06)}{0.67} I_t$$

$$\ln htp_t = \underset{(0.02)}{0.6} \ln durp_t - \underset{(0.08)}{0.38} \ln I_t$$

Suntan.

$$\ln berp_t = \underset{(0.18)}{1.7} \ln s_t + \underset{(0.32)}{5.4} \ln c_t$$

$$\ln asp_t = \underset{(0.03)}{0.56} berp_t$$

Film.

$$\ln fujp = \underset{(0.06)}{0.56} \ln kodp_t + \underset{(0.03)}{0.06} \ln s_t - \underset{(0.08)}{0.22} I_t$$

$$\ln kodp_t = \underset{(0.22)}{0.75} \ln fujp_t + \underset{(0.14)}{1.3} \ln I_t$$

Water.

$$\ln evip_t = \underset{(0.03)}{0.07} \ln perip_t - \underset{(0.1)}{0.26} \ln s_t + \underset{(0.21)}{1.7} \ln c_t - \underset{(0.13)}{0.37} I_t$$

$$\ln perip_t = \underset{(1.07)}{1.8} \ln s_t + \underset{(2.09)}{11.8} I_t$$

Confectionery.

$$ln\,tobp_t = \underset{(0.04)}{0.4}\,ln\,c_t + \underset{(0.07)}{0.32}\,ln\,I_t$$

$$ln\,galp_t = \underset{(0.12)}{1.17}\,ln\,tobp_t$$

Each of the long run solutions was tested to ensure that the results were not subject to any significant statistical problems. Diagnostic tests were run to check for autocorrelation, i.e. that the error terms from different observations are not serially correlated, and for heteroscedasticity, i.e. to confirm that the error terms have a constant variance.

Table 2.

Diagnostic Tests in the Long Run Model.

Test type	**Batteries**	**Suntan Creams**	**Films**	**Water**	**Confectionery**
Auto-correlation	1.2256	1.0376	1.2071	1.7085	0.7835
	(0.2330)	(0.4196)	(0.1794)	(0.003)**	(0.8476)
	F(50,53)	F(50,167)	F(50,235)	F(50,327)	F(50,327)
Hetero-scedasticity				0.6635	0.5939
				(1.00)	(1.00)
				F(600,488)	F(600,488)

The figures in parenthesis are probabilities and ** indicates significant at 1%. The diagnostic tests, with the exception of the autocorrelation test on the water system, do not highlight any problems with the results of the models.

Table 3.

Partial Elasticity Effects in the Long Run Model.

Product Group	prefix	Currency effect	Cost effect	Income effect	Alternative product effect
Batteries.					
Duracell	Dur	0.46	2.10	0.67	0.56
Hi-tech	Ht			-0.38	0.60
Suntan.					
Bergasol	Ber	1.70	5.40		
Ambre Solaire	As				0.56
Film.					
Fuji	Fuj	0.06		-0.22	0.56
Kodak	Kod			1.30	0.75
Water.					
Evian	Evi	-0.26	1.70	-0.37	0.07
Perrier	Peri	1.80		11.8	
Confectionery					
Toblerone	Tob		0.40	0.32	
Galaxy	Gal				1.17

The partial elasticities table shows the long run pass throughs for each of the product group prices. When the variable has no long run statistically significant impact it is omitted from the table. As discussed in Chapter 2, it is the practice in empirical studies of this area to construct the exchange rate variable so that the expected sign of the empirical exchange rate pass through coefficient is negative. This practice is continued here.

Three of the groups, Batteries, Suntan and Film have a positive empirical exchange rate elasticity. In the Water group, both of the selected products, Evian and Perrier, are manufactured in France. Evian has negative exchange rate pass through, whereas Perrier has positive pass through, this implies that the firms have significantly different pricing strategies. Finally, neither of the firms in the Confectionery sector pass through any currency changes into their prices, nor do the remainder of alternative products.

From the theoretical derivation of exchange rate pass through, it would be predicted that all of the principal products should undertake negative pass through. The alternative products should, with the exception of Perrier which is manufactured in the same country as Evian, display either negative or zero pass through dependant upon the model of competition and type of demand function that they face. Perrier should pass through exchange rate shocks negatively. The graphical analysis comparing the relative price ratios to movements in the bilateral exchange rate provides support for this conclusion.

The positive pass throughs of exchange rate shocks, found in the econometric models would imply that once all factors are controlled for firms do not react as predicted by theory. They might be operating in the inelastic portion of their demand curve, as they are adjusting prices to amplify the exchange rate shocks. This is counterintuitive in the context of the models that have been derived to date, as it implies that the firms are not setting price according to strict profit maximising rules. This will be investigated further in chapter 3, as will the finding of zero pass through in the Confectionery model.

The cost effects for the Battery, Suntan and Water models are all greater than one, whereas Toblerone in the Confectionery model only passes through forty percent of cost adjustments and there is no detectable pass through of costs in the Film model. The sign of the cost pass through agrees with the theoretical prediction with the exception of zero pass through for Films. As cost and currency effects are linked, as a consequence of the construction of this model, the finding that firms are passing through costs changes as predicted gives a further reason for the need to investigate the price setting behaviour of firms. It could be hypothesised that cost changes are perceived as permanent shifts to the total cost curve, whereas exchange rate shocks are deemed as temporary shifts.

The prediction of the iso-elastic form of product demand was that there would be no pass through of changes in consumers' income. Whereas the linear demand form anticipates a positive pass through of consumer income changes. Whilst most income pass throughs were positive, Hi-tech, Fuji and Evian display negative consumer income pass throughs, which implies that the consumers consider these goods to be Inferior. Hi-Tech is a relatively small brand of batteries and this hypothesis might have some credence, but it seems improbable in the case of Fuji and Evian and this lends further support to investigate the price setting behaviour of firms.

The Battery and Film models both have coefficients in the range 0.56 to 0.75 with respect to alternative products. This indicates that firms in these sectors react to the pricing strategy of competitors. In the Suntan and Confectionery models, only one of the firms takes account of the price of rival products, implying that the firm with a zero coefficient on the alternative product variable acts as a price leader in these markets. The firms in the Water market display little concern for the price of competitive products.

Overall, with the exception of the exchange rate pass through coefficients, the partial elasticities conform to the expected theoretical signs, and offer support for the hypothesis that the likely demand form faced by consumers is iso-elastic. In addition, the *derm* coefficient was not statistically significant in any of the models, implying that the entry into the European exchange rate mechanism did not alter the firms long run pass through strategy.

Short run, equilibrium correction models were then run using the first differences of the variables in each model, together with the lag of the error term from the relevant long run models, u_{t-1}. Insignificant variables were then deleted, using the Hendry general to specific procedure, with particular care taken to ensure that the overall model characteristics were not changed by reviewing the LR test of over-identifying restrictions. Additionally the test statistics were checked after each reduction to ensure that Gaussian errors were not being introduced, and heteroscedasticity adjusted standard errors (HCSE) were used to counteract the impact of heteroscedasticity and autocorrelation that could be introduced during the reduction process. The resultant parsimonious models are presented in the same two-equation form as the long run system but in the general form as given in (3.6):

$$\begin{aligned} \Delta L\, ln\, ap_t &= V_1(L)\Delta ln\, ap_{t-1} + W_1(L)\Delta ln\, bp_t + X_1(L)\Delta ln\, s_t + M_1(L)\Delta ln\, i_t \\ &\quad + R_1(L) ln\, c_t + \Sigma_1 \hat{u}_{t-1} + \varpi_{1t} \\ \Delta L\, ln\, bp_t &= V_2(L)\Delta ln\, bp_{t-1} + W_2(L)\Delta ln\, ap_t + X_2(L)\Delta ln\, s_t + M_2(L)\Delta ln\, i_t \\ &\quad + R_2(L) ln\, c_t + \Sigma_2 \hat{u}_{t-1} + \varpi_{2t} \end{aligned}$$

The results for the equilibrium correction models for each of the product groups are given below, the figures in parenthesis are standard errors.

Batteries

$$\Delta \ln durp_t = -0.004 + \underset{(0.087)}{0.307}\,\Delta \ln durp_{t-6} - \underset{(0.078)}{0.2}\,\Delta \ln durp_{t-12} + \underset{(0.156)}{0.331}\,\Delta \ln htp_{t-12} + \underset{(0.07)}{0.13}\,\Delta \ln s_{t-9}$$
$$- \underset{(0.067)}{0.19}\,\Delta \ln s_{t-10} - \underset{(0.077)}{0.178}\,\Delta \ln s_{t-12} + \underset{(0.61)}{1.41}\,\Delta \ln c_{t-1} + \underset{(0.436)}{1.22}\,\Delta \ln c_{t-9}$$
$$+ \underset{(0.517)}{1.15}\,\Delta \ln c_{t-11} - \underset{(0.51)}{1.03}\,\Delta \ln c_{t-12} + \underset{(0.462)}{0.81}\,\Delta \ln c_{t-13} - \underset{(0.46)}{0.56}\,\Delta \ln c_{t-14}$$
$$- \underset{(0.13)}{0.13}\,\Delta \ln I_{t-2} - \underset{(0.15)}{0.2}\,\Delta \ln I_{t-3} + \underset{(0.12)}{0.12}\,\Delta \ln I_{t-4} - \underset{(0.15)}{0.3}\,\Delta \ln I_{t-5}$$
$$+ \underset{(0.1)}{0.17}\,\Delta \ln I_{t-11} + \underset{(0.14)}{0.12}\,\Delta \ln I_{t-13} + \underset{(0.11)}{0.21}\,\Delta \ln I_{t-14} - \underset{(0.12)}{0.294}\,udur_{t\ 1}$$

$$\Delta \ln htp_t = -0.0003 - \underset{(0.143)}{0.301}\,\Delta \ln durp_{t-1} - \underset{(0.062)}{0.11}\,\Delta \ln durp_{t-13} - \underset{(0.057)}{0.119}\,\Delta \ln htp_{t-4} + \underset{(0.24)}{0.31}\,\Delta \ln htp_{t-7}$$
$$+ \underset{(0.086)}{0.105}\,\Delta \ln s_{t-10} - \underset{(0.83)}{1.47}\,\Delta \ln c_{t-4} + \underset{(0.95)}{1.41}\,\Delta \ln c_{t-10} + \underset{(0.57)}{0.845}\,\Delta \ln c_{t-12}$$
$$+ \underset{(0.154)}{0.209}\,\Delta \ln I_{t-2} + \underset{(0.147)}{0.278}\,\Delta \ln I_{t-5} - \underset{(0.139)}{0.19}\,\Delta \ln I_{t-6} + \underset{(0.212)}{0.374}\,\Delta \ln I_{t-8}$$
$$- \underset{(0.147)}{0.331}\,\Delta \ln I_{t-10} + \underset{(0.004)}{0.008}\,derm + \underset{(0.225)}{0.36}\,udur_{t-1}$$

Suntan Creams.

$$\Delta \ln berp_t = -0.005 + \underset{(0.149)}{0.144}\,\Delta \ln asp_{t\ 4} - \underset{(0.091)}{0.24}\,\Delta \ln s_{t-8} + \underset{(1.22)}{1.856}\,\Delta \ln c_{t-3} + \underset{(0.277)}{0.334}\,\Delta \ln I_{t-5}$$
$$+ \underset{(0.177)}{0.351}\,\Delta \ln I_{t-7} + \underset{(0.158)}{0.277}\,\Delta \ln I_{t-10} + \underset{(0.007)}{0.01}\,derm - \underset{(0.264)}{0.473}\,beru_{t-1}$$

$$\Delta \ln asp_t = -0.007 - \underset{(0.177)}{0.54}\,\Delta \ln berp_{t-3} - \underset{(0.113)}{0.295}\,\Delta \ln berp_{t-4} - \underset{(0.117)}{0.273}\,\Delta \ln berp_{t-5} - \underset{(0.104)}{0.32}\,\Delta \ln berp_{t-6}$$
$$- \underset{(0.107)}{0.342}\,\Delta \ln berp_{t-8} - \underset{(0.075)}{0.241}\,\Delta \ln berp_{t-10} + \underset{(0.357)}{1.261}\,\Delta \ln asp_{t-1} + \underset{(0.112)}{0.248}\,\Delta \ln asp_{t-2}$$
$$+ \underset{(0.098)}{0.237}\,\Delta \ln asp_{t-3} + \underset{(0.077)}{0.175}\,\Delta \ln asp_{t-5} + \underset{(0.158)}{0.296}\,\Delta \ln asp_{t-6} + \underset{(0.98)}{0.243}\,\Delta \ln asp_{t-9}$$
$$+ \underset{(0.116)}{0.396}\,\Delta \ln s_t - \underset{(0.131)}{0.471}\,\Delta \ln s_{t-4} + \underset{(0.132)}{0.4}\,\Delta \ln s_{t-5} - \underset{(0.106)}{0.302}\,\Delta \ln s_{t-6}$$
$$+ \underset{(0.086)}{0.224}\,\Delta \ln s_{t-7} + \underset{(0.097)}{0.193}\,\Delta \ln s_{t-8} - \underset{(0.101)}{0.322}\,\Delta \ln s_{t-9} + \underset{(0.089)}{0.165}\,s_{t-10} + \underset{(1.019)}{3.336}\,\Delta \ln c_t$$
$$+ \underset{(1.12)}{1.61}\,\Delta \ln c_{t-3} + \underset{(1.103)}{2.47}\,\Delta \ln c_{t-4} - \underset{(1.124)}{2.241}\,c_{t-6} - \underset{(1.201)}{2.268}\,\Delta \ln c_{t-8} - \underset{(0.204)}{0.414}\,\Delta \ln I_t$$
$$- \underset{(0.175)}{0.3}\,\Delta \ln I_{t-1} + \underset{(0.254)}{0.605}\,I_{t-2} + \underset{(0.316)}{1.22}\,\Delta \ln I_{t-3} - \underset{(0.184)}{0.595}\,\Delta \ln I_{t-4} + \underset{(0.244)}{0.589}\,\Delta \ln I_{t-7} + \underset{(0.165)}{0.433}\,I_{t-9}$$
$$+ \underset{(0.008)}{0.019}\,\Delta derm - \underset{(0.443)}{1.65}\,asu_{t-1}$$

Films.

$$\Delta \ln fujp_t = -0.001 + \underset{(0.202)}{0.568} \Delta \ln kodp_{t-1} - \underset{(0.332)}{0.353} \Delta \ln kodp_{t-6} + \underset{(0.275)}{0.792} \Delta \ln kodp_{t-7}$$
$$+ \underset{(0.157)}{0.261} \Delta \ln I_{t-1} - \underset{(0.132)}{0.476} \Delta \ln I_{t-2} - \underset{(0.278)}{0.945} \Delta \ln fuju_{t-1} - \underset{(0.263)}{0.56} kodu_{t-1}$$

$$\Delta \ln kodp_t = 0.002 - \underset{(0.361)}{0.591} \Delta \ln c_{t-2} + \underset{(0.029)}{0.049} \Delta \ln s_{t-2}$$

Water.

$$\Delta \ln evip_t = -0.002 + \underset{(0.329)}{0.807} \Delta \ln evip_{t-1} + \underset{(0.168)}{0.24} \Delta \ln evip_{t-3} - \underset{(0.101)}{0.169} \Delta \ln perip_{t-1} - \underset{(0.82)}{0.14} \Delta \ln s_{t-2}$$
$$- \underset{(0.078)}{0.117} \Delta \ln s_{t-3} + \underset{(0.99)}{1.52} \Delta \ln c_{t-1} - \underset{(0.438)}{1.13} \Delta \ln eviu_{t-1} + \underset{(0.108)}{0.169} \Delta \ln periu_{t-1}$$

$$\Delta \ln perip_t = 0.003 + \underset{(1.64)}{1.718} \Delta \ln evip_{t-2} + \underset{(0.486)}{0566} \Delta \ln s_t$$

Confectionery.

$$\Delta \ln tobp_t = 0.0001 + \underset{(0.325)}{0.562} \Delta \ln tobp_{t-1} - \underset{(0.321)}{0.645} \Delta \ln c_{t-2} + \underset{(0.454)}{0.766} \Delta \ln c_{t-3} - \underset{(0.431)}{0.73} tobu_{t-1}$$

$$\Delta \ln galp_t = -0006 + \underset{(0.12)}{0.248} \Delta \ln tobp_{t-1} + \underset{(0.463)}{0.714} \Delta \ln c_t - \underset{(0.174)}{0.364} tobu_{t-1}$$

Diagnostic tests were then run on each model to ensure that there were no significant statistical problems within the reported results. The tests were the same as those applied on the long run models, with the exception that a test was run to ensure that as the models were reduced in complexity by the deletion of insignificant variables, that the final models were not over-identified.

Table 4.

Diagnostic Tests in the Short Run Model.

Test type	**Batteries**	**Suntan Cream**	**Films**	**Water**	**Confectionery**
Auto-correlation	0.421	1.803	0.31645	0.50809	0.33305
	(0.9071)	(0.0802)	(0.9592)	(0.8494)	(0.9524)
	F(8,156)	F(8,158)	F(8,192)	F(8,190)	F(8,194)
Hetero-scedasticity				1.0973	0.80552
				(0.2869)	(0.8992)
				F(123,168)	F(123,174)
Over-identifying Restrictions	142.87	78.523	87.618	28.0339	21.1779
	(0.0522)	(0.2270)	(0.1167)	(0.6677)	(0.9683)
	$\chi^2(117)$	$\chi^2(70)$	$\chi^2(73)$	$\chi^2(32)$	$\chi^2(35)$

The figures in parenthesis are probabilities. The diagnostic tests do not highlight any significant problems with the results of the models.

A summary of the cumulative effects within each of the error correction models is given below:

Table 5.

Cumulative Effects in the Short Run Model

Product Group	Currency Effects	Cost Effects	Income Effects	Rival Product Effects	Own price Effects	ECM effects
Batteries						
Duracell	-0.24	3.01	-0.01	0.33	0.44	-0.29
Hi-tech	0.11	0.85	0.34	-0.41	0.19	0.36
Suntan Cream						
Bergasol	- 0.24	1.86	0.96	0.14	0.00	-0.47
Ambre Solaire	0.28	2.93	1.95	2.46	-2.01	-1.65
Films						
Fuji	0.00	0.00	0.22	1.01	0.00	-0.95 -0.56
Kodak	0.05	-0.59	0.00	0.00	0.00	0.00
Water						
Evian	-0.25	1.52	0.00	-0.17	1.05	-1.13 0.17
Perrier	0.57	0.00	0.00	1.72	0.00	0.00
Confectionery						
Toblerone	0.00	0.12	0.00	0.00	0.56	-0.73
Galaxy	0.71	0.00	0.00	0.25	0.00	-0.36

The cumulative short run effects are difficult to interpret, as they do not appear to show any pattern of response between or within the models.

The existence of error correction models for each of the product groups containing statistically significant equilibrium correction terms provides further evidence that firms are allowing their prices to be away from the equilibrium position.

4.6 Comparison with Previous Results

The results that have been obtained from the disaggregated data set provide a different slant on the exchange rate pass through phenomenon. Three of the groups have positive pass through coefficients, confectionery has a pass through insignificantly different from zero and Evian in the Water model exhibits negative pass through. The import of these results which relate to full, rather than partial, pass through is to challenge the interpretation of the plethora of significant negative pass through findings that have been reported by previous authors.

Comparing the results in this chapter with the studies reported in the previous chapter, Marston's (1990) study of Japanese export behaviour has a range of pass through coefficients from 0.08 to 0.9 all of which are statistically significant. He compares the change in the ratio of domestic to export prices to changes in the exchange rate, but does not explicitly control for cost or income factors. The pass through coefficients, which are imputed could therefore be subject to omitted variable bias as well as the aggregation bias inherent in the price data. The study also does not test pass through coefficients directly and the influence of indirect responses such as a change in the margins in the home or export market could also adversely affect the results. Finally, and most importantly, this study uses as the dependant variable the relative price of export to domestic goods, these series in common with most price series are likely to be I(1) processes and this property will therefore be present in the ratio, however no testing is made of the underlying time series properties of the variables that are used. Accordingly, great care should be taken when considering these results, as they could well be subject to the problem of spurious regression which if present would call the results into question as each of the series could contain stochastic trends which need to be removed before the analysis is undertaken.

The study by Athukorala and Menon (1994) which is also on Japanese exports indicates negative pass through coefficients in the range 0.2 to 0.5, all of which are statistically significant. In addition to the aggregation bias from the use of price aggregates this study uses Ordinary Least Squares techniques on data that is integrated of order one. This implies that there could once again be problems with spurious regression and the results must therefore be treated with some caution.

In a second study, Athukorala and Menon (1995) consider the Swedish machinery export market and find negative pass through coefficients in the range 0.2 to 0.5 all of which are statistically significant. Whilst the econometric techniques adopted can be questioned, the variables tested have been reduced to I(0) by differencing, and therefore the problem of spurious regression has been eliminated. The study does not specifically allow for income effects in the destination market, causing potential omitted variable bias and also suffers from the use of aggregated price data. However in the small sample of industries tested these results could be of an appropriate order of magnitude and statistical significance for first stage pass through.

Gross and Schmitt (1996) consider the Swiss Automobile market finding pass through coefficients ranging from positive 0.3 to negative 0.9. Of the ten types of car tested only five had a significant pass through relationship and these were all negative and in the range 0.2 to 0.7. In common with previous studies, as there was no control for consumers' income, the results potentially contain omitted variable bias, but the econometric approach takes account of the time series properties of the underlying series.

In summary, the previous studies all contain some element of concern primarily in relation to aggregation and omitted variable bias. These biases could have the impact of reducing the level and significance of the reported exchange rate pass through thereby bringing them into a similar range to those found in the disaggregated study or as each of the reported studies considers just one market and it could be that the differences between the results of the aggregated studies and the disaggregated study simply reflect idiosyncrasies of the selected markets.

4.7 Conclusions.

Evidence has been found of deliberate pricing to market by Giovannini (1988), Marston (1990), and Rangan and Lawrence (1993) and this study offers further evidence of this. It also corroborates the findings of Kasa (1992) that firms use their profit margins to smooth out the effect of exchange rate movements, as in the confectionery model, for example, there is no evidence of exchange rate movements being passed through to consumers.

This study has focused on the pass through of exchange rate movements from the manufacturer to independent consumers in the United Kingdom and is not limited to just first stage pass through which has been the focus of previous studies. Those studies found consistent and high degrees of negative pass through but are subject to substantial concerns relating to the techniques that they employ. Only one study, by Gross and Schmitt (1996), for which there are few empirical concerns, has found a range of exchange rate pass through coefficients some of which are negative and significant whilst the remainder are insignificantly different from zero.

The empirical findings of this chapter are inconsistent with the one period profit maximising models that have been generated to explain the theoretical foundations of exchange rate pass through and implies that a different theoretical approach should be considered. The lack of variability of the price series would suggest that a model containing an element of price rigidity should be considered and this adds support for the approach taken in chapter 3.

Appendix 1

Cointegration Statistics.

Trace Statistics.

Size adjusted.

Ho: rank = p	Batteries	Suntan	Films	Water	Confectionery
P = 0	26.94	42.82*	39.06**	21.26	27.95
95%	(33.5)	(33.5)	(33.5)	(33.5)	(33.5)
P < = 1	22.89	26.3	22.93	18.74	20.68
95%	(27.1)	(27.1)	(27.1)	(27.1)	(27.1)
P < = 2	12.52	13.37	18.85	15.27	11.4
95%	(21.0)	(21.0)	(21.0)	(21.0)	(21.0)

The figures in parenthesis are critical values.

Max. Statistics.

Size adjusted.

Ho: rank = p	Batteries	Suntan	Films	Water	Confectionery
P = 0	69.94*	89.05*	87.91**	69.61*	70.95*
95%	(68.5)	(68.5)	(68.5)	(68.5)	(68.5)
P < = 1	43.0	46.23	48.85*	48.35*	43.01
95%	(47.2)	(47.2)	(47.2)	(47.2)	(47.2)
P < = 2	20.11	19.93	25.92	29.61	22.33
95%	(29.7)	(29.7)	(29.7)	(29.7)	(29.7)

The figures in parenthesis are critical values.

LR test of general cointegrating restrictions.

	Batteries	Suntan	Films	Water	Confectionery
Rank = 2	1.0462	13.14	6.3084	1.5737	9.8696
95%	(0.7901)	(0.1071)	(0.2774)	(0.6654)	(0.2743)

The figures in parenthesis are probabilities.

*** (**) indicates significant at 5% (1%).**

Appendix 2

Product Data

Products selected

1) Ambre Solaire Factor 4 Cream 100ml. Trade price.
2) Bergasol After Sun Moisturising Lotion 125ml. Trade price.
3) Duracell Mn1500 Battery Retail Price.
4) Hi-Tech Hearing Aid Battery 13H. Trade price.
5) Fuji Film HR1600 Colour Film 135-24. Trade Price.
6) Kodacolor Gold 100 Ga135-24. Trade price.
7) Evian Natural Mineral Water 1½ litre plastic. Trade Price.
8) Perrier Mineral water 200ml. Trade Price.
9) Toblerone 200 gram. Retail Price.
10) Galaxy 85 gram. Retail Price.

The products were then placed into the following groups:

Name of Group	**Product nos.**
Suntan	1,2
Battery	3,4
Film	5,6
Water	7,8
Confectionery	9,10

Additionally the following statistics were collected:

From *International Financial Statistics*,

1) Price indexes for:

a) Belgium - Consumer

b) France - Consumer

c) Japan - Wholesale

d) Switzerland - Consumer

2) End of month exchange rates for the four above-mentioned countries.

3) United Kingdom Industrial Production (seasonally adjusted, as this was the only series available on a monthly basis).

The country of manufacture of a product from each group was confirmed with its UK distributor.

Group	Product	Country of Manufacture
Battery	Duracell	Belgium
Suntan	Bergasol	France
Film	Fuji film	Japan
Water	Evian	France
Confectionery	Toblerone	Switzerland

Chapter 5.

Exchange Rate Pass Through in the UK: A Panel Data Analysis of Imports 1965 to 1996

5.1 Introduction.

As discussed in chapters 3 and 4 the rigidity in prices noted in the disaggregated price series and similar findings by Carlton (1986), Cecchetti (1986), Danziger (1987 and Kashyap (1995) lead to a conclusion that disaggregated price series might not contain sufficient variability in the dependent variable to allow standard time series techniques to be applied. A further consequence of this rigidity is that aggregated series, where they comprise relatively few underlying product groups, might also suffer from limited variability of the dependent variable. To counter this problem it was decided to construct a panel of products that were imported into the U.K., thereby ensuring variability in the series to be tested.

The simple theoretical model that was derived in chapter 3 has the optimal price of a firm that exports its output as a function of a constant, costs of manufacture and the bilateral exchange rate. This model will be run using the selected panel of products. To allow the results of these tests to be compared directly with previous studies an initial base model, comprising the price, a constant and the bilateral exchange rate, will be run. However, this simple form does not explicitly allow for cost changes in the source or destination country following the exchange rate shock, they are incorporated into the error term. To allow for costs explicitly, the results of the base model will be augmented, with cost variables for both the source and destination country, and the resulting exchange rate pass through pass through coefficients can then be compared.

The results that are generated show a similar pattern of responses to Gross and Schmitt (1996). The exchange rate pass through coefficients for imports into the UK indicate both significant positive and negative pass through behaviour but there are also a large number of pass through coefficients that are insignificantly different from zero. This latter finding would support the theoretical hypothesis of the previous chapter that firms do not pass through exchange rate shocks considered to be temporary.

The remainder of this chapter is organised as follows: section 5.2 sets out the empirical model and the estimation procedures; section 5.3 details the data and the modelling approach; sections 5.4 and 5.5 have the empirical results; and section 5.6 concludes.

5.2 The Empirical Model and Estimation Procedures.

In chapter 3 the optimal price for a firm setting prices for one period was derived under the assumption that the firm faces a linear demand curve:

$$p_t^o = \frac{a}{2b} + \frac{\phi_t}{2} \tag{3.4}$$

This is the standard result from the literature, and this was transformed into a multi-period price setting model by following the Ball and Mankiw pricing rule. Under this setting price will always be a function of a constant and a function of the firm's costs.

In chapter 3 the firm's cost function is augmented by a trend inflation term, the firm operates in two countries and a bilateral exchange rate is incorporated. It is shown that if there are no unanticipated exchange rate changes, then for a firm adopting three-period optimal pricing its optimal price is:

$$\hat{p}_t = \frac{a}{2b} + \frac{s_t \phi_h}{2} + \frac{\phi_f}{2} + s_t \pi_h \phi_h + \pi_f \phi_f \tag{3.31}$$

The optimal price is a function of a constant, average costs for the pricing period and the current bilateral exchange rate. The trend inflation and exchange rate terms enter as part of the firm's cost function and therefore this change to the structure of the cost function does not affect the underlying pricing relationship.

To test the relationship between the price of a firm's product and movements in the exchange rate econometrically, it is proposed to use an expression that encapsulates equations (3.4) and (3.31), i.e. that a firm's optimal price is a function of a constant and its costs which will include the bilateral exchange rate between the country of manufacture of the good and the country of sale, this expression will later be augmented to include foreign cost variables (see section 5.3.3).

This can be written in the following logarithmic form:

$$p_{it} = con + s_t + \phi_{it} + u_{it}, \tag{5.1}$$

Where p_{it} is the price of a cross section of products indexed i at time t, con is a constant term which does not vary over time, s_t is the bilateral exchange rate defined, as the number of units of domestic currency required to purchase a unit of foreign currency, ϕ_{it} are the product costs, and u_{it} is the error term.

Following Knetter (1995) and Gagnon and Knetter (1995) the empirical relationship that will be tested will be the change in the price of goods as the dependant variable and changes in firms' costs and the exchange rate as the independent variables. Knetter (1995) analysed possible causes of price changes and concluded that apart from a firm's costs, the key explanatory variable will be the adjustment in the exchange rate, he further asserted whilst other factors such as consumers' incomes will play a role it will be of secondary importance. The relative size and variability of changes in exchange rates when compared to changes in consumers' incomes, justifies the exclusion of consumer's income from the econometric model to be tested.

In Knetter (1995), the model of price adjustment to be estimated for the UK took the form:

$$p_{it} = \psi_t + s_t + u_{it}, \tag{5.2}$$

This corresponds to a fixed effects model specification with the ψ_t term allowed to adjust in each period to capture the cost adjustments over time.

As it is proposed to test specifically for the effects of changes in the underlying costs of the product in the source and the destination country a model of the form:

$$p_{it} = \psi + s_t + u_{it}, \tag{5.3}$$

which corresponds to a random effects model will be used. The error term is decomposed into two elements: $u_{it} = \rho_i + v_{it}$; ρ_i is included to capture product specific group effects which do not vary over time. This approach will capture the changes to price, which are not correlated to changes in the exchange rate in the error term and is appropriate where the sampled units are drawn from a large population. Finally, by running Hausman (1978) specification tests on the results, significant differences between the fixed effects and random effects coefficients can be reported, thereby identifying whether the Knetter fixed effects model specification provides a better insight into the pass through of exchange rate changes.

Testing of the change in the relationship will therefore be carried out on a model of the form:

$$\Delta p_{it} = con + \beta_i \Delta s_t + u_{it}, \qquad (5.4)$$

where Δ represents the annual difference between the levels of the variable and

$i = 1 \ldots N$ and $t = 1, \ldots, T$ index the industry group and time respectively and β and *con* are the parameters to be estimated.

The error term u_{it} is assumed to be independently and identically distributed with mean zero and variance σ_μ^2 and uncorrelated with the ρ_i term. Finally, by using the logarithmic form, the coefficients generated can be considered as partial elasticities.

The exchange rate is defined as the number of units of domestic currency required to purchase a unit of foreign currency therefore the sign taken by β_i can be considered to have resulted from the following underlying causes:

1) if β_i is zero, then the price movements in the United Kingdom are not correlated with the movements in the bilateral exchange rate.
2) If β_i is negative, then following a depreciation of the currency there would be an increase in the price of the product in the United Kingdom.

3) If β_i is positive, then following a depreciation of the currency there would be a decrease in the price of the product in the United Kingdom.

As discussed in chapters 3 and 4, it is theoretically possible for β to take any sign, however researchers such as Knetter (1995) have predominantly found a negative coefficient, implying that firms are passing through a proportion of their cost changes into price. Others such as Gross and Schmidt (1996) have found a mix of sign on the exchange rate pass through coefficient.

5.3 Data and Modelling Approach.

5.3.1 Product and Market Considerations.

Data was collected on a wide range of products that are imported into the UK, details of which are given in appendix 1 to this chapter. Additionally, a range of countries were selected on the basis that they were major trading partners of the United Kingdom and that they were geographically diverse. Details of selected countries are given in Appendix 2 to this chapter.

Whilst the initial sample will give the response of the whole UK economy to a change in exchange rates, it is also interesting to investigate how individual sectors react. Sub-groups were therefore constructed from the initial sample. Details of the composition of these sub-groups, which cover the Food, Chemicals, Stone, Copper and Miscellaneous Building products sectors, are given in Appendix 3 to this chapter.

5.3.2 Data Collection.

Product groups were selected from the International Trade by Commodities CD-ROM published by the OECD. The basis on which they were selected was that they were frequently traded products between the selected exporting countries and the UK over the period, 1964 to 1996. A total of 141 industry product groups at the 7-digit level were selected for each of the years. The same groups were used for each exporting country.

Having established the product groups in the initial sample, these were then grouped into sub-sectors on the basis that there was a group of similar products that was sufficiently large to ensure that there was variability in the series. Accordingly, subsets of the initial sample were constructed to consider responses in: the food sector; the chemical sector; the stone and glassware sector; the metal products sector; and the sundry building products sector. In principle any sector could have been chosen, hence the choice of product groups is not a substantive issue provided there is sufficient variation within the sub-sectors.

The data was held in the form of total quantity and total value for each year. Price data was therefore extracted by dividing the total value of each good in the year by the corresponding total quantity of each good and the resulting average price is treated as the goods price for the year. This will lead to problems of aggregation and averaging bias in the results but this problem cannot be overcome, but this should not distort the underlying trends within the data. The results will smooth the impact of exchange rate shocks on prices and the reported coefficients will tend to under report the extent of pass through of exchange rate changes into prices.

Exchange rates were collected from *International Financial Statistics*, as the period average bilateral exchange rate for each country from which goods were imported for each year from 1964 to 1996.

5.3.3 Modelling Approach.

For the initial sample and each of the sub-groups, a random effects model was run for each of the selected countries for the period 1965 to 1996 in the general form given by (5.4).

Diagnostic tests were reported for each of the models. The first test reported is the Breusch-Pagan (1980) test, which considers the null hypothesis that the variance on the error term is zero. The null hypothesis is:

$H_0 : \sigma_u^2 = 0$

The assumption that the error terms are random variables, implies that the sample that has been selected can be regarded as a random sample from some larger population, it further implies that the error term and the explanatory variables are uncorrelated. If the null hypothesis of the test cannot be rejected this provides support for using the random effects model.

The second test that is reported is the Hausman (1978) specification test. This tests that there is no significant difference between the fixed effect and random effect coefficients.

The null hypothesis is that estimates computed under the assumptions of Ordinary Least Squares and Generalised Least Squares should not differ systematically. Hausman's result is that the covariance of an efficient estimator with its difference from an inefficient estimator is zero. The test is that there is orthogonality between the random effects and the regressors.

Where differences arise this can imply that there has been misspecification of the model and further investigation of the causes of these differences, which can include omitted variables, is required. Where a significant difference does not occur, it additionally shows that there is no conflict over the panel data methodology that has been employed.

Following the approach set out in section 5.2 the basic model given in (5.4) was then augmented by the inclusion of variables to account for changes in costs in both the source and destination country. This approach, rather than a general to specific approach has been taken so that the results can be compared with those in the literature. As the actual changes in costs cannot be determined, the first augmentation included a proxy for the change in costs in the destination country, the United Kingdom. The proxy chosen was the GDP deflator for the United Kingdom as published in International Financial Statistics, changes in the deflator should mirror changes in the costs that were experienced by the firms in the sample on their U.K. operations, and the following model was therefore tested:

$$\Delta p_{it} = con + \beta_i \Delta s_t + \gamma_i \Delta v_{it}^{uk} + u_{it}, \tag{5.5}$$

where v^{uk} represents the UK GDP deflator and γ_i is the additional parameter to be estimated.

The second augmentation included a proxy for the change in costs in the source country, the country of manufacture of the product. The proxy that was chosen for this was the GDP deflator for each source country as changes to this deflator should be reflective of changes in the individual firms' costs; accordingly, the following model was tested:

$$\Delta p_{it} = con + \beta_i \Delta s_t + \varpi_i \Delta v_{it}^{cost} + u_{it}, \tag{5.6}$$

where v^{cost} is the cost proxy for each source country.

Finally, both the home country and the United Kingdom deflators were included in the regressions and the following model, which is the econometric equivalent of the model derived in chapter 3, was tested:

$$\Delta p_{it} = con + \beta_i \Delta s_t + \gamma_i \Delta v_{it}^{uk} + \varpi_i \Delta v_{it}^{cost} + u_{it}, \qquad (5.7)$$

It is acknowledged that the inclusion of both deflators might introduce problems with correlation between the deflators and the exchange rate and this will be considered when the results of this augmentation are reviewed.

To test the robustness of the estimates for exchange rate pass through, the period tested was truncated to include only those years when the exchange rates were floating between countries, the basic model (5.4) was therefore run for the floating rate period of 1973 to 1996.

As a final test, to allow for the impact of correlation between the product groups, the basic model (5.4) was run once more but this time the variance estimator was specified as the Huber/White/Sandwich estimator of variance (Liang and Zeger 1986).

5.4 Empirical Results

The model as specified in (5.4) was run for the sample population and for each of the sub-groups for the countries listed in Appendix 1. The results are given in Appendix 4. In the sample population, exchange rate pass through which is measured by the β coefficients, fluctuated from minus 2.3 to positive 1.8, indicating that there is a large range in the response of prices to exchange rate changes. The largest responses are from countries such as Germany and Finland and they are also extremely statistically significant with low standard errors and consequently high t-ratios. However this is not the case for all countries, with many such as Canada, France and New Zealand having extremely low t-ratios and combined with very small β values, this would lead to a presumption of the true coefficient for β in these countries of zero, implying that for these members of the initial sample exchange rate changes are not passed through.

The initial sample results accept the Breusch-Pagan (1980) null hypothesis and the results of all the sub-groups accept it at the 5% level, with the exception of certain of the countries in the miscellaneous building products group for which it is only accepted at the 10% level. Accordingly, this supports the use of the random effects model.

If the results of the Hausman test are considered, there are a number of rejections of the null hypothesis in the sample population, including Ireland, Hong Kong and the United States, however there are no rejections in any of the sub-groups. Where there is rejection of the null hypothesis of orthogonality of the regressors and the random effects under the Hausman test, consideration must be given to misspecification of the initial sample for those countries where there is a significant difference between the fixed and random effects coefficients. The most likely reason for this difference is an omitted variable and this issue will be addressed by running the augmented models.

The results from the first augmentation are shown in Appendix 5. It is interesting to note that there is very little change in the value of the β coefficients, i.e. adding in a proxy for cost changes in the destination country does not seem to alter the exchange rate pass through coefficients that were found in the base line model. The standard errors are generally smaller in absolute values thereby tending to increase the previous levels of significance. Turning to the diagnostic tests; the Breusch-Pagan test is now accepted at the 5% level in all of the regressions, and more of the initial sample results accept the null hypothesis of orthogonality of the regressors and the random effects under the Hausman test, but there still are some significant rejections, notably France, Japan, Sweden and the United States.

These results of the second augmentation are shown in Appendix 6. Once again there is very little variation in the majority of the β coefficients when compared to the previous equation or the standard errors from the original specification given by (5.3), so adding a proxy for cost changes in the source country where manufacturing takes place does not significantly alter the exchange rate pass through coefficient estimates. With the inclusion of the source country cost proxy variable however, all of the regressions accept the null hypotheses of the Breusch-Pagan and the Hausman tests at the 5% level. In addition, adding a variable to account for cost changes in the country of manufacture of the product, corrects for the omitted variable bias which can be implied from the rejection of the null hypothesis under the Hausman test, and also changes the exchange rate pass through coefficient for those countries that had previously failed the Hausman test at the 5% level of significance. For example, the β for USA alters from –1.02 to –0.49 and the β for Japan alters from –1.10 to –0.90. The regressions which omitted this variable were upwardly biasing the β's reported for these countries.

The results of the third augmentation are shown in Appendix 7. Under this specification, which includes cost proxy variables for the source and the destination countries, there is little variation in the values of the β's and the related standard errors from the previous models. The regressions all accepted the null hypotheses of the Breusch-Pagan and the Hausman tests at the 5% level, with the exception of the Copper products sub-group where the Breusch-Pagan test was only accepted at the 10% level for Belgium-Luxembourg. This would imply that there is little to be gained by augmenting the source country cost variable with a destination country cost variable, which is probably a reflection of the relative size of the costs suffered by the firm in the respective countries.

The results of the truncation of the sample period from 1965 to 1996, to 1973 to 1996, are shown in Appendix 8. With the exception of a few countries, the β's were of the same order as in the previous models. The standard errors are generally much smaller in absolute values thereby increasing the statistical significance of each result. Generally there was a drift in the β's to be smaller in size, although this was principally in the sample population results.

