TRADE FLOWS, RELATIVE PRICES AND THE EXCHANGE RATE IN THE SHORT RUN

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ABSTRACT

This research investigates how exchange rate movements affect a Country's domestic and export prices compared with those of its competitors,and to what extent do competitors' prices in turn feed back onto a Country domestic and export pricing. Since,as the evidence seems to suggest,exchange rate movements have an important,persistent effect on relative prices or competitiveness,we further investigate the extent and the speed with which trade flows respond to changes in competitiveness.

Chapter 1 discusses alternative theories of the mechanism of price formation in open economies,and in particular of the transmission of short run exchange rate disturbances into relative prices.

In Chapter 2 we investigate the response of export flows to changes in relative prices. We address the issues raised by the simultaneity between the supply function and the domestic and foreign demand for exportables,analysing the microeconomic foundations of the simultaneous price and output decisions of a firm which operates in the exportables sector of an open economy,facing a domestic and a foreign demand for its output.One specific characteristic of the model is that it allows for the possibility of price discrimination,which is suggested by the observed divergence in the behaviour of domestic and export prices.

Chapter 3 provides empirical evidence on all these issues,investigating the behaviour of prices and output in three industries which are representative of the behaviour of the exportables sector in Germany and Italy.

In Chapter 4 we investigate the response of import flows to domestic activity. We make an attempt at clarifying an issue which has recently been the cause of some concern in the area of international trade: the disturbing result is the apparent persistence of the empirical finding that the income elasticity of demand for U.S. imports is substantially higher than that of demand for U.S. exports. We show that the results obtained explicitly taking into account the domestic excess-demand and the foreign excess-supply functions,indicate that disturbingly high estimates of the income elasticity of U.S. imports are essen tially the outcome of mispecified equations.

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INTRODUCTION

The recent experience of industrialized Countries, characterized by considerable exchange rate flexibility, provides interesting evidence for understanding the real effects of exchange rate movements, and hence the mechanism through which foreign disturbances get transmitted to the domestic economy. While flexible rates were the mechanism most economists had long advocated for attaining external balance in Europe, since the appreciation of the deutsche-mark in 1969, the large fluctuations experienced in the exchange rates seem to have led Countries like Germany into what have been named "virtuous circles" of appreciation, falling import prices and decelerating rates of inflation, while others, Italy in particular, were experiencing "vicious circles" of currency depreciation and accelerating rates of inflation.

The first part of this research (Chapters 1 to 3) discusses the specific role of the exportables sector in the transmission mechanism, integrating a model which is suggestive of the short-run behavior of prices and output in this sector, with the available evidence from the recent experience of a set of representative industries in these two Countries, Germany and Italy, characterized by such different exchange rate developments. We are particularly interested in studying how exchange rate movements affect a Country's domestic and export prices compared with those of its competitors, and to what extent do competitors' prices in turn

feed back into a Country's domestic and export pricing. Since, as the evidence seems to suggest, exchange rate movements have an important, persistent effect on relative prices or competitiveness, the second key issue will be the extent and the speed with which trade flows adjust to changes in competitiveness. Evidence on the short-run response of trade flows to exchange rate changes will allow us to better understand the possibility of a short-run "perverse" response of the trade balance--a phenomenon which is known as the J-curve and which may arise if, in the short run, physical trade flows adjust slowly to changes in relative prices.

Chapter 1 discusses alternative theories of the mechanism of price formation in open economies and in particular of the transmission of short-run exchange rate disturbances into relative prices. We briefly review recent empirical findings, all of which seem to contradict the assumption usually referred to as "the law of one price." Since the evidence seems to suggest that exchange rate changes affect relative prices or competitiveness in the short run, next we discuss the implications of different paths of adjustment of trade flows to changes in competitiveness. Although the link between movements in relative prices and export flows in the short run has sound theoretical foundations, we argue that its empirical verification has often resulted in inconsistent or at least inefficient estimates, since most of the empirical work in this area has followed the single-equation approach, so strongly criticized by Orcutt more than twenty years ago.

In Chapter 2 we therefore try to address the issues raised by the simultaneity between the supply function and the domestic and foreign demand for exportables, analyzing the microeconomic foundations of the

simultaneous price and output decisions of a firm which operates in the exportables sector of an open economy, facing a domestic and a foreign demand for its output. One specific characteristic of the model is that it allows for the possibility of price discrimination, which is suggested by the observed divergencies in the behavior of domestic and export prices.

Chapter 3 provides empirical evidence on all these issues, investigating the behavior of prices and output in three industries which are representative of the behavior of the exportables sector in Germany and Italy. The three industries are manufacturers of non-electrical machinery, electrical machinery and transport equipment; the period we study is 1969-1976. We specifically address the issues of price discrimination, of the relative effect of domestic costs and competitors' prices on domestic and export pricing, of the effect of exchange rate changes on relative prices and finally of the short-run response of export flows to changes in competitiveness. Throughout we make use of our model, which we estimate both in its structural and reduced forms.

The second part of this research discusses the relation between import flows and domestic activity: we attempt to clarify an issue which has recently been the cause of some concern in the area of international trade. The disturbing result is the apparent persistence of Houthakker and Magee's empirical finding that the income elasticity of demand for U.S. imports is substantially higher than that of demand for U.S. exports. Recent empirical findings by Humphrey (1976) suggest that the same is true in the case of U.K. imports, particularly for imports of finished

manufactures. The persistence of this result is troublesome since, as Houthakker and Magee have pointed out, a country with a high income elasticity of demand for imports and a relatively lower income elasticity of demand for its exports is constrained to grow at a slower rate than its trading partners, if it is to maintain external balance.

In Chapter 4 we address this issue developing a simple model of the demand and excess-supply of imports which assumes as a starting point our previous results on the behavior of firms operating in the exportables sector. We then use the model to investigate the response of U.S. imports of a specific category of steel products to changes in U.S. domestic activity, over the period 1968-1977. The empirical findings support the predictions of our model; we show in particular that, at least for this specific group of commodities, disturbingly high estimates of the income elasticity of U.S. imports are essentially the result of misspecified equations.

CHAPTER 1

EXCHANGE RATE, RELATIVE PRICES AND COMPETITIVENESS IN THE SHORT-RUN

1. Exchange Rate and Relative Prices

The response of relative prices to exchange rate disturbances is a crucial point in understanding the different international adjustment mechanisms implied by competing theories of the Balance of Payments. These could be distinguished in two groups: those who do and those who do not use some variant of the "law of one price" (LOOP). Among the latter the extreme case is represented by the Keynesian model which identifies the terms of trade with the exchange rate, implicitly assuming that prices and costs are fixed in terms of the suppliers' currency: exchange rate changes are hence fully reflected in changes in relative prices or competitiveness[1/]. Underlying the theories which make use of the LOOP is the assumption of a high degree of international commodity arbitrage which guarantees that the domestic price of traded goods will correspond to the world price, converted at the going exchange rate. The terms of trade are therefore constant and the only possible changes in relative prices - in the least extreme versions of these models[2/] - are those occuring between traded and non-traded goods: exchange rate changes have no effect on relative prices of traded goods. Another way of viewing the difference between the two approaches is in the fact that while both assume the existence of two distinct goods, the Keynesian model distinguishes between home goods and foreign goods, while the Monetarist and the Scandinavian approach tend to made the distinction between traded and non-traded goods.

However, although no one would argue against a general tendency towards the international equalization of prices in the long run, it seems reasonable to distinguish not only between Countries, but also between traded goods with different characteristics. A necessary distinction is that between auction goods and customer goods [3]. Auction goods are traded in internationally organized markets, and their price is fixed through a market-clearing process: exchange rate changes may affect supply, but will cause no departures from the LOOP. Customer goods - we would include among these most of the manufactured goods - are traded in markets in which tend to prevail conditions of imperfect competition, and where the price is often fixed by mark-up over standard unit cost. In the short-run, exchange rate changes will not alter domestic costs and will hence be fully reflected in changes in relative prices of competing customer goods.

There is however one more question about the LOOP which, although seldom discussed in the literature [4], seems to us critical in the case of exportables: does the LOOP holds when applied to the domestic and the export price of exportables, i.e., do firms discriminate between the domestic and the foreign market? In fact, although one may believe that, especially in the case of small Countries, the LOOP will hold when it relates the export price of exportables to the price of foreign competing goods, it is less obvious why there should be no divergences, not even in the short run, between the price charged on the domestic and on the foreign market. A sufficient condition would be that the two markets were separated, at least in the short run, due to the

existence of either imperfect or differentiated information in each market, or of institutional constraints, as in the case of protection of the home industry.

Both the deviations from the LOOP and the possibility of price discrimination may be a crucial factor for short-run economic policy: exportable goods, while still remaining the channel through which foreign and domestic disturbances get transmitted, will not necessarily transmit their full amount, therefore creating an additional degree of freedom.

Increasing empirical evidence is becoming available on these issues. The work of Kravis and Lipsey (1977, 1978) and Isard (1977) suggests that a high degree of international commodity arbitrage does not characterize the real world. Kravis and Lipsey, looking at specific groups of commodities, have observed sizeable divergences in the movement of export prices of different countries for similar products, and substantial differences within countries both between the levels and the rates of change of domestic and export prices, hence suggesting the presence of price discrimination. The behavior of export prices, and in particular, their response to domestic costs and competitors' prices, has also been investigated by Dornbusch and Krugman (1976). Their results support the evidence provided by Kravis and Lipsey in that they show that export prices remain sensitive to domestic costs, hence not simply matching competitors' prices; however, they also show that for several countries there is a considerable responsiveness of export prices to competitors' prices, contrary to the assumption of

constant export prices in the Keynesian model. The assumption that domestic and export prices should positively respond both to domestic costs and competitors' prices also appears in a recent work by Modigliani and Padoa Schioppa (1978). These authors, although not distinguishing between domestic and export prices, derive a price equation for the open-economy assuming that "...international trade affects the price equation mainly in two ways. First, unit costs will include not only labor costs, but also the cost of imported raw materials. Second, we must recognize that prices may be directly influenced by foreign prices through foreign competition, both in the international and in the domestic market."[5/] Similar assumptions underlie the relatively common practice of introducing competitors' prices as independent variable in the estimation of export price equations for open economies: all the available evidence seems to confirm the results of Dornbusch and Krugman[6/].

2. Relative Prices, Competitiveness and Trade Flows: The Case of the Exportables Sector

If, as the evidence seems to suggest, exchange rate changes affect relative prices, at least in the short run, the next question is to which extent do trade flows respond to changes in competitiveness. In the Keynesian model an appreciation of the exchange rate, improving the terms of trade, shifts demand away from the goods produced by the appreciating country, hence lowering world demand for domestic output and worsening the trade balance. However, evidence on the short-run response of the trade balance to changes in relative prices seems often

to contradict the prediction of the Keynesian model. The phenomenon is known as the J-curve, and it may arise if, in the short run, physical trade flows respond slowly to changes in relative prices. The evidence provided by Dornbusch and Krugman confirms that a depreciation, improving a country's competitive position, will raise exports over time; the results they present indicate, however, that in the short run relative price elasticities are small, hence, allowing for the possibility of a J-curve. Their conclusions, and in particular, the relatively long adjustment lags, seems to be confirmed in recent empirical literature[7/].

Most of the results on export flows, however, should be taken cautiously, since they usually refer to single equation estimates of the foreign demand for a country's exports, independently of domestic supply and demand, and hence implicitly assume an infinitely elastic supply function. But in the case of customer goods - which, as we have recognized, represent the only group of commodities for which exchange rate changes may affect relative prices or competitiveness - omission of either the domestic demand or supply functions would yield inconsistent estimates of the parameters of the foreign demand function. In fact, while the study of foreign demand for any type of commodity implicitly calls for the simultaneous specification of a supply and a demand function, we should recognize that most of the exported customer goods are really exportables, and hence that both the domestic excess-supply and demand functions should be explicitly taken into account. The point is hardly new: much of the criticism of empirical studies which treat as isolated the export demand function could be found in the work done in

the 1950's by Orcutt (1950), Machlup (1950) and Harberger (1953). Orcutt, in particular, warned against underestimating the bias that arises when one does not consider the simultaneity caused by the interaction between prices and quantities, and between the domestic and foreign markets. The warning, however, has long been neglected and most empirical studies have continued to use the single-equation, OLS, approach. In fact, it is in some sense surprising that while more sophisticated assumptions were made about the foreign demand function,[8] little was done to bring domestic supply and demand into the picture. Recently some studies[9], while maintaining the single-equation demand for exports model, have used instrumental variables estimators to avoid the simultaneity between prices and quantities. However, the very fact of using the single-equation approach left doubts about the correct choice of instruments: this has led Magee to report in his recent survey[10] that "the findings on simultaneous equations bias are somewhat mixed." Another group of studies[11], while still using the single-equation approach, have come to recognize the fact that since the groups of commodities they were studying were really exportables, then somehow the domestic market should matter. But rather than deriving an explicit model for exportables, most of these studies have "modeled" the effects of the domestic market by just adding a domestic demand-pressure variable to the export equation, thus presumably estimating a semi-reduced form.[12] Finally, there have been attempts in the literature to consider explicitly the interaction between the demand and supply for exports functions: however, although these studies show a definite

advance in the estimation of export flows, still they have the serious drawback of assuming that the goods exported are not domestically consumed.

A recent work by Aspe and Giavazzi (1977) tries to address the issues raised by the simultaneity between prices and quantities and between domestic and foreign demand analyzing the microeconomic foundations of the simultaneous pricing and production decisions of a firm which operates in the exportables sector of an open economy, facing a foreign and a domestic demand for its output. Since the evidence provided by Kravis and Lipsey indicates that domestic and export prices may differ, the model explicitly allows for the possibility of price discrimination, assuming that the domestic and foreign market are separated, at least in the short-run, due to the existence of either imperfect or differentiated information, or of institutional constraints 13/. Assuming that each firm operates under conditions of imperfect competition in both markets, and aggregating over firms, they derive four structural equations that describe the simultaneous determination of prices and output in the exportables sector. The reduced form of the domestic and export price equations offers a theoretical background to the practice of introducing competitors' prices as an independent variable in the estimation of these equations. Since the model deals with structural relations, all the coefficients have straight economic interpretation: in particular, it is shown that under specific assumptions about the form of the demand functions and the value of the elasticity of output with respect to the variable factors

of production, the sign of the coefficient of competitors' prices in the two price equations is consistent with available empirical evidence. Since our next step will be to provide empirical evidence on the role of the exportables sector in the transmission mechanism, explicitly taking into account the simultaneity between prices and output in each market - foreign and domestic - and across the two markets, and allowing for the possibility of price discrimination, this model seems, at the moment, the best available framework. Therefore we shall first briefly review it.

FOOTNOTES TO CHAPTER 1:

1. For a review of the Keynesian model within this framework, see Dornbusch and Krugman (1976).

2. In fact while the Scandinavian approach (see Aukrust (1977), Calmorfs (1977)), although assuming that the price of both exportables and importables is given by the rest of the world, allows for relative price changes between traded and non-traded goods, some extreme versions of the Monetary approach (see the discussion in M. von Whitman (1975)) postulate that the LOOP holds for all goods, hence implicitly assuming a high degree of substitubility between traded and home goods in consumption and between their inputs in production (on this point see H.G. Johnson (1972), p.235).

3. For this distinction see Hicks (1974), Okun (1975), Nordhaus (1976), R.J. Gordon (1975) and also M.V. Whitman (1975).

4. Some empirical evidence pointing in the direction of price discrimination has been provided by Kravis and Lipsey (1977 and 1978).

5. F. Modigliani and T. Padoa Schioppa (1978).

6. A significant response of export prices to competitors' prices for different Countries appears in the results of J. Artus (1974) and Deppler and Ripley (1978). The elasticities of export prices with respect to competitors' prices for manufactures range betwee .544 (s.e. .096) for Japan and .087 (s.e. .095) for the US in Artus' study, and between 1.31 (s.e. .198) for Norway and .40 (s.e. n.a.) for Germany in the study by Deppler and Ripley. In the case of Italy, Deppler and Ripley find an elasticity of .44 (s.e. .10).

7. Dornbusch and Krugman with estimates allowing for lags up to 12 quarters find that the mean lag is around 4 to 6 quarters for most Countries - 8 for the US. Their results, however, are not comparable with other findings on export flows, since they estimate export shares. For manufactures Deppler and Ripley find significant short-term responses of export flows to changes in relative prices (i.e., significant relative price elasticities over two periods, using semi-annual data) in the case of Austria, Belgium-Luxemburg, Denmark, France, Japan, Norway, Sweden, Switzerland: the point estimates are between .77 (s.e. .21) for Austria and 1.82 (s.e. .03) for Sweden; they find longer lags in the case of the US, UK, the Netherlands and Germany, while they fail to find any significant response of export flows to changes in relative prices in the case of Italy. Low short-run relative price elasticities for exports of non-electrical machinery in the case of the US, UK and Germany are also found by Artus (1978).

