Global Influences on UK Manufacturing Prices 1970-2000

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ABSTRACT

This paper presents substantial new evidence on the competitive process that links together industrial economics and international economics. Our time-series data base concerns manufactured product prices and their domestic and international determinants. We identify cointegrating relationships, using single equation and multivariate methods. We find that both market imperfections, largely ignored in international economics, and international factors, mostly neglected in industrial economics, should be jointly incorporated into pricing analysis. The significance of global factors varies markedly: differentiated-product sectors respond little to foreign price signals. Our findings are relevant to many fields within economics, including the transmission of inflation.

JEL Classification: C32; D43; F14; L10; L60

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1. Introduction

In common with other West European countries over the last quarter century, the UK economy has become increasingly integrated in relation to international trade in goods and services. Since gaining membership of the European Union, it has substantially increased its trade with other EU nations. Before this, the influence of foreign competition in determining or modifying the price-setting behaviour of firms was thought to be a minor one, given the dominant market position of domestic firms in home markets. This view, derived from the industrial economics literature, contrasts sharply with the traditional literature on trade, tariffs and exchange rates (Corden (1971); Krugman and Obstfeld (1994)), where the central dictum is that domestic prices are determined by the prices of internationally-traded competitive goods.

The impact of global influences on industrial pricing is of central interest in many areas of economics, and for the following reasons. First, the extent to which domestic prices respond to changes in external prices, tariffs or exchange rates represents the transmission of inflation between countries. Large open economies, such as the UK, exhibit the effects of monetary policy through its influence on the exchange rate and the degree of pass-through into domestic prices. Accordingly, the Bank of England has undertaken several studies of pricing behaviour (Bank of England (1999)). Second, central propositions in or derived from international trade theory depend crucially on assumptions made about the nature of international competition and its effects on price behaviour. Although there are some developments in trade theory that treat

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international markets as imperfectly competitive, the main applications of trade and tariff theory depend on an assertion that the ‘law of one price’ [Norman (1996), Isard (1977) and Menon (1995)] applies to *all* tradeable goods.

Open-economy models feature price effects and transmission mechanisms. There is an increasing call for industrial economics to incorporate international influences and to be used more fully in international economics. (Martin, (1992)). In each field, the essential task is to follow the formation of prices and price effects when international influences are present and potentially significant. Finally, practical and policy-relevant questions remain to be answered, and they call for input from both areas of economics. For instance, given the substantial share of imported goods in many domestic markets for manufactured products that exists today, we ask what evidence there is that UK manufacturing prices now mainly follow the prices of competing imported goods? The aim of this paper is to examine this question using data for the main sectors of UK manufacturing industry over the past twenty-five years.

2. Price Behaviour, Evidence and Economic Theory

In principle, economic theory should provide guidance and hypotheses about price-setting strategies and relevant specifications for econometric work. In practice there are many alternative (often extreme) hypotheses available. Standard trade and tariff theory is built upon the premises of highly-competitive conditions where domestic products are perfect substitutes for similarly-described products that are imported. In these circumstances, domestic firms have no option but to match and adjust to the duty-corrected import prices which dominate their pricing decisions; meanwhile, domestic demand and cost conditions play no role whatever. (Corden (1971).) Contrarily, cost-based pricing theories emphasise the degree of market power and the discretion it confers on firms, including domestic firms competing with foreign products, to set prices as a mark-up on some (unit) cost base, with demand and the prices of competitors playing a minor role, or none at all. An alternative justification for stable mark-ups is given by Okun (1981) who emphasised the importance of competition in “customer markets” which trade in differentiated products.

The most common approach in the modern industrial-pricing literature is to derive price setting behaviour from imperfect competition assumptions, including (strangely) *perfect* information. Standard results here give prices as a mark-up above marginal cost – the size of the mark-up being determined by the price elasticity of the demand. While this approach does enable one to introduce cost factors through assumptions about technology, demand pressure through its impact on the elasticity of demand, and the influence of (domestic and foreign) competitors through cross-demand effects, it has significant limitations as an explanation of pricing behaviour. First, the approach is static and assumes the decision-maker has full information about all relevant responses of customers and rivals (as embodied in fixed-position demand functions). Given that the price-making firms are assumed to face stable and well-defined demand curves, given technology and other cost conditions, price is uniquely determined by the usual marginal conditions. This approach neglects the pricing strategies that arise in reacting to rival producers, the uncertainties in knowing consumer demand for the product, and the dynamics of how firms change prices over time – indeed the entire activity (and subject) of modern industrial economics and marketing. Martin (1992) defines (modern) industrial economics as covering everything *except* perfect competition. As standard international economics relies predominantly on perfect competition assumptions, the derived hypotheses are potentially inconsistent and the task of reconciliation is considerable. There are thus polar extremes in theoretical pricing premises directed ostensibly to the same situations and data. We need to draw insights from each field.

In studying how prices have been adjusted in practice in the U. K. since 1970 it would thus be unjustifiably limiting to utilise any tightly-specified hypothesis derived solely from theoretical models that focus on extreme single-dominating causes. We believe that it is important to retain a flexible specification to incorporate factors that might influence price-setting in manufacturing industries, and which takes into account not only alternative theoretical arguments, but also the evidence of available surveys of price behaviour.

A number of surveys have been carried out for UK and US manufacturing firms that complements the long history of econometric studies since the 1960s. A recent survey for the UK is by the Bank of England (Hall *et al* (1996)). We summarise the main findings of these surveys:

i. Manufacturing firms typically install capacity on a scale that permits them to produce with spare capacity in most situations. Competitive pressure is insufficient to force them to lower prices until capacity is fully utilised[1].
ii. The existence of spare capacity allows most demand changes to be accommodated by changing utilisation to adjust production, rather than to adjust prices, at least initially. The response of price to demand changes associated with the business cycle is likely to be small.
iii. When they occur, price responses to demand changes may be asymmetric. Strong demand may result in rationing (lengthening of order books) rather than "charging what the market will bear". If the demand pressure is sustained, it may lead to higher prices, but also to a rise in investment to expand capacity. In conditions of low demand, firms may try to stimulate sales and raise utilisation of capacity by cutting prices (e.g. sales, special offers). But if the fall in demand is prolonged, firms are under pressure to cut capacity (especially to reduce labour costs) in order to rebuild profit margins at a lower level of output and capacity.
iv. Firms are not the static creatures of elementary economic theory that set their location, product specification and technology once and for ever. They are constantly ready to

implement product specification and other changes as markets evolve, often with little advance warning.

We wish to adopt a specification of price adjustment that does not rule out the kind of evidence found by these survey investigations and by case studies of pricing in practice.

3. Econometric studies

It is difficult to find any econometric studies that support the law of one price in international trade, at least for heterogeneous commodities. (Norman (1975), Isard (1977), Coutts, Godley & Nordhaus (1979), Menon (1995) and Martin (1997)).

A recent and authoritative study for the United Kingdom is by Martin (1997) in this Journal. This study, using data for the period from 1951 to 1991, found only about one quarter of the movement of world prices was reflected in UK prices. Martin's study is highly aggregated, using national accounts data to estimate the principal factors influencing the value-added deflator for the UK economy. The study aims to identify the long-run factors influencing UK prices by establishing cointegrating relationships amongst the variables. Martin's specification is also derived from static imperfect competition theory with CES technology assumptions. A log-linear approximation to the optimal price is derived in which price is determined by earnings, productivity and the competing import price. While our study will use a similar set of variables, we are not constrained by the limiting specification. We thus depart from Martin's interpretation of the evidence as confirming that pricing behaviour is explicable by simple static imperfect competition theory and increasing marginal costs. [2] An attractive feature of imperfect competition

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[1] A simple model in which demand uncertainty creates excess capacity is given in Champernowne (1970).
[2] Martin's findings imply that the elasticity of substitution between labour and capital is 1.19, an estimate that it considerably higher than other estimates. Rowthorn (1999) quotes a number of studies where the

is that one does not need to assume that marginal costs in the short run are rising. A determinate price is consistent with a degree of constant or falling variable costs, which is likely to be the case where firms can vary their degree of capacity utilisation.