The introduction of robust standard errors produced the results detailed in Appendix 9. The initial sample results show a remarkable consistency with the results of the first base model; where there are differences it is to bring the results of the initial regression into line with the amendments found after removing the omitted variable bias from the initial regression specification as discussed above. The results of all of the sub-groups are identical in terms of the β's with those of the first model, the difference is only in the size of the standard errors.

The results as tabled in Appendix 9 will be treated as the best estimates of the β coefficients. The results are given below with the following modifications to improve the readability of the data. Where the result is shown in bold type the standard error is such that the coefficient can be accepted at the 5% error level. Where the coefficient can only be accepted at greater than 5% but less than 10% error level, this is shown on normal typeface. However where the standard error is such that the coefficient cannot be accepted at the 10% level, then it is treated as being insignificantly different from zero and the β coefficient for that country is recorded as zero. The key for abbreviations used in the tables below and in appendices 4 to 9 is given in appendix 10.

5.4.1 Initial Sample Results.

Country	β	S. E. on β	t-ratio	P>|t|
Australia	**.308**	**.1046**	**2.947**	**0.003**
Austria	0			
Belgium Luxembourg	**-.957**	**.1669**	**-5.734**	**0.000**
Canada	0			
Switzerland	**-.692**	**.1334**	**-5.189**	**0.000**
Germany	**-1.65**	**.1197**	**-13.84**	**0.000**
Denmark	0			
Spain	**-.416**	**.1838**	**-2.265**	**0.024**
Finland	**1.296**	**.2274**	**5.699**	**0.000**
France	**.5002**	**.1415**	**3.533**	**0.000**
Greece	**.4448**	**.1132**	**3.928**	**0.000**
Hong Kong	**-.300**	**.1374**	**-2.185**	**0.029**
Ireland	-.130	.0746	-1.745	0.081
Italy	0			
Japan	**-.906**	**.1308**	**-6.927**	**0.000**
Holland	**-1.15**	**.1242**	**-9.333**	**0.000**
Norway	0			
New Zealand	0			
Portugal	**.1854**	**.0810**	**2.288**	**0.022**
Singapore	**.6119**	**.1477**	**4.142**	**0.000**
Sweden	-.283	.1656	-1.712	0.087
U.S.A.	**-.488**	**.0570**	**-8.566**	**0.000**

Of the twenty two countries which were tested; six display exchange rate pass through that is insignificantly different from zero; six have significant positive pass through; eight significant negative pass through; and two negative pass through that is significant at the ten percent level. There is therefore no distinct pattern of pass through for this sample of products when its major trading partners import them into the UK. These findings conflict with the results of Knetter (1989) where he only found significant negative pass through of exchange rate shocks, but are supported by the findings of Gross and Schmitt (1995) who find a range of positive and negative responses. Whilst averaging bias discussed earlier means that the results will tend to under-report the extent of exchange rate pass through, almost forty percent of the sample display negligible or zero pass through of exchange rate shocks. This is a high proportion of the sample and this aspect will be discussed more fully in section 5.5.2 below.

It is noticeable that countries with generally low levels of inflation over the period display significant negative pass through, these include U.S.A., Japan, Switzerland and Germany, and it also includes those countries whose economies are traditionally linked with Germany such as Holland and Belgium-Luxembourg. They pass through a proportion of the effects of exchange rate movements into their prices in the export market. Countries, such as Portugal, Greece, Finland and Australia, which have a poorer inflation record show positive pass through in their export prices, as do France and Singapore.

5.4.2 Food Sector Results.

Country	β	S. E. on β	t-ratio	P>|t|
Australia	0			
Austria	**-.761**	**.3600**	**-2.114**	**0.035**
Belgium Luxembourg	**-1.21**	**.5749**	**-2.115**	**0.034**
Canada	0			
Switzerland	-.630	.3572	-1.765	0.078
Germany	**-1.11**	**.3728**	**-2.996**	**0.003**
Denmark	0			
Spain	**-1.36**	**.5423**	**-2.515**	**0.012**
Finland	**1.778**	**.8424**	**2.111**	**0.035**
France	0			
Greece	0			
Hong Kong	0			
Ireland	**.6143**	**.2918**	**2.109**	**0.035**
Italy	0			
Japan	0			
Holland	**-1.48**	**.3313**	**-4.467**	**0.000**
Norway	0			
New Zealand	0			
Portugal	0			
Singapore	0			
Sweden	0			
U.S.A.	0			

The food sub-group shows a similar pattern in terms of country pass through signs, with Holland, Germany and Belgium-Luxembourg again having negative pass through and Finland exhibiting positive pass through. However there are now many more countries exhibiting zero pass through and Ireland has switched from negative to positive pass through, which would imply that there are other forces, such as competition effects, being exerted in this market which are not felt to the same extent at the initial sample level.

5.4.3 Chemicals Sector Results.

Country	β	S. E. on β	t-ratio	P>|t|
Australia	**.4036**	**.1797**	**2.245**	**0.025**
Austria	0			
Belgium Luxembourg	0			
Canada	0			
Switzerland	-.683	.3788	-1.803	0.071
Germany	**-1.24**	**.2682**	**-4.644**	**0.000**
Denmark	0			
Spain	0			
Finland	0			
France	0			
Greece	0			
Hong Kong	0			
Ireland	0			
Italy	0			
Japan	-.828	.3469	-2.389	0.017
Holland	0			
Norway	0			
New Zealand	0			
Portugal	0			
Singapore	**.4372**	**.2190**	**1.996**	**0.046**
Sweden	0			
U.S.A.	**-.251**	**.1276**	**-1.972**	**0.049**

In the chemicals subgroup the same pattern of results can be seen with the U.S.A., Japan and Germany all exhibiting strong negative pass through, and

Australia and Singapore once again exhibiting positive pass through. However, the remaining countries' pass through are all insignificant.

5.4.4 Stone and Glassware Sector Results.

Country	β	S. E. on β	t-ratio	P>|t|
Australia	0			
Austria	0			
Belgium Luxembourg	0			
Canada	**-1.49**	**.6722**	**-2.224**	**0.026**
Switzerland	**-1.65**	**.3491**	**-4.736**	**0.000**
Germany	**-2.04**	**.4728**	**-4.333**	**0.000**
Denmark	0			
Spain	0			
Finland	**1.762**	**.9048**	**1.948**	**0.051**
France	0			
Greece	0			
Hong Kong	0			
Ireland	0			
Italy	0			
Japan	**-1.12**	**.5500**	**-2.049**	**0.040**
Holland	**-1.34**	**.4867**	**-2.760**	**0.006**
Norway	**1.590**	**.5420**	**2.935**	**0.003**
New Zealand	0			
Portugal	0			
Singapore	0			
Sweden	0			
U.S.A.	0			

The stone and glassware group also has the same pattern of exchange rate pass through with Switzerland, Germany, Holland and Japan being negative and Finland positive.

5.4.5 Copper, Nickel and Aluminium Products Sector Results.

Country	β	S. E. on β	t-ratio	P>|t|
Australia	0			
Austria	0			
Belgium Luxembourg	**-.568**	**.2405**	**-2.362**	**0.018**
Canada	0			
Switzerland	0			
Germany	**-.013**	**.0018**	**-7.313**	**0.000**
Denmark	**-.868**	**.3527**	**-2.463**	**0.014**
Spain	0			
Finland	0			
France	**1.154**	**.4202**	**2.747**	**0.006**
Greece	**.3721**	**.1287**	**2.890**	**0.004**
Hong Kong	0			
Ireland	**-.630**	**.3110**	**-2.028**	**0.043**
Italy	**.9971**	**.4793**	**2.080**	**0.038**
Japan	0			
Holland	0			
Norway	**-1.72**	**.4569**	**-3.773**	**0.000**
New Zealand	**.2723**	**.1183**	**2.302**	**0.021**
Portugal	0			
Singapore	0			
Sweden	**-.543**	**.1475**	**-3.685**	**0.000**
U.S.A.	**-.279**	**.0751**	**-3.720**	**0.000**

The copper, nickel and aluminium products group primarily displays the same pass through patterns, but there are fewer insignificant pass throughs. Belgium-Luxembourg, Switzerland, Germany and the U.S.A. have negative coefficients and Greece has a positive coefficient. Noticeably the coefficients for both France and Italy are both large and significantly positive rather than the insignificant level of pass through that they display in all of the other sub-groups.

5.4.6 Miscellaneous Building Products Sector Results.

Country	β	S. E. on β	t-ratio	P>|t|
Australia	0			
Austria	0			
Belgium Luxembourg	**-1.44**	**.4207**	**-3.441**	**0.001**
Canada	**1.017**	**.4324**	**2.353**	**0.019**
Switzerland	**-1.1**	**.2317**	**-5.142**	**0.000**
Germany	**-1.88**	**.1891**	**-9.989**	**0.000**
Denmark	0			
Spain	**-.729**	**.3229**	**-2.258**	**0.024**
Finland	**2.485**	**.5321**	**4.671**	**0.000**
France	0			
Greece	**1.212**	**.3489**	**3.475**	**0.001**
Hong Kong	0			
Ireland	**-.384**	**.1699**	**-2.264**	**0.024**
Italy	0			
Japan	**-1.58**	**.1533**	**-10.36**	**0.000**
Holland	**-1.48**	**.2411**	**-6.139**	**0.000**
Norway	0			
New Zealand	0			
Portugal	0			

Singapore	.5838	.3399	1.717	0.086
Sweden	-.752	.4362	-1.725	0.085
U.S.A.	**-.887**	**.1789**	**-4.959**	**0.000**

The miscellaneous building product group also has more significant results but shows the same general pattern with the strong economies such as U.S.A., Japan, Switzerland and Germany, plus Belgium-Luxembourg and Holland having negative pass through and Finland having positive pass through.

5.4.7 Results by Exporting Country

A summary of the β coefficients by country is shown below:

<u>Country</u>	Population	Food	Chemicals	Stone etc	Copper etc	Misc.
Australia	**.30843**	0	**.40360**	0	0	0
Austria	0	**-.7610**	0	0	0	0
Belgium Luxembourg	**-.9574**	**-1.215**	0	0	**-.5681**	**-1.447**
Canada	0	0	0	**-1.495**	0	**1.0174**
Switzerland	**-.6923**	-.6305	-.6832	**-1.653**	0	**-1.191**
Germany	**-1.657**	**-1.117**	**-1.246**	**-2.048**	**-.0138**	**-1.889**
Denmark	0	0	0	0	**-.8688**	0
Spain	**-.4163**	**-1.364**	0	0	0	**-.7293**
Finland	**1.2964**	**1.7787**	0	**1.7629**	0	**2.4859**
France	**.50022**	0	0	0	**1.1545**	0
Greece	**.44480**	0	0	0	**.37213**	**1.2127**
Hong Kong	**-.3003**	0	0	0	0	0
Ireland	-.1302	**.61431**	0	0	**-.6307**	**-.3847**
Italy	0	0	0	0	**.99719**	0
Japan	**-.9062**	0	-.8288	**-1.127**	0	**-1.589**

Holland	-1.159	-1.480	0	-1.343	0	-1.480
Norway	0	0	0	1.5907	-1.724	0
New Zealand	0	0	0	0	.27236	0
Portugal	.18547	0	0	0	0	0
Singapore	.61196	0	.43722	0	0	.58386
Sweden	-.2836	0	0	0	-.5437	-.7522
U.S.A.	-.4886	0	-.2517	0	-.2796	-.8873

There is no discernible pattern of exchange rate pass through response within either the countries in the sample population or within the sub-groups thereof. However, there does seem to be a pattern of responses by individual country, as apart from Canada, Ireland and Norway, whenever a country displays a significant exchange rate pass through coefficient, the sign is always the same in each of the sub-groups in which it is also significant. This implies that firms within a country respond to exchange rate shocks in a similar way and could be the result of a source country effect. This will be explored further in Chapter 6.

5.4.8 Results by Geographic Region

Regional patterns can be analysed by rearranging countries into geographical location as follows:

Country	Sample Population	Food	Chemicals	Stone etc	Copper etc	Misc.
European						
Austria	0	-.7610	0	0	0	0
Belgium	-.9574	-1.215	0	0	-.5681	-1.447

Luxembourg						
Denmark	0	0	0	0	-.8688	0
Finland	1.2964	1.7787	0	1.7629	0	2.4859
France	.50022	0	0	0	1.1545	0
Germany	-1.657	-1.117	-1.246	-2.048	-.0138	-1.889
Greece	.44480	0	0	0	.37213	1.2127
Holland	-1.159	-1.480	0	-1.343	0	-1.480
Ireland	-.1302	.61431	0	0	-.6307	-.3847
Italy	0	0	0	0	.99719	0
Norway	0	0	0	1.5907	-1.724	0
Portugal	.18547	0	0	0	0	0
Spain	-.4163	-1.364	0	0	0	-.7293
Sweden	-.2836	0	0	0	-.5437	-.7522
Switzerland	-.6923	-.6305	-.6832	-1.653	0	-1.191
North American						
Canada	0	0	0	-1.495	0	1.0174
U.S.A.	-.4886	0	-.2517	0	-.2796	-.8873
Asian						
Hong Kong	-.3003	0	0	0	0	0
Japan	-.9062	0	-.8288	-1.127	0	-1.589
Singapore	.61196	0	.43722	0	0	.58386
Australasia						
Australia	.30843	0	.40360	0	0	0
New Zealand	0	0	0	0	.27236	0

There is no obvious pattern of responses to exchange rate movements between European countries. This also applies to the North American and the Asian countries that were tested. Whilst most of the Australasian responses were insignificant, where they responded significantly they were of the same sign and order of magnitude, however, it must be concluded that these tests do not show evidence of a regional response to exchange rate pass through.

5.5 Discussion of Results.

5.5.1 Comparison with Existing Empirical Work.

The range of results in this study, from a positive pass through of 2.4 to a negative pass through of 2.0, is only comparable with the results of Gross and Schmitt (1996). In that paper, pass throughs range from positive 0.3 to negative 0.7, but consideration is only given to the motor vehicle industry. Industry effects are commonly reported to be important, but the Gross and Schmitt (1996) study shows that even within the motor vehicle industry large variations of pass through are seen from country to country and this finding is replicated in the panel study.

It is not possible to make a direct comparison of individual lines from previous studies to the current panel as the main focus of these studies has been on the automobile industry. It is interesting to note that whilst early studies such as Knetter (1989) have generally found large and significant pass through effects, this study finds a large number of instances where pass through is insignificantly different from zero and this result is also found in Knetter (1993) and Gross and Schmitt (1996).

5.5.2 Evaluation under a Multi-period Pricing Model.

The model developed in chapter 3 is able to differentiate between the impact of a temporary and a permanent exchange rate shock on the price that is optimal for a firm to charge. If the shock is considered to be a one period temporary shock by the firm, it will not pass the shock through into its price. If it considers the shock to be temporary, but anticipates that it will last for several periods, it was demonstrated that it would only pass it through into price if the shock were large. Permanent shocks, where they are relatively small, will not be carried through into a price adjustment until the end of the pricing period. However, larger permanent exchange rate shocks will be passed through into prices as soon as is practical.

The results which indicate that the pass through of exchange rate shocks into price is insignificantly different from zero, can be taken to indicate that the firms in the countries where this occurs believe that the exchange rate changes are temporary in nature and do not affect the net costs of the firm to a substantial extent when compared with the costs of executing the price alteration. The significant pass through coefficients can be taken to relate to either permanent or temporary exchange rate shocks, but in either case, the impact of the shock is large in comparison to the cost of passing through the shock into prices.

It is noticeable that whilst there is a range of pass throughs related to each country dependent upon the type of product, almost without exception, each country only has one sign relating to significant exchange rate pass throughs. Firms in a country either passed through a percentage of the exchange rate shock directly into their prices, defined as negative pass through, or adjusted their prices in the opposite direction to the exchange rate shock, positive pass through. This will be discussed further in Chapter 6 where consideration will be given to the impact that the source country and the destination country can have on the extent of pass through that a firm finds optimal to apply.

The results that have been generated correspond to economic theory, with positive pass through of cost changes in both the home and foreign markets, where these are statistically significant. The level of R^2 that is reported is consistently low. This indicates that there is a high level of heterogeneity within the response of individual sectors and this offers support for the sectoral approach taken in this chapter and also suggests that a greater level of disaggregation should be considered in the future..

The economic models that have been developed to explain exchange rate pass through, and are discussed in chapter 2, can explain negative pass through that is less than unity in terms of demand elasticities in the target market. The model developed in chapter 3 provides an insight into why firms might choose to not pass through exchange rate shocks which are considered to be of a temporary nature. The only explanation that can be offered for positive pass through is where the benefits of economies of scale outweigh the costs of the exchange rate adjustment. Clearly the range and magnitude of positive pass throughs would suggest that there are other influences on firms pricing decisions that have not been taken into account. One conjecture that should be considered is that the price rigidity in the market is causing firms to operate away from their profit maximising price and this is an area for future research.

5.6 Conclusions

This study has used panel data methodology to test the model that was derived in Chapter 3. The exchange rate pass through coefficients that have been found show a similar pattern of values to the studies by Gross and Schmitt (1996) and Knetter (1993) but the range of values is larger. The larger number of industries covered by this study could explain the greater range of results.

Interestingly, only a minority of the results have a negative pass through coefficient, which would be expected if firms were simply passing through a proportion of their costs into price. Using the insights provided by the multi-period model this can be attributed to firms either not considering the exchange rate shocks to be permanent or that the size of the exchange rate shock has a limited impact on the firms' costs when compared with the cost of passing through the price change.

The results also highlight that, almost without exception, in each country that was investigated, the same sign of pass through was displayed in all of the sectors that were considered. This implies that source country or destination country effects could be having an impact on firms' actions and this will be investigated further in Chapter 6.

Chapter 6.

Exchange Rate Pass Through in the UK:

A Panel Data Analysis of Exports 1965 to 1996

6.1 Introduction.

The exchange rate pass through coefficients that are reported in Chapter 5 indicate that all but three of the countries had the same sign of significant pass through, regardless of the product groups that were considered. This would suggest that the characteristics of the country from which the product is sourced, or the country to which it is exported, could play a role in determining the extent to which firms pass through exchange rate shocks.

This phenomenon may be termed country specific pass-through. There are two variants: source-country effects arise when all exports from a country where the good is manufactured have the same or similar level of pass-through; or destination-country effects which arise when all exports to a particular country exhibit the same or similar levels of pass-through.

To quote from Gross and Schmitt (1996), 'If there is agreement as to the relevance of pricing-to-market and exchange rate pass-through to understand the pricing of traded goods, there is not yet a consensus about their determinants. The recent literature has uncovered significant differences in behaviour depending on the source country, destination country, the industry and the class of products within an industry' (page 278).

However, Bleaney (1995) comments that the empirical findings to date in the literature have been inconsistent with the theoretical models and it is the effect of dominating sectoral variables such as market share, industry concentration and perceived demand and cost curves, that will cause pass through to vary across industry rather than country. Accordingly, this is an area where the debate about the relevance of the impact of the behavioural variable has not been settled.

It was Mann (1986) who first highlighted that foreign importers into the United States appeared to adjust their profit margins to mitigate the impact of exchange rate changes, whereas this effect could not be found when considering U.S. exporters. Knetter (1993) also tested for and found that country effects were significant in the exchange rate pass through behaviour of U.S., Germany, Japan and the U.K.

The exchange rate pass through coefficients in Chapter 5 range from -2.3 to 1.8, this range is too large to give support to the hypothesis that the United Kingdom exerts a destination country effect on the pass through behaviour of exporters into the U.K. There is a pattern within each country that exports goods to the U.K., the response to exchange rate changes are all of the same sign for each of the industrial sectors that were tested. To further investigate whether country effects can be found to have a behavioural impact on the pass through response of U.K. exporters, the same sample of countries will be tested to establish whether source country effects can be found in the pass through coefficients of U.K. exporting firms.

The study will be carried out, utilising the same methodology that was applied in the previous chapter, into the export behaviour of United Kingdom firms into the same sample of countries that were selected for the import study. This will establish whether source country effects can be identified in the exchange rate pass through behaviour of U.K. exporting firms. It will also provide a range of parameter values for pass through to each of the selected countries, which can then be compared to the values that were found in Chapter 5. Comparison of the pass through coefficients will provide further evidence of the validity of the pricing model derived in Chapter 3, and permit further conclusions to be drawn with regard to the pass through behaviour of firms in the selected countries.

The remainder of the chapter is organised as follows: section 6.2 considers the empirical model and the estimation procedures; in section 6.3 the data and modelling approach as discussed; section 6.4 presents the empirical results which are discussed in section 6.5. Section 6.6 concludes.

6.2 The Empirical Model and Estimation Procedures.

The approach that will be adopted is test the pricing model derived in Chapter 3. As the problem of potential autocorrelation of cost variable proxies in the source and destination country with the bilateral exchange rate is still relevant, the approach taken in Chapter 5 will also be taken in this chapter. A base model will be specified which will be augmented with variables to account for cost changes in the country of manufacture, the U.K., and cost changes in the countries of sale.

The base model will take the logarithmic form:

$$\Delta p_{it} = con + \beta_i \Delta s_t + u_{it}, \qquad (6.1)$$

where Δ represents the annual difference between the levels of the variable and

$i = 1...N$ and $t = 1...T$ index the industry group and time respectively and β and con are the parameters to be estimated. The error term is decomposed into two elements: $u_{it} = \rho_i + v_{it}$; ρ_i is included to capture product specific group effects which do not vary over time. The error term v_{it} is assumed to be independently and identically distributed with mean zero and variance σ_μ^2 and uncorrelated with the ρ_i term.

The change in price variable, p_{it}, relates to the prices of goods exported from the U.K. and the exchange rate, s_t, is expressed in inverse form.

6.3 Data and Modelling Approach.

6.3.1 Product and Market Considerations.

To ensure that the results of this study can be compared with the results in Chapter 5 the products that were selected were taken from product groups that were similar to those selected for the import study. Details of the products selected are given in Appendix 1 to this chapter. Additionally, the same range of countries was selected. Details of selected countries are given in Appendix 2 to this chapter.

Whilst this initial sample will give a view of the response of the economy, it is also interesting to investigate how individual sectors react and to compare them to the results of Chapter 3. Accordingly, subsets of the population were constructed to consider responses in the food sector; the chemical sector; the stone and glassware sector; the metal products sector; and the sundry building products sector. Details of the composition of these groups are given in Appendix 3 to this chapter.

6.3.2 Data Collection.

Product groups were selected from the *International Trade by Commodities CD-ROM* published by the OECD. The basis on which they were selected was that they were frequently traded products between the UK and the selected importing countries over the period, 1964 to 1996, and that they were similar in type to the products selected for the import study. A total of 150 industry product groups at the 7-digit level were selected for each of the years. The same groups were used for each importing country. Details of the groups and the countries selected are given in Appendices 1 and 2 to this chapter, whilst the countries selected are identical to the import study, the product groups are not.

Exchange rates were collected from *International Financial Statistics*, as the period average bilateral exchange rate for each country from which goods were imported for each year from 1964 to 1996.

6.3.3 Modelling Approach.

For the sample population and each of the sub-groups, a random effects model was run for each of the selected countries for the period 1965 to 1996 in the general form given by (6.1).

The basic model given in (6.1) was then augmented by the inclusion of variables to account for changes in costs in both the source and destination country, as the multi-period pricing hypothesis outlined in Chapter 3 provides a role for these variables in the determination of exchange rate pass through. As the actual changes in costs of firms cannot be determined, the first augmentation was to add a proxy for the change in costs in the destination country for the goods. The proxy chosen was the GDP deflator for that country as published in *International Financial Statistics*, changes in this deflator should correspond to changes in the costs that were experienced by firms, the following model was therefore tested:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \varpi_i \Delta v_{it}^{cost} + u_{it}, \tag{6.2}$$

where v^{cost} is the overall price change proxy for each destination country.

The second augmentation includes a variable to adjust for changes in underlying costs of the firms in the country of manufacture of the product, the UK. To proxy for this the GDP deflator for the UK was included and the following model was tested:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + u_{it}, \qquad (6.3)$$

where v^{uk} represents the UK GDP deflator and γ_i is the additional parameter to be estimated.

Finally both the export country and the United Kingdom deflators were included in the regressions and the following model was tested:

$$\Delta p_{it} = con_t + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + \varpi_i \Delta v_{it}^{cost} + u_{it}, \qquad (6.5)$$

It is acknowledged that the inclusion of both deflators might introduce problems with correlation between the variables and this will be considered when the results of this augmentation are reviewed.

To test the robustness of the long run estimates for exchange rate pass through the period tested was truncated to include only those years when the exchange rates were floating between countries, the basic model (6.1) was therefore run for the floating rate period of 1973 to 1996.

As a final test, to allow for the impact of correlation between the product groups, the basic model (6.1) was run once more but this time the variance estimator was specified as the Huber/White/sandwich estimator of variance (Liang and Zeger 1986), this estimator produces valid standard errors even if the correlations within group are not as hypothesised by the specified correlation structure.

6.4 Empirical Results.

The model as specified in (6.1) was run for the sample population and for each of the sub-groups for the countries listed in Appendix 2. The results are given in Appendix 4. To provide consistency in the reporting of the coefficient of the exchange rate pass through, the exchange rate was estimated in its inverse form in this chapter. Accordingly, a negative β coefficient corresponds to an increase in the price of the exported product following a depreciation of the home currency. If the initial sample results are considered, the β coefficients fluctuate from -0.96 to 0.33, indicating that there is a large range in the response of prices to exchange rate changes. Consideration of the sub-groups shows a similar picture.

The first test reported is the Breusch-Pagan (1980) test that the variance on the error term is zero. The initial sample results would indicate that the test accepts the null hypothesis that the error term is zero. This is repeated for all of the sub-groups, where all but one accepts the null hypothesis at the 5% level. The exception is Switzerland where the export of copper products only accepts the null hypothesis at the 10% level.

If the results of the Hausman test are considered, whilst these support the null hypothesis that there is no significant difference between the fixed and random effects specification for the subgroups, there is varying evidence for the initial sample. In particular Holland and the United States reject the hypothesis at the 5% level and Norway at the 10% level.

The diagnostic test results infer that utilising the random effects model is acceptable but consideration must be given to misspecification of the sample population where there is a significant difference between the fixed and random effects coefficients. This issue will be addressed whilst reviewing the augmented model results.

The results from the first augmentation are shown in Appendix 5. It is interesting to note that there is very little change in the value of the β coefficients, nor in the levels of the standard errors. Turning to the diagnostic tests; the Breusch-Pagan test is again accepted at the 5% level in all of the regressions, however the results of the Hausman tests leads to the rejection of more countries including Australia and Ireland in addition to those mentioned above at the 5% level and also Austria at the 10% level. The addition of a variable to take account of cost movements in the destination market provides little additional information into the exchange rate pass through behaviour of exporting firms.

The results of the second augmentation are shown in Appendix 6. Once again, there is very little variation in the β coefficients or the standard errors from the original specification given by (6.2). With the inclusion of this variable however, all of the regressions accept the null hypotheses of the Breusch-Pagan and the Hausman tests at the 5% level, with the exception of exports of copper products to Switzerland which only the Breusch-Pagan null hypothesis at the 10% level. Therefore, including a cost variable relating to the country of manufacture, whilst not significantly altering the reported pass through behaviour of firms, does remove the differences that existed between the coefficients when modelled under a random or fixed effects specification.

The results of the third augmentation are given in Appendix 7. The regressions all accepted the null hypotheses of the Breusch-Pagan and the Hausman tests at the 5% level, with the exception of the Copper products sub-group where the Breusch-Pagan test was only accepted at the 10% level for Switzerland. Once again, there is very little variation in the values of the β coefficients and including both cost variable adds nothing to the analysis of pass through behaviour.

The results of the truncation of the sample period are given in Appendix 8. With the exception of Copper exports to France and Miscellaneous product exports to Japan which became insignificant, the β's were of the same order as in the previous models as were the standard errors. This adds support to the view that the pass through values that have been reported are stable over time.

The results detailed in Appendix 9 follow the introduction of robust standard errors. They show a remarkable consistency with the results of the first model, the variation in the β's during the augmentation process is much lower than the variation in the import panel when it was similarly augmented. The results of the sub-groups are identical in terms of the β's with those of the first model, the adjustment is only in the size of the standard errors.

Accordingly, the results as tabulated in Appendix 9 will be reviewed in detail with the following modifications to improve the readability of the data. Where the result is shown in bold type the standard error is such that the coefficient can be accepted at the 5% error level. Where the coefficient can only be accepted at greater than 5% but less than 10% error level, this is shown on normal typeface. However where the standard error is such that the coefficient cannot be accepted at the 10% level, then it is treated as being insignificantly different from zero and accordingly this is recorded as the β coefficient for that country. The key for abbreviations used in the tables below and in Appendices 4 to 10 is given in Appendix 10.

6.4.1 Initial Sample Results.

Country	β	S. E. on β	t-ratio	P>|t|
Australia	-.55707	.05931	-9.392	0.000
Austria	0			
Belgium Luxembourg	0			
Canada	-.42871	.08938	-4.796	0.000
Switzerland	.2596	.08770	2.960	0.003
Germany	.3014	.10306	2.925	0.003
Denmark	0			
Spain	0			
Finland	0			
France	0			
Greece	0			
Hong Kong	-.67412	.11249	-5.993	0.000
Ireland	-.34266	.02632	-13.015	0.000
Italy	-.29826	.14422	-2.068	0.039
Japan	-.67105	.12119	-5.537	0.000
Holland	0			
Norway	-.38677	.19568	-1.977	0.048
New Zealand	-.27571	.05549	-4.968	0.000
Portugal	-.17088	.07121	-2.400	0.016
Singapore	-.92175	.10422	-8.844	0.000
Sweden	0			
U.S.A.	-.43632	.03671	-11.883	0.000

The range of exchange rate pass through is from a positive pass through of 0.30 to a negative pass through of -0.92. There does not seem to be any consistency of response by United Kingdom exporters across export markets; exports to two countries have a positive response, nine countries having an insignificant response and eleven countries having a negative response that range from -0.17 to -0.92.

6.4.2 Food Sector Results.

Country	β	**S. E. on** β	**t-ratio**	**P>|t|**
Australia	**-.59496**	**.09627**	**-6.180**	**0.000**
Austria	0			
Belgium Luxembourg	**-.45365**	**.22988**	**-1.973**	**0.048**
Canada	**-.94826**	**.22595**	**-4.197**	**0.000**
Switzerland	.5918	.31744	1.864	0.062
Germany	0			
Denmark	0			
Spain	0			
Finland	0			
France	0			
Greece	**-.34075**	**.15208**	**-2.241**	**0.025**
Hong Kong	**-.38356**	**.13721**	**-2.795**	**0.005**
Ireland	**-.33615**	**.04130**	**-8.138**	**0.000**
Italy	0			
Japan	0			
Holland	0			
Norway	**-1.4653**	**-.58126**	**2.521**	**0.012**
New Zealand	**-.29108**	**-.07495**	**3.883**	**0.000**
Portugal	0			
Singapore	**-.52140**	**.14853**	**-3.510**	**0.000**
Sweden	**-.27868**	**.11857**	**-2.350**	**0.019**
U.S.A.	**-.29532**	**.11836**	**-2.495**	**0.013**

The food sub-group shows a similar pattern of responses to the sample population. There are ten export markets where there is no significant pass through; Switzerland has a positive 0.59 pass through and the remaining countries having a range of negative pass throughs from -0.29 to -1.46. Additionally there is little pattern to the change in β coefficients when comparing the food group results with the sample population, most countries display slightly higher pass throughs in the food sector, although Hong Kong and the United States have much lower pass throughs.

6.4.3 Chemical Sector Results.

Country	β	**S. E. on** β	**t-ratio**	**P>|t|**
Australia	-.32632	.17855	-1.828	0.068
Austria	0			
Belgium Luxembourg	0			
Canada	0			
Switzerland	0			
Germany	**1.079**	**.48983**	**-2.203**	**0.028**
Denmark	-.73193	.39619	-1.847	0.065
Spain	0			
Finland	-.68170	.41036	-1.661	0.097
France	0			
Greece	0			
Hong Kong	-.81997	.41781	-1.963	0.050
Ireland	**-.30413**	**.06862**	**-4.432**	**0.000**
Italy	0			
Japan	0			
Holland	0			

Norway	0			
New Zealand	**-.5084**	**.10311**	**-4.930**	**0.000**
Portugal	**-.72334**	**.18317**	**-3.949**	**0.000**
Singapore	**-1.1568**	**.44078**	**-2.624**	**0.009**
Sweden	0			
U.S.A.	**-.31050**	**.13015**	**-2.386**	**0.017**

In the chemicals subgroup the same pattern of results can be seen. Whilst the number of insignificant countries has grown to twelve and the range of significant responses has increased from positive 1.0 for Germany to negative -1.1 for Singapore.

6.4.4 Stone and Glassware Sector Results.

Country	β	**S. E. on** β	**t-ratio**	**P>|t|**
Australia	0			
Austria	0			
Belgium Luxembourg	0			
Canada	0			
Switzerland	0			
Germany	0			
Denmark	0			
Spain	0			
Finland	0			
France	-.97562	.57251	-1.704	0.088
Greece	0			
Hong Kong	**-1.6633**	**.57404**	**-2.898**	**0.004**
Ireland	-.17392	.15412	-1.128	0.259
Italy	0			
Japan	**-.95751**	**.43167**	**-2.218**	**0.027**

Holland	0			
Norway	0			
New Zealand	**-.47257**	**.24312**	**-1.944**	**0.052**
Portugal	0			
Singapore	-.80469	.43177	-1.864	0.062
Sweden	0			
U.S.A.	-.61833	.13020	-4.749	0.000

The stone and glassware group has insignificant pass through in fifteen countries, and no country has a positive pass through. The range of negative β's values is still large ranging from -0.17 to -1.66.

6.4.5 Copper, Nickel and Aluminium Products Sector Results.

Country	β	**S. E. on** β	**t-ratio**	**P>|t|**
Australia	**-.59291**	**.17318**	**-3.424**	**0.001**
Austria	-.24926	.51308	-0.486	0.627
Belgium Luxembourg	0			
Canada	**-.68912**	**.29120**	**-2.366**	**0.018**
Switzerland	0			
Germany	0			
Denmark	0			
Spain	0			
Finland	0			
France	**-.59681**	**.18381**	**-3.247**	**0.001**
Greece	0			
Hong Kong	0			
Ireland	**-.38963**	**.07091**	**-5.494**	**0.000**
Italy	0			
Japan	-1.1204	.62782	-1.785	0.074

Holland	0			
Norway	0			
New Zealand	**-.53862**	**.22144**	**-2.432**	**0.015**
Portugal	0			
Singapore	**-1.2776**	**.43152**	**-2.961**	**0.003**
Sweden	0			
U.S.A.	**-.34923**	**.10116**	**-3.452**	**0.001**

The copper, nickel and aluminium products group mimic the pass through patterns of the previous sub-groups, with thirteen countries displaying insignificant pass throughs and a range of negative β's from -0.24 to -1.27.

6.4.6 Miscellaneous Building Products Sector Results.

Country	β	**S. E. on** β	**t-ratio**	**P>|t|**
Australia	**-.56112**	**.09053**	**-6.198**	**0.000**
Austria	0			
Belgium Luxembourg	0			
Canada	**-.61840**	**.22947**	**-2.695**	**0.007**
Switzerland	0			
Germany	0			
Denmark	.4565	.24222	1.885	0.059
Spain	0			
Finland	0			
France	0			
Greece	0			
Hong Kong	**-.50867**	**.15604**	**-3.260**	**0.001**
Ireland	**-.37167**	**.03411**	**-10.895**	**0.000**
Italy	-.54408	.30551	-1.781	0.075
Japan	0			

Holland	0			
Norway	-1.5444	.47708	-3.237	0.001
New Zealand	0			
Portugal	-.28396	.13652	-2.080	0.038
Singapore	-.95503	.17326	-5.512	0.000
Sweden	.5909	.19580	3.018	0.003
U.S.A.	-.25392	.11812	-2.150	0.032

The miscellaneous building product group shows a similar pattern to the food sub-group with eleven countries displaying an insignificant pass through, three positive β's and a range of negative β's from -0.25 to -1.54.

6.4.7 Results by Importing Country.

A summary of the coefficients by country is shown below:

Country	Population	Food	Chemicals	Stone etc	Copper etc	Misc.
Australia	-.55707	-.59496	-.32632	0	-.59291	-.56112
Austria	0	0	0	0	-.24926	0
Belgium Luxembourg	0	-.45365	0	0	0	0
Canada	-.42871	-.94826	0	0	-.68912	-.61840
Switzerland	.2596	.5918	0	0	0	0
Germany	.3014	0	1.079	0	0	0
Denmark	0	0	-.73193	0	0	.4565
Spain	0	0	0	0	0	0
Finland	0	0	-.68170	0	0	0
France	0	0	0	-.97562	-.59681	0
Greece	0	-.34075	0	0	0	0
Hong Kong	-.67412	-.38356	-.81997	-1.6633	0	-.50867
Ireland	-.34266	-.33615	-.30413	-.17392	-.38963	-.37167
Italy	-.29826	0	0	0	0	-.54408

Japan	-.67105	0	0	-.95751	-1.1204	0
Holland	0	0	0	0	0	0
Norway	-.38677	-1.4653	0	0	0	-1.5444
New Zealand	-.27571	-.29108	-.5084	-.47257	-.53862	0
Portugal	-.17088	0	-.72334	0	0	-.28396
Singapore	-.92175	-.52140	-1.1568	-.80469	-1.2776	-.95503
Sweden	0	-.27868	0	0	0	.5909
U.S.A.	-.43632	-.29532	-.31050	-.61833	-.34923	-.25392

When the columns are reviewed, there is little pattern of exchange rate response within either the sample population or the sub-groups thereof. However there is a pattern of responses by individual country as apart from Denmark and Sweden the sign of the β's is maintained across all of the sub-groups. This provides evidence that responses by exporters to a particular country are consistent, i.e. always positive or always negative, but there does not appear to be any evidence of a consistent response to exchange rate changes when countries are compared.

6.4.8 Results by Geographic Region.

Rearranging countries into their geographical location shows:

Country	Sample Population	Food	Chemicals	Stone etc	Copper etc	Misc.
European						
Austria	0	0	0	0	-.24926	0
Belgium	0	-.45365	0	0	0	0

Luxembourg						
Denmark	0	0	-.73193	0	0	.4565
Finland	0	0	-.68170	0	0	0
France	0	0	0	-.97562	**-.59681**	0
Germany	**.3014**	0	**1.079**	0	0	0
Greece	0	**-.34075**	0	0	0	0
Holland	0	0	0	0	0	0
Ireland	**-.34266**	**-.33615**	**-.30413**	-.17392	**-.38963**	**-.37167**
Italy	**-.29826**	0	0	0	0	-.54408
Norway	**-.38677**	**-1.4653**	0	0	0	**-1.5444**
Portugal	**-.17088**	0	**-.72334**	0	0	**-.28396**
Spain	0	0	0	0	0	0
Sweden	0	**-.27868**	0	0	0	**.5909**
Switzerland	**.2596**	.5918	0	0	0	0
North American						
Canada	**-.42871**	**-.94826**	0	0	**-.68912**	**-.61840**
U.S.A.	**-.43632**	**-.29532**	**-.31050**	-.61833	**-.34923**	**-.25392**
Asian						
Hong Kong	**-.67412**	**-.38356**	-.81997	**-1.6633**	0	**-.50867**
Japan	**-.67105**	0	0	**-.95751**	-1.1204	0
Singapore	**-.92175**	**-.52140**	**-1.1568**	-.80469	**-1.2776**	**-.95503**
Australasia						
Australia	**-.55707**	**-.59496**	-.32632	0	**-.59291**	**-.56112**
New Zealand	**-.27571**	**-.29108**	**-.5084**	**-.47257**	**-.53862**	0

If Europe is reviewed there is no obvious pattern of responses to exchange rate movements between the countries. This also applies to the North American results. In Asia, there were few occurrences of insignificant pass through and all significant βs were negative. These results are repeated in

Australasia. However, it must be concluded that there was little evidence of a regional response to exchange rate pass through by UK exporters.

6.5 Discussion of Results.

6.5.1 Comparison with Existing Empirical Work.

Knetter (1989) tested six US export products and found, for each product in each of ten separate destinations, that the country effects were almost all significantly different from zero, and further that F-tests for the inclusion of country effects in the model are overwhelmingly significant for every industry. It was also found that US exporters adjust their prices in a manner that amplifies the exchange rate effect, i.e. the US exporters positively passed through exchange rate shocks. This can be compared with ten German export industries where it was found that the German firms tended to stabilise dollar prices in the US market. The US market appears to be the only national market where this price stabilisation is seen however.

The findings of Knetter's (1989) study are not reproduced in the reported results of either this chapter or Chapter 5. A significant number of pass through coefficients are found to be insignificantly different from zero and the range of the reported β coefficients would not support the hypothesis of identical country effects for importers into or exporters from the U.K..

Additionally US exporters are found to negatively pass through exchange rate shocks.

In Knetter (1993), the results for exports from the UK into the USA show that seven out of the nine products tested have β coefficients that are not statistically significant at either the five percent or ten percent level. Additionally, four of the seven have β coefficients that are less than 0.1; i.e. they are very small. The two products that have significant β's, Synthetic Dyes and Books display exchange rate pass through of -0.6 and -1.47 respectively.

The results in this chapter give the following exchange rate pass through coefficients for exports to the USA:

Initial Sample	-0.43
Food sector	-0.30
Chemicals sector	-0.31
Stone etc. sector	-0.61
Copper etc. sector	-0.35
Misc. sector	-0.25

All of these results are significant at the five percent level except Stone, which is significant at the ten percent level.