8. See, for instance, Armington (1969).

9. See Magee (1970) and Richardson (1972).

10. See Magee (1975).

11. See Artus (1970), Henry (1970) and Ball et al. (1966).

12. See Goldstein and Kahn (1978) and Artus (1978).

13. As for instance in the case of protection of the home industry.

CHAPTER 2

THE SHORT-RUN DETERMINATION OF PRICES AND OUTPUT IN THE EXPORTABLES SECTOR: MICROFOUNDATIONS

1. The Technology and the Restricted Cost Function

We start considering the short-run behavior of a firm which produces an output X employing two variable factors of production, labor, L, and basic materials, M, under the constraint represented by a fixed stock of capital, $\bar{K}$. We assume the technology to be embodied in a neoclassical production function which is separable in capital, so that it may be written in the form:

$$(1) \qquad X = f(\bar{K};L,M) = \psi'(\bar{K}) \cdot [\phi(L,M)]^{t} \quad ;$$

where we assume ϕ to be a function homogeneous of degree one in its arguments, and t is the output elasticity with respect to the variable factors. The restricted cost function (when $\bar{K}$ is fixed) may be shown to have the form:

$$(2) \qquad C_{R}(X;w,z;\bar{K}) = X^{\frac{1}{t}} \cdot \psi(\bar{K})^{-\frac{1}{t}} \cdot \phi(w,z)$$

where w and z are the wage rate and the unit price of basic materials, respectively. Finally from equation (2) we may derive the restricted marginal cost function:

$$(3) \qquad MC_R(X;w,z,\bar{K}) = \ell X^{\ell-1} \cdot \psi(\bar{K})^{-\ell} \cdot \phi(w,z)$$

where $\ell = \frac{1}{t}$.

2. The Demand Functions on the Domestic and the Foreign Market

Since we wish our firm to be representative of the behavior of firms operating in the exportables sector, we shall assume that it sells its output both in the domestic and in the foreign market. We assume the two markets to be separated, at least in the short run, in the sense described in Chapter I. Since we are primarily interested in "customer goods", we shall assume, for the reasons expressed above, that the firm operates both at home and abroad under conditions of imperfect competition, facing on each market a downward sloping demand curve, which is a function of relative prices and of real income. Assuming a constant-elasticity, long-linear specification, the domestic and foreign demand functions will have the form:

$$(4) \qquad \ln X_1 = a_0 + a_1 \ln \frac{p}{p_1} + a_2 \ln y$$

$$(5) \qquad \ln X_2 = b_0 + b_1 \ln \frac{p^*}{p_2/e} + b_2 \ln y^*$$

where:

X_1 = domestic demand for the firm's output;

X_2 = foreign demand for the firm's output;

p_1 = domestic currency price of the firm's sales on the domestic market;

p_2/e = foreign currency price of the firm's sales on the foreign market

e = exchange rate in domestic currency;

p = domestic currency price of competing goods in the domestic market;

p* = foreign currency price of competing goods in the foreign market;

y = domestic real income;

y* = foreign real income.

3. Profit Maximization

If the firm knows the domestic and foreign demand with certainty, it will maximize profits by equating marginal revenue in each market to marginal cost of total output:

$$(6) \qquad MC_R = MR_1 = MR_2 ;$$

substituting into (6) the marginal revenue functions derived from our two demand functions, we may rewrite the firms' profit maximizing conditions in the following form:

$$(7) \qquad \ln p_1 = c_1 - \ell \ln \psi(\bar{K}) + \ln \phi(w,z) + (\ell-1) \ln (X_1 + X_2)$$

$$(8) \qquad \ln p_2 = c_2 - \ell \ln \psi(\bar{K}) + \ln \phi(w,z) + (\ell-1) \ln (X_1 + X_2)$$

where $c_1 = \ln \left[\ell \frac{a_1}{a_1 - 1} \right]$; $c_2 = \ln \left[\ell \frac{b_1}{b_1 - 1} \right]$,

and a_1, b_1 are the own price elasticities of demand in the two markets.

Notice that (7) and (8) are not the firm's supply functions: since we do not assume perfect competition, there is no such thing as a supply function, although because of the assumption of constant elasticity demand functions, price and marginal revenue only differ by a constant term.

4. Aggregate Price and Output Equations for the Exportables Sector

Having described the optimal behavior of an individual firm, we now intend to aggregate our results in order to describe the behavior of prices and output for the exportables sector. Our use of the term aggregation may be improper; we do not intend to verify the conditions under which all the firms belonging to the exportables sector may be treated as a single firm facing aggregate demand functions in the domestic and foreign market, and therefore we do not intend to derive an aggregate cost function for this sector. This problem has been solved under very stringent conditions for the case of perfect competition[1/] but it remains yet to be solved for the case of imperfect competition. What we intend to do does not postulate the existence of an aggregate. We assume that firms have symmetric cost functions and face identical factor prices, and that each firm knows its demand function - these not necessarily identical across firms because of the assumption of imperfect competition - with certainty. If exportable goods were homogeneous, total output of the sector would be the sum of the outputs of the individual firms, so that we are left with the problem of building two price

indices that describe the set of individual prices in each market. Various possibilities are available and in recent literature it has been common to choose the Divisia Price Index. It has been shown elsewhere [2/] that under certain conditions the Divisia Index could, in fact, be the best choice, but in this chapter, without going further, it just represents one of the available choices. Adding a subscript i to the equations that describe the i^{th} firm, and defining δ_{1i}, δ_{2i} as the expenditure shares in each market, we obtain the following four equations that describe the simultaneous behavior of prices and output in the exportables sector:

$$(9)\quad \sum_i \delta_{1i} \ln p_{1i} = \sum_i \delta_{1i} c_{1i} - \sum_i \delta_{1i} \ell \ln \psi(\bar{K}_i) + \sum_i \delta_{1i} \ln \phi(w,z) + \sum_i \delta_{1i}(\ell-1) \ln(X_{1i} - X_{2i})$$

$$(10)\quad \sum_i \delta_{1i} \ln p_{2i} = \sum_i \delta_{2i} c_{2i} - \sum_i \delta_{2i} \ell \ln \psi(\bar{K}_i) + \sum_i \delta_{2i} \ln \phi(w,z) + \sum_i \delta_{2i} (\ell-1) \ln(X_{1i} + X_{2i})$$

$$(11)\quad \sum_i \delta_{1i} \ln X_{1i} = \sum_i \delta_{1i} a_{oi} + \sum_i \delta_{1i} a_{1i} \ln \frac{e\, p_1^*}{p_{1i}} + \sum_i \delta_{1i} \ln y$$

$$(12)\quad \sum_i \delta_{2i} \ln X_{2i} = \sum_i \delta_{2i} b_{oi} + \sum_i \delta_{2i} b_{1i} \ln \frac{p_2^*}{p_{2i}/e} + \sum_i \delta_{2i} \ln y^*$$

where: $\delta_{1i} = \dfrac{p_{1i}X_{1i}}{\sum_i p_{1i} X_{1i}}$; $\delta_{2i} = \dfrac{p_{2i}X_{2i}}{\sum_i p_{2i} X_{2i}}$; $\sum_i \delta_{1i} = \sum_i \delta_{2i} = 1.$

Notice that in order to simplify the derivation of the aggregate demand functions, we have made the additional assumption that in both markets there is only one good which is competing with the output of each firm and which is produced by foreign competitors. We have allowed the foreign currency price of this good to differ at home and abroad assuming that also foreign producers may discriminate between the two markets: the two prices are p_1^* and p_2^*, respectively.

Equations (9) through (12) are the structural relations of the model. Substituting equations (11) and (12) into (9) and (10), and linearizing $\ln(X_{1i} + X_{2i})$ around the sample means, we may derive the reduced form domestic and export price equations which are functions of all the exogenous cost and demand variables of the model. Omitting for simplicity all the aggregation terms we obtain:

$$(13)\quad \ln p_1 = \frac{1}{\Delta}\{c_3 - \ell \ln \psi(\bar{K}) + \ln \phi(w,z) + (\ell-1)$$
$$[k_1a_1 \ln(ep_1^*) + k_1a_2 \ln y + k_2b_1 \ln (e\, p_2^*) + k_2b_2 \ln y^*]\}$$

$$(14)\quad \ln p_2 = \frac{1}{\Delta}\{c_4 - \ell \ln \psi(\bar{K}) + \ln \phi(w,z) + (\ell-1)$$
$$[k_1a_1 \ln(ep_1^*) + k_1a_2 \ln y + k_2b_1 \ln(ep_2^*) + k_2b_2 \ln y^*]\}$$

where $\Delta = 1 + (\ell-1)(k_1a_1 + k_2b_1) > 0$

and $k_i = e^{\overline{\ln X_i}} / (e^{\overline{\ln X_1}} + e^{\overline{\ln X_2}})$, $i=1,2$,

where $\overline{\ln X_i}$ denotes the sample mean.

All the predetermined cost and demand variables in the model enter the final form of the two price equations, and, in particular, competitors' prices in the domestic and in the foreign market. Notice that the assumption of constant elasticity demand functions implies that the ratio of domestic to export prices is constant, and hence that their response to changes in factor costs and competitors' prices is identical. This is reflected in the two price equations being identical except for the constant term. The sum of the coefficients on wages and on the unit price of basic materials is:

$$\Delta^{-1} = [1 + (\ell - 1)(k_1 a_1 + k_2 b_1)]^{-1} \quad ;$$

the coefficients of competitors' prices in the domestic and in the foreign market are respectively:

$$\frac{a_1 k_1}{(\ell - 1)^{-1} + (k_1 a_1 + k_2 b_1)} \quad \text{and} \quad \frac{b_1 k_2}{(\ell - 1)^{-1} + (k_1 a_1 + k_2 b_1)} \quad .$$

For given values of the relative price elasticities, a_1 and b_1, the steeper the marginal cost schedule ($\ell >> 1$), the smaller the coeffficient on the domestic cost variables and the larger the coefficient on competitors' prices. The two polar cases are $\ell = \infty$ and $\ell = 1$. If supply is

fixed, the sector is a price taker and prices are determined by demand conditions in the two markets, independently of factor costs. If the short-run marginal cost function is flat, competitors' prices have no influence on domestic and export pricing. For any given slope of the marginal cost schedule, higher values of the relative price elasticity of demand in the two markets reduce the coefficients of wages, capital and basic materials price, and increase the coefficient of competitors' prices. In the limiting case of perfect competition, when demand functions are infinitely elastic, we obtain the normal result that the sector is a price-taker in the world market.

These results, however, correspond to a very special case: what is particularly restrictive is the assumption of a constant ratio of domestic to export prices, and its implication that their response to factor costs and competitors' prices is identical and crucially depends upon the slope of the short-run marginal cost schedule. The critical assumption is the specification of the demand functions; conclusions about the response of domestic and export prices to changes in factor costs and competitors' prices therefore require specific assumptions about the form of the demand functions on the domestic and on the foreign market. As an example, we show how the results would change in the case in which firms face, in each market, decreasing elasticity demand functions of the type:

$$(15) \qquad X_1 = a_1 \ln \frac{ep^*}{p_1} + a_2 \ln y$$

$$(16) \qquad X_2 = b_1 \ln \frac{ep^*}{p_2} + b_2 \ln y^*$$

where the interpretation of each variable is the same as in equations (4) and (5), and we have made the simplifying assumption that foreign producers do not discriminate between the domestic and foreign markets. Under these assumptions, from the firms' equilibrium conditions, we derive the following two price equations:

$$(17) \qquad \ln p_i \cong c_i - \ell \ln \psi(\bar{K}) + \ell \ln \phi(w,z) + (\ell-1)\ln (X_1+X_2) + \ln X_i, \quad i=1,2$$

where the ~ comes from the Taylor expansions of $\ln (1-X_1/a_1)$ and $\ln (1-X_2/b_1)$, a_1/X_1 and b_1/X_2 being the relative price elasticity of demand in the domestic and the foreign market respectively. Notice that demand functions like (15) and (16) imply that movements in the ratio of domestic to export prices are proportional to changes in the relative allocation of output between the two markets. Contrary to the case of constant elasticity, the response to changes in competitors' prices will in general be different for domestic and export prices, and it does not vanish when the marginal cost function is flat. Substituting (15) and (16) into (17), we may derive the elasticities of domestic and export prices with respect to competitors' prices; these have the form:

$$\varepsilon_{p_1,ep^*} = \frac{a_1}{x_1}\,[k_1(\ell - 1) + 1] + \frac{b_1}{x_2}\,k_2(\ell - 1)\ ,$$

$$\varepsilon_{p_2,ep^*} = \frac{b_1}{x_2}[k_2(\ell - 1) + 1] + \frac{a_1}{x_1}\,k_1(\ell - 1)\ .$$

The response to changes in competitors' prices will be smaller for domestic than for export prices if the domestic demand is more inelastic.

The choice of the model to be used in empirical work will therefore depend upon the type of commodities considered and will in general require a specific statistical test on the form of the demand functions[3/].

Finally, if we relax the assumption that the firm knows its domestic and foreign demand functions with certainty, explicitly introducing uncertainty on the demand side, a different elasticity of demand in the two markets is no longer a necessary condition for price discrimination: assuming that in the presence of uncertainty the firm maximizes its market value, it may be shown that a sufficient condition is that the two markets have different risk class, i.e., that the variance of the two demand functions is different[4/].

APPENDIX A

Our model, as developed in Chapter 2 made no explicit assumption about the technology, and hence the functional form of the restricted cost function. In order to derive the functional forms we need more specific assumptions. Maintaining a log-linear specification for the demand functions, and assuming a Cobb-Douglas technology, the structural price equations of our model, (9) and (10) become:

$$(9') \quad \ln p_1 = c_1 - \alpha \ln \bar{K} + \frac{\beta}{\beta+\gamma} \ln w + \frac{\gamma}{\beta+\gamma} \ln z + \left(\frac{1}{\beta+\gamma} - 1\right) \ln (X_1+X_2)$$

$$(10') \quad \ln p_2 = c_2 - \alpha \ln \bar{K} + \frac{\beta}{\beta+\gamma} \ln w + \frac{\gamma}{\beta+\gamma} \ln z + \left(\frac{1}{\beta+\gamma} - 1\right) \ln (X_1+X_2),$$

where we have omitted for simplicity all the aggregation terms, and where the implied production function is:

$$X = A \cdot \bar{K}^{\alpha} \cdot L^{\beta} \cdot M^{\gamma} \qquad \text{and}$$

$$c_1 = \ln a_1 - \ln A - \frac{\beta}{\beta+\gamma} \ln \beta - \frac{\gamma}{\beta+\gamma} \ln \gamma ,$$

$$c_2 = \ln b_1 - \ln A - \frac{\beta}{\beta+\gamma} \ln \beta - \frac{\gamma}{\beta+\gamma} \ln \gamma ,$$

X_1, X_2 represent the output allocated to the domestic and the foreign market, respectively, and a_1, b_1 are the own price elasticities of demand in the two markets. Under these assumptions, the reduced form price equations (13) and (14) become:

$$(13') \quad \ln p_1 \tilde{=} \frac{1}{\Delta}\left[(\ell-1)(c_3 + a_1 k_1 \ln ep_1^* + b_1 k_2 \ln ep_2^* + a_2 k_1 \ln y + b_2 k_2 \ln y^*)\right.$$

$$\left. + (c_1 - \alpha \ln \bar{K} + \frac{\beta}{\beta+\gamma} \ln w + \frac{\gamma}{\beta+\gamma} \ln z)\right]$$

$$(14') \quad \ln p_2 \tilde{=} \frac{1}{\Delta}\left[(\ell-1)(c_4 + a_1 k_1 \ln ep_1^* + b_1 k_2 \ln ep_2^* + a_2 k_1 \ln y + b_2 k_2 \ln y^*\right.$$

$$\left. + (c_2 - \alpha \ln \bar{K} \frac{\beta}{\beta+\gamma} \ln w + \frac{\gamma}{\beta+\gamma} \ln z)\right] ,$$

where ℓ is the inverse of the short-run output elasticity with respect to variable costs, c_3, c_4 are constant terms and the $\tilde{}$ sign derives from the Taylor expansion of $\ln(X_1 + X_2)$.

APPENDIX B

This Appendix discusses the optimal behavior of a firm which operates in the exportables sector of an open economy, in the presence of demand uncertainty. As in the case of certainty, we shall assume that the domestic and foreign markets are separated in the short-run, and that in each market the firm operates under conditions of imperfect competition, facing downwards sloping demand functions. There are basically two kinds of demand uncertainty [5]: (i) uncertainty about the parameters, i.e., uncertainty about the form of the demand function, and (ii) uncertainty about the position of a known function, as in the case in which the firm knows its demand function up to a stochastic-term [6]. We shall assume that demand uncertainty is of the second kind. In an uncertain framework the firm, given its expectations about domestic and foreign demand, can follow one of two strategies: it can either set a production target and then act as a "price-taker" in both markets, or it can set a price - more likely two different prices, one on the domestic and one of the foreign market - and then act as a "quantity taker". In the latter case, if production does not take place instanteneously, the firm will also care about the probability of foregone profits (excess-demand) and of undesired inventories (excess-supply). Finally, in the case of uncertainty, profit maximization will no longer be a sufficient criterion for the firm's decisions, since profit itself becomes a random variable. In what follows we assume that the objective of the firm is to maximize its

market value, defined as[7]:

$$(A1) \qquad V = \frac{1}{i}\,(E\pi - R\beta\sigma_{\pi}) \ ,$$

where V is the market value of the firm, $E\pi$ is the expected value of profits, defined as the value of total cash-flow to stockholders at the end of the period, σ_{π} is their standard deviation, R is the market price per unit of risk, β the correlation coefficient between the profits of the firm and the overall return on the market, and (i-1) is the return on the riskless asset. Notice that the interpretation of (A1) is different if we assume that there are no capital markets and that stockholders are characterized by constant absolute-risk-aversion utility functions. In this case, $R\beta = \lambda\sigma_{\pi}/n$, where λ is the coefficient of absolute risk-aversion and n is the number of stockholders[8].

