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Integration and Co-integration: Do Canada-U.S. Manufacturing Prices Obey the 'Law of One Price'?

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Abstract

This paper uses a detailed industry-level data base of industry prices in the manufacturing sector in Canada and the United States to investigate whether prices are co-integrated in the two countries and whether the relationship between the two sets of prices follows the law of one price. We find that aggregate Canadian price movements track U.S. price movements closely, but not perfectly, in the long run. But there are substantial deviations from the law of one price in the short run. Moreover, many individual industries deviate from the law of one price. These deviations are related to the degree of tariff protection and to the degree of product differentiation at the industry level.

Keywords: purchasing power parity, law of one price, panel unit roots, panel co-integration, Canada-United States

JEL Classification: E31, F31, L60

Executive summary

Trade liberalization has increased the degree of economic integration between Canada and the United States over the last forty years. One measure of the impact of economic integration is the extent to which identical products sell for the same common-currency price in each country, thereby obeying the so-called 'Law of One Price' (LOP).

This is the second of two papers that examine price differences between Canada and the United States. The first paper (Yan, 2002) focused on commodity price data in the two countries that come from Statistics Canada's Purchasing Power Parity (PPP) program to ask whether the level of Canadian prices in the late 1980s and 1990s approaches the level of U.S. prices corrected for the exchange rate. This paper makes use of price indices at the industry level to ask whether changes in aggregate industry prices in Canada over the period 1961 to 1996 are the same as U.S. price changes that are corrected for the exchange rate. Each data source has its strengths and weaknesses. Commodity data allow for a more precise matching of price data since industry data may involve more aggregation than matched commodity data. But the commodity data are not available for as long a time period as the industry average price data. The latter therefore permits long-run trends in price differences between the two countries to be more fully examined.

This paper uses recently developed techniques for testing hypotheses in co-integrated panels to examine the relationship between the prices charged in Canada and the United States for commodities produced by 84 Canadian and U.S. industries over the period of 1961-1996. It deals with four issues.

1) Do prices in the two countries move together? Are they co-integrated?
2) Is this movement so close that the average price level in manufacturing follows the law of one price in both the short and long run?
3) Do the individual industries that make up the manufacturing sector exhibit similar behaviour? Does the behaviour of Canadian prices in all individual industries that make up the manufacturing industry follow the law of one price?
4) Are deviations from the law of one price at the industry level associated with the level of tariff protection and the degree of product differentiation?

We find evidence that Canadian and U.S. prices at the aggregate level tend to move together in the long run, lending some support to a 'weaker' version of the law of one price hypothesis. Our conclusions differ slightly whether we examine price behaviour under mixed exchange-rate regimes or in the post Bretton-Woods flexible exchange-rate regime.

We do not find support for the hypothesis that manufacturing products sell for the same common-currency price in both countries. We find that there is a slight deviation from perfect purchasing power parity in the long run when we examine the aggregate manufacturing level. There are substantial deviations in the short run at this level, that correspond to exchange-rate fluctuations.

At the individual industry level, there are substantial deviations from the law of one price, even in the long run. We briefly investigate the extent to which the long-run relationship varies with industry characteristics, finding that the correlation between Canadian and U.S. prices is stronger for those industries with lower tariffs, and with a high degree of product substitutability.

1. Introduction

Trade liberalization has increased the degree of economic integration between Canada and the United States over the last forty years. One measure of the impact of economic integration is the extent to which identical products sell for the same common-currency price in each country, thereby obeying the so-called 'Law of One Price' (LOP).

This paper examines the long-run relationship between Canadian and U.S. producer prices. According to the 'absolute' version of the LOP, identical products should sell for the same common-currency price internationally. The assumption is an important one in many theoretical models in international economics, underpinning—for example—the open economy monetarist model of the 1960s and 1970s. In addition, the extent to which it is obeyed (or violated) between markets can be regarded as an indicator of the degree of integration of those markets.

This paper tests the hypothesis that the LOP holds between Canada and the United States, using detailed producer price indexes covering 84 manufacturing industries over the period of 1961-1996. From the perspective of a statistical agency, the issue is one of considerable practical importance. To the extent that the LOP holds, analysts would be justified in using simple nominal exchange rates for the purpose of carrying out inter-country comparisons of economic aggregates such as GDP. On the other hand, the frequency, degree, and persistence of violations in LOP/PPP will determine the extent to which such a practice would lead to serious measurement biases. This would affect among other things the course of productivity comparisons between two countries that deflate changes in nominal output by price indices to derive changes in real GDP.

Our primary purpose is to ask how Canadian prices respond to U.S. prices that are expressed in Canadian dollars (that is, corrected for the exchange rate). Failure to find that Canadian prices respond fully to U.S. prices may be the result of market power that allows firms to price discriminate across the two markets. If firms can choose the extent to which they respond to changes in competition from foreign sources, they may vary their response across different shocks that change the landed price in Canada of U.S. goods.

Landed prices may change if either U.S. prices expressed in U.S. dollars change or if the exchange-rate changes. And Canadian firms may choose to react differently to each—if they perceive that the long-run changes in each may have very different trends. Changes in U.S. prices probably reflect long-run cost and productivity trends. On the other hand, exchange-rate changes may exhibit cycles that lead Canadian firms to expect changes to reverse themselves. If so, Canadian prices may react differently to these two sources. Canadian price-setters may regard the underlying U.S. prices as more permanent and adjust their prices more fully to changes therein while they may regard exchange-rate movements as more temporary and adjust slowly to these changes.

We present two sets of estimates of the relationship between Canadian and U.S. prices that consider these different responses. The first just asks how Canadian prices respond to U.S. prices expressed in Canadian dollars. This set of results comes from estimating that relationship using a specification that does not include time-dummies. The second set purges the U.S. prices expressed in Canadian dollars of the exchange-rate effect, that is, it considers only changes in U.S. prices measured in U.S. dollars. It comes from taking what will be referred to in this paper as a “with time-dummies” approach, designed to control for industry-invariant but time-varying fixed effects.

The LOP hypothesis that we will test is based on several assumptions (such as identical goods, costless transactions and perfect commodity arbitrage) that may appear at first sight to be restrictive. However, if these assumptions are to be (approximately) satisfied anywhere, we might expect them to be satisfied by goods and services traded between Canada and the United States—given the physical and cultural proximity of the countries and the relatively open border between them. In addition, the fact that the Canadian and U.S. ‘prices’ used in the paper are *producer* price indices, might lead us to suppose that the test presented in this paper is one that offers a better chance of success than the use of consumer prices. Producer price indices are free of many of the imperfections of the consumer price indices that are typically used in the literature. Consumer price indices contain significant non-tradable components, such as rents, local shipping costs, local labour inputs, insurance, different taxes, wholesale and retail profit margins. On the other hand, use of price indices at the industry level may involve a higher level of aggregation and less precision in this dimension.

We wish to emphasize that there is an important distinction between the LOP and the more familiar Purchasing Power Parity (PPP) condition. Whilst the LOP arbitrage relation is postulated to hold for the prices of individual commodities, (absolute) PPP is said to hold if the LOP holds for *all* products between two countries (see Goldberg and Knetter, 1997, p.1246).

Much of the extensive empirical literature currently available (see below) uses aggregate price indices to test Purchasing Power Parity (PPP) rather than using disaggregated price data to test the LOP. However, the use of aggregate indices will generally tend to lead to the rejection of the (absolute) LOP hypothesis, even if the LOP holds (pairwise) for identical commodities, since strict equality of aggregate price levels between countries would require that such prices be arrived at using a common basket of goods and services with identical expenditure weights. International differences in consumption patterns and product qualities make it impossible to know whether the aggregate price movements (in the same currency) between two countries are due to the changes in the consumption patterns and product qualities or due to the price movements of each individual commodity. Even with matched commodities and expenditure weights it can still be misleading to use aggregate prices to conclude any arbitrage relationship.[1] This motivates us to examine the LOP using disaggregated industry data.

The views of international economists on the LOP and PPP have been in a state of flux over the past two decades. Earlier studies (before the mid-80s) typically did not find strong evidence of PPP for the post-1973 floating exchange-rate period. More recently, concerns over the power of the statistical test in small samples have prompted testing of PPP using longer time series and cross-country panel data. These results generally suggest that there is a long-run convergence towards PPP, with slow speed of adjustment at half-life of 3-5 years.[2] Froot and Rogoff (1995) and Rogoff (1996) provide surveys of the literature.

1. For detail, see Yan (2002).
2. This means that it takes around 3-5 years for 50% of the PPP deviation to disappear.

Compared to the profusion of studies using the aggregate (i.e. PPP) approach, there have been relatively few examinations of the LOP. Studies by Isard (1977), Richardson (1978) and Giovannini (1988) examined the size and volatility of short-run LOP deviations. Their general finding was that deviations from the LOP tended to be large, and that the volatility of such deviations reflected that of fluctuations in nominal exchange rates. However, they did not formally test whether the correlation between LOP deviations and fluctuations in the nominal exchange rate tended to disappear over longer time horizons, i.e. whether long-run convergence towards the LOP takes place.

More recent work, such as that by Wei and Parsley (1995) and Rogers and Jenkins (1995), use recently developed econometric techniques (typically the Augmented Dickey-Fuller test) to test the long-run validity of the LOP.[3] In general, they find convergence towards the LOP for highly tradable goods. A limitation of these studies is that they typically test the absolute version of the LOP outlined at the outset of this paper. However, as many authors have recognized, the 'identical goods', 'costless transactions' and 'perfect commodity arbitrage' assumptions underlying this version of LOP are restrictive. To the extent that these assumptions do *not* hold in practice, a complete equalization of prices may be unlikely to occur. A weaker model (the so-called relative LOP model) has been advanced in which domestic and foreign prices (in the same currency) move proportionately in the long run. A third—still weaker—model maintains the notion of co-movement, but relaxes the assumption of proportionality. Relaxation of the absolute LOP also allows for the possibility that the relationship between domestic and foreign prices may differ across industries.

Recent developments in panel unit root and panel co-integration methodology allow these various flavors of the LOP to be specified and tested. Techniques developed by Pedroni (1995, 1997, 1999) allow us to test a weak version of LOP (i.e. the hypothesis that Canadian and United States' prices move together in long-run equilibrium—that is, to test whether there is what is referred to as a co-integrating relationship) without imposing either the condition that prices (expressed in a common currency) be exactly equal (as in the *absolute* LOP), or even that their co-movements satisfy proportionality (as in the *relative* LOP). Such restrictions can however be tested explicitly.

The remainder of this paper is set out as follows. Section 2 outlines the LOP hypothesis. Section 3 introduces the econometric methods that are used. Section 4 describes the data employed and provides a preliminary analysis of the data. Section 5 reports empirical results. Section 6 summarizes and concludes.

3. Wei and Parsley refer to their work as an examination of PPP rather than LOP, but use relatively disaggregated data.

2. *Basic framework*

The absolute LOP may be written as

$$P_{it}^{C} = E_t P_{it}^{US} \tag{1}$$

where P_{it}^{C} and P_{it}^{US} are the Canadian and the U.S. dollar prices for the ith commodity at time t, and E_t is the nominal exchange rate, defined as the Canadian dollar in terms of U.S. dollar.

In view of the assumptions underlying this 'absolute' LOP condition[4] many authors have worked with the less demanding 'relative' version of equation (1). This version is designed to recognize the possibility that the domestic and foreign prices for a given commodity may (when expressed in the same currency) move together in equilibrium, whilst not restricting such movements to be exactly equal. The 'relative' version of equation (1) can also accommodate the reality that most price data are available in the form of indices relative to some base year, rather than in the form of levels.[5] The relative LOP can be written as

$$P_{it}^{C} = \left[\alpha_{i0}(P_{i0}^{US} / P_{i0}^{C})\right] E_t P_{it}^{US} \tag{2}$$

where $\alpha_{i0}(.)$ is a scaling factor arising from the violation of at least some of the assumptions underlying the absolute LOP. P_{it}^{C} and P_{it}^{US} are the values of Canadian and the U.S. price indices in year t relative to some base year prices P_{i0}^{C} and P_{i0}^{US} respectively.

For the purpose of empirical testing, we can write equation (2) in log form as:

$$\ln P_{it}^{C} = \alpha_i + \beta_i \ln(E_t P_{it}^{US}) + v_{it} \tag{3}$$

where $\alpha_i = \left[\alpha_{i0}(P_{i0}^{US} / P_{i0}^{C})\right]$ is a time invariant constant, and v_{it} is an error term capturing the deviation from long-run relationship. The absolute LOP, which should hold under conditions of perfect commodity substitutability and perfect market integration, is consistent with the restrictions $\alpha_i = 0$ and $\beta_i = 1$. Note the coefficient β is indexed by industry subscript i, which allows for heterogeneity in the long-run co-integrating relationships across industries. Such heterogeneity is likely since industries differ in their extent of home and foreign product substitutability and in the degree of the product market integration.

4. Perfect commodity arbitrage, costless transactions, and perfect substitutability of home and foreign products.
5. Pedroni (2001) draws a distinction between 'strong' and 'weak' arbitrage conditions (which may be PPP or LOP conditions). This 'strong' versus 'weak' distinction appears to be useful in the context of panel studies. Within this context, the adjective 'strong' tends to be applied to situations in which the estimated coefficients in the individual co-integrating regressions are all identically equal to 1. In contrast, the adjective 'weak' applies to situations in which there is co-integration (that is, there is a relationship), but the coefficients that measure the strength of the relationship display heterogeneity.

It is important to recognize that equation (3) embodies an important coefficient restriction. To see this, note that we could rewrite it as

$$\ln P_{it}^{C} = \alpha_i + \beta_{iE} \ln E_t + \beta_{iP} \ln P_{it}^{US} + \nu_{it} \tag{4}$$

and that the version contained in equation (3)—which we will go on to estimate—imposes the restriction $\beta_{iE} = \beta_{iP} = \beta_i$. Such a restriction embodies the assumption that an increase of given magnitude in U.S. prices in the ith industry will have the same consequences for Canadian prices in the ith industry as would an increase of the same magnitude in the nominal exchange rate.

Heuristically, the *co-integration* approach to testing for the existence of long-run (i.e. equilibrium) relationships is based on the notion that if an equilibrium relationship exists between the members of a set of individually non-stationary variables, the residuals calculated by imposing that equilibrium relationship on the data will be stationary.[6] It is possible to develop a procedure to parameterize and test for an equilibrium relationship based on this idea. Such a procedure could involve testing a null hypothesis of non-stationarity for each individual variable and then—unless such testing had led to the rejection of the null—investigating whether it is possible to establish a relationship between those variables such that the residuals from that relationship are stationary. Broadly, this is the procedure adopted by this paper.

Within this framework, there are two basic approaches that can be used to test for the long-run LOP. Note that equation (3) can be alternatively expressed as:

$$q_{it} = \gamma X' = \alpha_i + \nu_{it} \tag{5}$$

where X' is a vector of variables $\left(\ln P_{it}^{C}, \ln E_t P_{it}^{US}\right)$, γ is a vector of the coefficients $\left(1, \beta_i\right)$, and their product, $q_{it} = \ln P_{it}^{C} - \beta_i \ln E_t P_{it}^{US}$, measures the difference between the U.S. and Canadian prices of the ith industry's product at time t.[7] If a long-run equilibrium relationship exists between the comparative Canadian and U.S. prices $\ln P_{it}^{C}, \ln E_t P_{it}^{US}$, then it should be possible—despite the non-stationarity of P_{it}^{C} and $E_t P_{it}^{US}$—to find values of β_i such that q_{it} fluctuates around some constant α_i. In other words, there should exist values of β_i such that q_{it} is stationary, and the shocks associated with realizations of the disturbance term ν_{it} generate only temporary deviations from α_i.

One approach to testing for the co-integration involves simply imposing the restriction that $\beta_i = 1$, as suggested by the LOP, and testing whether $q_{it} = \ln P_{it}^{C} - \ln E_t P_{it}^{US}$ is stationary. This is

6. Strictly, this statement is only true for cases in which the individual series are integrated of order 1—or "I(1)" — which is to say that they are themselves stationary *after first differencing*.

7. q_{it} can also be thought of as a *sector specific* real exchange rate.

the most commonly used approach, whether in a time-series setting or in a pooled panel data setting.

A weakness of this approach is that the imposed condition $\beta_i = 1$ may be too restrictive. In an attempt to address this problem, a number of authors have carried out investigations that retain the assumption that $\beta_1 = \beta_2 = \ldots \beta_N$ whilst not imposing the restriction that the common value is 1. The panel co-integration and estimation method adopted in this paper is even less restrictive. Recently developed by Pedroni (1997, 1999), it allows for heterogeneity in the coefficients β_i. Thus, this approach combines the advantages of the panel approach favoured by many recent authors (freedom from the size and power deficiencies associated with non-panel approaches), whilst allowing considerable heterogeneity across industries.

Using the new econometric technique, we examine the following issues. First, we investigate whether there are any long-run co-integrating relationships between the Canadian and the U.S. prices (i.e., to test whether they are co-integrated). Second, using the estimated co-integrating factor β_i, we test the validity of the LOP (i.e.$\beta_i = 1$). Third, we examine whether the long-run relationships (β_i) vary with industry characteristics, such as the degree of product differentiation and market integration.

In the next section we briefly introduce the econometric methodology used in the paper, especially Pedroni's panel co-integration and panel estimation techniques, and demonstrate how it is implemented in this paper.

3. *Econometric methods*

3.1 Panel unit root tests of individual series

Before examining the hypotheses of interest and applying the co-integration tests, we need to examine whether each individual series—$\ln P_{it}^C$ and $\ln(E_t P_{it}^{US})$—is stationary. To do this, we employ the panel unit root tests developed by Levin and Lin (1993) and Im, Pesaran and Shin (1997). We refer to these as the LL and IPS tests.

Consider running the following regression:

$$\Delta x_{it} = \gamma_{0i} + \gamma_{1i} t + \delta_i x_{it-1} + \sum_K \Delta x_{it-k} + \varepsilon_{it} \qquad t = 1 \ldots T \quad \text{and} \quad i = 1 \ldots N$$

where t captures the time trend and Δx_{it-k} are lagged first-difference terms included to control for serial correlation of the error term ε_{it}. The null hypothesis under both the LL and IPS tests is that each individual time series x follows a unit root non-stationary process (H_o: $\delta_i = \delta = 0 \;\; \forall \;\; i = 1, \ldots, N$). The difference is in their alternative hypothesis. The IPS test allows for a heterogeneous dynamic adjustment process (i.e., H_A: $\delta_i < 0 \; \forall \; i = 1, \ldots, N$) while the LL test imposes the dynamics to be the same across sectors (H$_A$: $\delta_i = \delta < 0 \quad \forall \quad i = 1,\ldots,N$). The standardized LL and IPS t-statistics converge to the standard normal distribution *N(0,1)* under the null.

3.2 Panel co-integration test

We now turn to Pedroni's panel co-integration tests. In a series of papers, Pedroni (1995, 1997, 1999) proposes a set of statistics for testing the null of no co-integration in panel settings. These tests are similar to the panel unit root tests described above. Essentially, they can be characterized as panel unit root tests on the estimated residuals of the hypothesized (co-integrating) regression.

Pedroni constructs seven panel co-integration test statistics, using the residuals of the co-integrating regression, along with various nuisance parameter estimators (the member-specific long-run conditional variance for the residuals) as adjustment terms.

These seven statistics can be broadly divided into two categories, which differ according to the alternative hypotheses (H$_A$) employed in the tests for which they are designed. The first category consists of what are referred to as the "within-dimension" statistics, while the second consists of the "between-dimension" statistics. The null hypothesis for *both* categories of statistics is that for each member of the panel the variables are not co-integrated (i.e., H$_o$: $\delta_i = \delta = 0 \quad \forall \quad i = 1,\ldots,N$, where δ_i is the autoregressive coefficient of the estimated residuals from the first-stage regression).

The alternative hypothesis depends on the category to which the statistics belong. The alternative hypothesis for the within-dimension statistics is that for each member of the panel there exists a single and identical autoregressive coefficient (i.e., H$_A$: $\delta_i = \delta < 0 \; \forall \; i = 1,\ldots,N$). By contrast, the alternative hypothesis for the between-dimension statistics allows for heterogeneity in member-specific autoregressive coefficients (i.e., H$_A$: $\delta_i < 0 \; \forall \; i = 1,\ldots,N$). Thus the between-dimension statistics, like the IPS test statistics discussed above, do not presume a common value under the alternative hypothesis, and thus allow heterogeneous dynamic adjustment across sectors.

Of the seven statistics developed by Pedroni, four are based on within-dimension and the other three are based on between-dimension. The four within-dimension statistics are the panel v-statistic, the panel PP ρ-statistic, the panel PP t-statistic, and the panel ADF t-statistic. The three between-dimension statistics are the group PP ρ-statistic, the group PP t-statistic, and the group ADF t-statistic.

The distribution of the seven standardized statistics converges asymptotically towards the standard normal distribution. Each of the seven test statistics, with the exception of the panel v-statistic, diverges to negative infinity under the alternative hypothesis, meaning that large negative values lead to the rejection of the null hypothesis of no co-integration. In contrast, the panel v-statistic diverges to positive infinity under the alternative hypothesis so that large positive values lead to the rejection of the null hypothesis of no co-integration.

3.3 *Correcting for finite-sample bias using fully modified ordinary least squares (FMOLS) estimators*

Park and Phillips (1988), Phillips and Durlauf (1986) and others have argued that the performance of estimators of co-integrating vectors based on static regressions (such as equation 3) is adversely affected by the existence of 'second-order' biases resulting from endogeneity of the regressors and/or serial correlation and heteroscedasticity in the error terms. The fully modified ordinary least squares (FMOLS) approach proposed by Phillips and Hansen (1990) attempts to correct for these biases.

Pedroni (2001) extends Phillips and Hansen's FMOLS approach to heterogeneous panels where the coefficients as well as the value of the dynamic serial correlation are all allowed to differ across individual members of the panel. He proposes three different panel FMOLS estimators: the residual-FM, the adjusted-FM and the group-FM. The first two are *within*-dimension estimators while the group-FM is a *between*-dimension estimator.

Pedroni suggests that the group-FMOLS estimator has advantages over the within-dimension estimators. Specifically, it allows for heterogeneous co-integrating vectors, while the within-FM constrains the co-integrating vector to be the same under the alternative null hypothesis. In addition, Pedroni (2000) shows that the between-dimension estimator exhibits much lower small-sample size distortions than the within-dimension estimators. In the analysis below, the group-FMOLS estimator is used in testing the LOP. The coefficient of interest in our hypothesis tests is β_i in equation (3).

3.4 Contemporaneous cross section correlation

All the approaches mentioned above, including the LL-test, the IPS-test, Pedroni's panel co-integration test and the group-FMOLS estimation, require that disturbances be independent across different members of the panel for a given time period. The assumption of the cross-sectional contemporaneous independence is likely to be violated, since such factors as economy-wide inflation, is likely to drive co-movements of prices across industries. Maddala and Wu (1999) and O'Connell (1998) show that the presence of contemporaneous correlation could significantly change the critical values of test statistics.

A partial and frequently used method for controlling the cross-sectional contemporaneous dependence is to subtract cross-sectional means before performing tests and estimations, which is equivalent to including common time dummies. We present results both with and without controlling for the common time-effects. The inclusion/exclusion of such effects also allows us to investigate two different hypotheses regarding the long-run equilibrium relationship between Canadian and U.S. prices. The coefficients we obtain from the "without time-specific fixed effects" regressions will shed light on what is essentially a *composite* hypothesis, regarding movements in Canadian prices in response to movements in the price of U.S. goods denoted in Canadian dollar terms (the landed price). In contrast, the "with time-specific fixed effects" estimation results will capture the influence of movements in U.S. prices measured in U.S. dollar terms, since the inclusion of time-specific dummy variables will 'explain' the variation in the data due to nominal exchange rate movements.

4. Data and preliminary empirical analysis

4.1 Data source

The price data for the U.S. are the price deflators for the total value of shipments from the NBER-CES productivity database, which covers 459 four-digit U.S. manufacturing industries. The U.S. industries are all matched to the 84 Canadian P-level (around three- and four-digit) industries, using the Standard Industrial Classification created by Statistics Canada and the U.S. Bureau of the Census. The price data for Canada are the implicit price index for gross output from the Canadian KLEMS productivity database. The price data for both countries are available from 1961-1996.

4.2 Preliminary data analysis

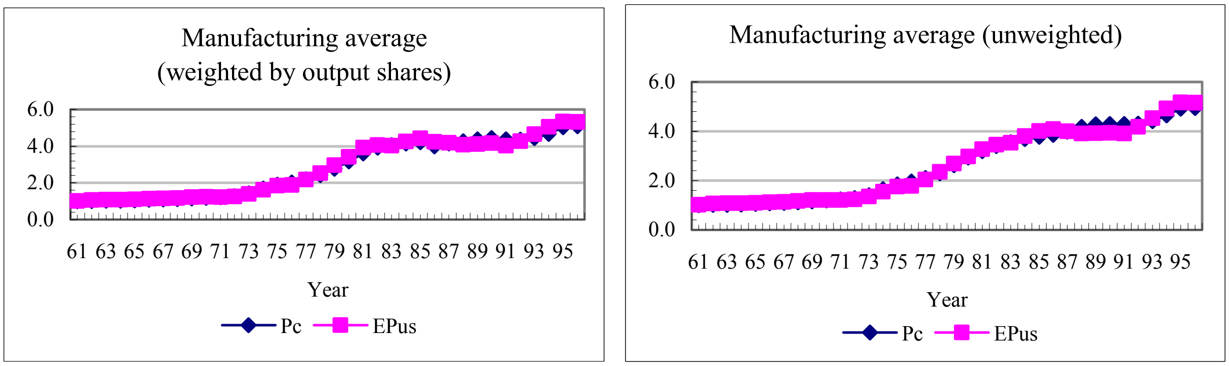
Figures 1 and 2 plot the average price movements for the manufacturing sector as a whole. The price movements for each of the 84 industries are included in Appendix A. There are two main observations.

First, when expressed in a common currency, average manufacturing prices in Canada and the U.S. appear to track each other fairly closely over the 1961-1996 period (see Figure 1). Equivalently, as illustrated in Figure 2, the relative price ratio ($P_t^C / E_t P_t^{US}$) fluctuates around a mean of one—which is consistent with the LOP. The individual manufacturing industries' Canadian and U.S. prices also seem to be reasonably closely associated in the long run when expressed in a common currency, as can be seen from Figure 3. Figure 3 consists of a pair of scatter plots of the average annual percentage changes of the 84 Canadian and U.S. prices (expressed in common currency terms) over the periods 1961-1996 and 1973-1996 respectively. Taken together, the data in Figures 1 and 3 suggest the existence of a strong positive correlation between the long-run movements of Canadian and U.S. prices.[8]

Second, we observe from Figure 2 that considerable fluctuations occur in the relative price ratio ($P_t^C / E_t P_t^{US}$) in the short-run. These are highly correlated with movements in the nominal exchange rate. This strongly suggests that the LOP will be violated in the short run.