The results of the export panel show a greater level of significance than the Knetter (1993) study. This could be a direct consequence of pooling the price data, however the range of values for the β's is similar for both studies. Knetter (1993) also considers whether pass through can be considered identical across all destinations and rejects this proposition. This conclusion is endorsed by the results of this study.

In Knetter (1993) evidence could not be found that national markets were treated differently, implying that destination specific mark-up adjustments could be the same for all countries and he shows that the hypothesis of identical export price adjustment behaviour across all industries within a source country can be rejected for the US and the UK but not for Germany or Japan. The results of the export panel which range from -1.6 to 1.08, cannot support the hypothesis that destination specific mark-ups are the same for all countries. The study supports Knetter's view that the U.K. does not exhibit identical export price adjustment behaviour across industries.

6.5.2 Comparison with the Import Panel Data Results.

The response of prices to changes in exchange rates was tested in twenty-two countries. In ten of the countries, including France, Germany, Italy and Switzerland, the sign of the significant β's changed dependant upon whether the country was an importer or exporter, therefore if exports to the country exhibited negative pass through, imports from the country exhibited positive pass through. Germany and Switzerland for example, exhibited negative pass through when they exported goods to the UK but positive pass through when they imported goods from the UK. The opposite was true for France, Italy and Portugal.

Five countries including Austria, Japan and the USA, exhibited negative pass throughs for imports and exports and two, Holland and Spain, changed from negative for imports to all pass throughs being insignificant for exports. The five remaining countries exhibited mixed responses, although the most regularly recurring response was an insignificant pass through.

For both the import and the export panels, the sign of the exchange rate pass through coefficient is almost always the same when comparing results within each country. The magnitude of the responses reflects the differing competitive pressures within each sector.

The country effects that have been found in the import and export panels are bilateral in nature, the country effect does not have the same impact on each of the countries that the importer or exporter trades with as found by Knetter (1989) and Mann (1986). A bilateral effect suggests that the reason for the change in firms' pass through behaviour is related to how the individual countries react the exchange rate shock.

6.5.3 Evaluation under a Multi-period Pricing Model.

As discussed previously, where pass through coefficients are insignificantly different from zero, the model developed in Chapter 3 ascribes this to firms believing that the exchange rate shocks are temporary and the impact of the exchange rate shock is not significant when compared to the menu costs of passing it through into prices. Zero pass through could also occur following a permanent shock if the country of manufacture bears all of the adjustment costs, i.e. the country responds to the shock so quickly that there is no need to adjust prices in the country in which the exports are being sold. As there are only two countries, Spain and Holland, where there is zero pass through in all sectors, little support for the hypothesis of zero pass through following a permanent exchange rate shock is provided by the country results reported here.

The results that have been generated correspond to economic theory, with positive pass through of cost changes in both the home and foreign markets, where these are statistically significant. The level of R^2 that is reported is consistently low. This indicates that there is a high level of heterogeneity within the response of individual sectors and this offers support for the sectoral approach taken in this chapter and also suggests that a greater level of disaggregation should be considered in the future..

As highlighted in the comparison of the import and export results, a very high proportion of the countries only display one sign of pass through and ten of the countries switch signs dependent upon whether they are importing or exporting goods. This suggests an hypothesis that it is the speed with which firms within each individual country react to an exchange rate shock that determines the extent to which that the shock is passed through into prices in the country. If prices are particularly rigid in one country, and consequently react very slowly to exchange rate shocks, then a trading partner in another country where firms react much faster to exchange rate shocks would bear a greater proportion of the cost of adjustment to the shock.

The alternative hypothesis, that there are source or destination country effects that have an impact on the general pass through behaviour of firms to all countries, is not supported by the results of the export and the import panels.

6.6 Conclusions.

One of the purposes of this study has been to determine whether UK firms exhibit consistent exchange rate pass through behaviour over the range of destinations that have been selected. Researchers such as Mann (1986) and Knetter (1989) have found this type of consistent response to exchange rate shocks. Later work by researchers including Knetter (1993) has found that when different industries are considered the consistency of response can be challenged. A discernible pattern of responses to exchange rate shocks cannot be found in the responses of the sample population or the sub-sectors, nor can a pattern be found when the sample is split into geographic regions. The proposition that the UK exhibits a source country effect when exporting goods cannot therefore be supported for the sample of countries and products that were selected.

If the country responses are considered, the results of the import and the export panels provide evidence to support the hypothesis that it is the bilateral response between countries that is important with a majority of countries switching sign of response dependent upon whether the firms were acting as exporters and importers. This provides a role for price rigidity to have an impact on how firms react to exchange rate changes, in countries where firms react to shocks the fastest they are likely to have to bear the greater share of burden in passing through the shock into prices.

Chapter 7.

Conclusions.

This thesis has explored exchange rate pass through from both a theoretical and an empirical standpoint. It has identified weaknesses in the existing methodologies that have been adopted and raised questions about the underlying assumptions of the models that have been formulated and published in this area. Finally it has proposed an alternative theoretical approach which offers new insights into the actions of firms and has tested these insights empirically utilising both time series and panel data techniques. The principal conclusions that can be drawn from this work are detailed below, together with a brief description of the underlying concerns that motivated the particular issue.

Existing theoretical models are able to explain less than full exchange rate pass through but do not address the issue when a firm might not pass through exchange rate shocks. The theoretical model derived in chapter 3 allows firms to fix their price for many periods, although allowing more frequent price adjustment in extreme circumstances. Under this multi-period pricing model, it has been shown that firms will not pass through temporary exchange rate shocks that are anticipated to last for one period and the model also provides a minimum bound for the level of shocks that will passed through for longer lasting shocks. Where the shock is deemed to be permanent, as the model provides a mechanism that induces sluggishness in the adjustment of nominal prices, and if firms in one of the countries responds faster than firms in the other to shocks, then this model can explain how there can be zero long run exchange rate pass through. These findings differ from the outcome of the two period model employed by Froot and Klemperer (1989) where, although temporary shocks cause prices to be adjusted by less than permanent shocks they will be adjusted. Similarly, Gross and Schmitt (1999) find in a two period model that first period exchange rate shocks affect prices in the second period.

The asymmetric response to shocks found by Ball and Mankiw when firms operate in an environment of rising prices is also found to hold when they are subjected to an exchange rate shock. Firms are more likely to pass through shocks that increase their optimal price than those that would generate a price reduction.

The empirical study in chapter 4 generated economically sensible long run results. The impact of changes in competitor prices was positive and in the range 0.5 to 1.2 which indicates that firms respond to competitors actions. Similarly, changes in income levels and underlying costs have positive signs which would be anticipated. However, in one of the five product groups that was tested, the long run exchange rate pass through was insignificantly different from zero. Additionally in three of the other groups price adjustments are made that amplify the effect of the exchange rate shock. This conflicts with the findings of authors such as Marston (1990) and Athukorala and Menon (1992) and (1995), where only significant negative pass through coefficients were found, but the studies use aggregated data and there are also some reservations about the econometric techniques that have been applied in each case. However the findings are similar to those of Gross and Schmitt (1996), where a large proportion of the pass through coefficients are insignificantly different from zero.

These results show that firms are not passing through the effects of exchange rate movements to their customers. This accords to a response of a firm in a monopolistically competitive environment who prices strategically in relation to competitors who may not be subject to the same shock. Accordingly it is a rational response particularly where the firm believes the shock to be temporary.

Chapter 4 offers evidence that firms are pricing to market and supports the findings of Giovannini (1988), Marston (1990) and Rangan and Lawrence (1993). It also confirms the findings in Kasa (1992) that firms use their profit margins to smooth out exchange rate movements.

Chapter 5 conducted a similar study to chapter 4 but this time applying panel data techniques to a large group of imports into the UK. The results showed that firms were passing through changes to their costs into their prices but they did not pass exchange rate changes in a large number of cases. Significantly it was found that, with only a few minor exceptions, where a country experienced a significant exchange rate pass through the sign of the pass through was the same in each of the sub-groups that were tested. This implies that when firms within a country are subjected to exchange rate shock they will respond in a symmetrical way and this raises the issue of whether there are country specific effects that should be taken into account. Testing imports into the UK allows a test to be undertaken as to whether there are any destination country effects associated with this country. A review of the responses of the twenty-two countries that were tested would indicate that this effect is not apparent and considering regional groupings of countries also rejected any common regional response.

Additionally it was noted in Chapter 5 that when the countries that have a negative pass through of exchange rate shocks are compared with the countries where the pass through is positive, the former countries tend to be those who are recognised as low inflation economies whereas the latter tend to be those who are recognised as higher inflation economies.

Theses results add further weight to the findings of chapter 4, firms whilst rationally passing through cost changes are not passing through exchange rate changes. As changes in exchange rates have an impact on the firms costs, the lack of response must indicate that firms consider them to be temporary adjustments that will revert back to their former levels.

Whilst testing imports into the UK confirms that there do not appear to any source country effects associated with the UK, it does not allow consideration of destination country effects of exporters from the UK. A similar panel of products was selected but they were considered for UK exporters. The results of these tests that are detailed in chapter 6 were broadly in line with the import panel in chapter 5. The responses to exchange rate shocks by UK exporters were nine with a pass through that was insignificantly different from zero, eleven with a negative pass through and two with a positive pass through. It was not possible to detect any destination country effects or regional effects. However apart from the United States, Singapore and Japan, the sign of significant pass throughs in the export study was the opposite to the sign of significant pass throughs in the import study.

Whilst the trend of responses to exchange rate shocks is similar in both panel data studies, the reaction of individual sectors for any country whilst taking the same sign is different in scale implying that industries react differently to shocks. This confirms the theoretical findings of Dornbusch (1989), Knetter

(1989), Feenstra (1989) and Feenstra, Gagnon and Knetter (1996) that pass through depends on the elasticity of demand in the destination market and will therefore vary by industry.

The finding that country specific effects could not be detected is contrary to the findings of Mann (1986) and Knetter (1989). However the former study uses only very high level data and can therefore only be considered illustrative. A later study by Knetter (1993) and two studies by Gross and Schmitt (1996) and (1999), also failed to find country specific effects.

To summarise, the novel findings of the empirical tests is that a significant number of firms importing into and exporting out of the UK do not pass through exchange rate shocks. The theoretical analysis offers two explanations of this, either the firms consider the shocks to be temporary and are discounting them, or that they are using their profit margins to smooth out the effects of the shocks and this allows the general price levels in the countries in which they operate to respond to the shock thereby potentially mitigating, or nullifying the initial impact of the shock. Additionally where firms do react to shocks, in a majority of the countries selected, the signs of the pass through for importers and exporters are opposite. This would imply that the time it takes for a country to react to shocks and the affect an exchange rate shock has on a country's economy must be taken into account in theoretical models.

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ADDITIONAL APPENDICES.

CHAPTER 5

Appendix 1.

List of products selected.

SITC CODE	Description
04841	Bread, ships, biscuits & other ordinary bakers wares
04842	Pastry, biscuits, cakes and other fine bakers wares
05461	Vegetables, preserved by freezing, cooked or not
05488	Vegetables products of a kind used for human food
05659	Vegetables prepared/preserved otherwise than by vinegar
05794	Berries, fresh
05798	Other fresh fruit
05799	Other dried fruit
08199	Sweetened forage; other preptions for animal feeding
09804	Sauces; mixed condiments and mixed seasonings
09805	Soups and broths, in liquid, solid or powder form
09809	Food preparations, n.e.s.
11101	Waters (including spa & aerated waters); ice and snow
11102	Lemonade, flavoured spa waters & flavoured waters
11212	Wine of fresh grapes; grape must
51482	Carboxyimide-function compounds etc.
51489	Compounds with other nitrogen functions
51559	Organo-inorganic compounds, n.e.s.
51571	Sulphonamides
51611	Ethers, ether-alcohols, ether-phenols etc.

51621 Aldehydes, aldehyde-alcohols, aldehyde-phenols, etc

51631 Phosphoric esters, their salts, & their derivatives

51691 Enzymes

52214 Fluorine, bromine and iodine

52218 Carbon (including carbon black), n.e.s.

52229 Other inorganic acids & oxygen compounds of non-metals

52259 Hydrazine & hydroxylamine & their inorganic salts

52311 Fluorides; fluorosilicates, fluoroborates and salts

52312 Chlorides and oxychlorides

52314 Chlorates and perchlorates

52331 Salts of metallic acids (e.g., chromates etc.)

53351 Prepared pigments, preparations opacifiers & preparations colours

53354 Glaziers'putty; grafting putty; painters'fillings

59221 Casein, caseinates and other casein derivatives

59222 Albumins, albuminates and other albumin derivatives

59223 Gelatin & gelat.derivatives; glues deriv.from bones

59224 Peptones & other protein substanc.& their derivat.

59225 Dextrins & dextrin glues; soluble/roasted starches

59229 Prepared glues, n.e.s.

59831 Artificial waxes (including water-soluble waxes)

59832 Artificial graphite; colloidal graphite

59896 Pickling preparations for metal surfaces

62101 Plates, sheets and strip, n.e.s., of rubber

62102 Unvulcanized n.a.tural or synthetic rubber

62104 Plates, sheets, strip, rods & profile shapes, of rubb.

62105 Piping and tubing, of unhardened vulcanized rubber

62898 Articles of unhardened vulcanized rubber, n.e.s.

63302 Agglomerated cork & articles of agglomerated cork

63491 Hoopwood; split poles; pickets and stakes of wood

63492 Wooden beadings and mouldings

63542 Household utensils of wood

63591 Wooden tools, tool bodies, tool handles, etc.of wood
63599 Other articles of wood, n.e.s.
64121 Printing & writing paper uncoated
64197 Wallpaper & lincrusta; window transparencies paper
64242 Carbon and other copying papers & transfer papers
64281 Bobbins, spools & similar supports of paper pulp
65121 Wool tops
65195 Yarn, slivers and rovings of glass fibre
65196 Flax or ramie yarn, not put up for retail sale
65223 Pile fabrics and chenille fabrics, woven, of cotton
65601 Narrow woven fabrics consist of warp without weft
65732 Textile fabrics coated, with preparation of cellulose derivatives
65733 Rubberized textile fabrics
65751 Twine, cordage, ropes and cables, plaited or not
65771 Wadding and articles of wadding, n.e.s.
65773 Textile fabrics & articles used in machinary/plant
66132 Building & monument.stone, worked, nes mosaic cubes
66339 Articles of stone/of other mineral substances, nes
66381 Fabricated asbestos and articles thereof
66391 Laboratory, chemical or industrial wares, ceramic
66392 Other articles of ceramic materials, n.e.s.
66415 Glass in balls, rods and tubes, unworked
66491 Cast, rolled, drawn/blown glass cut to shape or bent
66494 Glass fibre and articles made therefrom, n.e.s.
66511 Carboys, bottles, jars, pots, tubular containers
66582 Glass beads, imitation pearls, imit.precious stones
66589 Other articles of glass, n.e.s.
67941 Castings of iron
68221 Bars, rods, angles, shapes & sectns.wrought, of copper
68222 Plates, sheets and strip, wrought, of copper
68225 Tubes, pipes, blanks therefor; hollow bars of copper

68321 Bars, rods, angles, shapes & sectns.wrought, of nickel
68322 Plates, sheets & strip, wrought, of nickel; nick.foil
68422 Plates, sheets and strip, wrought, of aluminium
68423 Aluminium foil, of a thickness not exceeding 0, 20mm
68425 Tubes, pipes, blanks therefor; hollow bars of alumin.
69241 Casks, drums, boxes of sheet or plate for pack.gds.
69242 Casks, drums, boxes of aluminium for packing goods
69243 Containers of iron/steel for compressed gas
69311 Stranded wire etc.of iron or steel
69351 Gauze, cloth, grill of iron or steel
69401 Nails, tacks, staples, spiked cramps, studs, of copper
69402 Bolts & nuts screws & rivets of iron or steel
69531 Saws & blades for hand or machine saws
69539 Hand tools n.e.s.blow lamps, anvils, port.forges
69541 Interchang.tools for pressing, stamping drilling
69606 Spoons, forks, fish-eaters and sim.kitchenware
69608 Knives with cutting blades serrated or not
69751 Sanitary ware for indoor use of iron or steel
69782 Statuettes & other ornaments used indoors
69911 Locks and padlocks and parts thereof of base metal
69913 Base metal fittings & mountings for furniture
69933 Clasps, frames with clasps for handbags & the like
69941 Springs & leaves for springs of iron or steel
69963 Stoppers, crown corks, bottle caps etc of base met.
73732 Electric welding, brazing, cutting mach.and parts
74132 Ind.& lab.furnaces & ovens, non electric, and parts
74991 Moulding boxes for metal foundry, moulds
74999 Machinery parts not containing electrical connect.
77511 Clothes washing machines, not exceeding 6 kgs
77811 Primary cells and primary batteries and parts
77831 Electr.starting & ignition equipment

77832 Electr.lighting & signaling equip., defrosters etc.

77881 Electro-magnets, permanent magnets, clamps, vices etc

77884 Elect.capacitors, condensers, fixed or variable

77887 Carbon brushes, arc-lamp carbons, carbon electrodes

78539 Parts of accessories of 785--

78613 Containers, spec.designed for carriage

82122 Mattress supports, eiderdowns, cushions, pouffes etc.

84721 Gloves, mittens, mitts, knitted or crocheted

84722 Stockings, ankle-socks and the like

85101 Footwear with outer soles & uppers, rubber/plastic

85102 Footwear with outer soles of leather

88221 Photographic plates, sensitized, unexposed

88222 Film in rolls, sensitized, unexposed

88223 Paper, paperboard & cloth, unexposed, sensitized

88522 Clocks, n.e.s.

89211 Printed books, booklets, brochures, leaflets

89212 Children's picture & painting books

89281 Paper and paperboard labels

89421 Wheeled toys designed to be ridden

89422 Dolls

89423 Toys, n.e.s.; working models for recreation.a.l purp.

89424 Equipment for parlour, table-tennis, etc. games

89425 Carnival articles, entertainment art. etc.

89472 Appl.appa.acces.for gymnastics or for sports

89512 Fittings for loose-leaf binders, clips, staples etc.

89521 Fountain pens, stylograph pens and pencils

89523 Pencils, pencil leads, slate p., pastels, charcoals

89594 Typewriter and sim.ribbons, ink-pads

CHAPTER 5

Appendix 2.

List of selected exporting countries by geographical region.

Europe.

Austria
Belgium-Luxembourg
Denmark
Germany
Spain
France
Greece
Ireland
Italy
Netherlands
Norway
Portugal
Switzerland
Finland
Sweden

Australasia

Australia
New Zealand

North America

Canada

United States of America

Asian.

Hong Kong

Japan

Singapore

CHAPTER 5

Appendix 3

Products subdivided by sub-group.

Food Group.

<u>SITC CODE</u>	<u>Description</u>
04841	Bread, ships, biscuits & other ordinary bakers wares
04842	Pastry, biscuits, cakes and other fine bakers wares
05461	Vegetables, preserved by freezing, cooked or not
05488	Vegetables products of a kind used for human food
05659	Vegetables prepared/preserved otherwise than by vinegar
05794	Berries, fresh
05798	Other fresh fruit
05799	Other dried fruit
08199	Sweetened forage; other preptions for animal feeding
09804	Sauces; mixed condiments and mixed seasonings
09805	Soups and broths, in liquid, solid or powder form
9809	Food preparations, n.e.s.

Chemicals Group.

<u>SITC CODE</u>	<u>Description</u>
51482	Carboxyimide-function compounds etc.
51489	Compounds with other nitrogen functions
51559	Organo-inorganic compounds, n.e.s.

51571 Sulphonamides

51611 Ethers, ether-alcohols, ether-phenols etc.

51621 Aldehydes, aldehyde-alcohols, aldehyde-phenols, etc

51631 Phosphoric esters, their salts, & their derivatives

51691 Enzymes

52214 Fluorine, bromine and iodine

52218 Carbon (including carbon black), n.e.s.

52229 Other inorganic acids & oxygen compounds of non-metals

52259 Hydrazine & hydroxylamine & their inorganic salts

52311 Fluorides; fluorosilicates, fluoroborates and salts

52312 Chlorides and oxychlorides

52314 Chlorates and perchlorates

52331 Salts of metallic acids (e.g., chromates etc.)

53351 Prepared pigments, preparations opacifiers & preparations colours

53354 Glaziers'putty; grafting putty; painters'fillings

59221 Casein, caseinates and other casein derivatives

59222 Albumins, albuminates and other albumin derivatives

59223 Gelatin & gelat.derivatives; glues deriv.from bones

59224 Peptones & other protein substanc.& their derivat.

59225 Dextrins & dextrin glues; soluble/roasted starches

59229 Prepared glues, n.e.s.

59831 Artificial waxes (including water-soluble waxes)

59832 Artificial graphite; colloidal graphite

59896 Pickling preparations for metal surfaces

Stone and Glassware Group

<u>SITC</u> <u>Description</u>

<u>CODE</u>

66132 Building & monument.stone, worked, nes mosaic cubes

66339 Articles of stone/of other mineral substances, nes

66381 Fabricated asbestos and articles thereof

66391 Laboratory, chemical or industrial wares, ceramic

66392 Other articles of ceramic materials, n.e.s.

66415 Glass in balls, rods and tubes, unworked

66491 Cast, rolled, drawn/blown glass cut to shape or bent

66494 Glass fibre and articles made therefrom, n.e.s.

66511 Carboys, bottles, jars, pots, tubular containers

66582 Glass beads, imitation pearls, imit.precious stones

66589 Other articles of glass, n.e.s.

Copper, Nickel and Aluminium Products Group.

SITC CODE	Description
68221	Bars, rods, angles, shapes & sectns.wrought, of copper
68222	Plates, sheets and strip, wrought, of copper
68225	Tubes, pipes, blanks therefor; hollow bars of copper
68321	Bars, rods, angles, shapes & sectns.wrought, of nickel
68322	Plates, sheets & strip, wrought, of nickel; nick.foil
68422	Plates, sheets and strip, wrought, of aluminium
68423	Aluminium foil, of a thickness not exceeding 0, 20mm
68425	Tubes, pipes, blanks therefor; hollow bars of alumin.

Miscellaneous Building Products Group.

SITC CODE	Description
69241	Casks, drums, boxes of sheet or plate for pack.gds.
69242	Casks, drums, boxes of aluminium for packing goods
69243	Containers of iron/steel for compressed gas

69311	Stranded wire etc.of iron or steel
69351	Gauze, cloth, grill of iron or steel
69401	Nails, tacks, staples, spiked cramps, studs, of copper
69402	Bolts & nuts screws & rivets of iron or steel
69531	Saws & blades for hand or machine saws
69539	Hand tools n.e.s.blow lamps, anvils, port.forges
69541	Interchang.tools for pressing, stamping drilling
69606	Spoons, forks, fish-eaters and sim.kitchenware
69608	Knives with cutting blades serrated or not
69751	Sanitary ware for indoor use of iron or steel
69782	Statuettes & other ornaments used indoors
69911	Locks and padlocks and parts thereof of base metal
69913	Base metal fittings & mountings for furniture
69933	Clasps, frames with clasps for handbags & the like
69941	Springs & leaves for springs of iron or steel
69963	Stoppers, crown corks, bottle caps etc of base met.

CHAPTER 5

Appendix 4.

Panel Data Regression Analysis 1.

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_t + u_{it}, \qquad (5.4)$$

number of observations 4653

Sample Population Results.

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3085	.1116	2.763	0.006	0.0016	63.01	0.0000	0.00	0.9954
Austria	-.091	.2158	-0.423	0.672	0.0000	14.54	0.0001	0.09	0.767
Belgium Luxembourg	-1.22	.2598	-4.707	0.000	0.0110	1666.	0.0000	2.30	0.1293
Canada	.0574	.2240	0.256	0.798	0.0000	29.43	0.0000	0.98	0.3221
Switzerland	-.984	.3207	-3.068	0.002	0.0041	1173.	0.0000	4.02	0.0449
Germany	-2.35	.4633	-5.079	0.000	0.0166	10808	0.0000	2.04	0.1531
Denmark	-.189	.2432	-0.779	0.436	0.0002	6.32	0.0119	0.03	0.8719
Spain	-.585	.3300	-1.775	0.076	0.0007	119.4	0.0000	5.69	0.0170
Finland	1.832	.4724	3.878	0.000	0.0057	764.0	0.0000	7.22	0.0072
France	-.010	.4322	-0.024	0.981	0.0016	4835.	0.0000	2.61	0.1064
Greece	.4968	.2054	2.419	0.016	0.0017	36.70	0.0000	6.03	0.0141
Hong Kong	-.578	.2682	-2.156	0.031	0.0008	400.4	0.0000	11.82	0.0006
Ireland	-.360	.1766	-2.042	0.041	0.0006	2277.	0.0000	4.98	0.0256
Italy	.1454	.3147	0.462	0.644	0.0001	144.8	0.0000	0.21	0.6434
Japan	-1.10	.2652	-4.162	0.000	0.0104	1489.	0.0000	2.06	0.1509
Holland	-1.80	.4725	-3.819	0.000	0.0071	3899.	0.0000	3.92	0.0478
Norway	.1920	.3918	0.490	0.624	0.0000	232.6	0.0000	0.64	0.4243
New Zealand	-.055	.0853	-0.647	0.518	0.0000	38.63	0.0000	2.51	0.1130
Portugal	.2215	.2223	0.997	0.319	0.0004	155.6	0.0000	0.74	0.3884
Singapore	.6365	.2731	2.331	0.020	0.0024	129.7	0.0000	0.00	0.9490
Sweden	-.780	.4161	-1.876	0.061	0.0004	877.0	0.0000	10.04	0.0015
U.S.A.	-1.01	.1588	-6.414	0.000	0.0116	4032.	0.0000	23.69	0.0000

Food Results.

number of observations 396

Country	β	**S. E. on β**	**t-ratio**	**P>|t|**	**R-sq:**	**B-P Test**	P>[c]	**H-man Test**	**P>[c]**
Australia	.29842	.22463	1.329	0.184	0.0045	5.24	0.0220	0.00	1.0000
Austria	-.7610	.38890	-1.957	0.050	0.0096	5.29	0.0214	0.00	1.0000
Belgium Luxembourg	-1.215	.48818	-2.491	0.013	0.0155	6.06	0.0139	0.00	1.0000
Canada	.19586	.34231	0.572	0.567	0.0008	5.69	0.0171	0.00	1.0000
Switzerland	-.6305	.36655	-1.720	0.085	0.0075	5.54	0.0186	0.00	1.0000
Germany	-1.117	.46903	-2.382	0.017	0.0142	5.90	0.0151	0.00	1.0000
Denmark	.35917	.68312	0.526	0.599	0.0007	6.03	0.0140	0.00	1.0000
Spain	-1.364	.79129	-1.724	0.085	0.0075	6.03	0.0140	0.00	1.0000
Finland	1.7787	.91560	1.943	0.052	0.0095	5.78	0.0162	0.00	1.0000
France	-.3812	.52983	-0.720	0.472	0.0013	5.98	0.0144	0.00	1.0000
Greece	-.0099	.41079	-0.024	0.981	0.0000	5.88	0.0153	0.00	1.0000
Hong Kong	-.2833	.35527	-0.798	0.425	0.0016	5.42	0.0199	0.00	1.0000
Ireland	.61431	.25185	2.439	0.015	0.0149	5.89	0.0153	0.00	1.0000
Italy	.90058	.67341	1.337	0.181	0.0045	5.95	0.0148	0.00	1.0000
Japan	.03531	.29385	0.120	0.904	0.0000	5.20	0.0226	0.00	1.0000
Holland	-1.480	.70804	-2.090	0.037	0.0110	6.01	0.0142	0.00	1.0000
Norway	.28239	.50955	0.554	0.579	0.0008	5.10	0.0240	0.00	1.0000
New Zealand	-.1019	.17130	-0.595	0.552	0.0009	5.65	0.0174	0.00	1.0000
Portugal	.06191	.43534	0.142	0.887	0.0001	5.87	0.0154	0.00	1.0000
Singapore	.43712	.42730	1.023	0.306	0.0026	5.78	0.0162	0.00	1.0000
Sweden	.31399	.47811	0.657	0.511	0.0011	5.34	0.0208	0.00	1.0000
U.S.A.	-.0340	.17217	-0.198	0.843	0.0001	5.58	0.0182	0.00	1.0000

Chemicals Results.

number of observations 691

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.4036	.2160	1.868	0.062	0.0039	12.74	0.0004	0.00	1.0000
Austria	-.147	.4480	-0.328	0.743	0.0001	11.81	0.0006	0.00	1.0000
Belgium Luxembourg	-.397	.2822	-1.410	0.159	0.0022	12.49	0.0004	0.00	1.0000
Canada	-.279	.4383	-0.639	0.523	0.0005	13.15	0.0003	0.00	1.0000
Switzerland	-.683	.4036	-1.693	0.091	0.0032	12.13	0.0005	0.00	1.0000
Germany	-1.24	.4522	-2.755	0.006	0.0085	13.33	0.0003	0.00	1.0000
Denmark	.0666	.4778	0.139	0.889	0.0000	12.96	0.0003	0.00	1.0000
Spain	-.296	.5325	-0.557	0.578	0.0003	13.13	0.0003	0.00	1.0000
Finland	.7476	.4779	1.564	0.118	0.0027	13.42	0.0002	0.00	1.0000
France	.0313	.3746	0.084	0.933	0.0000	11.71	0.0006	0.00	1.0000
Greece	-.129	.1952	-0.664	0.506	0.0005	12.14	0.0005	0.00	1.0000
Hong Kong	.2719	.2564	1.060	0.289	0.0013	12.31	0.0004	0.00	1.0000
Ireland	.0025	.1929	0.013	0.989	0.0000	12.72	0.0004	0.00	1.0000
Italy	-.303	.5545	-0.546	0.585	0.0003	12.53	0.0004	0.00	1.0000
Japan	-.828	.2808	-2.951	0.003	0.0097	11.93	0.0006	0.00	1.0000
Holland	-.466	.4284	-1.090	0.276	0.0013	12.40	0.0004	0.00	1.0000
Norway	.3171	.3762	0.843	0.399	0.0008	12.03	0.0005	0.00	1.0000
New Zealand	-.031	.0902	-0.347	0.728	0.0001	12.59	0.0004	0.00	1.0000
Portugal	.0852	.2127	0.401	0.689	0.0002	13.34	0.0003	0.00	1.0000
Singapore	.4372	.3640	1.201	0.230	0.0016	8.86	0.0029	0.00	1.0000
Sweden	.7586	.5302	1.431	0.152	0.0023	12.89	0.0003	0.00	1.0000
U.S.A.	-.251	.1520	-1.656	0.098	0.0031	12.43	0.0004	0.00	1.0000

Stone and Glassware Results.

number of observations 363

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3876	.4034	0.961	0.337	0.0026	4.87	0.0274	0.00	1.0000
Austria	-.283	.7033	-0.403	0.687	0.0004	4.72	0.0298	0.00	1.0000
Belgium Luxembourg	-.116	.4378	-0.266	0.790	0.0002	5.01	0.0253	0.00	1.0000
Canada	-1.49	.6479	-2.308	0.021	0.0145	5.15	0.0233	0.00	1.0000
Switzerland	-1.65	.7588	-2.179	0.029	0.0130	5.20	0.0225	0.00	1.0000
Germany	-2.04	.7197	-2.847	0.004	0.0220	5.33	0.0209	0.00	1.0000
Denmark	1.056	.8594	1.230	0.219	0.0042	5.42	0.0199	0.00	1.0000
Spain	.7143	.7807	0.915	0.360	0.0023	5.39	0.0202	0.00	1.0000
Finland	1.762	.9102	1.937	0.053	0.0103	5.45	0.0195	0.00	1.0000
France	-.042	.7178	-0.059	0.953	0.0000	5.10	0.0239	0.00	1.0000
Greece	-.091	.4917	-0.186	0.853	0.0001	5.44	0.0197	0.00	1.0000
Hong Kong	-.505	.7930	-0.637	0.524	0.0011	5.27	0.0217	0.00	1.0000
Ireland	.2871	.3014	0.953	0.341	0.0025	5.42	0.0199	0.00	1.0000
Italy	-.160	.8099	-0.198	0.843	0.0001	5.07	0.0244	0.00	1.0000
Japan	-1.12	.5273	-2.138	0.033	0.0125	5.27	0.0216	0.00	1.0000
Holland	-1.34	.9955	-1.350	0.177	0.0050	5.50	0.0190	0.00	1.0000
Norway	1.590	.8004	1.987	0.047	0.0108	4.63	0.0314	0.00	1.0000
New Zealand	.0752	.1930	0.390	0.697	0.0004	4.73	0.0297	0.00	1.0000
Portugal	.2945	.5762	0.511	0.609	0.0007	5.49	0.0191	0.00	1.0000
Singapore	-.661	.5531	-1.196	0.232	0.0039	5.51	0.0189	0.00	1.0000
Sweden	-.676	.9032	-0.749	0.454	0.0016	5.29	0.0215	0.00	1.0000
U.S.A.	-.177	.2286	-0.777	0.437	0.0017	4.77	0.0290	0.00	1.0000

Copper, Nickel and Aluminium Products Results.

number of observations 264

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0173	.4610	0.038	0.970	0.0000	3.09	0.0786	0.00	1.0000
Austria	-.049	.6919	-0.072	0.943	0.0000	3.23	0.0723	0.00	1.0000
Belgium Luxembourg	-.568	.3380	-1.681	0.093	0.0107	2.98	0.0845	0.00	1.0000
Canada	1.663	.8167	2.037	0.042	0.0156	3.23	0.0722	0.00	1.0000
Switzerland	-.208	.4387	-0.476	0.634	0.0009	2.93	0.0871	0.00	1.0000
Germany	-1.60	.6269	-2.554	0.011	0.0243	3.18	0.0745	0.00	1.0000
Denmark	-.868	.6915	-1.256	0.209	0.0060	3.17	0.0751	0.00	1.0000
Spain	-.411	1.025	-0.401	0.688	0.0006	3.22	0.0726	0.00	1.0000
Finland	.5838	.9152	0.638	0.524	0.0016	3.21	0.0730	0.00	1.0000
France	1.154	.5876	1.965	0.049	0.0145	3.11	0.0780	0.00	1.0000
Greece	.3721	.2894	1.286	0.199	0.0063	3.01	0.0826	0.00	1.0000
Hong Kong	.3326	.6689	0.497	0.619	0.0009	3.17	0.0749	0.00	1.0000
Ireland	-.630	.3548	-1.777	0.076	0.0119	3.10	0.0784	0.00	1.0000
Italy	.9971	.7614	1.310	0.190	0.0065	3.19	0.0740	0.00	1.0000
Japan	-.370	.5686	-0.652	0.515	0.0016	3.12	0.0775	0.00	1.0000
Holland	-.176	.6485	-0.273	0.785	0.0003	3.22	0.0726	0.00	1.0000
Norway	-1.72	1.026	-1.679	0.093	0.0106	3.13	0.0768	0.00	1.0000
New Zealand	.2723	.2028	1.343	0.179	0.0068	2.71	0.0995	0.00	1.0000
Portugal	-.293	.4759	-0.617	0.537	0.0015	3.10	0.0781	0.00	1.0000
Singapore	.2398	.8114	0.296	0.768	0.0003	3.25	0.0715	0.00	1.0000
Sweden	-.543	.4359	-1.247	0.212	0.0059	2.99	0.0836	0.00	1.0000
U.S.A.	-.279	.1699	-1.646	0.100	0.0102	3.02	0.0824	0.00	1.0000

Miscellaneous Building Products Results.

number of observations 627

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0063	.3509	0.018	0.985	0.0000	8.85	0.0029	0.00	1.0000
Austria	-.327	.5129	-0.639	0.523	0.0007	8.24	0.0041	0.00	1.0000
Belgium Luxembourg	-1.44	.3781	-3.829	0.000	0.0229	9.12	0.0025	0.00	1.0000
Canada	1.017	.4771	2.133	0.033	0.0072	9.03	0.0027	0.00	1.0000
Switzerland	-1.19	.3308	-3.601	0.000	0.0203	8.05	0.0045	0.00	1.0000
Germany	-1.88	.4388	-4.305	0.000	0.0288	8.79	0.0030	0.00	1.0000
Denmark	-.310	.4492	-0.691	0.490	0.0008	8.63	0.0033	0.00	1.0000
Spain	-.729	.4971	-1.467	0.142	0.0034	8.71	0.0032	0.00	1.0000
Finland	2.485	.8450	2.942	0.003	0.0137	9.20	0.0024	0.00	1.0000
France	.2483	.5091	0.488	0.626	0.0004	8.84	0.0029	0.00	1.0000
Greece	1.212	.5962	2.034	0.042	0.0066	9.12	0.0025	0.00	1.0000
Hong Kong	-.394	.3909	-1.009	0.313	0.0016	8.84	0.0029	0.00	1.0000
Ireland	-.384	.1929	-1.994	0.046	0.0063	8.98	0.0027	0.00	1.0000
Italy	.0994	.5092	0.195	0.845	0.0001	8.85	0.0029	0.00	1.0000
Japan	-1.58	.2970	-5.350	0.000	0.0438	9.00	0.0027	0.00	1.0000
Holland	-1.48	.4463	-3.317	0.001	0.0173	8.56	0.0034	0.00	1.0000
Norway	-.682	.7518	-0.907	0.364	0.0013	9.03	0.0027	0.00	1.0000
New Zealand	-.019	.2021	-0.094	0.925	0.0000	8.24	0.0041	0.00	1.0000
Portugal	.2496	.3923	0.636	0.525	0.0006	8.62	0.0033	0.00	1.0000
Singapore	.5838	.6231	0.937	0.349	0.0014	9.08	0.0026	0.00	1.0000
Sweden	-.752	.4471	-1.682	0.093	0.0045	8.87	0.0029	0.00	1.0000
U.S.A.	.1306	.1071	1.219	0.223	0.0024	8.26	0.0041	0.00	1.0000

CHAPTER 5

Appendix 5.

Panel Data Regression Analysis 2.

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + u_{it}, \qquad (5.5)$$

number of observations 4653

Sample Population Results.

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3293	.1121	2.935	0.003	0.0024	63.95	0.0000	0.00	1.0000
Austria	-.032	.1807	-0.181	0.856	0.0013	60.38	0.0000	0.00	1.0000
Belgium Luxembourg	-1.09	.1342	-8.142	0.000	0.0184	64.95	0.0000	0.00	1.0000
Canada	.0264	.1764	0.150	0.881	0.0002	65.88	0.0000	0.00	1.0000
Switzerland	-.799	.1598	-5.006	0.000	0.0082	61.52	0.0000	0.00	1.0000
Germany	-1.95	.4636	-4.205	0.000	0.0328	10445	0.0000	28.90	0.0000
Denmark	-.237	.2434	-0.974	0.330	0.0008	5.42	0.0199	0.04	0.9821
Spain	-.561	.3337	-1.683	0.092	0.0009	124.9	0.0000	14.20	0.0008
Finland	1.863	.4523	4.119	0.000	0.0212	596.7	0.0000	8.12	0.0173
France	.1408	.4318	0.326	0.744	0.0070	4773.	0.0000	66.40	0.0000
Greece	.4758	.2058	2.311	0.021	0.0022	33.56	0.0000	7.92	0.0191
Hong Kong	-.605	.2682	-2.257	0.024	0.0015	405.2	0.0000	25.74	0.0000
Ireland	-.370	.1753	-2.113	0.035	0.0043	2234.	0.0000	11.41	0.0033
Italy	.1810	.3290	0.550	0.582	0.0001	141.	0.0000	1.40	0.4969
Japan	-.931	.2707	-3.439	0.001	0.0123	1480.	0.0000	43.09	0.0000
Holland	-1.65	.4695	-3.526	0.000	0.0164	3738.	0.0000	29.61	0.0000
Norway	.1689	.3944	0.428	0.668	0.0002	238.8	0.0000	1.32	0.5169
New Zealand	-.059	.0866	-0.685	0.494	0.0002	36.44	0.0000	2.70	0.2588
Portugal	.2705	.2260	1.197	0.231	0.0009	155.3	0.0000	0.73	0.6933
Singapore	.616	.2676	2.302	0.021	0.0051	109.2	0.0000	1.47	0.4794
Sweden	-.825	.4151	-1.989	0.047	0.0013	866.2	0.0000	15.06	0.0005
U.S.A.	-.969	.1579	-6.137	0.000	0.0159	4012.	0.0000	51.42	0.0000

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + u_{it}, \qquad (5.5)$$

number of observations 4653

Sample Coefficient Results.

