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Exchange Rate Fluctuations and U.K. Manufacturing Exports

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Abstract

This paper examines the impact of exchange rate fluctuations on U.K. manufacturing exports. The results indicate a recursive structure in the long run, wherein prices influence the volume of exports demanded but are not influenced by it. They also indicate that U.K. exporters only partially offset the impact on foreign consumers of fluctuations in the effective exchange rate of the pound. During the ERM period, however, the extent of pass-through to foreign prices weakened, a process that appears to have reversed after exit from the ERM. Hysteresis in the form of limited exchange rate pass-through is supported by the results, but that arising from regime switches in supply is not.

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Table of Contents

		Page
Summary		iii
I.	Introduction	1
II.	Manufacturing Export Prices and Volumes Since 1975	2
III.	The Model	4
IV.	Estimation and Results	7
V.	Conclusions	10

Text Tables

1.	ML Estimates of the Parameters of Manufacturing Exports Models for the United Kingdom	9
2.	Parameter Estimates of the Preferred Model for Manufacturing Export Price for the United Kingdom	10
3.	Parameter Estimates of the Preferred Model for Manufacturing Export Volume for the United Kingdom	10

Charts

1.	United Kingdom: Effective Exchange Rate and Export Prices in Local Currency	2a
2.	United Kingdom: Effective Exchange Rate and Export Prices in Foreign Currency	2b
3.	United Kingdom: Export Prices Relative to Unit Labor Cost	2c
4.	United Kingdom: Manufacturing Prices and Unit Labor Cost	4a
5.	United Kingdom: Actual and Dynamic Forecasts for Manufacturing Export Price in Foreign Currency	12a

References 13

Summary

The United Kingdom's export performance since the 1970s, it has often been argued, has reflected a tendency for U.K. exporters to use favorable exchange rate movements to improve profit margins rather than to strengthen their competitive position and boost foreign demand for their products. Exports, however, also depend on supply-side performance, which, unlike demand, is positively influenced by improved profit margins. The effect of exchange rate fluctuations on export performance therefore depends on the price sensitivities of both supply and demand and on the pricing policies of exporting firms. In a competitive international market, exporting firms follow a pricing-to-market policy, taking prices in foreign currencies as given and offsetting the effects of exchange rate depreciation by appropriately adjusting local currency export prices. At the opposite extreme, setting prices based only on domestic factors, for example in order to preserve profit margins, implies a full exchange rate pass-through to consumer prices abroad. The former pricing policy maintains demand while the latter sustains the firm's ability to invest and supply.

Depending on the market structure, a lack of response (or a partial response) of export prices to sharp or sudden exchange rate fluctuations could indicate the presence of hysteresis in the sense that a transitory shock to the system would permanently change relative prices. Moreover, when investment and production involve costs that are irreversible, the supply of exported goods may manifest hysteresis that arises from the entry and exit decisions of firms. The response of export prices to exchange rate movements may also depend on the prevailing exchange rate regime. A question in relation to the United Kingdom is whether this response was influenced by sterling's membership in the ERM and its subsequent departure from the system in September 1992. In principle, the disciplinary effects of a credible fixed exchange rate system are likely to influence price determination by, for example, reducing the likelihood that devaluations will be used to improve competitiveness.

This paper examines the impact of exchange rate fluctuations on U.K. manufacturing exports. The results indicate a recursive structure in the long run, wherein prices influence the volume of exports demanded but are not influenced by it. They also indicate that U.K. exporters only partially offset the impact on foreign consumers of fluctuations in the effective exchange rate of the pound. During the ERM period, however, the extent of pass-through to foreign prices weakened, a process that appears to have reversed after exit from the ERM. Hysteresis in the form of limited exchange rate pass-through is supported by the results, but that arising from regime switches in supply is not.

I. Introduction

The United Kingdom's export performance since the 1970s, it has often been argued, has reflected a tendency for U.K. exporters to use favorable exchange rate movements to improve profit margins rather than to strengthen their competitive position and boost foreign demand for their products. Exports, however, also depend on supply side performance, which, unlike demand, is positively influenced by improved profit margins. The effect of exchange rate fluctuations on export performance, therefore, depends on the price sensitivities of both supply and demand, and the pricing policies of exporting firms. Thus, in a competitive international market, exporting firms follow a pricing-to-market policy, taking prices in foreign currencies as given and offsetting the effects of exchange rate depreciation by appropriately adjusting local currency export prices. This helps to preserve market shares and would imply a negative relation between the exchange rate (defined as the foreign currency price of local currency) and export prices in local currency. At the opposite extreme, setting prices based only on domestic factors, for example in order to preserve profit margins, implies a full exchange rate pass-through to consumer prices abroad. The former pricing policy maintains demand while the latter sustains the firm's ability to invest and supply.

Depending on the market structure, a lack of response (or a partial response) of export prices to sharp or sudden exchange rate fluctuations could indicate the presence of hysteresis in the sense that a transitory shock to the system would permanently change relative prices. Moreover, when investment and production involve costs that are irreversible the supply of exported goods may manifest hysteresis that arise from entry/exit decisions of firms. In this case exports at any point in time may depend not only on the current level of the exchange rate but also on its past history. 1/ As a result, current exchange rate changes may not be effective in correcting current account imbalances. This is an important issue for the United Kingdom because of the relatively sharp movements of sterling and the persistence of current account deficits in recent years.

The response of export prices to exchange rate movements may also depend on the prevailing exchange rate regime. A question in relation to the United Kingdom is whether this response was influenced by sterling's membership of the ERM and its subsequent departure from the system in September 1992. In principle, the disciplinary effects of a credible fixed exchange rate system is likely to influence price determination by, for example, reducing the likelihood of the use of devaluations to improve competitiveness.

To measure the impact of exchange rate fluctuations on export prices and volumes, it is necessary to examine the supply-demand structure of the United Kingdom's manufacturing exports and the various elasticities. On the demand side, it has been argued that the income elasticity of demand for U.K exports has risen over the first half of the 1980s (Landesmann and Snell

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1/ See, for example, Krugman and Baldwin (1989), Dornbusch (1987), Dixit (1991), Krugman (1991), and Giovannetti and Samiei (1994).