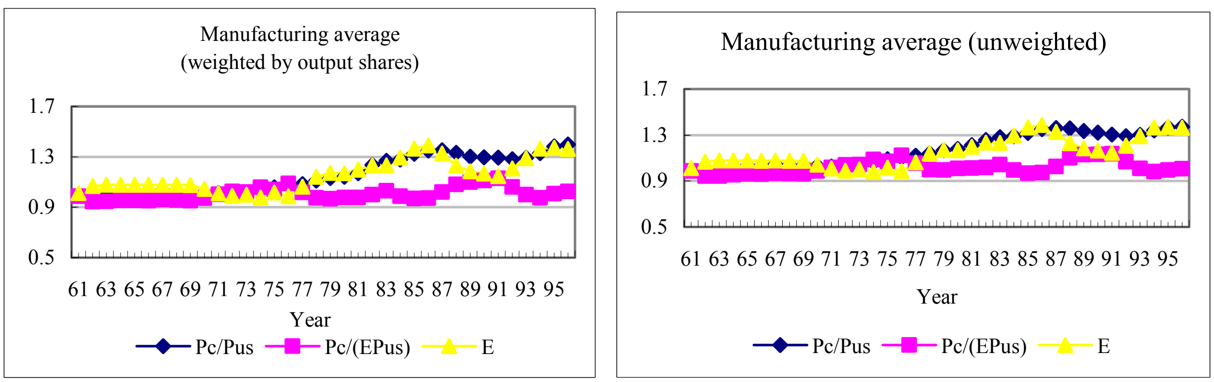
8. In fact the correlation coefficients for the 1961-1996 and 1973-1996 periods are 0.92 and 0.93 respectively. A simple regression of the form $\Delta \ln P_i^C = a + b \Delta \ln EP_i^{US}$ was also run for the 84 manufacturing industries. The results indicate that the association between the two variables, as captured by the coefficient b, is 0.75 and 0.72 for the two periods respectively, which is statistically significant at the 1% level.

Figure 1. Plots of Canadian prices (P^c) and exchange rate adjusted U.S. prices (EP^{us}) for the manufacturing sector



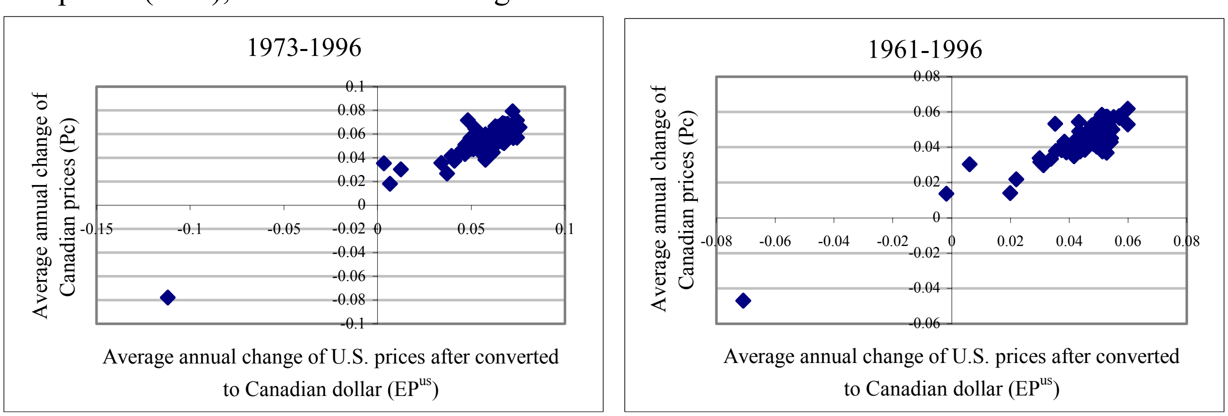
Note: P^c, P^{us} and E stand for Canadian dollar price, U.S. dollar price and nominal exchange rate (Canadian dollar relative to U.S. dollar) respectively. Prices for base year 1961=1.

Figure 2. Plots of own currency relative prices (P^c/P^{us}), common currency relative prices (P^c/EP^{us}) and nominal exchange rate (E), for the manufacturing sector



Note: P^c, P^{us} and E stand for Canadian dollar price, U.S. dollar price and nominal exchange rate (Canadian dollar relative to U.S. dollar) respectively. Prices for base year 1961=1.

Figure 3. Scatter plot of average annual changes of Canadian prices (P^c) and common-currency U.S. prices (EP^{us}), for 84 manufacturing industries



Note: Average annual change is calculated as the log difference of the last and the first year of a decade divided by the number of years.

To examine this further, we divide the whole period (1961-1996) into five sub-periods corresponding to the appreciation and depreciation cycles of the Canadian dollar relative to the U.S. dollar. The average annual percentage changes in nominal exchange rates and in the relative price ratio over these five sub-periods are presented in Table 1. Changes in the ratio are negatively associated with fluctuations in the nominal exchange rate. Most industries share the pattern exhibited by manufacturing average prices. For the 84 industries, the short-run correlation between changes in the relative price ratio and nominal exchange rate is –0.8. This suggests that prices $(P_{it}^{C} / P_{it}^{US})$, in a country's own currency, do not adjust to changes in the nominal exchange rate instantaneously. As a result, the fluctuation in price differences $(P_{it}^{C} / E_t P_{it}^{US})$ largely reflects shifts in the nominal exchange rate in the short run.

The following section uses formal econometric analysis to quantify the extent to which the LOP holds in the long run.

Table 1. Short-run volatility of nominal exchange rate and price differences for the manufacturing sector

Using unweighted average manufacturing prices

Average annual percentage changes	1961-1969	1969-1976	1976-1986	1986-1991	1991-1996
Nominal exchange rate (E)	0.008	-0.013	0.034	-0.039	0.035
Average manufacturing price differences in own currency (P^c/P^{us})	0.004	0.009	0.020	-0.007	0.010
Average manufacturing price differences in common currency (P^c/EP^{us})	-0.003	0.022	-0.014	0.031	-0.025

Using average manufacturing prices weighted by output shares

Average annual percentage changes	1961-1969	1969-1976	1976-1986	1986-1991	1991-1996
Nominal exchange rate (E)	0.008	-0.013	0.034	-0.039	0.035
Average manufacturing price differences in own currency (P^c/P^{us})	0.003	0.006	0.023	-0.008	0.015
Average manufacturing price differences in common currency (P^c/EP^{us})	-0.004	0.019	-0.011	0.030	-0.019

Note: the average annual changes are calculated as the log difference of the last and the first years of a period divided by the number of years in that period. P^c, P^{us} and E stand for Canadian dollar price, U.S. dollar price and nominal exchange rate (Canadian dollar relative to U.S. dollar) respectively.

5. *Empirical results*[9]

The empirical results are presented in the following order. First, we examine the stationarity of the relevant series using panel unit root tests. Second, we explore whether there is any long-run relationship between Canadian and the U.S. prices, using the panel co-integration technique. Third, we test the validity of the absolute LOP using the FMOLS estimator. Finally, we investigate whether the long-run relationship varies with industry characteristics, such as the degree of product differentiation and market integration.

5.1 Levin and Lin (LL) and Im, Pesaran and Shin (IPS) panel unit root tests

Before we begin the panel co-integration test of equation (3), we examine whether each series under consideration contains a unit root. Results for the LL and IPS panel unit root tests, with and without time dummies, are displayed in Table 2. All the statistics are in standardized forms and are distributed according to the standard normal distribution.

The first column of Table 2 reports the test results without common time dummies. Both LL and IPS tests fail to reject the null hypothesis of a unit root for the Canadian prices ($\ln P_{it}^{C}$) and the exchange rate adjusted U.S. prices ($\ln E_t P_{it}^{US}$).

We also carry out tests on the series after attempting to control for cross-sectional dependence via the inclusion of common time dummies. In our case, the $\ln E_t P_{it}^{US}$ series are cross sectional correlated by construction, since they contain a common time component—the nominal exchange rate. In addition to this common component, there are other likely sources for believing *a priori* that there is cross sectional correlation of prices, such as the overall inflation rate. The inclusion of common time dummies reduces the size of the test statistics, but we still fail to reject the unit-root null. Overall then, the series appear to be non-stationary. We now turn to the question of whether they are co-integrated.

Table 2. Panel unit root test of individual series

	Without time dummies		With time dummies	
	$\ln P_{it}^{c}$	$\ln E_t P_{it}^{us}$	$\ln P_{it}^{c}$	$\ln E_t P_{it}^{us}$
Levin and Lin ADF t-stat	4.500	7.051	2.051	3.237
Im, Pesaran and Shin ADF t-stat	2.986	8.443	-1.598	1.020

Note: P_{it}^{c}, P_{it}^{us} and E_t stand for Canadian dollar price, U.S. dollar price and nominal exchange rate (Canadian dollar relative to U.S. dollar) respectively. Statistics reported are all in standardized forms and follows the standard normal distribution.

9. The empirical results in this section were performed using the RATS software. Peter Pedroni is gratefully acknowledged for providing the programs.

5.2 Panel co-integration tests

Many PPP studies suggest that it is more difficult to find parity during a flexible exchange-rate regime. We thus report the panel co-integration test results for two different periods: the whole period (1961-1996) and the flexible exchange-rate period (1973-1996). While it is true that Canada and the United States were on a floating exchange-rate regime well before the collapse of Bretton-Woods, examination of the exchange-rate fluctuations over time, as depicted in Figure 4, shows that the exchange rate followed a very stable route until the mid-70s.

Figure 4. Nominal exchange rate
(Canadian dollar relative to U.S. dollar)

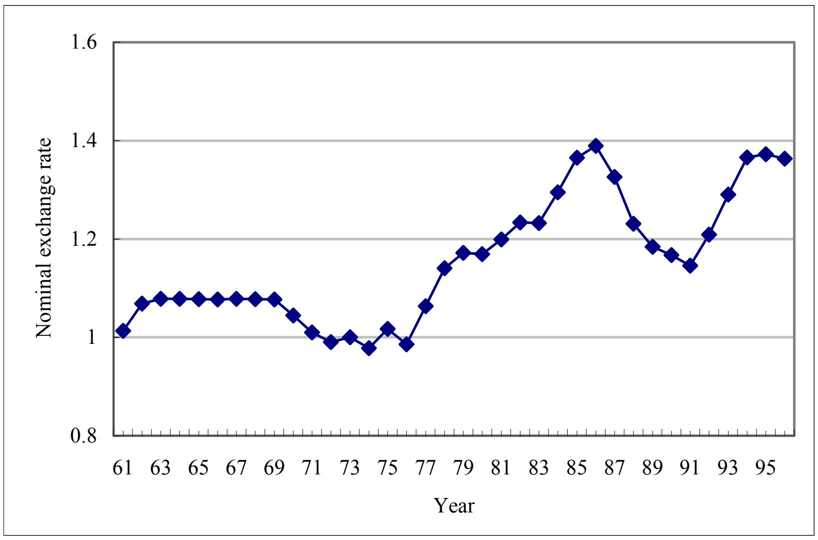


Table 3 contains the panel co-integration test results both with and without time dummies for the null hypothesis of no co-integration.[10] A rejection of the null hypothesis indicates a long-run (or co-integrating) relationship between Canadian and U.S. prices. Statistics reported in Table 3 are all in standardized forms and follow the standard normal distribution. As indicated in section 3.2, a rejection of the null hypothesis requires large positive value for the panel v-statistic and a large negative value for all other statistics.

When we do not correct for common time-effects (without time dummies), the null of no co-integration is strongly rejected for the whole period 1961-1996 by all the seven panel statistics at the 10 percent level or better. For the post Bretton-Woods flexible exchange-rate period (1973-1996), similar results are obtained except that the group ρ-statistic is not significant. Overall, these results are broadly supportive of the hypothesis that a co-integrating relationship of some form exists between Canadian and U.S. prices.

We next turn to the case when time dummies are used to allow for some degree of dependence across sectors.

10. Time trends were not included.

Table 3. Panel co-integration test of ($\ln P_{it}^{c}$) and ($\ln E_t P_{it}^{us}$)

1961-1996	Without time dummies	With time dummies (or remove cross-sectional mean)
panel v-statistic	7.462 *	2.690 *
panel PP ρ-statistic	-4.400 *	-1.334 *
panel PP t-statistic	-3.653 *	-1.957 *
panel ADF t-statistic	-8.781 *	-3.593 *
group PP ρ-statistic	-2.676 *	0.168
group PP t-statistic	-3.644 *	-1.475 *
group ADF t-statistic	-11.075 *	-4.467 *
1973-1996		
panel v-statistic	5.892 *	1.068
panel PP ρ-statistic	-3.335 *	-1.241
panel PP t-statistic	-3.738 *	-2.578 *
panel ADF t-statistic	-7.155 *	-2.131 *
group PP ρ-statistic	-0.011	0.404
group PP t-statistic	-2.449 *	-2.862 *
group ADF t-statistic	-8.433 *	-4.013 *

Note: based on equation (3): $\ln P_{it}^{c} = \alpha_i + \beta_i \ln(E_t P_{it}^{us}) + e_{it}$, where P_{it}^{c}, P_{it}^{us} and E_t stand for Canadian dollar price, U.S. dollar price and nominal exchange rate (Canadian dollar relative to U.S. dollar) respectively. The statistics reported are in standardized forms and follows normal distribution. The panel v-statistic diverges to positive infinity under the alternative hypothesis so that large positive values lead to the rejection of the null of no co-integration. All other statistics diverge to negative infinity under the alternative hypothesis, meaning that large negative values lead to the rejection of the null hypothesis of no co-integration. An asterisk (*) indicates statistical significance at the 10% level or better.

These results are also displayed in Table 3. In this case, we see that for the whole period 1961-1996, results are obtained that are similar to those without time dummies. The null hypothesis of no co-integration is rejected by all the seven panel statistics except the group ρ-statistic at 10 percent level or better, suggesting the series are co-integrated.

For the flexible exchange-rate period (1973-1996) however, the results are less definitive though still suggestive. Four out of the seven statistics reject the null of co-integration for models with time dummies.

Faced with this mixed evidence, how are we to evaluate the level of support (or lack thereof) for the hypothesis of co-integration between $\ln P_{it}^{C}$ and $\ln E_t P_{it}^{US}$? First, we note that of the 14 tests carried out on the *longer* span of data—(1961-1996)—13 suggest rejection of the 'no co-integration' null. The test values that fail to support rejection arise when testing is carried out on the basis of the *shorter* span of data (1973-1996). This latter finding is perhaps, not entirely unexpected, since the rationale for using panel-data in testing PPP in the first place is the low power of tests based on short spans of data. In light of this, and of the fact that—according to Pedroni (1997, 2001)—"[I]f the panel is fairly large...the panel ν-statistic tends to have the best power relative to the other statistics…", we view the results presented in Table 3 as broadly supportive of the co-integration hypothesis.

5.3 Fully modified ordinary least squares (FMOLS) estimates and tests of absolute law of one price (LOP)

Based on what we view as support for the hypothesis that Canadian and U.S. prices obey some form of long-run (co-integrating) relationship, this section describes the results of our attempt to estimate the magnitude of this long-run relationship using Pedroni's FMOLS estimator, testing the validity of the relative version of the LOP along the way.

Tables 4A and 4B contain estimates of the industry-specific co-integrating vectors for each of the 84 industries in our data, for specifications with and without time dummies.

In considering these results, we should be aware of two important aspects of the estimation procedure that was employed. First, as discussed in Section 2, the LOP notion of equality between prices in different countries *when expressed in a common currency* leads naturally to the estimation of a relationship such as equation (3). Such a relationship embodies the implicit assumption that an increase of given magnitude in U.S. prices in the i th industry will have the same consequences for Canadian prices in the i th industry as would an increase of the same magnitude in the nominal exchange rate. Second, as discussed in Section 3.4, when we include time-dummies (or—equivalently—transform the data by expressing it in terms of deviations from time-specific means) we remove all variation in the data resulting from time-varying, industry invariant factors. Crucially, the nominal exchange rate is one such factor and probably a very important one in this category. Consequently, the results presented in Table 4B will be similar to those we would obtain by using $\ln(P_{it}^{US})$ rather than $\ln(E_t P_{it}^{US})$ as the right-hand side variable in our regressions.

By carrying out such a regression, we are implicitly assuming that the exchange rate plays no role in the relationship between Canadian and U.S. prices—i.e., that the value of β_{iE} in equation (4) is zero. In considering these results it should be borne in mind that this is an assumption that might be deemed rather unlikely *a priori*. Presumably however it might apply if goods arbitrage between markets were negligible, or if arbitrageurs faced high 'sunk costs' that left them unwilling to react to (potentially) temporary exchange-rate fluctuations, but responsive to price differences resulting from underlying cost movements (i.e., technological improvements).

Two points are worth noting on the magnitude of the long-run co-integrating relationship.

First we plot the histogram of the long-run co-integrating estimates of β_i by industry in Figure 5, for the cases without and with time dummies. The point estimates range from 0.47 to 1.57 for models without time dummies and range from -2.67 to 2.16 for models with time dummies. This is consistent with other cross-country studies that typically find the estimates of β having wide variation (Froot and Rogoff, *op. cit.*). For example, using the same FMOLS estimation technique, Canzoneri *et al.* (1999)[11] find the long-run coefficients range from -0.03 for Denmark to 1.91 for Austria, while Pedroni (2001)[12] finds the coefficients range from 0.31 for Belgium to 2.12 for India (U.S. dollar is used as a reference country).

11. Canzoneri et al. (1999) use implicit deflators of traded goods (which consist of 'Manufacturing' and 'Agriculture, Hunting, Forestry and Fishing' sectors) for thirteen OECD countries.
12. Pedroni (2001) uses aggregate CPI for twenty countries.

Table 4A. FMOLS estimates and tests of absolute LOP (without time-dummies)

Code	Industry Name	β	t-stat	Code	Industry Name	β	t-stat
14	Poultry, meat and meat product industry	1.08	(4.95)*	56	Ornamental and architectural metal prod. ind.	0.95	(-1.79)
15	Fish products industry	1.05	(1.32)	57	Stamped, pressed and coated metal prod. ind.	0.85	(-6.80)*
16	Fruit and vegetable industry	1.03	(1.15)	58	Wire and wire products industry	0.95	(-2.53)*
17	Dairy products industry	1.35	(7.30)*	59	Hardware, tool and cutlery industry	1.09	(2.28)*
18	Feed, cane and beet sugar, misc. food prod. ind.	1.09	(4.39)*	60	Heating equipment industry	1.08	(2.81)*
19	Vegetable oil mills (except corn oil)	0.98	(-0.30)	61	Machine shop industry	0.94	(-2.23)*
20	Biscuit, bread and other bakery products ind.	1.09	(3.88)*	62	Other metal fabricating industry	0.96	(-1.66)
21	Soft drink industry	1.05	(1.07)	63	Agricultural implement industry	0.83	(-8.32)*
22	Distillery products industry	1.12	(2.22)*	64	Commercial refrigerator and air cond. equip. ind.	1.07	(1.34)
23	Brewery products industry	1.57	(6.95)*	65	Other machinery and equipment industry	0.95	(-2.77)*
24	Wine industry	1.00	(0.17)	66	Aircraft and aircraft parts industry	1.09	(2.96)*
25	Tobacco products industries	0.97	(-0.88)	67	Motor vehicle industry	1.07	(3.85)*
26	Rubber products industries	0.91	(-3.71)*	68	Truck and bus body and trailer industry	0.98	(-0.68)
27	Plastic products industries	1.02	(0.60)	69	Motor vehicle parts and accessories industry	0.74	(-27.02)*
28	Leather, footwear, misc.leather and allied prod. ind.	0.98	(-0.44)	70	Railroad rolling stock industry	1.07	(3.08)*
29	Man-made fibre yarn and woven cloth, wool yarn and woven cloth	1.04	(1.10)	71	Shipbuilding and repair industry	0.98	(-1.06)
30	Broad knitted fabric industry	0.80	(-4.38)*	72	Misc. transportation equipment industry	0.91	(-2.18)*
31	Miscellaneous textile products industry	1.08	(2.60)*	73	Small electrical appliance industry	1.06	(0.85)
32	Carpet, mat and rug industry	0.96	(-1.25)	74	Major appliance ind. (electric and non-electric)	1.10	(1.85)*
33	Clothing, hosiery industry	1.09	(2.07)*	75	Other electrical & electronic prod., battery ind.	1.01	(0.17)
34	Sawmill, planing mill, shingle mill product ind.	0.88	(-8.93)*	76	Record player, radio and television receiver ind.	0.47	(-0.58)
35	Veneer and plywood industry	0.99	(-0.14)	77	Communication and other electronic equip. ind.	1.45	(2.38)*
36	Sash, door and other millwork industry	1.01	(0.13)	78	Office, store and business machine industry	0.72	(-2.80)*
37	Wooden box and coffin industry	1.17	(2.84)*	79	Commun. and energy wire and cable industry	1.09	(1.92)*
38	Other wood industry	1.06	(0.68)	80	Clay products industry	1.07	(1.72)
39	Household furniture industry	1.12	(2.93)*	81	Hydraulic cement industry	1.09	(1.91)*
40	Office furniture industry	1.02	(0.95)	82	Concrete products industry	1.07	(1.77)
41	Other furniture and fixture industry	1.08	(2.04)*	83	Ready-mix concrete industry	1.04	(1.06)
42	Pulp and paper industry	1.04	(1.02)	84	Glass and glass products industry	0.92	(-3.50)*
43	Asphalt roofing industry	0.89	(-4.43)*	85	Misc. non-metallic mineral product industry	0.99	(-0.31)
44	Paper box and bag industry	0.97	(-1.37)	86	Refined petroleum and coal products industry	1.04	(1.07)
45	Other converted paper products industry	0.99	(-0.32)	87	Industrial chemicals industries n.e.c.	0.94	(-2.68)*
46	Printing and publishing industry	0.98	(-0.64)	88	Chemical products industries n.e.c.	1.05	(1.71)
47	Platemaking, typesetting and bindery industry	1.09	(1.83)*	89	Plastic and synthetic resin industry	0.87	(-3.84)*
48	Primary steel industry	0.94	(-4.26)*	90	Pharmaceutical and medicine industry	0.91	(-2.28)*
49	Steel pipe and tube industry	0.85	(-4.58)*	91	Paint and varnish industry	1.11	(4.98)*
50	Iron foundries	0.93	(-2.86)*	92	Soap and cleaning compounds industry	0.90	(-3.52)*
51	Non-ferrous metal smelting and refining ind.	0.96	(-1.65)	93	Toilet preparations industry	0.94	(-1.49)
52	Aluminum rolling, casting and extruding ind.	0.93	(-2.22)*	94	Floor tile, linoleum and coated fabric	1.18	(4.91)*
53	Copper and alloy roll., cast. and extr. industry	0.83	(-5.00)*	95	Jewellery and precious metal industries	1.21	(2.74)*
54	Other roll., cast and extr. non-ferr. met. prod. ind.	0.97	(-1.37)	96	Sporting goods and toy industries	1.06	(1.32)
55	Power boiler and structural metal industry	1.03	(1.33)	97	Sign and display industry	0.93	(-2.61)*
Pooled group-FMOLS estimates (without time dummies):		1.01	(-3.18)*				

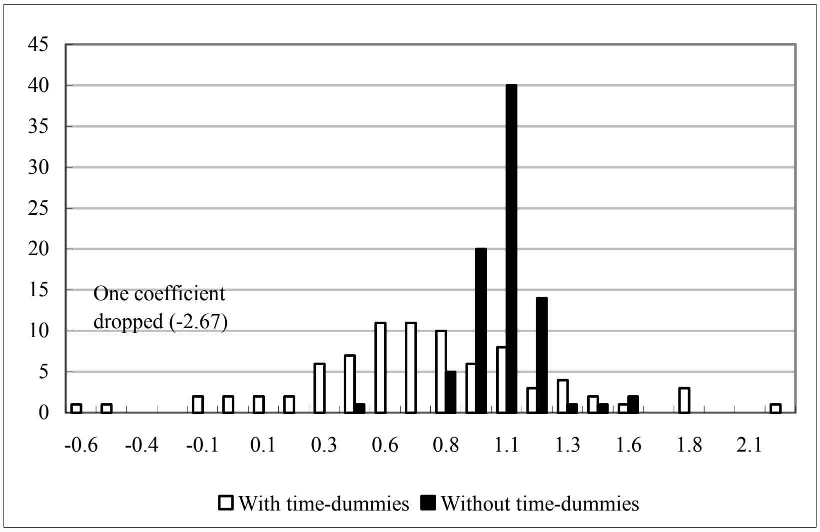
Note: based on equation (3): $lnP_{it}^{c} = \alpha_i + \beta_i\, ln(E_t\, P_{it}^{us}) + e_{it}$ without time dummies. The t-statistics are reported for individual hypothesis test that H_o:β_i=*1*and for panel hypothesis test that H_o:β_1= β_2=..β_i=*1*. One asterisk (*) indicates statistically significant at 10% level or better.