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	.3293	.1121	**			.5710	.30688	*	
Austria	-.032	.1807				.6369	.26276	**	
Belgium Luxembourg	-1.09	.1342	**			1.520	.25854	**	
Canada	.0264	.1764				.3316	.31576		
Switzerland	-.799	.1598	**			1.211	.27795	**	
Germany	-1.95	.4636	**			4.998	.84568	**	
Denmark	-.237	.2434				.4986	.34131		
Spain	-.561	.3337	*			.3849	.43498		
Finland	1.863	.4523	**			3.124	.62639	**	
France	.1408	.4318				3.903	.71613	**	
Greece	.4758	.2058	**			.4460	.32243		
Hong Kong	-.605	.2682	**			.8759	.47124	*	
Ireland	-.370	.1753	**			2.032	.70923	**	
Italy	.1810	.3290				.1858	.41559		
Japan	-.931	.2707	**			2.039	.63307	**	
Holland	-1.65	.4695	**			3.454	.75101	**	
Norway	.1689	.3944				.3071	.49101		
New Zealand	-.059	.0866				.2292	.29169		
Portugal	.2705	.2260				.4628	.42398		
Singapore	.616	.2676	**			.9648	.42752	**	
Sweden	-.825	.4151	**			1.063	.58011	*	
U.S.A.	-.969	.1579	**			2.742	.62842	**	

Food Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3014	.2260	1.334	0.182	0.0045	5.24	0.0220	0.00	1.0000
Austria	-.764	.3921	-1.950	0.051	0.0096	5.29	0.0214	0.00	1.0000
Belgium Luxembourg	-1.48	.4900	-3.026	0.002	0.0399	6.05	0.0139	0.00	1.0000
Canada	.1958	.3427	0.571	0.568	0.0009	5.69	0.0171	0.00	1.0000
Switzerland	-.660	.3713	-1.777	0.076	0.0081	5.54	0.0186	0.00	1.0000
Germany	-1.13	.4663	-2.433	0.015	0.0283	5.90	0.0152	0.00	1.0000
Denmark	.2722	.6877	0.396	.396	0.0036	6.03	0.0140	0.00	1.0000
Spain	-1.24	.7935	-1.563	0.118	0.0139	6.03	0.0140	0.00	1.0000
Finland	1.954	.9118	2.143	0.032	0.0256	5.77	0.0163	0.00	1.0000
France	-.353	.5284	-0.670	0.503	0.0098	5.98	0.0145	0.00	1.0000
Greece	-.005	.4123	-0.014	0.989	0.0001	5.88	0.0153	0.00	1.0000
Hong Kong	-.297	.3568	-0.833	0.405	0.0022	5.42	0.0199	0.00	1.0000
Ireland	.6546	.2531	2.586	0.010	0.0198	5.89	0.0153	0.00	1.0000
Italy	1.565	.6966	2.247	0.025	0.0302	5.94	0.0148	0.00	1.0000
Japan	.0604	.2974	0.203	0.839	0.0008	5.20	0.0226	0.00	1.0000
Holland	-1.51	.6989	-2.163	0.031	0.0387	6.00	0.0143	0.00	1.0000
Norway	.3793	.5126	0.740	0.459	0.0067	5.09	0.0241	0.00	1.0000
New Zealand	-.053	.1738	-0.310	0.757	0.0068	5.65	0.0175	0.00	1.0000
Portugal	.0926	.4455	0.208	0.835	0.0003	5.87	0.0154	0.00	1.0000
Singapore	.4446	.4273	1.040	0.298	0.0052	5.78	0.0162	0.00	1.0000
Sweden	.3110	.4798	0.648	0.517	0.0011	5.34	0.0208	0.00	1.0000
U.S.A.	-.036	.1724	-0.210	0.834	0.0005	5.58	0.0182	0.00	1.0000

Food Results.

Sample Coefficient Results.

number of observations 396

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	.3014	.2260				.0825	.61830		
Austria	-.764	.3921	**			.0478	.57017		
Belgium Luxembourg	-1.48	.4900	**			-2.983	.94336	**	
Canada	.1958	.3427				.0791	.61350		
Switzerland	-.660	.3713	*			.3317	.64589		
Germany	-1.13	.4663	**			1.604	.67264		
Denmark	.2722	.6877				1.031	.95870		
Spain	-1.24	.7935				1.598	1.0033		
Finland	1.954	.9118	**			3.019	1.1848	**	
France	-.353	.5284				1.366	.74523	*	
Greece	-.005	.4123				.0975	.64155		
Hong Kong	-.297	.3568				.2893	.60352		
Ireland	.6546	.2531	**			1.306	.93033		
Italy	1.565	.6966	**			2.777	.86060	**	
Japan	.0604	.2974				.3545	.62678		
Holland	-1.51	.6989	**			3.310	.98264	**	
Norway	.3793	.5126				.9424	.61748		
New Zealand	-.053	.1738				.8844	.58005		
Portugal	.0926	.4455				.2747	.82524		
Singapore	.4446	.4273				.6718	.6675		
Sweden	.3110	.4798				.0566	.63170		
U.S.A.	-.036	.1724				.2382	.60544		

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.4035	.2172	1.857	0.063	0.0039	12.74	0.0004	0.00	1.0000
Austria	-.153	.4515	-0.340	0.734	0.0001	11.81	0.0006	0.00	1.0000
Belgium Luxembourg	-.464	.2863	-1.623	0.105	0.0043	12.48	0.0004	0.00	1.0000
Canada	-.280	.4384	-0.639	0.523	0.0009	13.15	0.0003	0.00	1.0000
Switzerland	-.772	.4083	-1.891	0.059	0.0054	12.13	0.0005	0.00	1.0000
Germany	-1.27	.4473	-2.857	0.004	0.0313	13.31	0.0003	0.00	1.0000
Denmark	.1434	.4809	0.298	0.766	0.0021	12.96	0.0003	0.00	1.0000
Spain	-.338	.5352	-0.633	0.527	0.0011	13.13	0.0003	0.00	1.0000
Finland	.8429	.4777	1.765	0.078	0.0105	13.41	0.0002	0.00	1.0000
France	.0162	.3745	0.043	0.965	0.0023	11.71	0.0006	0.00	1.0000
Greece	-.125	.1958	-0.642	0.521	0.0006	12.14	0.0005	0.00	1.0000
Hong Kong	.2747	.2574	1.067	0.286	0.0013	12.31	0.0004	0.00	1.0000
Ireland	-.015	.1942	-0.082	0.935	0.0008	12.71	0.0004	0.00	1.0000
Italy	-.488	.5804	-0.842	0.400	0.0017	12.52	0.0004	0.00	1.0000
Japan	-.812	.2841	-2.861	0.004	0.0099	11.93	0.0006	0.00	1.0000
Holland	-.478	.4276	-1.120	0.263	0.0061	12.40	0.0004	0.00	1.0000
Norway	.3949	.3787	1.043	0.297	0.0039	12.02	0.0005	0.00	1.0000
New Zealand	-.036	.0918	-0.401	0.688	0.0003	12.59	0.0004	0.00	1.0000
Portugal	.0937	.2175	0.431	0.666	0.0002	13.34	0.0003	0.00	1.0000
Singapore	.4379	.3642	1.202	0.229	0.0016	8.86	0.0029	0.00	1.0000
Sweden	.7655	.5317	1.440	0.150	0.0023	12.89	0.0003	0.00	1.0000
U.S.A.	-.261	.1518	-1.722	0.085	0.0076	12.42	0.0004	0.00	1.0000

Chemicals Results.
Sample Coefficient Results.

number of observations 660

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	.4035	.2172	*			.0025	.59432		
Austria	-.153	.4515				.0768	.65648		
Belgium Luxembourg	-.464	.2863				.7482	.55128		
Canada	-.280	.4384				.5123	.78487		
Switzerland	-.772	.4083	*			1.002	.71021		
Germany	-1.27	.4473	**			2.951	.64529	**	
Denmark	.1434	.4809				.9117	.67039		
Spain	-.338	.5352				.5447	.67672		
Finland	.8429	.4777	*			1.639	.62075		
France	.0162	.3745				.7529	.52818		
Greece	-.125	.1958				.0894	.30467		
Hong Kong	.2747	.2574				.0575	.43552		
Ireland	-.015	.1942				.5982	.71393		
Italy	-.488	.5804				.7761	.71704		
Japan	-.812	.2841	**			.2264	.59880		
Holland	-.478	.4276				1.247	.60125		
Norway	.3949	.3787				.7560	.45621	*	
New Zealand	-.036	.0918				.1016	.30641		
Portugal	.0937	.2175				.0762	.40301		
Singapore	.4379	.3642				.0609	.56897		
Sweden	.7655	.5317				.1324	.70003		
U.S.A.	-.261	.1518	*			1.077	.53302	**	

Stone and Glassware Results.

number of observations 363

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.4156	.4057	1.024	0.306	0.0039	4.87	0.0274	0.00	1.0000
Austria	-.223	.7088	-0.315	0.753	0.0019	4.72	0.0299	0.00	1.0000
Belgium Luxembourg	-.069	.4448	-0.157	0.875	0.0012	5.00	0.0253	0.00	1.0000
Canada	-1.49	.6476	-2.309	0.021	0.0182	5.15	0.0233	0.00	1.0000
Switzerland	-1.80	.7673	-2.353	0.019	0.0175	5.20	0.0226	0.00	1.0000
Germany	-2.08	.7096	-2.940	0.003	0.0521	5.32	0.0211	0.00	1.0000
Denmark	.8968	.8636	1.038	0.299	0.0110	5.42	0.0199	0.00	1.0000
Spain	.8128	.7838	1.037	0.300	0.0068	5.39	0.0203	0.00	1.0000
Finland	1.900	.9090	2.091	0.037	0.0212	5.45	0.0196	0.00	1.0000
France	.0042	.7138	0.006	0.995	0.0148	5.09	0.0240	0.00	1.0000
Greece	-.064	.4932	-0.131	0.895	0.0017	5.44	0.0197	0.00	1.0000
Hong Kong	-.532	.7966	-0.669	0.503	0.0016	5.27	0.0217	0.00	1.0000
Ireland	.2858	.3038	0.941	0.347	0.0025	5.42	0.0199	0.00	1.0000
Italy	.3871	.8434	0.459	0.646	0.0133	5.06	0.0245	0.00	1.0000
Japan	-1.00	.5322	-1.883	0.060	0.0193	5.27	0.0217	0.00	1.0000
Holland	-1.35	.9951	-1.366	0.172	0.0087	5.50	0.0190	0.00	1.0000
Norway	1.572	.8077	1.947	0.052	0.0109	4.63	0.0314	0.00	1.0000
New Zealand	.0458	.1964	0.233	0.815	0.0023	4.73	0.0297	0.00	1.0000
Portugal	.3182	.5898	0.540	0.589	0.0008	5.49	0.0191	0.00	1.0000
Singapore	-.665	.5538	-1.202	0.229	0.0045	5.51	0.0189	0.00	1.0000
Sweden	-.736	.9054	-0.813	0.416	0.0041	5.29	0.0215	0.00	1.0000
U.S.A.	-.181	.2290	-0.791	0.429	0.0023	4.77	0.0290	0.00	1.0000

Stone and Glassware Results.

Sample Coefficient Results.

number of observations 363

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	.4156	.4057				.7661	1.1098		
Austria	-.223	.7088				.7355	1.0306		
Belgium Luxembourg	-.069	.4448				.5192	.85640		
Canada	-1.49	.6476	**			1.341	1.1592		
Switzerland	-1.80	.7673	**			1.714	1.3346		
Germany	-2.08	.7096	**			3.465	1.0236	**	
Denmark	.8968	.8636				1.899	1.2039		
Spain	.8128	.7838				1.269	.99103		
Finland	1.900	.9090	**			2.370	1.1811		
France	.0042	.7138				2.34	1.0066		
Greece	-.064	.4932				.5892	.76750		
Hong Kong	-.532	.7966				.5693	1.3474		
Ireland	.2858	.3038				.0424	1.1165		
Italy	.3871	.8434				2.287	1.0419	**	
Japan	-1.00	.5322	*			1.767	1.1214		
Holland	-1.35	.9951				1.612	1.3990		
Norway	1.572	.8077	**			.1796	.97291		
New Zealand	.0458	.1964				.5406	.65523		
Portugal	.3182	.5898				.2120	1.0926		
Singapore	-.665	.5538				.3804	.86516		
Sweden	-.736	.9054				1.142	1.1920		
U.S.A.	-.181	.2290				.3737	.80420		

Copper, Nickel and Aluminium Products Results.

number of observations 264

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0167	.4642	0.036	0.971	0.0000	3.91	0.0481	0.00	1.0000
Austria	-.020	.6980	-0.030	0.976	0.0005	4.06	0.0439	0.00	1.0000
Belgium Luxembourg	-.661	.3421	-1.935	0.053	0.0202	3.53	0.0602	0.00	1.0000
Canada	1.663	.8182	2.033	0.042	0.0158	4.03	0.0448	0.00	1.0000
Switzerland	-.297	.4435	-0.670	0.503	0.0072	3.72	0.0536	0.00	1.0000
Germany	-1.63	.6124	-2.672	0.008	0.0729	3.93	0.0475	0.00	1.0000
Denmark	-.657	.6886	-0.954	0.340	0.0314	3.89	0.0486	0.00	1.0000
Spain	-.558	1.028	-0.543	0.587	0.0086	4.04	0.0445	0.00	1.0000
Finland	.7376	.9109	0.810	0.418	0.0203	4.01	0.0452	0.00	1.0000
France	1.208	.5769	2.095	0.036	0.0545	3.73	0.0533	0.00	1.0000
Greece	.3519	.2901	1.213	0.225	0.0100	3.73	0.0535	0.00	1.0000
Hong Kong	.3519	.6722	0.524	0.601	0.0014	3.91	0.0479	0.00	1.0000
Ireland	-.741	.3527	-2.103	0.035	0.0402	3.85	0.0496	0.00	1.0000
Italy	1.157	.7979	1.450	0.147	0.0083	3.99	0.0457	0.00	1.0000
Japan	-.324	.5758	-0.564	0.573	0.0027	3.87	0.0492	0.00	1.0000
Holland	-.198	.6424	-0.308	0.758	0.0231	4.03	0.0448	0.00	1.0000
Norway	-2.08	1.021	-2.040	0.041	0.0402	3.93	0.0474	0.00	1.0000
New Zealand	.2574	.2065	1.246	0.213	0.0074	3.29	0.0697	0.00	1.0000
Portugal	-.335	.4872	-0.688	0.492	0.0021	3.86	0.0495	0.00	1.0000
Singapore	.2367	.8130	0.291	0.771	0.0005	4.08	0.0433	0.00	1.0000
Sweden	-.579	.4365	-1.328	0.184	0.0115	3.56	0.0591	0.00	1.0000
U.S.A.	-.289	.1692	-1.710	0.087	0.0225	3.82	0.0505	0.00	1.0000

Copper, Nickel and Aluminium Products Results.

Sample Coefficient Results.

number of observations 264

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	.0167	.4642				.0164	1.2698		
Austria	-.020	.6980				.3485	1.0148		
Belgium Luxembourg	-.661	.3421	*			1.049	.65865		
Canada	1.663	.8182	**			.3406	1.4646		
Switzerland	-.297	.4435				.9953	.77142		
Germany	-1.63	.6124	**			3.267	.88335	**	
Denmark	-.657	.6886				2.514	.96003	**	
Spain	-.558	1.028				1.887	1.3003		
Finland	.7376	.9109				2.643	1.1837	**	
France	1.208	.5769	**			2.703	.81358	**	
Greece	.3519	.2901				.4502	.45144		
Hong Kong	.3519	.6722				.4017	1.1371		
Ireland	-.741	.3527				3.596	1.2960	**	
Italy	1.157	.7979	**			.6692	.98573		
Japan	-.324	.5758				.6483	1.2134		
Holland	-.198	.6424				2.228	.90310	**	
Norway	-2.08	1.021	**			3.488	1.2301	**	
New Zealand	.2574	.2065				.2745	.68903		
Portugal	-.335	.4872				.3681	.90256		
Singapore	.2367	.8130				.2745	1.2699		
Sweden	-.579	.4365				.6968	.57472		
U.S.A.	-.289	.1692	*			1.077	.59432		

Miscellaneous Building Products Results.

number of observations 627

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0581	.3524	0.165	0.869	0.0035	8.85	0.0029	0.00	1.0000
Austria	-.244	.5162	-0.473	0.636	0.0036	8.23	0.0041	0.00	1.0000
Belgium Luxembourg	-1.62	.3818	-4.265	0.000	0.0346	9.11	0.0025	0.00	1.0000
Canada	1.018	.4722	2.156	0.031	0.0288	9.01	0.0027	0.00	1.0000
Switzerland	-1.28	.3342	-3.847	0.000	0.0255	8.05	0.0046	0.00	1.0000
Germany	-1.91	.4348	-4.401	0.000	0.0484	8.77	0.0031	0.00	1.0000
Denmark	-.370	.4523	-0.819	0.413	0.0028	8.63	0.0033	0.00	1.0000
Spain	-.674	.4994	-1.351	0.177	0.0054	8.71	0.0032	0.00	1.0000
Finland	2.764	.8352	3.309	0.001	0.0435	9.18	0.0024	0.00	1.0000
France	.2856	.5070	0.563	0.573	0.0112	8.83	0.0030	0.00	1.0000
Greece	1.195	.5981	1.999	0.046	0.0068	9.12	0.0025	0.00	1.0000
Hong Kong	-.432	.3921	-1.104	0.270	0.0039	8.84	0.0030	0.00	1.0000
Ireland	-.456	.1926	-2.371	0.018	0.0233	8.97	0.0028	0.00	1.0000
Italy	.2340	.5332	0.439	0.661	0.0012	8.85	0.0029	0.00	1.0000
Japan	-1.52	.3001	-5.072	0.000	0.0472	9.00	0.0027	0.00	1.0000
Holland	-1.49	.4450	-3.357	0.001	0.0249	8.55	0.0035	0.00	1.0000
Norway	-.821	.7569	-1.086	0.278	0.0049	9.03	0.0027	0.00	1.0000
New Zealand	-.027	.2052	-0.135	0.893	0.0001	8.24	0.0041	0.00	1.0000
Portugal	.3017	.4012	0.752	0.452	0.0013	8.62	0.0033	0.00	1.0000
Singapore	.6118	.6203	0.986	0.324	0.0121	9.07	0.0026	0.00	1.0000
Sweden	-.761	.4485	-1.697	0.090	0.0046	8.87	0.0029	0.00	1.0000
U.S.A.	-.904	.2000	-4.520	0.000	0.0413	9.35	0.0022	0.00	1.0000

Miscellaneous Building Products Results.

Sample Coefficient Results.

number of observations 627

Country	β	S. E. on β	Signifi cance			γ	S. E. on γ	Signifi cance	
Australia	.0581	.3524				1.417	.96398		
Austria	-.244	.5162				1.021	.75058		
Belgium Luxembourg	-1.62	.3818	**			2.022	.73512	**	
Canada	1.018	.4722	**			3.150	.84533	**	
Switzerland	-1.28	.3342	**			1.062	.58131	*	
Germany	-1.91	.4348	**			2.247	.62723	**	
Denmark	-.370	.4523				.7142	.63052		
Spain	-.674	.4994				.7051	.63150		
Finland	2.764	.8352	**			4.786	1.0853	**	
France	.2856	.5070				1.865	.71501	**	
Greece	1.195	.5981	**			.3848	.93071		
Hong Kong	-.432	.3921				.8000	.66324		
Ireland	-.456	.1926	**			2.334	.70798	**	
Italy	.2340	.5332				.5623	.65869		
Japan	-1.52	.3001	**			.9495	.63248		
Holland	-1.49	.4450	**			1.378	.6256	**	
Norway	-.821	.7569				1.360	.91169		
New Zealand	-.027	.2052				.1594	.68625		
Portugal	.3017	.4012				.4647	.74319		
Singapore	.6118	.6203				2.515	.96902	**	
Sweden	-.761	.4485	*			.1736	.59054		
U.S.A.	-.904	.2000	**			1.881	.70237	**	

CHAPTER 5

Appendix 6.

Panel Data Regression Analysis 3.

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \varpi_i \Delta v_{it}^{cost} + u_{it}, \qquad \textbf{(5.6)}$$

number of observations 4653

Sample Population Results.

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3299	.1123	2.938	0.003	0.0023	63.95	0.0000	0.00	1.0000
Austria	.0456	.1842	0.248	0.804	0.0021	60.37	0.0000	0.00	1.0000
Belgium Luxembourg	-1.01	.1333	-7.581	0.000	0.0140	64.99	0.0000	0.00	1.0000
Canada	.1215	.1796	0.677	0.499	0.0016	65.87	0.0000	0.00	1.0000
Switzerland	-.789	.1590	-4.965	0.000	0.0091	61.51	0.0000	0.00	1.0000
Germany	-1.99	.1904	-10.45	0.000	0.0296	66.73	0.0000	0.00	1.0000
Denmark	-.197	.2137	-0.922	0.356	0.0011	66.26	0.0000	0.00	1.0000
Spain	-.461	.2279	-2.024	0.043	0.0011	66.81	0.0000	0.00	1.0000
Finland	1.591	.2602	6.116	0.000	0.0096	66.65	0.0000	0.00	1.0000
France	.5017	.1834	2.736	0.006	0.0016	64.07	0.0000	0.00	1.0000
Greece	.5024	.1860	2.700	0.007	0.0018	66.61	0.0000	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.	0.00	1.0000
Ireland	-.202	.0853	-2.359	0.018	0.0016	65.66	0.0000	0.00	1.0000
Italy	.0080	.2225	0.036	0.971	0.0004	65.39	0.0000	0.00	1.0000
Japan	-.898	.1293	-6.948	0.000	0.0157	63.70	0.0000	0.00	1.0000
Holland	-1.17	.2019	-5.816	0.000	0.0072	64.87	0.0000	0.00	1.0000
Norway	.1167	.2438	0.479	0.632	0.0001	64.69	0.0000	0.00	1.0000
New Zealand	-.031	.0660	-0.472	0.637	0.0001	60.05	0.0000	0.00	1.0000
Portugal	-.060	.1789	-0.337	0.736	0.015	64.03	0.0000	0.00	1.0000
Singapore	.6503	.1858	3.498	0.000	0.0028	61.61	0.0000	0.00	1.0000
Sweden	-.286	.2138	-1.339	0.180	0.0005	64.82	0.0000	0.00	1.0000
U.S.A.	-.488	.0660	-7.392	0.000	0.0117	63.74	0.0000	0.00	1.0000

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \varpi_i \Delta v_{it}^{\cos t} + u_{it}, \qquad \textbf{(5.6)}$$

number of observations 4653

Sample Coefficient Results.

Country	β	S. E. on β	Significance			ω	S. E. on ω	Significance	
Australia	.3299	.1123	**			.6820	.38806	*	
Austria	.0456	.1842				2.306	.74169	**	
Belgium Luxembourg	-1.01	.1333	**			1.921	.51983	**	
Canada	.1215	.1796				1.372	.49651	**	
Switzerland	-.789	.1590	**			2.943	.60617	**	
Germany	-1.99	.1904	**			6.300	.80009	**	
Denmark	-.197	.2137				1.003	.47957	**	
Spain	-.461	.2279	**			.3992	.30121		
Finland	1.591	.2602	**			1.719	.40243	**	
France	.5017	.1834	**			.0231	.36770		
Greece	.5024	.1860	**			.1186	.19933		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	-.202	.0853	**			.6064	.27857	**	
Italy	.0080	.2225				.2396	.18106		
Japan	-.898	.1293	**			1.792	.35852	**	
Holland	-1.17	.2019	**			.2619	.43708		
Norway	.1167	.2438				.1768	.36700		
New Zealand	-.031	.0660				.0139	.21360		
Portugal	-.060	.1789				.4786	.20865	**	
Singapore	.6503	.1858	**			.4196	.29356		
Sweden	-.286	.2138				.3000	.45975		
U.S.A.	-.488	.0660	**			.2195	.45567		

Food Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3138	.2261	1.388	0.165	0.0054	5.24	0.0221	0.00	1.0000
Austria	-.785	.3998	-1.963	0.050	0.0098	5.29	0.0214	0.00	1.0000
Belgium Luxembourg	-1.30	.4901	-2.653	0.008	0.0217	6.06	0.0139	0.00	1.0000
Canada	.2329	.3490	0.667	0.505	0.0016	5.69	0.0171	0.00	1.0000
Switzerland	-.648	.3699	-1.753	0.080	0.0078	5.54	0.0186	0.00	1.0000
Germany	-1.41	.4769	-2.962	0.003	0.0334	5.89	0.0152	0.00	1.0000
Denmark	.3590	.6839	0.525	0.600	0.0008	6.03	0.0140	0.00	1.0000
Spain	-1.41	.8010	-1.763	0.078	0.0079	6.03	0.0140	0.00	1.0000
Finland	1.739	.9508	1.830	0.067	0.0095	5.78	0.0162	0.00	1.0000
France	-.325	.5346	-0.609	0.543	0.0030	5.98	0.0145	0.00	1.0000
Greece	-.348	.4806	-0.725	0.468	0.0046	5.88	0.0153	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	.6754	.2733	2.471	0.013	0.0157	5.89	0.0153	0.00	1.0000
Italy	.5550	.7155	0.776	0.438	0.0096	5.94	0.0148	0.00	1.0000
Japan	.0334	.2941	0.114	0.909	0.0008	5.20	0.0226	0.00	1.0000
Holland	-1.62	.7125	-2.276	0.023	0.0170	6.01	0.0142	0.00	1.0000
Norway	.2762	.5106	0.541	0.589	0.0010	5.10	0.024	0.00	1.0000
New Zealand	-.086	.1724	-0.503	0.615	0.0026	5.65	0.0175	0.00	1.0000
Portugal	-.357	.5430	-0.658	0.511	0.0043	5.87	0.0154	0.00	1.0000
Singapore	.4654	.4322	1.077	0.282	0.0032	5.78	0.0162	0.00	1.0000
Sweden	.3124	.4788	0.653	0.514	0.0012	5.34	0.0208	0.00	1.0000
U.S.A.	-.033	.1723	-0.197	0.844	0.0008	5.58	0.0182	0.00	1.0000

Food Results.

Sample Coefficient Results.

number of observations 396

Country	β	S. E. on β	Significance			ω	S. E. on ω	Significance	
Australia	.3138	.2261				.4880	.78147		
Austria	-.785	.3998	**			-.4246	1.6099		
Belgium Luxembourg	-1.30	.4901	**			3.020	1.9103		
Canada	.2329	.3490				.5344	.96500		
Switzerland	-.648	.3699	*			-.5425	1.4094		
Germany	-1.41	.4769	**			5.592	2.0034	**	
Denmark	.3590	.6839				.3392	1.5342		
Spain	-1.41	.8010	*			.4282	1.0585		
Finland	1.739	.9508	*			-.2262	1.4704		
France	-.325	.5346				-.8620	1.0718		
Greece	-.348	.4806				.6966	.51493		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	.6754	.2733	**			.5134	.88702		
Italy	.5550	.7155				.8239	.58223		
Japan	.0334	.2941				-.4374	.81538		
Holland	-1.62	.7125	**			2.402	1.541		
Norway	.2762	.5106				.2179	.76835		
New Zealand	-.086	.1724				.4502	.55733		
Portugal	-.357	.5430				.8162	.63316		
Singapore	.4654	.4322				.3099	.68262		
Sweden	.3124	.4788				.1653	1.0292		
U.S.A.	-.033	.1723				.6054	1.1881		

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.4035	.2174	1.855	0.064	0.0039	12.74	0.0004	0.00	1.0000
Austria	-.158	.4604	-0.345	0.730	0.0001	11.81	0.0006	0.00	1.0000
Belgium Luxembourg	-.455	.2835	-1.606	0.108	0.0061	12.48	0.0004	0.00	1.0000
Canada	-.258	.4468	-0.579	0.563	0.0005	13.15	0.0003	0.00	1.0000
Switzerland	-.758	.4066	-1.866	0.062	0.0056	12.13	0.0005	0.00	1.0000
Germany	-1.69	.4591	-3.689	0.000	0.0296	13.32	0.0003	0.00	1.0000
Denmark	.0667	.4780	0.140	0.889	0.0001	12.96	0.0003	0.00	1.0000
Spain	-.337	.5387	-0.627	0.531	0.0007	13.13	0.0003	0.00	1.0000
Finland	1.061	.4944	2.147	0.032	0.0091	13.42	0.0002	0.00	1.0000
France	.0262	.3780	0.070	0.945	0.0000	11.71	0.0006	0.00	1.0000
Greece	-.198	.2287	-0.868	0.386	0.0009	12.14	0.0005	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	.0033	.2093	0.016	0.987	0.0000	12.72	0.0004	0.00	1.0000
Italy	-.637	.5893	-1.082	0.279	0.0034	12.52	0.0004	0.00	1.0000
Japan	-.825	.2808	-2.940	0.003	0.0107	11.93	0.0006	0.00	1.0000
Holland	-.520	.4319	-1.206	0.228	0.0024	12.40	0.0004	0.00	1.0000
Norway	.3241	.3767	0.860	0.390	0.0010	12.03	0.0005	0.00	1.0000
New Zealand	-.032	.0908	-0.358	0.720	0.0002	12.59	0.0004	0.00	1.0000
Portugal	.1227	.2657	0.462	0.644	0.0002	13.34	0.0003	0.00	1.0000
Singapore	.4440	.3680	1.206	0.228	0.0016	8.86	0.0029	0.00	1.0000
Sweden	.7590	.5306	1.431	0.153	0.0023	12.89	0.0003	0.00	1.0000
U.S.A.	-.251	.1520	-1.654	0.098	0.0033	12.43	0.0004	0.00	1.0000

Chemicals Results.

Sample Coefficient Results.

number of observations 660

Country	β	S. E. on β	Significance			ω	S. E. on ω	Significance	
Australia	.4035	.2174	*			-.0019	.75151		
Austria	-.158	.4604				-.2077	1.8538		
Belgium Luxembourg	-.455	.2835				2.054	1.1049	*	
Canada	-.258	.4468				.3045	1.2352		
Switzerland	-.758	.4066	**			2.284	1.5494		
Germany	-1.69	.4591	**			8.479	1.9287	**	
Denmark	.0667	.4780				-.3606	1.0724		
Spain	-.337	.5387				.3688	.71196		
Finland	1.061	.4944	**			1.828	.76462		
France	.0262	.3780				.0775	.75790		
Greece	-.198	.2287				.1414	.24507		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	.0033	.2093				.0062	.67955		
Italy	-.637	.5893				.7976	.47959		
Japan	-.825	.2808	**			.7507	.77860		
Holland	-.520	.4319				.9156	.93476		
Norway	.3241	.3767				-.2457	.56687		
New Zealand	-.032	.0908				-.0356	.29380		
Portugal	.1227	.2657				-.0730	.30982		
Singapore	.4440	.3680				.0741	.58123		
Sweden	.7590	.5306				-.0430	1.1406		
U.S.A.	-.251	.1520	*			.4625	1.0484		

Stone and Glassware Results.

number of observations 363

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3968	.4063	0.976	0.329	0.0027	4.87	0.0274	0.00	1.0000
Austria	-.063	.7215	-0.088	0.930	0.0054	4.71	0.0299	0.00	1.0000
Belgium Luxembourg	-.106	.4410	-0.241	0.809	0.0003	5.01	0.0253	0.00	1.0000
Canada	-1.61	.6602	-2.450	0.014	0.0171	5.15	0.0233	0.00	1.0000
Switzerland	-1.74	.7650	-2.281	0.023	0.0154	5.20	0.0226	0.00	1.0000
Germany	-2.56	.7289	-3.518	0.000	0.0488	5.32	0.0211	0.00	1.0000
Denmark	1.056	.8594	1.229	0.219	0.0070	5.42	0.0199	0.00	1.0000
Spain	.8138	.7898	1.030	0.303	0.0043	5.39	0.0202	0.00	1.0000
Finland	1.800	.9453	1.905	0.057	0.0103	5.45	0.0195	0.00	1.0000
France	.0091	.7247	0.013	0.990	0.0008	5.10	0.0239	0.00	1.0000
Greece	-.315	.5763	-0.547	0.585	0.0016	5.44	0.0197	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	.2912	.3273	0.890	0.374	0.0025	5.42	0.0199	0.00	1.0000
Italy	-.475	.8615	-0.552	0.581	0.0033	5.07	0.0244	0.00	1.0000
Japan	-1.11	.5270	-2.125	0.034	0.0163	5.27	0.0217	0.00	1.0000
Holland	-1.40	1.004	-1.400	0.161	0.0057	5.50	0.0190	0.00	1.0000
Norway	1.597	.8022	1.991	0.046	0.0109	4.63	0.0314	0.00	1.0000
New Zealand	.0490	.1941	0.253	0.800	0.0046	4.72	0.0297	0.00	1.0000
Portugal	-.457	.7174	-0.638	0.523	0.0092	5.49	0.0191	0.00	1.0000
Singapore	-.671	.5597	-1.199	0.230	0.0040	5.51	0.0189	0.00	1.0000
Sweden	-.691	.9038	-0.765	0.444	0.0034	5.29	0.0215	0.00	1.0000
U.S.A.	-.177	.2289	-0.777	0.437	0.0020	4.77	0.0290	0.00	1.0000

Stone and Glassware Results.

Sample Coefficient Results.

number of observations 363

Country	β	S. E. on β	Significance			ω	S. E. on ω	Significance	
Australia	.3968	.4063				.2908	1.4042		
Austria	-.063	.7215				3.889	2.9051		
Belgium Luxembourg	-.106	.4410				.3569	1.7187		
Canada	-1.61	.6602	**			1.765	1.8250		
Switzerland	-1.74	.7650	**			2.764	2.9151		
Germany	-2.56	.7289	**			9.760	3.0622	**	
Denmark	1.056	.8594				1.947	1.9279		
Spain	.8138	.7898				.8843	1.0437		
Finland	1.800	.9453	*			.2193	1.4619		
France	.0091	.7247				.7977	1.4529		
Greece	-.315	.5763				.4603	.61746		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	.2912	.3273				.0342	1.0623		
Italy	-.475	.8615				.7523	.70106		
Japan	-1.11	.5270	**			1.733	1.461		
Holland	-1.40	1.004				-1.074	2.1742		
Norway	1.597	.8022	**			-.23	1.2071		
New Zealand	.0490	.1941				-.7732	.62751		
Portugal	-.457	.7174				1.465	.83643		
Singapore	-.671	.5597				-.1081	.88403		
Sweden	-.691	.9038				1.587	1.9430		
U.S.A.	-.177	.2289				.5239	1.5786		

Copper, Nickel and Aluminium Products Results.

number of observations 264

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0378	.4645	0.082	0.935	0.0006	3.91	0.0481	0.00	1.0000
Austria	-.083	.7118	-0.117	0.907	0.0002	4.06	0.0439	0.00	1.0000
Belgium Luxembourg	-.621	.3393	-1.831	0.067	0.0184	3.53	0.0601	0.00	1.0000
Canada	1.744	.8333	2.093	0.036	0.0166	4.03	0.0448	0.00	1.0000
Switzerland	-.318	.4398	-0.723	0.470	0.0155	3.72	0.0537	0.00	1.0000
Germany	-1.92	.6377	-3.023	0.003	0.0438	3.93	0.0474	0.00	1.0000
Denmark	-.868	.6921	-1.255	0.210	0.0081	3.89	0.0485	0.00	1.0000
Spain	-.530	1.038	-0.511	0.609	0.0029	4.04	0.0445	0.00	1.0000
Finland	.6556	.9509	0.689	0.491	0.0019	4.01	0.0452	0.00	1.0000
France	1.235	.5925	2.086	0.037	0.0187	3.75	0.0529	0.00	1.0000
Greece	.3836	.3396	1.129	0.259	0.0063	3.73	0.0534	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	-.828	.3842	-2.157	0.031	0.0186	3.86	0.0495	0.00	1.0000
Italy	1.589	.8045	1.975	0.048	0.0239	3.99	0.0458	0.00	1.0000
Japan	-.369	.5697	-0.649	0.516	0.0016	3.87	0.0492	0.00	1.0000
Holland	-.086	.6536	-0.132	0.895	0.0048	4.03	0.0447	0.00	1.0000
Norway	-1.68	1.028	-1.643	0.100	0.0130	3.94	0.0472	0.00	1.0000
New Zealand	.2642	.2043	1.293	0.196	0.0073	3.29	0.0697	0.00	1.0000
Portugal	-.484	.5949	-0.814	0.415	0.0025	3.86	0.0495	0.00	1.0000
Singapore	.2830	.8213	0.345	0.730	0.0008	4.08	0.0433	0.00	1.0000
Sweden	-.540	.4367	-1.238	0.216	0.0064	3.57	0.0590	0.00	1.0000
U.S.A.	-.279	.1701	-1.642	0.101	0.0111	3.83	0.0504	0.00	1.0000

Copper, Nickel and Aluminium Products Results.

Sample Coefficient Results.

number of observations 264

Country	β	S. E. on β	Significance			ω	S. E. on ω	Significance	
Australia	.0378	.4645				.6494	1.6052		
Austria	-.083	.7118				.6026	2.8662		
Belgium Luxembourg	-.621	.3393	*			1.901	1.3225		
Canada	1.744	.8333	**			1.164	2.3036		
Switzerland	-.318	.4398				3.302	1.6761	**	
Germany	-1.92	.6377	**			6.185	2.6790	**	
Denmark	-.868	.6921				1.158	1.5526		
Spain	-.530	1.038				1.054	1.3717		
Finland	.6556	.9509				.4182	1.4706		
France	1.235	.5925	**			1.255	1.1879		
Greece	.3836	.3396				-.0236	.36386		
Hong Kong	n.a.	n.a.							
Ireland	-.828	.3842	**			1.663	1.2469		
Italy	1.589	.8045	**			1.411	.65467	**	
Japan	-.369	.5697				.1275	1.5792		
Holland	-.086	.6536				1.537	1.4144		
Norway	-1.68	1.028	*			-1.212	1.5478		
New Zealand	.2642	.2043				-.2404	.66068		
Portugal	-.484	.5949				.3714	.69369		
Singapore	.2830	.8213				.4730	1.2971		
Sweden	-.540	.4367				-.3459	.93886		
U.S.A.	-.279	.1701	*			.5504	1.1732		

Miscellaneous Building Products Results.

number of observations 627

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0248	.3533	0.070	0.944	0.0004	8.85	0.0029	0.00	1.0000
Austria	-.237	.5269	-0.450	0.653	0.0016	8.23	0.0041	0.00	1.0000
Belgium Luxembourg	-1.52	.3796	-4.020	0.000	0.0285	9.11	0.0025	0.00	1.0000
Canada	1.267	.4837	2.620	0.009	0.0187	9.02	0.0027	0.00	1.0000
Switzerland	-1.34	.3303	-4.063	0.000	0.0404	8.02	0.0046	0.00	1.0000
Germany	-2.16	.4477	-4.836	0.000	0.0406	8.78	0.0031	0.00	1.0000
Denmark	-.310	.4490	-0.692	0.489	0.0034	8.63	0.0033	0.00	1.0000
Spain	-.768	.5030	-1.528	0.127	0.0039	8.71	0.0032	0.00	1.0000
Finland	2.975	.8740	3.404	0.001	0.0207	9.20	0.0024	0.00	1.0000
France	.2554	.5139	0.497	0.619	0.0004	8.84	0.0029	0.00	1.0000
Greece	1.408	.6988	2.016	0.044	0.0070	9.12	0.0025	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	-.444	.2092	-2.124	0.034	0.0072	8.98	0.0027	0.00	1.0000
Italy	.0951	.5422	0.176	0.861	0.0001	8.85	0.0029	0.00	1.0000
Japan	-1.58	.2967	-5.338	0.000	0.0474	9.00	0.0027	0.00	1.0000
Holland	-1.47	.4504	-3.264	0.001	0.0173	8.56	0.0034	0.00	1.0000
Norway	-.650	.7524	-0.864	0.387	0.0029	9.03	0.0027	0.00	1.0000
New Zealand	.0013	.2034	0.007	0.995	0.0014	8.23	0.0041	0.00	1.0000
Portugal	.1815	.4901	0.370	0.711	0.0007	8.62	0.0033	0.00	1.0000
Singapore	.6729	.6297	1.069	0.285	0.0029	9.08	0.0026	0.00	1.0000
Sweden	-.756	.4475	-1.691	0.091	0.0049	8.87	0.0029	0.00	1.0000
U.S.A.	-.886	.2010	-4.413	0.000	0.0312	9.36	0.0022	0.00	1.0000

Miscellaneous Building Products Results.

Sample Coefficient Results.

number of observations 627

Country	β	S. E. on β	Significance			ω	S. E. on ω	Significance	
Australia	.0248	.3533				.5840	1.2208		
Austria	-.237	.5269				1.605	2.1216		
Belgium Luxembourg	-1.52	.3796	**			2.795	1.4794	**	
Canada	1.267	.4837	**			3.604	1.3371		
Switzerland	-1.34	.3303	**			4.548	1.2586	**	
Germany	-2.16	.4477	**			5.218	1.8807	**	
Denmark	-.310	.4490				1.295	1.0073		
Spain	-.768	.5030				.3493	.66475		
Finland	2.975	.8740	**			2.853	1.3517	**	
France	.2554	.5139				-.1088	1.0303		
Greece	1.408	.6988	**			-.4028	.74866		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	-.444	.2092	**			.5012	.67917		
Italy	.0951	.5422				.0101	.44121		
Japan	-1.58	.2967	**			1.267	.82269		
Holland	-1.47	.4504	**			.1752	.97465		
Norway	-.650	.7524				1.121	1.1323		
New Zealand	.0013	.2034				.6059	.65755		
Portugal	.1815	.4901				.1326	.57148		
Singapore	.6729	.6297				.9755	.99447		
Sweden	-.756	.4475	*			.506	.96209		
U.S.A.	-.886	.2010	**			1.061	1.385		

CHAPTER 5

Appendix 7.

Panel Data Regression Analysis 4.

Testing the relationship:

$$\Delta p_{it} = con_t + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + \varpi_i \Delta v_{it}^{\cos t} + u_{it}, \qquad (5.7)$$

number of observations 4653

Sample Population Results.