Our purpose is to show that the presence of uncertainty will affect the firm's decisions in two ways: when the firm acts as a price-taker, the presence of uncertainty will decrease the ouput allocated to each market, and an increase in the variance of demand in any of the two markets will shift the allocation of output away from that market; when the firm acts as a quantity-taker it will respond to an increase in the variance of demand in any of the two markets setting a higher price in that market. A consequence of our results is that in the case of uncertainty a different elasticity of demand in the two markets is no longer a necessary condition for price discrimination: a sufficient condition is that the two markets have different risk class. We next derive our results.

We first consider the case in which the firm sets its level of production and then acts as a price-taker in both markets; in this case we may rewrite our domestic and foreign demand functions (4) and (5) in the form [8]:

$$\text{(A2)} \qquad \tilde{p}_1 = c_1 p y^{-a_2/a_1} X_1^{-1/a_1} \tilde{\varepsilon}_1 = A_1 X_1^{-1/a_1} \tilde{\varepsilon}_1$$

$$\text{(A3)} \qquad \tilde{p}_2 = c_2 (ep^*) y^{*-b_2/b_1} X_2^{-1/b_1} \tilde{\varepsilon}_2 = A_2 X_2^{-1/b_1}$$

where ~ denotes a random variable and we assume:

$$\tilde{\varepsilon}_i \sim \text{lognormal } (1, \sigma_i^2) \quad i=1,2$$

$$\text{cov } (\tilde{\varepsilon}_1, \tilde{\varepsilon}_2) = \sigma_{12} \quad .$$

Under these assumptions the firm's objective function may be written in the form:

$$\text{(A4)} \quad \underset{X_1, X_2}{\text{Max}} \; \frac{1}{i} \left\{ A_1 X_1^{1-1/a_1} + A_2 X_2^{1-1/b_1} - C(X_1+X_2;\, w,z,\bar{K}) + \right.$$

$$- R\beta \left(A_1^2 X_1^{2-2/a_1} \sigma_1^2 + A_2^2 X_2^{2-2/b_1} \sigma_2^2 + \right.$$

$$\left. \left. + 2A_1 A_2 X_1^{1-1/a_1} X_2^{1-1/b_1} \sigma_{12} \right)^{1/2} \right\}$$

and the first order conditions (FOC) are:

$$(A5) \qquad EMR_i - \frac{R\beta}{2\sigma_\pi} \frac{\partial \sigma_\pi^2}{\partial X_i} = MC \quad , \quad i=1,2$$

where EMR_i is marginal revenue evaluated along the expected demand function, and the second term on the left-hand side represents a marginal risk adjustment. (A5) says that, in the presence of uncertainty, for any given level of output allocated to each market the firm will require an expected marginal revenue which is higher than in the certainty case or, what is equivalent, that for any expected marginal revenue the output allocated to each market will be lower in the presence of uncertainty. Notice that:

$$\frac{\partial \sigma_\pi^2}{\partial X_1} = (1 - \frac{1}{a_1}) \left[A_1^2 X_1^{1-2/a_1} \sigma_1^2 + A_1 A_2 X_2^{1-1/b_1} X_1^{-1/a_1} \sigma_{12} \right];$$

for $\sigma_1^2 = \sigma_{12} = 0$ (A5) reduces to our price equations (7) and (8) in the certainty case; for $\beta > 0$, that is for a positive correlation between the profits of the firm and the overall return on the market, and for a given covariance between domestic and foreign demand, an increase in the variance of demand in one market will decrease the output allocated to that market. Notice that we have so far assumed that the goods produced for each market, although originated from the same production function, are not substitutable ex-post [10/]. If we allowed substitubility ex-post, then an increase in the variance of demand in any of

the two markets would decrease - for $\beta > 0$ - the total level of output, though not the relative allocation between the two markets.

If instead the firm acts as a monopolist, setting a price in each market, we may rewrite our demand functions (4) and (5) in the form:

$$\text{(A6)} \qquad \tilde{X}_1 = a_o(p/p_1)^{a_1}\, y^{a_2}\, \tilde{\eta}_1 = A_1\, P_1^{-a_1}\, \tilde{\eta}_1$$

$$\text{(A7)} \qquad \tilde{X}_2 = b_o(ep^*/p_2)^{b_1}\, y^{*b_2}\, \tilde{\eta}_2 = A_2\, P_2^{-b_1}\, \tilde{\eta}_2$$

and the FOC are:

$$\text{(A9)} \qquad EMC = EMR_i - \frac{R\beta}{\sigma_\pi}\frac{\partial \sigma_\pi^2}{\partial p_i} \qquad i=1,2 \quad ,$$

where EMC is the expected value of the marginal cost of total output, itself a random variable if we assume that the firm produces instantaneously the realized values of demand. Similar to the previous case, the implication is that, for a given level of expected demand, the firm will set a higher price in the presence of uncertainty than in the certainty case, and that - for $\beta > 0$ - it will respond to an increase in the variance of demand in any of the two markets setting a higher price in that market.

These results are still very preliminary and call for statistical verification of the effects of changes in uncertainty - we think in particular at the effect of the increased variability of the exchange

rate which followed the transition to flexible rates - on the volume of trade and on the behavior of domestic and export prices.[11/] However, suggesting an additional source of divergence between domestic and export prices, they reinforce the presumption that exportable goods, while still remaining the channel through which foreign and domestic disturbances get transmitted, will not necessarily transmit their full amount; countercyclical domestic policies could be sufficient to create this "buffer effect".

FOOTNOTES TO CHAPTER 2:

1. See F.M. Fisher (1969). I am indebted to Prof. Fisher for explaining this point to me.

2. See Hulten (1973).

3. For a statistical test of the functional form of a demand function, see Box and Cox (1964), Kahn and Ross (1977), and Chang (1977).

4. For a discussion of the behavior of a firm which operates in the exportables sector in the presence of demand uncertainty, see Appendix B to this Chapter.

5. For a discussion of this issue see the comments of F.M. Fisher to Nordhaus (1971).

6. In what follows we assume that the firm faces perfectly elastic supply functions for its factors of production, whose price is known with certainty. Uncertainty therefore only arises on the demand side; our approach however could be extended to consider the case in which uncertainty enters also on the supply side.

7. For a derivation of (A1) see for instance Fama (1972).

8. For a derivation see O.J. Blanchard (1977).

9. Notice that the specification of (A2) and (A3) - and similarly of (A7) and (A8) below - is general enough to allow for different sources of uncertainty. (A3) and (A7) in particular include the case in which uncertainty originates from the exchange rate. Notice that in (A7) we have assumed that the firm sets its export price in terms of the domestic currency, but the equation could be easily generalized to the case in which the price is set in the foreign currency. Finally our analysis should be extended to consider the case in which the firm hedges on the forward exchange market: this possibility is analyzed in Hopper and Kohlhagen (1976), although these authors only consider one of the possible strategies of the firm, i.e., when it acts as a price-taker.

10. This is, for instance, the case of cars requiring different safety standards according to the market of destination.

11. For a discussion of the effects of exchange rate uncertainty on export and import prices,see Hooper and Kohlhagen (1976).

CHAPTER 3

EMPIRICAL EVIDENCE FROM COMPETING INDUSTRIES IN THE MANUFACTURING SECTOR IN GERMANY AND ITALY: 1969-1976

1. The Choice of the Manufacturing Sector

In both Germany and Italy exportables mainly coincide with manufactured goods, which, as we have seen in Chapter 1, belong to the category of customer goods, for which exchange rate changes are more likely to affect relative prices in the short-run. This was the reason for concentrating on the manufacturing sector. A main concern of the empirical part of this paper is to avoid problems deriving from aggregation bias, while presenting results still representative of the overall behavior of the exportables sector. We have therefore chosen to study, in each Country, the industry producing Machinery and Transport Equipment, disaggregating the sector in its three main components: non-electrical machinery (NEM), electrical machinery (EM), and transport equipment. Each of these sectors seemed homogeneous enough to exclude, as far as possible, serious aggregation bias. However the sector of EM does include non-homogeneous commodities such as power-generating machinery, domestic electrical appliances and telecommunication equipment, and the problem is particularly serious with Transport Equipment which includes road motor-vehicles, ships and aeroplanes. We have therefore restricted the sector of transport equipment to include only road motor-vehicles (RMV), while more disaggregate information was not available for EM[1/]. Of course, the fact that the three sectors include

the same type of commodities in each Country, does not imply that they are comparable across Countries, since, within any given sector, each Country may specialize in different commodities. For example, within EM, electrical power machinery represents approximately 26%[2/] of the total German exports in this sector, while only 15% of Italian exports; the opposite happens for domestic electrical appliances, which represent only 10% of German exports of EM, while 33% of Italian exports in the same group of commodities. In each of the two Countries however, the industry we have chosen may be considered representative of the behavior of the whole exportables sector: its share of total manufacturing exports, defined as SITC categories 6, 7 and 8, was, in 1975, 62% in Germany and 54% in Italy. Since the model we shall use in studying the behavior of the exportables sector explicitly considers the fact that firms may sell their goods on both the domestic and the foreign market, in Table A we show the composition of total sales on the domestic market - imported goods vs. sales of domestic producers - and the share of exports over total sales of domestic producers.

2. The Behavior of Domestic and Export Prices

2.a Evidence on different behavior of domestic and export prices

We start our investigation of the effect of exchange rate changes on relative prices looking first for evidence of different behavior of domestic and export prices. In order to do this we want to compare domestic producers' prices with export contract prices: this information, however, was only available for Germany; in the case of Italy

TABLE A

I. EXPORTS AS A PERCENTAGE OF DOMESTIC PRODUCERS' TOTAL SALES

	SECTOR NEM		SECTOR EM		SECTOR RMV	
	Germany	Italy	Germany	Italy	Germany	Italy
1969	42%	33%	24%	23%	45%	37%
1970	43	33	24	24	43	32
1971	43	34	24	23	44	33
1972	46	39	24	17	46	34
1973	48	33	26	16	49	34
1974	55	34	29	16	53	36
1975	54	38	30	18	50	37

II. COMPOSITION OF SALES ON THE DOMESTIC MARKET:

IMPORTS AS A PERCENTAGE OF TOTAL SALES

	SECTOR NEM		SECTOR EM		SECTOR RMV	
	Germany	Italy	Germany	Italy	Germany	Italy
1969	15%	22%	13%	22%	18%	22%
1970	17	23	15	25	20	22
1971	17	24	15	21	24	23
1972	18	27	15	14	25	24
1973	17	26	17	17	25	25
1974	18	25	18	17	24	23
1975	19	25	21	16	29	25

the existing information on both domestic and export prices could be very misleading, and our results should therefore be taken very cautiously. Since no information on producers' prices is available, we used domestic wholesale prices which refer to contract prices of all transactions which take place on the domestic market, hence covering also imported goods: the share of imports over total sales on the domestic market for each of the categories we are considering (see Table A) should caution against the reliability of this information as an indicator of domestic producers' prices. On the side of exports we were forced to use, for Italy, export unit values: since unit values are moving-weight indeces, while contract prices are based on a fixed-weight Laspeyres' formula, at constant contract prices the behavior of the two indeces will differ if there is a change in the commodity composition of exports. Moreover export unit values could be compared with actual contract prices only after some allowance is made for delivery delays. Estimates by J. Artus (1974) indicate that export unit values for manufactured goods reflect contract price changes with a relatively short lag, averaging around three months; in the case of Germany he finds that 40% of the variation in contract prices is reflected in the export unit value index after a lag of only one month, the remaining effect being concentrated around a six-month lag. But as Artus himself points out, information available on delivery delays suggests longer lags. The explanation he gives for this anomaly is that the composition of the contract price index is biased in favor of commodities with short delivery lags. However, since in the case of

Italy no estimates were available on delivery days, we decided to use current unit values as indicators of export contract prices: our results should therefore be taken very cautiously. Tables B1, B2 and B3 show the behavior of domestic and export prices in each sector for the two Countries [3/].

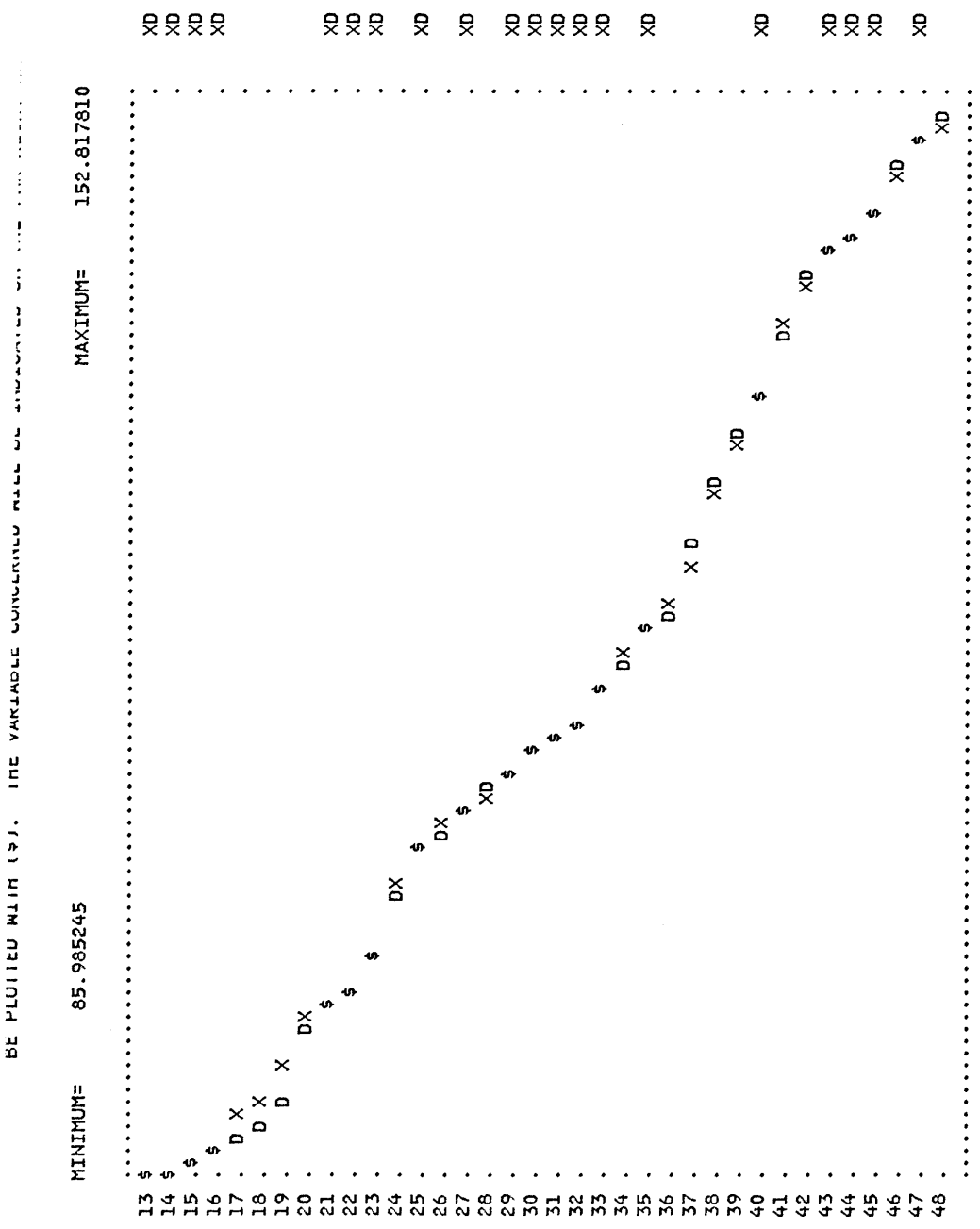
In the case of NEM there is no evidence of a different behavior of German domestic and export prices; the same seems to be true in the case of Italy: the rates of change of export unit values and domestic wholesale prices seem almost identical, but the levels are different, export unit values being consistently lower. Note however that this could depend on the presence of delivery delays: the behavior of the export unit value index in the last three quarters of 1972 seems to indicate the presence of 3-quarters delivery lags: if domestic wholesale prices were compared with export unit values three quarters ahead, as in the case of Germany, there would be very little evidence of a different behavior. In the case of EM, domestic and export prices behave differently in both Countries. The effect is particularly strong in the case of Italy: the rate of change of export unit values is higher than that of domestic wholesale prices, and the tendency would be reinforced if some allowance were made for delivery delays. However we have already argued that this sector is the least homogeneous among those we are considering and hence the composition of sales on the domestic and the foreign market may be different: in this case the different behavior of the two price indeces would depend on the different - and possibly