Table 4B. FMOLS estimates and tests of absolute LOP (with time-dummies)

Code	Industry Name	β	t-stat	Code	Industry Name	β	t-stat
14	Poultry, meat and meat product industry	0.75	(-5.52)*	56	Ornamental and architectural metal prod. ind.	-0.23	(-5.83) *
15	Fish products industry	1.09	(0.93)	57	Stamped, pressed and coated metal prod.ind.	-0.11	(-4.93) *
16	Fruit and vegetable industry	1.00	(0.02)	58	Wire and wire products industry	0.28	(-5.34) *
17	Dairy products industry	-2.67	(-7.74)*	59	Hardware, tool and cutlery industry	1.72	(2.83) *
18	Feed, cane and beet sugar, misc. food prod. ind.	0.59	(-4.00)*	60	Heating equipment industry	0.58	(-1.77) *
19	Vegetable oil mills (except corn oil)	0.82	(-2.01)*	61	Machine shop industry	0.44	(-7.99) *
20	Biscuit, bread and other bakery products ind.	1.26	(2.75)*	62	Other metal fabricating industry	0.47	(-3.90) *
21	Soft drink industry	1.12	(0.36)	63	Agricultural implement industry	-0.18	(-21.89) *
22	Distillery products industry	0.75	(-2.50)*	64	Commercial refrigerator and air cond. equip. ind.	0.56	(-5.04) *
23	Brewery products industry	-0.68	(-3.46)*	65	Other machinery and equipment industry	0.57	(-7.09) *
24	Wine industry	0.61	(-1.65)	66	Aircraft and aircraft parts industry	1.39	(4.34) *
25	Tobacco products industries	0.79	(-2.85)*	67	Motor vehicle industry	1.00	(0.00)
26	Rubber products industries	1.75	(0.81)	68	Truck and bus body and trailer industry	0.90	(-0.39)
27	Plastic products industries	1.07	(0.30)	69	Motor vehicle parts and accessories industry	-0.52	(-8.85) *
28	Leather, footwear, misc. leather and allied prod. ind.	0.25	(-6.91)*	70	Railroad rolling stock industry	1.27	(2.29) *
29	Man-made fibre yarn and woven cloth, wool yarn and woven cloth	0.97	(-0.43)	71	Shipbuilding and repair industry	0.69	(-5.37) *
30	Broad knitted fabric industry	1.24	(6.38)*	72	Misc. transportation equipment industry	0.27	(-2.35) *
31	Miscellaneous textile products industry	0.57	(-1.87)*	73	Small electrical appliance industry	0.72	(-3.67) *
32	Carpet, mat and rug industry	1.07	(1.72)*	74	Major appliance ind. (electric and non-electric)	0.69	(-4.08) *
33	Clothing, hosiery industry	0.72	(-5.96)*	75	Other electrical and electronic prod., battery ind.	0.31	(-4.85) *
34	Sawmill, planing mill, shingle mill product ind.	0.48	(-3.86)*	76	Record player, radio and television receiver ind.	0.67	(-15.15) *
35	Veneer and plywood industry	0.82	(-1.18)	77	Communication and other electronic equip. ind.	0.43	(-17.75) *
36	Sash, door and other millwork industry	0.88	(-0.57)	78	Office, store and business machine industry	0.80	(-4.00) *
37	Wooden box and coffin industry	0.70	(-0.74)	79	Commun. and energy wire and cable industry	0.43	(-4.84) *
38	Other wood industry	1.29	(0.39)	80	Clay products industry	1.52	(2.99) *
39	Household furniture industry	0.17	(-1.65)	81	Hydraulic cement industry	1.13	(0.44)
40	Office furniture industry	0.93	(-0.92)	82	Concrete products industry	1.40	(1.21)
41	Other furniture and fixture industry	0.80	(-0.48)	83	Ready-mix concrete industry	1.04	(0.21)
42	Pulp and paper industry	0.97	(-0.14)	84	Glass and glass products industry	-0.04	(-5.42) *
43	Asphalt roofing industry	0.51	(-4.48)*	85	Misc. non-metallic mineral product industry	0.69	(-2.88) *
44	Paper box and bag industry	0.60	(-4.21)*	86	Refined petroleum and coal products industry	0.98	(-0.18)
45	Other converted paper products industry	0.70	(-3.19)*	87	Industrial chemicals industries n.e.c.	0.62	(-5.58) *
46	Printing and publishing industry	0.93	(-0.75)	88	Chemical products industries n.e.c.	0.34	(-6.06) *
47	Platemaking, typesetting and bindery industry	0.40	(-1.22)	89	Plastic and synthetic resin industry	0.21	(-4.87) *
48	Primary steel industry	0.50	(-10.80)*	90	Pharmaceutical and medicine industry	0.70	(-2.43) *
49	Steel pipe and tube industry	0.04	(-4.43)*	91	Paint and varnish industry	1.71	(3.12) *
50	Iron foundries	0.38	(-7.83)*	92	Soap and cleaning compounds industry	0.03	(-1.73)
51	Non-ferrous metal smelting and refining ind.	0.71	(-1.90)*	93	Toilet preparations industry	0.58	(-3.82) *
52	Aluminum rolling, casting and extruding ind.	0.40	(-3.31)*	94	Floor tile, linoleum and coated fabric	0.28	(-4.10) *
53	Copper and alloy roll., cast. and extr. industry	0.51	(-1.36)	95	Jewellery and precious metal industries	2.16	(3.77) *
54	Oth. roll., cast and extr. non-ferr. met. prod. ind.	0.79	(-2.05)*	96	Sporting goods and toy industries	0.85	(-0.83)
55	Power boiler and structural metal industry	0.94	(-0.91)	97	Sign and display industry	0.51	(-6.15) *
Pooled group-FMOLS estimates (with time dummies):		0.66	(-26.75)*				

Note: based on equation (3): $lnP^{c}_{it} = \alpha_i + \beta_i\, ln(E_t\, P^{us}_{it}) + e_{it}$ with time dummies. The t-statistics are reported for individual hypothesis test that $H_o{:}\beta_i=1$ and for panel hypothesis test that $H_o{:}\beta_1= \beta_2=..\beta_i=1$. One asterisk (*) indicates statistically significant at 10% level or better.

Figure 5. Estimates of co-integrating coefficients, by industry



Tests of the null hypothesis that the long-run co-integrating relationship β_i = 1 are presented in Tables 4A and 4B. A finding that β_i is significantly different from unity constitutes a rejection of the stronger forms of the LOP. In more than half of the industries, the null hypothesis is rejected at the 10% level or better. For models without time dummies, 47 out of 84 industries (56%) have coefficients significantly different form one. And for models with time dummies, 57 of 84 industries (66%) have coefficients significantly different from one.

Second, the panel estimates of β for the manufacturing sector as a whole are 1.01 for the model without time dummies and 0.66 for the model with time dummies.[13] Both are close to but significantly different from one, suggesting a rejection of the LOP.[14] The point estimates of 0.66 are similar to those found by Canzoneri et al. (1999) who, find that the long-run coefficient between Canada and the U.S. traded goods is 0.61.

The above evidence thus points to the rejection of the stronger forms of LOP. While the average across all industries that considers how Canadian manufacturing prices respond to U.S. prices expressed in Canadian dollars is very close to one, there is a small statistically significant difference. However, what is more important, most industries deviate from one.

Whilst the individual (i.e., industry-specific) β_i s are not the focus of the tests carried out here, it is nonetheless instructive to consider how sensitive these coefficient values are to the estimation techniques employed. To address this issue, we obtain comparable estimates of the 84 industry specific β_i s (as presented in Tables 4A and 4B in the paper) in two different ways:

13. We excluded the two industries (77 and 78) where U.S. prices are not market prices, but rather are determined using hedonics.
14. Both the 'absolute' and the 'relative' forms of the LOP would require $\beta = 1$. Hence we can reject both, without considering the values of the industry-specific intercept terms.

- By simple OLS
  - With industry-specific fixed effects only
  - With industry-specific fixed effects and time-specific fixed-effects
- Using a GLS approach
  - With industry-specific fixed-effects only
  - With industry-specific fixed-effects and time-specific fixed effects

The OLS approach will be consistent, but is inefficient if errors are not independently and identically distributed within and/or between equations. The GLS approach to system-estimation with cross-correlated errors—also known as Joint Generalized Least Squares estimation, or as Seemingly Unrelated Regression (SUR) —will be consistent *and* efficient in such a case. Results are presented in Table B1[15], and in Figures B1-B4 in Appendix B.[16]

There is very little difference between the Fully-Modified OLS results with time-specific fixed-effects (*without time-specific fixed-effects*) and the simpler OLS results with time-specific fixed-effects (*without time-specific fixed-effects*). The additional 'sophistication' (the correction for data non-stationarity) makes relatively little difference for the purposes of inference.

We should note that FGLS with the variance matrix constrained to be diagonal should yield the same results as OLS, and running the SUR procedure with the *sdiag* option in SAS, no time-specific fixed effects, but including industry-specific fixed effects does indeed yield the same results as simple OLS. These results change relatively little when we allow for non-zero off-diagonal covariances. Given that the 'with time-specific fixed effects' results differ substantially from the 'without time-specific fixed effects' results for both the FMOLS and OLS regressions, we can infer that the move to SUR estimation does ***not*** capture the variation in the data which is captured by the inclusion of time dummies.[17]

Overall, the results from employing two alternatives to FMOLS are broadly similar to the FMOLS results.

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15. Note that t-stats are very different in the FMOLS results. That's because the FMOLS results are testing a different hypothesis ($\beta = 1$) than the other t-stats (which are for $\beta = 0$).
16. When the cross-equation covariance matrix Σ required by the GLS approach is unknown (as is the case here) we need to estimate it. However, there are limitations to the dimension of the system which can be estimated using Feasible GLS. In particular, we must have $T \geq N$ if the covariance matrix is to be non-singular (and hence invertible). Since we have $T = 36$ and $N = 84$ it will not be possible to estimate our entire system of industry PPP equations jointly. Nonetheless, there may be efficiency gains from carrying out FGLS/SUR estimation jointly on subsets of equations. The SUR results presented below are from carrying out SUR estimation on each of three systems. Those systems consist of the equations for industries 14-41, 42-69 and 70-97 respectively.
17. The reason may be that the GLS/SUR formulation imposes time-homogeneity on the covariance matrix (the correlation between industry-specific disturbance terms is allowed to be different for different pairs of industries, but is constrained to be identical—for a given pair of industries—in every time period). In contrast, the FMOLS and OLS approaches to modelling common (across all industries) disturbances allows for the time-specific fixed effects to vary over time.

5.4 Industry effect

The FMOLS estimates of β suggest that the slopes of the co-integrating relationships do vary with industries. This is what one would have expected, since industries differ in their product and market characteristics and are thus subject to different degrees of commodity arbitrage. In this section, we investigate whether the long-run relationships differ systematically with these industry characteristics.

First, we classify industries into two groups according to the degree of product differentiation, as measured by the Grubel-Lloyd intra-industry trade index.[18] The top 25% and the bottom 25% of industries in terms of intra-industry trade index are classified as industries with high and low product differentiation respectively. One would expect the long-run relationship for homogenous products to be close to one, as predicted under the LOP ($\beta_i = 1$). Perfect non-substitutability between home and foreign products would suggest, by contrast, that $\beta_i = 0$. The lower the degree of product differentiation within an industry, the closer to 1 we would expect β_i to be. Table 5 reports the FMOLS estimates of β_i for the two groups. The point estimate for those industries characterized by a low degree of product differentiation is closer to 1 than that for industries with a high degree of product differentiation. This is true for both cases: with and without time dummies.

Next we classify industries into two groups according to the 'degree of market integration'—measured by an industry's average tariff rate over the period 1961-1996.[19] The top 25% and the bottom 25% of industries in terms of the height of the tariff rate are classified as industries with 'high' and 'low' tariff rates respectively. One would expect the long-run relationship for perfectly integrated home and foreign markets would be close to one. Perfect segmentation of markets would suggest, by contrast, that $\beta_i = 0$. Table 5 also reports the FMOLS estimates of β_i for the two groups according to tariff rate. The point estimates are closer to 1 for the 'low' tariff rate industries. This is true for both cases (i.e., with and without time dummies).

18. 'Intra-industry trade' refers to the phenomenon of simultaneous import and export in the same industry between similar countries. It is intimately associated with the notion of product differentiation (Grubel and Lloyd 1975). Data for our intra-industry trade index was constructed using Canadian input-output tables.
19. Tariff rates are constructed using Canadian input-output tables.

Table 5. FMOLS estimates of β_i by industry groups

Equation (3): $lnP_{it}^{c} = \alpha_i + \beta_i \, ln(E_t \, P_{it}^{us}) + e_{it}$

Without time dummy		Product Differentiation (Grubel intra-industry trade index) High (high GB index)	Product Differentiation (Grubel intra-industry trade index) Low (low GB index)	Product Differentiation (Grubel intra-industry trade index) All values of GB index
Market integration	High average tariff rate	1.08* (4.67)	1.06* (2.18)	1.07* (5.62)
	Low average tariff rate	0.96* (-4.38)	0.98* (-4.89)	0.95* (-14.49)
	All values of tariff rate	1.07* (6.03)	0.99 (0.03)	

With time dummy		Product Differentiation (Grubel intra-industry trade index) High (high GB index)	Product Differentiation (Grubel intra-industry trade index) Low (low GB index)	Product Differentiation (Grubel intra-industry trade index) All values of GB index
Market Integration	High average tariff rate	0.62* (-4.89)	0.80 (-0.77)	0.51* (-11.87)
	Low average tariff rate	0.99 (-1.46)	0.92* (-6.38)	0.67* (-8.20)
	All values of tariff rate	0.64* (-12.65)	0.72* (-12.04)	

Note: The t-statistics (in parentheses) are reported for group hypothesis test that H_o:β_i=*1*. One asterisk (*) indicates statistically significant at 10% level or better.

6. Conclusion

This paper has examined a panel of 84 Canadian and U.S. industries in an attempt to answer the question "*How well does the Law of One Price (LOP) explain the behaviour of Canadian and U.S. prices?*"

Preliminary data analysis suggests the LOP fails to hold across a wide range of industries in the short run, as demonstrated by the frequent departure of 'commodity specific real exchange rates' from their LOP-consistent value of 1. We find that fluctuations in these 'commodity-specific real exchange rates' are closely associated with fluctuations in the value of the nominal Canada/U.S. exchange rate.

We also examined the nature of long-run relationship between Canadian prices and U.S. prices expressed in Canadian dollar terms. Our results are broadly supportive of a relationship (i.e., there is evidence of co-movement of common-currency Canadian and U.S. prices in the long run). This conclusion is relatively insensitive to whether we examine the price behaviour under mixed exchange-rate regimes or in the post Bretton-Woods flexible exchange-rate regime.

While there is a long-run relationship, we do not find support for the absolute version of the Law of One Price. Support for the LOP based on tests of the residuals from co-integrating regressions (i.e. based on the panel co-integration techniques mentioned above) constitutes support for what is arguably a rather weak version of the LOP hypothesis.

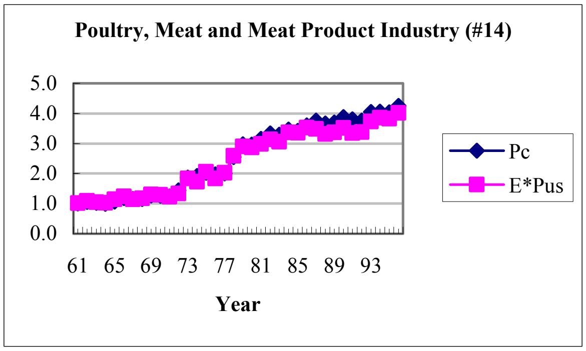
We then proceed to examine an aspect of what some might regard as the essence of arbitrage relationships like the LOP—the notion of proportionality between common-currency Canadian and U.S. prices. Is, say, a doubling of Canadian prices matched by a doubling of U.S. prices when those prices are expressed in common currency terms? This is a question that is clearly of considerable importance to a statistical agency. Its validity would allow us to infer the (proportionate) increase in a Canadian industry's price index based on the increase in the corresponding United States' industry's index, together with the change in the nominal exchange rate between the two countries. In particular, when a price of a traded good is missing from the Canadian but not the American statistical system, the agency would be justified in filling in the missing observation with the U.S. price corrected for the exchange rate.

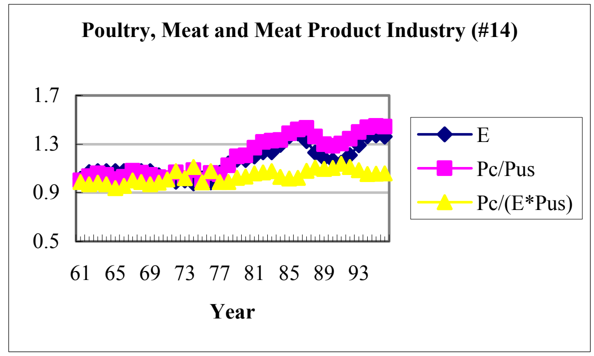
Our evidence does not support the hypothesis of the Law of One Price at the industry level. Not only do we reject the hypothesis that common-currency prices for all 84 industries *jointly* satisfy proportionality (though admittedly the deviation of the coefficient from one is not large), but more importantly we reject proportionality for the majority of industries considered *individually*. Specifically, we reject the proportionality hypothesis at the individual (industry) level for forty-seven out of eighty-four industries in regressions that consider how Canadian prices respond to U.S. prices expressed in common currency, and for fifty-seven industries in regressions that rule out common effects such as exchange-rate changes. Although Canadian and the U.S. prices move together in the long run, the magnitude of the co-movement relationship is not one-to-one, especially at the industry level.

Finally, we investigate whether the extent of the co-movements between Canadian and the U.S. prices varies with industry characteristics. We find that as the degree of product substitutability and market integration increase, the correlation between Canadian and the U.S. prices also become stronger.

Three major questions are left unanswered and will provide the focus for future research. The first is the extent to which the short-run lags of Canadian prices in reaction to changes in the exchange rate differ by industry and how the adaptation coefficients are related to industry characteristics. The second is the extent to which Canadian prices react differentially to the exchange rate and to movements in U.S. prices expressed in U.S. dollars. The third project will explore in more detail differences in the performance of industries whose long-run adaptation coefficient is above, as opposed to, below zero.

Appendix A


Poultry, Meat and Meat Product Industry (#14)
5.0
4.0
3.0
2.0
1.0
0.0
61 65 69 73 77 81 85 89 93
Year
Pc
E*Pus


Poultry, Meat and Meat Product Industry (#14)
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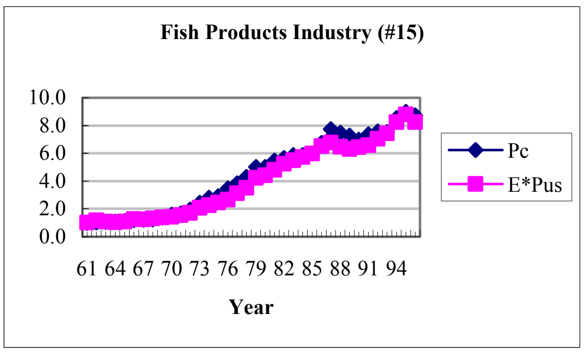
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)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2.0
0.0
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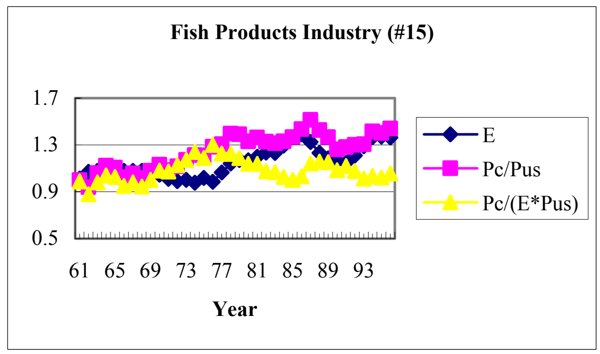
Year
Pc
E*Pus


Fish Products Industry (#15)
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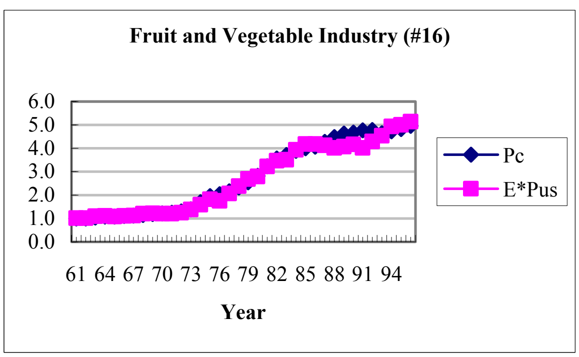
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)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4.0
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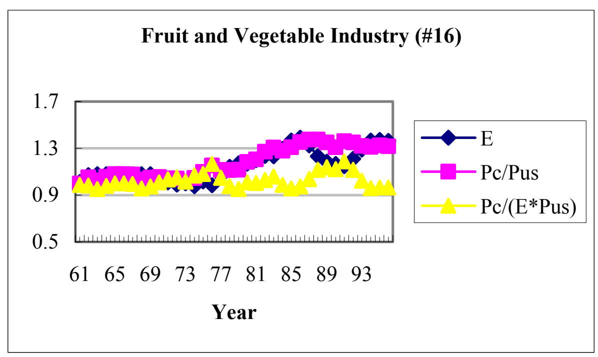
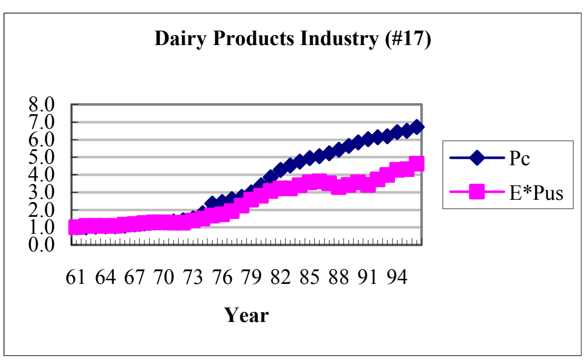
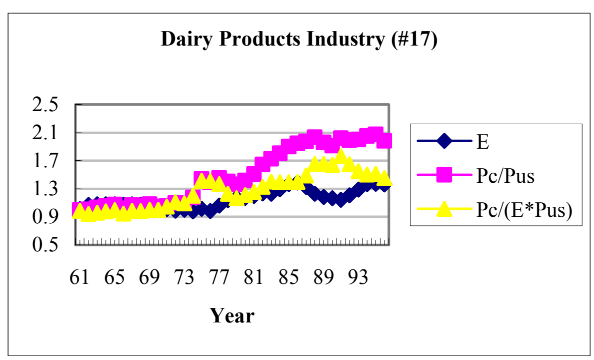
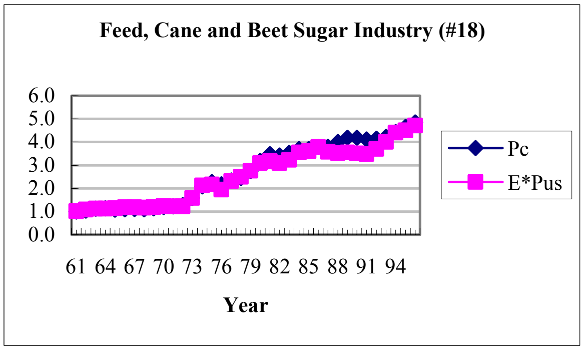
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Fruit and Vegetable Industry (#16)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)


Dairy Products Industry (#17)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Dairy Products Industry (#17)
2.5
2.1
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)


Feed, Cane and Beet Sugar Industry (#18)
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5.0
4.0
3.0
2.0
1.0
0.0
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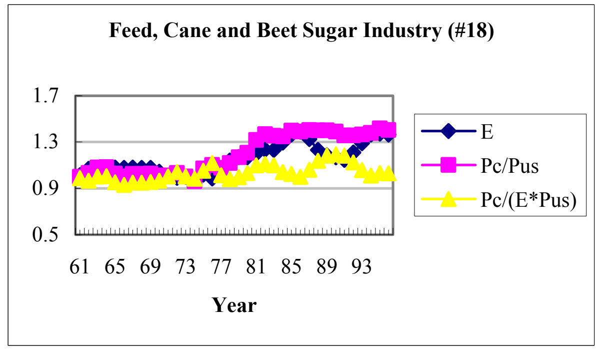
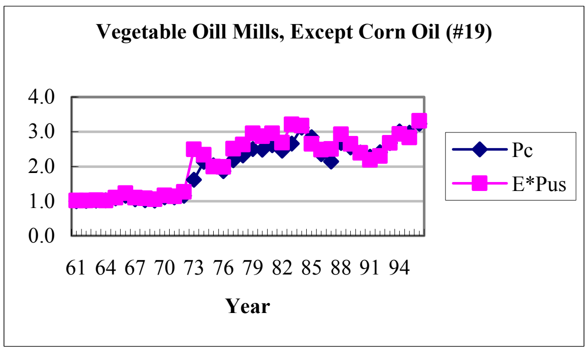
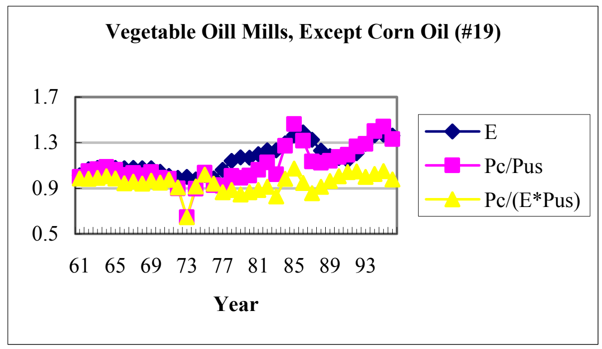
Year
Pc
E*Pus


Feed, Cane and Beet Sugar Industry (#18)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)


Vegetable Oill Mills, Except Corn Oil (#19)
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Vegetable Oill Mills, Except Corn Oil (#19)
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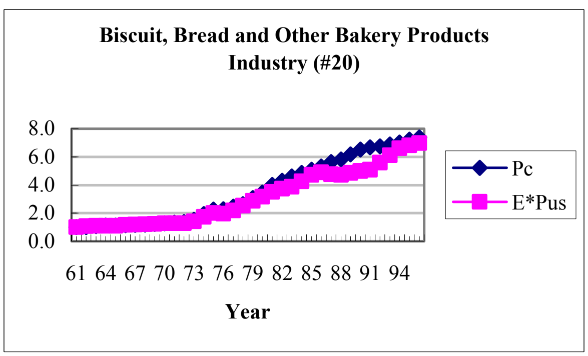
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)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6.0
4.0
2.0
0.0
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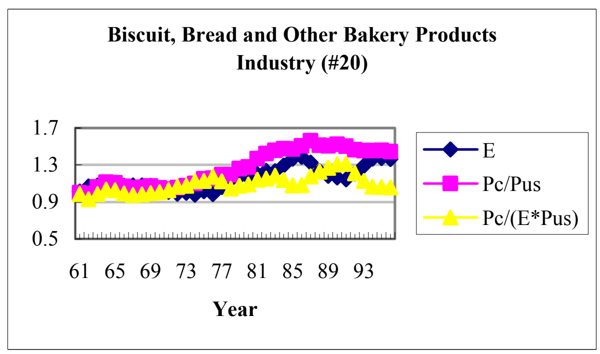
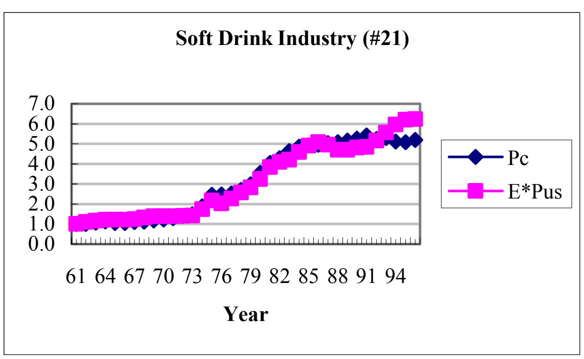
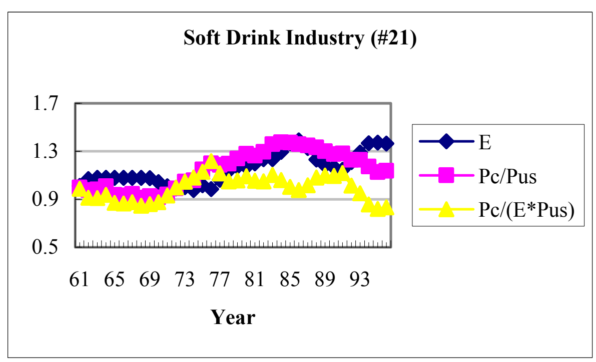
Year
Pc
E*Pus


Biscuit, Bread and Other Bakery Products Industry (#20)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)