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3320	.1123	2.956	0.003	0.0024	63.95	0.0000	0.00	1.0000
Austria	.0440	.1842	0.239	0.811	0.0023	60.37	0.0000	0.00	1.0000
Belgium Luxembourg	-1.09	.1343	-8.143	0.000	0.0184	64.95	0.0000	0.00	1.0000
Canada	.2125	.1854	1.146	0.252	0.0025	65.86	0.0000	0.00	1.0000
Switzerland	-.863	.1602	-5.389	0.000	0.0117	61.48	0.0000	0.00	1.0000
Germany	-1.85	.1908	-9.740	0.000	0.0379	66.68	0.0000	0.00	1.0000
Denmark	-.206	.2166	-0.954	0.340	0.0011	66.26	0.0000	0.00	1.0000
Spain	-.464	.2278	-2.039	0.041	0.0023	66.80	0.0000	0.00	1.0000
Finland	1.342	.2606	5.150	0.000	0.0218	66.58	0.0000	0.00	1.0000
France	.3027	.1830	1.653	0.098	0.0192	63.91	0.0000	0.00	1.0000
Greece	.5162	.1862	2.773	0.006	0.0024	66.61	0.0000	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	-.102	.0894	-1.148	0.251	0.0050	65.63	0.0000	0.00	1.0000
Italy	.0468	.2246	0.209	0.835	0.0008	65.39	0.0000	0.00	1.0000
Japan	-.740	.1307	-5.666	0.000	0.0256	63.61	0.0000	0.00	1.0000
Holland	-1.07	.2012	-5.356	0.000	0.0192	64.78	0.0000	0.00	1.0000
Norway	.0795	.2479	0.321	0.748	0.0002	64.69	0.0000	0.00	1.0000
New Zealand	-.042	.0667	-0.632	0.527	0.0003	60.05	0.0000	0.00	1.0000
Portugal	-.080	.1790	-0.452	0.651	0.0029	64.02	0.0000	0.00	1.0000
Singapore	.6388	.1857	3.440	0.001	0.0052	61.59	0.0000	0.00	1.0000
Sweden	-.423	.2156	-1.963	0.050	0.0047	64.79	0.0000	0.00	1.0000
U.S.A.	-.520	.0657	-7.904	0.000	0.0244	63.63	0.0000	0.00	1.0000

Testing the relationship:

$$\Delta p_{it} = con_t + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + \varpi_i \Delta v_{it}^{cost} + u_{it}, \qquad (5.7)$$

number of observations 4653

Sample Coefficient Results.

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	.3320	.1123	**	.3836	.48824		.30469	.61738	
Austria	.0440	.1842		.2701	.31415		1.8878	.88713	**
Belgium Luxembourg	-1.09	.1343	**	1.46	.31965	**	.19622	.64124	
Canada	.2125	.1854		1.04	.52969	**	2.6877	.83348	**
Switzerland	-.863	.1602	**	.986	.28276	**	2.5287	.61697	**
Germany	-1.85	.1908	**	1.95	.30772	**	3.3955	.91899	**
Denmark	-.206	.2166		.1135	.41927		.87643	.67004	
Spain	-.464	.2278	**	.909	.39306	**	1.0546	.41343	**
Finland	1.342	.2606	**	3.22	.42310	**	.8254	.52080	
France	.3027	.1830	*	3.75	.41118	**	4.2087	.58934	**
Greece	.5162	.1862	**	.4416	.25255	*	.18777	.20317	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.102	.0894		1.79	.45307	**	.69748	.43108	*
Italy	.0468	.2246		.394	.31264		.37200	.20929	*
Japan	-.740	.1307	**	2.14	.31300	**	3.1393	.40717	**
Holland	-1.07	.2012	**	2.49	.33041	**	1.7922	.51273	**
Norway	.0795	.2479		.301	.36362		.04099	.45117	
New Zealand	-.042	.0667		.305	.26923		.17859	.25813	
Portugal	-.080	.1790		.756	.28988	**	.68365	.22285	**
Singapore	.6388	.1857	**	.9796	.29603		.1752	.30241	
Sweden	-.423	.2156	**	2.13	.47723	**	3.1028	.77761	**
U.S.A.	-.520	.0657	**	3.30	.42366	**	5.2217	.83151	**

Food Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3107	.2264	1.373	0.170	0.0062	5.24	0.0221	0.00	1.0000
Austria	-.785	.4004	-1.961	0.050	0.0098	5.29	0.0214	0.00	1.0000
Belgium Luxembourg	-1.48	.4905	-3.019	0.003	0.0402	6.05	0.0139	0.00	1.0000
Canada	.3197	.3605	0.887	0.375	0.0040	5.69	0.0171	0.00	1.0000
Switzerland	-.670	.3735	-1.795	0.073	0.0083	5.54	0.0186	0.00	1.0000
Germany	-1.35	.4796	-2.819	0.005	0.0366	5.89	0.0152	0.00	1.0000
Denmark	.2144	.6925	0.310	0.757	0.0050	6.03	0.0140	0.00	1.0000
Spain	-1.42	.7953	-1.792	0.073	0.0245	6.03	0.0140	0.00	1.0000
Finland	1.329	.9452	1.407	0.159	0.0390	5.77	0.0163	0.00	1.0000
France	-.449	.5365	-0.837	0.403	0.0124	5.98	0.0145	0.00	1.0000
Greece	-.357	.4816	-0.742	0.458	0.0051	5.88	0.0153	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	.5558	.2849	1.954	0.051	0.0212	5.88	0.0153	0.00	1.0000
Italy	1.002	.7042	1.423	0.155	0.0609	5.93	0.0149	0.00	1.0000
Japan	.0518	.2991	0.173	0.862	0.0011	5.20	0.0226	0.00	1.0000
Holland	-1.48	.7069	-2.103	0.035	0.0389	6.00	0.0143	0.00	1.0000
Norway	.4327	.5179	0.835	0.403	0.0081	5.09	0.0241	0.00	1.0000
New Zealand	-.053	.1741	-0.310	0.757	0.0068	5.65	0.0175	0.00	1.0000
Portugal	-.377	.5438	-0.694	0.488	0.0061	5.87	0.0154	0.00	1.0000
Singapore	.4580	.4324	1.059	0.289	0.0053	5.78	0.0162	0.00	1.0000
Sweden	.2868	.4842	0.592	0.554	0.0015	5.34	0.0208	0.00	1.0000
U.S.A.	-.033	.1728	-0.192	0.848	0.0008	5.58	0.0182	0.00	1.0000

Food Results.

Sample Coefficient Results.

number of observations 396

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	.3107	.2264		.5508	.9840333		1.02973	1.244299	
Austria	-.785	.4004	**	.04956	.6827711		.5014	1.92804	
Belgium Luxembourg	-1.48	.4905	**	3.207	1.167517	**	.761659	2.342142	
Canada	.3197	.3605		.9924	1.029898		1.78897	1.620556	
Switzerland	-.670	.3735	*	.2948	.6589624		.41879	1.437798	
Germany	-1.35	.4796	**	.8935	.7734877		4.2623	2.309932	**
Denmark	.2144	.6925		1.7248	1.340119		1.5856	2.141661	
Spain	-1.42	.7953	*	3.541	1.372069	**	2.98087	1.443196	**
Finland	1.329	.9452		5.3185	1.534102	**	4.4190	1.888331	**
France	-.449	.5365		2.335	1.204919	**	1.76882	1.727006	
Greece	-.357	.4816		.2764	.6532348		.739969	.5255135	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	.5558	.2849	**	2.1473	1.442688		1.0474	1.372675	
Italy	1.002	.7042		4.537	.9802665	**	2.34797	.6562338	**
Japan	.0518	.2991		.2506	.7161914		.28024	.9316581	
Holland	-1.48	.7069	**	3.465	1.161021	**	.453017	1.801661	
Norway	.4327	.5179		1.2697	.7595148	*	.69837	.9423845	
New Zealand	-.053	.1741		.90662	.7018973		-.03790	.6729783	
Portugal	-.377	.5438		.7414	.8805176		1.01734	.6769045	
Singapore	.4580	.4324		.63569	.6892357		.151263	.7040918	
Sweden	.2868	.4842		.3981	1.071772		.689194	1.746371	
U.S.A.	-.033	.1728		.06900	1.113173		.71906	2.184768	

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.4035	.2176	1.854	0.064	0.0039	12.74	0.0004	0.00	1.0000
Austria	-.158	.4607	-0.344	0.731	0.0001	11.81	0.0006	0.00	1.0000
Belgium Luxembourg	-.467	.2862	-1.635	0.102	0.0062	12.48	0.0004	0.00	1.0000
Canada	-.094	.4612	-0.204	0.838	0.0028	13.15	0.0003	0.00	1.0000
Switzerland	-.821	.4101	-2.002	0.045	0.0071	12.12	0.0005	0.00	1.0000
Germany	-1.55	.4602	-3.380	0.001	0.0378	13.31	0.0003	0.00	1.0000
Denmark	.1901	.4840	0.393	0.695	0.0029	12.96	0.0003	0.00	1.0000
Spain	-.335	.5389	-0.623	0.533	0.0011	13.13	0.0003	0.00	1.0000
Finland	.9714	.4980	1.951	0.051	0.0114	13.41	0.0002	0.00	1.0000
France	.1246	.3799	0.328	0.743	0.0053	11.70	0.0006	0.00	1.0000
Greece	-.202	.2290	-0.884	0.377	0.0011	12.14	0.0005	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	.0840	.2182	0.385	0.700	0.0019	12.71	0.0004	0.00	1.0000
Italy	-.661	.5953	-1.110	0.267	0.0035	12.52	0.0004	0.00	1.0000
Japan	-.777	.2853	-2.724	0.006	0.0118	11.93	0.0006	0.00	1.0000
Holland	-.470	.4323	-1.088	0.277	0.0062	12.40	0.0004	0.00	1.0000
Norway	.4863	.3820	1.273	0.203	0.0072	12.02	0.0005	0.00	1.0000
New Zealand	-.036	.0919	-0.401	0.689	0.0003	12.59	0.0004	0.00	1.0000
Portugal	.1214	.2664	0.456	0.648	0.0003	13.34	0.0003	0.00	1.0000
Singapore	.4434	.3683	1.204	0.229	0.0016	8.86	0.0029	0.00	1.0000
Sweden	.7874	.5363	1.468	0.142	0.0025	12.89	0.0003	0.00	1.0000
U.S.A.	-.279	.1516	-1.845	0.065	0.0136	12.41	0.0004	0.00	1.0000

Chemicals Results.

Sample Coefficient Results.

number of observations 660

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	.4035	.2176	*	.003	.94601		.00139	1.1962	
Austria	-.158	.4607		.052	.78563		.12688	2.2185	
Belgium Luxembourg	-.467	.2862		.223	.68122		1.7914	1.3665	
Canada	-.094	.4612		1.88	1.3174		2.6850	2.0730	
Switzerland	-.821	.4101	**	.832	.72353		1.9347	1.5786	
Germany	-1.55	.4602	**	2.04	.74221	**	5.4371	2.2165	**
Denmark	.1901	.4840		1.47	.93670		1.2818	1.4969	
Spain	-.335	.5389		.5739	.92980		.04493	.97800	
Finland	.9714	.4980	*	1.166	.80834		.9093	.99499	
France	.1246	.3799		1.857	.85321		2.0140	1.2229	
Greece	-.202	.2290		.128	.31071		.16154	.24996	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	.0840	.2182		1.44	1.1065		1.0597	1.0528	
Italy	-.661	.5953		.2383	.82860		.71758	.55470	
Japan	-.777	.2853	**	.657	.68315		1.1628	.88868	
Holland	-.470	.4323		1.30	.70994		.15603	1.1016	
Norway	.4863	.3820		1.316	.56021	**	1.1957	.69509	*
New Zealand	-.036	.0919		.117	.37051		.02785	.35525	
Portugal	.1214	.2664		.048	.43093		.05980	.33128	
Singapore	.4434	.3683		.0460	.58707		.06266	.59972	
Sweden	.7874	.5363		.4415	1.1870		.62391	1.9341	
U.S.A.	-.279	.1516	*	2.96	.97652		4.4199	1.9165	

Stone and Glassware Results.

number of observations 363

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.4050	.4066	0.996	0.319	0.0046	4.87	0.0274	0.00	1.0000
Austria	-.063	.7226	-0.088	0.930	0.0054	4.71	0.0299	0.00	1.0000
Belgium Luxembourg	-.070	.4454	-0.158	0.874	0.0013	5.00	0.0253	0.00	1.0000
Canada	-1.50	.6824	-2.212	0.027	0.0182	5.15	0.0233	0.00	1.0000
Switzerland	-1.85	.7715	-2.410	0.016	0.0189	5.20	0.0226	0.00	1.0000
Germany	-2.39	.7300	-3.286	0.001	0.0601	5.32	0.0211	0.00	1.0000
Denmark	.8845	.8703	1.016	0.310	0.0111	5.42	0.0199	0.00	1.0000
Spain	.8092	.7899	1.024	0.306	0.0068	5.39	0.0203	0.00	1.0000
Finland	1.505	.9460	1.591	0.112	0.0272	5.45	0.0196	0.00	1.0000
France	-.254	.7214	-0.353	0.724	0.0265	5.09	0.0241	0.00	1.0000
Greece	-.337	.5770	-0.585	0.558	0.0040	5.44	0.0197	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	.3006	.3417	0.880	0.379	0.0025	5.42	0.0199	0.00	1.0000
Italy	-.100	.8589	-0.117	0.907	0.0307	5.05	0.0246	0.00	1.0000
Japan	-.889	.5316	-1.672	0.094	0.0327	5.27	0.0217	0.00	1.0000
Holland	-1.33	1.006	-1.330	0.183	0.0087	5.50	0.0190	0.00	1.0000
Norway	1.583	.8167	1.939	0.052	0.0109	4.63	0.0314	0.00	1.0000
New Zealand	.0444	.1964	0.226	0.821	0.0047	4.72	0.0297	0.00	1.0000
Portugal	-.485	.7183	-0.676	0.499	0.0112	5.49	0.0191	0.00	1.0000
Singapore	-.667	.5605	-1.190	0.234	0.0045	5.51	0.0189	0.00	1.0000
Sweden	-1.04	.9047	-1.158	0.247	0.0242	5.28	0.0216	0.00	1.0000
U.S.A.	-.197	.2291	-0.860	0.390	0.0071	4.76	0.0291	0.00	1.0000

Stone and Glassware Results.

Sample Coefficient Results.

number of observations 363

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	.4050	.4066		1.486	1.7674		1.1707	2.2348	
Austria	-.063	.7226		.028	1.2322		3.9335	3.4795	
Belgium Luxembourg	-.070	.4454		.6336	1.0601		.39038	2.1266	
Canada	-1.50	.6824	**	1.24	1.9492		.19797	3.0671	
Switzerland	-1.85	.7715	**	1.52	1.3610		2.1234	2.9695	
Germany	-2.39	.7300	**	2.44	1.1773	**	6.1237	3.5160	*
Denmark	.8845	.8703		2.047	1.6842		.33753	2.6916	
Spain	.8092	.7899		1.30	1.3627		.05804	1.4334	
Finland	1.505	.9460		3.825	1.5354	**	2.7961	1.8900	
France	-.254	.7214		4.98	1.6202	**	4.8143	2.3222	**
Greece	-.337	.5770		.728	.78263		.57428	.62961	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	.3006	.3417		.168	1.7329		.15646	1.6488	
Italy	-.100	.8589		3.81	1.1955		2.0320	.80032	**
Japan	-.889	.5316	*	3.13	1.2729	**	3.7020	1.6559	**
Holland	-1.33	1.006		1.73	1.6533		.35334	2.5655	
Norway	1.583	.8167	**	.108	1.1976		.15171	1.4860	
New Zealand	.0444	.1964		.121	.79202		.70423	.75939	
Portugal	-.485	.7183		1.01	1.1631		1.7388	.89419	**
Singapore	-.667	.5605		.376	.89343		.01474	.91269	
Sweden	-1.04	.9047		5.54	2.0025	**	8.8774	3.2629	**
U.S.A.	-.197	.2291		2.01	1.4753		3.8424	2.8956	

Copper, Nickel and Aluminium Products Results.

number of observations 264

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0320	.4653	0.069	0.945	0.0017	3.91	0.0481	0.00	1.0000
Austria	-.087	.7128	-0.123	0.902	0.0013	4.06	0.0439	0.00	1.0000
Belgium Luxembourg	-.663	.3425	-1.938	0.053	0.0216	3.53	0.0602	0.00	1.0000
Canada	1.807	.8621	2.096	0.036	0.0169	4.02	0.0448	0.00	1.0000
Switzerland	-.372	.4438	-0.840	0.401	0.0188	3.72	0.0538	0.00	1.0000
Germany	-1.72	.6325	-2.729	0.006	0.0741	3.93	0.0475	0.00	1.0000
Denmark	-.539	.6914	-0.781	0.435	0.0398	3.89	0.0487	0.00	1.0000
Spain	-.577	1.881	-0.307	0.759	0.0090	4.04	0.0445	0.00	1.0000
Finland	.3384	.9474	0.357	0.721	0.0286	4.01	0.0453	0.00	1.0000
France	.9568	.5799	1.650	0.099	0.0768	3.72	0.0536	0.00	1.0000
Greece	.3984	.3399	1.172	0.241	0.0103	3.73	0.0535	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	-.526	.3958	-1.330	0.184	0.0455	3.85	0.0497	0.00	1.0000
Italy	1.537	.8134	1.891	0.059	0.0247	3.99	0.0458	0.00	1.0000
Japan	-.303	.5793	-0.524	0.601	0.0033	3.87	0.0492	0.00	1.0000
Holland	.0637	.6400	0.100	0.921	0.0533	4.02	0.0448	0.00	1.0000
Norway	-2.23	1.031	-2.166	0.030	0.0443	3.93	0.0474	0.00	1.0000
New Zealand	.2571	.2069	1.243	0.214	0.0075	3.29	0.0697	0.00	1.0000
Portugal	-.478	.5966	-0.802	0.423	0.0028	3.86	0.0495	0.00	1.0000
Singapore	.2878	.8229	0.350	0.727	0.0012	4.08	0.0433	0.00	1.0000
Sweden	-.637	.4400	-1.448	0.147	0.0155	3.56	0.0591	0.00	1.0000
U.S.A.	-.306	.1686	-1.818	0.069	0.0364	3.82	0.0506	0.00	1.0000

Copper, Nickel and Aluminium Products Results.

Sample Coefficient Results.

number of observations 264

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	.0320	.4653		1.05	2.0223		1.6845	2.5572	
Austria	-.087	.7128		.6661	1.2156		1.6345	3.4327	
Belgium Luxembourg	-.663	.3425	**	.752	.81519		1.0145	1.6353	
Canada	1.807	.8621	**	.716	2.4627		2.0701	3.8751	
Switzerland	-.372	.4438		.731	.78301		2.9954	1.7084	*
Germany	-1.72	.6325	**	2.97	1.0202	**	1.7590	3.0467	
Denmark	-.539	.6914		3.91	1.3379	**	3.2161	2.1382	
Spain	-.577	1.881		2.262	1.7887		.57705	1.8814	
Finland	.3384	.9474		4.113	1.5376	**	2.8242	1.8927	
France	.9568	.5799	*	5.26	1.3024	**	4.6777	1.8667	**
Greece	.3984	.3399		.4738	.46105		.09783	.37091	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.526	.3958		5.42	2.007	**	2.2827	1.9097	
Italy	1.537	.8134	*	.5190	1.1322		1.5855	.75796	**
Japan	-.303	.5793		.906	1.387		.69559	1.8044	
Holland	.0637	.6400		3.83	1.0511	**	4.6991	1.6312	**
Norway	-2.23	1.031	**	4.41	1.5119	**	1.9723	1.8759	
New Zealand	.2571	.2069		.195	.83427		.13528	.79989	
Portugal	-.478	.5966		.2258	.96608		.31025	.74268	
Singapore	.2878	.8229		.412	1.3116		.57596	1.3399	
Sweden	-.637	.4400		1.50	.97392		1.6395	1.5869	
U.S.A.	-.306	.1686	*	2.83	1.0857	**	4.1234	2.1310	**

Miscellaneous Building Products Results.

number of observations 627

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0396	.3528	0.112	0.911	0.0052	8.84	0.0029	0.00	1.0000
Austria	-.242	.5268	-0.461	0.645	0.0036	8.23	0.0041	0.00	1.0000
Belgium Luxembourg	-1.62	.3821	-4.265	0.000	0.0348	9.11	0.0025	0.00	1.0000
Canada	.9443	.4972	1.899	0.058	0.0292	9.01	0.0027	0.00	1.0000
Switzerland	-1.39	.3331	-4.182	0.000	0.0425	8.02	0.0046	0.00	1.0000
Germany	-2.04	.4484	-4.551	0.000	0.0504	8.77	0.0031	0.00	1.0000
Denmark	-.334	.4554	-0.735	0.462	0.0036	8.63	0.0033	0.00	1.0000
Spain	-.774	.5018	-1.544	0.123	0.0104	8.70	0.0032	0.00	1.0000
Finland	2.543	.8708	2.921	0.003	0.0447	9.18	0.0024	0.00	1.0000
France	.0053	.5111	0.010	0.992	0.0268	8.81	0.0030	0.00	1.0000
Greece	1.424	.6998	2.035	0.042	0.0075	9.12	0.0025	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	N.a.
Ireland	-.185	.2153	-0.863	0.388	0.0352	8.96	0.0028	0.00	1.0000
Italy	.1702	.5473	0.311	0.756	0.0017	8.85	0.0029	0.00	1.0000
Japan	-1.44	.3001	-4.825	0.000	0.0574	8.99	0.0027	0.00	1.0000
Holland	-1.39	.4490	-3.100	0.002	0.0288	8.55	0.0035	0.00	1.0000
Norway	-.805	.7649	-1.053	0.292	0.0049	9.03	0.0027	0.00	1.0000
New Zealand	-.025	.2056	-0.125	0.900	0.0027	8.23	0.0041	0.00	1.0000
Portugal	.1651	.4908	0.337	0.736	0.0016	8.62	0.0033	0.00	1.0000
Singapore	.6446	.6273	1.028	0.304	0.0123	9.07	0.0026	0.00	1.0000
Sweden	-.835	.4519	-1.848	0.065	0.0073	8.87	0.0029	0.00	1.0000
U.S.A.	-.932	.1993	-4.681	0.000	0.0526	9.35	0.0022	0.00	1.0000

Miscellaneous Building Products Results.

Sample Coefficient Results.

number of observations 627

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	.0396	.3528	**	2.677	1.5334	*	2.0487	1.9389	
Austria	-.242	.5268	**	1.014	.89845		.03392	2.5371	
Belgium Luxembourg	-1.62	.3821	**	1.83	.90939		.62672	1.8243	
Canada	.9443	.4972	**	3.694	1.4203	**	1.0651	2.2349	
Switzerland	-1.39	.3331	**	.686	.58767		4.2599	1.2822	**
Germany	-2.04	.4484	**	1.83	.72328	**	2.4927	2.1599	
Denmark	-.334	.4554	**	.2889	.88124		.97323	1.4083	
Spain	-.774	.5018	**	1.75	.86568	**	1.6173	.91056	*
Finland	2.543	.8708	**	5.597	1.4133	**	1.5589	1.7397	
France	.0053	.5111	**	4.72	1.1478	**	5.2099	1.6452	**
Greece	1.424	.6998	**	.5012	.94929		.48134	.76369	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.185	.2153	**	4.64	1.0914	**	2.8733	1.0385	**
Italy	.1702	.5473	**	.761	.76190		.26596	.51005	
Japan	-1.44	.3001	**	1.84	.71857	**	2.4268	.93475	**
Holland	-1.39	.4490	**	2.00	.73746	**	1.8256	1.1443	
Norway	-.805	.7649	**	1.26	1.1216		.21154	1.3916	
New Zealand	-.025	.2056	**	.751	.82893		1.0104	.79478	
Portugal	.1651	.4908	**	.600	.79472		.29542	.61095	
Singapore	.6446	.6273	**	2.426	.99999	**	.3698	1.0215	
Sweden	-.835	.4519	**	1.21	1.0003		2.1108	1.6299	
U.S.A.	-.932	.1993	**	4.81	1.2833	**	6.8663	2.5187	**

CHAPTER 5

Appendix 8.

Panel Data Regression Analysis 5.

Testing the relationship:

$\Delta p_{it} = con + \beta_i \Delta s_t + u_{it}$, ***(Floating Rate Period)*** **(5.4)**

number of observations 3807

Sample Population Results.

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3248	.1311	2.478	0.013	0.0018	63.87	0.0000	0.00	1.0000
Austria	-.065	.2166	-0.303	0.762	0.0000	60.27	0.0000	0.00	1.0000
Belgium Luxembourg	-1.01	.1544	-6.553	0.000	0.0125	61.91	0.0000	0.00	1.0000
Canada	.0259	.2093	0.124	0.901	0.0000	64.15	0.0000	0.00	1.0000
Switzerland	-.840	.1861	-4.515	0.000	0.0060	57.07	0.0000	0.00	1.0000
Germany	-1.85	.2248	-8.243	0.000	0.0197	62.82	0.0000	0.00	1.0000
Denmark	-.154	.2472	-0.625	0.532	0.0001	62.55	0.0000	0.00	1.0000
Spain	-.461	.2545	-1.812	0.070	0.0010	63.10	0.0000	0.00	1.0000
Finland	1.473	.3014	4.886	0.000	0.0070	66.53	0.0000	0.00	1.0000
France	.6016	.2246	2.678	0.007	0.0021	61.36	0.0000	0.00	1.0000
Greece	.5554	.2229	2.491	0.013	0.0018	66.75	0.0000	0.00	1.0000
Hong Kong	-.327	.1829	-1.790	0.073	0.0009	59.07	0.0000	0.00	1.0000
Ireland	-.152	.0928	-1.641	0.101	0.0008	63.48	0.0000	0.00	1.0000
Italy	.0196	.2687	0.073	0.942	0.0000	60.27	0.0000	0.00	1.0000
Japan	-.961	.1537	-6.254	0.000	0.0114	62.66	0.0000	0.00	1.0000
Holland	-1.30	.2426	-5.373	0.000	0.0085	63.17	0.0000	0.00	1.0000
Norway	.1221	.3004	0.406	0.684	0.0000	64.15	0.0000	0.00	1.0000
New Zealand	-.041	.0805	-0.518	0.604	0.0001	59.17	0.0000	0.00	1.0000
Portugal	.1400	.1813	0.772	0.440	0.0002	61.71	0.0000	0.00	1.0000
Singapore	.7697	.2275	3.383	0.001	0.0034	60.40	0.0000	0.00	1.0000
Sweden	-.415	.2590	-1.602	0.109	0.0008	60.56	0.0000	0.00	1.0000
U.S.A.	-.541	.0727	-7.440	0.000	0.0161	55.88	0.0000	0.00	1.0000

Food Results.

number of observations 352

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3178	.2560	1.241	0.214	0.0054	5.20	0.0226	0.00	1.0000
Austria	-.813	.4796	-1.695	0.090	0.0099	5.14	0.0234	0.00	1.0000
Belgium Luxembourg	-1.28	.5736	-2.247	0.025	0.0173	5.89	0.0152	0.00	1.0000
Canada	.1538	.3962	0.388	0.698	0.0005	5.71	0.0169	0.00	1.0000
Switzerland	-.734	.3977	-1.846	0.065	0.0118	5.10	0.0239	0.00	1.0000
Germany	-1.31	.5725	-2.295	0.022	0.0181	6.14	0.0132	0.00	1.0000
Denmark	.4265	.8052	0.530	0.596	0.0010	5.90	0.0152	0.00	1.0000
Spain	-1.51	.9045	-1.676	0.094	0.0097	6.04	0.0140	0.00	1.0000
Finland	1.974	1.111	1.776	0.076	0.0109	5.84	0.0157	0.00	1.0000
France	-.112	.6809	-0.165	0.869	0.0001	6.16	0.0131	0.00	1.0000
Greece	-.191	.5490	-0.348	0.728	0.0004	5.87	0.0154	0.00	1.0000
Hong Kong	-.259	.4184	-0.620	0.536	0.0013	5.74	0.0166	0.00	1.0000
Ireland	.6659	.2935	2.268	0.023	0.0177	5.97	0.0145	0.00	1.0000
Italy	1.093	.8786	1.244	0.213	0.0054	6.07	0.0137	0.00	1.0000
Japan	.0611	.3557	0.172	0.863	0.0001	5.49	0.0192	0.00	1.0000
Holland	-1.50	.8745	-1.719	0.086	0.0102	6.10	0.0135	0.00	1.0000
Norway	.3455	.6314	0.544	0.586	0.0010	5.07	0.0243	0.00	1.0000
New Zealand	-.156	.2019	-0.776	0.438	0.0021	5.62	0.0178	0.00	1.0000
Portugal	.0173	.5587	0.031	0.975	0.0000	5.91	0.0151	0.00	1.0000
Singapore	.6253	.5140	1.217	0.224	0.0051	5.73	0.0167	0.00	1.0000
Sweden	.3847	.5937	0.648	0.517	0.0015	5.24	0.0220	0.00	1.0000
U.S.A.	-.033	.2044	-0.166	0.868	0.0001	5.63	0.0177	0.00	1.0000

Chemicals Results.

number of observations 648

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.3976	.2528	1.573	0.116	0.0038	12.46	0.0004	0.00	1.0000
Austria	-.048	.5509	-0.088	0.930	0.0000	11.81	0.0006	0.00	1.0000
Belgium Luxembourg	-.425	.3216	-1.323	0.186	0.0027	13.20	0.0003	0.00	1.0000
Canada	-.326	.5250	-0.621	0.534	0.0006	12.76	0.0004	0.00	1.0000
Switzerland	-.810	.4850	-1.671	0.095	0.0043	11.99	0.0005	0.00	1.0000
Germany	-1.50	.5443	-2.773	0.006	0.0118	12.67	0.0004	0.00	1.0000
Denmark	.1524	.5600	0.272	0.786	0.0001	12.93	0.0003	0.00	1.0000
Spain	-.368	.6053	-0.609	0.542	0.0006	12.98	0.0003	0.00	1.0000
Finland	.8607	.5664	1.519	0.129	0.0036	13.43	0.0002	0.00	1.0000
France	.0963	.4095	0.235	0.814	0.0001	12.22	0.0005	0.00	1.0000
Greece	-.221	.2761	-0.804	0.422	0.0010	12.25	0.0005	0.00	1.0000
Hong Kong	.2807	.3112	0.900	0.368	0.0013	12.16	0.0005	0.00	1.0000
Ireland	-.011	.2252	-0.049	0.961	0.0000	11.91	0.0006	0.00	1.0000
Italy	-.560	.7392	-0.765	0.444	0.0009	12.71	0.0004	0.00	1.0000
Japan	-.835	.3370	-2.479	0.013	0.0094	11.91	0.0006	0.00	1.0000
Holland	-.405	.5113	-0.792	0.428	0.0010	12.14	0.0005	0.00	1.0000
Norway	.4685	.4608	1.020	0.308	0.0016	11.45	0.0007	0.00	1.0000
New Zealand	-.061	.1108	-0.554	0.579	0.0005	12.53	0.0004	0.00	1.0000
Portugal	.0881	.2762	0.319	0.750	0.0002	13.47	0.0002	0.00	1.0000
Singapore	.5147	.4537	1.134	0.257	0.0020	9.08	0.0026	0.00	1.0000
Sweden	.9054	.6362	1.423	0.155	0.0031	11.72	0.0006	0.00	1.0000
U.S.A.	-.284	.1481	-1.923	0.054	0.0057	12.11	0.0005	0.00	1.0000

Stone and Glassware Results.

number of observations 297

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.4186	.4688	0.893	0.372	0.0030	4.85	0.0277	0.00	1.0000
Austria	-.063	.8521	-0.074	0.941	0.0000	5.11	0.0238	0.00	1.0000
Belgium Luxembourg	-.095	.4494	-0.212	0.832	0.0002	4.48	0.0343	0.00	1.0000
Canada	-1.48	.7567	-1.965	0.049	0.0145	5.35	0.0207	0.00	1.0000
Switzerland	-1.98	.8704	-2.279	0.023	0.0194	4.65	0.0310	0.00	1.0000
Germany	-2.35	.8613	-2.730	0.006	0.0277	4.64	0.0312	0.00	1.0000
Denmark	1.185	.9604	1.234	0.217	0.0058	5.39	0.0203	0.00	1.0000
Spain	.7870	.8199	0.960	0.337	0.0035	4.47	0.0345	0.00	1.0000
Finland	1.872	1.066	1.757	0.079	0.0116	5.42	0.0199	0.00	1.0000
France	-.046	.9119	-0.051	0.959	0.0000	5.27	0.0217	0.00	1.0000
Greece	-.277	.6763	-0.411	0.681	0.0006	5.35	0.0207	0.00	1.0000
Hong Kong	-.589	.9446	-0.624	0.532	0.0015	5.24	0.0221	0.00	1.0000
Ireland	.2481	.3457	0.718	0.473	0.0020	5.35	0.0207	0.00	1.0000
Italy	-.259	1.043	-0.249	0.803	0.0002	4.94	0.0262	0.00	1.0000
Japan	-1.25	.6116	-2.059	0.040	0.0159	5.31	0.0211	0.00	1.0000
Holland	-1.58	1.213	-1.304	0.192	0.0065	5.23	0.0222	0.00	1.0000
Norway	1.724	.9148	1.937	0.053	0.0141	4.42	0.0356	0.00	1.0000
New Zealand	.0889	.2428	0.366	0.714	0.0005	4.78	0.0288	0.00	1.0000
Portugal	.3393	.6755	0.502	0.615	0.0010	5.46	0.0194	0.00	1.0000
Singapore	-.639	.6785	-0.943	0.346	0.0034	5.57	0.0183	0.00	1.0000
Sweden	-1.17	1.087	-1.077	0.281	0.0044	4.83	0.0279	0.00	1.0000
U.S.A.	-.173	.2339	-0.740	0.459	0.0021	3.75	0.0529	0.00	1.0000

Copper, Nickel and Aluminium Products Results.

number of observations 216

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0157	.5496	0.029	0.977	0.0000	3.86	0.0494	0.00	1.0000
Austria	-.144	.8499	-0.170	0.865	0.0002	4.13	0.0421	0.00	1.0000
Belgium Luxembourg	-.645	.3789	-1.703	0.088	0.0150	3.65	0.0561	0.00	1.0000
Canada	1.872	.9746	1.921	0.055	0.0190	4.07	0.0436	0.00	1.0000
Switzerland	-.486	.5067	-0.960	0.337	0.0048	3.02	0.0821	0.00	1.0000
Germany	-1.61	.7575	-2.130	0.033	0.0233	4.07	0.0438	0.00	1.0000
Denmark	-.937	.8129	-1.153	0.249	0.0069	3.78	0.0518	0.00	1.0000
Spain	-.326	1.195	-0.273	0.785	0.0004	3.91	0.0480	0.00	1.0000
Finland	.6413	1.118	0.574	0.566	0.0017	4.05	0.0442	0.00	1.0000
France	.8914	.7058	1.263	0.207	0.0083	3.89	0.0485	0.00	1.0000
Greece	.4003	.4122	0.971	0.331	0.0049	3.75	0.0528	0.00	1.0000
Hong Kong	.3374	.8176	0.413	0.680	0.0009	3.90	0.0484	0.00	1.0000
Ireland	-.681	.4222	-1.614	0.107	0.0135	4.08	0.0434	0.00	1.0000
Italy	1.101	.9433	1.168	0.243	0.0071	3.66	0.0557	0.00	1.0000
Japan	-.352	.6884	-0.512	0.609	0.0014	3.98	0.0460	0.00	1.0000
Holland	-.576	.7502	-0.768	0.442	0.0031	3.93	0.0474	0.00	1.0000
Norway	-2.13	1.301	-1.643	0.100	0.0140	3.95	0.0468	0.00	1.0000
New Zealand	.3142	.2452	1.282	0.200	0.0086	3.54	0.0599	0.00	1.0000
Portugal	-.448	.5907	-0.754	0.451	0.0030	3.88	0.0489	0.00	1.0000
Singapore	.3722	1.016	0.366	0.714	0.0007	4.13	0.0421	0.00	1.0000
Sweden	-.671	.5253	-1.279	0.201	0.0085	3.88	0.0488	0.00	1.0000
U.S.A.	-.367	.1807	-2.033	0.042	0.0213	3.78	0.0520	0.00	1.0000

Miscellaneous Building Products Results.

number of observations 456

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0196	.3968	0.050	0.961	0.0000	8.59	0.0034	0.00	1.0000
Austria	-.503	.5958	-0.846	0.398	0.0016	7.96	0.0048	0.00	1.0000
Belgium Luxembourg	-1.52	.4491	-3.401	0.001	0.0248	8.84	0.0029	0.00	1.0000
Canada	1.110	.5699	1.948	0.051	0.0083	8.60	0.0034	0.00	1.0000
Switzerland	-1.41	.3689	-3.847	0.000	0.0316	7.22	0.0072	0.00	1.0000
Germany	-2.05	.5286	-3.893	0.000	0.0323	8.44	0.0037	0.00	1.0000
Denmark	-.342	.5185	-0.661	0.508	0.0010	8.84	0.0029	0.00	1.0000
Spain	-.675	.5236	-1.289	0.197	0.0036	7.57	0.0059	0.00	1.0000
Finland	2.804	1.019	2.752	0.006	0.0164	9.43	0.0021	0.00	1.0000
France	.2254	.6370	0.354	0.723	0.0003	8.11	0.0044	0.00	1.0000
Greece	1.592	.8434	1.888	0.059	0.0078	9.21	0.0024	0.00	1.0000
Hong Kong	-.294	.4637	-0.636	0.525	0.0009	8.85	0.0029	0.00	1.0000
Ireland	-.440	.2283	-1.930	0.054	0.0081	8.92	0.0028	0.00	1.0000
Italy	.0260	.6628	0.039	0.969	0.0000	8.89	0.0029	0.00	1.0000
Japan	-1.73	.3455	-5.019	0.000	0.0526	8.54	0.0035	0.00	1.0000
Holland	-1.66	.5408	-3.078	0.002	0.0204	8.42	0.0037	0.00	1.0000
Norway	-.864	.9342	-0.926	0.355	0.0019	9.11	0.0025	0.00	1.0000
New Zealand	-.020	.2464	-0.083	0.934	0.0000	7.84	0.0051	0.00	1.0000
Portugal	.2767	.4935	0.561	0.575	0.0007	8.66	0.0033	0.00	1.0000
Singapore	.7886	.7754	1.017	0.309	0.0023	9.06	0.0026	0.00	1.0000
Sweden	-1.01	.5376	-1.886	0.059	0.0078	7.59	0.0059	0.00	1.0000
U.S.A.	-.997	.2356	-4.232	0.000	0.0380	8.82	0.0030	0.00	1.0000

CHAPTER 5

Appendix 9.

Panel Data Regression Analysis 6.

Testing the relationship:

$\Delta p_{it} = con + \beta_i \Delta s_t + u_{it}$, ***(robust std. Errors)*** **(5.4)**

number of observations 4653

Sample Population Results.

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.30843	.10466	2.947	0.003	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.0848	.16184	-0.524	0.600	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.9574	.16697	-5.734	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	.02633	.21003	0.125	0.900	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	-.6923	.13342	-5.189	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	-1.657	.11975	-13.84	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	-.1968	.15428	-1.276	0.202	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	-.4163	.18380	-2.265	0.024	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	1.2964	.22747	5.699	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
France	.50022	.14159	3.533	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	.44480	.11322	3.928	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.3003	.13747	-2.185	0.029	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.1302	.07462	-1.745	0.081	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	.10854	.18487	0.587	0.557	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-.9062	.13082	-6.927	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-1.159	.12422	-9.333	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	.11175	.18540	0.603	0.547	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.0316	.04511	-0.701	0.483	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	.18547	.08107	2.288	0.022	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	.61196	.14774	4.142	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	-.2836	.16563	-1.712	0.087	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.4886	.05704	-8.566	0.000	n.a.	n.a.	n.a.	n.a.	n.a.

Food Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.29842	.18875	1.581	0.114	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.7610	.36007	-2.114	0.035	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-1.215	.57499	-2.115	0.034	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	.19586	.50982	0.384	0.701	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	-.6305	.35728	-1.765	0.078	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	-1.117	.37284	-2.996	0.003	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	.35917	.44986	0.798	0.425	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	-1.364	.54237	-2.515	0.012	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	1.7787	.84249	2.111	0.035	n.a.	n.a.	n.a.	n.a.	n.a.
France	-.3812	.37511	-1.016	0.309	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	-.0099	.22361	-0.045	0.964	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.2833	.22312	-1.270	0.204	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	.61431	.29128	2.109	0.035	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	.90058	.59135	1.523	0.128	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	.03531	.41440	0.085	0.932	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-1.480	.33132	-4.467	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	.28239	.39376	0.717	0.473	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.1019	.19855	-0.513	0.608	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	.06191	.18684	0.331	0.740	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	.43712	.37439	1.168	0.243	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	.31399	.46731	0.672	0.502	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.0340	.19938	-0.171	0.864	n.a.	n.a.	n.a.	n.a.	n.a.