We therefore adopt a generic specification that relates prices to costs, competing imported prices and demand pressure in order to estimate the relative importance of these factors. We do not interpret the specification as ruling out alternative hypotheses to simple imperfect competition. We also apply our methods to narrower definitions of industry, using a new data set assembled after extensive research work and with the co-operation of the statistical authorities.

4. The Data for UK Manufacturing Industry

We have used as our main subject variable the producer price index series (PPI) for all (aggregate) manufacturing industry and for 16 major, individual sectors of industry using quarterly data from 1974q1 to 2000q4.[3] The disaggregated data are re-classified according to the 1992 SIC and have been linked with data based on the 1980 SIC. One advantage of the PPI published by the Office for National Statistics (ONS) is that they are exactly matched with the series for prices of materials and fuels purchased by each sector. The PPI are indices calculated from direct price quotations and it is important to distinguish the effects on UK prices of world prices that affect UK costs of production, from the effects of direct price competition in finished products. Series for earnings, output and employment, matched to the sectors for prices were compiled and linked to 1992 SIC classifications. As a measure of the price of competing imported commodities we use unit value data on imports, converting from SITC classifications to match

elasticities are much lower, in the range of 0.2-0.4. Using a formula derived by Rowthorn relating the elasticity of substitution, the price elasticity of demand, the share of profit in income and elasticity of employment with respect to the real wage, then even with quite modest values for the price elasticity of demand, an elasticity of substitution of 1.19 implies a real wage elasticity of employment in the range of 5-

with the SIC for the PPI data. The unit value series are adjusted for import duties (mainly of importance for the food, drink and tobacco sector). As an indicator of demand pressure at the aggregate level we use survey data on capacity utilisation published by the Confederation of British Industry (CBI.) For individual series we have computed capacity utilization indexes derived from ONS-matched production data.[4]

5. Aggregate Manufacturing

5.1 Specifications

We adopt the following specifications as a means of estimating the relative importance of costs and competing import prices on UK manufacturing prices:

$$lp = a_0 + a_1 t + a_2 luc + a_3\, lpm + u \qquad (1)$$

where

lp is the log of the product price (PPI), t is a time trend, *luc* is the log of unit costs of production, *lpm* is the log of the prices of imported manufactured goods and *u* is a stochastic error term. The unit cost of production, UC, is a weighted average of unit labour costs, WUC, and the price of materials and fuels purchased by (the same) manufacturing industry, PMAT:

$$UC = aWUC + (1\text{-}a)PMAT \qquad (2).$$

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6. A one percent fall in the real wage would generate, according to this estimate, about one and a half million jobs in the UK economy – an implausibly high response.

[3] The 'all industry' data commence earlier at 1970q1.

Hence, unit cost is the sum of both materials and labour cost indices, but it enters the specification in proportional form (as the log of unit cost, *uc.*) The weighting coefficient used to combine labour and materials costs (α) is obtained from the (ONS) Input-Output Tables for 1990. Unit labour cost is defined as the ratio of earnings to productivity, the latter being the index of production to an index of the number of employed persons. We further disaggregate costs by separating unit labour costs, *WUC* and materials prices, *PMAT*[5].

$$lp = a_0 + a_1 t + a_2 lwuc + a_3\, lpmat + a_4\, lpm + u \qquad (3)$$

Finally, we split unit labour cost into earnings and productivity components, as:

$$lp = a_0 + a_1 t + a_2 lw + a_3\, ln + a_4\, lpmat + a_5\, lpm + u \qquad (4)$$

where *lw* is the log of earnings and *ln* is the log of productivity, as defined above. The final specification is very close to that used in Martin (1997) and is included for comparability with his results.

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[4] A document entitled 'Pricing Project Data Digest' explains the intensive process of data collection, re-classification, matching and index conversion and is available from the authors.
[5] Assuming invariant materials-to-output productivity over time, as no materials productivity data are available.

5.2 Estimation strategy

The price and cost data covering a quarter-century time period are non-stationary and highly likely to be difference stationary. We aim to examine long-run relationships between the variables by estimating cointegrating combinations. The cointegrating vectors would indicate the relative long-run contributions of the different factors. We adopt both univariate and multivariate approaches.

The univariate approach to estimating a cointegrating vector is based on an autoregressive distributive lagged model (ARDL). In this approach, the PPI (domestic) price is taken as the dependent variable, and the other variables are the exogenous forcing variables. It is assumed that there is only one cointegrating relationship. This approach does not require prior testing to establish whether the data are I(0) or I(1) variables, but since we shall also use the multivariate approach, ADF unit root tests of the data are carried out.

Wu Hausman tests for exogeneity of domestic costs and import prices were carried out. The results for the aggregate data indicated that the cost and competing price variables might be treated as exogenous[6].

The ARDL approach to cointegration proceeds in two stages. In the first we test for the existence of a long-run relationship by estimating the above specifications in error-correction form and test for the joint significance of the variables in levels.

[6] The F statistic for the null hypothesis that the unit cost and import price variables are weakly exogenous is 1.78 with critical value $F(2,96)=3.1$.

The ECM regressions are repeated with unit cost and international prices in turn as the dependent variable. The distributions of the F and Wald tests of the joint significance of the levels terms are non standard but Pesaran, Shin and Smith (1996) have tabulated a bounds test for the distribution. There is some evidence for the existence of a single cointegrating relationship with domestic costs and import prices as the forcing variables, but the results are sensitive to the lag lengths used in the error correction[7]. One might expect that wages and prices are jointly dependent (even at the level of aggregation where manufacturing is only about one quarter of GDP). It is also possible that import prices might be influenced by domestic prices, if foreign suppliers practise pricing to market. For these reasons it is important to supplement the single equation approach with the multivariate approach.

The second stage is to estimate an ARDL equation for a maximum length of lag and use model selection criteria (the Akaike criterion, AIC, and the Schwarz Bayes criterion, SBC) to choose the most suitable order of lags amongst the variables. The long-run solution to the chosen ARDL specification gives an estimate of the coefficients of the cointegrating relationship, with standard errors obtained as non-linear functions of the ARDL variance-covariance matrix.

For the all-manufacturing data we use the sample period from 1970 to 1996 to estimate the ARDL model and the out of sample data to end 2000 to test for the predictive properties of the model. We chose this sample because from the second quarter of 1996 the sterling exchange rate began to appreciate strongly against other currencies, particularly against other European currencies. Our data provide a good test of whether the big increase in competitive advantage to

[7] The F form of the bounds test indicates that the lagged levels variables enter significantly into the regression for domestic price, but not for unit cost or international prices. But the values of the F tests decline as the lag order of the ECM is increased.

foreign suppliers conferred by the exchange rate appreciation has had a significant convergent effect on the prices charged by UK manufacturers in domestic markets.

The price, cost and competing import price variables are treated as jointly dependent in the multivariate approach developed by Johansen (1991). Tests for cointegrating vectors are done by testing the rank of the matrix of coefficients multiplying the vector of lagged levels of jointly dependent variables in a VAR model.

5.1 Orders of Integration

The data for the aggregate study of manufacturing prices we have chosen are from 1970q1 to 2000q4. Augmented Dickey-Fuller tests are used to test for orders of integration. The null hypothesis is that the series in levels are I(1) with alternative I(0). Each series is also expressed in first differences so that the test for a unit root in the first difference of the series is equivalent to the null that series in levels are I(2) with the alternative that they are I(1). In each case they are tested with up to 4 lags, both with a time trend and without. Table 1 summarises this large batch of tests for orders of integration.[8] The tests with a time trend do not reject the null of I(1) for variables in levels[9], but they do reject the null of I(2) in favour of I(1) for variables in first differences. The tests without a trend are more varied, sometimes rejecting I(1) in favour of I(0), or for variables in first differences of not rejecting I(2). It is quite likely that there are shifts in the mean of the data for prices and costs when expressed as rates of change, and this may only be partly captured by the ADF tests with a trend.

[8] All estimation has been carried out using the econometrics package: *Microfit 4.1* by Pesaran and Pesaran (1999).
[9] The tests for LUC and LMAT in levels reject the null hypothesis. Since LUC is a weighted average of unit wage cost and material price, this suggests that the materials price may be stationary. However the test on LMAT in first differences indicates that it is an I(1) variable.