(1989)). On the supply side, there is evidence that as a result of the supply side reforms, export supply price elasticity rose in the early 1980s compared with the earlier period (Holly and Wade (1991)). Given the structural changes in the United Kingdom during the early part of the 1980s, it would be interesting to investigate whether there have been further changes in the supply and demand elasticities.

This paper examines the impact of exchange rate fluctuations on U.K. manufacturing exports. The results indicate a recursive structure in the long run, wherein prices influence the volume of exports demanded but are not influenced by it. They also indicate that U.K. exporters only partially offset the impact on foreign consumers of fluctuations in the effective exchange rate of the pound. During the ERM period, however, the extent of pass-through to foreign prices weakened, a process that appears to have reversed after exit from the ERM. Hysteresis in the form of limited exchange rate pass-through is supported by the results, but not that arising from regime switches in supply is not.

The structure of the paper is as follows. Section II examines some stylized facts in relation to the performance of United Kingdom manufacturing export volumes and prices, before and during the ERM membership, and proposes some hypotheses of interest. Section III develops simultaneous supply-demand models for the United Kingdom's export volume and prices, within a framework that allows for hysteresis effects. Section IV presents and discusses the results. Section V concludes.

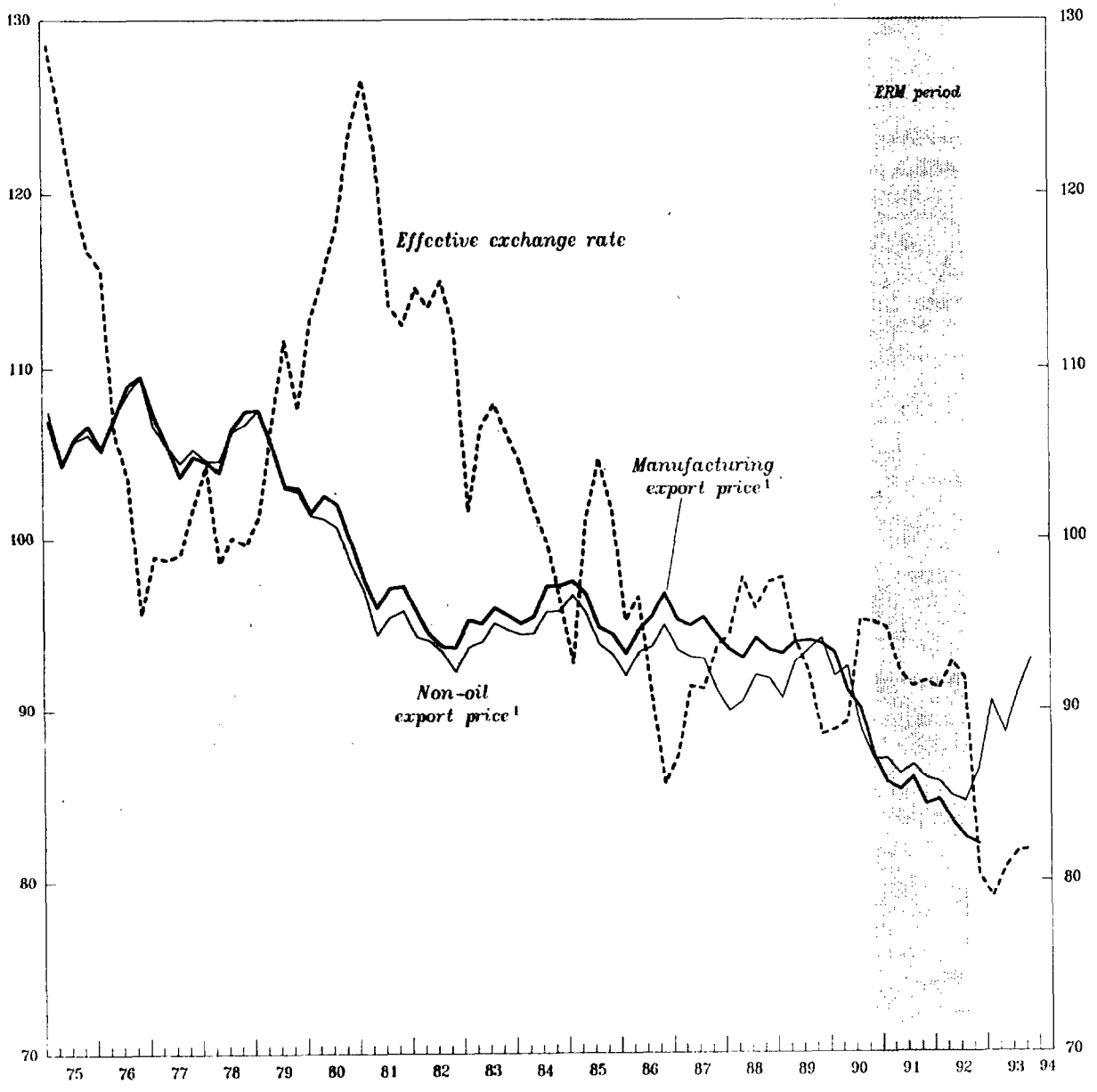
II. Manufacturing Export Prices Since 1975

This section examines the behavior of U.K. manufacturing export prices before and during the country's membership of the ERM and its relationship with the exchange rate, domestic manufacturing prices, and unit labor costs. Some working hypotheses are outlined.

Visual evidence appears to support a limited degree of exchange rate pass-through. The relationship between the effective exchange rate and export prices in local currency as a ratio to domestic manufacturing prices--which is the relative price that influences export supply--is broadly negative (Chart 1). The weakness of this relationship, however, is illustrated by the close movements between the exchange rate and export prices in foreign currency, defined as local currency prices times the effective exchange rate (Chart 2). This indicates that the impact of fluctuations in the exchange rate on prices for consumers abroad is only partially offset.