Soft Drink Industry (#21)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Soft Drink Industry (#21)
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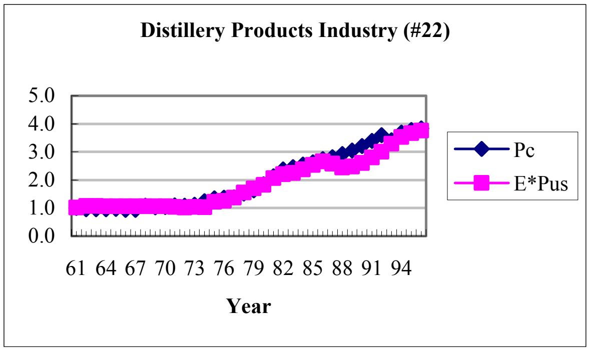
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)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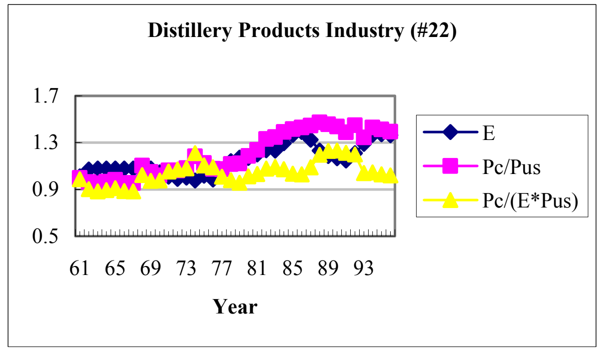
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus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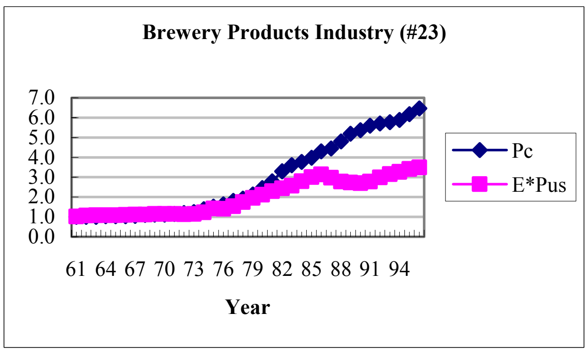
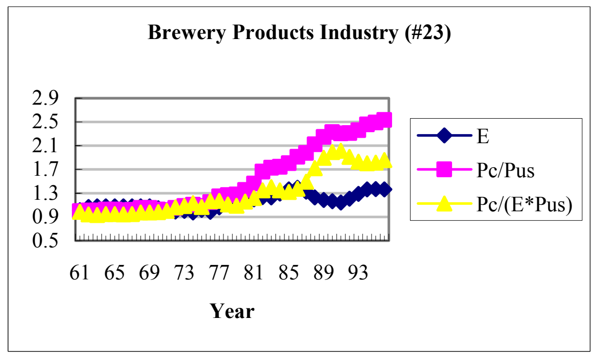
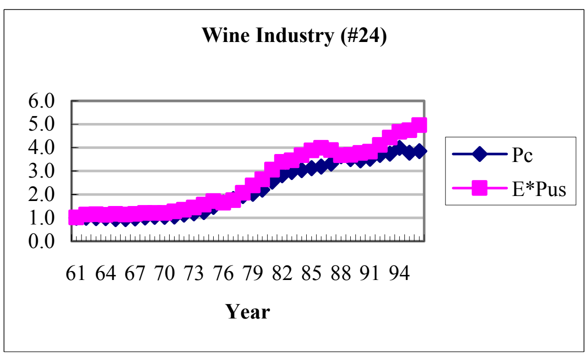
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)


Brewery Products Industry (#23)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Brewery Products Industry (#23)
2.9
2.5
2.1
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)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2.0
1.0
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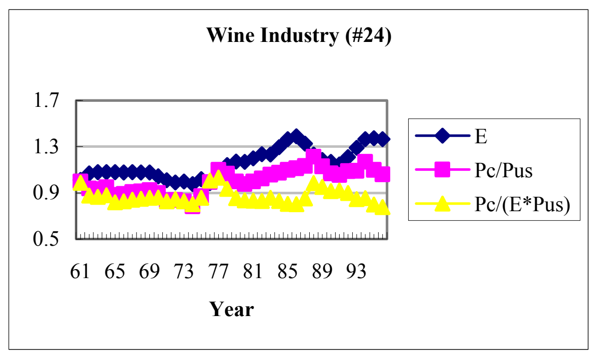
Year
Pc
E*Pus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1.7
1.3
0.9
0.5
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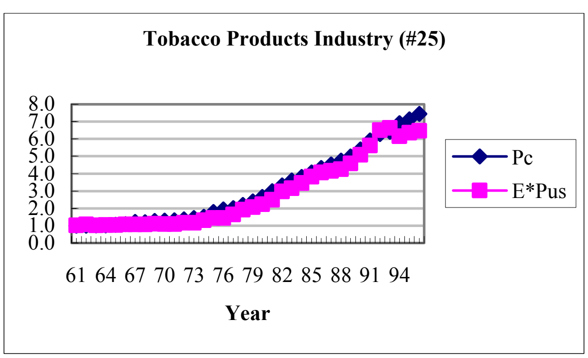
Year
E
Pc/Pus
Pc/(E*Pus)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1.0
0.0
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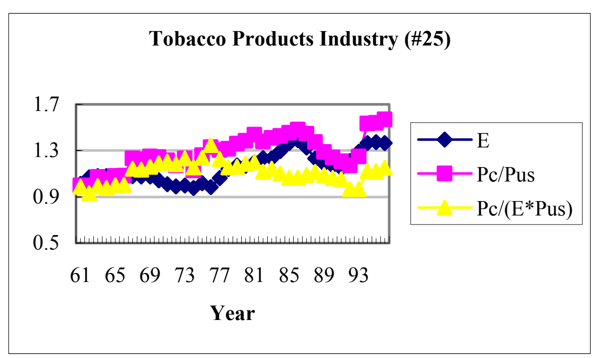
Year
Pc
E*Pus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1.3
0.9
0.5
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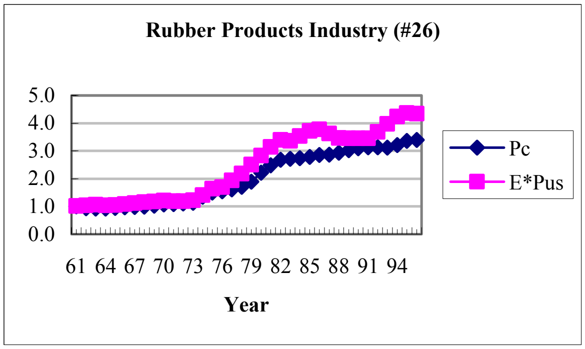
Year
E
Pc/Pus
Pc/(E*Pus)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1.0
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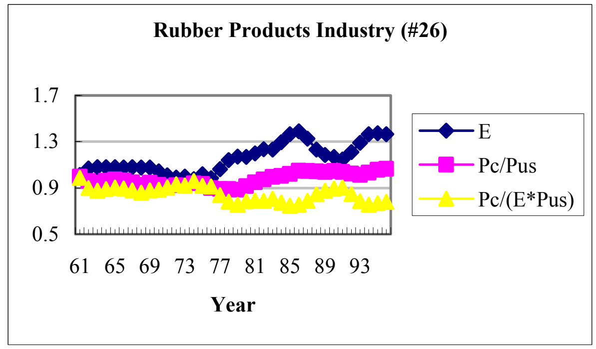
Year
Pc
E*Pus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1.3
0.9
0.5
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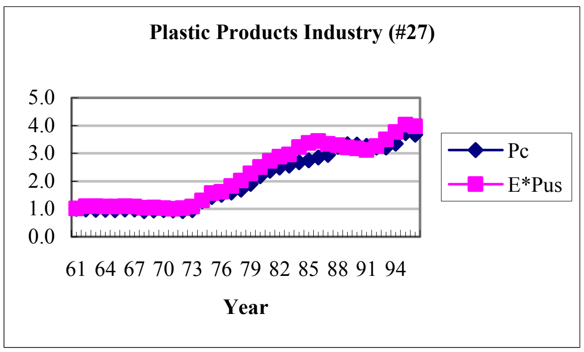
Year
E
Pc/Pus
Pc/(E*Pus)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3.0
2.0
1.0
0.0
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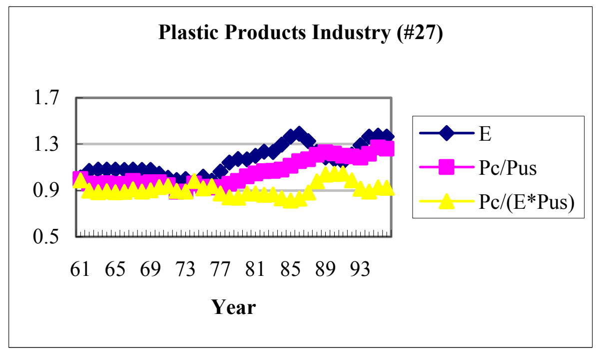
Year
Pc
E*Pus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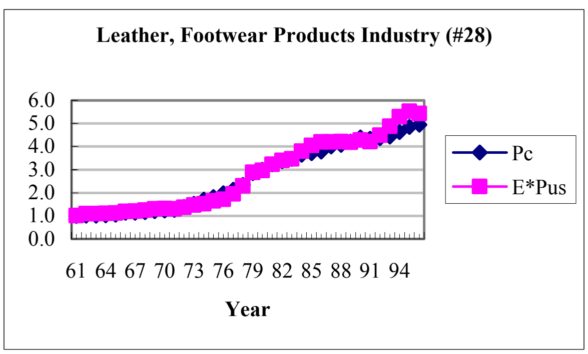
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)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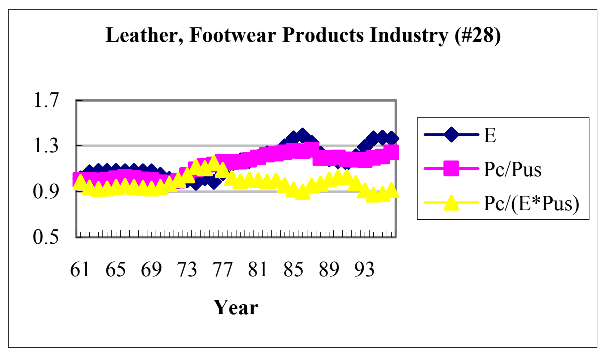
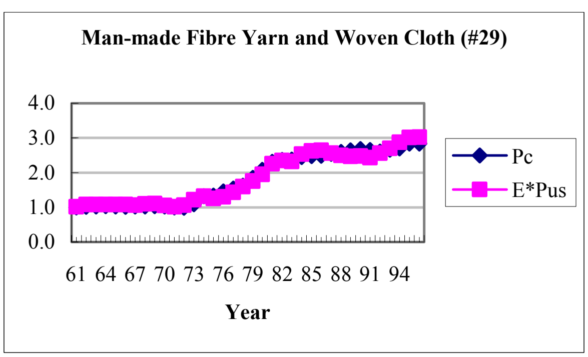
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Leather, Footwear Products Industry (#28)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)


Man-made Fibre Yarn and Woven Cloth (#29)
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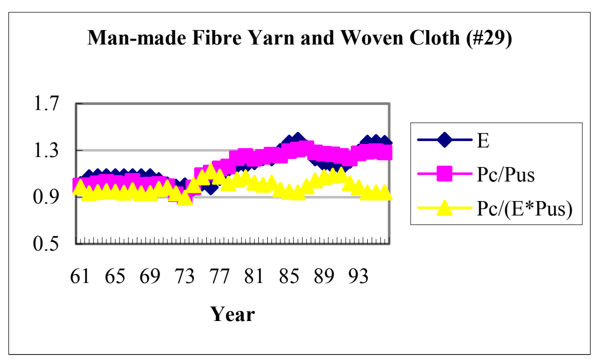
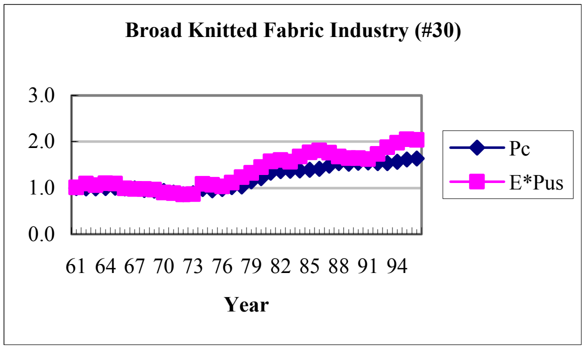
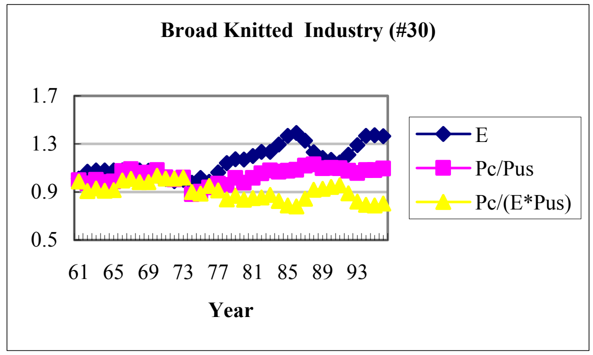
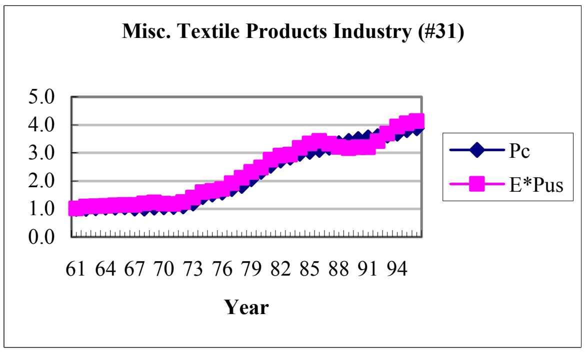
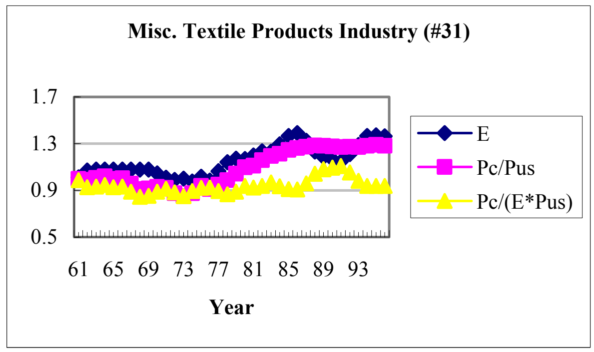
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

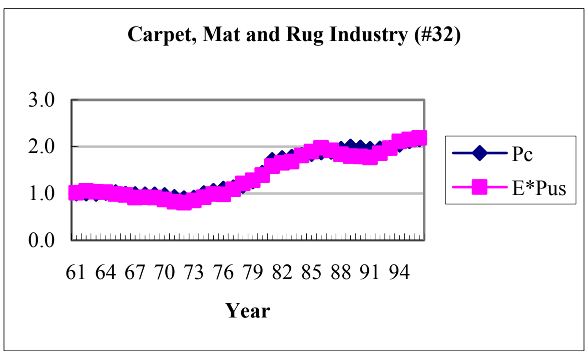

Man-made Fibre Yarn and Woven Cloth (#29)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

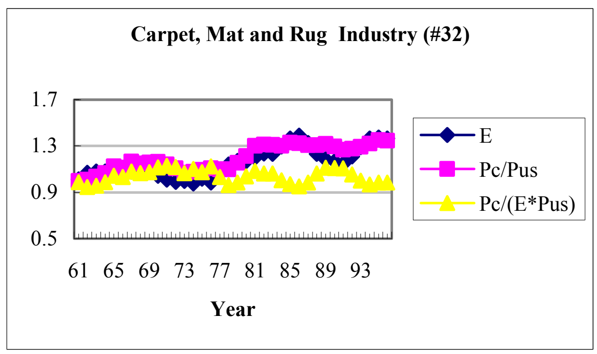

Broad Knitted Fabric Industry (#30)
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

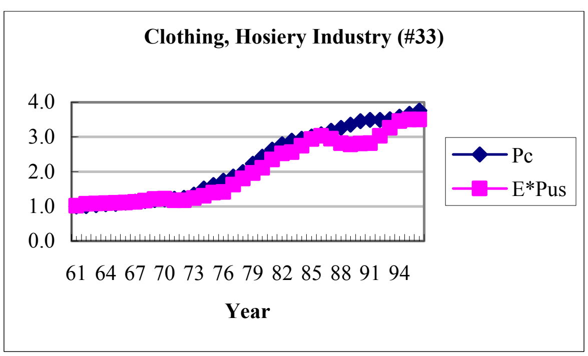

Broad Knitted Industry (#30)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

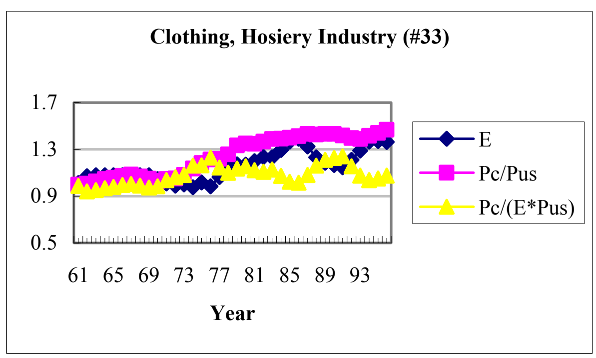

Misc. Textile Products Industry (#31)
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

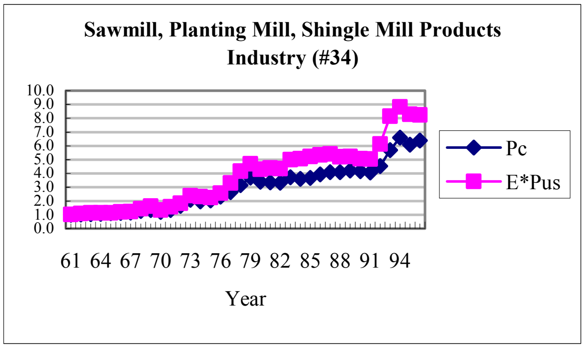

Misc. Textile Products Industry (#31)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

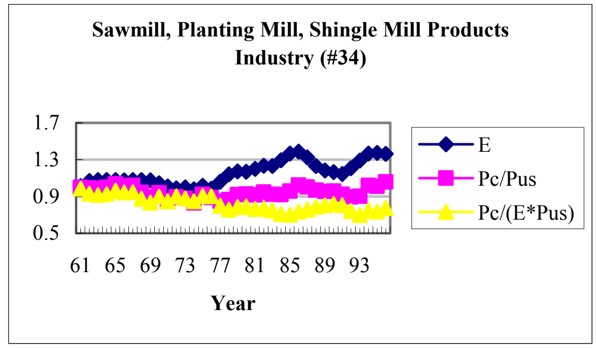

Carpet, Mat and Rug Industry (#32)
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

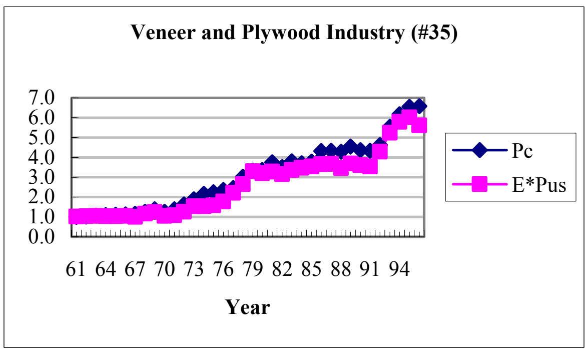

Carpet, Mat and Rug Industry (#32)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

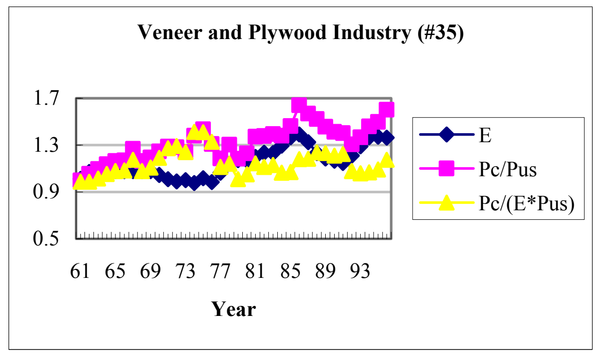

Clothing, Hosiery Industry (#33)
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

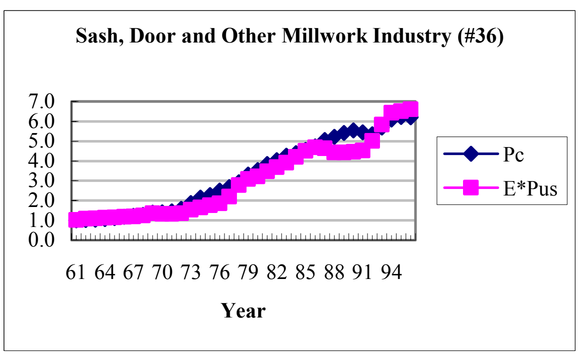

Clothing, Hosiery Industry (#33)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

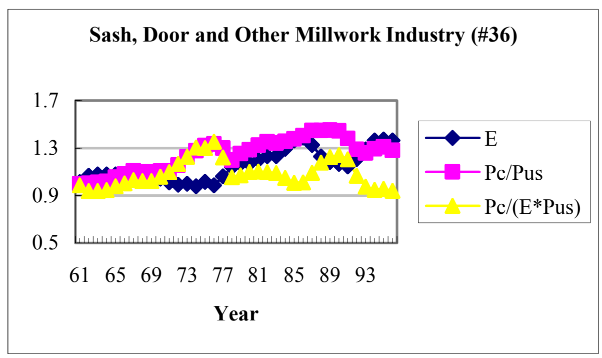

Sawmill, Planting Mill, Shingle Mill Products Industry (#34)
10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

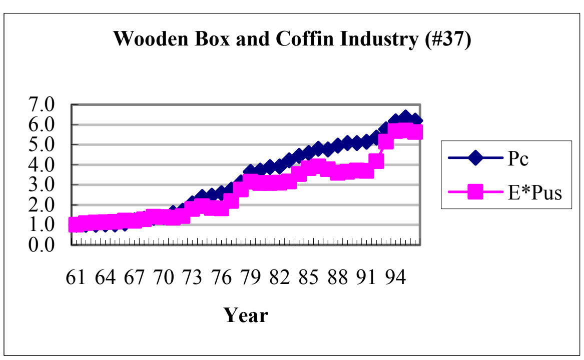

Sawmill, Planting Mill, Shingle Mill Products Industry (#34)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

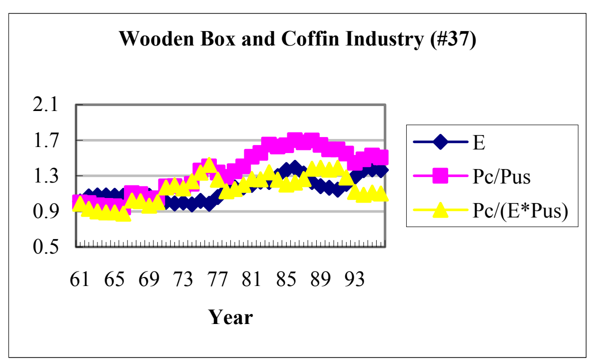

Veneer and Plywood Industry (#35)
7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

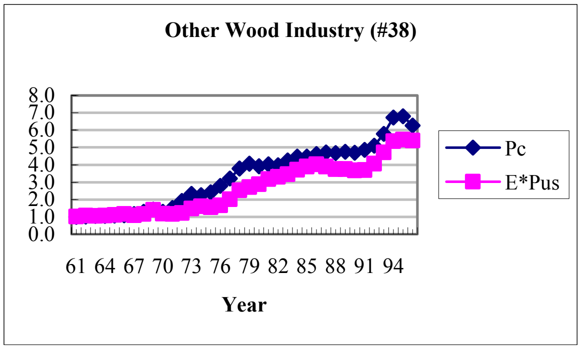

Veneer and Plywood Industry (#35)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

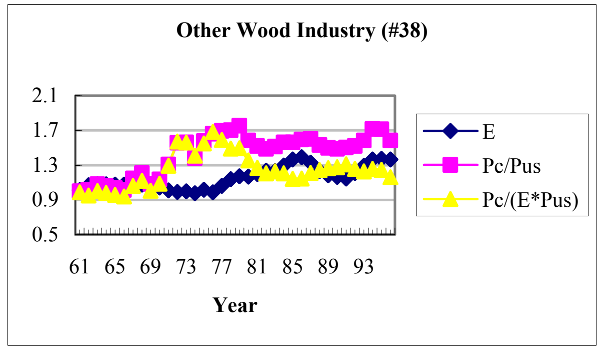

Sash, Door and Other Millwork Industry (#36)
7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

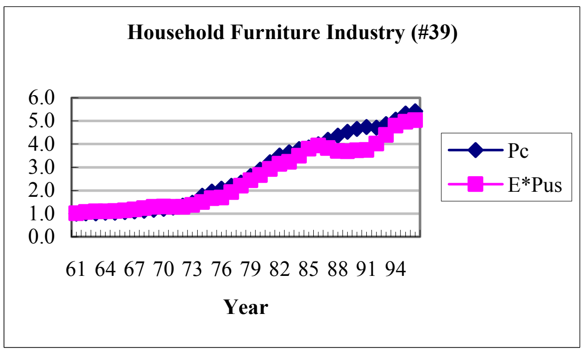

Sash, Door and Other Millwork Industry (#36)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

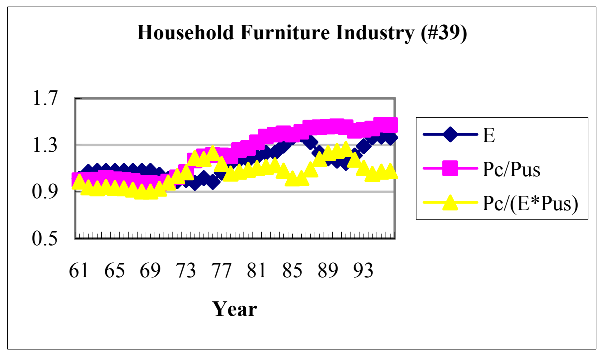

Wooden Box and Coffin Industry (#37)
7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

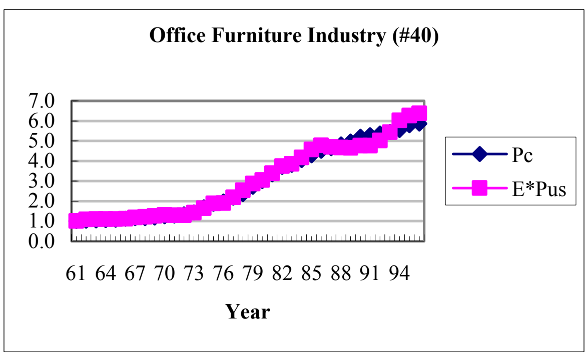

Wooden Box and Coffin Industry (#37)
2.1 1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

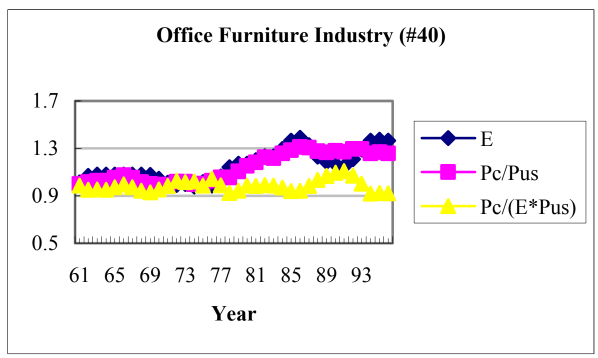

Other Wood Industry (#38)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

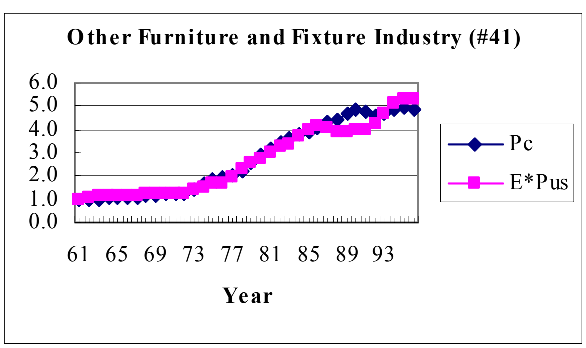

Other Wood Industry (#38)
2.1
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