Table 1 Summary tests for orders of integration of the data

Variable	Without trend	With trend
LP	I(0) *	I(1) †
DLP	I(2) †	I(1) *
LUC	I(0) *	I(0) *
DLUC	I(2) †	I(1) *
LWUC	I(0) *	I(1) †
DLWUC	I(2) †	I(1) *
LW	I(0) *	I(1) †
DLW	I(2) †	I(1) *
LV	I(1) †	I(1) †
DLV	I(1) *	I(1) *
LMAT	I(0) *	I(0) *
DLMAT	I(1) *	I(1) *
LPM	I(0) *	I(1) †
DLPM	I(1) *	I(1) *

Notes: * indicates that the null hypothesis is rejected. † indicates that the null hypothesis is not rejected.

5.2 ARDL Estimates

We search for suitable orders of lags of up to fourth order for each of the three variables, *lp, luc, lpm.* Table 2 summarises the diagnostics for the preferred ARDL specification relating the domestic manufacturing price including a time trend. Using model selection criteria the preferred lag is *ARDL(2,2,0)*. The equation has generally satisfactory diagnostic properties, except that there is evidence of heteroscedasticity. Inspection of the residuals reveals relatively large variance during the 1970s compared with the 1980s and 1990s. Table 3 gives the long-run estimates of the relation between prices, unit costs and competing import prices. Both coefficients are significant with the dominant component being unit cost.

Table 2

Autoregressive Distributed Lag Estimates
ARDL(2,2,0) selected based on Schwarz Bayes Criterion

Dependent variable is LP (All Manufacturing)
104 observations used for estimation from 1971Q1 to 1996Q4

Regressor	Coefficient	T-Ratio
LP(-1)	1.1424	13.1888
LP(-2)	-.27030	-3.8801
LUC	.13647	3.4895
LUC(-1)	.093690	1.4991
LUC(-2)	-.14893	-3.1167
LPM	.028041	2.4035
CO	.031106	1.6104
TR	.5937E-3	2.7246
S.E. of Regression	.0070680	

Diagnostic Tests

A:Serial Correlation	CHSQ(4)=	3.2701
B:Functional Form	CHSQ(1)=	1.0005
C:Normality	CHSQ(2)=	1.0315
D:Heteroscedasticity	CHSQ(1)=	10.0330

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

Table 3

Estimated Long Run Coefficients: ARDL(2,2,0) Schwarz Bayes Criterion

Regressor	Coefficient	T-Ratio
LUC	.63500	8.8005
LPM	.21921	2.2424
CO	.24317	2.1729
TR	.0046409	6.3971

Table 4 summarises the long-run coefficient estimates obtained from the specification with unit labour cost and materials price as separate regressors including a trend. The trend is statistically significant. The SBC chooses ARDL(2,0,2,1) compared with the AIC which chooses ARDL(2,1,2,2). A test of the joint significance of the additional variables included by the AIC criterion is not significant at the 5% level. The long-run coefficient values show a total of 0.62 for domestic unit costs (0.44 for unit labour cost and 0.18 for materials price). Each coefficient is significant. The import price is also significant with a coefficient of 0.29. The sum of the cost and import price coefficients is 0.91 with a standard error that does not exclude a sum of unity. Once again, the main diagnostic test that is unsatisfactory is for heteroscedasticity.

Table 4

Estimated Long Run Coefficients: ARDL(2,0,2,1) Schwarz Bayes Criterion

Dependent variable is LP

104 observations used for estimation from 1971Q1 to 1996Q4

Regressor	Coefficient	T-Ratio
LULC	.43612	5.8052
LPMAT	.17536	2.3874
LPM	.29364	3.4195
CO	.096046	.69186
TR	.0036790	4.3196

The final specification is to separate unit labour cost into earnings and productivity, which is the specification closest to the one used by Martin [10]. The estimates with the trend are similar to the results discussed above. A test of linear restriction shows that the sum of the coefficients on earnings and productivity is not significantly different from zero. The other coefficients are well determined. The sum of earnings, material and import price is 0.95 and not significantly different from unity. The time trend is no longer significant. While the import price has a significant effect on domestic price, the main influence comes from the components of manufacturing costs (both domestic and imported).

5.5 *Predictive properties*

Chart 1 shows that the out-of-sample dynamic forecast is satisfactory when expressed as quarterly percent rates of change (equivalent to presenting the dynamic forecast in error-correction form). The implied price level is progressively over-predicted. Between 1996 and late 1999, the prices in

[10] Martin's principal specification is given by equation (11), page 1394, in Martin (1997).

sterling terms of imported manufactured goods fell by about 15%. Unit costs decreased by about 2%, mainly because of a 19% fall in materials and fuel prices, whereas unit wage costs increased by about 10%. UK manufacturing prices in home markets thus rose by about 3%, implying a significant rise in profit margins. There was therefore a differential movement in UK and international prices of 18% in a three-year period. This is illustrated in Chart 2. Apparently UK firms have increased their mark-ups at a time when the prices of imported goods have fallen absolutely. Yet the price equation, given unit costs and import prices forecasts a rise in price that is slightly larger than actually occurred. The key findings are that the dynamic forecast is a good predictor of the movement of domestic prices, given domestic costs and competitive import prices. Yet prices of UK products relative to those of imported manufactured products increased by 18%. We shall later consider the possible explanation for and significance of this finding that may be thought surprising.

5.6 Demand pressure

To test whether changes in domestic demand have an influence on prices, given costs and competing prices we used an indicator of demand pressure. The indicator was based on the Confederation of British Industry (CBI) survey of manufacturing firms published on a quarterly basis. It measures the percent of manufacturing firms working below capacity. We used a scaled transform of this series as a measure of demand (see Muellbauer (1991)). We use this measure in preference to the index of production because at this level of aggregation, prices and output may be jointly dependent. The CBI measure of capacity utilisation should be a good indicator of the state of the business cycle to test directly whether the mark-up is sensitive to the rate of capacity utilisation at which firms are currently working. To the preferred specifications of ARDL estimates we added the current and up to six quarters of lagged demand terms and tested for their joint significance. We found no significant demand effects.

This is unexpected because our specification of unit labour costs does not correct for the effect of the business cycle on unit costs. Since productivity is expected to have greater cyclical amplitude than earnings, we would expect unit costs to be counter-cyclical, and therefore that the ex post mark-up should vary procyclically. Given the large structural changes in productivity that occurred following the prolonged recession of the manufacturing sector from the beginning of the 1980s, it is very difficult to estimate what normal (or cyclically corrected) unit costs would have been.

5.7 Multivariate estimates

The first step is to classify variables as I(0) and I(1). The ADF results reported in Table 1 indicated that we could treat the cost and price variables as I(1). The second step is to choose the order of lag of the VAR. An unrestricted VAR of 6 quarters lag was estimated. The SBC chose a lag length of 2, whereas the AIC chose a lag length of 4 quarters. Likelihood ratio tests suggested that 2 quarters was preferred to 3, but 4 preferred to 2. There is a balance between choosing a high enough order of lag to ensure that there is no serial correlation in the errors, and low enough to avoid over parameterisation of the model and loss of degrees of freedom. The ARDL results suggest that a lag length of 2 meets this requirement. We also estimated unrestricted VARs of order 2, and tested for evidence of residual serial correlation in each equation, but none was found. Accordingly, we use a lag order of 2 in the subsequent analysis. The unrestricted VAR also included a time trend, which was statistically significant. For the cointegrating VAR model, we therefore allow an unrestricted constant but a restricted trend. This implies that the trend will appear as a variable in the set of cointegrating variables.

Table 5

Cointegration with unrestricted intercepts and restricted trends in the VAR
LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

106 observations from 1970Q3 to 1996Q4. Order of VAR = 2.
List of variables included in the cointegrating vector:
LP LUC LPM Trend
List of eigenvalues in descending order:
.26481 .069059 .045762 .0000

Null	Alternative	Statistic	95% Critical Value	90% Critical Valu
r = 0	r = 1	32.6083	25.4200	23.1000
r<= 1	r = 2	7.5852	19.2200	17.1800

Cointegration LR Test Based on Trace of the Stochastic Matrix

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	45.1588	42.3400	39.3400
r<= 1	r>= 2	12.5505	25.7700	23.0800

The next stage is to test for the existence of one or more cointegrating vectors among the jointly dependent variables: *lp, luc, lpm.* We use Johansen's tests, based on the maximum eigenvalue and trace statistics. Table 5 summarises the tests. Both tests imply that there is one cointegrating vector. In addition both the AI and SB criteria suggest one cointegrating vector.