EXPORT AND DOMESTIC PRICES

GERMANY 1968:1 - 1976:4

Sector: Non-Electrical Machinry

Exp.P. : X
Dom.P. : D



EXPORT AND DOMESTIC PRICES

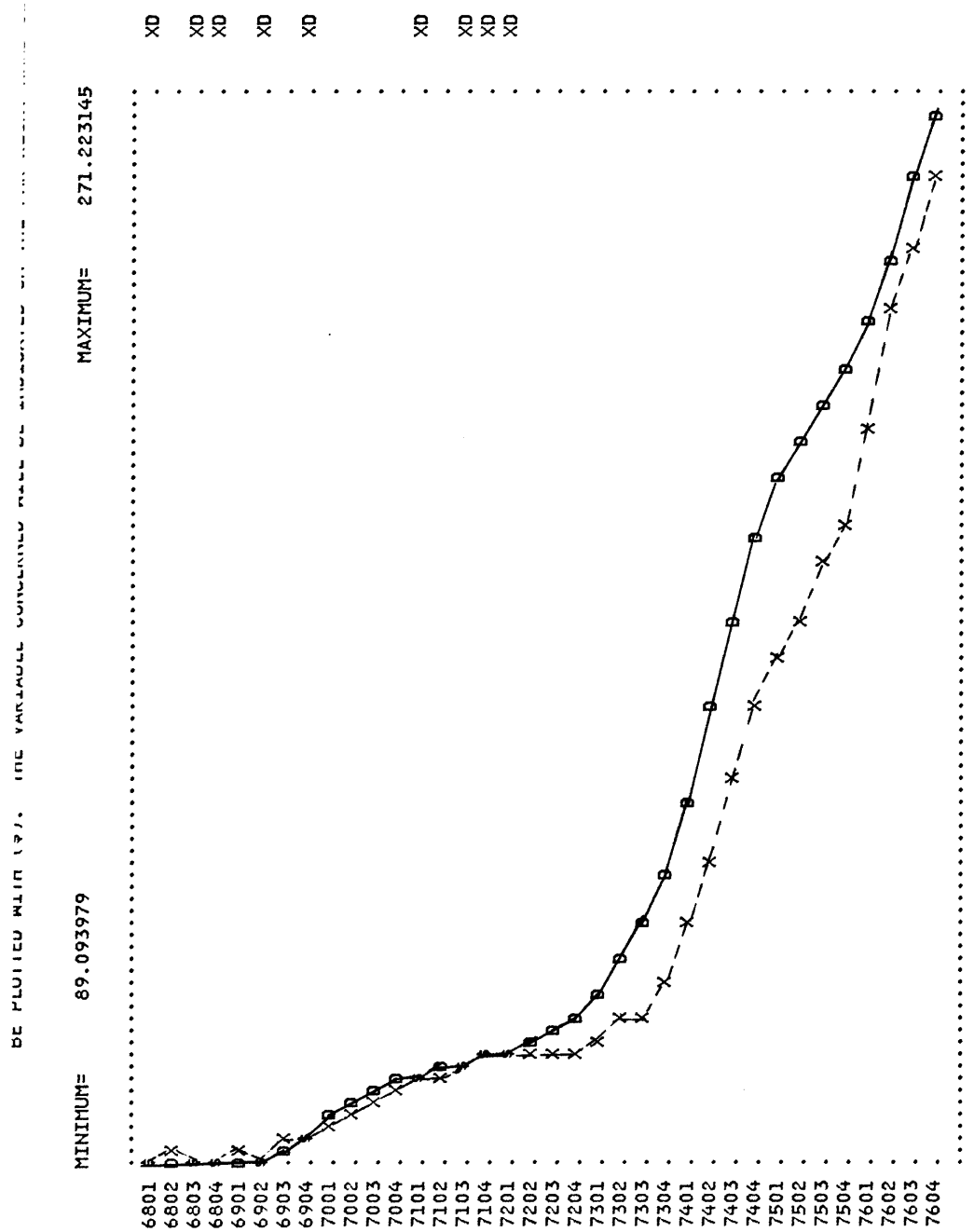
ITALY 1968:1 - 1976:4

Sector: Non-Electrical Machinery

Index Numbers : 1970 = 100

Exp,P, : – – – –

Dom..P. : ————



EXPORT AND DOMESTIC PRICES

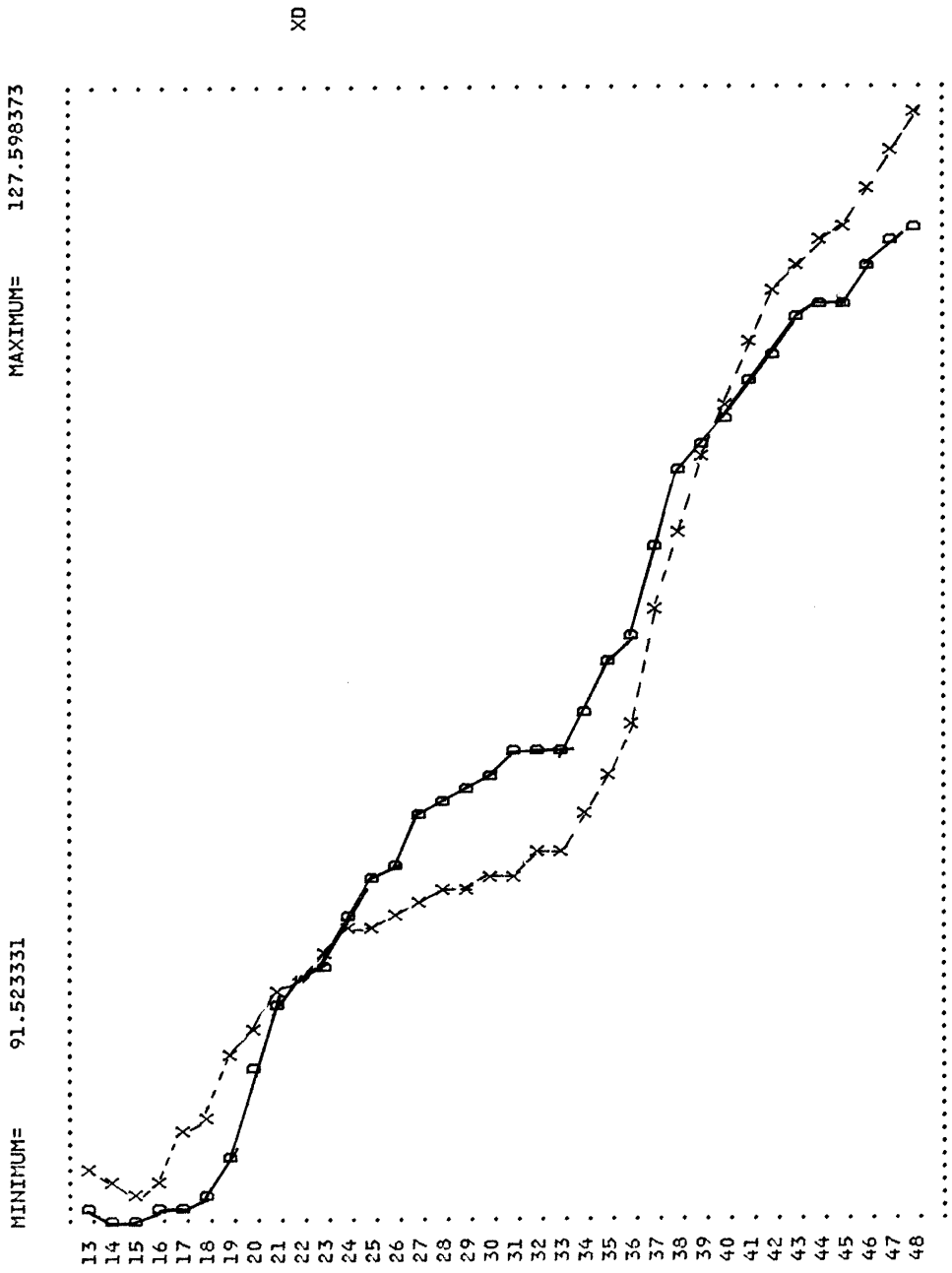
GERMANY 1968:1 - 1976:4

Sector: Electrical Machinery

Index Numbers 1970=100

Exp.P. :- - - - -

Dom.P. :————



DOMESTIC AND EXPORT PRICES

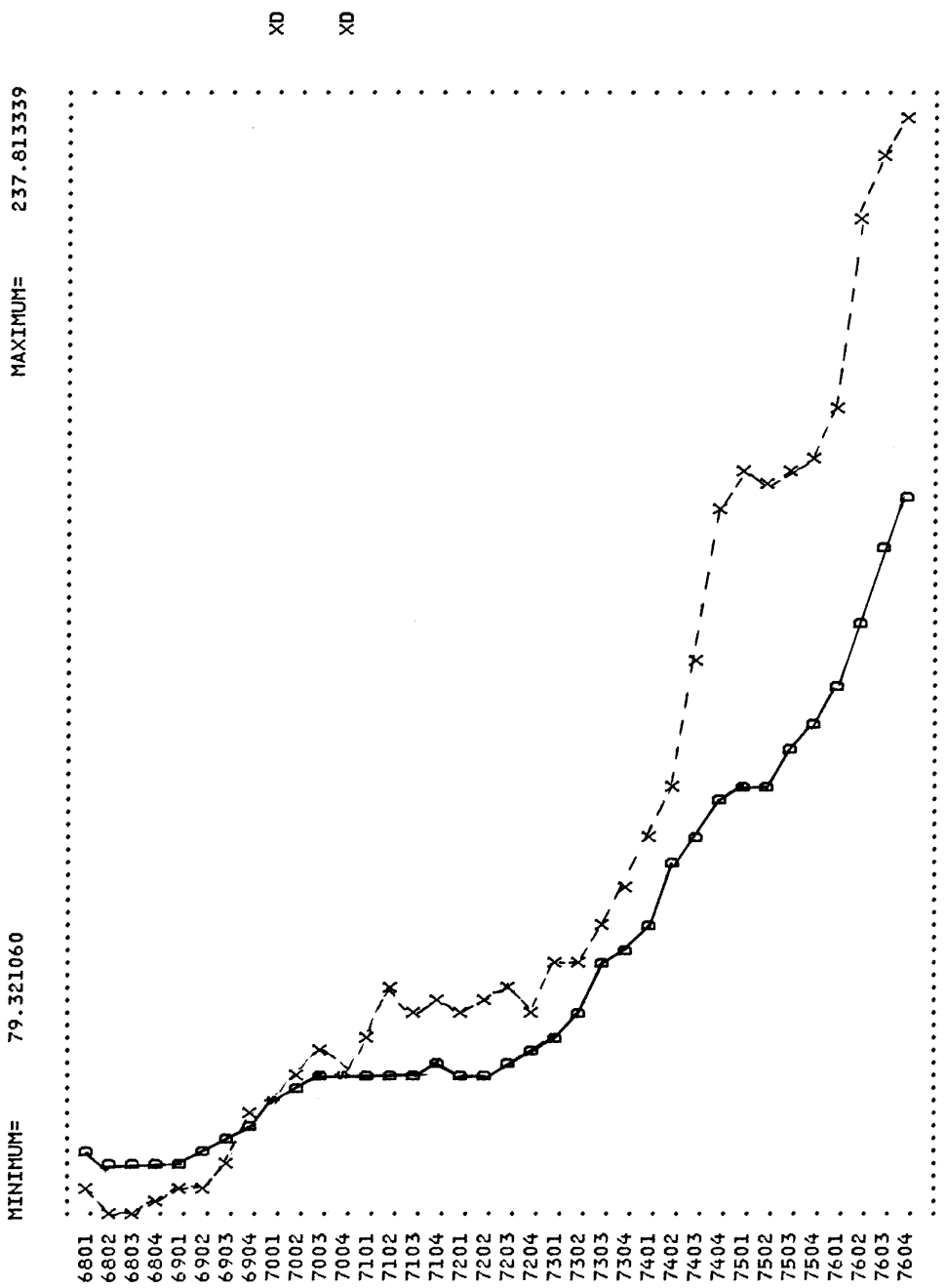
ITALY 1968:1 - 1976:4

Sector: Electrical Machinery

Index Numbers: 1970= 100

Dom.P. : _____

Exp..P.: _ _ _ _ _



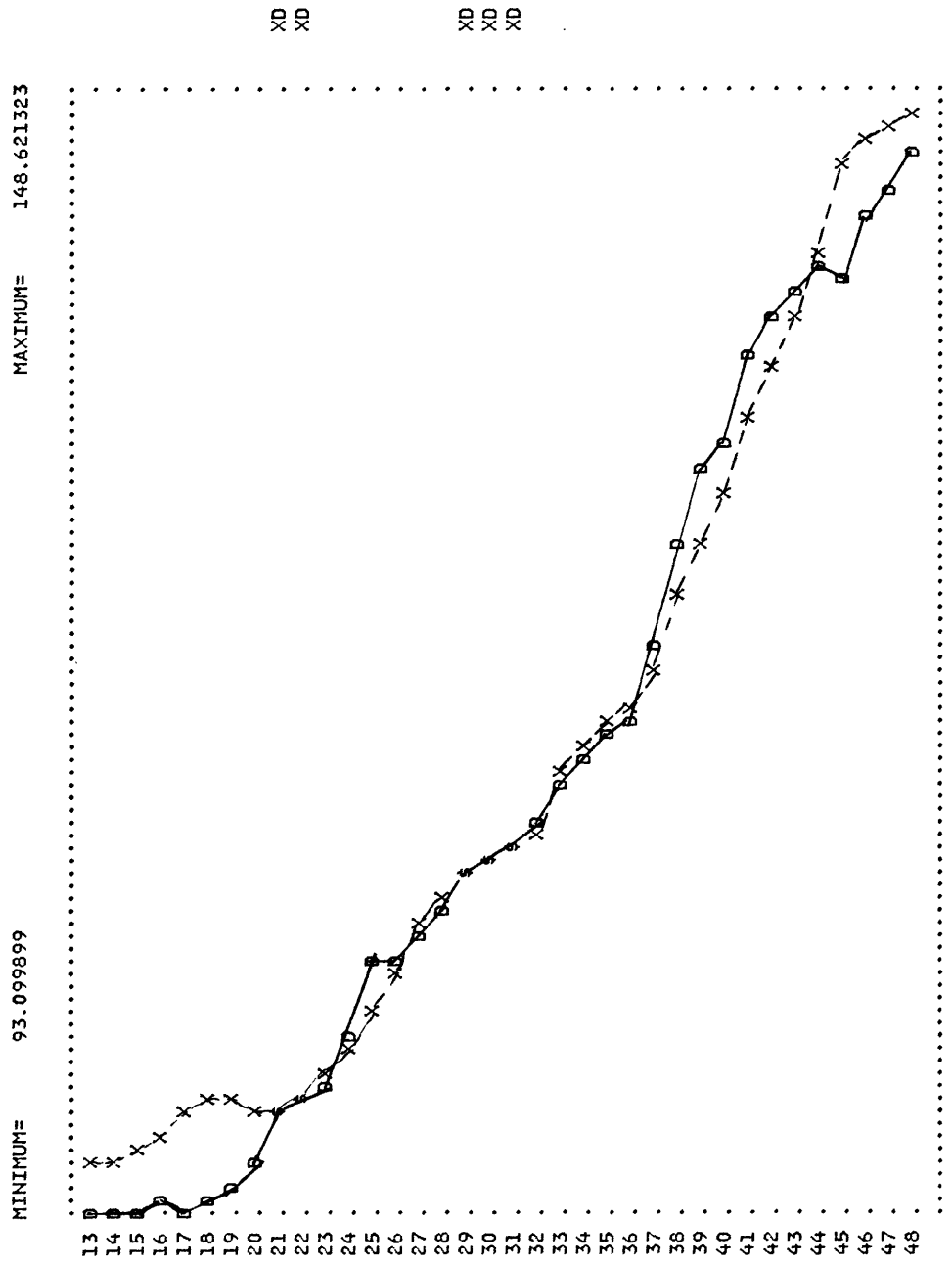
EXPORT AND DOMESTIC PRICES

GERMANY 1968:1 - 1976:4

Sector: Road Motor-Vehicles

Index Numbers 1970=100

Exp.P. : – – – –
Dom.P. : ————————



DOMESTIC AND EXPORT PRICES

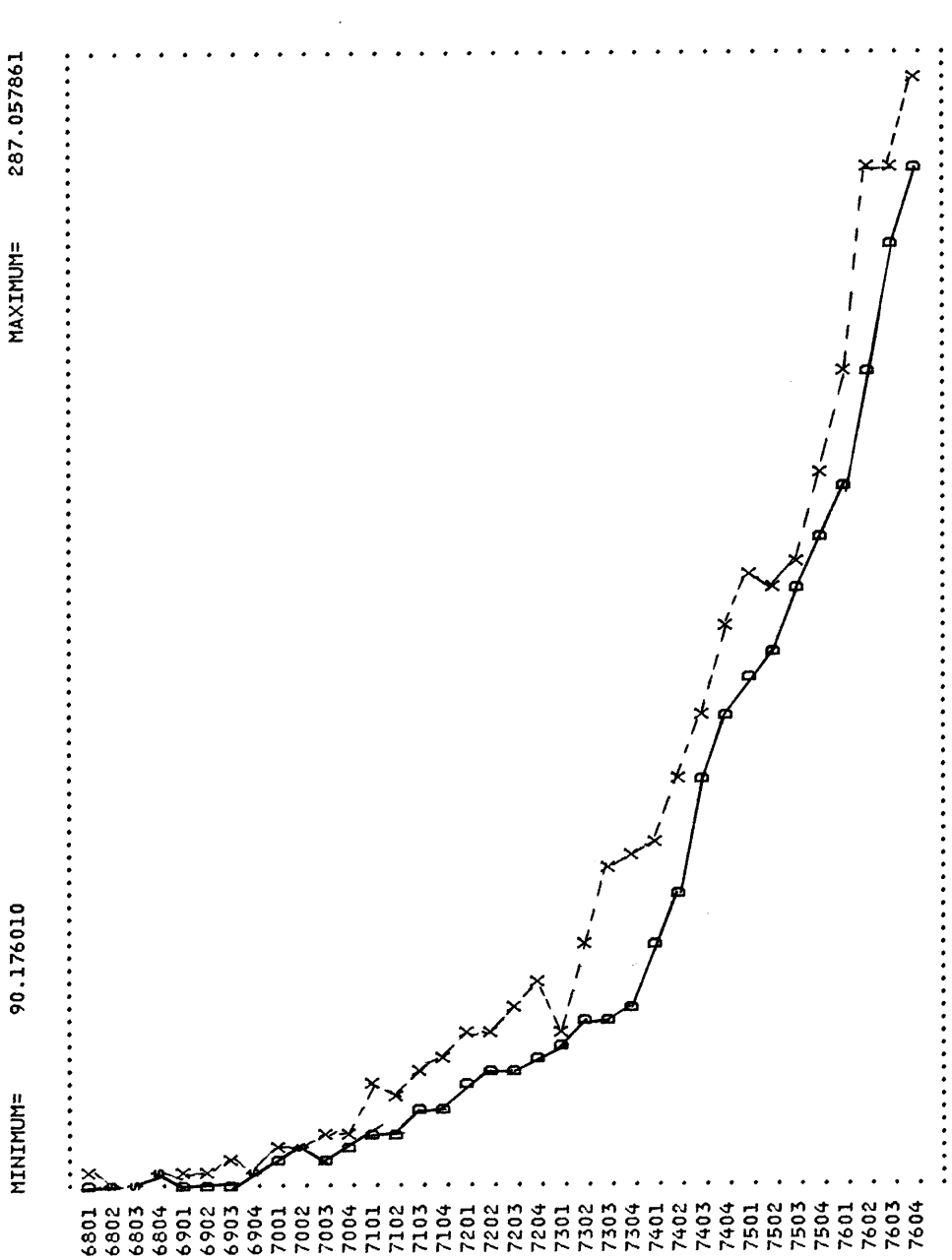
ITALY 1968:1 - 1976:4

Sector: Road Motor-Vehicles

Index Numbers: 1970=100

Dom.P. : ————

Exp.P. : – – – – –



changing in the case of Italy where we used unit values - commodity composition. Finally, for RMV, in the case of Germany the behavior of the two price indeces is almost identical, while for Italy the levels are different and the tendency would be reinforced if allowance were made for delivery lags.