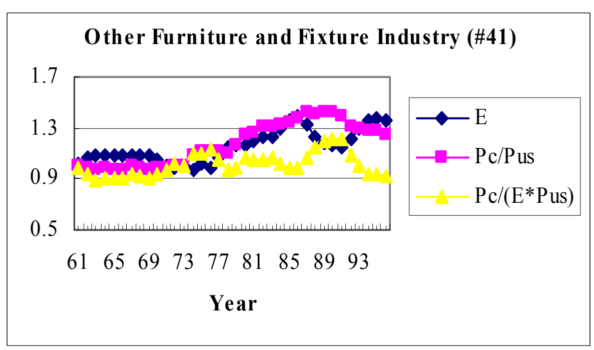

Household Furniture Industry (#39)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

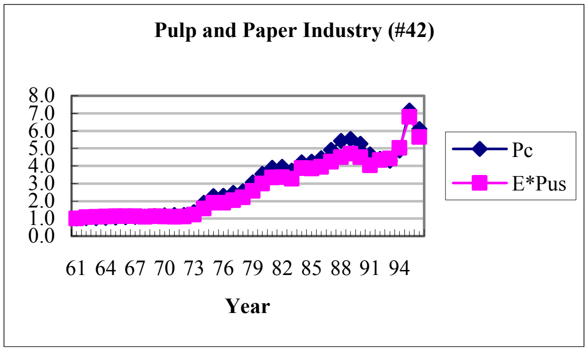

Household Furniture Industry (#39)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

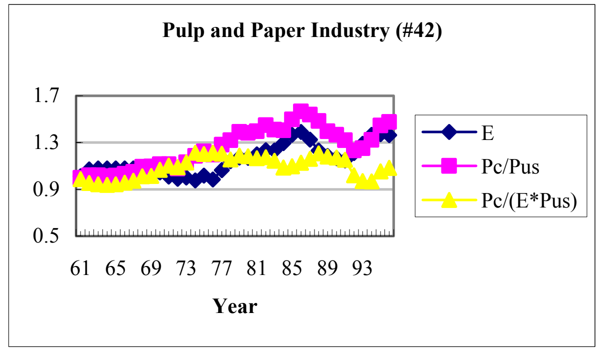

Office Furniture Industry (#40)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

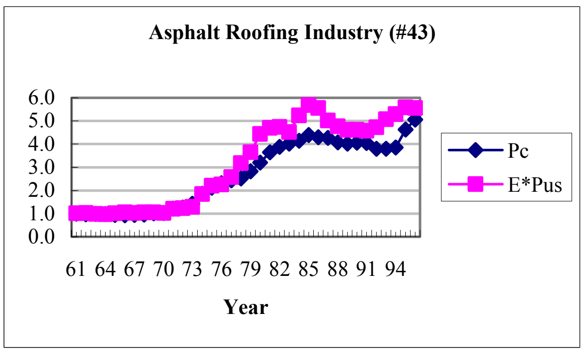

Office Furniture Industry (#40)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

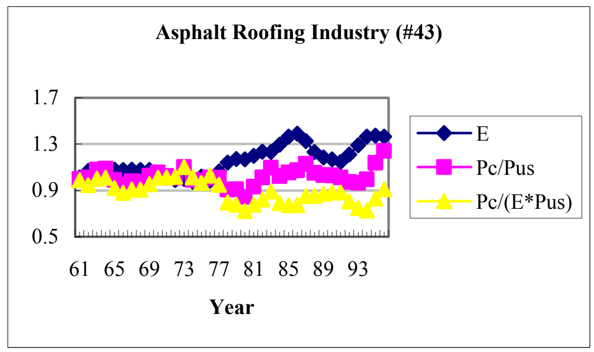

Other Furniture and Fixture Industry (#41)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 65 69 73 77 81 85 89 93
Year
Pc
E*Pus

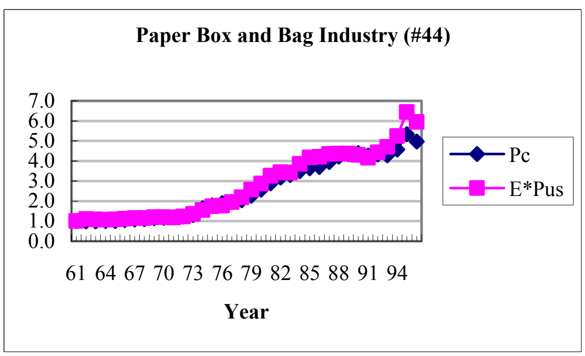

Other Furniture and Fixture Industry (#41)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

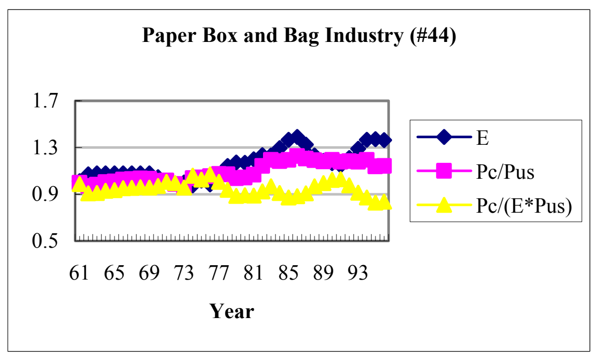

Pulp and Paper Industry (#42)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

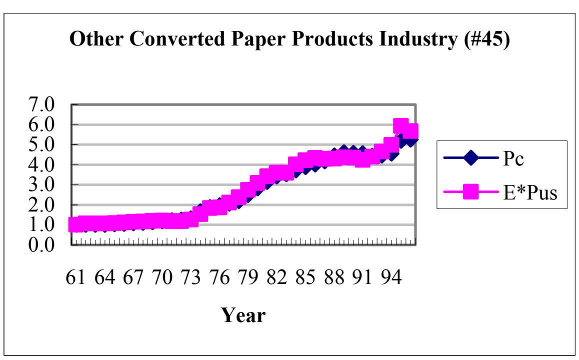

Pulp and Paper Industry (#42)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

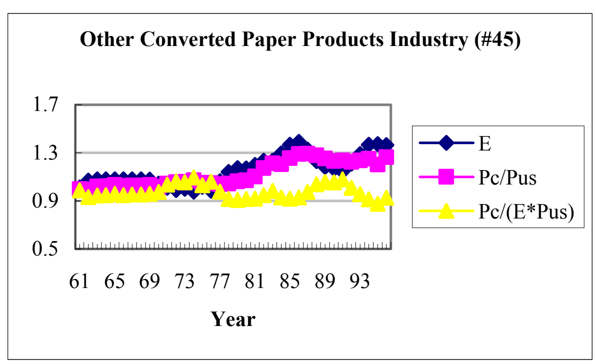

Asphalt Roofing Industry (#43)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

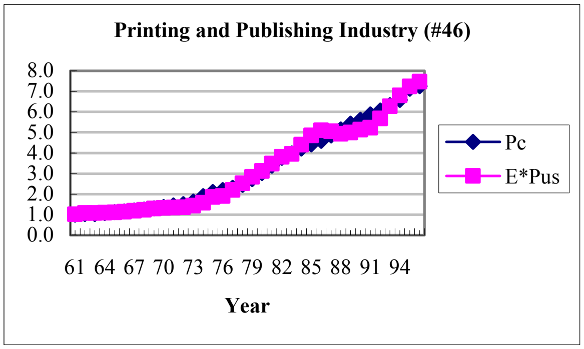

Asphalt Roofing Industry (#43)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

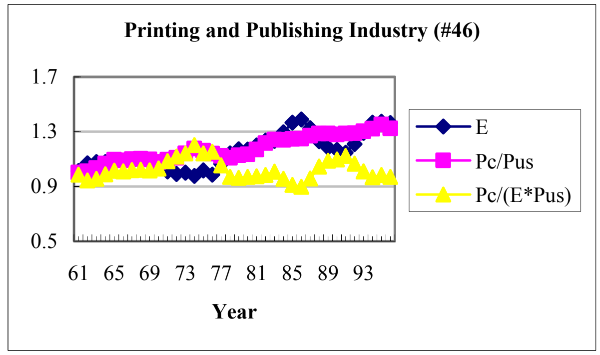

Paper Box and Bag Industry (#44)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

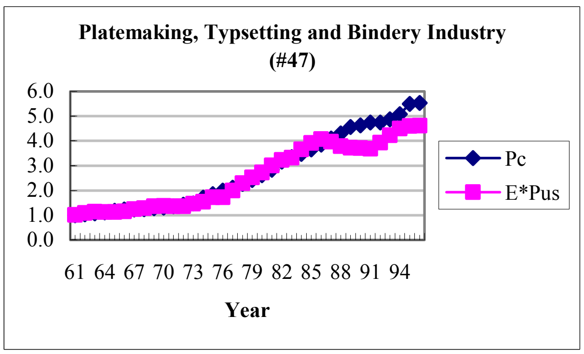

Paper Box and Bag Industry (#44)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

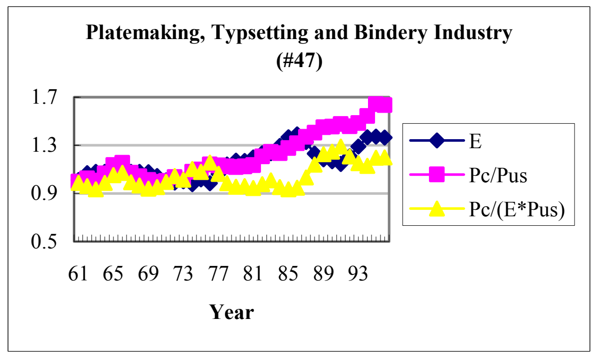

Other Converted Paper Products Industry (#45)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

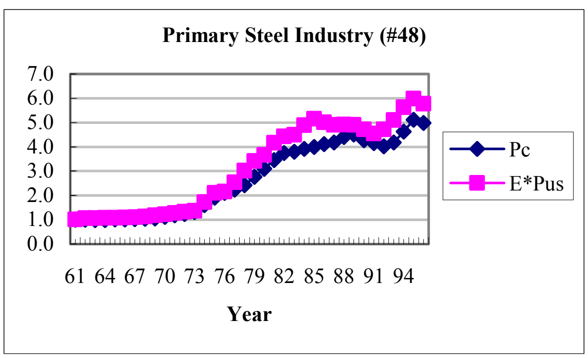

Other Converted Paper Products Industry (#45)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

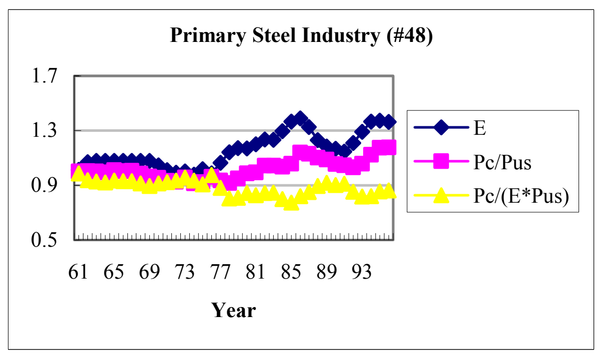

Printing and Publishing Industry (#46)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

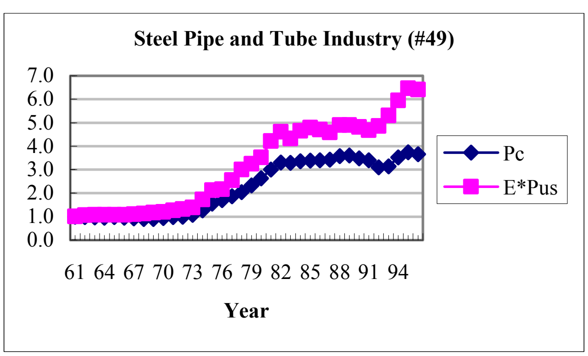

Printing and Publishing Industry (#46)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

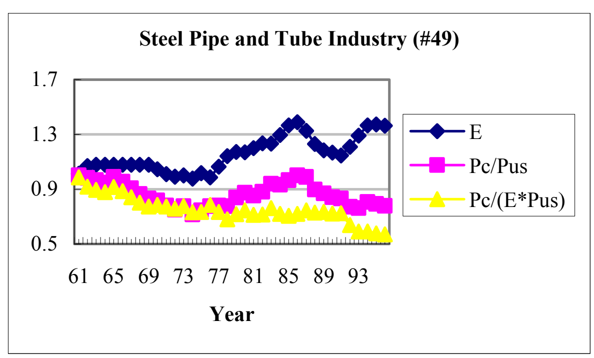

Platemaking, Typsetting and Bindery Industry (#47)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

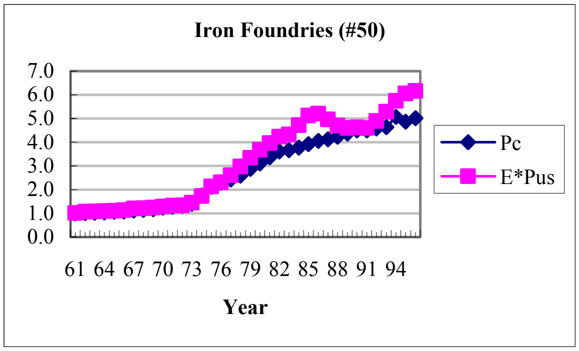

Platemaking, Typsetting and Bindery Industry (#47)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

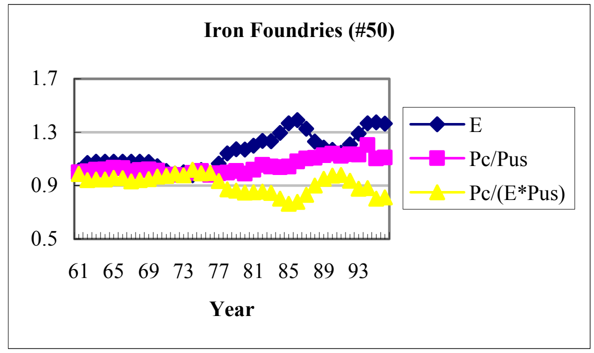

Primary Steel Industry (#48)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

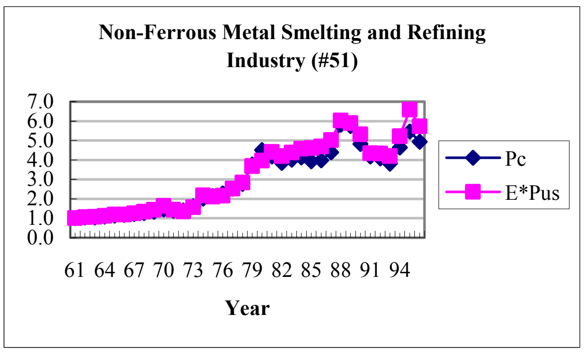

Primary Steel Industry (#48)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

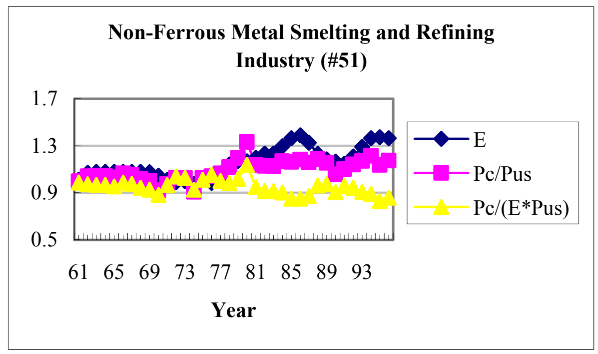

Steel Pipe and Tube Industry (#49)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

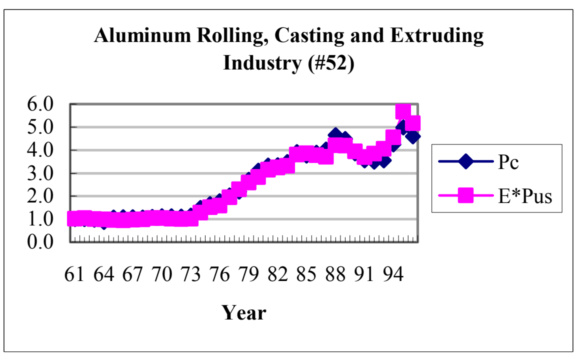

Steel Pipe and Tube Industry (#49)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

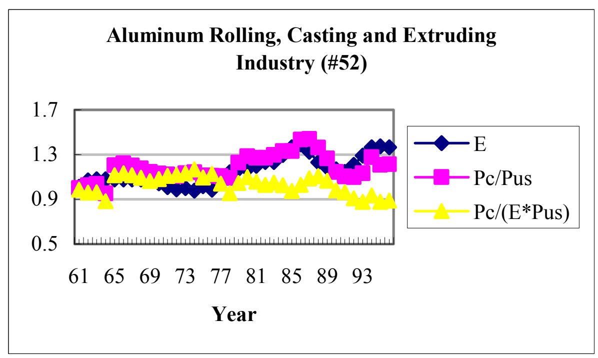

Iron Foundries (#50)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

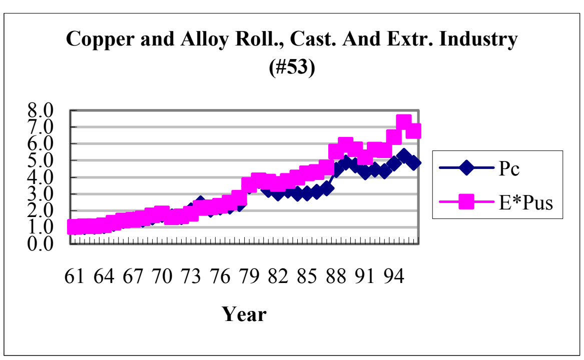

Iron Foundries (#50)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

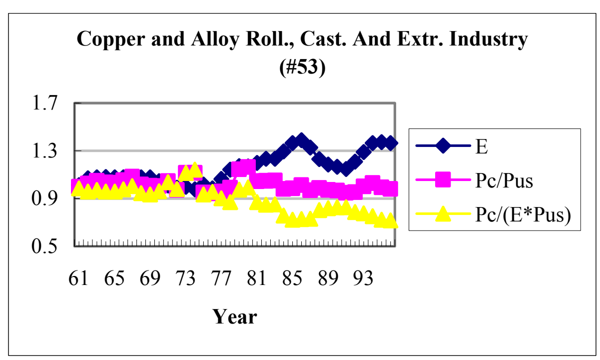

Non-Ferrous Metal Smelting and Refining Industry (#51)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

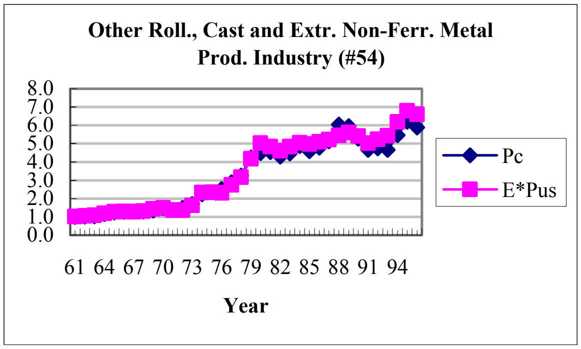

Non-Ferrous Metal Smelting and Refining Industry (#51)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

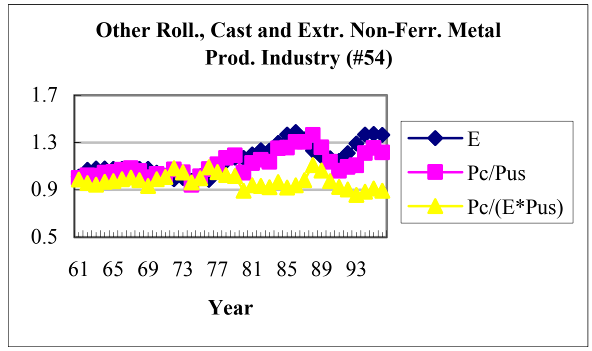

Aluminum Rolling, Casting and Extruding Industry (#52)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

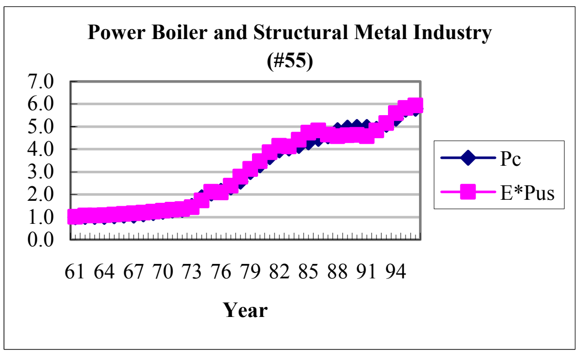

Aluminum Rolling, Casting and Extruding Industry (#52)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

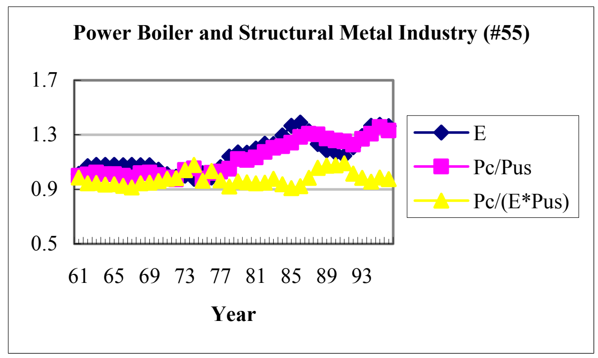

Copper and Alloy Roll., Cast. And Extr. Industry (#53)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

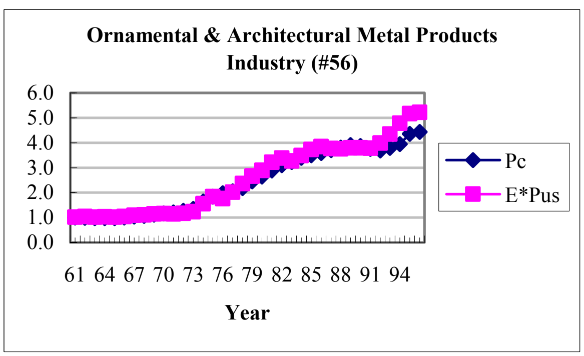

Copper and Alloy Roll., Cast. And Extr. Industry (#53)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

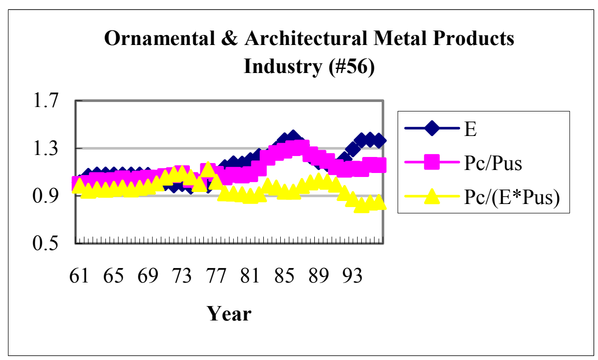

Other Roll., Cast and Extr. Non-Ferr. Metal Prod. Industry (#54)
8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

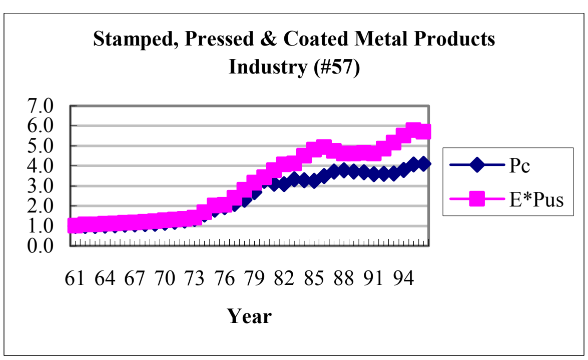

Other Roll., Cast and Extr. Non-Ferr. Metal Prod. Industry (#54)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

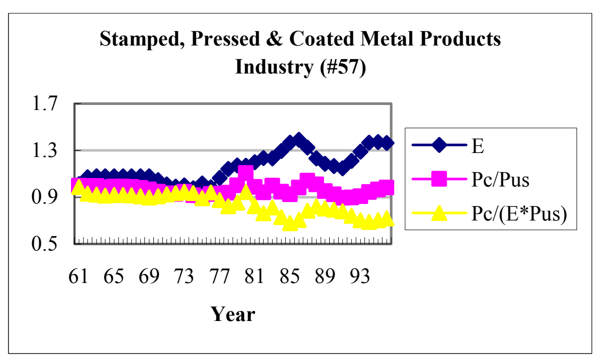

Power Boiler and Structural Metal Industry (#55)
7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

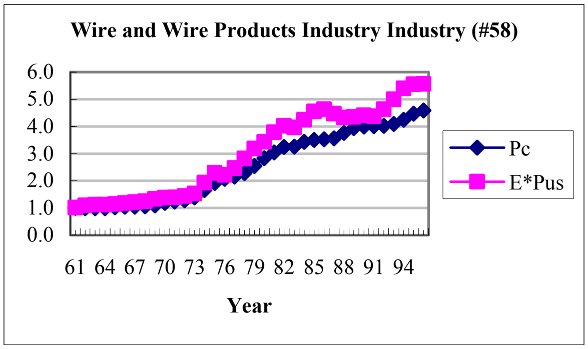

Power Boiler and Structural Metal Industry (#55)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

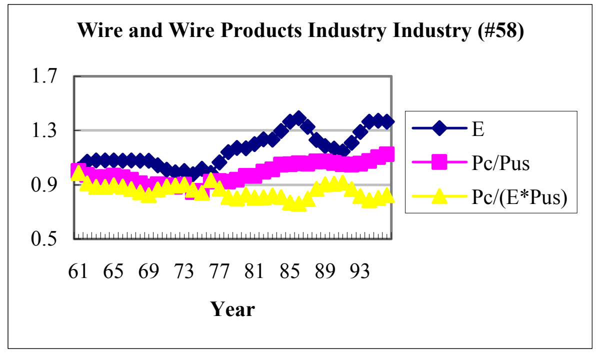

Ornamental & Architectural Metal Products Industry (#56)
6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

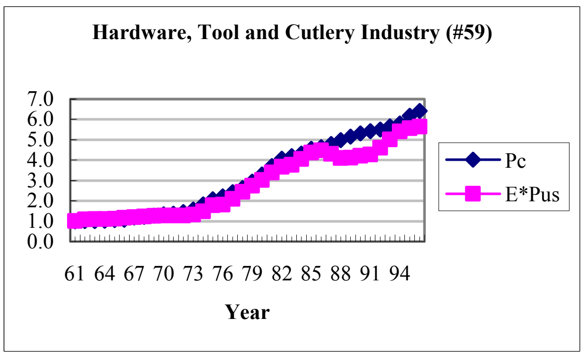

Ornamental & Architectural Metal Products Industry (#56)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