Table 6

ML estimates subject to exactly identifying restriction(s)

106 observations from 1970Q3 to 1996Q4. Order of VAR = 2, chosen r =1.
List of variables included in the cointegrating vector:
LP LUC LPM Trend

List of imposed restriction(s) on cointegrating vectors:

	Cointegrating vector
LP	-1.0000
	(N/A)
LUC	.58509
	(0.061587)
LPM	.24007
	(0.080867)
Trend	.0047757
	(0.5409E-3)

Standard errors in brackets
Exactly identifying restriction normalises the price variable

With the just identifying restrictions imposed (normalising the coefficient on the price variable), the long-run relation confirms the results of the ARDL analysis, with statistically significant coefficients on *luc* and *lpm*, and the dominant component being domestic unit costs (Table 6). The sum of the unit cost and import price coefficients is 0.83, which is significantly less than unity. The ECM representation of the VAR for the manufacturing price variable is also given in Table 7, and shows generally satisfactory diagnostics, the exception again being some evidence of heteroscedasticity[11].

Table 7

ECM for log of price, OLS estimate based on cointegrating VAR

Dependent variable is dLP
106 observations used for estimation from 1970Q3 to 1996Q4

Regressor	Coefficient	T-Ratio
Intercept	.062354	6.0813
dLP1	.25104	3.4912
dLUC1	.16943	3.5715
dLPM1	-.033599	-1.0428
ecm1(-1)	.16598	5.6797

ecm1 = -1.0000*LP + .58509*LUC + .24007*LPM + .0047757*Trend

R-Squared	.79247	Serial Correlation	CHSQ(4)=	2.2443
S.E. of Regression	.0073751	Functional Form	CHSQ(1)=	.72282
		Normality	CHSQ(2)=	.64757
		Heteroscedasticity	CHSQ(1)=	13.4528

The analysis is repeated for the specification with separate labour cost and material prices. Tests on the order of lag selection suggest that a lag of order two is adequate to deal with serial correlation in the VAR residuals. The maximal eigenvalue and trace statistics indicated one cointegrating vector. When the just-identifying restriction is imposed, the long-run relationship

[11] The feedback coefficients from the cointegrating vector in the other two ECM regressions suggest a significant feedback to unit costs, but not to international prices. This suggests that there may be simultaneity between domestic prices and unit costs at the level of aggregate manufacturing. This warrants

shows statistically significant coefficients for each cost component separately, and a significant effect of import prices. The sum of the coefficients is 0.9. The ECM representation suggests no residual correlation, but once again there is some evidence of heteroscedasticity.

5.8 Summary of Findings

The statistical analysis of the relationship between aggregate UK manufacturing prices of home sales, UK manufacturing unit costs, and the prices of manufactured imported goods from 1970 to 2000 has been carried out using both single equation and multivariate methods. The aim has been to establish what long-run relationship, if any, exists between them and to estimate the relative importance of the influence of costs and the prices of international competitors' goods on the pricing behaviour of UK-based manufacturing.

The main results are that domestic unit costs (either measured as a single variable or as separate components) and import prices both have significant long-run effects on UK manufacturing prices in the aggregate, but costs play the dominant role. The single-equation (ARDL) and the multivariate methods (VAR) give similar results, confirming a single cointegrating vector. The main statistical caveats are that there is evidence for some change in the implied mark-up of price above unit cost during the second half of the period that is not captured by competitive import prices. The other diagnostics are satisfactory, although there is evidence of heteroscedasticity. Inspection of the residuals suggests greater variance during the 1970s is associated with oil shocks and possibly the high rate of inflation in this period. The predictive performance of the equations are satisfactory from 1996 onwards, despite the large appreciation of sterling and the differential movement of domestic and import prices during this period. While the prices of imported competitive products, in sterling, fell by about 15%, UK firms chose to maintain (or

the use of the multivariate approach to supplement the results of the single equation ARDL approach to increase) the mark-up over unit costs. The major response of UK firms to the deterioration in competitive advantage appears to have been to maintain profit margins and compete with non-price initiatives to limit the fall in the share of the market taken by UK producers. The alternative of cutting prices to match competing imports might have resulted in catastrophic profit losses and the threat of greater factory closures. Our findings are consistent with direct evidence of the cessation of production in the U. K., which is an easier decision for multinational firms (e.g. Vauxhall cars), and some product re-specification as a market response to increased competitive difficulty[12].

Charts 1 and 2 illustrate the aggregate results and show: (1) how our equation both fits the data well and predicts the period from 1996 closely, using the generic specification of domestic cost and import-price variables in our central specification; and (2) that pronounced swings in foreign-domestic price ratios have taken place, including the large rise in relative sterling prices in recent years.

The results for aggregate manufacturing broadly confirm those obtained for the whole economy found previously by Martin. But is this result typical of individual sectors within manufacturing industry?

6. The Sectoral Analysis

Manufacturing activity comprises an enormous diversity of products, industrial organisation, market types and degrees of openness to international competition. Our econometric results for

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cointegration.

[12] Some direct evidence of down-sizing, relocation of operations and the creation of great product differentiation as compared with imported products is available from published company reports, such as from Cassidy Brothers/Cassedon (domestic appliances) which has ceased some production lines, substituting imported versions in some cases. The Churchill Group notes in its 2001 report that it has gained from responding by progressively differentiating its range to concentrate increasingly on traditional English lines.

the aggregate, although suggestive of a robust long-run relationship, need to be investigated at a more disaggregated level to see how far the aggregate relation survives, given the underlying heterogeneity within manufacturing.

Table 8 sets out some structural, ownership and other economic characteristics of the main sectors of manufacturing. We have derived matched data on prices of output, input prices (materials and fuel) earnings, employment and output, import prices of competing manufactured goods for 16 out of the 18 two-digit sectors of manufacturing, according to the 1992 SIC. Statistical problems of missing or incompatible data prevented us from including office machinery and computers, and electrical equipment in our study. But the 16 sectors for which we have data comprise nearly 94% of aggregate manufacturing output. The main problems in compiling such a data set are the changes in industrial classification and in definitions of coverage. Although there are problems in trying to match precisely such diverse sources of data, we feel confident that the sectors for which we have data on costs and import prices provide useable information on which to carry out econometric analysis.[13]

The table indicates the heterogeneous character of manufacturing industry. Some activities, such as chemicals, the food, drink and tobacco industry (FDT), pulp and paper products, and mechanical equipment are large in terms of value-added. These four sectors alone are nearly half of the entire manufacturing sector. Some activities, such as vehicles and other transport are highly concentrated as measured by the proportion of output produced by the five largest firms within the sector. Others, like mechanical equipment, though a large sector of manufacturing, have a much wider dispersion of firm size. Chemicals and motor vehicles both have a high percentage of

[13] Again, the full description of data-generation procedures is explained in the Data Digest available from the authors

foreign-owned plant, while firms in clothing and textiles, although competing with a high share of imports in home sales, are largely UK-owned.

Table 8 Characteristics of the Manufacturing Sector

Industry Name	92 SIC	CRs	Foreign ownership	Import share %	Gross Value Added
"High" price response					
Wood and wood products	20	2.95%	4.46%	36	1.35%
Chemicals	24	8.70%	41.29%	34	11.62%
Base Metals	27	20.70%	19.78%	44	3.86%
"Medium" price response					
Food, Drink & Tobacco	15&16	6.40%	27.60%	19 & 8	14.55%
Textiles	17	6.10%	8.96%	36	3.17%
Leather Products	19	32%	ns	55	0.67%
Pulp and paper products	21&22	10.20%	26.50%	35 & 7	12.55%
Rubber and Plastics	25	9.80%	24.47%	24	5.36%
Fabricated Metals	28	2.80%	14.40%	16	7.68%
"Low" price response					
Clothing	18	9.30%	9.48%	45	1.95%
Non-metallic Minerals	26	8.30%	14.04%	16	3.74%
Mechanical Equipment	29	4.20%	32.41%	36	9.39%
Precision Instruments	33	8.10%	28.65%	42	3.28%
Motor Vehicles	34	41%	74.31%	39	7.23%
Other Transport Equipment	35	34.40%	19.11%	31	3.93%
Other Manufacturing	36	4.80%	10.07%	35	3.63%

Notes: The sectors are divided into three groups classified according to the extent of price adjustment observed after 1996 when import prices generally fell.