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.40360	.17975	2.245	0.025	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.1471	.32870	-0.448	0.654	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.3978	.37662	-1.056	0.291	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	-.2799	.52761	-0.531	0.596	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	-.6832	.37889	-1.803	0.071	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	-1.246	.26828	-4.644	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	.06663	.36800	0.181	0.856	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	-.2964	.39554	-0.749	0.454	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	.74764	.54035	1.384	0.166	n.a.	n.a.	n.a.	n.a.	n.a.
France	.03132	.31114	0.101	0.920	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	-.1297	.15699	-0.826	0.409	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	.27195	.29833	0.912	0.362	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	.00256	.16990	0.015	0.988	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-.3030	.44014	-0.688	0.491	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-.8288	.34693	-2.389	0.017	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-.4668	.31520	-1.481	0.139	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	.31718	.38999	0.813	0.416	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.0313	.07824	-0.401	0.689	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	.08524	.13273	0.642	0.521	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	.43722	.21904	1.996	0.046	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	.75868	.48520	1.564	0.118	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.2517	.12762	-1.972	0.049	n.a.	n.a.	n.a.	n.a.	n.a.

Stone and Glassware Results.

number of observations 363

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.38762	.32701	1.185	0.236	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.2835	.80537	-0.352	0.725	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.1163	.39079	-0.298	0.766	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	-1.495	.67229	-2.224	0.026	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	-1.653	.34911	-4.736	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	-2.048	.47289	-4.333	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	1.0567	.81150	1.302	0.193	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	.71430	.86550	0.825	0.409	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	1.7629	.90485	1.948	0.051	n.a.	n.a.	n.a.	n.a.	n.a.
France	-.0425	.62280	-0.068	0.946	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	-.0912	.42875	-0.213	0.831	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.5055	.66513	-0.760	0.447	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	.28719	.23579	1.218	0.223	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-.1603	.59838	-0.268	0.789	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-1.127	.55002	-2.049	0.040	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-1.343	.48676	-2.760	0.006	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	1.5907	.54205	2.935	0.003	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	.07522	.14137	0.532	0.595	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	.29454	.34466	0.855	0.393	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	-.6614	.52697	-1.255	0.209	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	-.6769	.86097	-0.786	0.432	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.1777	.14600	-1.217	0.224	n.a.	n.a.	n.a.	n.a.	n.a.

Copper, Nickel and Aluminium Products Results.

number of observations 264

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.01737	.32916	0.053	0.958	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.0495	.50387	-0.098	0.922	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.5681	.24056	-2.362	0.018	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	1.6637	1.1303	1.472	0.141	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	-.2088	.32549	-0.642	0.521	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	-.0138	.00189	-7.313	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	-.8688	.35274	-2.463	0.014	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	-.4117	.81177	-0.507	0.612	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	.58388	.95994	0.608	0.543	n.a.	n.a.	n.a.	n.a.	n.a.
France	1.1545	.42024	2.747	0.006	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	.37213	.12878	2.890	0.004	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	.33265	.62913	0.529	0.597	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.6307	.31104	-2.028	0.043	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	.99719	.47937	2.080	0.038	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-.3705	.48232	-0.768	0.442	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-.1767	.38227	-0.462	0.644	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	-1.724	.45697	-3.773	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	.27236	.11830	2.302	0.021	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	-.2938	.31442	-0.934	0.350	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	.23980	.62314	0.385	0.700	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	-.5437	.14755	-3.685	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.2796	.07517	-3.720	0.000	n.a.	n.a.	n.a.	n.a.	n.a.

Miscellaneous Building Products Results.

number of observations 627

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.00639	.32065	0.020	0.984	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.3279	.56151	-0.584	0.559	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-1.447	.42072	-3.441	0.001	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	1.0174	.43243	2.353	0.019	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	-1.191	.23171	-5.142	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	-1.889	.18915	-9.989	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	-.3102	.33990	-0.913	0.361	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	-.7293	.32296	-2.258	0.024	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	2.4859	.53216	4.671	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
France	.24838	.48165	0.516	0.606	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	1.2127	.34899	3.475	0.001	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.3944	.31630	-1.247	0.212	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.3847	.16994	-2.264	0.024	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	.09944	.53148	0.187	0.852	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-1.589	.15337	-10.36	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-1.480	.24116	-6.139	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	-.6820	.47085	-1.448	0.147	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.0191	.10433	-0.183	0.855	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	.24966	.27920	0.894	0.371	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	.58386	.33996	1.717	0.086	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	-.7522	.43620	-1.725	0.085	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.8873	.17894	-4.959	0.000	n.a.	n.a.	n.a.	n.a.	n.a.

CHAPTER 5

Appendix 10

Key of abbreviations used:

Heading	Abbreviation Used
β coefficient	β
Standard error on β	S. E. on β
Significance of β	P>|t|
Breusch-Pagan Test	B-P Test
Hausman Test	H-man Test
Significance of test results	P>[c]
**	Significant at 5%
*	Significant at 10%

ADDITIONAL APPENDICES.

CHAPTER 6

Appendix 1.

List of products selected.

SITC CODE	**Description**
04812	Prepared foods obtain. by the swelling or roasting
04841	Bread, ships, biscuits & other ordinary bakers wares
04842	Pastry, biscuits, cakes and other fine bakers wares
05484	Hop cones and lupulin
05651	Vegetables & fruit, prepared/preserved by vinegar
05861	Fruit, preserved by freezing, no sugar added
07231	Cocoa paste whether or not defatted
07232	Cocoa butter (fat or oil)
08199	Sweetened forage; other preptions for animal feeding
09803	Mustard flour and prepared mustard
09804	Sauces; mixed condiments and mixed seasonings
09805	Soups and broths, in liquid, solid or powder form
09809	Food preparations, n.e.s.
11101	Waters (including spa & aerated waters); ice and snow
11102	Lemonade, flavoured spa waters & flavoured waters
11212	Wine of fresh grapes;grape must
26861	Waste of sheep's/lamb's not pulled or garneted
33452	Lubricating preparations
51482	Carboxyimide-function compounds etc.
51485	Diazo-, azo-, and azoxy-compounds

51489 Compounds with other nitrogen functions
51611 Ethers, ether-alcohols, ether-phenols etc.
51621 Aldehydes, aldehyde-alcohols, aldehyde-phenols, etc
51699 Other organic compounds
52211 Oxygen, nitrogen, hydrogen and rare gases
52213 Chlorine
52229 Other inorganic acids & oxygen compounds of non-metals
52241 Zinc oxide and zinc peroxide
52254 Potassium hydroxide; peroxides of sodium/potassium
52259 Hydrazine & hydroxylamine & their inorganic salts
52312 Chlorides and oxychlorides
52311 Fluorides; fluorosilicates, fluoroborates and salts
53351 Prepared pigments, preparations opacifiers & preparations colours
59221 Casein, caseinates and other casein derivatives
59223 Gelatin & gelat.derivatives; glues deriv.from bones
59894 Preparations and charges for fire extinguishers
59896 Pickling preparations for metal surfaces
59897 Composite solvents and thinners for varhishes etc.
62101 Plates, sheets and strip, n.e.s., of rubber
62102 Unvulcanized natural or synthetic rubber
62104 Plates, sheets, strip, rods & profile shapes, of rubb.
62105 Piping and tubing, of unhardened vulcanized rubber
63599 Other articles of wood, n.e.s.
64121 Printing & writing paper uncoated
64122 Printing & writing paper coated, impregnated etc.
64153 Parchment or greaseproof paper and paperboard
64197 Wallpaper & lincrusta; window transparencies paper
64242 Carbon and other copying papers & transfer papers
64281 Bobbins, spools & similar supports of paper pulp
65121 Wool tops
65122 Yarn containing 85% wgt of carded wool not for sale

65124 Yarn of fine animal hair not put up for retail sale
65135 Cotton yarn put up for retail sale
65149 Monofil, strip & imitation.catgut, synthetic fibre materials
65151 Yarn of >85% continuous synthetic fibres
65196 Flax or ramie yarn, not put up for retail sale
65198 Yarn of jute or of other textile bast fibres
65601 Narrow woven fabrics consist.of warp without weft
65732 Textile fabrics coated, with preparation of cellulose derivatives
65733 Rubberized textile fabrics
65739 Textile fabrics otherwise impregnated or coated
65751 Twine, cordage, ropes and cables, plaited or not
65771 Wadding and articles of wadding, n.e.s.
65899 Made-up text.articles, not knitted or crocheted nes
65912 Linoleum and materials prepared on a textile base
66132 Building & monument.stone, worked, nes mosaic cubes
66133 Slate, worked, and articles of slate
66339 Articles of stone/of other mineral substances, nes
66381 Fabricated asbestos and articles thereof
66382 Friction material for brakes, for clutches etc.
66391 Laboratory, chemical or industrial wares, ceramic
66392 Other articles of ceramic materials, n.e.s.
66414 Glass in the mass; waste glass
66415 Glass in balls, rods and tubes, unworked
66492 Glass envelopes for electric lamps, electronic valv
66494 Glass fibre and articles made therefrom, n.e.s.
66511 Carboys, bottles, jars, pots, tubular containers
66582 Glass beads, imitation pearls, imit.precious stones
66589 Other articles of glass, n.e.s.
68221 Bars, rods, angles, shapes & sectns.wrought, of copper
68222 Plates, sheets and strip, wrought, of copper
68223 Copper foil, of a thickness not exceeding 0, 15mm

68224 Copper powders and flakes
68225 Tubes, pipes, blanks therefor; hollow bars of copper
68226 Tube and pipe fittings, of copper
68321 Bars, rods, angles, shapes & sectns.wrought, of nickel
68322 Plates, sheets & strip, wrought, of nickel; nick.foil
68421 Bars, rods, angles, shapes & sectns.wrgt.of aluminium
68422 Plates, sheets and strip, wrought, of aluminium
68423 Aluminium foil, of a thickness not exceeding 0, 20mm
68425 Tubes, pipes, blanks therefor; hollow bars of alumin.
69211 Containers of iron or steel
69241 Casks, drums, boxes of sheet or plate for pack.gds.
69242 Casks, drums, boxes of aluminium for packing goods
69243 Containers of iron/steel for compressed gas
69311 Stranded wire etc.of iron or steel
69312 Stranded wire etc.of copper
69313 Stranded wire etc.of aluminium
69351 Gauze, cloth, grill of iron or steel
69401 Nails, tacks, staples, spiked cramps, studs, of copper
69402 Bolts & nuts screws & rivets of iron or steel
69539 Hand tools n.e.s.blow lamps, anvils, port.forges
69603 Razors and razor blades
69608 Knives with cutting blades serrated or not
69741 Art.commonly used for dom.purp.of iron or steel
69751 Sanitary ware for indoor use of iron or steel
69782 Statuettes & other ornaments used indoors
69911 Locks and padlocks and parts thereof of base metal
69912 Safes, strong boxes, strong room doors and the like
69913 Base metal fittings & mountings for furniture
69933 Clasps, frames with clasps for handbags & the like
69941 Springs & leaves for springs of iron or steel
69961 Flexible tubing and piping of base metal

69963 Stoppers, crown corks, bottle caps etc of base met.

69965 Wire, rods, tubes, plates & similar prod.for solder.

69971 Anchors & grapnels, parts thereof, of iron or steel

72812 Mach.tools for working wood, cork, bone, plastics etc

73732 Electric welding, brazing, cutting mach.and parts

74132 Ind.& lab.furnaces & ovens, non electric, and parts

74521 Calendering & sim.rolling mach, and cylinders, parts

74524 Automatic vending machines and parts

77511 Clothes washing machines, not exceeding 6 kgs

77811 Primary cells and primary batteries and parts

77831 Electr.starting & ignition equipment

77832 Electr.lighting & signaling equip., defrosters etc.

77881 Electro-magnets, permanent magnets, clamps, vices etc

77883 Elect.sound & visual signalling apparatus

77884 Elect.capacitors, condensers, fixed or variable

77889 Elect.parts of machinery and apparatus n.e.s.

78539 Parts of accessories of 785--

78613 Containers, spec.designed for carriage

84722 Stockings, ankle-socks and the like

84822 Art.of apparel of unhardened vulcanized rubber

85101 Footwear with outer soles & uppers, rubber/plastic

85102 Footwear with outer soles of leather

87452 Instruments, app.or models for demomstr. purposes

88221 Photographic plates, sensitized, unexposed

88222 Film in rolls, sensitized, unexposed

88223 Paper, paperboard & cloth, unexposed, sensitized

89211 Printed books, booklets, brochures, leaflets

89241 Transfers (decalcomanias)

89242 Picture postcards, christmas cards, etc.

89281 Paper and paperboard labels

89423 Toys, n.e.s.; working models for recreational purp.

89424 Equipment for parlour, table-tennis, etc. games

89472 Appl.appa.acces.for gymnastics or for sports

89511 Filing cabinets, racks, sim.office equipment

89512 Fittings for loose-leaf binders, clips, staples etc.

89521 Fountain pens, stylograph pens and pencils

89591 Writing and other inks

CHAPTER 6

Appendix 2.

List of importing countries selected by geographical region.

Europe.

Austria

Belgium-Luxembourg

Denmark

Germany

Spain

France

Greece

Ireland

Italy

Netherlands

Norway

Portugal

Switzerland

Finland

Sweden

Australasia

Australia

New Zealand

North America

Canada

United States of America

Asian.

Hong Kong

Japan

Singapore

CHAPTER 6

Appendix 3

Products subdivided by group.

Food Group.

SITC CODE	Description
04812	Prepared foods obtain. by the swelling or roasting
04841	Bread, ships, biscuits & other ordinary bakers wares
04842	Pastry, biscuits, cakes and other fine bakers wares
05484	Hop cones and lupulin
05651	Vegetables & fruit, prepared/preserved by vinegar
05861	Fruit, preserved by freezing, no sugar added
07231	Cocoa paste whether or not defatted
07232	Cocoa butter (fat or oil)
08199	Sweetened forage; other preptions for animal feeding
09803	Mustard flour and prepared mustard
09804	Sauces; mixed condiments and mixed seasonings
09805	Soups and broths, in liquid, solid or powder form
09809	Food preparations, n.e.s.

Chemicals Group.

SITC	Description
51482	Carboxyimide-function compounds etc.
51485	Diazo-, azo-, and azoxy-compounds
51489	Compounds with other nitrogen functions

51611 Ethers, ether-alcohols, ether-phenols etc.

51621 Aldehydes, aldehyde-alcohols, aldehyde-phenols, etc

51699 Other organic compounds

52211 Oxygen, nitrogen, hydrogen and rare gases

52213 Chlorine

52229 Other inorganic acids & oxygen compounds of non-metals

52241 Zinc oxide and zinc peroxide

52254 Potassium hydroxide; peroxides of sodium/potassium

52259 Hydrazine & hydroxylamine & their inorganic salts

52312 Chlorides and oxychlorides

52311 Fluorides; fluorosilicates, fluoroborates and salts

53351 Prepared pigments, preparations opacifiers & preparations colours

59221 Casein, caseinates and other casein derivatives

59223 Gelatin & gelat.derivatives; glues deriv.from bones

59894 Preparations and charges for fire extinguishers

59896 Pickling preparations for metal surfaces

59897 Composite solvents and thinners for varhishes etc.

Stone and Glassware Group

<u>SITC</u> **<u>Description</u>**

<u>CODE</u>

66132 Building & monument.stone, worked, nes mosaic cubes

66133 Slate, worked, and articles of slate

66339 Articles of stone/of other mineral substances, nes

66381 Fabricated asbestos and articles thereof

66382 Friction material for brakes, for clutches etc.

66391 Laboratory, chemical or industrial wares, ceramic

66392 Other articles of ceramic materials, n.e.s.

66414 Glass in the mass; waste glass

66415 Glass in balls, rods and tubes, unworked

66492 Glass envelopes for electric lamps, electronic valv
66494 Glass fibre and articles made therefrom, n.e.s.
66511 Carboys, bottles, jars, pots, tubular containers
66582 Glass beads, imitation pearls, imit.precious stones
66589 Other articles of glass, n.e.s.

Copper, Nickel and Aluminium Products Group.

SITC CODE	Description
68221	Bars, rods, angles, shapes & sectns.wrought, of copper
68222	Plates, sheets and strip, wrought, of copper
68223	Copper foil, of a thickness not exceeding 0, 15mm
68224	Copper powders and flakes
68225	Tubes, pipes, blanks therefor; hollow bars of copper
68226	Tube and pipe fittings, of copper
68321	Bars, rods, angles, shapes & sectns.wrought, of nickel
68322	Plates, sheets & strip, wrought, of nickel; nick.foil
68421	Bars, rods, angles, shapes & sectns.wrgt.of aluminium
68422	Plates, sheets and strip, wrought, of aluminium
68423	Aluminium foil, of a thickness not exceeding 0, 20mm
68425	Tubes, pipes, blanks therefor; hollow bars of alumin.

Miscellaneous Building Products Group.

SITC CODE	Description
69211	Containers of iron or steel
69241	Casks, drums, boxes of sheet or plate for pack.gds.

69242 Casks, drums, boxes of aluminium for packing goods
69243 Containers of iron/steel for compressed gas
69311 Stranded wire etc.of iron or steel
69312 Stranded wire etc.of copper
69313 Stranded wire etc.of aluminium
69351 Gauze, cloth, grill of iron or steel
69401 Nails, tacks, staples, spiked cramps, studs, of copper
69402 Bolts & nuts screws & rivets of iron or steel
69539 Hand tools n.e.s.blow lamps, anvils, port.forges
69603 Razors and razor blades
69608 Knives with cutting blades serrated or not
69741 Art.commonly used for dom.purp.of iron or steel
69751 Sanitary ware for indoor use of iron or steel
69782 Statuettes & other ornaments used indoors
69911 Locks and padlocks and parts thereof of base metal
69912 Safes, strong boxes, strong room doors and the like
69913 Base metal fittings & mountings for furniture
69933 Clasps, frames with clasps for handbags & the like
69941 Springs & leaves for springs of iron or steel
69961 Flexible tubing and piping of base metal
69963 Stoppers, crown corks, bottle caps etc of base met.
69965 Wire, rods, tubes, plates & similar prod.for solder.
69971 Anchors & grapnels, parts thereof, of iron or steel

CHAPTER 6

Appendix 4.

Panel Data Regression Analysis 1.

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_t + u_{it}, \qquad (6.2)$$

number of observations 4950

Sample Population Results.

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.557	.0654	-8.514	0.000	0.0144	62.74	0.0000	0.00	1.0000
Austria	.0974	.2239	0.435	0.663	0.0000	150.8	0.0000	1.91	0.1669
Belgium Luxembourg	-.082	.1465	-0.565	0.572	0.0000	265.9	0.0000	0.69	0.4051
Canada	-.453	.1523	-2.974	0.003	0.0034	123.6	0.0000	0.57	0.4514
Switzerland	.3287	.1809	1.817	0.069	0.0011	284.8	0.0000	2.32	0.1275
Germany	.2757	.1948	1.415	0.157	0.0015	440.3	0.0000	0.18	0.6688
Denmark	.0845	.2123	0.398	0.690	0.0003	289.6	0.0000	1.32	0.2510
Spain	.1983	.2369	0.837	0.402	0.0002	279.2	0.0000	0.70	0.4027
Finland	.2482	.2312	1.073	0.283	0.0004	272.0	0.0000	0.33	0.5629
France	-.032	.1965	-0.163	0.871	0.0002	432.8	0.0000	2.07	0.1502
Greece	-.037	.1892	-0.198	0.843	0.0000	74.68	0.0000	0.08	0.7766
Hong Kong	-.685	.1901	-3.603	0.000	0.0068	299.7	0.0000	0.04	0.8327
Ireland	-.345	.0692	-4.992	0.000	0.0163	639.3	0.0000	0.02	0.8947
Italy	-.272	.2427	-1.122	0.262	0.0008	270.2	0.0000	0.17	0.6779
Japan	-.692	.1715	-4.034	0.000	0.0067	147.8	0.0000	0.25	0.6187
Holland	-.299	.2462	-1.214	0.225	0.0001	219.9	0.0000	8.28	0.0040
Norway	-.556	.3358	-1.658	0.097	0.0008	399.8	0.0000	3.24	0.0719
New Zealand	-.280	.0918	-3.050	0.002	0.0036	80.18	0.0000	0.10	0.7568
Portugal	-.150	.1763	-0.853	0.394	0.0005	176.8	0.0000	0.57	0.4493
Singapore	-.960	.1914	-5.019	0.000	0.0100	128.0	0.0000	1.04	0.3069
Sweden	-.037	.2142	0.173	0.863	0.0000	354.5	0.0000	1.01	0.3157
U.S.A.	-.498	.0888	-5.608	0.000	0.0157	588.8	0.0000	4.15	0.0417

Food Results.

number of observations 429

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.594	.1765	-3.370	0.001	0.0259	5.93	0.0149	0.00	1.0000
Austria	.2403	.3513	0.684	0.494	0.0011	6.08	0.0137	0.00	1.0000
Belgium Luxembourg	-.453	.1975	-2.296	0.022	0.0122	6.12	0.0134	0.00	1.0000
Canada	-.948	.2539	-3.734	0.000	0.0316	5.90	0.0151	0.00	1.0000
Switzerland	.5918	.3348	1.768	0.077	0.0073	6.22	0.0127	0.00	1.0000
Germany	.1687	.2784	0.606	0.544	0.0009	5.94	0.0148	0.00	1.0000
Denmark	-.230	.2998	-0.768	0.442	0.0014	5.74	0.0166	0.00	1.0000
Spain	.212	.4216	0.503	0.615	0.0006	6.19	0.0128	0.00	1.0000
Finland	-.153	.3483	-0.441	0.659	0.0005	5.94	0.0148	0.00	1.0000
France	.2365	.3547	0.667	0.505	0.0010	6.45	0.0111	0.00	1.0000
Greece	-.340	.2308	-1.476	0.140	0.0051	5.69	0.0170	0.00	1.0000
Hong Kong	-.383	.2482	-1.545	0.122	0.0056	5.86	0.0155	0.00	1.0000
Ireland	-.336	.0662	-5.077	0.000	0.0569	4.70	0.0301	0.00	1.0000
Italy	-.105	.4171	-0.254	0.799	0.0002	5.60	0.0180	0.00	1.0000
Japan	-.416	.2445	-1.704	0.088	0.0068	6.25	0.0124	0.00	1.0000
Holland	-.878	.6424	-1.367	0.172	0.0044	6.42	0.0113	0.00	1.0000
Norway	-1.46	.5335	-2.747	0.006	0.0174	6.32	0.0119	0.00	1.0000
New Zealand	-.291	.1161	-2.506	0.012	0.0145	5.43	0.0198	0.00	1.0000
Portugal	.0186	.1991	0.093	0.926	0.0000	5.80	0.0160	0.00	1.0000
Singapore	-.521	.2449	-2.129	0.033	0.0105	5.24	0.0221	0.00	1.0000
Sweden	-.278	.3355	-0.830	0.406	0.0016	6.05	0.0139	0.00	1.0000
U.S.A.	-.295	.1413	-2.089	0.037	0.0101	5.82	0.0158	0.00	1.0000

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.326	.2345	-1.391	0.164	0.0029	9.33	0.0023	0.00	1.0000
Austria	.2681	.4618	0.581	0.561	0.0005	9.35	0.0022	0.00	1.0000
Belgium Luxembourg	-.551	.3465	-1.592	0.111	0.0038	9.11	0.0025	0.00	1.0000
Canada	-.304	.3515	-0.866	0.386	0.0011	9.41	0.0022	0.00	1.0000
Switzerland	-.193	.3576	-0.540	0.589	0.0004	8.89	0.0029	0.00	1.0000
Germany	1.079	.4354	2.478	0.013	0.0092	8.82	0.0030	0.00	1.0000
Denmark	-.731	.4838	-1.513	0.130	0.0035	9.15	0.0025	0.00	1.0000
Spain	.0550	.4558	0.121	0.904	0.0000	9.47	0.0021	0.00	1.0000
Finland	-.681	.5457	-1.249	0.212	0.0024	9.32	0.0023	0.00	1.0000
France	.0493	.3969	0.124	0.901	0.0000	8.81	0.0030	0.00	1.0000
Greece	-.244	.3685	-0.664	0.507	0.0007	9.08	0.0026	0.00	1.0000
Hong Kong	-.819	.3667	-2.236	0.025	0.0075	9.48	0.0021	0.00	1.0000
Ireland	-.304	.1394	-2.181	0.029	0.0072	8.58	0.0034	0.00	1.0000
Italy	-.889	.5728	-1.552	0.121	0.0036	9.14	0.0025	0.00	1.0000
Japan	-.319	.3603	-0.885	0.376	0.0012	9.35	0.0022	0.00	1.0000
Holland	-.664	.4446	-1.495	0.135	0.0034	9.19	0.0024	0.00	1.0000
Norway	.1101	.5786	0.190	0.849	0.0001	9.75	0.0018	0.00	1.0000
New Zealand	-.508	.1980	-2.567	0.010	0.0099	8.95	0.0028	0.00	1.0000
Portugal	-.723	.3402	-2.126	0.034	0.0068	8.81	0.0030	0.00	1.0000
Singapore	-1.15	.4037	-2.866	0.004	0.0123	9.42	0.0021	0.00	1.0000
Sweden	-.359	.4692	-0.766	0.444	0.0009	8.89	0.0029	0.00	1.0000
U.S.A.	-.310	.1956	-1.587	0.113	0.0038	9.51	0.0020	0.00	1.0000

Stone and Glassware Results.

number of observations 462

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0910	.3051	0.298	0.765	0.0002	6.66	0.0098	0.00	1.0000
Austria	-.752	.7852	-0.958	0.338	0.0020	6.77	0.0093	0.00	1.0000
Belgium Luxembourg	-.331	.5012	-0.662	0.508	0.0010	6.78	0.0092	0.00	1.0000
Canada	-.510	.4940	-1.034	0.301	0.0023	6.38	0.0116	0.00	1.0000
Switzerland	.1018	.5498	0.185	0.853	0.0001	6.52	0.0107	0.00	1.0000
Germany	-.029	.6448	-0.046	0.964	0.0000	5.95	0.0148	0.00	1.0000
Denmark	.5710	.6442	0.886	0.375	0.0017	6.69	0.0097	0.00	1.0000
Spain	-.396	.6624	-0.598	0.550	0.0008	6.41	0.0114	0.00	1.0000
Finland	-.299	.6879	-0.435	0.664	0.0004	6.84	0.0089	0.00	1.0000
France	-.975	.5721	-1.705	0.088	0.0063	6.61	0.0102	0.00	1.0000
Greece	-.284	.5982	-0.475	0.635	0.0005	6.94	0.0084	0.00	1.0000
Hong Kong	-1.66	.5983	-2.780	0.005	0.0165	6.80	0.0091	0.00	1.0000
Ireland	-.173	.1895	-0.918	0.359	0.0018	5.87	0.0154	0.00	1.0000
Italy	.2332	.7428	0.314	0.754	0.0002	6.81	0.0091	0.00	1.0000
Japan	-.957	.4391	-2.180	0.029	0.0102	6.64	0.0100	0.00	1.0000
Holland	-.757	.7395	-1.024	0.306	0.0023	6.29	0.0121	0.00	1.0000
Norway	.2011	.8407	0.239	0.811	0.0001	6.53	0.0106	0.00	1.0000
New Zealand	-.472	.2931	-1.612	0.107	0.0056	6.49	0.0109	0.00	1.0000
Portugal	-.394	.4925	-0.800	0.424	0.0014	6.95	0.0084	0.00	1.0000
Singapore	-.804	.5990	-1.343	0.179	0.0039	6.58	0.0103	0.00	1.0000
Sweden	-.490	.6399	-0.766	0.444	0.0013	6.65	0.0099	0.00	1.0000
U.S.A.	-.618	.2285	-2.706	0.007	0.0157	6.30	0.0120	0.00	1.0000

Copper, Nickel and Aluminium Products Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.592	.1635	-3.626	0.000	0.0323	5.60	0.0180	0.00	1.0000
Austria	-.249	.3762	-0.662	0.508	0.0011	5.79	0.0161	0.00	1.0000
Belgium Luxembourg	-.001	.2321	-0.003	0.998	0.0000	5.12	0.0237	0.00	1.0000
Canada	-.689	.4048	-1.702	0.089	0.0073	5.96	0.0147	0.00	1.0000
Switzerland	-.168	.2150	-0.785	0.432	0.0016	3.01	0.0825	0.00	1.0000
Germany	.0694	.1923	0.361	0.718	0.0003	4.85	0.0277	0.00	1.0000
Denmark	.1145	.3004	0.381	0.703	0.0004	5.50	0.0190	0.00	1.0000
Spain	-.155	.3602	-0.432	0.666	0.0005	5.58	0.0182	0.00	1.0000
Finland	.0627	.4384	0.143	0.886	0.0001	5.41	0.0201	0.00	1.0000
France	-.596	.2123	-2.811	0.005	0.0197	5.15	0.0233	0.00	1.0000
Greece	.1062	.5627	0.189	0.850	0.0001	5.82	0.0158	0.00	1.0000
Hong Kong	-.295	.3829	-0.773	0.440	0.0015	5.86	0.0155	0.00	1.0000
Ireland	-.389	.0714	-5.454	0.000	0.0702	4.11	0.0426	0.00	1.0000
Italy	-.052	.2982	-0.175	0.861	0.0001	5.01	0.0252	0.00	1.0000
Japan	-1.12	.4120	-2.719	0.007	0.0184	5.85	0.0156	0.00	1.0000
Holland	.1302	.4028	0.323	0.747	0.0003	5.74	0.0166	0.00	1.0000
Norway	-.829	.7532	-1.102	0.271	0.0031	5.91	0.0150	0.00	1.0000
New Zealand	-.538	.2339	-2.302	0.021	0.0133	5.88	0.0153	0.00	1.0000
Portugal	.0330	.3111	0.106	0.915	0.0000	5.80	0.0161	0.00	1.0000
Singapore	-1.27	.3427	-3.728	0.000	0.0341	5.98	0.0145	0.00	1.0000
Sweden	-.005	.1941	-0.031	0.975	0.0000	4.94	0.0263	0.00	1.0000
U.S.A.	-.349	.1091	-3.200	0.001	0.0253	5.45	0.0195	0.00	1.0000

Miscellaneous Building Products Results.

number of observations 825

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.561	.1444	-3.885	0.000	0.0180	11.27	0.0008	0.00	1.0000
Austria	-.214	.3689	-0.580	0.562	0.0004	11.84	0.0006	0.00	1.0000
Belgium Luxembourg	.1092	.1757	0.622	0.534	0.0005	10.46	0.0012	0.00	1.0000
Canada	-.618	.2270	-2.724	0.006	0.0089	10.86	0.0010	0.00	1.0000
Switzerland	.2272	.2777	0.818	0.413	0.0008	11.57	0.0007	0.00	1.0000
Germany	.1413	.1946	0.726	0.468	0.0006	8.54	0.0035	0.00	1.0000
Denmark	.4565	.3017	1.513	0.130	0.0028	11.20	0.0008	0.00	1.0000
Spain	.1258	.2991	0.421	0.674	0.0002	11.84	0.0006	0.00	1.0000
Finland	.2660	.3101	0.858	0.391	0.0009	10.38	0.0013	0.00	1.0000
France	.2549	.2288	1.114	0.265	0.0015	10.67	0.0011	0.00	1.0000
Greece	-.078	.3285	-0.238	0.812	0.0001	11.71	0.0006	0.00	1.0000
Hong Kong	-.508	.2263	-2.247	0.025	0.0061	10.68	0.0011	0.00	1.0000
Ireland	-.371	.0670	-5.539	0.000	0.0359	8.63	0.0033	0.00	1.0000
Italy	-.544	.3299	-1.649	0.099	0.0033	11.13	0.0009	0.00	1.0000
Japan	-.614	.3408	-1.801	0.072	0.0039	11.68	0.0006	0.00	1.0000
Holland	-.308	.3559	-0.866	0.386	0.0009	11.49	0.0007	0.00	1.0000
Norway	-1.54	.5103	-3.027	0.002	0.0110	12.24	0.0005	0.00	1.0000
New Zealand	-.155	.1472	-1.057	0.290	0.0014	11.32	0.0008	0.00	1.0000
Portugal	-.283	.2744	-1.035	0.301	0.0013	11.21	0.0008	0.00	1.0000
Singapore	-.955	.3020	-3.162	0.002	0.0120	11.72	0.0006	0.00	1.0000
Sweden	.5909	.2558	2.309	0.021	0.0064	10.32	0.0013	0.00	1.0000
U.S.A.	-.253	.0992	-2.558	0.011	0.0079	11.07	0.0009	0.00	1.0000

CHAPTER 6

Appendix 5.

Panel Data Regression Analysis 2.

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \varpi_i \Delta v_{it}^{\cos t} + u_{it}, \qquad \textbf{(6.3)}$$

Sample Population Results.

number of observations 4950

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.707	.1085	-6.521	0.000	0.0187	288.5	0.0000	20.45	0.0000
Austria	-.029	.2245	-0.132	0.895	0.0034	126.2	0.0000	4.61	0.0998
Belgium Luxembourg	-.108	.1456	-0.746	0.456	0.0028	242.5	0.0000	0.55	0.7599
Canada	-.574	.1471	-3.903	0.000	0.0116	78.74	0.0000	0.67	0.7162
Switzerland	.3022	.1826	1.654	0.098	0.0016	281.0	0.0000	2.52	0.2840
Germany	.1664	.1958	0.850	0.395	0.0062	389.8	0.0000	0.18	0.9152
Denmark	.0896	.2097	0.428	0.669	0.0034	262.5	0.0000	1.44	0.4858
Spain	.2849	.2340	1.217	0.223	0.0049	238.3	0.0000	1.15	0.5632
Finland	.0069	.2285	0.030	0.976	0.0095	196.6	0.0000	1.26	0.5313
France	.0243	.1959	0.124	0.901	0.0036	397.2	0.0000	2.14	0.3427
Greece	.2103	.2164	0.971	0.331	0.0021	64.76	0.0000	0.50	0.7788
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.247	.1569	-1.573	0.116	0.0163	639.3	0.0000	27.11	0.0000
Italy	-.165	.2564	-0.645	0.519	0.0015	264.7	0.0000	0.26	0.8767
Japan	-.695	.1681	-4.138	0.000	0.0105	123.7	0.0000	0.22	0.8937
Holland	-.316	.2485	-1.273	0.203	0.0003	217.0	0.0000	10.01	0.0067
Norway	-.563	.3372	-1.671	0.095	0.0007	399.6	0.0000	5.81	0.0546
New Zealand	-.292	.0918	-3.186	0.001	0.0044	74.84	0.0000	3.53	0.1714
Portugal	.0424	.2170	0.196	0.845	0.0013	172.4	0.0000	1.18	0.5532
Singapore	-1.03	.1868	-5.538	0.000	0.0150	97.51	0.0000	2.26	0.3235
Sweden	-.017	.2111	-0.083	0.934	0.0037	316.7	0.0000	2.06	0.3567
U.S.A.	-.493	.0882	-5.595	0.000	0.0177	553.0	0.0000	15.57	0.0004

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \varpi_i \Delta v_{it}^{\cos t} + u_{it}, \qquad (6.3)$$

Sample Coefficient Results.

number of observations 4950

Country	β	S. E. on β	Significance			ω	S. E. on ω	Significance	
Australia	-.707	.1085	**			1.154	.38898	**	
Austria	-.029	.2245				2.316	.92289	**	
Belgium Luxembourg	-.108	.1456				1.339	.59846	**	
Canada	-.574	.1471	**			1.863	.41602	**	
Switzerland	.3022	.1826	*			.7690	.70704		
Germany	.1664	.1958				2.299	.84729	**	
Denmark	.0896	.2097				1.183	.48632	**	
Spain	.2849	.2340				.8873	.31352	**	
Finland	.0069	.2285				1.483	.36406	**	
France	.0243	.1959				.9994	.41569	**	
Greece	.2103	.2164				.5267	.23297	**	
Hong Kong	n.a.	n.a.							
Ireland	-.247	.1569				.6064	.2786	**	
Italy	-.165	.2564				.2728	.21165		
Japan	-.695	.1681	**			1.416	.48533	**	
Holland	-.316	.2485				.2905	.54897		
Norway	-.563	.3372	*			-.1533	.50861		
New Zealand	-.292	.0918	**			.3911	.30015		
Portugal	.0424	.2170				.3867	.25385		
Singapore	-1.03	.1868	**			.9660	.29140	**	
Sweden	-.017	.2111				1.094	.46620	**	
U.S.A.	-.493	.0882	**			.7802	.63567		

Food Results.

number of observations 429

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.636	.1768	-3.601	0.000	0.0366	5.92	0.0150	0.00	1.0000
Austria	.1898	.3610	0.526	0.599	0.0020	6.08	0.0137	0.00	1.0000
Belgium Luxembourg	-.467	.1988	-2.348	0.019	0.0131	6.12	0.0134	0.00	1.0000
Canada	-1.03	.2581	-4.005	0.000	0.0384	5.90	0.0152	0.00	1.0000
Switzerland	.6039	.3379	1.787	0.074	0.0075	6.22	0.0127	0.00	1.0000
Germany	.1996	.2858	0.699	0.485	0.0014	5.94	0.0148	0.00	1.0000
Denmark	-.230	.3000	-0.767	0.443	0.0026	5.74	0.0166	0.00	1.0000
Spain	.3366	.4249	0.792	0.428	0.0096	6.19	0.0129	0.00	1.0000
Finland	-.308	.3606	-0.856	0.392	0.0066	5.94	0.0148	0.00	1.0000
France	.3027	.3573	0.847	0.397	0.0058	6.44	0.0111	0.00	1.0000
Greece	-.232	.2705	-0.859	0.390	0.0065	5.69	0.0170	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.384	.0716	-5.367	0.000	0.0636	4.69	0.0303	0.00	1.0000
Italy	.1814	.4424	0.410	0.682	0.0086	5.59	0.0180	0.00	1.0000
Japan	-.417	.2448	-1.704	0.088	0.0069	6.25	0.0124	0.00	1.0000
Holland	-.833	.6482	-1.285	0.199	0.0050	6.42	0.0113	0.00	1.0000
Norway	-1.51	.5319	-2.843	0.004	0.0272	6.32	0.0119	0.00	1.0000
New Zealand	-.290	.1169	-2.480	0.013	0.0145	5.43	0.0198	0.00	1.0000
Portugal	.3793	.2472	1.534	0.125	0.0138	5.79	0.0161	0.00	1.0000
Singapore	-.603	.2462	-2.450	0.014	0.0227	5.22	0.0223	0.00	1.0000
Sweden	-.272	.3357	-0.813	0.416	0.0034	6.05	0.0139	0.00	1.0000
U.S.A.	-.294	.1411	-2.090	0.037	0.0158	5.82	0.0159	0.00	1.0000

Food Results.

Sample Coefficient Results

number of observations 429

Country	β	S. E. on β	Signifi cance			ϖ	S. E. on ϖ	Signifi cance	
Australia	-.636	.1768	**			1.328	.61104	**	
Austria	-.189	.3610				.8920	1.4537		
Belgium Luxembourg	-.467	.1988	*			.4767	.77508		
Canada	-1.03	.2581	**			1.234	.71351		
Switzerland	.6039	.3379	*			-.3651	1.2875		
Germany	.1996	.2858				-.5852	1.2006		
Denmark	-.230	.3000				.4770	.67304		
Spain	.3366	.4249				1.106	.56158	**	
Finland	-.308	.3606				.9038	.55767	*	
France	.3027	.3573				1.021	.71639		
Greece	-.232	.2705				.2229	.28978		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	-.384	.0716	**			.4049	.23242		
Italy	.1814	.4424				.6854	.35999	*	
Japan	-.417	.2448	*			.1494	.67882		
Holland	-.833	.6482				.7609	1.4027		
Norway	-1.51	.5319	**			1.664	.80042		
New Zealand	-.290	.1169	**			-.0292	.37812		
Portugal	.3793	.2472				.7024	.28824	**	
Singapore	-.603	.2462	**			.8975	.38893	**	
Sweden	-.272	.3357				.6238	.72174		
U.S.A.	-.294	.1411	**			1.521	.97282		

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.349	.2360	-1.479	0.139	0.0041	9.33	0.0023	0.00	1.0000
Austria	.239	.4745	0.504	0.614	0.0006	9.35	0.0022	0.00	1.0000
Belgium Luxembourg	-.534	.3489	-1.532	0.126	0.0041	9.11	0.0025	0.00	1.0000
Canada	-.357	.3582	-0.998	0.318	0.0020	9.41	0.0022	0.00	1.0000
Switzerland	-.217	.3607	-0.604	0.546	0.0009	8.89	0.0029	0.00	1.0000
Germany	1.052	.4469	2.356	0.018	0.0094	8.82	0.0030	0.00	1.0000
Denmark	-.732	.4840	-1.512	0.130	0.0038	9.15	0.0025	0.00	1.0000
Spain	.1180	.4610	0.256	0.798	0.0013	9.47	0.0021	0.00	1.0000
Finland	-.876	.5656	-1.550	0.121	0.0049	9.32	0.0023	0.00	1.0000
France	.0536	.4006	0.134	0.893	0.0000	8.81	0.0030	0.00	1.0000
Greece	.0060	.4316	0.014	0.989	0.0026	9.08	0.0026	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.335	.1512	-2.218	0.027	0.0076	8.57	0.0034	0.00	1.0000
Italy	-.773	.6097	-1.268	0.205	0.0041	9.14	0.0025	0.00	1.0000
Japan	-.319	.3606	-0.887	0.375	0.0012	9.35	0.0022	0.00	1.0000
Holland	-.614	.4483	-1.370	0.171	0.0046	9.19	0.0024	0.00	1.0000
Norway	.1048	.5796	0.181	0.856	0.0001	9.75	0.0018	0.00	1.0000
New Zealand	-.503	.1993	-2.525	0.012	0.0100	8.95	0.0028	0.00	1.0000
Portugal	-.840	.4250	-1.976	0.048	0.0071	8.81	0.0030	0.00	1.0000
Singapore	-1.21	.4079	-2.978	0.003	0.0138	9.42	0.0021	0.00	1.0000
Sweden	-.357	.4696	-0.760	0.447	0.0010	8.89	0.0029	0.00	1.0000
U.S.A.	-.310	.1957	-1.585	0.113	0.0043	9.51	0.0020	0.00	1.0000

Chemicals Results.