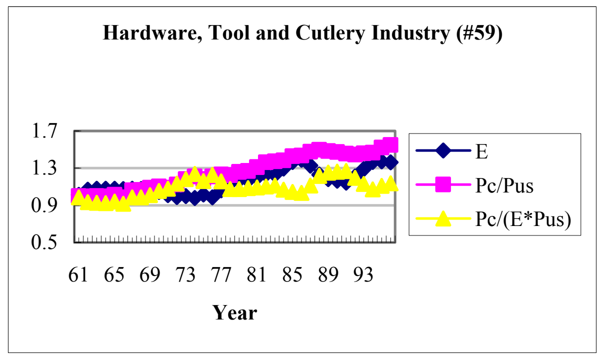

Stamped, Pressed & Coated Metal Products Industry (#57)
7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

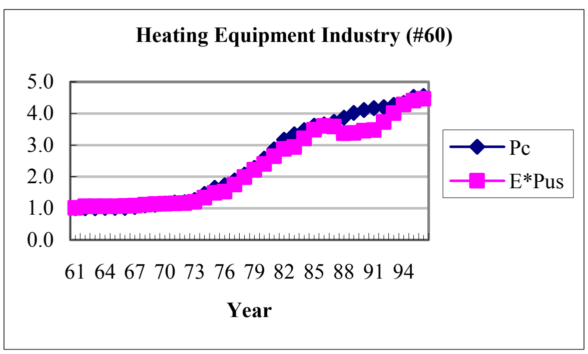

Stamped, Pressed & Coated Metal Products Industry (#57)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

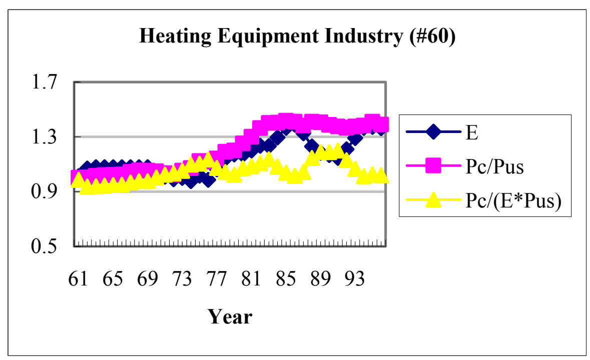

Wire and Wire Products Industry Industry (#58)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

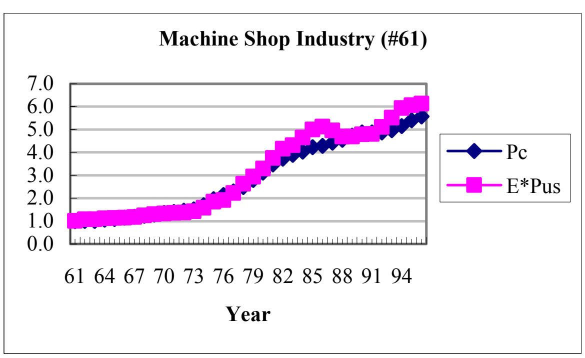

Wire and Wire Products Industry Industry (#58)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

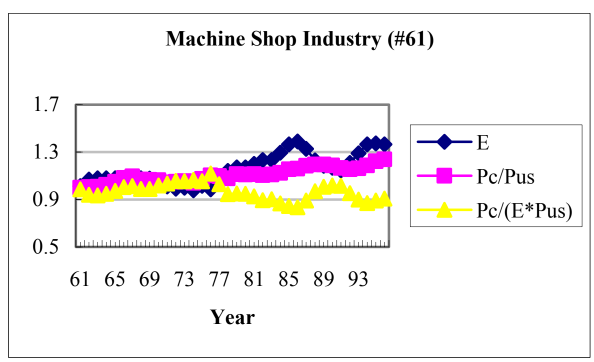

Hardware, Tool and Cutlery Industry (#59)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

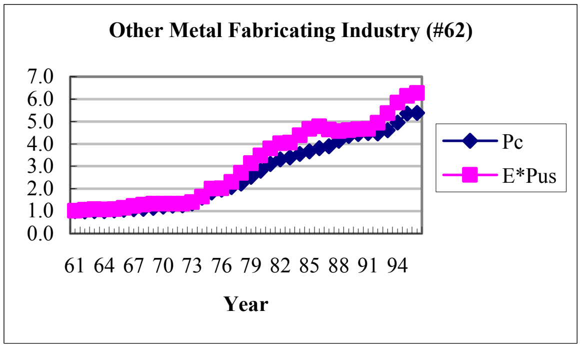

Hardware, Tool and Cutlery Industry (#59)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

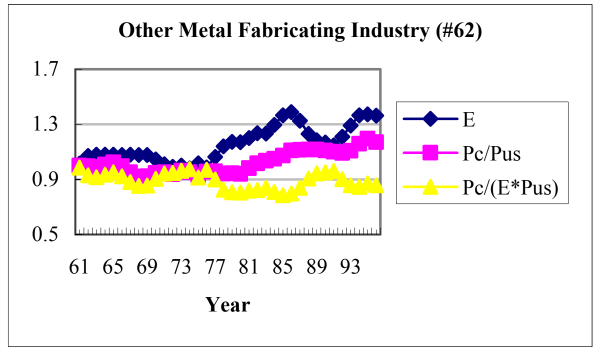

Heating Equipment Industry (#60)
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

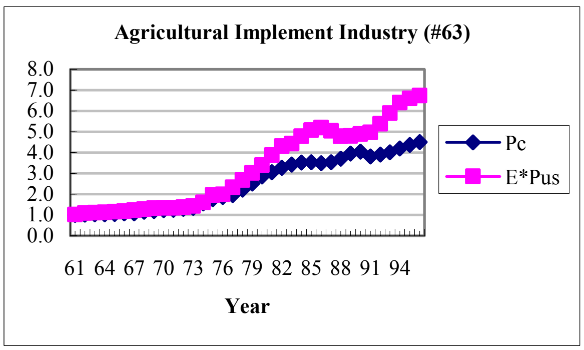

Heating Equipment Industry (#60)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

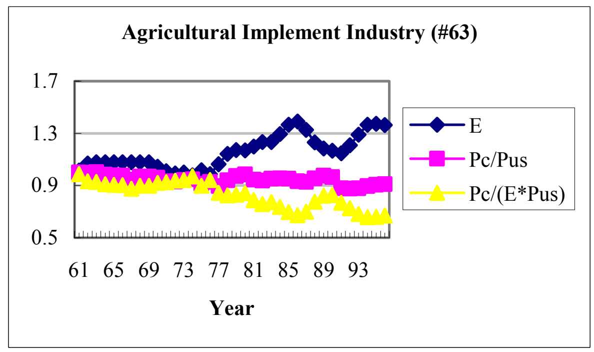

Machine Shop Industry (#61)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

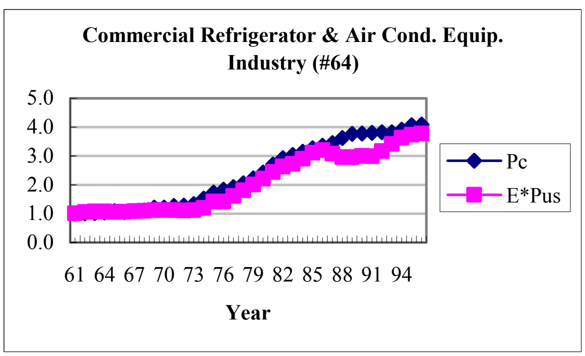

Machine Shop Industry (#61)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

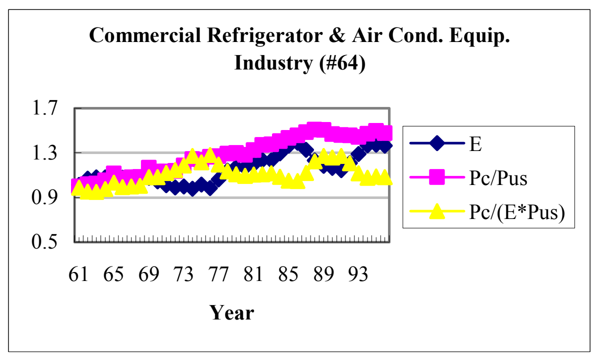

Other Metal Fabricating Industry (#62)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

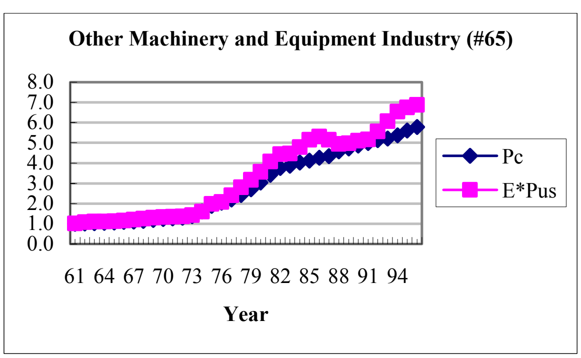

Other Metal Fabricating Industry (#62)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

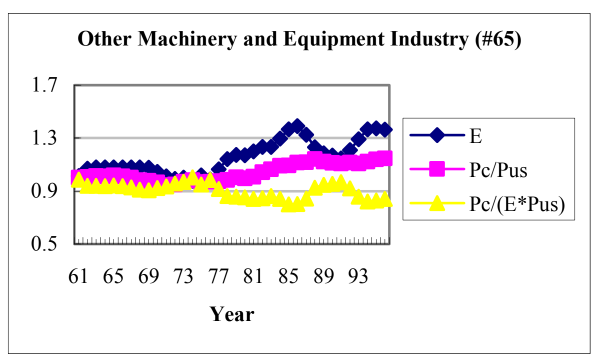

Agricultural Implement Industry (#63)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

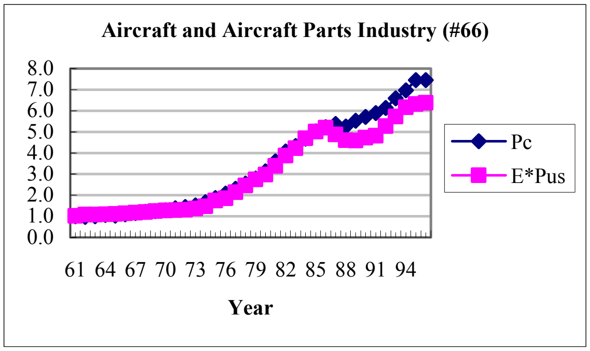

Agricultural Implement Industry (#63)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

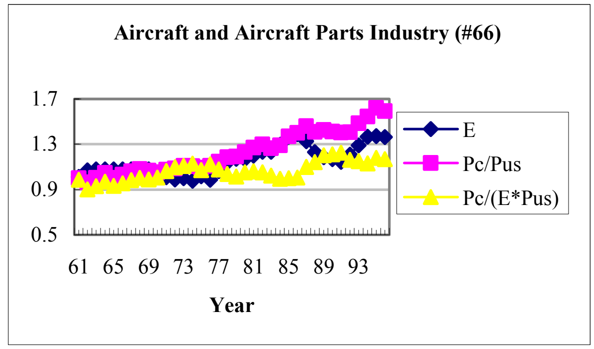

Commercial Refrigerator & Air Cond. Equip. Industry (#64)
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

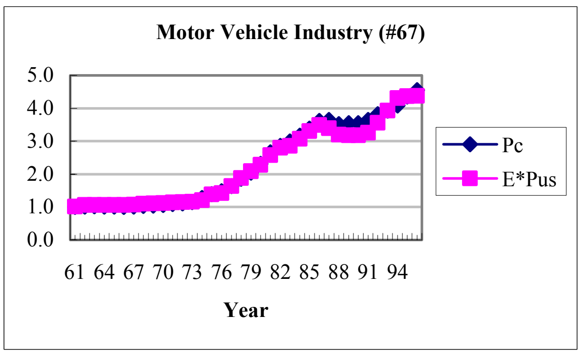

Commercial Refrigerator & Air Cond. Equip. Industry (#64)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

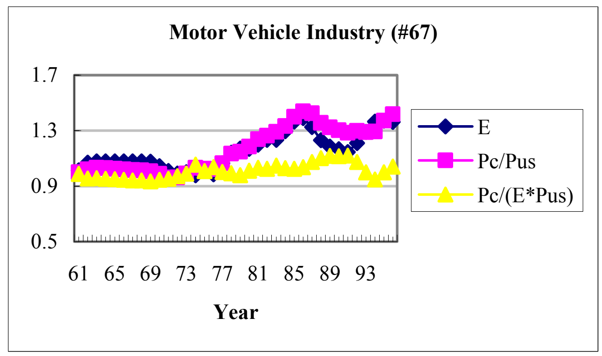

Other Machinery and Equipment Industry (#65)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

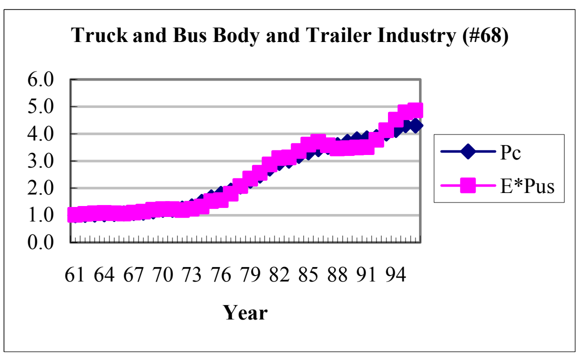

Other Machinery and Equipment Industry (#65)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

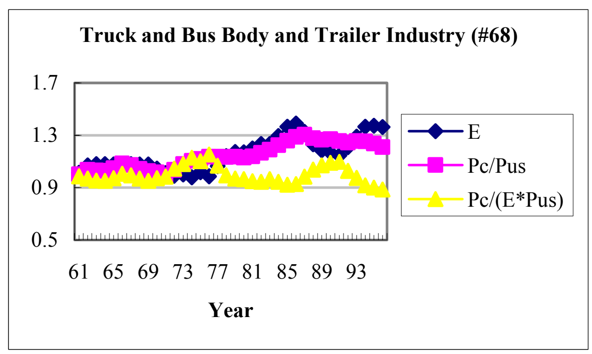

Aircraft and Aircraft Parts Industry (#66)
8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

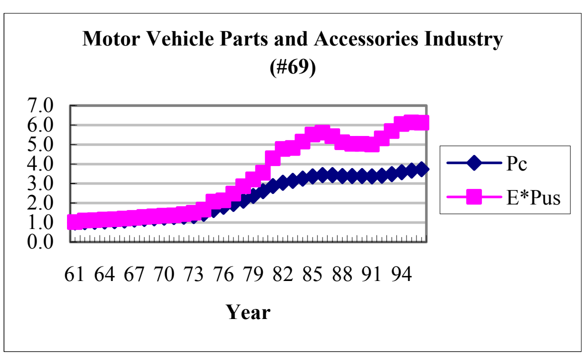

Aircraft and Aircraft Parts Industry (#66)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

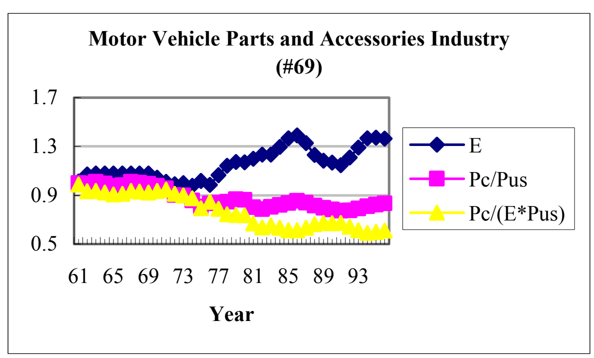

Motor Vehicle Industry (#67)
5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

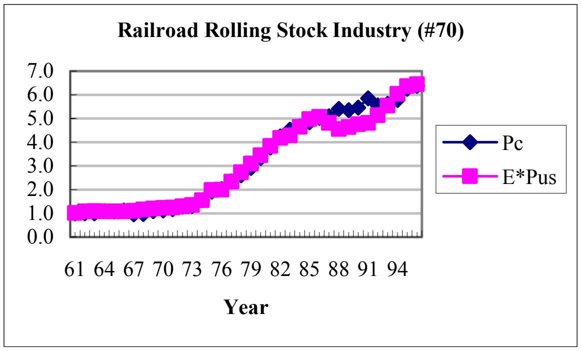

Motor Vehicle Industry (#67)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

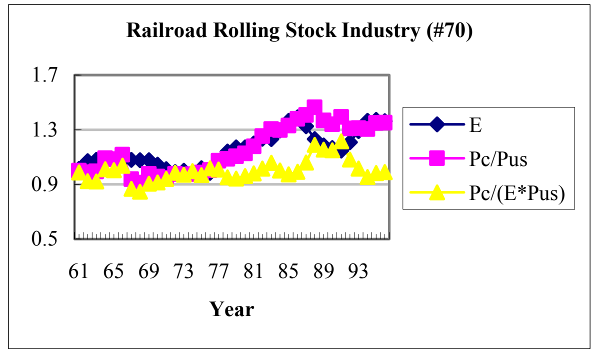

Truck and Bus Body and Trailer Industry (#68)
6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

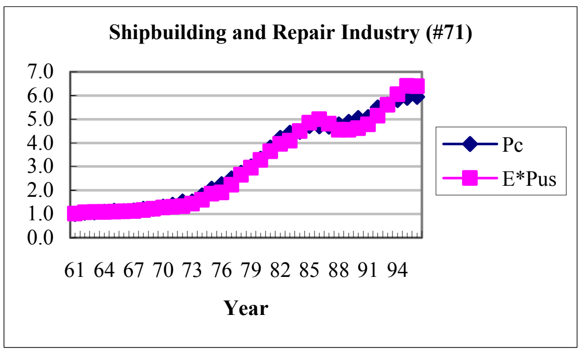

Truck and Bus Body and Trailer Industry (#68)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

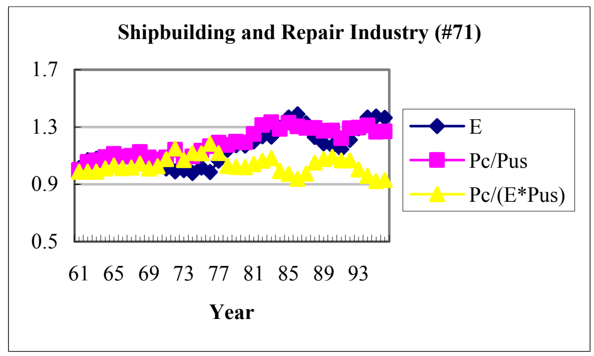

Motor Vehicle Parts and Accessories Industry (#69)
7.0 6.0 5.0 4.0 3.0 2.0 1.0 0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

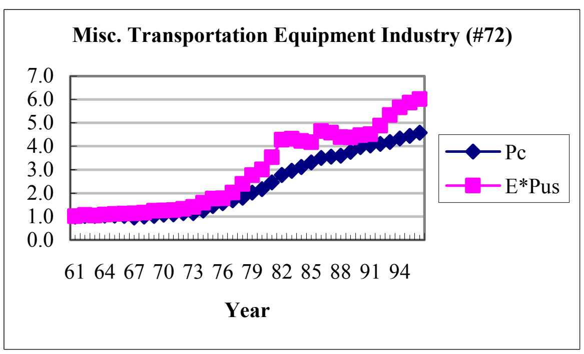

Motor Vehicle Parts and Accessories Industry (#69)
1.7 1.3 0.9 0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

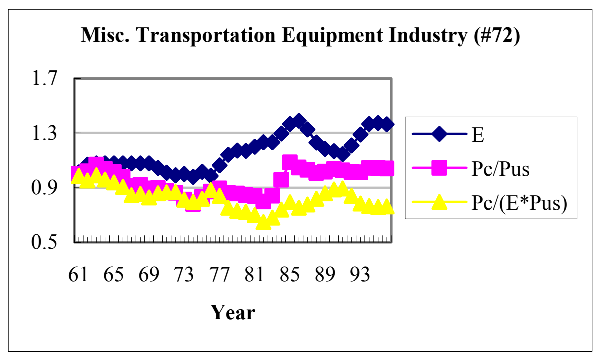

Railroad Rolling Stock Industry (#70)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

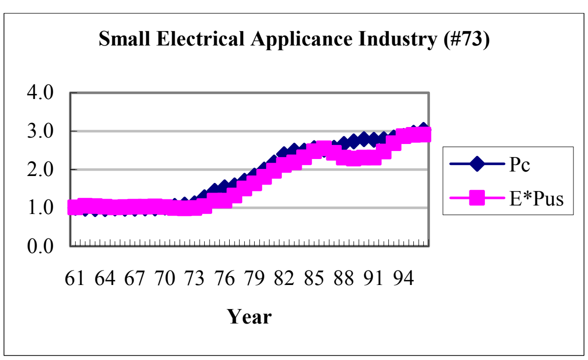

Railroad Rolling Stock Industry (#70)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

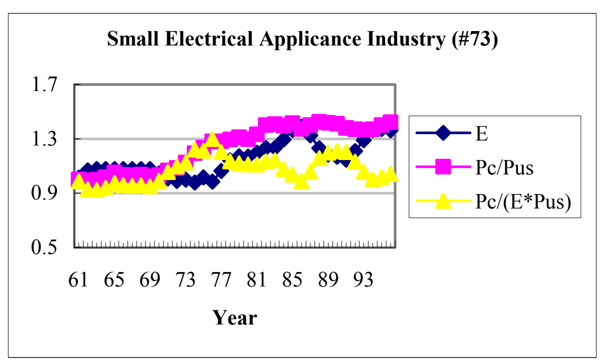

Shipbuilding and Repair Industry (#71)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

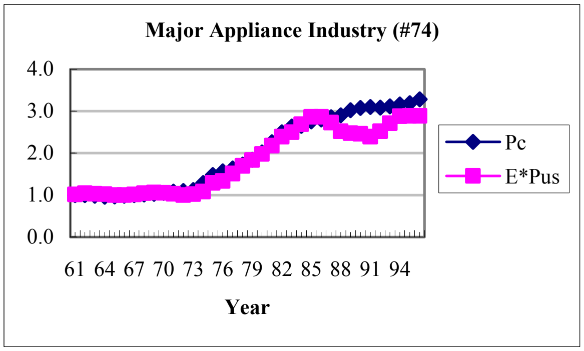

Shipbuilding and Repair Industry (#71)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

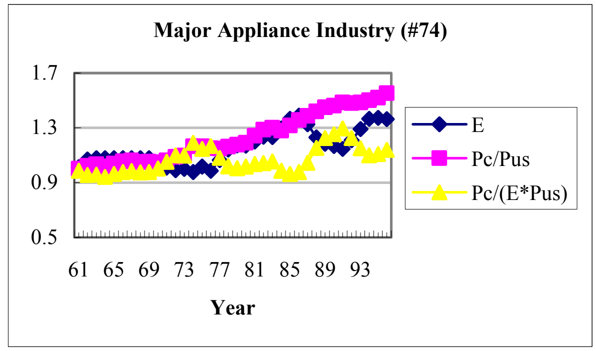

Misc. Transportation Equipment Industry (#72)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

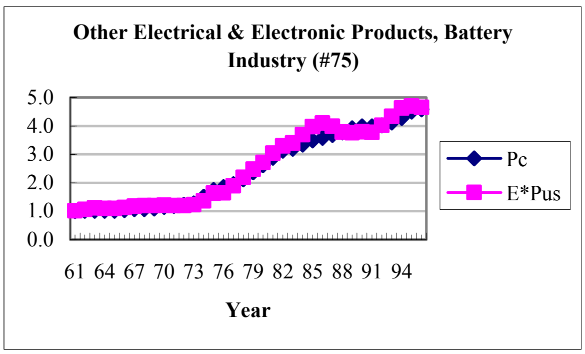

Misc. Transportation Equipment Industry (#72)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

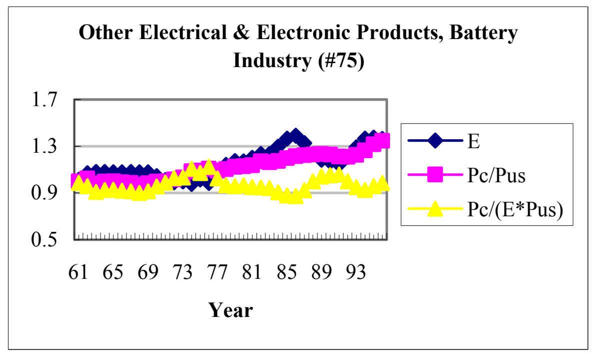

Small Electrical Applicance Industry (#73)
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

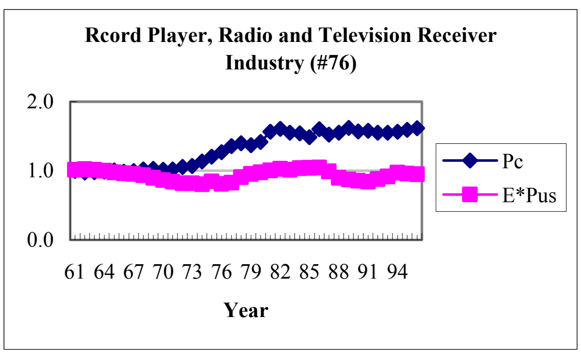

Small Electrical Applicance Industry (#73)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

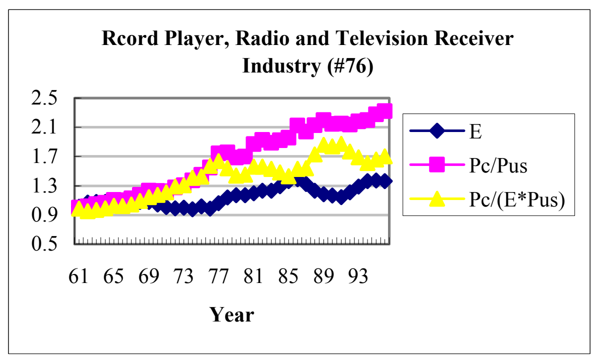

Major Appliance Industry (#74)
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

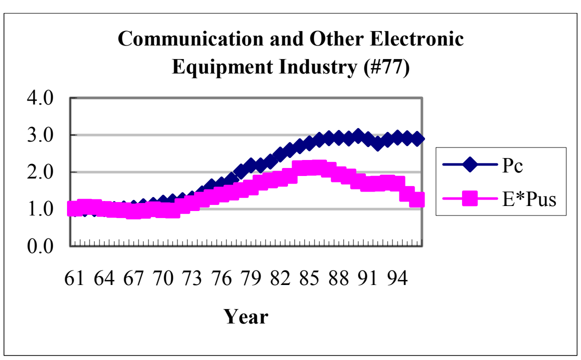

Major Appliance Industry (#74)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

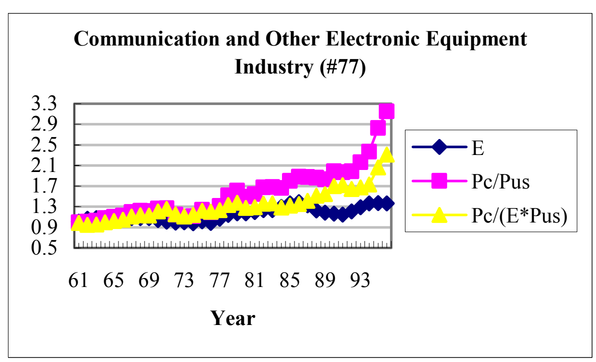

Other Electrical & Electronic Products, Battery Industry (#75)
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