6.1 Testing long-run relationships

For the sectoral analysis our approach was to use the same specification as for the aggregate data, relating the domestic price to unit costs and the competing import price. We also separated unit costs into labour and materials. For each of the 16 sectors and all the variables we carried out unit root tests using the ADF statistic. As with the aggregate data we tested the data in levels and first differences, with and without a time trend. We do not report all the details of this very large batch of tests. Tests including a trend generally did not reject the null of I(1) in levels, and rejected the null of I(2) against the alternative of I(1) when tested in first differences. For tests without a trend some variables rejected the null of I(1) in levels, or did not reject the null of I(2) when measured in first differences.

Table 9

Industry Name	**Costs combined** ARDL specification	Sample period	**Costs separate** ARDL specification	Sample period
Food, Drink & Tobacco	(2,2,0)	1977Q1-2000Q4	(1,2,2,0)	1977Q1-2000Q4
Textiles	(6,2,0)	1976Q1-2000Q4	(6,0,2,0)	1976Q1-2000Q4
Clothing	(1,0,0)	1975Q3-2000Q4	(1,0,0,0)	1975Q3-2000Q4
Leather Products	(4,0,0)	1975Q2-2000Q4	(4,0,0,0)	1975Q2-2000Q4
Wood and wood products	(4,4,0)	1975Q2-2000Q4	(4,2,2,0)	1975Q2-2000Q4
Pulp and paper products	(4,2,0)	1974Q4-2000Q4	(2,2,2,0)	1974Q4-2000Q4
Chemicals	(2,3,0)	1975Q1-2000Q4	(2,0,4,0)	1975Q1-2000Q4
Rubber and Plastics	(6,1,0)	1979Q1-2000Q4	(6,5,6,0)	1979Q1-2000Q4
Non-metallic Minerals	(6,3,0)	1984Q3-2000Q4	(3,1,2,0)	1984Q3-2000Q4
Base Metals	(6,1,4)	1976Q1-2000Q4	(6,3,3,4)	1976Q1-2000Q4
Fabricated Metals	(6,5,3)	1976Q1-2000Q4	(6,...,5,3)	1976Q1-2000Q4
Mechanical Equipment	(6,1,0)	1976Q1-2000Q4	(6,0,2,0)	1976Q1-2000Q4
Precision Instruments	(6,2,6)	1976Q1-2000Q4	(6,0,2,0)	1976Q1-2000Q4
Motor Vehicles	(3,5,1)	1976Q1-2000Q4	(5,5,1,1)	1976Q1-2000Q4
Other Transport Equipment	(1,0,1)	1987Q2-2000Q4	(1,0,4,2)	1987Q3-2000Q4
Other Manufacturing	(5,5,0)	1976Q1-2000Q4	(5,0,5,0)	1976Q1-2000Q4
Aggregate Manufacturing	(2,2,0)	1971Q1-1996Q4	(2,0,2,1)	1971Q1-1996Q4

Unrestricted VARs for each sector were estimated to help choose an appropriate lag length among the principal variables used in the price equations, and to decide whether to include a deterministic trend.

Table 10

Industry Name	LUC	LPM	Cointegration	LULC	LM	LPM	Cointegration
Food, Drink & Tobacco	.84492	.081748	No	.61337	.21703	.20712	Yes
	(4.23)	(0.49)		(14.75)	(3.82)	(5.83)	
Textiles	.25983	.34961	No	-1.8646	1.7543	-0.067814	No
	(0.87)	(1.27)		(-0.91)	(1.22)	(-0.13)	
Clothing +	.36263	.11468	No	-0.080787	.38924	.11373	
	(2.97)	(1.38)		(-.53)	(2.85)	(1.23)	
Leather Products	.76206	.20625	No	.16864	.57768	.21761	No
	(1.93)	(0.71)		(0.49)	(1.70)	(0.74)	
Wood and wood products	1.1221	.069408	No	-1.1541	2.1790	-0.83512	No
	(7.41)	(0.39)		(-0.69)	(1.44)	(-0.81)	
Pulp and paper products	1.0669	-0.16849	No	.00447	1.3463	-0.48161	No
	(5.12)	(-0.88)		(0.02)	(3.04)	(-1.41)	
Chemicals	.16384	.70416	No	.33334	-0.06683	.67189	No
	(0.61)	(2.52)		(3.18)	(-0.46)	(5.56)	
Rubber and Plastics	-0.05791	.63053	No	-4.2528	4.8980	-3.2937	No
	(-0.06)	(0.89)		(-1.21)	(1.28)	(-1.08)	
Non-metallic Minerals	-0.46913	.46586	No	-0.59344	.60711	.26233	No
	(-0.70)	(1.88)		(-1.02)	(1.02)	(1.22)	
Base Metals	-0.0347	.50303	No	-0.2425	-0.4051	.87812	No
	(-0.11)	(2.13)		(-1.56)	(-0.96)	(2.56)	
Fabricated Metals	.95053	.29148	No	n.a.	.97593	.23960	No
	(8.37)	(1.64)			(6.86)	(1.18)	
Mechanical Equipment	.94889	-0.0178	No	.12182	.87450	-0.0911	No
	(16.41)	(-0.21)		(0.86)	(4.63)	(-0.67)	
Precision Instruments	.89060	-0.07979	No	.074722	.66553	.00793	No
	(15.72)	(-0.93)		(1.58)	(15.43)	(0.11)	
Motor Vehicles ++	.18144	.92287	No	.02839	.91330	.23804	No
	(0.67)	(2.92)		(0.37)	(4.77)	(1.75)	
Other Transport Equipmt.	1.9165	-0.5220	No	.01584	2.8214	-0.7468	No
	(1.42)	(-1.07)		(0.15)	(2.97)	(-2.31)	
Other Manufacturing	.35761	.66931	No	.38486	.05037	.50964	No
	(1.44)	(1.40)		(1.17)	(0.13)	(1.56)	
Aggregate Manufacturing	.63500	.21921	Yes	.43612	.17536	.29364	Yes
	(8.80)	(2.24)		(5.81)	(2.39)	(3.42)	

Figures in brackets are t-ratios.

[shaded] Indicates significant at 5% level.

\+ Includes D80Q1 and D91Q1 in both specifications

++ includes dummy D93Q1 in both specifications

The full sample to 2000q4 was used to estimate ARDL regression models, using AIC and SBC to choose the appropriate order of ARDL, within the maximum lag set by the unrestricted VAR estimates. For some sectors where the residuals indicated non-normality (often outliers in the early part of the sample when inflation of costs and prices was rapid) a shorter sample period was used. In two sectors, clothing and motor vehicles, dummy variables were added where sharp unexplained increases in price occurred. We estimated ARDL equations combining unit labour costs with material prices, using weights derived from 1990 input-output tables.

At this degree of disaggregation, material costs make up about half to two-thirds of total direct costs. We also estimated ARDL equations with unit labour cost and material prices as separate variables. As with the aggregate analysis, all variables are entered as logarithms.

Table 9 summarises for each of our 16 sectors the preferred lag length and the sample period used for each of the two specifications. On the left hand side unit costs are combined into a single variable, while on the right hand side, unit labour cost and material price are separate variables. In the case of fabricated metals, no satisfactory estimates were obtained when unit labour costs were entered as a separate variable, so the equations were re-estimated, dropping labour costs from the specification.

From the preferred ARDL models, we obtain the long-run values of the relationship between domestic prices, domestic costs and import prices. These are summarised in Table 10. In contrast to the aggregate results, there is only one sector, food drink and tobacco, where long-run significant relationships are found for all the cost and competitive import price variables. The vehicles sector is also a case where there are positive coefficients on all variables but the import price is significant at the 10% level. For the majority of sectors (10 out of 16) there are statistically significant long-run cost influences on price. In addition, there are only three sectors which have statistically significant positive influences from import prices. There are three sectors for which no long-run influence of cost or competitive price could be found. Notwithstanding the lack of long-run effects, the ARDL equations provide a good short-run fit of the data. In one sector, fabricated metals, no long-run relations could be found that included unit labour costs.