The evidence is therefore somewhat mixed and while not excluding - at least in some sectors - the possibility of price discrimination, it calls for a specific statistical test. This seems to be possible in the case of Germany, while for Italy the available information does not allow one to distinguish the hypothesis of price discrimination from the distortions which may arise from the use of a unit value index. This preliminary evidence, however, seems to confirm our presumption that in order to study the behavior of prices and output in the exportables sector, the model should at least allow for the possibility of price discrimination.

2.b Evidence on the relative effect of domestic costs and competitors' prices on domestic and export pricing

In this section we investigate the relative response of domestic and export prices to domestic costs and competitors' prices. We intend to provide evidence on the following two issues: (i) the difference in the response of domestic and export prices to changes in domestic costs and competitors' prices; (ii) the validity of the Keynesian proposition that export prices are fixed in terms of suppliers' costs, versus the Scandinavian and Monetarist proposition that the relative prices of

tradable goods adjust quickly and independently of domestic costs to close any gaps which may originate from exchange rate changes.

We have therefore estimated the reduced form price equations derived from our model. All the predetermined variables in the model enter the reduced-form price equations, hence not only domestic costs - unit labor costs and unit price of basic materials - and competitors' prices, but also domestic and foreign income. Although two variables representing competitors' prices enter in each reduced form price equation - competitors' prices in the domestic market and competitors' prices in the foreign market - in order to save degrees of freedom we have introduced in each price equation only one competitors' price variable, hence implicitly assuming that foreign producers do not discriminate between the domestic and the foreign market. Our results appear in Tables 1A, 1B, and 1C.

The sample period was 1970:1 - 1976:4 for Germany, and 1968:1 - 1976:4 for Italy. A robust finding in each sector and in both countries - the only exception is NEM in Germany - is the evidence indicating that the response to changes in the domestic currency price of competitors' prices is higher for export than for domestic prices. More interesting however is the difference between the two countries, the elasticities being consistently lower in the case of Germany. As we have discussed in Chapter 2 the interpretation of these results, within the framework of our model, depends upon the characteristics of the demand functions in the two markets. If the demand functions are of the decreasing elasticity type, the finding that the response to changes in competitors'

prices is smaller for domestic than for export prices supports the intuition that demand on the foreign market is more elastic than domestic demand; the finding that the response is consistently smaller in the case of Germany suggests that German products have less close substitutes than Italian products in these categories. The latter result holds also when demand functions are of the constant elasticity type, provided the short-run marginal cost schedule is upward sloping. In this case however, differences, within each country, between the response of domestic and export prices could only be justified assuming that the adjustment does not take place instantaneously: under this assumption our results would indicate that the speed of adjustment to changes in competitors' prices is higher for export than for domestic prices. It should be noticed that the same conclusions about the difference in the speeds of adjustment would hold also in the decreasing elasticity case.

In the case of Germany the point estimates we obtained for the coefficient on competitors' prices in the export price equation - between .08 and .21 - are similar to the findings of Dornbusch and Krugman - .19, although not significantly different from zero. In the case of Italy the short-run elasticity with respect to competitors' prices is much higher and, except in the case of EM, the estimated coefficient is not statistically different from 1; our point estimates are also higher than the result obtained by Deppler and Ripley (1978) for the aggregate of manufactured goods - .44 (s.e., 10). In the case of Germany, attempts at finding a significant effect deriving from the

presence of a productivity trend were always unsuccessful; in the case of Italy this variable - defined as output per man-hour worked - is always significant and the coefficient has the sign predicted by theory.

In the case of Italy we also tested the hypothesis that the response of domestic and export prices was altered as a consequence of the transition to the system of "controlled floating", after Italy abandoned the "European snake" in February 1973. The parameters seem relatively stable, and performing a Chow-test, we were unable to reject the hypothesis that they had not changed over the sample periods 68:1 - 72:4 and 73:1 - 76:4.

Our findings allow the following conclusions about the mechanism of price formation in the exportables sector of the two countries:

- for Germany they seem to validate a price equation - both for domestic and export prices - much as that assumed by the Keynesian model, where prices are fixed in terms of the supplier's currency;

- for Italy they indicate that both domestic and export prices adjust rapidly to close any gaps that may originate from exchange rate changes;

- in both countries they suggest that export prices adjust more rapidly to changes in competitors' prices than domestic prices;

- finally, they are consistent with the presumption of a differentiated behavior of world demand for German and Italian products in these categories.

TABLE 1.A

THE RELATIVE ROLE OF DOMESTIC COSTS AND COMPETITORS' PRICES

DOMESTIC AND EXPORT PRICING

A. Non-Electrical Machinery

	GERMANY (69:1-76:4)		ITALY (68:1-76:4)		ITALY 73:1-76:4)	
	Domestic Price	Export Price	Domestic Price	Export Price	Domestic Price	Export Price
ep^*	.158*	.079*	.370	.836	.275	.649
	(.035)	(.031)	(.111)	(.104)	(.200)	(.145)
w	.601*	.718*	.284	.249	.385	.288
	(.126)	(.153)	(.078)	(.080)	(.140)	(.098)
π	--	--	-.117	-.131	-.163	-.384
			(.085)	(.089)	(.178)	(.136)
z	.150*	.198*	.150	.027	.219	.052
	(.020)	(.025)	(.049)	(.038)	(.044)	(.028)
y	-.077	.078	-.511	-.614	-.960	-.666
	(.073)	(.105)	(.299)	(.309)	(.785)	(.613)
y^*	.068	.034	.490	-.165	.454	1.02
	(.125)	(.161)	(.285)	(.264)	(1.04)	(.804)
c	1.14	2.80	1.42	2.112	1.78	-4.94
	(1.56)	(1.96)	(1.75)	(1.27)	(3.04)	(2.36)
$\hat{\delta}^*$	--	--	.883	.369	--	-.17
			(.080)	(.232)		(.25)
DW	2.10	2.26	1.78	1.74	1.71	2.39
R^2	.999	.999	.997	.996	.991	.995
S.E.R.	.0023	.0030	.0201	.0201	.0263	.0274

Sources: See Data Appendix, where w stands for monthly wages, π for a productivity trend, z for the price of basic materials, ep* for competitors' prices, y domestic income, y* foreign income, c a constant.

Estimation: OLS estimates except where a value for $\hat{\delta}^*$ appears which indicates estimation by Cochrane-Orcutt. Numbers in parentheses are standard errors.

*The coefficient is the sum of coefficients over 5 quarters; the standard error of the sum is in parentheses.

TABLE 1.B

THE RELATIVE ROLE OF DOMESTIC COSTS AND COMPETITORS' PRICES

DOMESTIC AND EXPORT PRICING

B. Electrical Machinery

	GERMANY (69:1-76:4)		ITALY (68:1-76:3)		ITALY (73:1-76:4)	
	Domestic Price	Export Price	Domestic Price	Export Price	Domestic Price	Export Price
ep^*	.052*	.204*	.419	.598	.281	.882
	(.075)	(.024)	(.082)	(.197)	(.085)	(.264)
w	.252*	-.036*	.189	.318	.240	.048
	(.061)	(.048)	(.047)	(.112)	(.052)	(.147)
π	--	--	-.117	-.373	-.115	.158
			(.059)	(.140)	(.091)	(.277)
z	.129*	.457*	.038	.031	.044	.105
	(.019)	(.012)	(.031)	(.075)	(.019)	(.051)
y	-.257	-.280	-.142	-.666	-.625	-1.90
	(.147)	(.116)	(.210)	(.501)	(.272)	(.852)
y^*	.199	.408	.110	.449	.947	.101
	(.201)	(.158)	(.188)	(.452)	(.335)	(1.14)
c	2.88	1.11	.846	-1.49	-.312	10.27
	(.167)	(.131)	(.721)	(1.77)	(1.56)	(4.91)
$\hat{\delta}^*$	--	--	.566	.623	--	--
			(.141)	(.134)		
DW	2.14	2.02	1.85	2.14	2.34	2.19
R^2	.998	.999	.995	.989	.997	.981
S.E.R.	.0029	.0023	.0139	.0294	.0105	.0314

Sources: See Data Appendix, where w stands for monthly wages, π for a productivity trend, z for the price of basic materials, ep* for competitors' prices, y domestic income, y* foreign income, c a constant.

Estimation: OLS estimates except where a value for $\hat{\delta}^*$ appears which indicates estimation by Cochrane-Orcutt. Numbers in parentheses are standard errors.

*The coefficient is the sum of coefficients over 5 quarters; the standard error of the sum is in parentheses.

TABLE 1.C

THE RELATIVE ROLE OF DOMESTIC COSTS AND COMPETITORS' PRICES

DOMESTIC AND EXPORT PRICING

C. Road Motor Vehicles

	GERMANY (69:1-76:4)		ITALY (68:1-76:4)		ITALY (73:1-76:4)	
	Domestic Price	Export Price	Domestic Price	Export Price	Domestic Price	Export Price
ep*	.103*	.210*	.562	.926	.512	1.04
	(.085)	(.053)	(.144)	(.116)	(.209)	(.236)
w	.396*	.975*	.373	.181	.348	.127
	(.264)	(.177)	(.091)	(.077)	(.155)	(.176)
π	--	--	-.105	.183	-.065	.204
			(.113)	(.101)	(.310)	(.231)
z	.280*	.159*	.079	-.064	.028	-.098
	(.064)	(.048)	(.055)	(.039)	(.049)	(.055)
y	-.176	.275	-1.32	-1.23	-2.69	-1.48
	(.175)	(.128)	(.454)	(.397)	(.927)	(1.05)
y*	.303	.018	.447	.825	2.39	.458
	(.259)	(.199)	(.400)	(.358)	(1.09)	(1.23)
c	1.55	6.15	3.44	3.68	2.09	7.70
	(1.88)	(2.05)	(1.62)	(1.38)	(3.77)	(4.26)
$\hat{\delta}$*	--	--	.444	--	--	--
			(.154)			
DW	2.14	1.93	1.66	2.15	2.03	2.21
R^2	.998	.999	.993	.994	.987	.982
S.E.R.	.0070	.0051	.0267	.0268	.0302	.0342

Sources: See Data Appendix, where w stands for monthly wages, π for a productivity trend, z for the price of basic materials, ep* for competitors' prices, y domestic income, y* foreign income, c a constant.

Estimation: OLS estimates except where a value for $\hat{\delta}$* appears which indicates estimation by Cochrane-Orcutt. Numbers in parentheses are standard errors.

*The coefficient is the sum of coefficients over 5 quarters; the standard error of the sum is in parentheses.

2.c Estimates of the structural parameters of the model: the price equations

Estimates of the two reduced form price equations allowed us to draw some preliminary conclusions about the short-run behavior of prices an output in the sectors we are studying. However, in order to better understand the mechanism of price formation and the response of prices to domestic and foreign demand and to competitors' prices, we need estimates of the structural parameters of our model. We have therefore estimated equations (9') and (10'), which are the structural price equations of our model if we assume constant elasticity demand functions. Although our previous results have shown this to be a quite restrictive assumption, no attempts were made, at this stage, at using less restrictive specifications. The model is identified, since a sufficient number of variables assumed predetermined in the model are excluded from each price equation. We shall first discuss the results obtained using a Two Stage estimation; we shall later discuss how these have improved estimating the complete model simultaneously.

In the estimation of (9') and (10') we have not assumed instantaneous adjustment of prices to factor costs, and we have therefore introduced short lags - 5 quarters in the case of Germany and 3 quarters in the case of Italy - on labor and material costs. Since our equations are derived from a restricted marginal cost function, they include both the level of output and the stock of capital. Under the assumption of a Cobb-Douglas technology, $X = \bar{K}^{a} \cdot L^{b} \cdot M^{c}$, the coefficients we are

estimating for these two variables are respectively (1/(b+c)-1) and a/(b+c), where constant returns to scale imply (b+c) < 1.

We shall first discuss our results for Germany - columns 1 and 2 of each Table: in this case, although it was possible to build a reliable series of quarterly observations on the capital stock [5/], we treated it as an error in the variables problem. For both NEM and RMV the adjustment of domestic and export prices to factor costs seems to be complete in 5 quarters: the sum of these coefficients in 1.05 and .85 for domestic prices and .83 and .87 for export prices - none is significantly different from 1. In both cases we found evidence of rising short-run marginal cost looking at either price equation. The results are less clear in the EM sector: the adjustment of domestic prices to factor costs seems much slower, and there is no evidence of a rising marginal cost effect. In the export price equation the fact that wages are insignificant and the presence of very high first-order serial correlation, while confirming the observed evidence of a different behavior of domestic and export prices, suggest that the price we observe might not be the relevant suppliers' price as it would be the case if in this sector institutional factors such as tax rebates to exporters had a stronger effect on contract prices than in the other sectors. This issue requires further investigation.

The estimation of our structural price equations were more complicated in the case of Italy, since no information was available on the stock of capital. The best alternative seemed to be the use of potential output as a proxy, and we constructed this series by use of

the Wharton peak-to-peak interpolation method: it should be noticed that the procedure we followed relies on the assumption that the following relation holds between the stock of capital and potential output: $\ln y^p_t = a + b \ln K_t + e_t$; under this hypothesis the use of y^p as a proxy in the price equation will introduce a bias in the constant term, while the estimated coefficient on capital will be divided by b, the constant elasticity of potential output with respect to the capital stock. One could notice however that after the introduction of potential output as a proxy for capital, our specification of the price equation is indistinguishable from a mark-up specification which assumes the mark-up be a function of capacity utilization. Under this hypothesis the coefficients on output and on potential output should be of opposite sign but equal in absolute value. We have estimated also this version of our price equations constraining the sum of the two coefficients to be equal to zero. Our results appear in the last four columns of Tables 2.A, 2.B, and 2.C. Following what we did in the reduced forms, we introduced a variable representing productivity defined as output per man-hour worked: under the hypothesis that the correct variable entering the price equation is unit labor cost, the coefficients on the wage rate and on productivity should be equal in absolute value. In the case of NEM the adjustment of prices to factor costs is complete in 3 quarters; this is also true for export prices of RMV, while domestic prices in this sector adjust slower; finally, in the case of EM, the speed of adjustment of domestic and export prices is approximately equal, but in neither case do we have full

TABLE 2.A

STRUCTURAL PRICE EQUATIONS

A. Non-Electrical Machinery

	GERMANY (70:1-76:4)		ITALY (68:4-76:4) UNCONSTRAINED		ITALY (68:4-76:4) CONSTRAINED	
	Domestic Price	Export Price	Domestic Price	Export Price	Domestic Price	Export Price
w	.864**	.590**	.602*	.724*	.609*	.581*
	(.219)	(.191)	(.078)	(.132)	(.082)	(.173)
π	--	--	-1.21*	.344*	-.743*	-.686*
			(.444)	(.755)	(.324)	(.698)
z	.182**	.232**	.315*	.285*	.321*	.317*
	(.093)	(.059)	(.039)	(.068)	(.040)	(.074)
K/capacity	-.506	-.043	-.226	-.837	--	--
	(.345)	(.333)	(.242)	(.387)		
Output	.134	.143	.685	-.835	--	--
	(.057)	(.050)	(.379)	(.641)		
Capacity gap	--	--	--	--	.271	.185
					(.262)	(.582)
c	4.49	.597	-12.3	10.53	-6.19	-5.61
	(2.97)	(2.76)	(5.05)	(8.34)	(2.99)	(6.38)
$\hat{\delta}^*$	--	--	.727	.527	.754	.926
			(.123)	(.153)	(.118)	(.068)
DW	2.02	1.98				
S.E.R.	.0053	.0062	.01150	.02153	.01186	.02299

Sources: See Data Appendix

Estimation: 2 SLS estimates except where a value for $\hat{\delta}^*$ appears which indicates estimates by Fain's method; where $\hat{\delta}^*$ does not appear after the estimation by Fain's method we could not reject the hypothesis of no first-order serial correlation in the residuals; numbers in parentheses are standard errors.