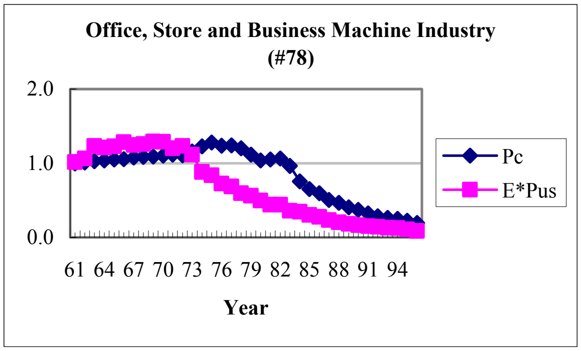

Other Electrical & Electronic Products, Battery Industry (#75)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

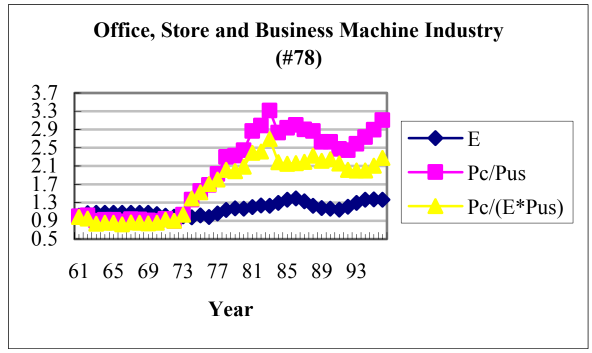

Rcord Player, Radio and Television Receiver Industry (#76)
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

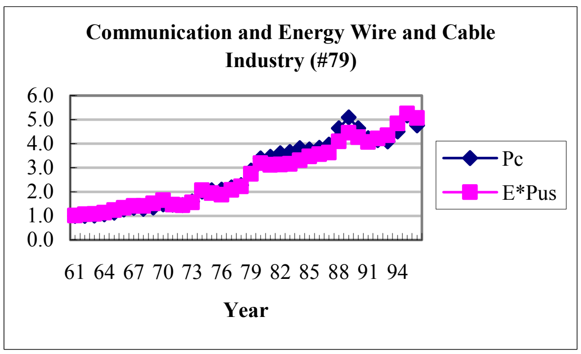

Rcord Player, Radio and Television Receiver Industry (#76)
2.5
2.1
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

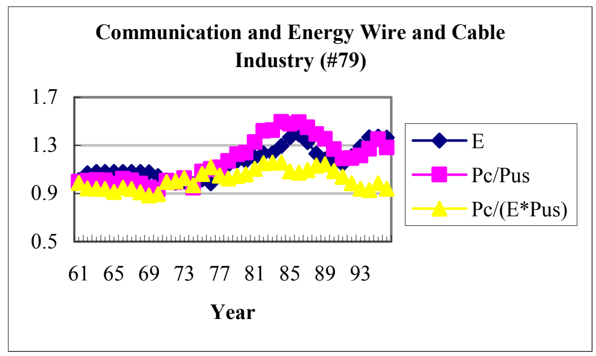

Communication and Other Electronic Equipment Industry (#77)
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

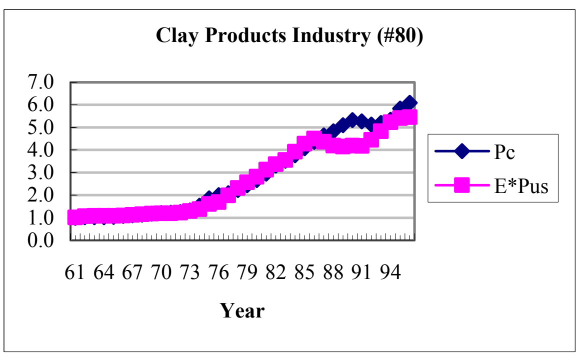

Communication and Other Electronic Equipment Industry (#77)
3.3
2.9
2.5
2.1
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

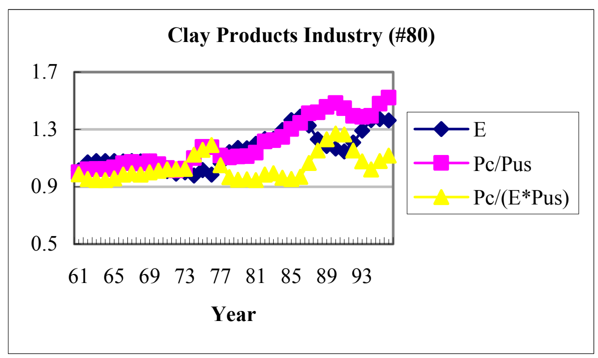

Office, Store and Business Machine Industry (#78)
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

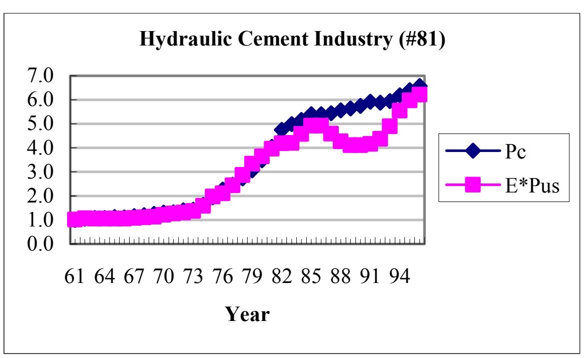

Office, Store and Business Machine Industry (#78)
3.7
3.3
2.9
2.5
2.1
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

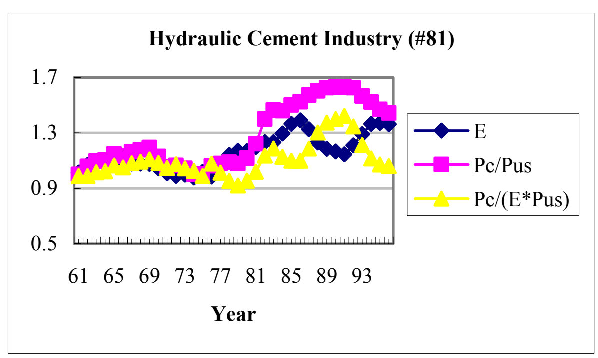

Communication and Energy Wire and Cable Industry (#79)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

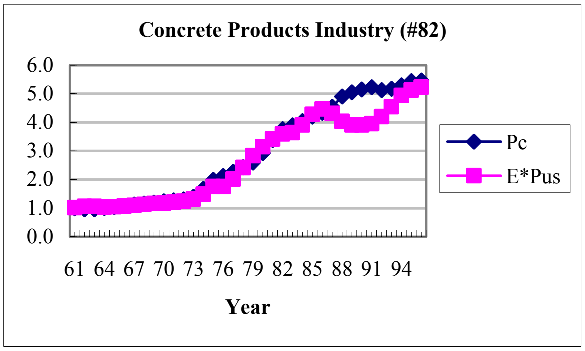

Communication and Energy Wire and Cable Industry (#79)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

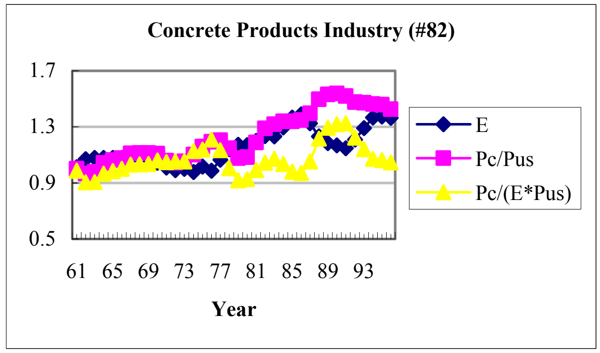

Clay Products Industry (#80)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

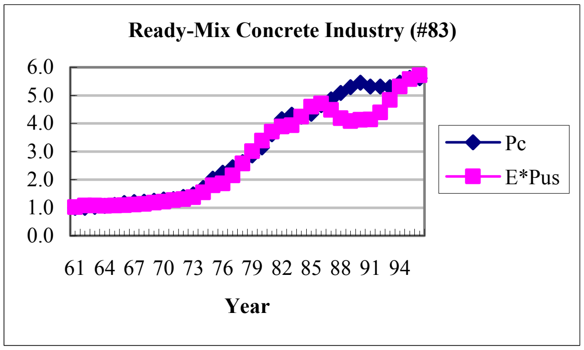

Clay Products Industry (#80)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

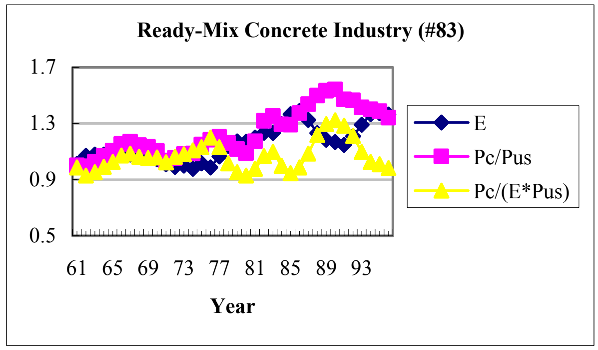

Hydraulic Cement Industry (#81)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

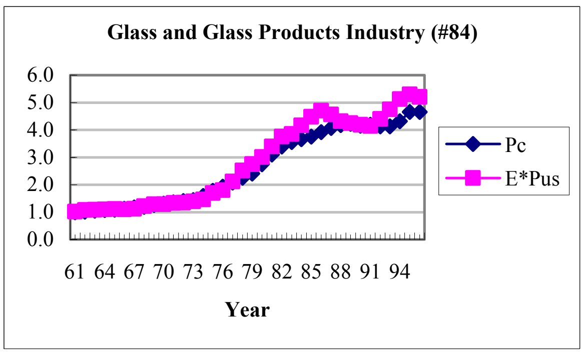

Hydraulic Cement Industry (#81)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

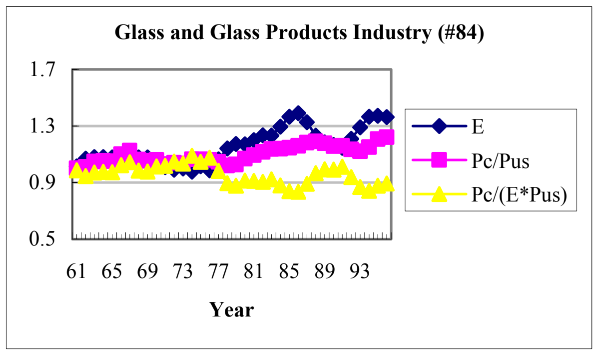

Concrete Products Industry (#82)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

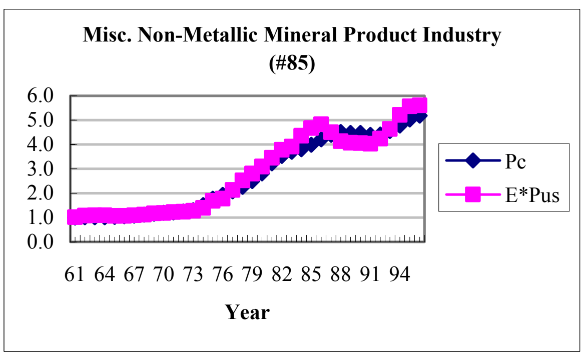

Concrete Products Industry (#82)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

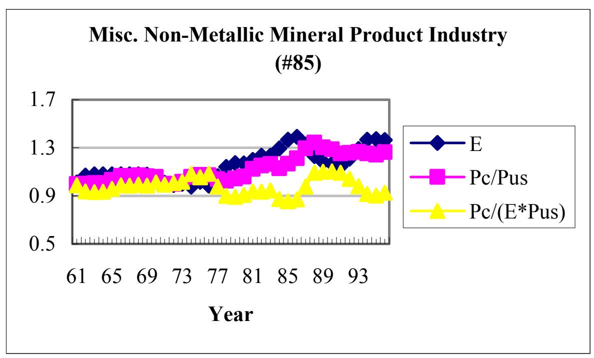

Ready-Mix Concrete Industry (#83)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

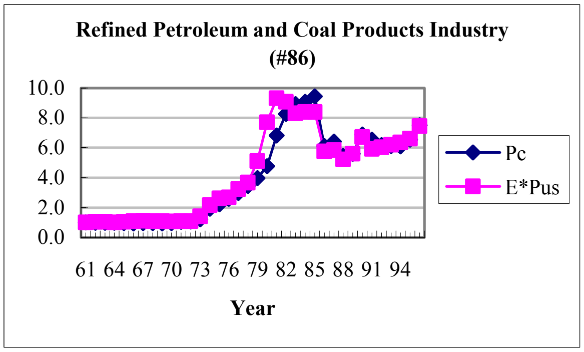

Ready-Mix Concrete Industry (#83)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

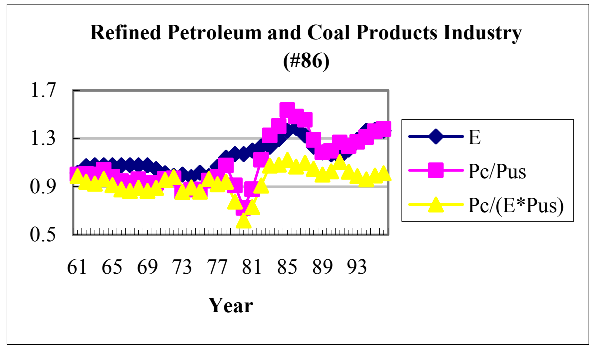

Glass and Glass Products Industry (#84)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

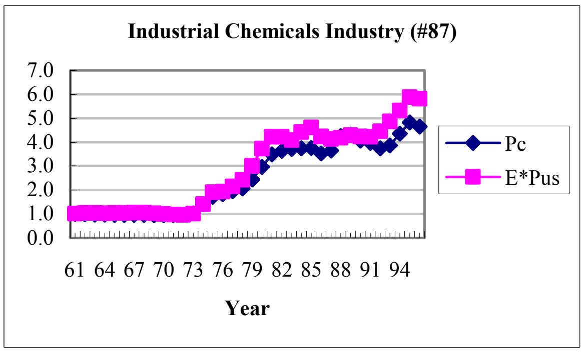

Glass and Glass Products Industry (#84)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

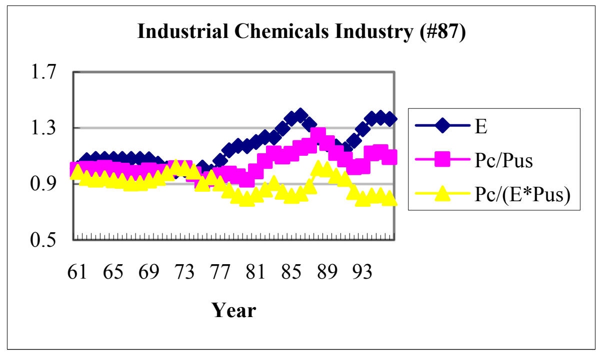

Misc. Non-Metallic Mineral Product Industry (#85)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

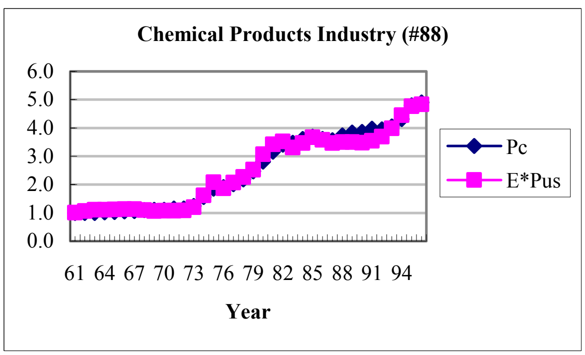

Misc. Non-Metallic Mineral Product Industry (#85)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

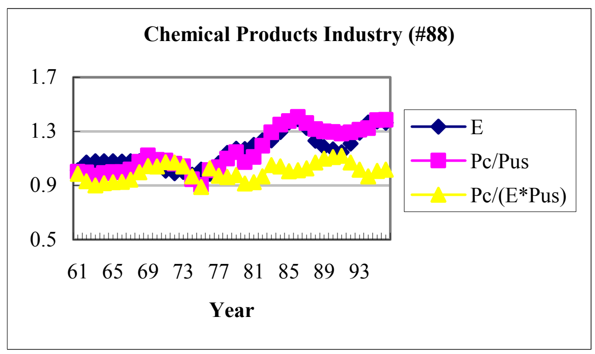

Refined Petroleum and Coal Products Industry (#86)
10.0
8.0
6.0
4.0
2.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

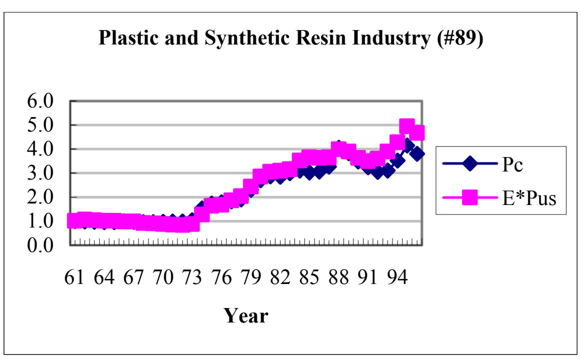

Refined Petroleum and Coal Products Industry (#86)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

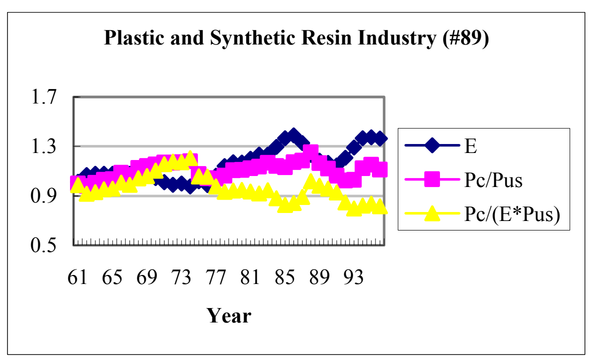

Industrial Chemicals Industry (#87)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

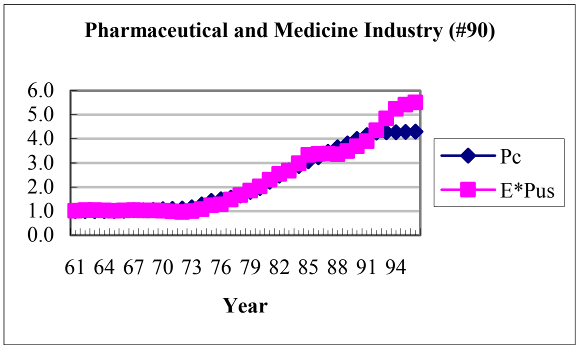

Industrial Chemicals Industry (#87)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

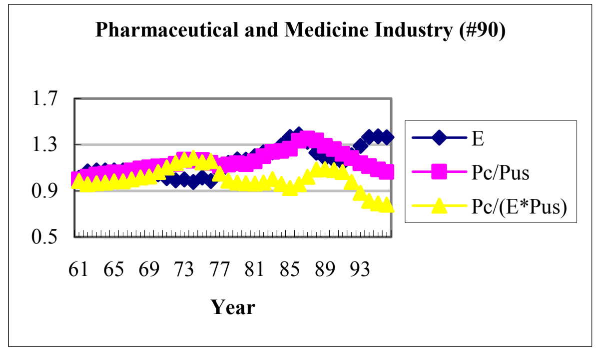

Chemical Products Industry (#88)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

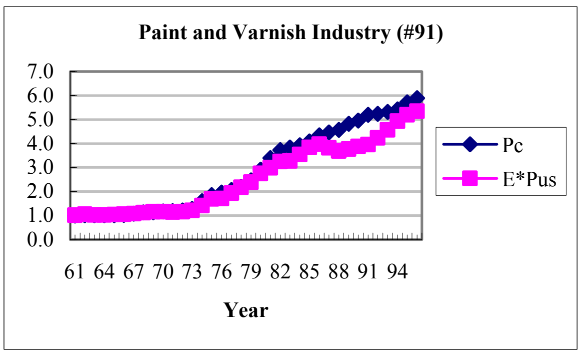

Chemical Products Industry (#88)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

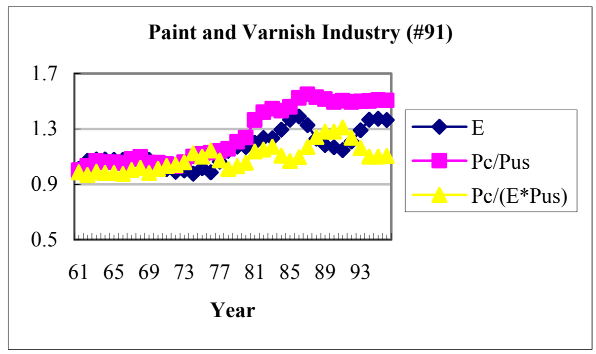

Plastic and Synthetic Resin Industry (#89)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

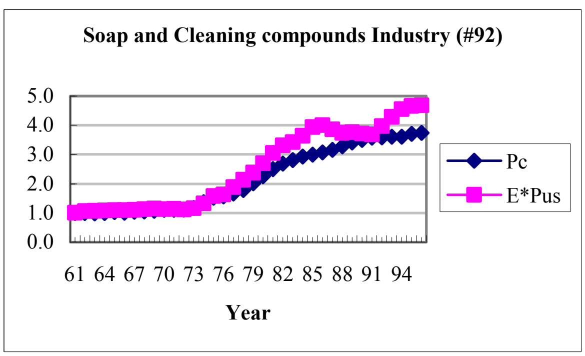

Plastic and Synthetic Resin Industry (#89)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

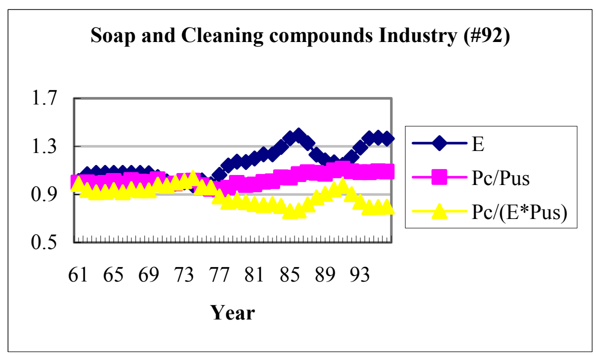

Pharmaceutical and Medicine Industry (#90)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

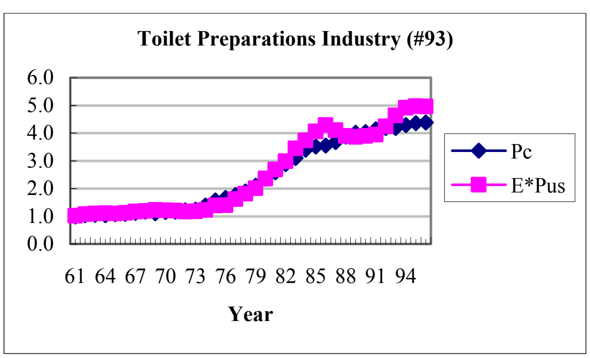

Pharmaceutical and Medicine Industry (#90)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

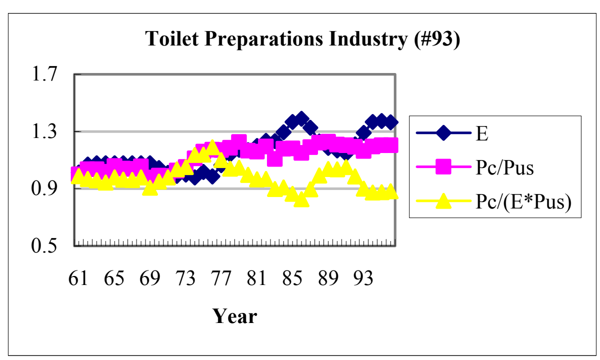

Paint and Varnish Industry (#91)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

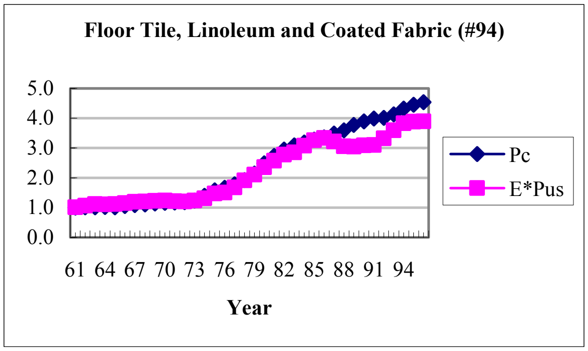

Paint and Varnish Industry (#91)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

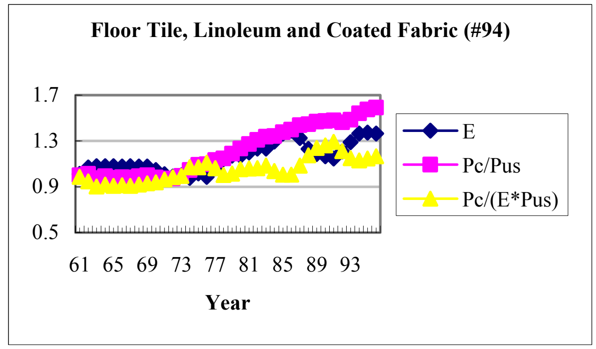

Soap and Cleaning compounds Industry (#92)
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

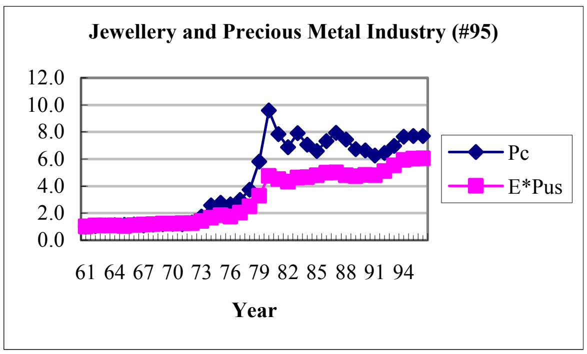

Soap and Cleaning compounds Industry (#92)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

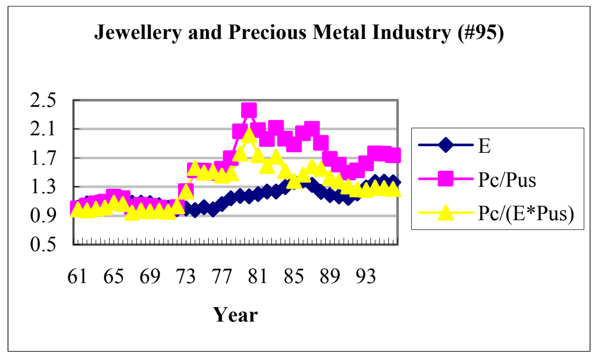

Toilet Preparations Industry (#93)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

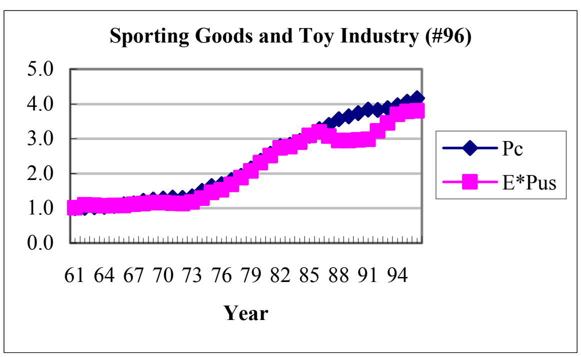

Toilet Preparations Industry (#93)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