There are several interesting features in these results. The first is that the disaggregated results tend to confirm that the main influence on industrial prices is the movement of costs. Food, drink and tobacco is the only sector that broadly reproduces the result obtained for aggregate manufacturing of a cointegrating relationship among all variables, with import prices having a significant, but not the dominant influence on prices. The two sectors where significant import price effects are found are chemicals and base metals. While within the chemicals division there are some differentiated products such as pharmaceuticals, the main category of activity is the relatively homogeneous sub-category: basic chemicals. Similarly trade in steel products is the main activity of base metals. Both these activities involve trade in near homogeneous products. One would therefore expect these markets to be closer to the behaviour of commodity markets than the "customer" markets that are more typical of differentiated products. These three sectors, food drink and tobacco, chemicals, and base metals, together with motor vehicles where the import price is almost significant, comprise about one-third of the whole manufacturing sector.

6.2 *Demand pressure*

We also tested whether demand pressure influenced the relationship between prices and costs in industrial sectors, using as indicators the index of production measured relative to a trend within each sector[14]. In some cases this is a simple trend, but in others we allow for changes in trend.[15]

[14] The CBI indicator of capacity utilisation is not available at this level of disaggregation. We rely *faute de mieux* on the production index as an indicator of demand pressure.
[15] Full details of the breaks in trend are given in the Data Description Digest.

For the preferred specifications shown in Table 9 we carried out variable addition tests, using the current and up to four quarter lags of the demand indicator. The hypothesis that the demand variables are jointly zero was tested using the F statistic. The results are summarised in Table 11. In most cases the joint test was not rejected. In textiles, base metals and precision instruments there were significant negative effects. In all cases the overall size of the demand effects were small. In two sectors, pulp and paper, and rubber and plastics, there were significant positive effects. Other manufacturing, which is mainly trade in toys and games, also revealed significant demand pressure. In motor vehicles there was a significant positive effect for the combined cost specification but not for the separate cost specification. The main result emerging is that demand pressure effects had little quantitative influence on domestic manufacturing sectors, relative to the influence of other factors over the period of our sample. As noted above, we found no significant demand effects for manufacturing at the aggregate level.

Table 11

Industry Name	Costs combined: Adj. import price significant	Costs combined: Demand significant	Costs separate: Adj. import price significant	Costs separate: Demand significant
Food, Drink & Tobacco	No	No	No	No
Textiles	Yes	Yes	No	No
Clothing	No	No	No	No
Leather Products	No	No	No	Yes
Wood and wood products	No	No	No	No
Pulp and paper products	Yes -ve	Yes	No	Yes
Chemicals	No	No	No	No
Rubber and Plastics	No	Yes	Yes -ve	No
Non-metallic Minerals	Yes	Yes	Yes	Yes
Base Metals	n.a.	Yes -ve	n.a.	Yes -ve
Fabricated Metals	No	No	No	No
Mechanical Equipment	No	Yes	No	Yes
Precision Instruments	Yes -ve	No	Yes	Yes -ve
Motor Vehicles	No	Yes	No	No
Other Transport Equipment	No	Yes -ve	No	No
Other Manufacturing	n.a.	No	n.a.	Yes
Aggregate Manufacturing		No		No

As mentioned in relation to aggregate manufacturing, to the extent that labour productivity is pro-cyclical and has greater amplitude than earnings (implying *counter-cyclical* unit costs), we might expect that the gross mark-up of price over unit cost might vary positively with the state of demand.

Unless firms really raise their prices when market demand increases, and cut them during a recession, we would not expect to find large effects of demand pressure for most sectors of manufacturing. The state of demand in international markets, rather than the state of home demand will influence those sectors where prices are more flexible, such as chemicals and base metals.

6.3 *Increasing competition from abroad*

It may be objected that the relatively small influence of competitive imported prices on domestic prices found in our results arose because we assumed that the influence was constant over the entire sample from the 1970s to 1999. During this period many (but not all) sectors of UK industry have experienced increasing competition from abroad in domestic markets, as the economy has become more open in both exports and imports[16]. The UK economy has become more integrated with other EU countries, particularly during the 1980s. Imports of goods from other EU countries supply over one-half of all imports of goods to the UK, which represents trade free of tariffs within the internal single European market. It might be expected that this scale of free trade would exert greater influence on UK prices than was evident in the 1970s. Martin (1997) qualified his conclusions about the economy-wide influence of international competing prices by noting that he had assumed a constant influence over time. To test the hypothesis that the influence of import prices increases with the openness of the market, we postulate that the coefficient on the import price varies positively with the share of the domestic market taken by imported goods in each sector. We measure this factor by the import penetration ratios published with breaks by the ONS, supplemented by the authors' estimates. We have managed to compile import penetration ratios for 14 of our sectors. Our test is to re-estimate the ARDL equations

[16] Food drink and tobacco, and pulp and paper have not had a rising share of imports in the domestic market. In contrast, there are seven sectors where the import share more than doubled in the twenty-five year period.

using the compound variable *MR*LPM* in place of *LPM* where *MR* is the import penetration ratio. Table 11 also summarises the results of this test. For both specifications with costs combined and separate we have re-estimated ARDL equations, choosing an appropriate length of lag using AI or SB criteria. The table indicates whether the long-run coefficient on the adjusted import price variable is statistically significant. For combined costs all sectors had insignificant import price effects except for textiles and mechanical equipment. Precision instruments had a significant effect but of the wrong sign. Unfortunately we could not compile a consistent series for base metals to compare with the test result for a significant price effect shown in Table 10. Both textiles and mechanical equipment were not significant in the earlier results, so this is a case where there is evidence for the effect of increasing international competition. But for both sectors, when costs were separately estimated there were no significant import price effects. Our tests do not indicate that the sectors which experienced a rise in the overseas share of domestic markets were more likely to modify their domestic prices according to the prices of foreign competitors.

6.4 *Dynamic predictions*

One of the fascinating features in our data is the divergent movement between domestic and international prices that opened up in the second half of 1996 with the appreciation of sterling and which has since generally been sustained. This is illustrated in the sample of charts, which compares the producer price index (PPI) with the competitive import price index, corrected for import duties. The latter is an index of unit values rather than of direct price quotations and shows more variability than the PPI index. The longer-run trends in the two series are more similar, at least until 1996. The charts show a characteristic “open-jaw” divergence in the series as the import price in sterling falls, but the domestic price continues to increase, or falls at a much slower rate. By 1999, the effective exchange rate was over 20% higher than in 1996. The response of the price index of competitive imports in about half of the manufacturing sectors was a fall in price by an amount roughly equivalent (or more) to the rise in the exchange rate. In six sectors: food drink and tobacco; textiles; pulp and paper; rubber and plastics; non-metallic minerals; other transport, the domestic price continued to increase or stabilised.

Table 12

Industry Name	**Costs combined** Predictive failure test	**Costs separate** Predictive failure test	**Costs combined** Mean prediction error	**Costs separate** Mean prediction error
Food, Drink & Tobacco	No	No	-0.064	-0.029
Textiles	No	No	-0.051	-0.050
Clothing	No	No	-0.02	-0.013
Leather Products	No	No	0.012	0.013
Wood and wood products	No	No	-0.019	-0.018
Pulp and paper products	No	No	-0.019	-0.002
Chemicals	No	No	-0.086	-0.068
Rubber and Plastics	Yes	Yes	-0.141	-0.152
Non-metallic Minerals	No	No	-0.010	0.092
Base Metals	No	No	-0.056	-0.023
Fabricated Metals	No	No	-0.064	-0.056
Mechanical Equipment	No	No	-0.045	-0.004
Precision Instruments	No	No	-0.020	-0.010
Motor Vehicles	No	No	-0.005	0.022
Other Transport Equipment	No	No	-0.046	0.037
Other Manufacturing	No	No	-0.083	-0.083
Aggregate Manufacturing	No	No	-0.023	-0.015

This opened a relative price gap between the domestic and import price, which for these six sectors averaged about 30%. In chemicals and base metals, the relative price increases were about 11%, which means that domestic prices fell substantially, although not fully in line with the import price. In the eight remaining sectors, the fall in import prices averaged only about 8%. In all cases, domestic prices either increased or fell by less than 3%.