During the ERM period, 1990:IV-1992:III, however, the relationship appears to break down: there is a secular fall in export prices in local currency in the absence of a rise in the exchange rate (see Chart 1). Prices also fell significantly in terms of foreign currency during this period (see Chart 2). The correlation coefficient between the rates of change in the exchange rate and manufacturing prices in foreign currency

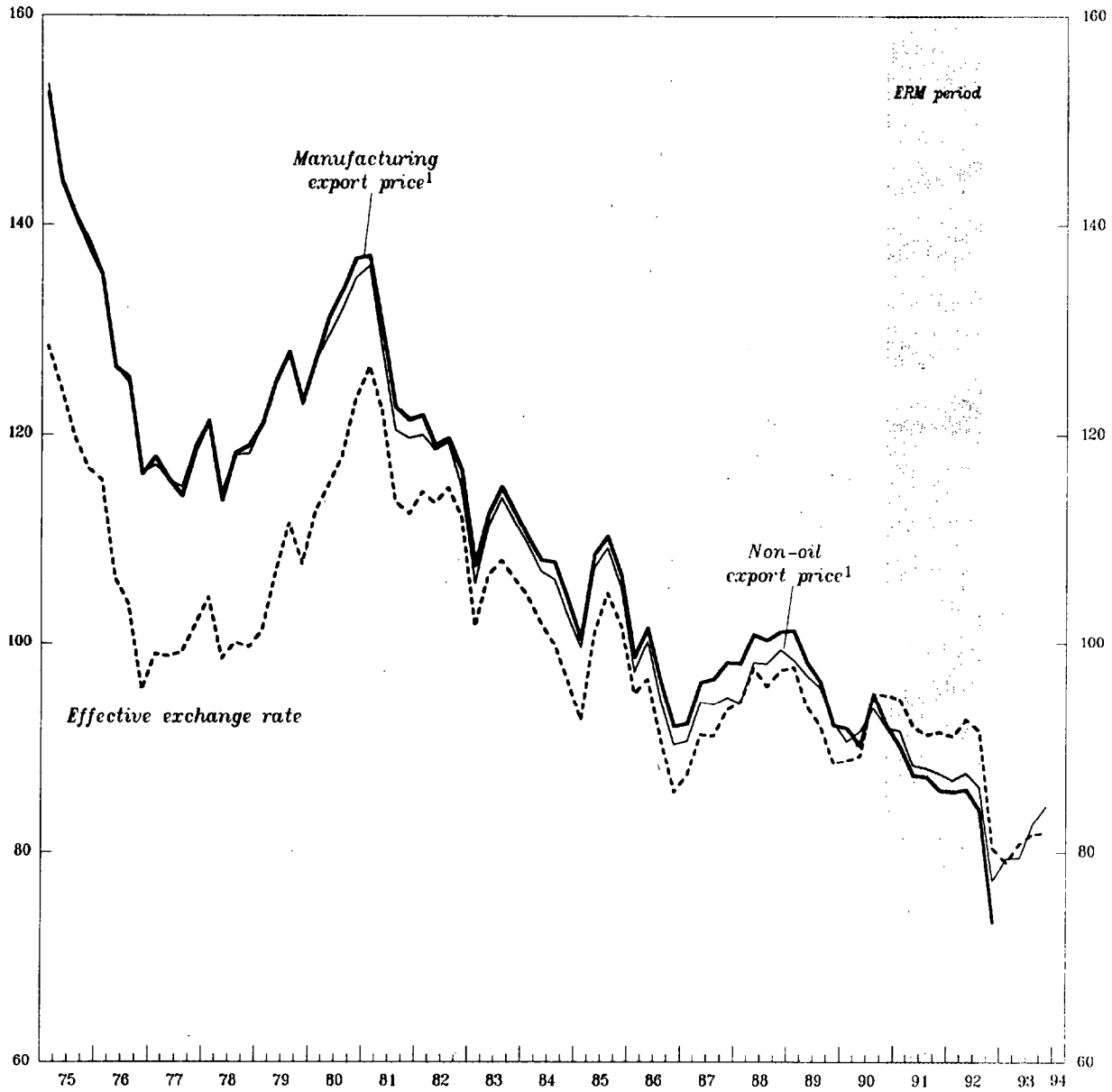
Chart 1. United Kingdom: Effective Exchange Rate and Export Prices in Local Currency



Sources: World Economic Outlook data base; OECD, Analytical Data Bank (Paris); and United Kingdom, Central Statistical Office, *Economic Trends* (London, 1994).

1 Deflated by domestic manufacturing price.

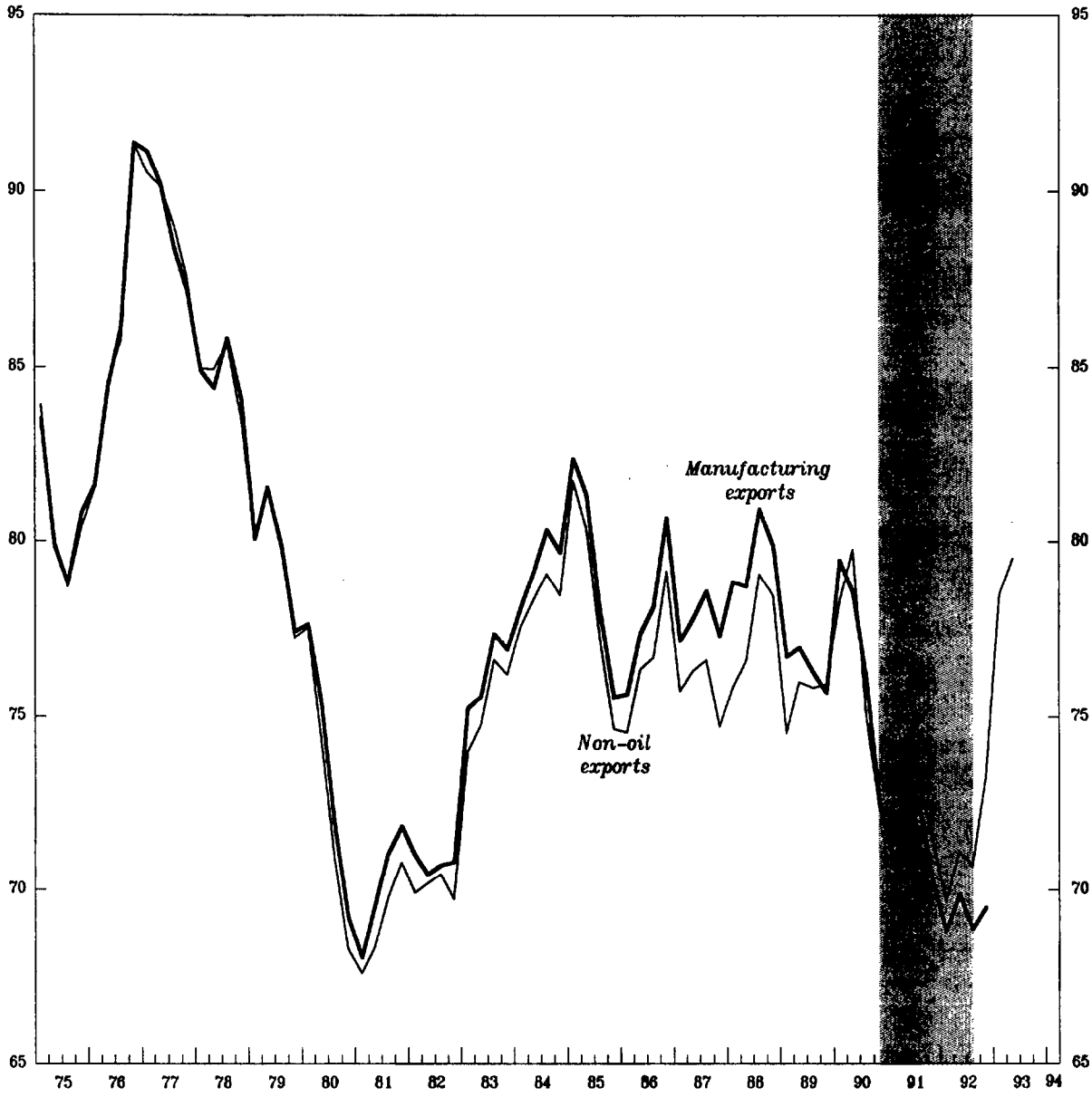
Chart 2. United Kingdom: Effective Exchange Rate and Export Prices in Foreign Currency