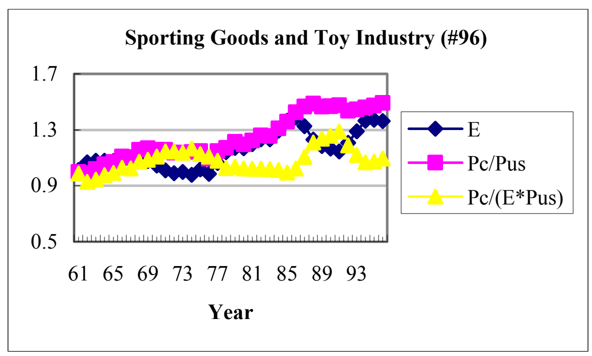

Floor Tile, Linoleum and Coated Fabric (#94)
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus

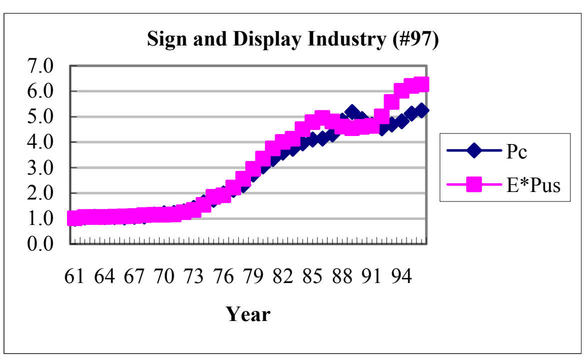

Floor Tile, Linoleum and Coated Fabric (#94)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

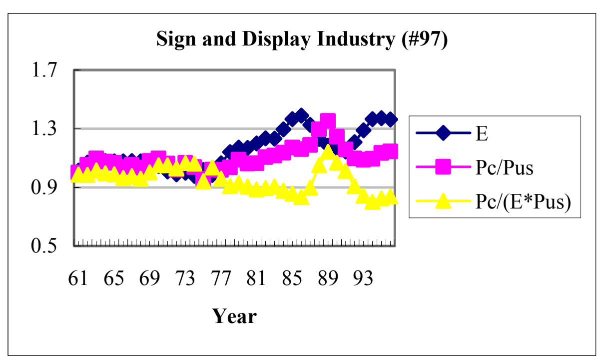

Jewellery and Precious Metal Industry (#95)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Jewellery and Precious Metal Industry (#95)
2.5
2.1
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)


Sporting Goods and Toy Industry (#96)
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Sporting Goods and Toy Industry (#96)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)


Sign and Display Industry (#97)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
61 64 67 70 73 76 79 82 85 88 91 94
Year
Pc
E*Pus


Sign and Display Industry (#97)
1.7
1.3
0.9
0.5
61 65 69 73 77 81 85 89 93
Year
E
Pc/Pus
Pc/(E*Pus)

Appendix B

Table B1

	Industry	FMOLS (without time-specific fixed effects, with industry fixed effects)		OLS (without time-specific fixed effects, with industry fixed effects)		SUR (without time-specific fixed effects, with industry fixed effects)		FMOLS (with time-specific fixed effects, with industry fixed effects)		OLS (with time-specific fixed effects, with industry fixed effects)		SUR (with time-specific fixed effects, with industry fixed effects)	
		Coeff	*t-stat*	*Coeff*	*t-stat*	*Coeff*	*t-stat*	*Coeff*	*t-stat*	*Coeff*	*t-stat*	*Coeff*	*t-stat*
14	Poultry, meat and meat product industry	1.08	4.95	1.07	84.28	1.06	130.14	0.75	-5.52	0.76	16.24	0.74	41.52
15	Fish products industry	1.05	-1.32	1.03	54.75	1.01	99.53	1.09	-0.93	1.09	21.74	1.09	61.82
16	Fruit and vegetable industry	1.03	-1.15	1.02	60.38	0.99	121.56	1	-0.02	0.98	10.60	0.92	22.36
17	Dairy products industry	1.35	7.30	1.33	45.01	1.28	70.71	-2.67	-7.74	-2.23	-7.05	-2.14	-32.83
18	Feed, cane and beet sugar, misc. food prod. ind.	1.09	4.39	1.08	64.30	1.06	106.30	0.59	-4.00	0.63	10.68	0.64	33.15
19	Vegetable oil mills (except corn oil)	0.98	-0.30	0.95	26.98	0.96	45.60	0.82	-2.01	0.77	13.33	0.75	36.92
20	Biscuit, bread and other bakery products ind.	1.09	3.88	1.09	69.28	1.07	134.86	1.26	2.75	1.30	25.06	1.29	82.99
21	Soft drink industry	1.05	-1.07	1.04	38.09	1.01	69.17	1.12	-0.36	1.03	6.51	1.03	43.98
22	Distillery products industry	1.12	2.22	1.10	35.53	1.09	71.76	0.75	-2.50	0.74	13.64	0.74	49.49
23	Brewery products industry	1.57	6.95	1.52	34.72	1.49	65.39	-0.68	-3.46	-0.61	-2.85	-0.57	-14.32
24	Wine industry	1.00	-0.17	0.99	46.79	0.96	61.19	0.61	-1.65	0.43	2.20	0.39	8.02
25	Tobacco products industries	0.97	-0.88	0.98	48.46	0.99	89.31	0.79	-2.85	0.74	14.40	0.74	54.28
26	Rubber products industries	0.91	-3.71	0.89	55.37	0.88	112.95	1.75	-0.81	1.41	3.19	1.43	28.33
27	Plastic products industries	1.02	-0.60	1.00	48.92	0.98	105.98	1.07	-0.3	1.14	9.09	1.12	58.57
28	Leather, footwear, misc. leather and allied prod. ind.	0.98	-0.44	0.98	52.90	0.96	104.82	0.25	-6.91	0.33	4.79	0.34	29.66
29	Man-made fibre yarn and woven cloth, wool yarn and woven cloth	1.04	-1.10	1.03	44.18	1.00	73.99	0.97	-0.43	0.94	23.43	0.94	74.83
30	Broad knitted fabric industry	0.80	-4.38	0.75	26.08	0.75	53.80	1.24	6.38	1.24	47.97	1.24	116.84
31	Miscellaneous textile products industry	1.08	2.60	1.07	52.01	1.05	94.19	0.57	-1.87	0.60	5.13	0.61	38.88
32	Carpet, mat and rug industry	0.96	-1.25	0.94	36.65	0.93	82.39	1.07	1.72	1.07	42.02	1.07	122.71
33	Clothing, hosiery industry	1.09	2.07	1.09	41.70	1.06	85.45	0.72	-5.96	0.70	26.33	0.7	33.83
34	Sawmill, planing mill, shingle mill product ind.	0.88	-8.93	0.87	85.00	0.86	118.89	0.48	-3.86	0.56	8.22	0.56	37.13
35	Veneer and plywood industry	0.99	-0.14	0.99	38.94	0.98	66.78	0.82	-1.18	0.81	7.86	0.8	45.89
36	Sash, door and other millwork industry	1.01	-0.13	1.00	36.28	0.97	81.81	0.88	-0.57	0.79	7.21	0.79	36.08
37	Wooden box and coffin industry	1.17	2.84	1.16	32.92	1.12	68.79	0.7	-0.74	0.68	3.52	0.67	34.97
38	Other wood industry	1.06	-0.68	1.07	24.00	1.04	42.48	1.29	-0.39	1.24	3.17	1.18	16.98
39	Household furniture industry	1.12	2.93	1.11	46.02	1.08	92.05	0.17	-1.65	0.13	0.56	0.14	3.61
40	Office furniture industry	1.02	-0.95	1.01	79.55	0.99	155.78	0.93	-0.92	0.92	19.31	0.92	58.13
41	Other furniture and fixture industry	1.08	2.04	1.07	44.92	1.04	95.97	0.8	-0.48	0.74	3.63	0.73	21.24
42	Pulp and paper industry	1.04	-1.02	1.06	48.62	1.04	75.51	0.97	-0.14	1.02	9.10	1.03	45.15
43	Asphalt roofing industry	0.89	-4.43	0.88	49.84	0.87	71.58	0.51	-4.48	0.52	8.35	0.5	25.58
44	Paper box and bag industry	0.97	-1.37	0.96	61.48	0.94	98.89	0.6	-4.21	0.57	10.34	0.58	36.78
45	Other converted paper products industry	0.99	-0.32	0.98	62.48	0.96	102.32	0.7	-3.19	0.67	13.19	0.67	29.99
46	Printing and publishing industry	0.98	-0.64	0.98	58.13	0.96	111.15	0.93	-0.75	0.86	19.00	0.86	100.78
47	Platemaking, typesetting and bindery industry	1.09	1.83	1.08	39.35	1.06	60.05	0.4	-1.22	0.46	1.91	0.47	13.08
48	Primary steel industry	0.94	-4.26	0.93	87.28	0.92	122.84	0.5	-10.8	0.50	14.62	0.49	40.06
49	Steel pipe and tube industry	0.85	-4.58	0.85	45.42	0.83	60.74	0.04	-4.43	0.07	0.65	0.06	2.67
50	Iron foundries	0.93	-2.86	0.92	61.58	0.90	107.01	0.38	-7.83	0.38	8.37	0.4	23.52
51	Non-ferrous metal smelting and refining ind.	0.96	-1.65	0.95	58.65	0.95	91.72	0.71	-1.90	0.76	8.91	0.76	44.2
52	Aluminum rolling, casting and extruding ind.	0.93	-2.22	0.94	47.93	0.94	61.83	0.4	-3.31	0.50	4.34	0.51	14.36
53	Copper and alloy roll., cast. and extr. industry	0.83	-5.00	0.84	38.39	0.82	58.80	0.51	-1.36	0.71	4.30	0.7	23.95
54	Oth. roll., cast and extr. non-ferr. met. prod. ind.	0.97	-1.37	0.97	65.47	0.95	81.63	0.79	-2.05	0.79	11.96	0.79	36.81
55	Power boiler and structural metal industry	1.03	-1.33	1.02	79.17	1.00	123.77	0.94	-0.91	0.91	19.84	0.89	46.75

Table B1. (End)

	Industry	FMOLS (without time-specific fixed effects, with industry fixed effects)		OLS (without time-specific fixed effects, with industry fixed effects)		SUR (without time-specific fixed effects, with industry fixed effects)		FMOLS (with time-specific fixed effects, with industry fixed effects)		OLS (with time-specific fixed effects, with industry fixed effects)		SUR (with time-specific fixed effects, with industry fixed effects)	
		Coeff	*t-stat*	*Coeff*	*t-stat*	*Coeff*	*t-stat*	*Coeff*	*t-stat*	*Coeff*	*t-stat*	*Coeff*	*t-stat*
56	Ornamental and architectural metal prod. ind.	0.95	-1.79	0.94	53.03	0.92	81.15	-0.23	-5.83	-0.06	-0.52	-0.03	-1.26
57	Stamped, pressed and coated metal prod.ind.	0.85	-6.80	0.85	59.13	0.84	85.98	-0.11	-4.93	-0.20	-1.74	-0.18	-5.31
58	Wire and wire products industry	0.95	-2.53	0.94	68.79	0.93	101.71	0.28	-5.34	0.22	3.24	0.24	14.45
59	Hardware, tool and cutlery industry	1.09	2.28	1.08	49.42	1.06	93.64	1.72	2.83	1.57	11.95	1.57	41.03
60	Heating equipment industry	1.08	2.81	1.07	61.30	1.06	102.01	0.58	-1.77	0.54	4.91	0.55	30.39
61	Machine shop industry	0.94	-2.23	0.94	62.46	0.92	114.82	0.44	-7.99	0.47	11.32	0.48	36.18
62	Other metal fabricating industry	0.96	-1.66	0.95	62.67	0.93	96.47	0.47	-3.90	0.42	6.31	0.4	25.09
63	Agricultural implement industry	0.83	-8.32	0.83	63.79	0.82	97.84	-0.18	-21.9	-0.15	-3.92	-0.15	-7.15
64	Commercial refrigerator and air cond. equip. ind.	1.07	-1.34	1.06	38.44	1.04	73.23	0.56	-5.04	0.59	11.92	0.59	24.95
65	Other machinery and equipment industry	0.95	-2.77	0.94	78.61	0.92	130.91	0.57	-7.09	0.57	19.85	0.57	73.91
66	Aircraft and aircraft parts industry	1.09	2.96	1.08	68.37	1.07	117.99	1.39	4.34	1.34	23.89	1.32	58.45
67	Motor vehicle industry	1.07	3.85	1.07	82.80	1.05	120.55	1	0	0.98	9.74	0.97	42.57
68	Truck and bus body and trailer industry	0.98	-0.68	0.97	50.43	0.95	87.17	0.9	-0.39	0.71	5.31	0.68	21.04
69	Motor vehicle parts and accessories industry	0.74	-27.0	0.74	112.54	0.73	156.96	-0.52	-8.85	-0.52	-5.70	-0.52	-18.62
70	Railroad rolling stock industry	1.07	3.08	1.06	62.77	1.06	100.98	1.27	2.29	1.23	16.91	1.22	31.94
71	Shipbuilding and repair industry	0.98	-1.06	0.98	68.20	0.97	155.64	0.69	-5.37	0.74	16.13	0.74	26.37
72	Misc. transportation equipment industry	0.91	-2.18	0.90	43.13	0.90	78.57	0.27	-2.35	0.18	1.17	0.16	5.42
73	Small electrical appliance industry	1.06	-0.85	1.06	28.94	1.05	106.23	0.72	-3.67	0.76	21.47	0.76	77.47
74	Major appliance ind. (electric and non-electric)	1.10	1.85	1.08	34.48	1.07	118.79	0.69	-4.08	0.71	19.29	0.71	77.22
75	Other electrical and electronic prod., battery ind.	1.01	-0.17	0.99	53.09	0.99	147.35	0.31	-4.85	0.30	3.39	0.3	20.06
76	Record player, radio and television receiver ind.	0.47	-0.58	0.31	0.76	0.33	4.33	0.67	-15.2	0.68	54.78	0.68	134.75
77	Communication and other electronic equip. ind.	1.45	2.38	1.42	13.50	1.40	52.09	0.43	-17.8	0.42	19.83	0.42	57.86
78	Office, store and business machine industry	0.72	-2.80	0.60	12.98	0.61	58.36	0.8	-4.00	0.75	32.25	0.74	133.28
79	Commun. and energy wire and cable industry	1.09	1.92	1.07	46.31	1.07	125.95	0.43	-4.84	0.50	6.99	0.5	29.83
80	Clay products industry	1.07	-1.72	1.05	47.00	1.05	142.44	1.52	2.99	1.38	13.34	1.37	50.6
81	Hydraulic cement industry	1.09	1.91	1.07	42.23	1.07	111.67	1.13	-0.44	0.97	7.01	0.96	41.92
82	Concrete products industry	1.07	-1.77	1.06	40.86	1.05	116.69	1.4	-1.21	1.12	5.96	1.09	20.85
83	Ready-mix concrete industry	1.04	-1.06	1.03	41.84	1.02	108.67	1.04	-0.21	0.89	7.21	0.87	24.75
84	Glass and glass products industry	0.92	-3.50	0.92	61.49	0.91	166.09	-0.04	-5.42	0.13	1.31	0.14	5.39
85	Misc. non-metallic mineral product industry	0.99	-0.31	0.98	52.04	0.97	152.48	0.69	-2.88	0.61	10.78	0.61	28.59
86	Refined petroleum and coal products industry	1.04	-1.07	1.03	43.85	1.03	79.66	0.98	-0.18	0.94	16.46	0.94	72.91
87	Industrial chemicals industries n.e.c.	0.94	-2.68	0.93	62.25	0.93	124.66	0.62	-5.58	0.62	13.46	0.62	43.38
88	Chemical products industries n.e.c.	1.05	-1.71	1.03	57.50	1.02	95.73	0.34	-6.06	0.33	4.87	0.33	28.54
89	Plastic and synthetic resin industry	0.87	-3.84	0.88	44.07	0.87	107.32	0.21	-4.87	0.38	3.93	0.39	20.62
90	Pharmaceutical and medicine industry	0.91	-2.28	0.91	40.20	0.91	168.22	0.7	-2.43	0.66	10.33	0.66	71.38
91	Paint and varnish industry	1.11	4.98	1.11	69.32	1.10	192.36	1.71	3.12	1.80	13.75	1.79	42.77
92	Soap and cleaning compounds industry	0.90	-3.52	0.89	54.22	0.89	160.64	0.03	-1.73	0.12	0.42	0.12	2.83
93	Toilet preparations industry	0.94	-1.49	0.94	44.45	0.93	109.63	0.58	-3.82	0.56	9.58	0.56	31.2
94	Floor tile, linoleum and coated fabric	1.18	4.91	1.16	51.75	1.15	125.28	0.28	-4.10	0.34	4.20	0.34	28.45
95	Jewellery and precious metal industries	1.21	2.74	1.22	32.44	1.22	87.92	2.16	3.77	2.10	13.43	2.08	72.6
96	Sporting goods and toy industries	1.06	-1.32	1.05	39.40	1.04	124.52	0.85	-0.83	0.85	9.60	0.85	47.87
97	Sign and display industry	0.93	-2.61	0.93	51.62	0.92	102.73	0.51	-6.15	0.46	8.47	0.45	14.68

Figure B1. FMOLS (with industry-specific, but without time-specific, fixed-effects) vs OLS (with industry-specific, but without time-specific, fixed effects)

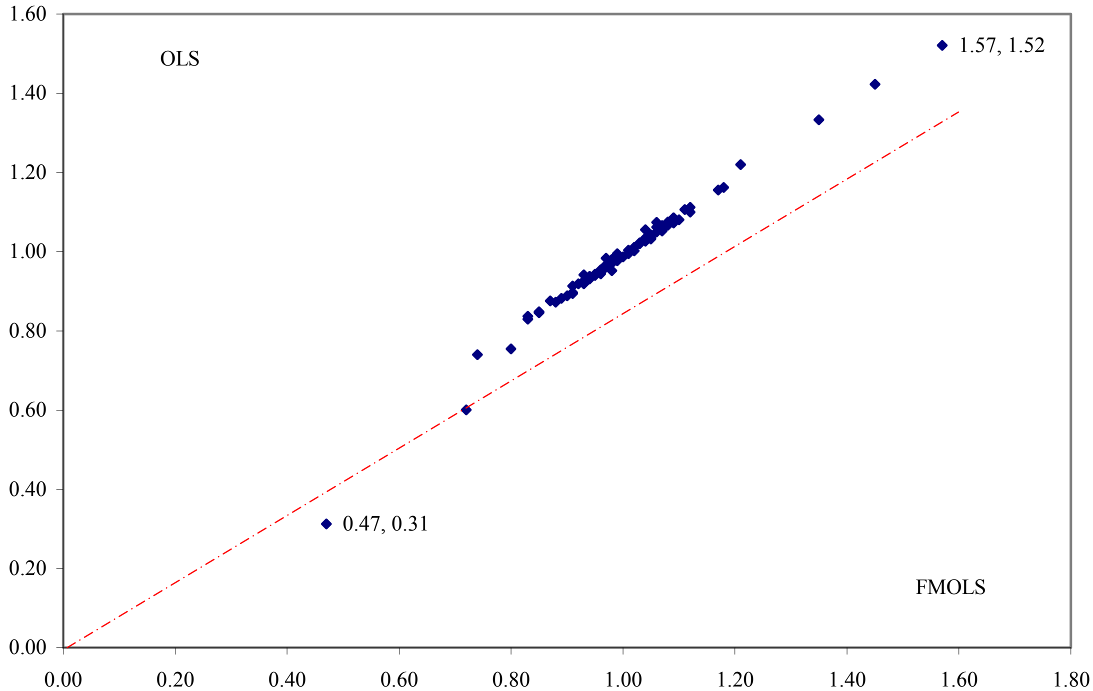


Figure B2. FMOLS (with industry-specific but without time-specific fixed effects) vs SUR (with industry-specific fixed-effects)

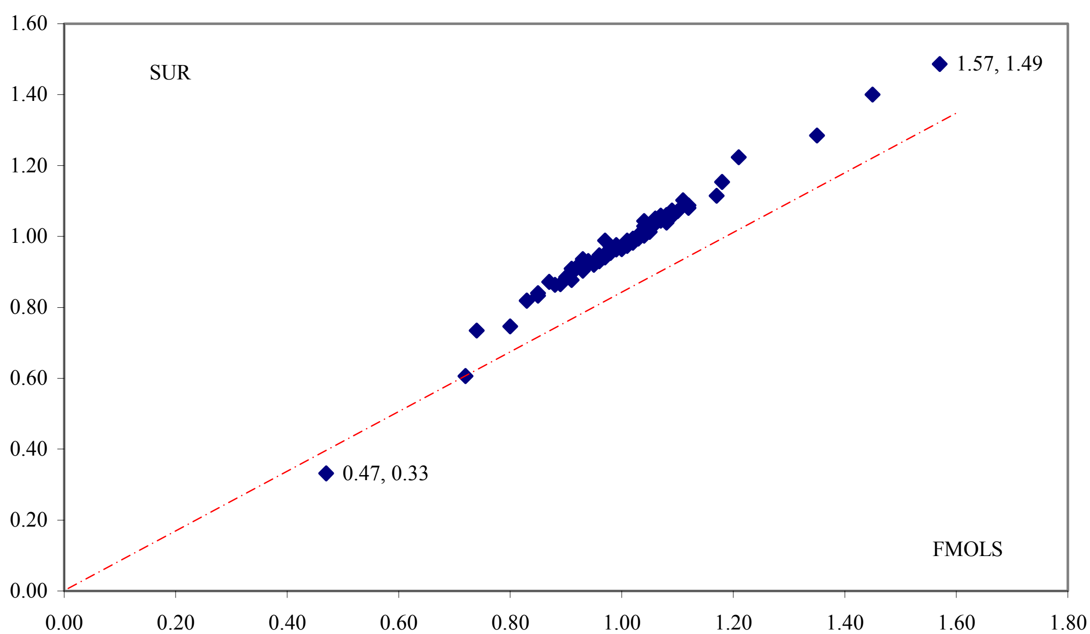


Figure B3. FMOLS vs OLS (both with industry- and time-specific fixed effects)

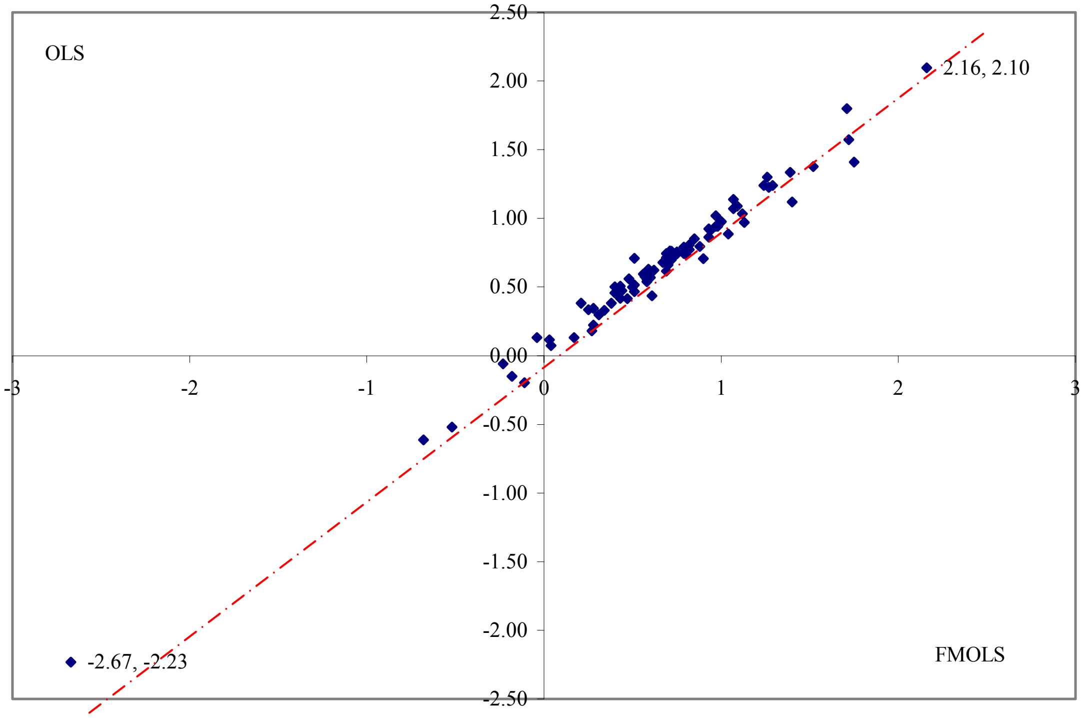
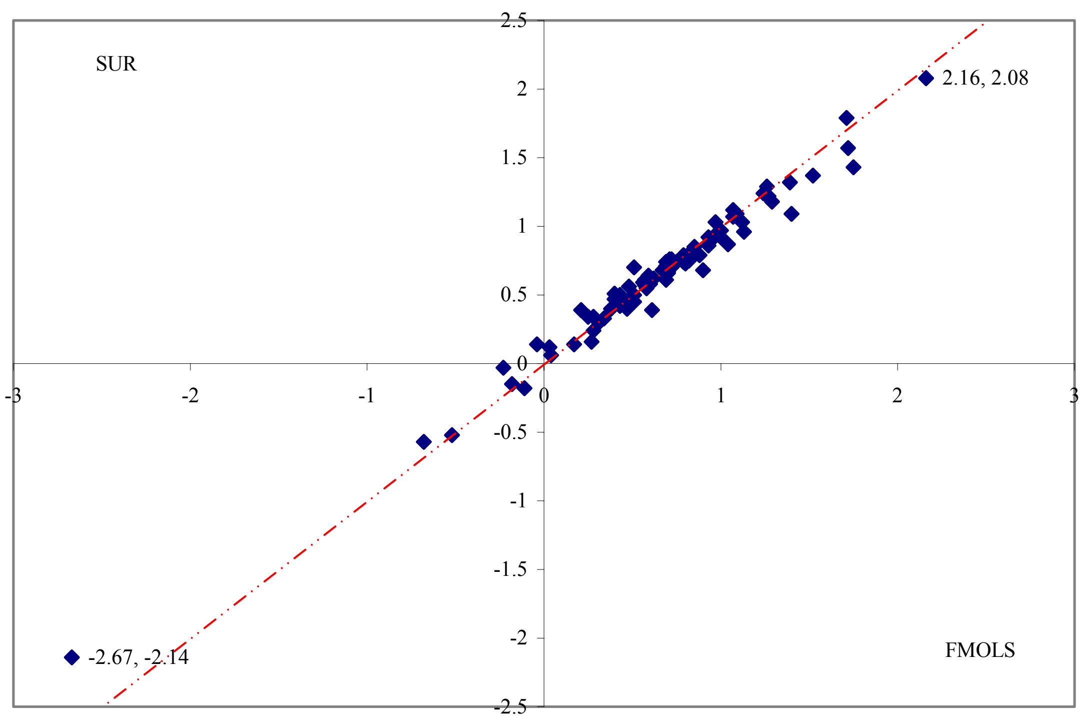


Figure B4. FMOLS (with industry-specific and time-specific fixed effects) vs SUR (with industry-specific and time-specific fixed effects)



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