Sample Coefficient Results

number of observations 660

Country	β	S. E. on β	Significance			ϖ	S. E. on ϖ	Significance	
Australia	-.349	.2360				.7201	.81549		
Austria	-.239	.4745				.5150	1.9107		
Belgium Luxembourg	-.534	.3489				.6126	1.3599		
Canada	-.357	.3582				.7646	.99037		
Switzerland	-.217	.3607				.7423	1.3745		
Germany	-1.05	.4469	**			.4964	1.8773		
Denmark	-.732	.4840				-.5358	1.0859		
Spain	-.118	.4610				.5589	.60921		
Finland	-.876	.5656				1.138	.87483		
France	.0536	.4006				.0665	.80330		
Greece	.0060	.4316				.5158	.46240		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	-.335	.1512	**			.2627	.49090		
Italy	-.773	.6097				.2764	.49613		
Japan	-.319	.3606				.1784	.99974		
Holland	-.614	.4483				.8605	.97019		
Norway	.1048	.5796				-.1864	.87221		
New Zealand	-.503	.1993	**			-.1468	.64452		
Portugal	-.840	.4250	**			.2274	.49558		
Singapore	-1.21	.4079	**			.6360	.64428		
Sweden	-.357	.4696				.2638	1.0097		
U.S.A.	-.310	.1957				.7877	1.3497		

Stone and Glassware Results.

number of observations 462

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0534	.3068	0.174	0.862	0.0029	6.66	0.0098	0.00	1.0000
Austria	-.887	.8068	-1.100	0.271	0.0032	6.77	0.0093	0.00	1.0000
Belgium Luxembourg	-.352	.5047	-0.698	0.485	0.0012	6.78	0.0092	0.00	1.0000
Canada	-.603	.5033	-1.200	0.230	0.0043	6.38	0.0116	0.00	1.0000
Switzerland	.1252	.5548	0.226	0.821	0.0003	6.52	0.0107	0.00	1.0000
Germany	-.051	.6620	-0.077	0.938	0.0001	5.95	0.0148	0.00	1.0000
Denmark	.5717	.6436	0.888	0.374	0.0058	6.69	0.0097	0.00	1.0000
Spain	-.328	.6702	-0.490	0.624	0.0018	6.41	0.0114	0.00	1.0000
Finland	-.672	.7112	-0.946	0.344	0.0089	6.84	0.0089	0.00	1.0000
France	-.953	.5776	-1.651	0.099	0.0065	6.61	0.0102	0.00	1.0000
Greece	-.001	.7011	-0.002	0.999	0.0018	6.94	0.0084	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.219	.2056	-1.066	0.287	0.0025	5.86	0.0154	0.00	1.0000
Italy	.704	.7884	0.893	0.372	0.0069	6.81	0.0091	0.00	1.0000
Japan	-.963	.4389	-2.195	0.028	0.0132	6.63	0.0100	0.00	1.0000
Holland	-.641	.7452	-0.861	0.389	0.0055	6.29	0.0122	0.00	1.0000
Norway	.1759	.8420	0.209	0.835	0.0012	6.53	0.0106	0.00	1.0000
New Zealand	-.496	.2950	-1.682	0.093	0.0068	6.49	0.0109	0.00	1.0000
Portugal	-.050	.6149	-0.082	0.935	0.0033	6.95	0.0084	0.00	1.0000
Singapore	-.895	.6053	-1.480	0.139	0.0063	6.58	0.0103	0.00	1.0000
Sweden	-.478	.6408	-0.748	0.455	0.0030	6.65	0.0099	0.00	1.0000
U.S.A.	-.617	.2276	-2.711	0.007	0.0249	6.30	0.0121	0.00	1.0000

Stone and Glassware Results.

Sample Coefficient Results

number of observations 462

Country	β	S. E. on β	Significance			ϖ	S. E. on ϖ	Significance	
Australia	.0534	.3068				1.192	1.0604		
Austria	-.887	.8068				2.397	3.2483		
Belgium Luxembourg	-.352	.5047				.7259	1.9670		
Canada	-.603	.5033				1.343	1.3914		
Switzerland	.1252	.5548				-.7066	2.1140		
Germany	-.051	.6620				.4125	2.7809		
Denmark	.5717	.6436				1.995	1.4438		
Spain	-.328	.6702				.6003	.88573		
Finland	-.672	.7112				2.176	1.0999	**	
France	-.953	.5776	*			.3432	1.1580		
Greece	-.001	.7011				.5826	.75106		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	-.219	.2056				.3798	.66754		
Italy	.704	.7884				1.123	.64162	*	
Japan	-.963	.4389	**			1.438	1.2168		
Holland	-.641	.7452				1.962	1.6127		
Norway	.1759	.8420				.8915	1.2670		
New Zealand	-.496	.2950	*			.7044	.95394		
Portugal	-.050	.6149				.6697	.71700		
Singapore	-.895	.6053				.9983	.95592		
Sweden	-.478	.6408				1.241	1.3762		
U.S.A.	-.617	.2276	**			3.273	1.5696	**	

Copper, Nickel and Aluminium Products Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.605	.1646	-3.677	0.000	0.0335	5.60	0.0180	0.00	1.0000
Austria	-.243	.3869	-0.630	0.529	0.0011	5.79	0.0161	0.00	1.0000
Belgium Luxembourg	.016	.2336	0.069	0.945	0.0011	5.11	0.0237	0.00	1.0000
Canada	-.739	.4128	-1.792	0.073	0.0083	5.96	0.0147	0.00	1.0000
Switzerland	-.140	.2168	-0.647	0.517	0.0043	3.01	0.0829	0.00	1.0000
Germany	-.133	.1920	-0.694	0.488	0.0547	4.77	0.0289	0.00	1.0000
Denmark	.1147	.3005	0.382	0.703	0.0020	5.50	0.0190	0.00	1.0000
Spain	-.103	.3643	-0.284	0.776	0.0028	5.57	0.0182	0.00	1.0000
Finland	.0729	.4553	0.160	0.873	0.0001	5.41	0.0201	0.00	1.0000
France	-.578	.2142	-2.698	0.007	0.0208	5.15	0.0233	0.00	1.0000
Greece	.4973	.6588	0.755	0.450	0.0034	5.82	0.0159	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.395	.0775	-5.102	0.000	0.0703	4.11	0.0426	0.00	1.0000
Italy	-.745	.3007	-2.479	0.013	0.1041	4.88	0.0271	0.00	1.0000
Japan	-1.11	.4126	-2.713	0.007	0.0186	5.85	0.0156	0.00	1.0000
Holland	.0199	.4043	0.049	0.961	0.0117	5.73	0.0167	0.00	1.0000
Norway	-.827	.7549	-1.097	0.273	0.0031	5.91	0.0150	0.00	1.0000
New Zealand	-.565	.2353	-2.404	0.016	0.0160	5.88	0.0153	0.00	1.0000
Portugal	-.088	.3888	-0.228	0.819	0.0007	5.80	0.0161	0.00	1.0000
Singapore	-1.29	.3467	-3.728	0.000	0.0343	5.98	0.0145	0.00	1.0000
Sweden	.0028	.1932	0.015	0.988	0.0128	4.92	0.0265	0.00	1.0000
U.S.A.	-.348	.1085	-3.211	0.001	0.0372	5.44	0.0196	0.00	1.0000

Copper, Nickel and Aluminium Products Results.
Sample Coefficient Results

number of observations 396

Country	β	S. E. on β	Significance			ϖ	S. E. on ϖ	Significance	
Australia	-.605	.1646	**			.3905	.56877		
Austria	-.243	.3869				-.0994	1.5578		
Belgium Luxembourg	.016	.2336				.5938	.91069		
Canada	-.739	.4128	*			.7301	1.1412		
Switzerland	-.140	.2168				.8604	.82612		
Germany	-.133	.1920				3.837	.80690	**	
Denmark	.1147	.3005				.5334	.67424		
Spain	-.103	.3643				.4619	.48151		
Finland	.0729	.4553				-.0596	.70421		
France	-.578	.2142	**			.2888	.42958		
Greece	.4973	.6588				.8045	.70583		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	-.395	.0775	**			.0513	.25172		
Italy	-.745	.3007	**			1.652	.24469	**	
Japan	-1.11	.4126	**			-.2737	1.1437		
Holland	.0199	.4043				1.868	.87499		
Norway	-.827	.7549				.0748	1.1359		
New Zealand	-.565	.2353	**			.8013	.76084		
Portugal	-.088	.3888				.2373	.45339		
Singapore	-1.29	.3467	**			.1633	.54755		
Sweden	.0028	.1932				.9372	.4153	**	
U.S.A.	-.348	.1085	**			1.646	.74868	**	

Miscellaneous Building Products Results.

number of observations 825

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.603	.1447	-4.165	0.000	0.0263	11.26	0.0008	0.00	1.0000
Austria	-.367	.3784	-0.970	0.332	0.0042	11.83	0.0006	0.00	1.0000
Belgium Luxembourg	.0652	.1763	0.370	0.711	0.0068	10.45	0.0012	0.00	1.0000
Canada	-.720	.2307	-3.122	0.002	0.0153	10.84	0.0010	0.00	1.0000
Switzerland	.1981	.2800	0.708	0.479	0.0016	11.57	0.0007	0.00	1.0000
Germany	-.015	.1982	-0.079	0.937	0.0159	8.47	0.0036	0.00	1.0000
Denmark	.4570	.3011	1.517	0.129	0.0079	11.20	0.0008	0.00	1.0000
Spain	.1970	.3021	0.652	0.514	0.0033	11.84	0.0006	0.00	1.0000
Finland	.1021	.3211	0.318	0.750	0.0054	10.37	0.0013	0.00	1.0000
France	.3487	.2295	1.519	0.129	0.0134	10.65	0.0011	0.00	1.0000
Greece	-.249	.3849	-0.649	0.516	0.0010	11.71	0.0006	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.436	.0725	-6.011	0.000	0.0421	8.60	0.0034	0.00	1.0000
Italy	-.447	.3510	-1.276	0.202	0.0041	11.13	0.0009	0.00	1.0000
Japan	-.615	.3410	-1.805	0.071	0.0041	11.68	0.0006	0.00	1.0000
Holland	-.369	.3587	-1.030	0.303	0.0031	11.49	0.0007	0.00	1.0000
Norway	-1.56	.5106	-3.072	0.002	0.0125	12.24	0.0005	0.00	1.0000
New Zealand	-.175	.1480	-1.188	0.235	0.0032	11.32	0.0008	0.00	1.0000
Portugal	-.371	.3427	-1.085	0.278	0.0015	11.21	0.0008	0.00	1.0000
Singapore	-1.02	.3049	-3.365	0.001	0.0151	11.72	0.0006	0.00	1.0000
Sweden	.6043	.2550	2.370	0.018	0.0146	10.30	0.0013	0.00	1.0000
U.S.A.	-.253	.0981	-2.577	0.010	0.0308	11.03	0.0009	0.00	1.0000

Miscellaneous Building Products Results.

Sample Coefficient Results

number of observations 825

Country	β	S. E. on β	Significance			ϖ	S. E. on ϖ	Significance	
Australia	-.603	.1447	**			1.327	.50028	**	
Austria	-.367	.3784				2.708	1.5237	*	
Belgium Luxembourg	.0652	.1763				1.571	.68708	**	
Canada	-.720	.2307	**			1.467	.63777	**	
Switzerland	.1981	.2800				.8793	1.0670		
Germany	-.015	.1982				2.973	.83267	**	
Denmark	.4570	.3011				1.398	.67565	**	
Spain	.1970	.3021				.6322	.39932		
Finland	.1021	.3211				.9550	.49667	**	
France	.3487	.2295				1.448	.46028	**	
Greece	-.249	.3849				-.3531	.41235		
Hong Kong	n.a.	n.a.				n.a.	n.a.		
Ireland	-.436	.0725	**			.5413	.23550	**	
Italy	-.447	.3510				.2295	.28566		
Japan	-.615	.3410	*			.3916	.94550		
Holland	-.369	.3587				1.034	.77627		
Norway	-1.56	.5106	**			-.8486	.76837		
New Zealand	-.175	.1480				.5974	.47855		
Portugal	-.371	.3427				-.1710	.39963		
Singapore	-1.02	.3049	**			.7772	.48154	*	
Sweden	.6043	.2550	**			1.434	.54824	**	
U.S.A.	-.253	.0981	**			2.984	.67692	**	

CHAPTER 6

Appendix 6.

Panel Data Regression Analysis 3.

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + u_{it}, \qquad (6.4)$$

Sample Population Results.

number of observations 4950

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.590	.0655	-9.009	0.000	0.0197	62.66	0.0000	0.00	1.0000
Austria	-.058	.1496	-0.390	0.697	0.0053	63.95	0.0000	0.00	1.0000
Belgium Luxembourg	-.134	.0941	-1.418	0.156	0.0064	62.48	0.0000	0.00	1.0000
Canada	-.428	.1041	-4.117	0.000	0.0116	64.16	0.0000	0.00	1.0000
Switzerland	.1562	.1110	1.407	0.159	0.0084	61.82	0.0000	0.00	1.0000
Germany	.2901	.1117	2.597	0.009	0.0097	55.81	0.0000	0.00	1.0000
Denmark	.2500	.1290	1.938	0.053	0.0099	60.04	0.0000	0.00	1.0000
Spain	.2363	.1449	1.630	0.103	0.0078	62.86	0.0000	0.00	1.0000
Finland	.1457	.1426	1.021	0.307	0.0082	59.00	0.0000	0.00	1.0000
France	-.097	.1132	-0.859	0.391	0.0114	59.03	0.0000	0.00	1.0000
Greece	.0084	.1357	0.062	0.951	0.0063	63.62	0.0000	0.00	1.0000
Hong Kong	-.739	.1156	-6.395	0.000	0.0165	64.74	0.0000	0.00	1.0000
Ireland	-.376	.0378	-9.953	0.000	0.0288	51.05	0.0000	0.00	1.0000
Italy	-.026	.1560	-0.168	0.867	0.0078	60.43	0.0000	0.00	1.0000
Japan	-.593	.1174	-5.059	0.000	0.0106	65.95	0.0000	0.00	1.0000
Holland	-.142	.1554	-0.913	0.361	0.0049	64.88	0.0000	0.00	1.0000
Norway	-.516	.1956	-2.637	0.008	0.0065	68.18	0.0000	0.00	1.0000
New Zealand	-.343	.0665	-5.169	0.000	0.0100	66.15	0.0000	0.00	1.0000
Portugal	-.049	.1148	-0.431	0.667	0.0057	64.98	0.0000	0.00	1.0000
Singapore	-.934	.1298	-7.197	0.000	0.0165	64.64	0.0000	0.00	1.0000
Sweden	-.035	.1262	-0.277	0.781	0.0086	58.92	0.0000	0.00	1.0000
U.S.A.	-.444	.0489	-9.084	0.000	0.0216	60.78	0.0000	0.00	1.0000

Testing the relationship:

$$\Delta p_{it} = con + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + u_{it}, \qquad \textbf{(6.4)}$$

Sample Coefficient Results.

number of observations 4950

Country	β	**S. E. on** β	**Significance**			γ	**S. E. on** γ	**Significance**	
Australia	-.590	.0655	**			.9260	.17942	**	
Austria	-.058	.1496				1.119	.21758	**	
Belgium Luxembourg	-.134	.0941				1.020	.18196	**	
Canada	-.428	.1041	**			1.195	.18650	**	
Switzerland	.1562	.1110				1.163	.19322	**	
Germany	-.290	.1117	**			1.035	.16117	**	
Denmark	.2500	.1290	*			1.251	.17987	**	
Spain	.2363	.1449	*			1.129	.18323	**	
Finland	.1457	.1426				1.150	.18540	**	
France	-.097	.1132				1.194	.15973	**	
Greece	.0084	.1357				1.184	.21130	**	
Hong Kong	-.739	.1156	**			1.368	.19570	**	
Ireland	-.376	.0378	**			1.109	.1391	**	
Italy	-.026	.1560				1.136	.19273	**	
Japan	-.593	.1174	**			1.088	.24739	**	
Holland	-.142	.1554				1.059	.21856	**	
Norway	-.516	.1956	**			1.256	.23570	**	
New Zealand	-.343	.0665	**			1.256	.22196	**	
Portugal	-.049	.1148				1.083	.21278	**	
Singapore	-.934	.1298	**			1.161	.20285	**	
Sweden	-.035	.1262				1.089	.16627	**	
U.S.A.	-.444	.0489	**			.9389	.17191	**	

Food Results.

number of observations 429

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.626	.1769	-3.540	0.000	0.0332	5.92	0.0150	0.00	1.0000
Austria	.2223	.3541	0.628	0.530	0.0015	6.08	0.0137	0.00	1.0000
Belgium Luxembourg	-.566	.1982	-2.857	0.004	0.0369	6.11	0.0135	0.00	1.0000
Canada	-.948	.2521	-3.762	0.000	0.0473	5.89	0.0152	0.00	1.0000
Switzerland	.5238	.3386	1.547	0.122	0.0112	6.22	0.0127	0.00	1.0000
Germany	.1596	.2773	0.576	0.565	0.0110	5.93	0.0149	0.00	1.0000
Denmark	-.166	.3011	-0.554	0.580	0.0089	5.74	0.0166	0.00	1.0000
Spain	.2905	.4224	0.688	0.492	0.0089	6.19	0.0129	0.00	1.0000
Finland	-.200	.3484	-0.574	0.566	0.0077	5.94	0.0148	0.00	1.0000
France	.2638	.3521	0.749	0.454	0.0185	6.44	0.0112	0.00	1.0000
Greece	-.315	.2309	-1.365	0.172	0.0108	5.69	0.0171	0.00	1.0000
Hong Kong	-.422	.2483	-1.700	0.089	0.0140	5.85	0.0155	0.00	1.0000
Ireland	-.364	.0655	-5.559	0.000	0.0883	4.64	0.0312	0.00	1.0000
Italy	.1461	.4352	0.336	0.737	0.0091	5.59	0.0181	0.00	1.0000
Japan	-.385	.2474	-1.558	0.119	0.0084	6.25	0.0124	0.00	1.0000
Holland	-.884	.6428	-1.376	0.169	0.0056	6.42	0.0113	0.00	1.0000
Norway	-1.55	.5370	-2.900	0.004	0.0218	6.32	0.0119	0.00	1.0000
New Zealand	-.330	.1177	-2.804	0.005	0.0222	5.42	0.0199	0.00	1.0000
Portugal	.1229	.2023	0.608	0.543	0.0143	5.79	0.0161	0.00	1.0000
Singapore	-.529	.2441	-2.169	0.030	0.0191	5.22	0.0223	0.00	1.0000
Sweden	-.312	.3358	-0.930	0.352	0.0067	6.04	0.0140	0.00	1.0000
U.S.A.	-.306	.1406	-2.177	0.029	0.0235	5.81	0.0159	0.00	1.0000

Food Results.

Sample Coefficient Results.

number of observations 429

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	-.626	.1769	**			.8649	.48409	*	
Austria	-.222	.3541				.2197	.51494		
Belgium Luxembourg	-.566	.1982	**			1.260	.38168	**	
Canada	-.948	.2521	**			1.194	.45134	**	
Switzerland	.5238	.3386				.7659	.58899		
Germany	.1596	.2773				.8347	.40012	**	
Denmark	-.166	.3011				.7565	.41979	*	
Spain	.2905	.4224				1.011	.53409	**	
Finland	-.200	.3484				.7991	.45280	*	
France	.2638	.3521				1.367	.49662	**	
Greece	-.315	.2309				.5663	.35942		
Hong Kong	-.422	.2483	*			.8012	.42006	**	
Ireland	-.364	.0655	**			.9234	.24103	**	
Italy	.1461	.4352				1.053	.53762	**	
Japan	-.385	.2474				.4416	.52142		
Holland	-.884	.6428				.6551	.90372		
Norway	-1.55	.5370	**			.8977	.64690		
New Zealand	-.330	.1177	**			.7202	.39283	*	
Portugal	.1229	.2023				.9321	.37484	**	
Singapore	-.529	.2441	**			.7373	.38143	**	
Sweden	-.312	.3358				.6511	.44221		
U.S.A.	-.306	.1406	**			1.194	.49370	**	

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.351	.2357	-1.491	0.136	0.0047	9.33	0.0023	0.00	1.0000
Austria	.1962	.4648	0.422	0.673	0.0031	9.35	0.0022	0.00	1.0000
Belgium Luxembourg	-.606	.3519	-1.725	0.085	0.0051	9.11	0.0025	0.00	1.0000
Canada	-.304	.3517	-0.865	0.387	0.0012	9.41	0.0022	0.00	1.0000
Switzerland	-.284	.3615	-0.787	0.431	0.0045	8.88	0.0029	0.00	1.0000
Germany	1.075	.4357	2.469	0.014	0.0096	8.82	0.0030	0.00	1.0000
Denmark	-.718	.4875	-1.474	0.141	0.0035	9.15	0.0025	0.00	1.0000
Spain	.093	.4581	0.205	0.838	0.0011	9.47	0.0021	0.00	1.0000
Finland	-.727	.5471	-1.330	0.183	0.0042	9.32	0.0023	0.00	1.0000
France	.0655	.3968	0.165	0.869	0.0032	8.80	0.0030	0.00	1.0000
Greece	-.211	.3692	-0.573	0.566	0.0032	9.08	0.0026	0.00	1.0000
Hong Kong	-.879	.3671	-2.395	0.017	0.0135	9.47	0.0021	0.00	1.0000
Ireland	-.335	.1400	-2.394	0.017	0.0130	8.57	0.0034	0.00	1.0000
Italy	-.676	.5994	-1.129	0.259	0.0058	9.14	0.0025	0.00	1.0000
Japan	-.252	.3642	-0.692	0.489	0.0035	9.35	0.0022	0.00	1.0000
Holland	-.667	.4449	-1.501	0.133	0.0038	9.19	0.0024	0.00	1.0000
Norway	.0424	.5832	0.073	0.942	0.0014	9.75	0.0018	0.00	1.0000
New Zealand	-.553	.2012	-2.752	0.006	0.0123	8.95	0.0028	0.00	1.0000
Portugal	-.705	.3480	-2.027	0.043	0.0069	8.81	0.0030	0.00	1.0000
Singapore	-1.16	.4032	-2.896	0.004	0.0162	9.42	0.0021	0.00	1.0000
Sweden	-.402	.4700	-0.856	0.392	0.0036	8.88	0.0029	0.00	1.0000
U.S.A.	-.317	.1957	-1.624	0.104	0.0060	9.50	0.0021	0.00	1.0000

Chemicals Results.

Sample Coefficient Results.

number of observations 660

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	-.351	.2357				.6883	.64474		
Austria	.1962	.4648				.8788	.67581		
Belgium Luxembourg	-.606	.3519	*			.6175	.67756		
Canada	-.304	.3517				.1007	.62967		
Switzerland	-.284	.3615				1.026	.62884		
Germany	1.075	.4357	**			.2960	.62856		
Denmark	-.718	.4875				.1594	.67962		
Spain	.093	.4581				.4985	.57923		
Finland	-.727	.5471				.7922	.71096		
France	.0655	.3968				.8105	.55956		
Greece	-.211	.3692				.7362	.57461		
Hong Kong	-.879	.3671	**			1.232	.62098	**	
Ireland	-.335	.1400	**			1.008	.51454	**	
Italy	-.676	.5994				.8873	.74048		
Japan	-.252	.3642				.9448	.76766		
Holland	-.667	.4449				.3137	.62546		
Norway	.0424	.5832				.6576	.70251		
New Zealand	-.553	.2012	**			.8389	.67145		
Portugal	-.705	.3480	**			.1583	.64473		
Singapore	-1.16	.4032	**			1.006	.62993		
Sweden	-.402	.4700				.8293	.61885		
U.S.A.	-.317	.1957	*			.8183	.68716		

Stone and Glassware Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0450	.3062	0.147	0.883	0.0051	6.66	0.0099	0.00	1.0000
Austria	-.895	.7896	-1.134	0.257	0.0070	6.77	0.0093	0.00	1.0000
Belgium Luxembourg	-.376	.5092	-0.740	0.460	0.0015	6.78	0.0092	0.00	1.0000
Canada	-.511	.4932	-1.036	0.300	0.0077	6.37	0.0116	0.00	1.0000
Switzerland	.0853	.5571	0.153	0.878	0.0002	6.52	0.0107	0.00	1.0000
Germany	-.033	.6454	-0.052	0.959	0.0003	5.95	0.0148	0.00	1.0000
Denmark	.7146	.6469	1.105	0.269	0.0094	6.69	0.0097	0.00	1.0000
Spain	-.308	.6650	-0.463	0.643	0.0047	6.40	0.0114	0.00	1.0000
Finland	-.436	.6853	-0.637	0.524	0.0155	6.83	0.0089	0.00	1.0000
France	-.962	.5726	-1.681	0.093	0.0077	6.61	0.0102	0.00	1.0000
Greece	-.199	.5977	-0.334	0.739	0.0094	6.93	0.0085	0.00	1.0000
Hong Kong	-1.72	.5997	-2.883	0.004	0.0204	6.80	0.0091	0.00	1.0000
Ireland	-.207	.1904	-1.090	0.276	0.0071	5.86	0.0155	0.00	1.0000
Italy	.5643	.7766	0.727	0.467	0.0047	6.81	0.0091	0.00	1.0000
Japan	-.894	.4441	-2.014	0.044	0.0122	6.63	0.0100	0.00	1.0000
Holland	-.764	.7400	-1.033	0.302	0.0034	6.29	0.0121	0.00	1.0000
Norway	.0823	.8470	0.097	0.923	0.0029	6.53	0.0106	0.00	1.0000
New Zealand	-.568	.2974	-1.910	0.056	0.0124	6.48	0.0109	0.00	1.0000
Portugal	-.192	.5019	-0.384	0.701	0.0095	6.95	0.0084	0.00	1.0000
Singapore	-.819	.5984	-1.370	0.171	0.0085	6.58	0.0103	0.00	1.0000
Sweden	-.546	.6409	-0.852	0.394	0.0048	6.65	0.0099	0.00	1.0000
U.S.A.	-.635	.2274	-2.795	0.005	0.0279	6.29	0.0121	0.00	1.0000

Stone and Glassware Results.

Sample Coefficient Results.

number of observations 660

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	.0450	.3062				1.259	.83771		
Austria	-.895	.7896				1.751	1.1480		
Belgium Luxembourg	-.376	.5092				.4988	.98041		
Canada	-.511	.4932				1.392	.88283		
Switzerland	.0853	.5571				.1863	.96897		
Germany	-.033	.6454				.3640	.93107		
Denmark	.7146	.6469				1.704	.90181	*	
Spain	-.308	.6650				1.134	.84084		
Finland	-.436	.6853				2.365	.89057	**	
France	-.962	.5726	*			.6475	.80748		
Greece	-.199	.5977				1.894	.93002	**	
Hong Kong	-1.72	.5997	**			1.366	1.0145		
Ireland	-.207	.1904				1.094	.69997		
Italy	.5643	.7766				1.383	.95946		
Japan	-.894	.4441	**			.8907	.93594		
Holland	-.764	.7400				.7426	1.0403		
Norway	.0823	.8470				1.154	1.0203		
New Zealand	-.568	.2974	*			1.756	.99214		
Portugal	-.192	.5019				1.797	.92978	*	
Singapore	-.819	.5984				1.363	.93470		
Sweden	-.546	.6409				1.076	.84386		
U.S.A.	-.635	.2274	**			1.919	.79855	**	

Copper, Nickel and Aluminium Products Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.627	.1636	-3.836	0.000	0.0433	5.59	0.0180	0.00	1.0000
Austria	-.312	.3785	-0.826	0.409	0.0061	5.79	0.0161	0.00	1.0000
Belgium Luxembourg	-.010	.2359	-0.045	0.964	0.0002	5.12	0.0237	0.00	1.0000
Canada	-.689	.4046	-1.704	0.088	0.0111	5.95	0.0147	0.00	1.0000
Switzerland	-.205	.2176	-0.946	0.344	0.0046	3.01	0.0829	0.00	1.0000
Germany	.0615	.1909	0.322	0.747	0.0178	4.82	0.0281	0.00	1.0000
Denmark	.1988	.3007	0.661	0.508	0.0147	5.49	0.0191	0.00	1.0000
Spain	-.121	.3620	-0.336	0.737	0.0028	5.57	0.0182	0.00	1.0000
Finland	.0250	.4395	0.057	0.955	0.0033	5.40	0.0201	0.00	1.0000
France	-.585	.2116	-2.765	0.006	0.0293	5.14	0.0234	0.00	1.0000
Greece	.1246	.5646	0.221	0.825	0.0006	5.82	0.0158	0.00	1.0000
Hong Kong	-.307	.3846	-0.800	0.424	0.0019	5.86	0.0155	0.00	1.0000
Ireland	-.405	.0716	-5.656	0.000	0.0789	4.09	0.0431	0.00	1.0000
Italy	.2326	.3087	0.754	0.451	0.0242	4.98	0.0256	0.00	1.0000
Japan	-1.11	.4172	-2.665	0.008	0.0185	5.85	0.0156	0.00	1.0000
Holland	.1247	.4029	0.310	0.757	0.0028	5.74	0.0166	0.00	1.0000
Norway	-.906	.7594	-1.194	0.232	0.0048	5.91	0.0150	0.00	1.0000
New Zealand	-.568	.2380	-2.386	0.017	0.0144	5.88	0.0153	0.00	1.0000
Portugal	.1701	.3167	0.537	0.591	0.0110	5.79	0.0161	0.00	1.0000
Singapore	-1.28	.3430	-3.732	0.000	0.0346	5.98	0.0145	0.00	1.0000
Sweden	-.042	.1930	-0.220	0.826	0.0191	4.92	0.0266	0.00	1.0000
U.S.A.	-.357	.1085	-3.295	0.001	0.0395	5.44	0.0197	0.00	1.0000

Copper, Nickel and Aluminium Products Results.

Sample Coefficient Results.

number of observations 396

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	-.627	.1636	**			.9506	.44751	**	
Austria	-.312	.3785				.7734	.55030		
Belgium Luxembourg	-.010	.2359				.1115	.45417		
Canada	-.689	.4046	*			.8887	.72426		
Switzerland	-.205	.2176				.4160	.37856		
Germany	.0615	.1909				.7275	.27542		
Denmark	.1988	.3007				1.001	.41920	**	
Spain	-.121	.3620				.4377	.45778		
Finland	.0250	.4395				.6487	.57117		
France	-.585	.2116	**			.5886	.29841	**	
Greece	.1246	.5646				.4108	.87858		
Hong Kong	-.307	.3846				.2429	.65061		
Ireland	-.405	.0716	**			.5079	.26332	**	
Italy	.2326	.3087				1.190	.38145	**	
Japan	-1.11	.4172	**			.1169	.87930		
Holland	.1247	.4029				.5627	.56640		
Norway	-.906	.7594				.7489	.91477		
New Zealand	-.568	.2380	**			.5427	.79419		
Portugal	.1701	.3167				1.223	.58674	**	
Singapore	-1.28	.3430	**			.2541	.53591		
Sweden	-.042	.1930				.7028	.25411	**	
U.S.A.	-.357	.1085	**			.9188	.38100	**	

Miscellaneous Building Products Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.629	.1432	-4.392	0.000	0.0444	11.23	0.0008	0.00	1.0000
Austria	-.310	.3707	-0.838	0.402	0.0062	11.83	0.0006	0.00	1.0000
Belgium Luxembourg	-.020	.1765	-0.116	0.908	0.0221	10.41	0.0013	0.00	1.0000
Canada	-.618	.2249	-2.751	0.006	0.0284	10.82	0.0010	0.00	1.0000
Switzerland	.1018	.2798	0.364	0.716	0.0109	11.56	0.0007	0.00	1.0000
Germany	.1257	.1916	0.656	0.512	0.0326	8.41	0.0037	0.00	1.0000
Denmark	.5877	.3015	1.949	0.051	0.0192	11.18	0.0008	0.00	1.0000
Spain	.2304	.2984	0.772	0.440	0.0155	11.83	0.0006	0.00	1.0000
Finland	.2057	.3099	0.664	0.507	0.0089	10.36	0.0013	0.00	1.0000
France	.2890	.2251	1.284	0.199	0.0354	10.60	0.0011	0.00	1.0000
Greece	-.025	.3284	-0.076	0.939	0.0066	11.70	0.0006	0.00	1.0000
Hong Kong	-.567	.2258	-2.512	0.012	0.0183	10.65	0.0011	0.00	1.0000
Ireland	-.411	.0664	-6.199	0.000	0.0682	8.50	0.0036	0.00	1.0000
Italy	-.248	.3438	-0.724	0.469	0.0134	11.11	0.0009	0.00	1.0000
Japan	-.537	.3444	-1.561	0.118	0.0066	11.68	0.0006	0.00	1.0000
Holland	-.323	.3541	-0.912	0.362	0.0123	11.48	0.0007	0.00	1.0000
Norway	-1.70	.5125	-3.321	0.001	0.0184	12.24	0.0005	0.00	1.0000
New Zealand	-.233	.1490	-1.569	0.117	0.0114	11.31	0.0008	0.00	1.0000
Portugal	-.169	.2800	-0.605	0.545	0.0060	11.20	0.0008	0.00	1.0000
Singapore	-.969	.3007	-3.224	0.001	0.0216	11.71	0.0006	0.00	1.0000
Sweden	.5353	.2550	2.099	0.036	0.0186	10.29	0.0013	0.00	1.0000
U.S.A.	-.268	.0980	-2.737	0.006	0.0336	11.03	0.0009	0.00	1.0000

Miscellaneous Building Products Results.

Sample Coefficient Results.

number of observations 396

Country	β	S. E. on β	Significance			γ	S. E. on γ	Significance	
Australia	-.629	.1432	**			1.866	.39196	**	
Austria	-.310	.3707				1.180	.53906	**	
Belgium Luxembourg	-.020	.1765				1.450	.33984	**	
Canada	-.618	.2249	**			1.634	.40260	**	
Switzerland	.1018	.2798				1.412	.48675	**	
Germany	.1257	.1916				1.439	.27645	**	
Denmark	.5877	.3015	**			1.559	.42038	**	
Spain	.2304	.2984				1.347	.37730	**	
Finland	.2057	.3099				1.036	.40279	**	
France	.2890	.2251				1.706	.31753	**	
Greece	-.025	.3284				1.185	.51112	**	
Hong Kong	-.567	.2258	**			1.221	.38203	**	
Ireland	-.411	.0664	**			1.301	.24412	**	
Italy	-.248	.3438				1.232	.42472	**	
Japan	-.537	.3444				1.075	.72594		
Holland	-.323	.3541				1.534	.49791	**	
Norway	-1.70	.5125	**			1.533	.61741	**	
New Zealand	-.233	.1490				1.439	.49705	**	
Portugal	-.169	.2800				1.023	.51867	**	
Singapore	-.969	.3007	**			1.332	.46983	**	
Sweden	.5353	.2550	**			1.072	.33578	**	
U.S.A.	-.268	.0980	**			1.611	.34440	**	

CHAPTER 6

Appendix 7.

Panel Data Regression Analysis 4.

Testing the relationship:

$$\Delta p_{it} = con_t + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + \varpi_i \Delta v_{it}^{cost} + u_{it}, \qquad (6.5)$$

Sample Population Results.

number of observations 4950

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.594	.0656	-9.047	0.000	0.0199	62.66	0.0000	0.00	1.0000
Austria	-.105	.1525	-0.693	0.488	0.0058	63.95	0.0000	0.00	1.0000
Belgium Luxembourg	-.134	.0945	-1.422	0.155	0.0064	62.48	0.0000	0.00	1.0000
Canada	-.501	.1096	-4.574	0.000	0.0125	64.15	0.0000	0.00	1.0000
Switzerland	.1513	.1116	1.356	0.175	0.0084	61.82	0.0000	0.00	1.0000
Germany	.2349	.1152	2.039	0.041	0.0105	55.79	0.0000	0.00	1.0000
Denmark	.2675	.1298	2.060	0.039	0.0102	60.03	0.0000	0.00	1.0000
Spain	.2500	.1458	1.714	0.086	0.0080	62.86	0.0000	0.00	1.0000
Finland	-.004	.1485	-0.030	0.976	0.0107	58.95	0.0000	0.00	1.0000
France	-.151	.1149	-1.319	0.187	0.0129	59.01	0.0000	0.00	1.0000
Greece	.1877	.1587	1.182	0.237	0.0073	63.61	0.0000	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.272	.0421	-6.436	0.000	0.0344	50.91	0.0000	0.00	1.0000
Italy	-.068	.1600	-0.430	0.667	0.0081	60.43	0.0000	0.00	1.0000
Japan	-.623	.1178	-5.287	0.000	0.0119	65.94	0.0000	0.00	1.0000
Holland	-.105	.1570	-0.671	0.502	0.0054	64.88	0.0000	0.00	1.0000
Norway	-.615	.1973	-3.118	0.002	0.0091	68.16	0.0000	0.00	1.0000
New Zealand	-.343	.0665	-5.160	0.000	0.0103	66.15	0.0000	0.00	1.0000
Portugal	-.027	.1404	-0.199	0.842	0.0057	64.98	0.0000	0.00	1.0000
Singapore	-1.00	.1310	-7.671	0.000	0.0193	64.60	0.0000	0.00	1.0000
Sweden	-.061	.1273	-0.482	0.630	0.0091	58.91	0.0000	0.00	1.0000
U.S.A.	-.450	.0490	-9.185	0.000	0.0225	60.77	0.0000	0.00	1.0000

Testing the relationship:

$$\Delta p_{it} = con_t + \beta_i \Delta s_{it} + \gamma_i \Delta v_{it}^{uk} + \varpi_i \Delta v_{it}^{cost} + u_{it}, \qquad \textbf{(6.5)}$$

Sample Coefficients Results.

number of observations 4950

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	-.594	.0656	**	.7079	.28543	**	.35452	.36092	
Austria	-.105	.1525		.8934	.26020	**	1.1645	.73476	
Belgium Luxembourg	-.134	.0945		.9490	.22496	**	.24248	.45129	
Canada	-.501	.1096	**	.6621	.31306	**	1.0447	.49260	**
Switzerland	.1513	.1116		1.146	.19691	**	.19693	.42965	
Germany	.2349	.1152	**	.8545	.18585	**	1.0819	.55503	**
Denmark	.2675	.1298	**	1.461	.25128	**	.47986	.40157	
Spain	.2500	.1458	*	.9852	.25163	**	.22186	.26467	
Finland	-.004	.1485		.5978	.24112	**	1.0627	.29679	**
France	-.151	.1149		1.747	.2581	**	1.008	.36994	**
Greece	.1877	.1587		1.093	.21533	**	.37730	.17323	**
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.272	.0421	**	1.994	.21508	**	1.1018	.20464	**
Italy	-.068	.1600		1.269	.22280	**	.17744	.14915	
Japan	-.623	.1178	**	.7347	.28219	**	.9544	.36709	**
Holland	-.105	.1570		1.284	.25788	**	.65800	.40018	
Norway	-.615	.1973	**	1.865	.28939	**	1.2985	.35907	**
New Zealand	-.343	.0665	**	1.449	.26823	**	.33061	.25717	
Portugal	-.027	.1404		1.062	.22741	**	.04652	.17482	
Singapore	-1.00	.1310	**	.9705	.20891	**	.79762	.21341	**
Sweden	-.061	.1273		1.460	.28175	**	.74869	.45909	
U.S.A.	-.450	.0490	**	1.493	.31560	**	1.2984	.61941	**

Food Results.

number of observations 429

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.637	.1770	-3.600	0.000	0.0366	5.92	0.0150	0.00	1.0000
Austria	.1902	.3615	0.526	0.599	0.0020	6.08	0.0137	0.00	1.0000
Belgium Luxembourg	-.563	.1978	-2.848	0.004	0.0429	6.10	0.0135	0.00	1.0000
Canada	-.894	.2655	-3.370	0.001	0.0482	5.89	0.0152	0.00	1.0000
Switzerland	.5418	.3405	1.591	0.112	0.0119	6.21	0.0127	0.00	1.0000
Germany	.2837	.2854	0.994	0.320	0.0182	5.92	0.0149	0.00	1.0000
Denmark	-.140	.3032	-0.464	0.643	0.0103	5.73	0.0166	0.00	1.0000
Spain	.3346	.4252	0.787	0.431	0.0109	6.19	0.0129	0.00	1.0000
Finland	-.265	.3635	-0.731	0.465	0.0087	5.94	0.0148	0.00	1.0000
France	.1909	.3574	0.534	0.593	0.0217	6.44	0.0112	0.00	1.0000
Greece	-.249	.2704	-0.921	0.357	0.0114	5.69	0.0171	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.304	.0737	-4.142	0.000	0.0953	4.63	0.0315	0.00	1.0000
Italy	.2525	.4464	0.566	0.572	0.0117	5.59	0.0181	0.00	1.0000
Japan	-.380	.2488	-1.528	0.126	0.0085	6.25	0.0137	0.00	1.0000
Holland	-.783	.6492	-1.207	0.228	0.0084	6.42	0.0113	0.00	1.0000
Norway	-1.82	.5343	-3.412	0.001	0.0506	6.31	0.0120	0.00	1.0000
New Zealand	-.329	.1176	-2.796	0.005	0.0263	5.41	0.0200	0.00	1.0000
Portugal	.3603	.2468	1.460	0.144	0.0208	5.78	0.0162	0.00	1.0000
Singapore	-.596	.2460	-2.426	0.015	0.0273	5.21	0.0224	0.00	1.0000
Sweden	-.335	.3388	-0.991	0.322	0.0074	6.04	0.0140	0.00	1.0000
U.S.A.	-.312	.1408	-2.218	0.027	0.0252	5.81	0.0160	0.00	1.0000

Food Results.