Sources: World Economic Outlook data base; OECD, Analytical Data Bank (Paris); and United Kingdom, Central Statistical Office, *Economic Trends* (London, 1994).

1 Deflated by domestic manufacturing price.

Chart 3. United Kingdom: Export Prices Relative to Unit Labor Cost



Sources: World Economic Outlook data base; OECD, Analytical Data Bank (Paris); and United Kingdom, Central Statistical Office, *Economic Trends* (London, 1994).

relative to domestic manufacturing prices is 0.95 for the pre-ERM period and only 0.57 during the ERM period. Furthermore, the movement of export prices relative to unit labor costs indicates that profit margins also fell during the ERM period (Chart 3). This is consistent with the observation that United Kingdom exports became more competitive during this period.

The apparent shift to more competitive export pricing during ERM membership may have resulted from the disciplinary effects of the system on costs and prices. Since the use of devaluations to improve competitiveness was ruled out and the entry into the system took place at a relatively high exchange rate, export prices and production costs had to adjust if exporters were to be competitive. It is, however, important to note that the decline in export prices started one or two quarters prior to joining the ERM, possibly resulting from the expectation that sterling would soon be joining the system.

The relationship between foreign currency export prices and the exchange rate appears to have regained strength following the departure from the ERM. The correlation coefficient between the rates of change in non-oil export prices in foreign currency and the exchange rate rises to 0.92 during this period. The increase in export prices, combined with subdued unit labor costs and lower growth in domestic prices, was reflected in higher profit margins, offsetting the profit squeeze of the ERM period (see Chart 3). This is likely to have encouraged supply and investment in the traded goods sector, but not demand.

The above observations lead to the following three hypotheses:

Hypothesis 1: *During the period prior to ERM membership, United Kingdom manufacturing exporters made a partial effort to preserve their competitive position by not fully passing on exchange rate fluctuations to foreign consumers.*

Hypothesis 2: *During the ERM membership the relationship between export prices and the exchange rate weakened: a secular fall in export prices, both in local and foreign currencies, occurred in the absence of a rise in the exchange rate, leading to a fall in profit margins.*

Hypothesis 3: *Following departure from the ERM, the relationship between export prices and the exchange rate has regained strength.*

Exchange rate movements influence export prices depending on the extent to which exporters care about market shares as opposed to profit margins. Domestic manufacturing prices and unit labor costs also influence export prices, but the correlation between export prices and domestic manufacturing prices starts to weaken prior to joining the ERM (Chart 4). The potential disciplinary effect of the ERM on costs, however, only appears to take effect towards the end of the ERM membership. The correlation coefficients between the rates of change in export prices (in local currency) and domestic manufacturing prices falls from 0.66 to 0.10, and with unit labor costs from 0.25 to -0.23. Thus:

Hypothesis 4: *Prior to the ERM, domestic prices influenced export prices in local currency but unit labor costs did not. During the ERM export prices seem to have moved independently of both variables.*

The relationship between price movements and the exchange rate discussed above could reflect hysteresis in the form of partial adjustment to exchange rate shocks, so that in the event of a shock there may be a permanent change in relative prices. Another form of hysteresis may occur in relation to the quantity supplied. In the presence of sunk costs, entry/exit decisions of firms operating in the international economy following shocks to the exchange rate could lead to permanent changes in the supply pattern. An econometric framework based on Giovannetti and Samiei (1994), will be used in order to test:

Hypothesis 5: *Large shocks to the exchange rate lead to permanent shifts in the supply of United Kingdom manufacturing exports, even after the shock has died down.*

III. The Model

Two versions of a simultaneous structural model of export supply and demand are examined. 1/ In the first version, M_1, hysteresis results only from the possibility of partial adjustment of export prices to exchange rate changes. The more elaborate version of the model, M_2, allows for hysteresis in the form of discrete changes in the distribution of exports, resulting from firms' entry/exit decisions.