* Indicates the sum of coefficients over 3 quarters (the standard error of the sum is in parentheses)

** Indicates the sum of coefficients over 5 quarters (the standard error of the sum is in parentheses)

TABLE 2.B

STRUCTURAL PRICE EQUATIONS

B. Electrical Machinery

	GERMANY (70:1-76:4)		ITALY (68:4-76:4) UNCONSTRAINED		ITALY (68:4-76:4) CONSTRAINED	
	Domestic Price	Export Price	Domestic Price	Export Price	Domestic Price	Export Price
w	.477**	.070**	.429*	.569*	.451*	.552*
	(.124)	(.141)	(.117)	(.235)	(.090)	(.158)
π	--	--	-.918*	-1.041*	-.969*	1.102*
			(.463)	(1.092)	(.437)	(1.055)
z	.197**	.395**	.100*	.206*	.096*	.208*
	(.023)	(.061)	(.050)	(.117)	(.049)	(.107)
K/capacity	-.391	.321	-.445	-.615	--	--
	(.218)	(.283)	(.757)	(1.07)		
Output	.004	-.004	.623	.549	--	--
	(.050)	(.042)	(.416)	(1.04)		
Capacity gap	--	--	--	--	.662	.617
					(.410)	(.995)
c	5.56	-.903	-5.92	6.84	-5.55	-7.54
	(1.50)	(2.24)	(4.23)	(9.08)	(3.51)	(8.36)
$\hat{\delta}^*$	.270	.909	.895	.624	.880	.625
	(.185)	(.080)	(.080)	(.140)	(.085)	(.140)
S.E.R.	.0029	.0036	.0150	.0359	.0147	.0349

Footnotes: see Table 2.A

TABLE 2.C

STRUCTURAL PRICE EQUATIONS

C. Road Motor Vehicles

	GERMANY (70:1-76:4)		ITALY (68:4-76:4) UNCONSTRAINED		ITALY (68:4-76:4) CONSTRAINED	
	Domestic Price	Export Price	Domestic Price	Export Price	Domestic Price	Export Price
w	.580 **	.626 **	.505 *	1.063 *	.532 *	.803 *
	(.444)	(.486)	(.210)	(.320)	(.250)	(.209)
π	--	--	-.134 *	-.280 *	.280 *	-.140 *
			(.206)	(.322)	(.497)	(.346)
z	.270 **	.250 **	.213 *	-.012 *	.196 *	.092 *
	(.130)	(.104)	(.078)	(.147)	(.98)	(.119)
K/capacity	-.164	-.298	-2.50	-.542	--	--
	(.539)	(.632)	(1.17)	(.622)		
Output	.041	.162	-.037	.066	--	--
	(.023)	(.036)	(.161)	(.267)		
Capacity gap	--	--	--	--	-.241	.013
					(.166)	(.298)
c	2.37	2.99	13.1	-.205	1.53	-.657
	(4.30)	(5.03)	(5.1)	(2.81)	(2.19)	(2.99)
$\hat{\delta}^*$	-	-	.96	.54	.94	.66
			(.105)	(.15)	(.06)	(.13)
DW	2.8	2.2				
S.E.R	.006	.001	.0089	.0425	.02372	.0412

Footnotes: see Table 2.A

adjustment in 3 quarters. The estimated coefficients on productivity have the correct sign but are rather unstable and have large standard errors; in no case could we reject the hypothesis that the coefficient was equal, in absolute value, to the coefficient on wages. The evidence in favor of a short-run rising marginal cost function is much weaker than in the case of Germany. Our results however should be taken cautiously, since they rely on an approximate construction of the index of potential output. There is some evidence of rising short-run marginal cost in both NEM and EM, although the result is stronger in the domestic than in the export price equations. Constraining the coefficients on output and potential output to be equal the standard errors decrease, though not enough to make the estimated coefficients different from zero. No conclusions on the slope of the marginal cost function may be drawn in the case of RMV.

3. Effective Exchange Rate, Relative Prices and Competitiveness

3.a Effective exchange rate and competitiveness

Our results up to now indicate that for the group of commodities we are considering export prices remain sensitive to domestic costs, hence not simply matching competitors' prices, as would be required by the LOOP. The result is particularly strong in the case of Germany where short-run movements in the exchange rate are likely to produce proportionate changes in competitiveness, while, in the case of Italy, we would expect competitiveness to be little affected by short-run fluctuations of the exchange rate. The issue becomes evident looking at Tables C1, C2 and C3 which show the behavior of the effective

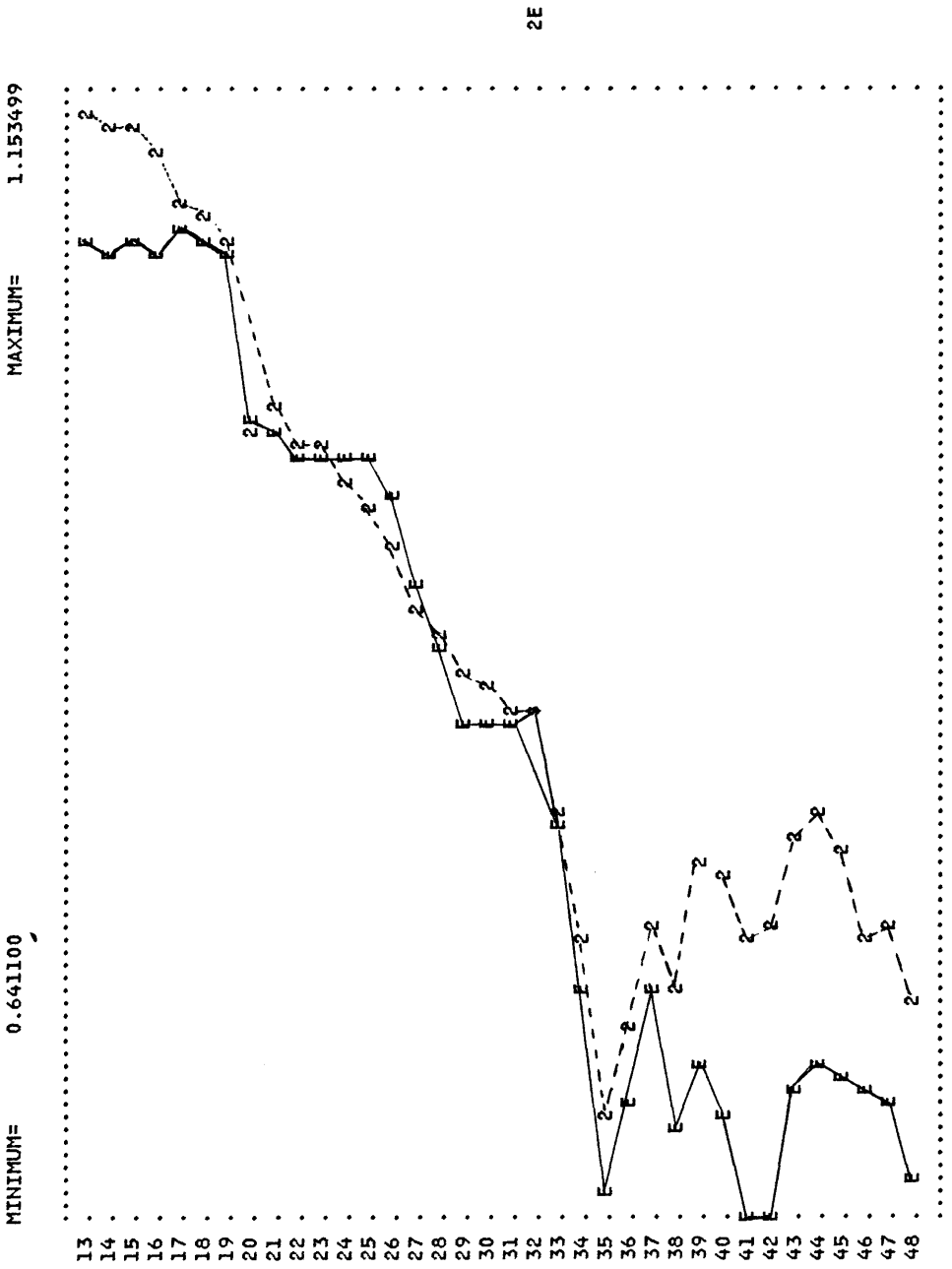
EFFECTIVE EXCHANGE RATE AND RELATIVE PRICES

GERMANY 1968:1 - 1976:4

Sector: Non-Electrical Machinery

Index Numbers:1970=1.00

Eff.E. : ———
Rel.P. : - - - -



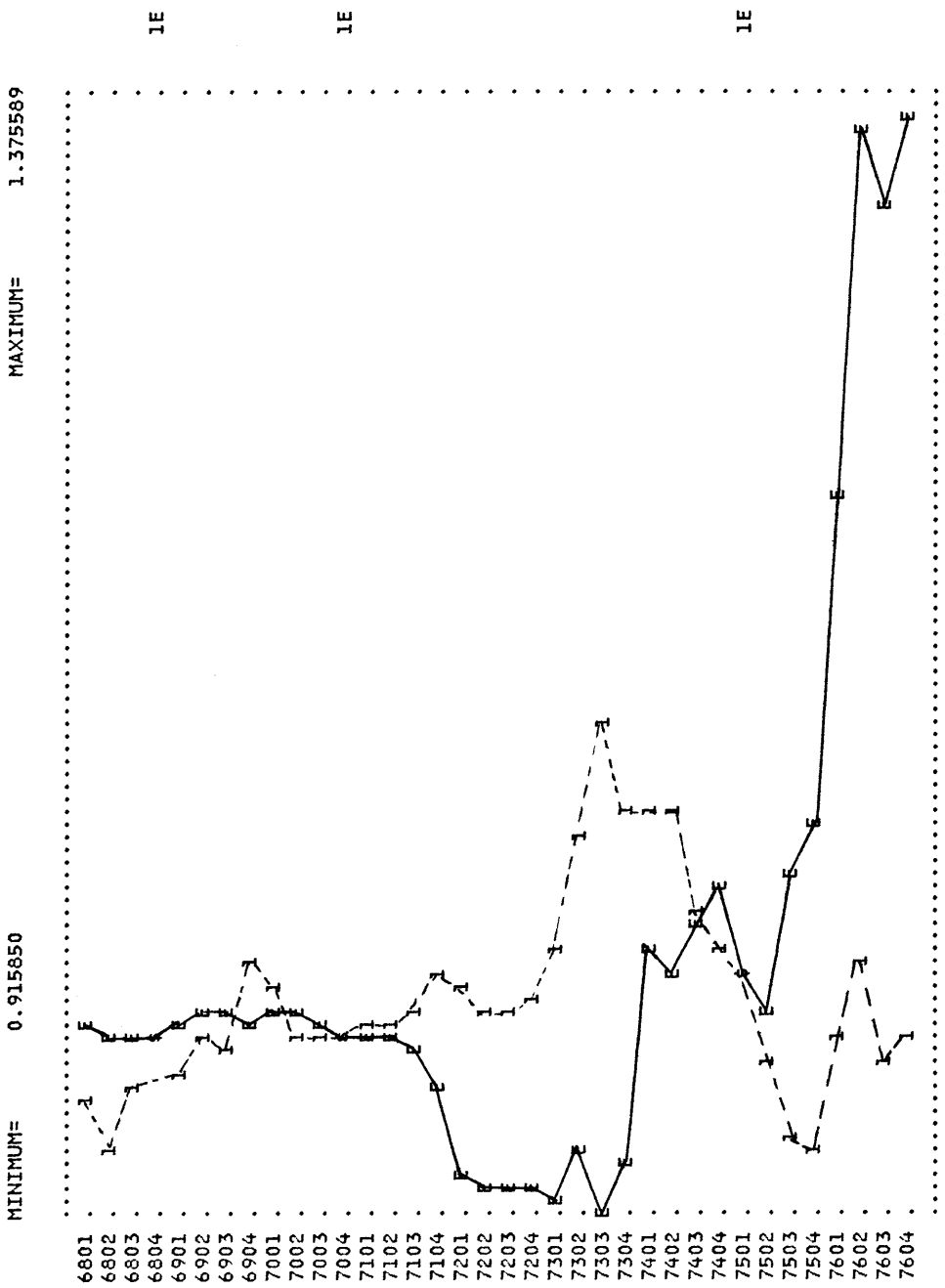
EFFECTIVE EXCHANGE RATE AND RELATIVE PRICES