Sample Coefficients Results.

number of observations 429

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	-.637	.1770	**	.1216	.76964		1.208	.97320	
Austria	.1902	.3615		.0664	.61647		.7890	1.7408	
Belgium Luxembourg	-.563	.1978	**	1.712	.47091	**	1.543	.94470	
Canada	-.894	.2655	**	1.591	.75840	**	.7772	1.1933	
Switzerland	.5418	.3405		.8288	.60070		.7131	1.3106	
Germany	.2837	.2854		1.240	.46037	**	2.431	1.3748	*
Denmark	-.140	.3032		1.069	.58675	*	.7167	.93770	
Spain	.3346	.4252		.5477	.73354		.7120	.77156	
Finland	-.265	.3635		.5575	.58999		.4643	.72623	
France	.1909	.3574		2.109	.80264	**	1.354	1.1504	
Greece	-.249	.2704		.5325	.36675		.1396	.29504	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.304	.0737	**	1.437	.37259	**	.6397	.35451	*
Italy	.2525	.4464		.7212	.62140		.4432	.41599	
Japan	-.380	.2488		.5031	.59578		-.1660	.77502	
Holland	-.783	.6492		1.275	1.0662		1.811	1.6546	
Norway	-1.82	.5343	**	2.535	.78437	**	3.494	.97322	**
New Zealand	-.329	.1176	**	1.077	.47430	**	.6091	.45476	
Portugal	.3603	.2468		.6964	.39974	*	.5136	.30730	*
Singapore	-.596	.2460	**	.5559	.39216		.7587	.40061	**
Sweden	-.335	.3388		.9824	.75008		.6686	1.2222	
U.S.A.	-.312	.1408	**	1.836	.90700	**	1.502	1.7801	

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.352	.2361	-1.492	0.136	0.0047	9.33	0.0023	0.00	1.0000
Austria	.2455	.4742	0.518	0.605	0.0035	9.35	0.0022	0.00	1.0000
Belgium Luxembourg	-.603	.3518	-1.715	0.086	0.0073	9.10	0.0025	0.00	1.0000
Canada	-.428	.3701	-1.159	0.247	0.0030	9.40	0.0022	0.00	1.0000
Switzerland	-.29	.3635	-0.805	0.421	0.0046	8.88	0.0029	0.00	1.0000
Germany	1.072	.4498	2.383	0.017	0.0096	8.82	0.0030	0.00	1.0000
Denmark	-.667	.4907	-1.361	0.174	0.0048	9.15	0.0025	0.00	1.0000
Spain	.117	.4613	0.254	0.800	0.0015	9.47	0.0021	0.00	1.0000
Finland	-.850	.5705	-1.491	0.136	0.0051	9.32	0.0023	0.00	1.0000
France	-.053	.4023	-0.133	0.894	0.0076	8.80	0.0030	0.00	1.0000
Greece	-.013	.4319	-0.032	0.975	0.0043	9.08	0.0026	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.228	.1571	-1.455	0.146	0.0163	8.56	0.0034	0.00	1.0000
Italy	-.683	.6154	-1.111	0.267	0.0058	9.14	0.0025	0.00	1.0000
Japan	-.235	.3666	-0.644	0.520	0.0038	9.35	0.0022	0.00	1.0000
Holland	-.581	.4491	-1.294	0.196	0.0066	9.18	0.0024	0.00	1.0000
Norway	-.033	.5802	-0.058	0.954	0.0027	9.75	0.0018	0.00	1.0000
New Zealand	-.552	.2012	-2.744	0.006	0.0142	8.94	0.0028	0.00	1.0000
Portugal	-.848	.4257	-1.993	0.046	0.0074	8.81	0.0030	0.00	1.0000
Singapore	-1.20	.4077	-2.954	0.003	0.0167	9.42	0.0021	0.00	1.0000
Sweden	-.485	.4735	-1.026	0.305	0.0065	8.88	0.0029	0.00	1.0000
U.S.A.	-.325	.1960	-1.661	0.097	0.0068	9.50	0.0021	0.00	1.0000

Chemicals Results.

Sample Coefficients Results.

number of observations 660

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	-.352	.2361		.6212	1.0264		.10921	1.2979	*
Austria	.2455	.4742		1.114	.80875		1.2108	2.2837	
Belgium Luxembourg	-.603	.3518	*	1.218	.83729		2.0492	1.6796	
Canada	-.428	.3701		.816	1.0572		1.7970	1.6635	
Switzerland	-.29	.3635		.9983	.64128		.32323	1.3992	
Germany	1.072	.4498	**	.2836	.7255		.07429	2.1668	
Denmark	-.667	.4907		.7682	.94957		1.3932	1.5175	
Spain	.117	.4613		.2534	.79587		.37621	.83713	
Finland	-.850	.5705		.3392	.92603		.87060	1.1398	
France	-.053	.4023		2.023	.90346		2.2129	1.2949	
Greece	-.013	.4319		.6354	.58590		.41642	.47134	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.228	.1571		1.916	.79675	**	1.1306	.75808	
Italy	-.683	.6154		.9089	.85666		-.02878	.57349	
Japan	-.235	.3666		1.144	.87667		.53923	1.1404	
Holland	-.581	.4491		.8470	.73764		1.5585	1.1446	
Norway	-.033	.5802		1.125	.86369		.99890	1.0716	
New Zealand	-.552	.2012	**	1.350	.81129	*	.87414	.77787	
Portugal	-.848	.4257	**	.2999	.68935		.30877	.52994	
Singapore	-1.20	.4077	**	.9088	.64992		.40926	.66393	
Sweden	-.485	.4735		2.006	1.0480	*	2.3758	1.7077	
U.S.A.	-.325	.1960	*	1.624	1.2623		1.8867	2.4776	

Stone and Glassware Results.

number of observations 462

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0460	.3069	0.150	0.881	0.0051	6.66	0.0099	0.00	1.0000
Austria	-.876	.8061	-1.088	0.277	0.0071	6.77	0.0093	0.00	1.0000
Belgium Luxembourg	-.376	.5098	-0.739	0.460	0.0015	6.78	0.0092	0.00	1.0000
Canada	-.429	.5194	-0.827	0.408	0.0083	6.37	0.0116	0.00	1.0000
Switzerland	.105	.5602	0.189	0.850	0.0005	6.52	0.0107	0.00	1.0000
Germany	-.024	.6666	-0.037	0.971	0.0003	5.95	0.0148	0.00	1.0000
Denmark	.7079	.6517	1.086	0.277	0.0094	6.69	0.0097	0.00	1.0000
Spain	-.333	.6699	-0.498	0.619	0.0050	6.40	0.0114	0.00	1.0000
Finland	-.511	.7151	-0.715	0.474	0.0158	6.83	0.0089	0.00	1.0000
France	-1.01	.5818	-1.748	0.080	0.0083	6.61	0.0102	0.00	1.0000
Greece	-.058	.6996	-0.083	0.934	0.0098	6.93	0.0085	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.113	.2135	-0.530	0.596	0.0091	5.86	0.0155	0.00	1.0000
Italy	.7757	.7965	0.974	0.330	0.0078	6.81	0.0091	0.00	1.0000
Japan	-.929	.4463	-2.082	0.037	0.0136	6.63	0.0100	0.00	1.0000
Holland	-.564	.7455	-0.758	0.449	0.0111	6.28	0.0122	0.00	1.0000
Norway	-.117	.8537	-0.137	0.891	0.0090	6.52	0.0107	0.00	1.0000
New Zealand	-.567	.2977	-1.905	0.057	0.0126	6.48	0.0109	0.00	1.0000
Portugal	-.096	.6142	-0.157	0.875	0.0096	6.95	0.0084	0.00	1.0000
Singapore	-.881	.6050	-1.458	0.145	0.0096	6.58.	0.0103	0.00	1.0000
Sweden	-.563	.6468	-0.872	0.383	0.0049	6.65	0.0099	0.00	1.0000
U.S.A.	-.634	.2280	-2.781	0.005	0.0279	6.29	0.0121	0.00	1.0000

Stone and Glassware Results.

Sample Coefficients Results.

number of observations 462

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	.0460	.3069		1.330	1.3341		-.11558	1.6870	
Austria	-.876	.8061		1.839	1.3746		.45179	3.8818	
Belgium Luxembourg	-.376	.5098		.4372	1.2133		.21030	2.4339	
Canada	-.429	.5194		1.993	1.4836		1.1766	2.3345	
Switzerland	.105	.5602		.2582	.98834		.81503	2.1564	
Germany	-.024	.6666		.3927	1.0751		-.17194	3.2106	
Denmark	.7079	.6517		1.625	1.2612		.18188	2.0155	
Spain	-.333	.6699		1.400	1.1557		.40944	1.2156	
Finland	-.511	.7151		2.090	1.1606	*	.52925	1.4287	
France	-1.01	.5818	*	1.201	1.3066		1.0094	1.8728	
Greece	-.058	.6996		1.822	.94901	*	.29743	.76346	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.113	.2135		1.896	1.0849	*	.99884	1.0323	
Italy	.7757	.7965		.7230	1.1086		.88081	.74219	
Japan	-.929	.4463	**	.4657	1.0685		1.1469	1.3900	
Holland	-.564	.7455		1.969	1.2243		3.5860	1.8999	*
Norway	-.117	.8537		2.376	1.2517	*	2.6067	1.5531	*
New Zealand	-.567	.2977	*	1.963	1.2002		.35254	1.1507	
Portugal	-.096	.6142		1.701	.99465	*	.20831	.76464	
Singapore	-.881	.6050		1.195	.96443		.69989	.98522	
Sweden	-.563	.6468		1.326	1.4316		.50382	2.3328	
U.S.A.	-.634	.2280	**	1.754	1.4681		.38610	2.8814	

Copper, Nickel and Aluminium Products Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.615	.1635	-3.762	0.000	0.0490	5.59	0.0181	0.00	1.0000
Austria	-.237	.3859	-0.614	0.539	0.0086	5.79	0.0161	0.00	1.0000
Belgium Luxembourg	-.008	.2359	-0.036	0.971	0.0026	5.11	0.0238	0.00	1.0000
Canada	-.612	.4261	-1.437	0.151	0.0119	5.95	0.0147	0.00	1.0000
Switzerland	-.178	.2185	-0.818	0.414	0.0088	3.00	0.0835	0.00	1.0000
Germany	-.125	.1934	-0.648	0.517	0.0551	4.77	0.0289	0.00	1.0000
Denmark	.2404	.3024	0.795	0.427	0.0184	5.49	0.0191	0.00	1.0000
Spain	-.104	.3647	-0.287	0.774	0.0032	5.57	0.0182	0.00	1.0000
Finland	.1618	.4581	0.353	0.724	0.0062	5.40	0.0201	0.00	1.0000
France	-.637	.2145	-2.972	0.003	0.0342	5.13	0.0235	0.00	1.0000
Greece	.4902	.6602	0.743	0.458	0.0035	5.82	0.0159	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.333	.0801	-4.156	0.000	0.0880	4.07	0.0435	0.00	1.0000
Italy	-.425	.2802	-1.519	0.129	0.2386	4.67	0.0307	0.00	1.0000
Japan	-1.09	.4196	-2.617	0.009	0.0188	5.85	0.0156	0.00	1.0000
Holland	.0158	.4056	0.039	0.969	0.0118	5.73	0.0167	0.00	1.0000
Norway	-.960	.7676	-1.252	0.211	0.0054	5.91	0.0150	0.00	1.0000
New Zealand	-.569	.2382	-2.391	0.017	0.0161	5.88	0.0153	0.00	1.0000
Portugal	-.130	.3868	-0.337	0.736	0.0155	5.79	0.0161	0.00	1.0000
Singapore	-1.28	.3471	-3.716	0.000	0.0347	5.98	0.0145	0.00	1.0000
Sweden	-.041	.1948	-0.211	0.833	0.0191	4.92	0.0266	0.00	1.0000
U.S.A.	-.355	.1087	-3.269	0.001	0.0398	5.44	0.0197	0.00	1.0000

Copper, Nickel and Aluminium Products Results.
Sample Coefficients Results.

number of observations 396

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	-.615	.1635	**	1.797	.71071	**	1.3776	.89868	
Austria	-.237	.3859		1.134	.65819	*	1.8563	1.8586	
Belgium Luxembourg	-.008	.2359		.4363	.56147		1.1084	1.1263	
Canada	-.612	.4261		1.454	1.2172		1.1089	1.9152	
Switzerland	-.178	.2185		.5108	.38546		1.0748	.84105	
Germany	-.125	.1934		.1160	.31199		3.6645	.93174	**
Denmark	.2404	.3024		1.499	.58527	**	1.1401	.93534	
Spain	-.104	.3647		.2580	.62928		.27591	.66190	
Finland	.1618	.4581		1.152	.74361		.96829	.91531	
France	-.637	.2145	**	1.124	.48190	**	.97816	.69070	
Greece	.4902	.6602		.2247	.89553		.76940	.72044	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.333	.0801	**	1.121	.40663	**	.76362	.38690	**
Italy	-.425	.2802		3.245	.39003	**	2.7428	.26110	**
Japan	-1.09	.4196	**	.2845	1.0047		.45213	1.3069	
Holland	.0158	.4056		-.106	.66624		1.9560	1.0338	**
Norway	-.960	.7676		1.078	1.1255		.70365	1.3966	
New Zealand	-.569	.2382	**	.1072	.96022		.74360	.92065	
Portugal	-.130	.3868		1.521	.62639	**	.64991	.48154	
Singapore	-1.28	.3471	**	.2287	.55333		.10623	.56526	
Sweden	-.041	.1948		.6848	.43121		.03635	.70263	
U.S.A.	-.355	.1087	**	.7251	.70050		.45320	1.3748	

Miscellaneous Building Products Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.617	.1433	-4.310	0.000	0.0474	11.22	0.0008	0.00	1.0000
Austria	-.361	.3782	-0.957	0.339	0.0068	11.83	0.0006	0.00	1.0000
Belgium Luxembourg	-.020	.1766	-0.114	0.910	0.0222	10.41	0.0013	0.00	1.0000
Canada	-.501	.2364	-2.123	0.034	0.0314	10.81	0.0010	0.00	1.0000
Switzerland	.0943	.2813	0.335	0.737	0.0110	11.56	0.0007	0.00	1.0000
Germany	.0693	.1976	0.351	0.726	0.0341	8.4	0.0038	0.00	1.0000
Denmark	.6120	.3035	2.016	0.044	0.0198	11.18	0.0008	0.00	1.0000
Spain	.1907	.3002	0.635	0.525	0.0171	11.83	0.0006	0.00	1.0000
Finland	.1727	.3233	0.534	0.593	0.0090	10.36	0.0013	0.00	1.0000
France	.2224	.2283	0.974	0.330	0.0387	10.59	0.0011	0.00	1.0000
Greece	-.291	.3840	-0.758	0.448	0.0087	11.70	0.0006	0.00	1.0000
Hong Kong	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.320	.0742	-4.306	0.000	0.0765	8.46	0.0036	0.00	1.0000
Italy	-.308	.3528	-0.873	0.383	0.0141	11.11	0.0009	0.00	1.0000
Japan	-.526	.3462	-1.521	0.128	0.0067	11.68	0.0006	0.00	1.0000
Holland	-.305	.3579	-0.853	0.394	0.0125	11.48	0.0007	0.00	1.0000
Norway	-1.92	.5148	-3.745	0.000	0.0301	12.23	0.0005	0.00	1.0000
New Zealand	-.233	.1490	-1.565	0.118	0.0117	11.31	0.0008	0.00	1.0000
Portugal	-.406	.3422	-1.187	0.235	0.0078	11.20	0.0008	0.00	1.0000
Singapore	-1.01	.3039	-3.328	0.001	0.0227	11.71	0.0006	0.00	1.0000
Sweden	.5377	.2572	2.090	0.037	0.0186	10.29	0.0013	0.00	1.0000
U.S.A.	-.263	.0982	-2.685	0.007	0.0346	11.03	0.0009	0.00	1.0000

Miscellaneous Building Products Results.

Sample Coefficients Results.

number of observations 825

Country	β	S. E. on β	Significance	γ	S. E. on γ	Significance	ϖ	S. E. on ϖ	Significance
Australia	-.617	.1433	**	2.656	.62293	**	1.2847	.78769	
Austria	-.361	.3782		.9355	.64495		1.2587	1.8212	
Belgium Luxembourg	-.020	.1766		1.512	.42035	**	-.21239	.84326	
Canada	-.501	.2364	**	2.495	.67542	**	1.6862	1.0627	
Switzerland	.0943	.2813		1.386	.49630	**	.29739	1.0828	
Germany	.0693	.1976		1.255	.31880	**	1.1053	.95207	
Denmark	.6120	.3035	**	1.850	.58746	**	.66628	.93883	
Spain	.1907	.3002		1.764	.51798	**	.63980	.54484	
Finland	.1727	.3233		.9148	.5247	*	.23389	.64591	
France	.2224	.2283		2.384	.51286	*	1.2378	.73508	*
Greece	-.291	.3840		1.321	.52083	**	.55994	.41900	
Hong Kong	n.a.	n.a.		n.a.	n.a.		n.a.	n.a.	
Ireland	-.320	.0742	**	2.082	.37691	**	.97284	.35862	**
Italy	-.308	.3528		1.417	.49111	**	.24671	.32877	
Japan	-.526	.3462		1.211	.82898		.36800	1.0783	
Holland	-.305	.3579		1.643	.58791	**	.31975	.91232	
Norway	-1.92	.5148	**	2.918	.75489	**	2.9547	.93664	**
New Zealand	-.233	.1490		1.591	.60099	**	.25921	.57623	
Portugal	-.406	.3422		1.258	.55415	**	.51221	.42600	
Singapore	-1.01	.3039	**	1.219	.48454	**	.47296	.49498	
Sweden	.5377	.2572	**	1.038	.56943	*	.06773	.92784	
U.S.A.	-.263	.0982	**	1.132	.63257	*	1.1201	1.2415	

CHAPTER 6

Appendix 8.

Panel Data Regression Analysis 5.

Testing the relationship:

$\Delta p_{it} = con + \beta_i \Delta s_t + u_{it}$, ***(Floating Rate Period)*** **(6.2)**

Sample Population Results.

number of observations 4327

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.579	.0730	-7.930	0.000	0.0172	61.70	0.0000	0.00	1.0000
Austria	-.010	.1786	-0.057	0.954	0.0000	61.31	0.0000	0.00	1.0000
Belgium Luxembourg	-.042	.1045	-0.410	0.682	0.0000	52.84	0.0000	0.00	1.0000
Canada	-.432	.1195	-3.619	0.000	0.0036	59.52	0.0000	0.00	1.0000
Switzerland	.2556	.1291	1.979	0.048	0.0011	58.24	0.0000	0.00	1.0000
Germany	.3429	.1240	2.764	0.006	0.0021	42.48	0.0000	0.00	1.0000
Denmark	.1395	.1426	0.978	0.328	0.0003	52.93	0.0000	0.00	1.0000
Spain	.1423	.1637	0.869	0.385	0.0002	59.48	0.0000	0.00	1.0000
Finland	.1560	.1647	0.947	0.344	0.0002	53.51	0.0000	0.00	1.0000
France	-.175	.1335	-1.315	0.189	0.0005	41.24	0.0000	0.00	1.0000
Greece	.1915	.1853	1.033	0.301	0.0003	61.76	0.0000	0.00	1.0000
Hong Kong	-.690	.1346	-5.127	0.000	0.0073	63.16	0.0000	0.00	1.0000
Ireland	-.361	.0390	-9.273	0.000	0.0233	43.57	0.0000	0.00	1.0000
Italy	-.230	.1842	-1.254	0.210	0.0004	52.44	0.0000	0.00	1.0000
Japan	-.716	.1356	-5.286	0.000	0.0077	62.44	0.0000	0.00	1.0000
Holland	-.200	.1871	-1.072	0.284	0.0003	61.13	0.0000	0.00	1.0000
Norway	-.437	.2394	-1.825	0.068	0.0009	66.21	0.0000	0.00	1.0000
New Zealand	-.289	.0794	-3.643	0.000	0.0037	61.47	0.0000	0.00	1.0000
Portugal	-.099	.1404	-0.707	0.480	0.0001	60.38	0.0000	0.00	1.0000
Singapore	-1.09	.1525	-7.209	0.000	0.0142	59.98	0.0000	0.00	1.0000
Sweden	.1060	.1495	0.709	0.478	0.0001	54.25	0.0000	0.00	1.0000
U.S.A.	-.467	.0533	8.749	0.000	0.0208	57.24	0.0000	0.00	1.0000

Food Results.

number of observations 394

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.669	.1976	-3.390	0.001	0.0357	5.48	0.0193	0.00	1.0000
Austria	.1392	.4262	0.327	0.744	0.0003	6.10	0.0135	0.00	1.0000
Belgium Luxembourg	-.560	.2270	-2.468	0.014	0.0193	6.18	0.0129	0.00	1.0000
Canada	-.967	.2965	-3.262	0.001	0.0332	6.34	0.0118	0.00	1.0000
Switzerland	.4952	.3973	1.246	0.213	0.0050	5.83	0.0158	0.00	1.0000
Germany	.2622	.3059	0.857	0.391	0.0024	5.70	0.0169	0.00	1.0000
Denmark	-.363	.3086	-1.177	0.239	0.0045	5.50	0.0191	0.00	1.0000
Spain	.2330	.4703	0.495	0.620	0.0008	5.88	0.0153	0.00	1.0000
Finland	-.272	.4024	-0.677	0.499	0.0015	6.12	0.0134	0.00	1.0000
France	-.042	.4183	-0.101	0.920	0.0000	5.90	0.0151	0.00	1.0000
Greece	-.187	.3076	-0.610	0.542	0.0012	5.53	0.0187	0.00	1.0000
Hong Kong	-.396	.2754	-1.439	0.150	0.0066	5.34	0.0209	0.00	1.0000
Ireland	-.371	.0632	-5.881	0.000	0.1004	5.46	0.0194	0.00	1.0000
Italy	-.144	.5326	-0.275	0.783	0.0002	4.55	0.0328	0.00	1.0000
Japan	-.530	.2810	-1.886	0.059	0.0113	6.13	0.0133	0.00	1.0000
Holland	-1.15	.7872	-1.465	0.143	0.0069	6.50	0.0108	0.00	1.0000
Norway	-1.87	.6552	-2.864	0.004	0.0258	6.59	0.0103	0.00	1.0000
New Zealand	-.311	.1400	-2.224	0.026	0.0157	5.33	0.0209	0.00	1.0000
Portugal	.1234	.2471	0.499	0.618	0.0008	5.48	0.0193	0.00	1.0000
Singapore	-.696	.2795	-2.490	0.013	0.0196	2.65	0.1037	0.00	1.0000
Sweden	-.291	.3775	-0.771	0.441	0.0019	6.13	0.0133	0.00	1.0000
U.S.A.	-.332	.1615	-2.057	0.040	0.0135	6.16	0.0131	0.00	1.0000

Chemicals Results.

number of observations 615

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.325	.2590	-1.258	0.208	0.0033	8.70	0.0032	0.00	1.0000
Austria	.258	.5620	0.461	0.645	0.0004	9.59	0.0020	0.00	1.0000
Belgium Luxembourg	-.630	.3892	-1.620	0.105	0.0055	8.37	0.0038	0.00	1.0000
Canada	-.311	.3953	-0.788	0.431	0.0013	8.22	0.0041	0.00	1.0000
Switzerland	-.257	.4187	-0.616	0.538	0.0008	8.84	0.0029	0.00	1.0000
Germany	1.30	.4738	2.759	0.006	0.0157	8.50	0.0035	0.00	1.0000
Denmark	-.761	.5422	-1.405	0.160	0.0041	8.31	0.0039	0.00	1.0000
Spain	.0690	.5139	0.134	0.893	0.0000	9.27	0.0023	0.00	1.0000
Finland	-.766	.6328	-1.212	0.226	0.0031	8.80	0.0030	0.00	1.0000
France	-.147	.4884	-0.301	0.763	0.0002	8.12	0.0044	0.00	1.0000
Greece	-.091	.4838	-0.189	0.850	0.0001	8.73	0.0031	0.00	1.0000
Hong Kong	-.883	.4163	-2.123	0.034	0.0093	9.32	0.0023	0.00	1.0000
Ireland	-.352	.1157	-3.043	0.002	0.0190	7.36	0.0067	0.00	1.0000
Italy	-.884	.6914	-1.279	0.201	0.0034	8.78	0.0030	0.00	1.0000
Japan	-.312	.4214	-0.741	0.459	0.0011	9.03	0.0027	0.00	1.0000
Holland	-.833	.5166	-1.613	0.107	0.0054	7.85	0.0051	0.00	1.0000
Norway	.0806	.6883	0.117	0.907	0.0000	8.89	0.0029	0.00	1.0000
New Zealand	-.579	.2363	-2.453	0.014	0.0124	8.43	0.0037	0.00	1.0000
Portugal	-.762	.4160	-1.833	0.067	0.0070	7.95	0.0048	0.00	1.0000
Singapore	-1.39	.4738	-2.954	0.003	0.0179	9.24	0.0024	0.00	1.0000
Sweden	-.348	.5573	-0.626	0.532	0.0008	8.10	0.0044	0.00	1.0000
U.S.A.	-.333	.1998	-1.667	0.096	0.0058	8.19	0.0042	0.00	1.0000

Stone and Glassware Results.

number of observations 425

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0869	.3397	0.256	0.798	0.0002	6.55	0.0105	0.00	1.0000
Austria	-1.03	.9255	-1.123	0.261	0.0038	7.08	0.0078	0.00	1.0000
Belgium Luxembourg	-.353	.5372	-0.659	0.510	0.0013	6.49	0.0109	0.00	1.0000
Canada	-.576	.5546	-1.039	0.299	0.0032	6.89	0.0087	0.00	1.0000
Switzerland	.0971	.6252	0.155	0.877	0.0001	6.34	0.0118	0.00	1.0000
Germany	.1918	.6908	0.278	0.781	0.0002	4.46	0.0346	0.00	1.0000
Denmark	.6513	.6888	0.946	0.344	0.0027	6.81	0.0091	0.00	1.0000
Spain	-.422	.7560	-0.559	0.576	0.0009	5.79	0.0161	0.00	1.0000
Finland	-.289	.7705	.376	0.707	0.0004	6.39	0.0115	0.00	1.0000
France	-1.47	.6524	-2.256	0.024	0.0150	4.96	0.0260	0.00	1.0000
Greece	-.107	.8122	-0.132	0.895	0.0001	6.96	0.0083	0.00	1.0000
Hong Kong	-1.72	.7121	-2.415	0.016	0.0172	7.11	0.0076	0.00	1.0000
Ireland	-.168	.1997	-0.845	0.398	0.0021	6.16	0.0130	0.00	1.0000
Italy	.3274	.9058	0.362	0.718	0.0004	6.02	0.0142	0.00	1.0000
Japan	-1.03	.4878	-2.117	0.034	0.0132	6.21	0.0127	0.00	1.0000
Holland	-.981	.8600	-1.141	0.254	0.0039	6.87	0.0088	0.00	1.0000
Norway	.184	.1848	0.185	0.853	0.0001	6.46	0.0110	0.00	1.0000
New Zealand	-.461	.3462	-1.331	0.183	0.0053	6.79	0.0092	0.00	1.0000
Portugal	-.354	.6010	-0.589	0.556	0.0010	6.64	0.0100	0.00	1.0000
Singapore	-.983	.6762	-1.454	0.146	0.0063	6.59	0.0103	0.00	1.0000
Sweden	-.469	.7459	-0.629	0.529	0.0012	6.45	0.0111	0.00	1.0000
U.S.A.	-.661	.2515	-2.631	0.009	0.0203	5.88	0.0153	0.00	1.0000

Copper, Nickel and Aluminium Products Results.

number of observations 352

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.592	.1843	-3.216	0.001	0.0349	5.19	0.0227	0.00	1.0000
Austria	-.081	.4392	-0.185	0.853	0.0001	5.46	0.0195	0.00	1.0000
Belgium Luxembourg	.100	.2609	0.387	0.699	0.0005	4.95	0.0262	0.00	1.0000
Canada	-.763	.4735	-1.611	0.107	0.0090	5.77	0.0163	0.00	1.0000
Switzerland	-.001	.2270	-0.004	0.997	0.0000	3.67	0.0553	0.00	1.0000
Germany	-.082	.1801	-0.459	0.646	0.0007	4.34	0.0372	0.00	1.0000
Denmark	.2074	.3250	0.638	0.523	0.0014	5.45	0.0196	0.00	1.0000
Spain	-.251	.3917	-0.643	0.520	0.0014	5.86	0.0155	0.00	1.0000
Finland	-.002	.5206	-0.005	0.996	0.0000	5.50	0.0190	0.00	1.0000
France	-.128	.2222	-0.580	0.562	0.0012	4.07	0.0437	0.00	1.0000
Greece	.0907	.7811	0.116	0.907	0.0000	5.87	0.0154	0.00	1.0000
Hong Kong	-.269	.4490	-0.599	0.549	0.0013	6.03	0.0141	0.00	1.0000
Ireland	-.395	.0723	-5.464	0.000	0.0945	4.18	0.0408	0.00	1.0000
Italy	-.125	.3193	-0.393	0.695	0.0005	4.22	0.0400	0.00	1.0000
Japan	-1.12	.4843	-2.330	0.020	0.0186	5.89	0.0153	0.00	1.0000
Holland	.3969	.4808	0.825	0.409	0.0024	5.80	0.0161	0.00	1.0000
Norway	-.818	.9491	-0.863	0.388	0.0026	5.87	0.0154	0.00	1.0000
New Zealand	-.605	.2819	-2.149	0.032	0.0159	5.65	0.0175	0.00	1.0000
Portugal	-.025	.3897	-0.066	0.948	0.0000	5.70	0.0170	0.00	1.0000
Singapore	-1.36	.4056	-3.359	0.001	0.0380	5.83	0.0157	0.00	1.0000
Sweden	.0880	.1942	0.453	0.650	0.0007	5.50	0.0190	0.00	1.0000
U.S.A.	-.361	.1179	-3.064	0.002	0.0318	5.01	0.0252	0.00	1.0000

Miscellaneous Building Products Results.

number of observations 798

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.553	.1685	-3.284	0.001	0.0177	11.71	0.0006	0.00	1.0000
Austria	-.344	.4451	-0.774	0.439	0.0010	11.20	0.0008	0.00	1.0000
Belgium Luxembourg	.125	.1962	0.641	0.522	0.0007	9.12	0.0025	0.00	1.0000
Canada	-.616	.2657	-2.320	0.020	0.0089	10.82	0.0010	0.00	1.0000
Switzerland	.2099	.3301	0.636	0.525	0.0007	10.94	0.0009	0.00	1.0000
Germany	.1680	.2113	0.795	0.427	0.0011	5.17	0.0230	0.00	1.0000
Denmark	.4728	.3379	1.399	0.162	0.0033	11.53	0.0007	0.00	1.0000
Spain	.0836	.3292	0.254	0.800	0.0001	11.39	0.0007	0.00	1.0000
Finland	.1855	.3554	0.522	0.602	0.0005	9.84	0.0017	0.00	1.0000
France	.2658	.2661	0.999	0.318	0.0017	8.13	0.0044	0.00	1.0000
Greece	.1856	.4434	0.419	0.675	0.0003	11.26	0.0008	0.00	1.0000
Hong Kong	-.485	.2514	-1.930	0.054	0.0062	10.21	0.0014	0.00	1.0000
Ireland	-.369	.0682	-5.414	0.000	0.0467	8.76	0.0031	0.00	1.0000
Italy	-.428	.4074	-1.053	0.292	0.0019	9.92	0.0016	0.00	1.0000
Japan	.5352	.3976	-1.346	0.178	0.0030	11.89	0.0006	0.00	1.0000
Holland	-.443	.4370	-1.014	0.310	0.0017	11.51	0.0007	0.00	1.0000
Norway	-1.82	.6427	-2.837	0.005	0.0133	12.08	0.0005	0.00	1.0000
New Zealand	-.143	.1795	-0.802	0.422	0.0011	10.63	0.0011	0.00	1.0000
Portugal	-.283	.3456	-0.819	0.413	0.0011	11.58	0.0007	0.00	1.0000
Singapore	-1.11	.3317	-3.375	0.001	0.0187	11.11	0.0009	0.00	1.0000
Sweden	.7575	.3080	2.459	0.014	0.0100	9.84	0.0017	0.00	1.0000
U.S.A.	-.268	.1125	-2.384	0.017	0.0094	9.32	0.0023	0.00	1.0000

CHAPTER 6

Appendix 9.

Panel Data Regression Analysis 6.

Testing the relationship:

$\Delta p_{it} = con + \beta_i \Delta s_t + u_{it}$,   ***(robust std. Errors)***   **(6.2)**

Sample Population Results.

number of observations 4950

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.55707	.05931	-9.392	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	.0332	.16890	0.197	0.844	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.04280	.11735	-0.365	0.715	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	-.42871	.08938	-4.796	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	.2596	.08770	2.960	0.003	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	.3014	.10306	2.925	0.003	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	.1446	.11727	1.234	0.217	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	.1486	.13499	1.101	0.271	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	.2126	.14008	1.518	0.129	n.a.	n.a.	n.a.	n.a.	n.a.
France	-.12112	.11550	-1.049	0.294	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	-.04467	.08751	-0.510	0.610	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.67412	.11249	-5.993	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.34266	.02632	-13.015	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-.29826	.14422	-2.068	0.039	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-.67105	.12119	-5.537	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-.13183	.15658	-0.842	0.400	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	-.38677	.19568	-1.977	0.048	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.27571	.05549	-4.968	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	-.17088	.07121	-2.400	0.016	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	-.92175	.10422	-8.844	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	.0214	.10635	0.201	0.840	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.43632	.03671	-11.883	0.000	n.a.	n.a.	n.a.	n.a.	n.a.

Food Results.

number of observations 429

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.59496	.09627	-6.180	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	.24031	.37164	0.647	0.518	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.45365	.22988	-1.973	0.048	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	-.94826	.22595	-4.197	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	.5918	.31744	1.864	0.062	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	.1687	.22095	0.764	0.445	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	-.23038	.29493	-0.781	0.435	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	.2120	.33468	0.633	0.526	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	-.15371	.51962	-0.296	0.767	n.a.	n.a.	n.a.	n.a.	n.a.
France	.2365	.39375	0.601	0.548	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	-.34075	.15208	-2.241	0.025	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.38356	.13721	-2.795	0.005	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.33615	.04130	-8.138	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-.10599	.43643	-0.243	0.808	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-.41666	-.26585	1.567	0.117	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-.87802	-.56469	1.555	0.120	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	-1.4653	-.58126	2.521	0.012	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.29108	-.07495	3.883	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	.0186	.07153	0.260	0.795	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	-.52140	.14853	-3.510	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	-.27868	.11857	-2.350	0.019	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.29532	.11836	-2.495	0.013	n.a.	n.a.	n.a.	n.a.	n.a.

Chemicals Results.

number of observations 660

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.32632	.17855	-1.828	0.068	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	.2681	.55720	0.481	0.630	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.55176	.51319	-1.075	0.282	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	-.30441	.24657	-1.235	0.217	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	-.19323	.30030	-0.643	0.520	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	1.079	.48983	-2.203	0.028	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	-.73193	.39619	-1.847	0.065	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	.0550	.60704	0.091	0.928	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	-.68170	.41036	-1.661	0.097	n.a.	n.a.	n.a.	n.a.	n.a.
France	.0493	.51155	0.097	0.923	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	-.24467	.19244	-1.271	0.204	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.81997	.41781	-1.963	0.050	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.30413	.06862	-4.432	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-.88908	.71232	-1.248	0.212	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-.31901	.32556	-0.980	0.327	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-.66484	.46633	-1.426	0.154	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	.1101	.48308	0.228	0.820	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.5084	.10311	-4.930	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	-.72334	.18317	-3.949	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	-1.1568	.44078	-2.624	0.009	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	-.35954	.50361	-0.714	0.475	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.31050	.13015	-2.386	0.017	n.a.	n.a.	n.a.	n.a.	n.a.

Stone and Glassware Results.

number of observations 462

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	.0910	.25949	0.351	0.726	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.75205	.98412	-0.764	0.445	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.33199	.49692	-0.668	0.504	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	-.51072	.45262	-1.128	0.259	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	.1018	.37084	0.275	0.784	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	-.02941	.46376	-0.063	0.949	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	.1657	.52881	0.313	0.754	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	-.39617	.49067	-0.807	0.419	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	-.29914	.66825	-0.448	0.654	n.a.	n.a.	n.a.	n.a.	n.a.
France	-.97562	.57251	-1.704	0.088	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	-.28442	.30984	-0.918	0.359	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-1.6633	.57404	-2.898	0.004	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.17392	.15412	-1.128	0.259	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	.2332	.60483	0.386	0.700	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-.95751	.43167	-2.218	0.027	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-.75749	.79860	-0.949	0.343	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	.2011	.83959	0.240	0.811	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.47257	.24312	-1.944	0.052	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	-.39406	.44767	-0.880	0.379	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	-.80469	.43177	-1.864	0.062	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	-.49032	.48817	-1.004	0.315	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.61833	.13020	-4.749	0.000	n.a.	n.a.	n.a.	n.a.	n.a.

Copper, Nickel and Aluminium Products Results.

number of observations 396

Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.59291	.17318	-3.424	0.001	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.24926	.51308	-0.486	0.627	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	-.0006	.22596	-0.003	0.998	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	-.68912	.29120	-2.366	0.018	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	-.16885	.14665	-1.151	0.250	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	.06944	.08312	0.835	0.403	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	.1145	.29484	0.388	0.698	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	-.15566	.51838	-0.300	0.764	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	.0627	.16150	0.388	0.698	n.a.	n.a.	n.a.	n.a.	n.a.
France	-.59681	.18381	-3.247	0.001	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	.1062	.38959	0.273	0.785	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.29593	.55013	-0.538	0.591	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.38963	.07091	-5.494	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-.05217	.23097	-0.226	0.821	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-1.1204	.62782	-1.785	0.074	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	.13020	.52104	0.250	0.803	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	-.82990	.82841	-1.002	0.316	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.53862	.22144	-2.432	0.015	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	.0330	.19531	0.169	0.865	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	-1.2776	.43152	-2.961	0.003	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	-.00599	.04090	-0.146	0.884	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.34923	.10116	-3.452	0.001	n.a.	n.a.	n.a.	n.a.	n.a.

Miscellaneous Building Products Results.

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Country	β	S. E. on β	t-ratio	P>|t|	R-sq:	B-P Test	P>[c]	H-man Test	P>[c]
Australia	-.56112	.09053	-6.198	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Austria	-.21407	.31873	-0.672	0.502	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium Luxembourg	.1092	.14209	0.769	0.442	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	-.61840	.22947	-2.695	0.007	n.a.	n.a.	n.a.	n.a.	n.a.
Switzerland	.2272	.25996	0.874	0.382	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	.1413	.12775	1.107	0.268	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	.4565	.24222	1.885	0.059	n.a.	n.a.	n.a.	n.a.	n.a.
Spain	.1258	.29954	0.420	0.674	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	.2660	.36838	0.722	0.470	n.a.	n.a.	n.a.	n.a.	n.a.
France	.2549	.17746	1.437	0.151	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	-.07819	.24756	-0.316	0.752	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	-.50867	.15604	-3.260	0.001	n.a.	n.a.	n.a.	n.a.	n.a.
Ireland	-.37167	.03411	-10.895	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Italy	-.54408	.30551	-1.781	0.075	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	-.61400	.37363	-1.643	0.100	n.a.	n.a.	n.a.	n.a.	n.a.
Holland	-.30841	.29540	-1.044	0.296	n.a.	n.a.	n.a.	n.a.	n.a.
Norway	-1.5444	.47708	-3.237	0.001	n.a.	n.a.	n.a.	n.a.	n.a.
New Zealand	-.15566	.11390	-1.367	0.172	n.a.	n.a.	n.a.	n.a.	n.a.
Portugal	-.28396	.13652	-2.080	0.038	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	-.95503	.17326	-5.512	0.000	n.a.	n.a.	n.a.	n.a.	n.a.
Sweden	.5909	.19580	3.018	0.003	n.a.	n.a.	n.a.	n.a.	n.a.
U.S.A.	-.25392	.11812	-2.150	0.032	n.a.	n.a.	n.a.	n.a.	n.a.

CHAPTER 6

Appendix 10.

Key of abbreviations used:

Heading	Abbreviation Used
β coefficient	β
Standard error on β	S. E. on β
Significance of β	P>|t|
Breusch-Pagan Test	B-P Test
Hausman Test	H-man Test
Significance of test results	P>[c]
**	Significant at 5%
*	Significant at 10%