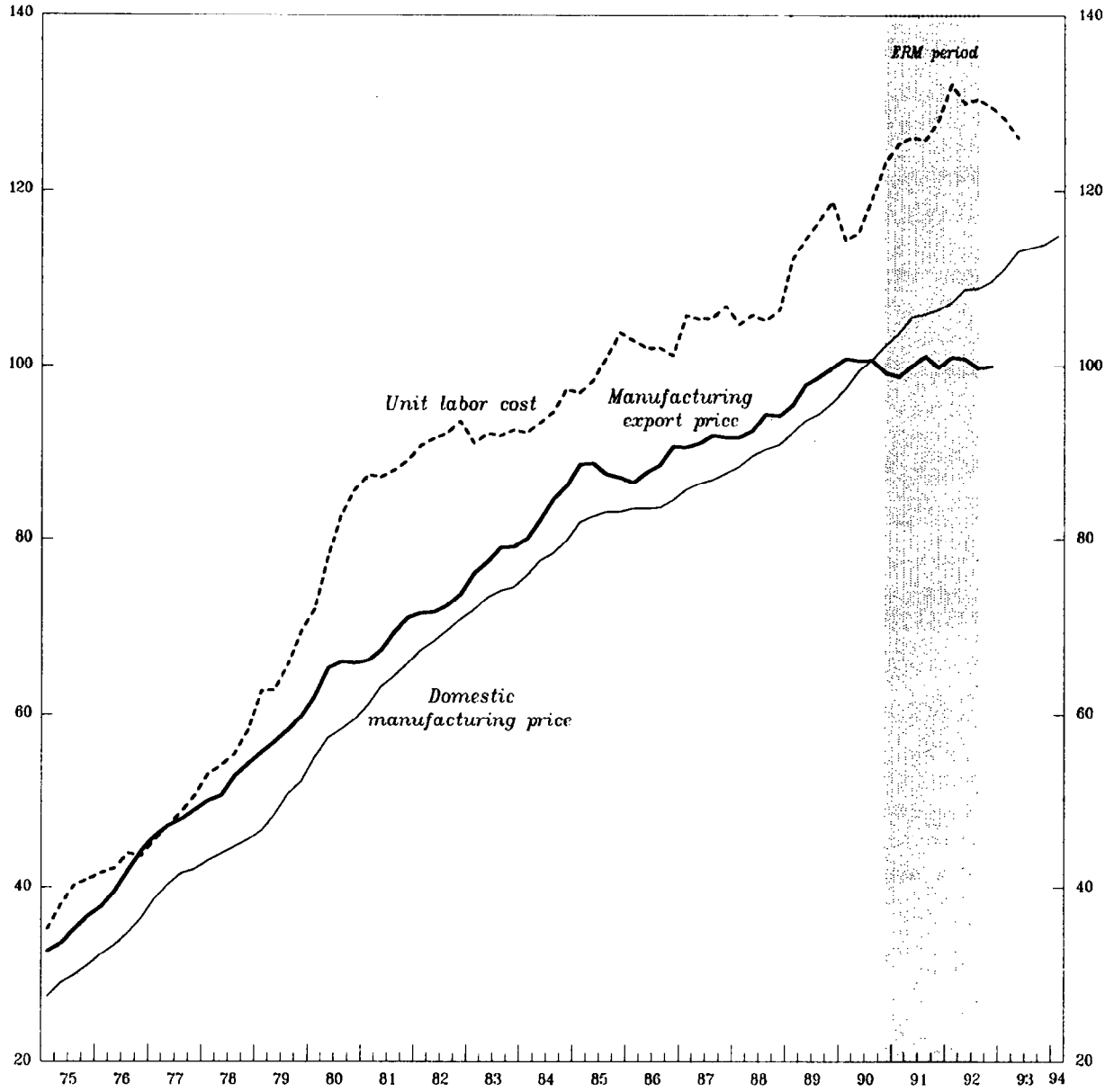
For producers, the alternative to exporting abroad is to supply for the domestic market. The supply of exports, x_{st}, is, therefore, assumed to depend on manufacturing export prices relative to domestic manufacturing prices, as well as unit labor costs relative to domestic prices. 2/ For estimation purposes a more general structure is used that allows the following variables to influence supply separately: export prices in foreign currency, p_{xt}, domestic manufacturing prices in local currency, p_{mt}, unit labor costs in local currency, c_t, as well as the nominal effective exchange rate, e_t. The rationale for the separate inclusion of these variables, in particular the exchange rate, will be made clear below. It is assumed that when supply decisions are made, producers know the values of the exogenous variables at time t. All variables are in logarithms. We have

Re-writing in terms of p_{xt}:

1/ See Goldstein and Khan (1984) for a survey of export and import models including simultaneous supply and demand models.

2/ Note that instead of (or together with) a cost variable, the capital stock can be used as a determinant of export supply (see, for example, Holly and Wade, 1991). That would be justified when rigidities in the production structure do not allow firms to fully optimize.

Chart 4. United Kingdom: Manufacturing Prices and Unit Labor Cost



Sources: World Economic Outlook data base; OECD, Analytical Data Bank (Paris); and United Kingdom, Central Statistical Office, *Economic Trends* (London, 1994).

$$x_t^s = f(\underset{(+)}{p_{xt}}, \underset{(-)}{p_{mt}}, \underset{(-)}{c_t}, \underset{(-)}{e_t}) \ . \tag{1}$$

Re-writing in terms of p_{xt}:

$$p_{xt} = g(\underset{(+)}{x_t^s}, \underset{(+)}{p_{mt}}, \underset{(+)}{c_t}, \underset{(+)}{e_t}) \ . \tag{2}$$

The supply equation written in terms of the price level makes the discussion of the pricing policy of the exporting firms more transparent. The exchange rate is included separately in order to examine the extent of exchange rate pass-through to foreign prices. When local currency export prices do not respond to exchange rate movements, the coefficient of the exchange rate would be around unity in a linear specification of the equation for p_{xt}. If, on the other hand, local currency export prices adjust fully or partially in order to preserve market share and lower the impact on consumers, then the exchange rate would appear with a coefficient of less than unity.

On the demand side, exports by United Kingdom producers and goods produced abroad are assumed to be imperfect substitutes. Thus:

$$x_t^d = h(\underset{(-)}{p_{dt}}, \underset{(+)}{y_t}), \tag{3}$$

where $p_{dt} = p_{xt} - p_{it}$ is the export price for consumers in terms of foreign currency deflated by the aggregate industrial country price index, p_{it}, and y_t is aggregate industrial country GDP. In estimation, industrial countries are represented by G7 excluding the United Kingdom.