Despite this divergent movement of relative prices, the conditional predictions of the price equations are good. Table 12 summarises the result of re-estimating the preferred ARDL equations up to 1996Q2 and forecasting the out of sample observations. In each case we carry out a test of predictive failure. This is equivalent to a test that the forecast errors from 1996Q3 to 2000Q4 are jointly zero. In all cases except rubber and plastics the null is not rejected. If the standard errors of the regression are large, this may not be a powerful test. But the standard error of estimate for most of our equations is quite small. As a further indication of the out of sample properties, we summarise the mean prediction errors for each sector. They are generally negative, indicating that the forecasts generally over predict the rise in prices (or under predict the fall in prices). The mean prediction errors are generally small, over half of the sectors being 3% or less. This is a particularly interesting finding because of the large divergence between domestic and imported prices that takes place in most sectors during the following three years. Despite relative price movements that are sometimes of the order of 30% or more, the prediction errors are generally less than three percent.

A selection of plots of domestic and foreign prices for some selected products illustrates our results and general theme, as in charts 3a ,3b,3c&3d.

7. Concluding comments

Our study has investigated the extent to which the increased integration of UK manufacturing industry into global competition has modified pricing behaviour of UK produced goods sold in the UK market. There are many caveats we would make about the quality of our data, and our conclusions must be qualified. We know that in contrast to the aggregate data, it is much harder to obtain well-matched time series on consistent definitions and uniform industrial classifications. The results of this study may stimulate other researchers and the statistical authorities to devote more resources to improvements in the measurement of large samples of time series data on which much econometric analysis depends.

Our results for all manufacturing industry confirm and complement the results obtained for the GDP price deflator by Martin (1997). Yet the apparent long-run stability of the relationship may be an artefact of aggregation. While there may be more measurement error in the disaggregated price and cost data, our results suggest that there is considerable heterogeneity across the industrial sectors within manufacturing, generating variety in price behaviour that is not visible in the aggregate. We classify these into three broad categories of price adjustment:

a) Sectors that produce mainly homogeneous products traded at international prices. The chemicals and base metals sectors largely belong to this group. In both sectors, the sterling price of imported goods fell much in line with the exchange rate appreciation between 1996 and 1999, and domestic prices fell substantially.
b) Sectors in which international competitor prices fell much in line with the exchange rate rise, but in which domestic prices increased, or fell by modest amounts.

c) Sectors whose competitor prices fell by only about 8% or less, while domestic prices increased, or fell by modest amounts.

The first category consists of the sectors that are similar in many ways to trade in primary commodities. Although the producers of such commodities can collectively influence prices to some extent by adjusting capacity utilisation in the short run, they are essentially following uniform prices set in international markets. In the second category product differentiation enables domestic firms to set prices that diverge from similar imported goods. Following the appreciation of the exchange rate, it may have been a better "survival" strategy for firms to maintain mark-ups on domestic costs than try to match the fall in import prices with catastrophic effects on profits. For firms maintaining profit mark-ups, the impact on their profits depends on the extent to which consumers substitute between foreign and domestic products to the switch in relative prices and the rate at which domestic firms lose significant market share. The third category (amounting to 35% of the output of the manufacturing sector) may consist of sectors where foreign competing firms practise "pricing to market". If this is the case foreign producers gain from the appreciation in sterling by allowing them to raise their profit margins. Domestic producers are the market leaders and can continue to charge prices that meet their normal mark-ups without significant loss of market share.

An example in this third category is motor vehicles. Our data cannot tell us about differences in the levels of prices in the UK and other EU countries, but it can indicate relative movements. During our sample period there were two major appreciations of the exchange rate, 1979-81 and 1996-98, and one depreciation, 1992-93, when the UK exited from the Exchange Rate Mechanism (ERM). In both appreciations, increases in the effective exchange rate against a basket of major currencies was about 26%. The depreciation in 1992-1993 was about 12% (nearly 15% against European currencies). What is remarkable is how little the sterling price of imported vehicles was affected in both appreciations. In the first episode, import prices were virtually unchanged over the period 1979-81; in the second appreciation, from March 1996, import prices fell over the following two years by only 6.5%. Following the depreciation in September 1992, import prices rose by 15% while domestic prices rose by 4%. In both 1979-81 and 1996-98 episodes, domestic prices continued to rise. It is well known that what matters in the car market is not the list price of the manufacturer, which is used as a benchmark for negotiation between dealer and purchaser, but the transaction price at which the car is sold. We can get some idea of the latter price (at least for consumers) by looking at the retail price index for the purchase of cars. Although this index shows more variation than the producer price, the trend in both indices is the same from 1987 to 1998 – including the two year period after the appreciation of the sterling exchange rate. Since then the retail price has declined by about 9%, but the import price and domestic producer price have declined by less than 5%.

Other implications of these results are relevant to the transmission of inflation and (via the terms of trade) to swings in aggregate demand. Although a floating exchange rate can be expected to exert a direct influence on the prices of finished goods imported to domestic markets, these results suggest that the impact on competing domestic goods is rather small. Similarly, to the extent that importers practise “pricing to market” in the UK market, the elasticity of the exchange rate with respect to the terms of trade may be very low. An interesting complementary development of this study will be to compare the prices of UK manufactured goods produced for export markets with the prices of similar products within the EU market.

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Chart 1 Manufacturing Prices 1970-2000
quarterly percentage changes