ITALY 1968:1 - 1976:4

Sector: Non_Electrical Machinery

Index Numbers: 1970=100

Eff.E. : _____
REL.P. : - - - - -



EFFECTIVE EXCHANGE RATE AND RELATIVE PRICES

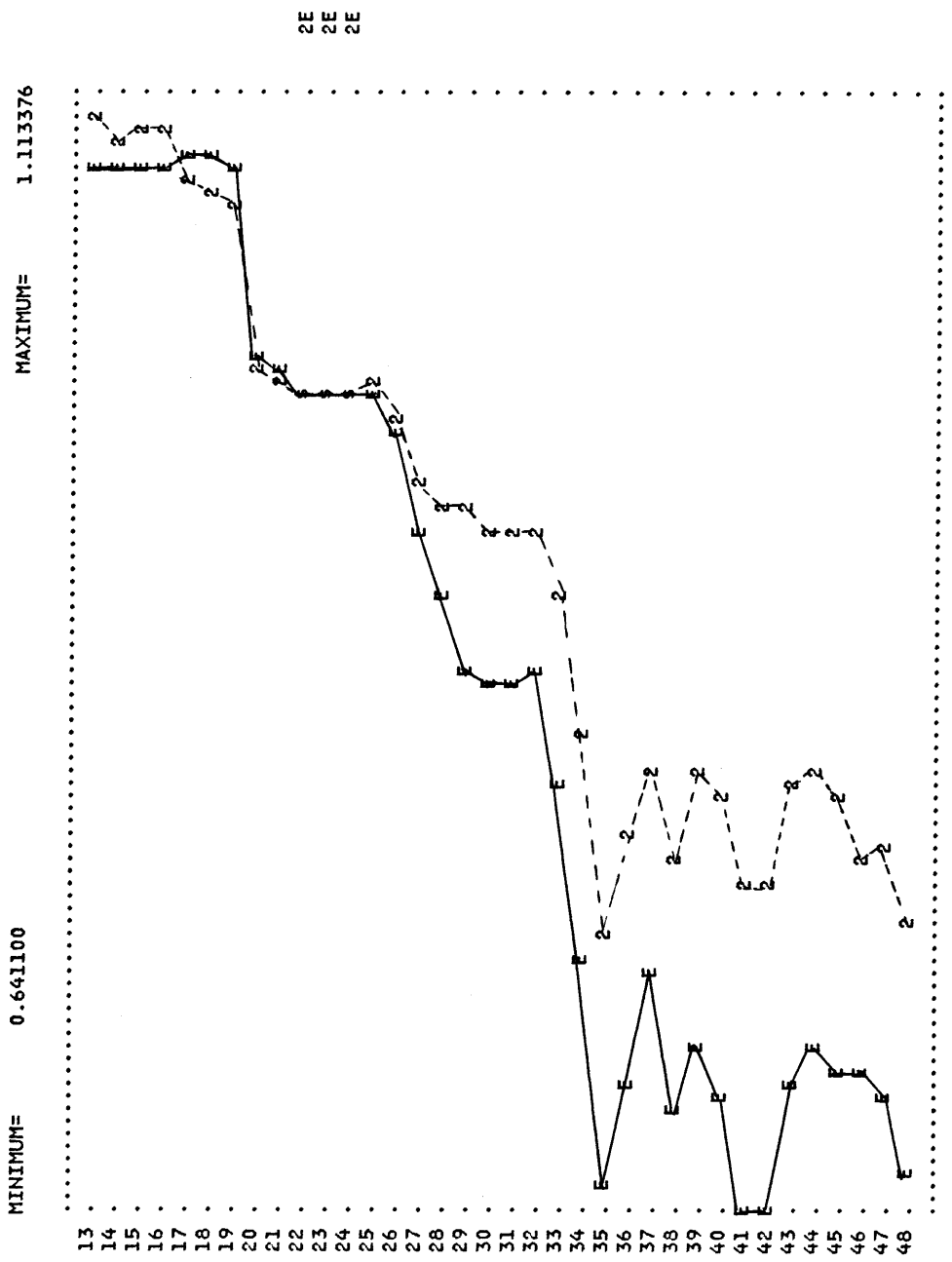
GERMANY 1968:1 - 1976:4

Sector: Electrical Machinery

Index Numbers 1970=1.00

Eff.E. :_____

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EFFECTIVE EXCHANGE RATE AND RELATIVE PRICES

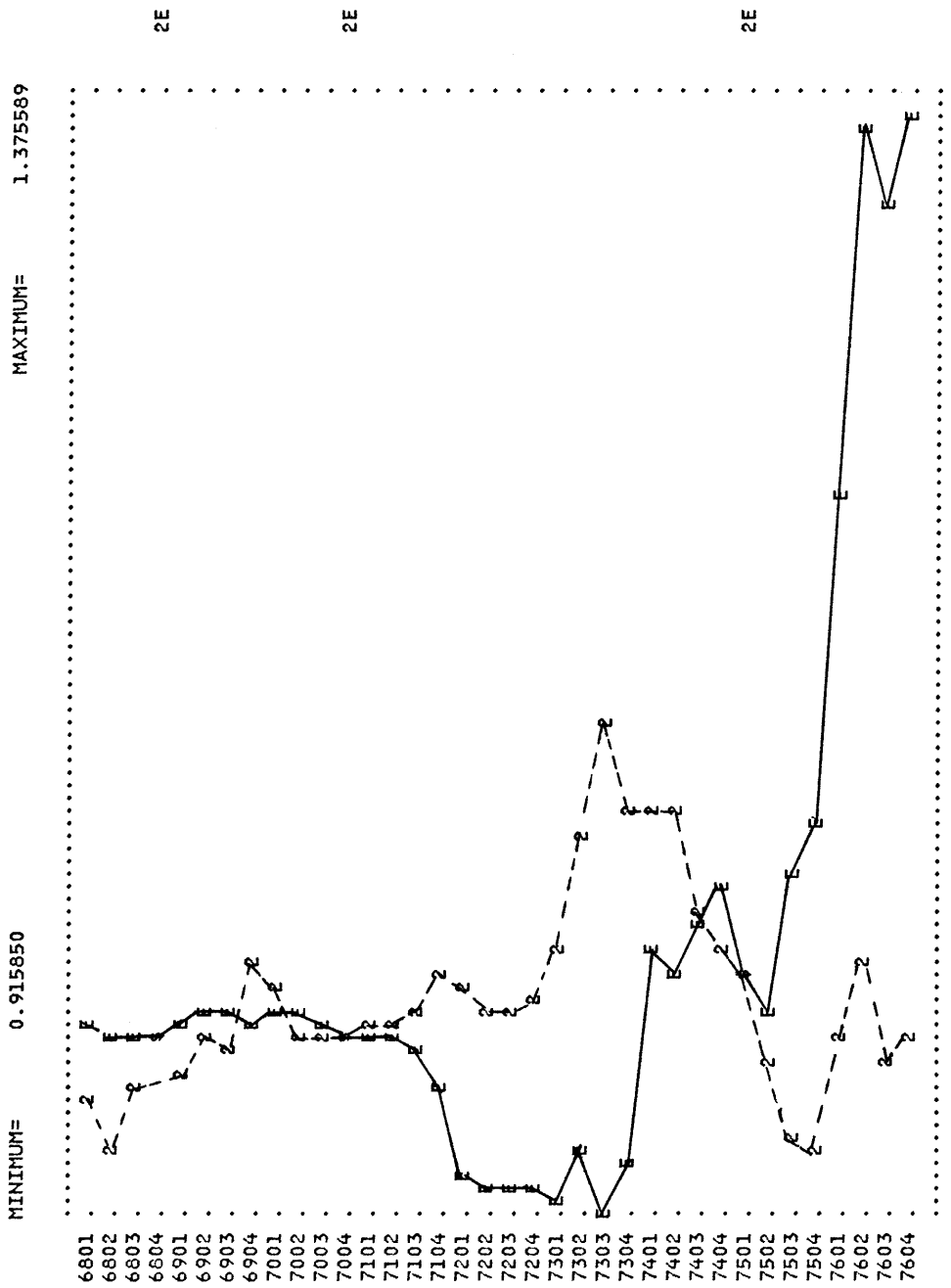
Italy 1968:1 - 1976:4

Sector: Electrical Machinery

Index Numbers: 1970= 100

Eff.E. : _____

Rel,P. : _ _ _ _



EFFECTIVE EXCHANGE RATE AND RELATIVE PRICES

GERMANY 1968:1 - 1976:4

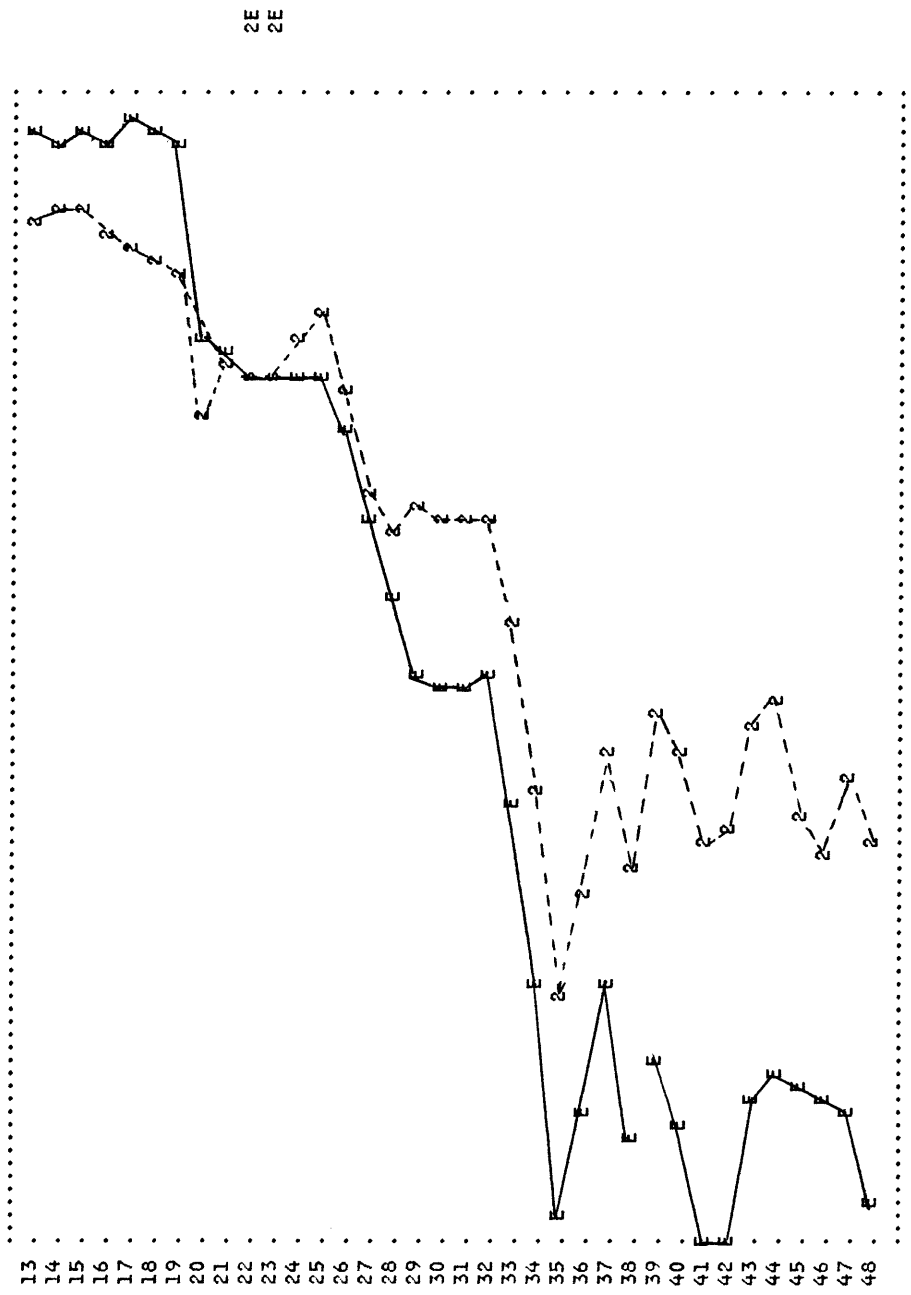
Sector: Road Motor-Vehicles

Index Numbers 1970=1.00

Eff.E. :_____

Rel.P. : - - - - - -

POINTS EXCEEDING THE SCALE OF THE GRAPH AND POINTS WHERE TWO OR MORE VARIABLES HAVE THE SAME VALUE WILL BE PLOTTED WITH ($). THE VARIABLE CONCERNED WILL BE INDICATED ON THE FAR RIGHT HAND SIDE OF THE GRAPH.



EFFECTIVE EXCHANGE RATE AND RELATIVE PRICES

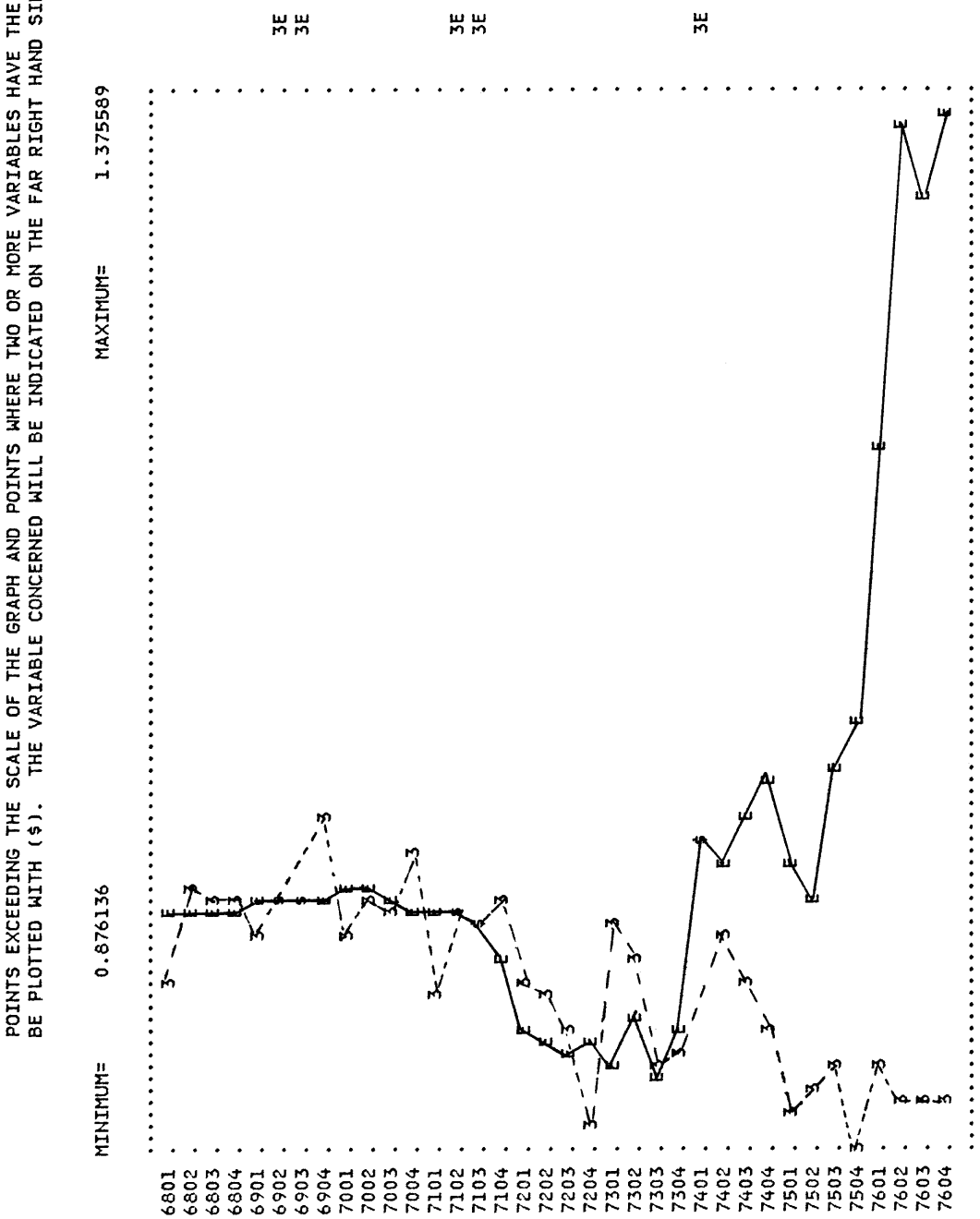
ITALY 1968:1 - 1976:4

Sector: Road Motor-Vehicles

Index Numbers: 1970=100

Eff.E. : ———

Rel.P. : - - - - -



exchange rate index and of a relative price index over the period 1968-1976. The effective exchange rate index measures the domestic currency price of a basket of foreign currencies, while the relative price index is defined as the ratio of competitors' prices on the foreign market to the Country's export prices, both expressed in the same currency.[6]

In the case of Germany, in all sectors, the constant revaluation of the mark between the end of 1969 and the third quarter of 1973 was accompanied by a progressive loss of competitiveness. Following 1973 the transition to a system of floating rates and the consequent fluctuations in the effective exchange rate were still accompanied by parallel, though more dampened, fluctuations in the index of competitiveness.[7] In the case of Italy exchange rate movements seem to have had relatively little impact on competitiveness: in all sectors--even if the effect is less pronounced in the case of RMV--there is evidence of a loss of competitiveness between the end of 1973 and the end of 1975, which was followed by the large devaluation of the Lira in January, 1976; in both the EM and NEM sectors the devaluation restored the pre-1973 levels of competitiveness, while in the case of RMV the effects of the devaluation seem dampened by the presence of a downwards trend in the index of competitiveness.[8]

Finally, taking a broader time perspective, it should be pointed out that the later changes in competitiveness which have occurred especially in Germany, do not seem to have altered significantly the Country's long-run share of total OECD exports. Between 1968 and 1975 Germany's loss of

SHARE OF EXPORTS IN TOTAL EXPORTS OF OECD COUNTRIES

		NEM	EM	RMV
Germany	1968	23.0%	18.5%	22.7%
	1975	22.8%	19.3%	20.4%
Italy	1968	7.2%	6.6%	5.9%
	1975	6.8%	6.0%	6.0%

competitiveness in each of the sectors we are considering amounted to approximately 30%, but except in the case of RMV, this does not seem to have affected export shares. In Italy the observed fall in export shares of machinery may depend on the fact that in both sectors our index of competitiveness reach its lowest level in 1975; in the case of RMV the negative trend in the index of competitiveness does not seem to have affected export shares.

3.b Competitiveness and trade flows in the exportables sector.

The path is now set to try to answer the central question of this paper: to what extent do short-run fluctuations in the exchange rate affect trade flows? Since there is evidence that in the sectors we are considering exchange rate movements have at least some effect on competitiveness, we now intend to investigate the response of trade flows--in our case export flows--to changes in competitiveness. Following the implications of our model we have estimated both the foreign and the domestic demand for exportables. The estimates which appear in Tables 3.A, 3.B, and 3.C, although consistent, since we used as instruments all the

variables assumed exogenous in our model, are still inefficient since they do not explicitly take into consideration the information contained in the variance-covariance matrix of the residuals.

Since the main interest of this paper is in studying the short-run impact of exchange rate changes on export flows, we used throughout very short lags--3 to 5 quarters. Looking first at the foreign demand functions:

(i) in all cases--except for NEM in Germany, but also this result will confirm our present findings when we shall use a more efficient estimation technique--we found evidence of a relatively low short-run income elasticity, ranging between .7 and 1.4;

(ii) the evidence on the short-run relative price elasticity is mixed and varies considerably across sectors and Countries:

- the sector of NEM, the largest in terms of total volume of exports, provides the only stable results: the short-run relative price elasticity is significant and of the same magnitude in both Countries. This finding, while confirming that--at least in this sector--short-run changes in competitiveness do affect export flows, is puzzling since from the results we obtained in the estimation of the reduced form price equations--namely the estimates of the response of export prices to changes in competitors' prices--we had expected the relative price elasticity to be higher in the case of Italy. Once again, however, our presumption will turn out to be correct when we shall use a more efficient estimator;

- for EM, in the case of Italy the price elasticity is significant and of the same magnitude as in the previous sector, while the short-run

TABLE 3.A

STRUCTURAL DEMAND EQUATIONS

A. Non-Electrical Machinery

Foreign Market

	GERMANY (70:1-76:4)	ITALY (68:4-76:4)
Relative Prices	.955*	.804***
	(.386)	(.348)
Foreign Income	2.29*	1.000
	(.48)	(.085)
c	-6.65	4.08
	(2.20)	(.400)
D694	--	-.166
		(.066)
DW	1.63	1.90
S.E.R.	.044	.0597

Domestic Market

	GERMANY (70:1-76:4)	ITALY (68:3-76:4)
Relative Prices	2.72*	1.375**
	(.674)	(.693)
Domestic Income	2.37*	2.14
	(.768)	(.549)
c	-6.37	3.396
	(3.53)	(2.768)
$\hat{\delta}^*$	.545	.726
	(.161)	(.118)
S.E.R.	.036	.080

Footnotes on page 66.