The equilibrium price and quantity are determined by the equality of supply and demand. A log-linear specification of equations (2) and (3) is used to estimate the model, and nonstationarity in the sense of the presence of unit roots is allowed for by employing a simultaneous error-correction formulation: 1/

1/ We include lagged values of the dependent variables. Including lagged values of the exogenous variables in the equations did not improve the fit significantly.

$$\Delta p_{xt} = \rho_1 \Delta p_{x,t-1} + \alpha_0 + \alpha_1 \Delta x_t + \alpha_2 \Delta c_t + \alpha_3 \Delta e_t + \alpha_4 \Delta p_{mt} + \delta_1 (p_{x,t-1} - \beta_1 x_{t-1} - \beta_2 c_{t-1} - \beta_3 e_{t-1} - \beta_4 p_{m,t-1}) + u_{1t} , \tag{4}$$

$$\Delta x_t = \rho_2 \Delta x_{t-1} + \gamma_0 + \gamma_1 \Delta p_{dt} + \gamma_2 \Delta y_t + \delta_2 (x_{t-1} - \omega_1 p_{d,t-1} - \omega_2 y_{t-1}) + u_{2t} , \tag{5}$$

where x_t is the equilibrium quantity supplied, and u_{it} (for i=1,2) is a normally distributed error term satisfying the standard assumptions. The short-run (or impact) and long-run elasticities are given, respectively, by the coefficients of the first difference terms and those in the error-correction expression.

The log-likelihood function for the above model, taking account of the simultaneity, is:

$$\ell_1(\theta_1) = n \log|J| - \frac{n}{2} \log(2\pi \sigma^2_{u_1} \sigma^2_{u_2}) - \frac{u'_{1t} u_{1t}}{2\sigma^2_{u_1}} - \frac{u'_{2t} u_{2t}}{2\sigma^2_{u_2}} , \tag{6}$$

where θ_1 is the vector of the parameters to be estimated, and J is the Jacobian of the transformation and is equal to

$$J = \begin{pmatrix} 1 & -\alpha_1 \\ -\gamma_1 & 1 \end{pmatrix} . \tag{7}$$

The second model, M_2, allows for hysteresis resulting from entry/exit decisions (see Giovannetti and Samiei (1994) for detailed derivation and discussion). In this specification, for a range of values of the exchange rate, referred to as the hysteresis band, exports may not respond to exchange rate fluctuations, while regime-switches may take place outside of this range depending on the path of the exchange rate. The hysteresis band is generated by the presence of sunk costs and uncertainty about future exchange-rate changes. If initially the firm is out of the market, it will not enter unless the exchange rate is larger than the upper threshold of the band, while if it is in the market it would exit only if the exchange rate is below the lower threshold. At the aggregate level, therefore, exports are determined by the proportion of firms that stay in the market. This proportion depends, in a highly non-linear manner, on the exchange rate path and the width of the hysteresis band for a typical firm. Using a similar structure as in M_1, the supply and demand functions for M_2 will have the following forms:

$$\Delta p_{xt} = \rho_1 \Delta p_{x,t-1} + \alpha_0 + \frac{\alpha_1 \Delta x_t}{1 - \Psi(\Delta e_t, \lambda)} + \alpha_2 \Delta c_t + \alpha_3 \Delta e_t + \alpha_4 \Delta p_{mt}$$
$$+ \delta_1 (p_{x,t-1} - \beta_1 x_{t-1} - \beta_2 c_{t-1} - \beta_3 e_{t-1} - \beta_4 p_{m,t-1}) + v_{1t} , \tag{8}$$

$$\Delta x_t = \rho_2 \Delta x_{t-1} + \gamma_0 + \gamma_1 \Delta p_{dt} + \gamma_2 \Delta y_t$$
$$+ \delta_2 (x_{t-1} - \omega_1 p_{d,t-1} - \omega_2 y_{t-1}) + v_{2t} , \tag{9}$$

where $\Psi(.)$ is the proportion of inactive firms at time t, λ is the width of the hysteresis band, and v_{it} (for i=1,2) is a normally distributed error term satisfying the standard assumptions. Thus, hysteresis in the form of changes in regimes is supported by a significant value of λ when Δx_t is also a significant determinant of prices (i.e., when α_1 is also significant). The likelihood function for model M_2 is similar in structure to that of M_1 except that the Jacobian is a now function of e_t and hence variable over time:

$$J_t = \begin{bmatrix} -1 & \frac{\beta_1}{1 - \Psi(\Delta e_t, \lambda)} \\ \beta_2 & -1 \end{bmatrix} . \tag{10}$$

IV. Estimation and Results

Models M_1 and M_2 are estimated for the United Kingdom, using data on manufacturing exports for the pre-ERM period, 1975:III-1990:I, and for the period including the ERM, 1975:III-1992:III (Table 1). 1/ Extending the econometric analysis beyond 1992:III is not attempted given the uncertainties in interpreting time series on the European trade data following the introduction of the new Intrastat system.

The results may be summarized as follows:

(i) Prices and quantities do not appear to be simultaneously determined in any of the models or periods (see Table 1). In the demand

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1/ The data sources for manufacturing export volumes and prices, industrial countries GDP's and prices are the OECD. The latter two variables were aggregated using the *World Economic Outlook* PPP weights. Industrial countries are defined as G7 excluding the United Kingdom. Unit labor costs and the effective exchange rate are from the *World Economic Outlook* database, and domestic manufacturing prices are from *Economic Trends*. The estimations are done by the maximum-likelihood method using Gauss version 2.2.

equation the price variable is significant only in the long run, while in the price equation quantity is not significant in the short or in the long run. This contrasts with the results reported in some earlier studies, for example, Holly and Wade (1991) where supply appears to respond to price movements. But note that the sample used in the latter study ends in 1982:IV. Furthermore, the present paper uses an error-correction formulation which is a more appropriate framework for dealing with possible unit-root problems.

(ii) For the pre-ERM sample, in the demand equation the price and income variables have significant coefficients in the long run as indicated by the t-ratios in the error-correction term (see Table 1, columns 1 and 2). The estimated long-run elasticities of -0.92 for relative prices and 1.20 for income are within the expected range.