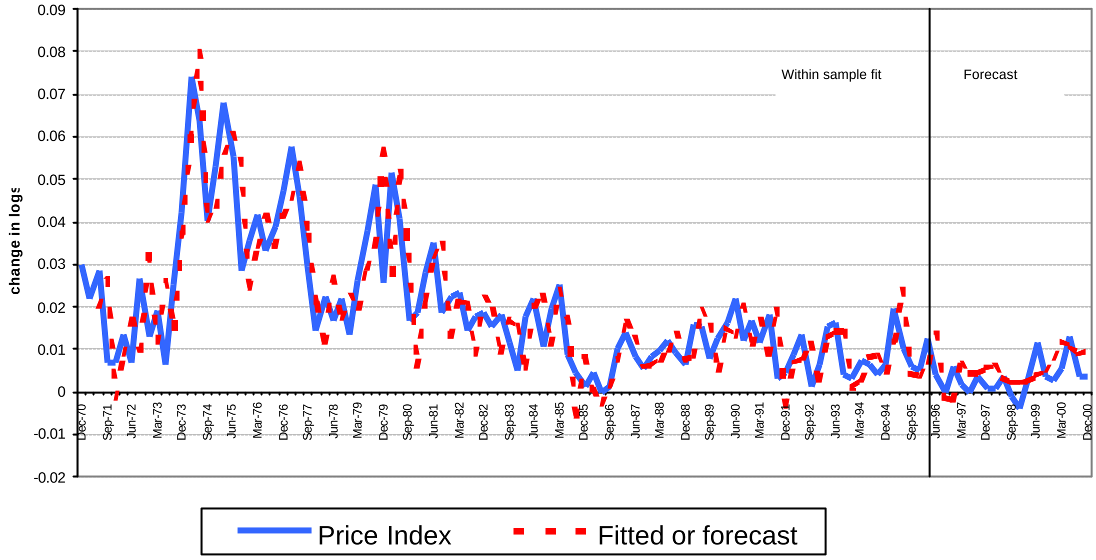

Chart 2: Gross Mark-up and relative price
UK manufacturing 1970-2000

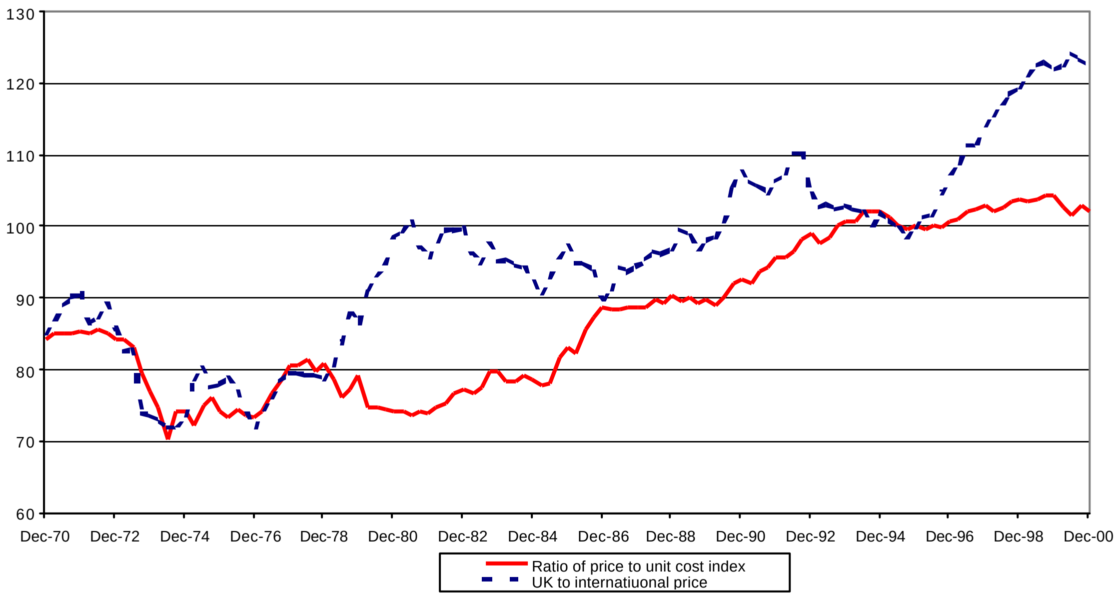

Chart 3.a: Food, Drink and Tobacco
1992 SIC, 15 & 16

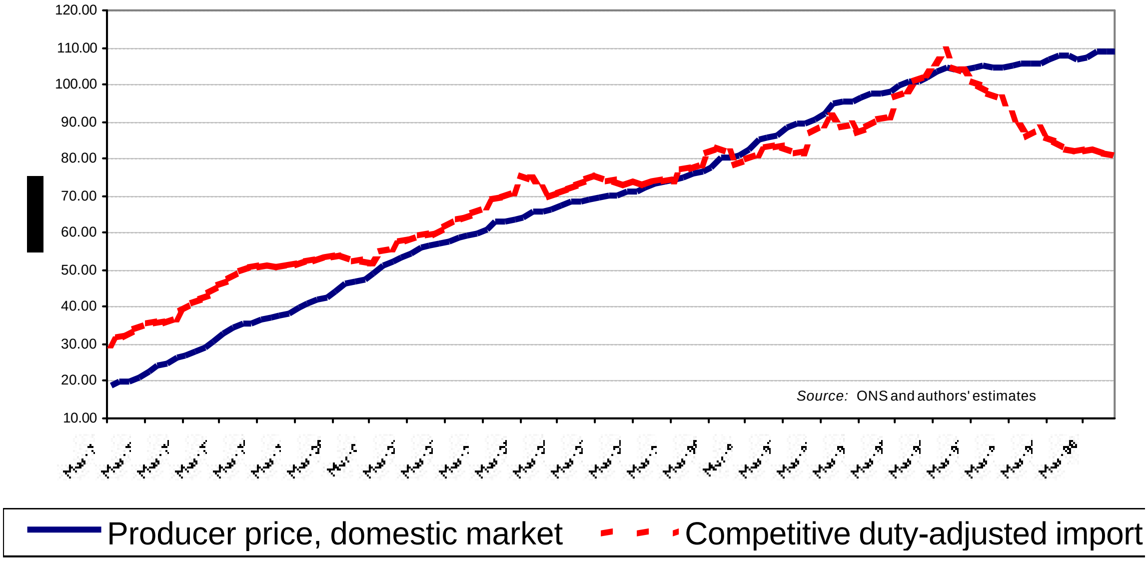

Chart 3.b: Textiles
1992 SIC, 17

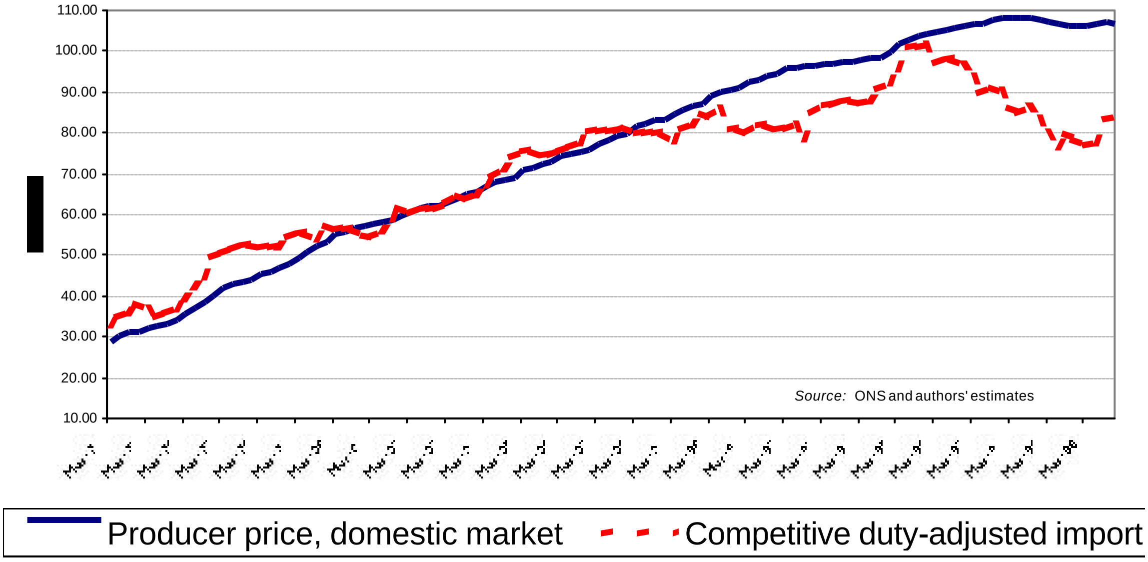

Chart 3.c: Chemicals
1992 SIC, 24

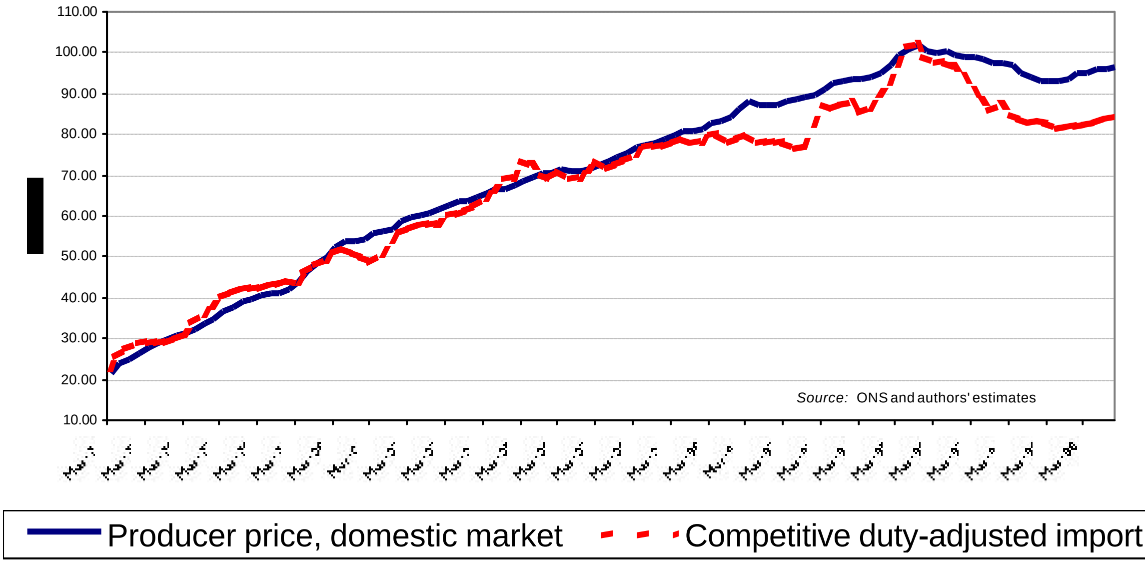

Chart 3.d: Motor Vehicles
1992 SIC, 34