On the supply side we find that manufacturing export prices in foreign currency are influenced by domestic manufacturing prices and the exchange rate, but not by quantity exported or costs. The adjustment to exchange rate fluctuations is partial and, in the long run, about 70 percent of changes in the exchange rate is transmitted into prices for consumers abroad. Hysteresis in the form of limited exchange rate pass-through is supported by the results, but that in the form of regime-switches on the quantity supplied is not. The reason is that although the estimated value of λ, the hysteresis band, is significant, that of α_1, the coefficient of Δx_t, is not. That the inclusion of the hysteresis variable does not significantly improve the fit is also indicated by comparing the maximized values of likelihood functions for the two models. This suggests that M_1 is the preferred specification.

Since simultaneity appears to be absent in the system, the supply and demand equations are re-estimated separately for the pre-ERM period, after dropping the insignificant variables (including the hysteresis variable) and the results are presented in Tables 2 and 3. The tests for serial correlation, reported in these tables, reject the hypothesis of serial correlation in the error terms.

Table 1. Maximum Likelihood Estimates of the Parameters of Manufacturing Exports Models for the United Kingdom 1/

	1975:III-1990:III		1975:III-1992:III	
	M_1	M_2	M_1	M_2
Supply				
Δx_t	-0.0218 (-0.7873)	-0.0148 (-0.9796)	-0.0257 (0.8897)	0.0001 (0.8964)
$\Delta p_{x,t-1}$	-0.0381 (-0.9155)	-0.0361 (-0.8684)	-0.0827 (-2.1355)	-0.0812 (-2.0797)
Δc_t	0.1165 (1.5896)	0.1081 (1.4518)	0.0619 (0.8893)	0.0691 (0.9881)
Δe_t	0.8554 (24.1463)	0.8559 (24.3117)	0.8573 (23.5028)	0.8704 (23.3210)
Δp_{mt}	0.6517 (4.5531)	0.6563 (4.6075)	0.5661 (3.9753)	0.5120 (3.6600)
$\hat{\delta}_1$	-0.2061 (-2.0032)	-0.2061 (-2.0088)	-0.0404 (-0.6479)	-0.0397 (-0.6435)
x_{t-1}	-0.0909 (-1.1956)	-0.0932 (-1.2307)	-0.5787 (-0.8390)	-0.4405 (-0.8477)
c_{t-1}	0.0903 (0.4292)	0.0883 (0.4201)	-0.2952 (-0.2284)	-0.3776 (-0.2716)
e_{t-1}	0.6868 (4.8219)	0.6841 (4.8229)	0.2540 (0.2705)	0.4932 (0.6257)
$p_{m,t-1}$	0.7191 (3.3948)	0.7207 (3.4102)	0.8425 (0.7543)	0.8657 (0.7527)
$\hat{\lambda}$		0.0924 (13.1758)		0.0650 (45.1110)
se	0.0088	0.0088	0.0092	0.0092
R^2	0.9424	0.9427	0.9325	0.9325
Demand				
Δp_{dt}	-0.0896 (-0.6487)	-0.0887 (-0.6471)	-0.0853 (-0.6626)	-0.1484 (-1.1469)
Δx_{t-1}	-0.4051 (-3.6977)	-0.4050 (-3.6972)	-0.4049 (-4.1145)	-0.4002 (-4.0651)
Δy_t	-0.9537 (1.0607)	0.9588 (1.0661)	0.9597 (1.1598)	0.9524 (1.1506)
$\hat{\delta}_1$	-0.2473 (-2.6973)	-0.2474 (-2.6991)	-0.2479 (-3.2032)	-0.2474 (3.1968)
$p_{d,t-1}$	-0.9221 (-3.0770)	-0.9207 (-3.0786)	-0.9020 (-3.8123)	-0.9207 (-3.8465)
y_{t-1}	1.1986 (7.0057)	1.1988 (7.0077)	1.1958 (8.4489)	1.1851 (8.3911)
se	0.0365	0.0365	0.0346	0.0346
R^2	0.3966	0.3966	0.3946	0.3943
ℓ	317.4298	317.5965	359.9235	360.0693

1/ M_1 refers to equations (4) and (5) in the text, and M_2 to (5) and (9). The dependent variables in the supply and demand equations are respectively Δp_{xt} and Δx_t, t-ratios are in parenthesis, *se* is the standard error of regression, and ℓ is the maximized value of the joint log-likelihood. Other notation is as in the text.

Table 2. Parameter Estimates of the Preferred Model for Manufacturing Export Price for the United Kingdom (Period: 1975:III-1990:III) 1/

Δe_t	0.8810
	(24.8201)
Δp_{mt}	0.6104
	(4.2116)
$\hat{\delta}_1$	-0.1762
	(-2.1588)
e_{t-1}	0.7958
	(7.9196)
$p_{m,t-1}$	0.7605
	(13.5045)
se	0.0097
R^2	0.9366
$F_{sc}(4,51)$	1.3253
ℓ	199.2777

1/ The dependent variable is Δp_{xt}, t-ratios are in parenthesis, se is the standard error of regression, F_{sc} is the F-statistic for testing serial correlation of order 4, and ℓ is the maximized value of the likelihood function. Other notation is as in the text.

Table 3. Parameter Estimates of the Preferred Model for Manufacturing Export Volume for the United Kingdom (Period: 1975:III-1990:III) 1/

Δx_{t-1}	-0.4141
	(-3.5750)
$\hat{\delta}2$	-0.2685
	(-2.8094)
$p_{d,t-1}$	-0.9549
	(-3.3724)
y_{t-1}	1.1642
	(7.3431)
se	0.0387
R^2	0.3778
$F_{sc}(4,52)$	0.8260
ℓ	114.4152

1/ The dependent variable is Δx_t. See also footnote to Table 2.

(iii) When the sample is extended to include the ERM period, the estimated demand equation remains relatively unchanged (see Table 1, columns 3 and 4). In the price equation, however, the long-run relationship between export prices, domestic prices and the exchange rate disappears as indicated by the insignificance of the latter two variables in the error correction term. The short-run coefficients, however, remain significant. Furthermore, the test for structural break using the preferred specification for supply gives a value of 1.996 for the *F* statistic, which does not reject the hypothesis of structural break at 10% significance. 1/

To examine further the apparent change in the extent of exchange rate pass-through, the estimated price equation in Table 2 is used to generate dynamic forecasts for the ERM period. Chart 5 plots the actual and forecast values for the rate of change in export prices for the ERM period. As can be seen, actual price changes are consistently below those forecast by the *pre-ERM estimation results. These results together with the informal* evidence presented in Section II, in particular the fact that the relative price of manufacturing exports fell during the ERM period while the exchange rate did not change significantly, suggest a weakening of the extent of exchange rate pass-through during the ERM period.

(iv) For the period following the departure from the ERM, given the revisions in trade data and the short length of the period, we have not relied on econometric evidence. As discussed in Section II, however, it appears that the relationship between the movements in the exchange rate and non-oil export prices (which are strongly correlated with manufacturing prices) has regained strength since the departure from the ERM. Non-oil export prices in foreign currency terms responded relatively fast to the depreciation of the exchange rate and picked up faster than the exchange rate with the consequent appreciation.

V. Conclusions

This study tests various hypotheses, set out in Section II, in relation to the determination of United Kingdom manufacturing export volumes and prices. Some of the conclusions have to be treated as tentative given the short duration of the ERM and post-ERM periods, and the revision in European trade data after 1992:IV.

The results indicate a recursive structure in the long run, wherein prices influence the volume of exports demanded but are not influenced by it. They also indicate that U.K. exporters only partially offset the impact on foreign consumers of fluctuations in the effective exchange rate of the pound. During the ERM period, however, the extent of pass-through to foreign prices weakened and export pricing behavior became more competitive, a process that appears to have reversed after exit from the ERM. Hysteresis

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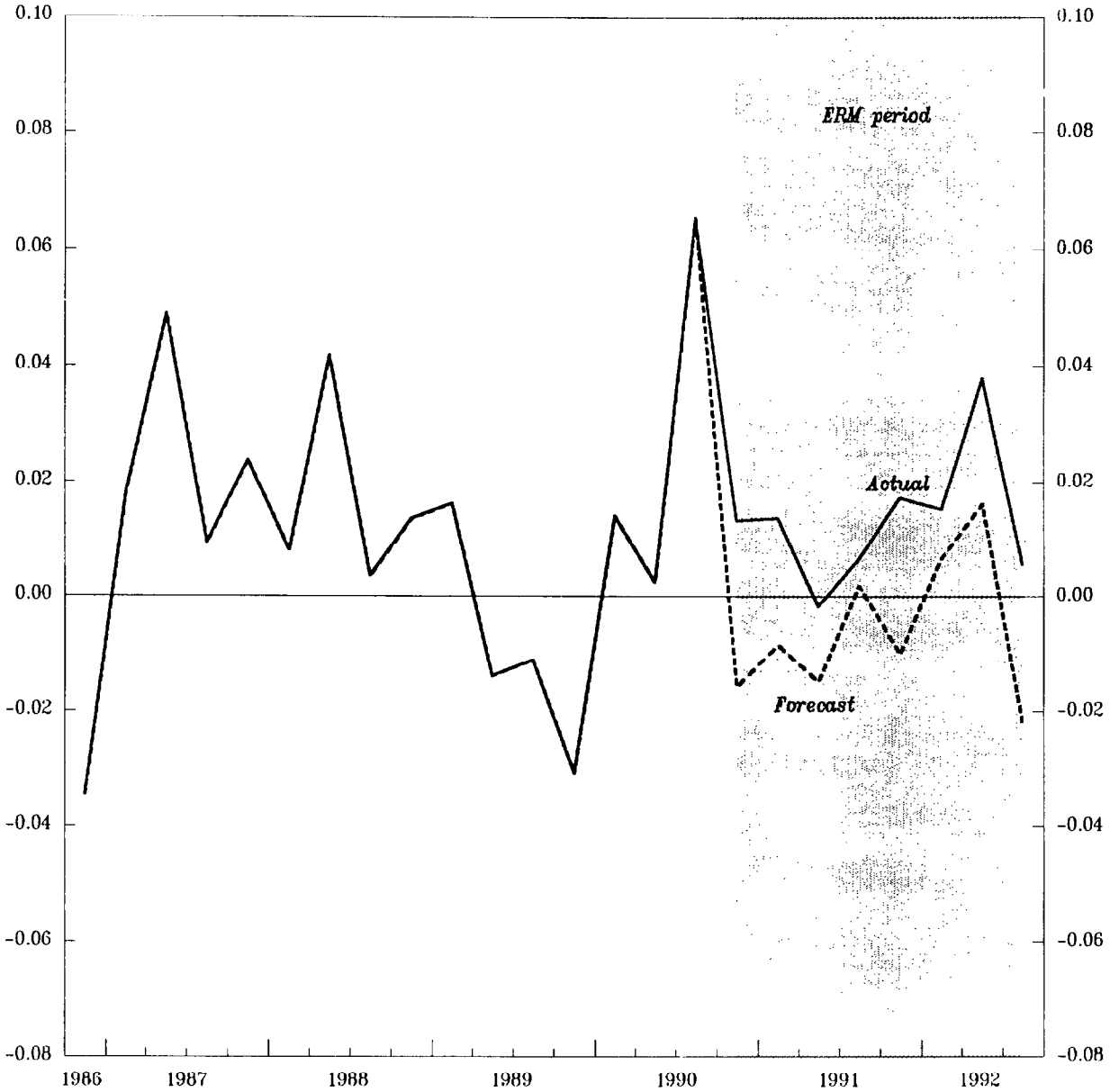
1/ This is a Chow test based on regression results for the pre-ERM sample and the whole sample using the specification in Table 3. The residual sum of squares for the two regressions are 0.005192 and 0.006699 respectively. Note, of course, that the power of this test is low due to the short length of the ERM period.

in the form of limited exchange rate pass-through is supported by the results, but not that arising from regime switches in supply is not. Finally, labor costs do not appear to influence export prices before or during the ERM, while domestic prices do, in particular before the ERM.

Chart 5. United Kingdom: Actual and Dynamic Forecasts for Manufacturing Export Price in Foreign Currency[1]

(Quarterly change, in percent)



Sources: World Economic Outlook data base and OECD, Analytical Data Bank (Paris).

1 Forecasts are based on the estimation results in Table 3.

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