TABLE 3.B

STRUCTURAL DEMAND EQUATIONS

B. Electrical Machinery

Foreign Market

	GERMANY (70:1-76:4)	ITALY (68:4-76:4)
Relative Prices	-1.198*	.760***
	(.416)	(.356)
Foreign Income	.718*	1.39**
	(.432)	(.191)
c	.008	.560
	(1.99)	(.905)
D694	--	-.198
		(.091)
$\hat{\delta}^*$	.030	--
	(.192)	
DW		1.40
S.E.R.	.027	.085

Domestic Market

	GERMANY (70:1-76:4)	ITALY (68:4-76:4)
Relative Prices	-.039*	-.269***
	(.385)	(.481)
Domestic Income	1.125*	1.638**
	(.344)	(.434)
c	-.557	5.27
	(1.57)	(2.16)
$\hat{\delta}^*$	.497	.522
	(.167)	(.148)
S.E.R.	.017	.062

Footnotes on page 66.

TABLE 3.C

STRUCTURAL DEMAND EQUATIONS

C. Road Motor Vehicles

Foreign Market

	GERMANY (70:1-76:4)	ITALY (68:4-76:4)
Relative Prices	.348*	-1.54***
	(.670)	(1.07)
Foreign Income	1.15*	.727
	(.83)	(.337)
c	-1.58	3.80
	(3.8)	(1.55)
D694	--	-.198
		(.139)
$\hat{\delta}$*	.260	--
	(.052)	
DW		1.80
S.E.R.	.065	.126

Domestic Market

	GERMANY (70:1-76:4)	ITALY (68:4-76:4)
Relative Prices	3.181*	1.997**
	(1.33)	(.571)
Domestic Income	2.321*	.742***
	(1.21)	(.324
c	6.46	9.63
	(5.64)	(1.63)
$\hat{\delta}$*	.388	.268
	(.145)	(.167)
S.E.R.	.071	.098

Footnotes on page 66.

FOOTNOTES TO TABLES 3.A, 3.B and 3.C

Source: See Data Appendix; D694 is a dummy variable used in the export equations for Italy to correct for the fall in exports due to the strikes in the 4th quarter of 1969.

Estimation: 2 SLS estimates except where a value appears for $\hat{\delta}^*$ which indicates estimate by Fain's method.

* Indicates the sum of coefficients over 5 quarters.

** Indicates the sum of coefficients over 2 quarters.

*** Indicates the sum of coefficients over 3 quarters.

elasticity of foreign demand for German exports has the wrong sign: it is doubtful, however, that in this case the index of relative prices that we used is a good measure of competitiveness, and no conclusions may be drawn until further work is done disaggregating the sector into its three main components: power generating machinery, telecommunication equipment and domestic electrical appliances;

- in the case of RMV the short-run relative price elasticities are not significantly different from zero in either Country; in the case of Italy the point estimate has the wrong sign.[9]

On the domestic market:

(i) income elasticities tend to be higher than in the foreign demand for exportables, with the exception of RMV in Italy;

(ii) for RMV and NEM the relative price elasticity is also higher than in the foreign demand function. Once again, however, for EM we find insignificant relative price elasticities.

These results should not be thought of as disappointing: on one side they point to one of the reasons--mainly aggregation bias--why it is often very difficult to find significant short-run elasticities for the aggregate manufacturing sector in these two Countries; on the other side the results we obtained for NEM, the largest sector, confirm recent empirical findings by J. Artus and S. Soza (1978), who have limited their investigation to SITC cathegory 71.[10]

4. Full Information Estimation of a Model of the Determination of Prices and Output in the Exportables Sector

We finally attempted at improving the estimates of the structural parameters explicitly taking into account a major characteristic of our

model, which is represented by the simultaneity, arising from its short-run nature, between the behavior of prices and output in each market and across the two markets. In what follows we shall discuss how our results have improved upon our previous findings.

In the case of Germany we estimated the model for NEM and RMV; our results in the case of EM indicated the possibility of a misspecification in the export price equation and/or the foreign demand function: if this was true, use of a simultaneous equations estimator would have spread the specification error throughout the other equations of the model. Simultaneous equations estimation allows us to impose cross-equations restrictions: the two implied by our model were on the coefficients of capital and output in the domestic and foreign price equations, which we imposed throughout. However, given the number of parameters we were estimating--44 in the case of Germany--we had the choice either to extend the sample period or to impose additional restrictions. We followed the second procedure and our results should be considered very preliminary. In the estimates we present in Table 4 we imposed the additional restriction of an identical pattern of adjustment of domestic and export prices to factor costs. Although this constraint appears ex-ante very restrictive, when we estimated the model over the extended period 1966-1976, we were not able to reject the hypothesis that the two adjustment patterns were equal.[11] In the sector of NEM our FIML results in general confirm and improve our previous findings.[12] The explicit introduction of the information contained in the variance-covariance matrix of the residuals provides us with a clear gain in efficiency which reinforces some crucial results:

(i) We find clearer evidence in favor of a short-run rising marginal cost function, a crucial link in our model, between the behavior of prices and output in the short run.

(ii) Price and income elasticities in both the foreign and domestic demand functions drop in magnitude.

- The foreign price elasticity drops from .955 with a s.e. of (.386) to .12 with a s.e. of (.035). This point estimate not only is statistically more significant but corrects a puzzle about the magnitude of the short-run price elasticity which had arisen in the TSLS results.

- The domestic relative price elasticity drops from 2.72 to 1.76.

- The domestic and foreign income elasticities drops from 2.37 to 1.96 and from 2.29 to 1.02, respectively.

In the case of Road Motor Vehicles our previous finding which indicated the absence of a short-run relative price elasticity on the foreign market is confirmed; domestic demand is also confirmed to show very high income and relative price elasticities.

Finally we return to the hypothesis of price discrimination performing a formal test of the hypothesis that, in these two sectors firms discriminate between the domestic and the foreign market. Given the assumption of constant elasticity demand functions in each market, and of a Cobb-Douglas technology, the presence of price discrimination would imply different constant terms in the structural domestic and export price equations--as it appears if we look at equations (9') and (10'). In terms of the structural parameters of our model, the two constants are:

TABLE 4

GERMANY: FULL INFORMATION ESTIMATION OF A CONSTRAINED VERSION OF THE MODEL, 1969:1-1976:4

	Non-Electrical Machinery			Road Motor Vehicles		
	Coefficient	Standard Error	t-Stat.	Coefficient	Standard Error	t-Stat.
C_0	1.35	.71	1.90	3.98	.739	5.39
C_1	1.34	.71	1.90	3.99	.739	5.39
$\bar{K}$	.165	.086	1.91	-.39	.093	4.20
Output	.182	.022	8.14	.093	.011	8.24
Σ Wages	.440	.06	7.33	.700	.077	9.09
Σ Materials	.312	.022	13.92	.253	.031	8.161
C_2	-4.56	1.84	2.50	-11.11	2.43	4.6
Σ RPD	1.76	.300	5.87	3.621	.710	5.1
Σ y	1.96	.400	4.90	3.320	.532	6.24
C_3	0.759	1.09	.70	-4.100	2.11	1.95
Σ RPF	.17	.035	4.86	.655	.437	1.50
Σ y*	1.02	.238	4.29	1.70	.459	3.70
$\ell n\ L$ = 364.12				$\ell n\ L$ = 310.12		

Four quarters free lags were used whenever a Σ symbol appears.

TABLE 4'

FACTOR COST ADJUSTMENT IN AN UNCONSTRAINED VERSION OF THE MODEL

Germany: 1966-1976 for Non-Electrical Machinery
1968-1976 for Road Motor Vehicles

	Non-Electrical Machinery				Road Motor Vehicles			
	Domestic Market		Foreign Market		Domestic Market		Foreign Market	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
MW	.212	.059	.207	.055	.189	.063	-.090	.114
MW_{-1}	.174	.068	.147	.063	.216	.070	.118	.153
MW_{-2}	-.110	.066	-.066	.062	.037	.069	.075	.150
MW_{-3}	.036	.064	.048	.061	.098	.054	.349	.170
MW_{-4}	-.049	.052	-.064	.049				
PBM	.081	.077	.023	.069	-.050	.067	.169	.142
PBM_{-1}	.188	.152	-.137	.136	.209	.136	.086	.290
PBM_{-2}	.583	.177	.474	.159	-.097	.147	-.388	.297
PBM_{-3}	-.492	.155	-.404	.140	.229	.085	.483	.149
PBM_{-4}	.457	.079	.403	.073				

MW: Monthly wages

PBM: Unit price of basic materials

$$c_0 \cong \ell n\ a_1 - \frac{1}{\beta+\gamma}\ \ell n\ A\ ;$$

$$c_1 \cong \ell n\ a_2 - \frac{1}{\beta+\gamma}\ \ell n\ A\ .$$

The hypothesis of price discrimination is rejected for both sectors.

In the case of Italy we estimated the model for NEM and EM. Throughout we imposed the constraint that the coefficients on output and potential output be equal in absolute value, though allowing the coefficient to be different in the domestic and in the export price equation. We have also allowed for a different pattern of adjustment of domestic and export prices to changes in factor costs. Our results appear in Table 5.

- The use of a more efficient estimator reinforces our previous findings in the demand equations: the point estimates of the short-run elasticity with respect to relative prices are stable, but the standard errors are consistently smaller. Only in the case of the domestic demand for EM there is no evidence of a significant short-run relative price elasticity.

- The evidence on a positive response of domestic and export prices to capacity utilization is still very weak; with the only exception of the domestic price of NEM--notice, however, that in the same sector there is no similar evidence in the export price equation. In the case of EM the point estimates for domestic and export prices are almost identical and both have the correct sign, but none of them is significantly different from zero.

TABLE 5

ITALY: FULL INFORMATION ESTIMATION (3SLS) OF THE COMPLETE MODEL OF THE DETERMINATION OF PRICES AND OUTPUT IN THE EXPORTABLES SECTOR: 1968-1976

	Non-Electrical Machinery			Road Motor Vehicles		
	Coefficient	Standard Error	t-Stat.	Coefficient	Standard Error	t-Stat.
C_0	-3.95	2.70	1.46	-.577	5.17	.112
C_1	-.236	.446	.529	-6.07	3.03	2.00
Σ Wages d.	.632*	.115	5.48	.304 *	.123	2.47
Σ Wages e.	.582*	.167	3.48	.608*	.097	6.28
Σ Prod. d.	-.999*	.433	2.31	-.370*	.918	.403
Σ Prod. e.	-.400*	.658	.608	-1.50*	.732	2.06
Σ Mater. d.	.329*	.063	5.25	.234*	.099	2.36
Σ Mater. e.	.300*	.072	4.18	.157*	.069	2.29
c. Gap d.	.995	.327	3.04	.815	.767	1.06
c. Gap e.	.002	.545	.004	.774	.679	1.14
C_2	4.41	.374	11.8	1.01	.761	1.32
Σ Rel. P.f.	.759*	.262	2.90	.553 *	.245	2.26
Σ y*	.929	.079	11.74	1.29**	.162	7.95
D 69:4	-.178	.050	3.54	-.212	.073	2.88

TABLE 5 CONTINUED

	Non-Electrical Machinery			Road Motor Vehicle		
	Coefficient	Standard Error	t-Stat.	Coefficient	Standard Error	t-Stat.
C_3	3.43	1.65	2.07	4.14	1.37	3.03
Σ Rel. P.d.	.696**	.319	2.18	-.571*	.312	1.83
Σ y	1.34	.393	3.40	1.57**	.232	6.75
$\hat{\rho}_1$	.533	.174	3.06	.273	.376	.726
$\hat{\rho}_2$	.926	-	-	.435	.203	2.15
$\hat{\rho}_3$	(D.W.=2.06)	-	-	(D.W.=1.45)	-	-
$\hat{\rho}_4$	.538	.129	4.18	.262	.163	1.61

$\hat{\rho}_1$, $\hat{\rho}_2$, $\hat{\rho}_3$, and $\hat{\rho}_4$ are the estimates of the first-order antecorrelation coefficient. In the export price equation for NEM we imposed the consistent estimate of $\hat{\rho}_2$ obtained using Fair's method; in all other cases we estimated ρ simultaneously with the other parameters of the model. In the foreign demand functions we were unable to reject the hypothesis of serially independent errors.

*Indicates that the coefficient is the sum of three quarters free lags.

**Indicates that the coefficient is the sum of two quarters free lags.

5. Conclusions

In Chapter 2 we have developed a theory of the short-run behavior of prices and output in the open economy. The main characteristics of the model are:

1) the aggregate price and output equations for the exportables sector are derived by explicitly considering the microeconomic foundations of the profit-maximizing decisions of a firm operating in an open economy;

2) as a consequence of (1) prices and output are determined simultaneously within the model from the interaction of the domestic and the foreign market;

3) the link between the two markets rests on the assumption of a short-run rising marginal cost schedule;

4) the reduced form domestic and export price equations provide microfoundations for the specification of a price equation which includes competitors' prices in the domestic and in the foreign market as independent variables. The reduced form coefficients of competitors' prices in the two price equations depend on the specification of the two demand functions: we show that in the case of decreasing elasticity demand functions, the response to changes in competitors' prices is smaller for the price charged in the market in which demand is more inelastic.

We have used our model to study the behavior of prices and output in three industries of the German and Italian manufacturing sector:

1) our findings in the reduced form price equations allow the following conclusions about the mechanism of price formation in the exportables sector of the two countries:

- for Germany they seem to validate a price equation, both for domestic and export prices, such as that assumed by the Keynesian model, in which prices are fixed in terms of the supplier's currency;

- for Italy they indicate that both domestic and export prices adjust rapidly to close any gaps that may originate from exchange rate changes;

- in both countries they suggest that export prices adjust more rapidly to changes in competitors' prices than domestic prices.

2) Estimates of the structural price equations provide, in the case of Germany, clear evidence of a rising short-run marginal cost schedule, thus calling for the simultaneous treatment of the domestic and the foreign market: the effect is particularly clear when we use a full-information estimator. The evidence is much weaker in the case of Italy.

3) Consistently with our results in the reduced form price equations, in the case of Germany, short-run fluctuations of the exchange rate tend to cause proportionate changes in relative prices on competitiveness, while in the case of Italy their effect on relative prices is dampened by the rapid response of both domestic and export prices. Evidence on the short-run response of export flows to changes in relative prices is consistent with the presumption of a differentiated behavior of world demand for German and Italian products in these sectors. Our results in the case of Germany confirm the persistence of the finding of very low short-run (allowing for lags up to five quarters) elasticities with respect to relative prices. The findings are different in the case of Italy, where (with the exception of RMV) we found relative price elasti-

cities not significantly different from 1.0 with lags of only three quarters.

4) We report mixed evidence on the international equalization of prices: with respect to the law of one price applied within one country, in the case of Germany for both NEM and RMV, performing a specific statistical test we were not able to reject the hypothesis of equalization of domestic and export prices; there seems to be evidence of price discrimination in the case of EM, although we were unable to perform a specific test. In the case of Italy, except for NEM, we found clear evidence of a different behavior of domestic and export prices, although the use of unit values does not allow for definite conclusions. With respect to the law of one price applied across Countries, the implication of our results is the rejection of the monetarist proposition that export prices simply match competitors' prices, irrespective of factor costs: the finding is true also in the case of Italian products, although for these goods we found that prices adjust very rapidly to match changes in the price of competing goods.

The combined behavior of the response of export prices to competitors' prices and of foreign demand to changes in relative prices, in sectors which represent over 50% of total exports of manufactures in each country, point in two different directions:

- in the case of Germany, an appreciation of the exchange rate, although deteriorating the country's competitive position, will have a small effect upon the volume of exports, so that, at least in the short run, results strongly suggest the possibility of a short-run J-curve;

- in the case of Italy, the evidence seems to suggest that following a depreciation of the currency, export prices will increase rapidly, so that gains in competitiveness will be short-lived. In the short run, however, there is evidence of a significant response of foreign demand to changes in relative prices, in two of the three sectors studied. Our findings, therefore, suggest a "correct" response of the trade balance--at least on the exports side--to changes in the exchange rate, even in the relative short run (one year).

DATA APPENDIX

Prices

Producers' and export prices for Germany, net of taxes, were taken from Source A. Both series were corrected to take into accout the effect on prices of the introduction of the value added tax in 1968. For competitors' prices on the domestic market we used import prices (Source A). In order to build competitors' prices on the foreign market we first considered separately the eight most relevant foreign markets for German exports of machinery and road vehicles: US, UK, France, Switzerland, Belgium, Netherlands, Austria, Italy, and the "less developed" countries. On each market we built an index of competitors' prices considering the country's main foreign suppliers - except Germany - and domestic producers: foreign suppliers prices (export prices where available, producers' prices where not, all from national sources) were weighted among them by import shares, and then weighted with domestic producers' prices by the share in total sales. The indices built for the eight markets were then weighted by the shares of German exports.

For Italy, domestic wholesale prices and export and import unit values were the only price indices available. Wholesale prices (from Source B) were corrected to take into account the change in the weights with which different commodities enter the market (1971), and the effect of the introduction of the value-added tax (1973). Moving-weight indices of export and import unit values are from Source B. In order to avoid the problems deriving from the use of unit values,

the index of competitors' prices in the domestic market was constructed using foreign producers' prices weighted by import shares. The index of competitors' prices in the foreign market was constructed using the same procedure as in the case of Germany.

Wages and Productivity

For Germany we used monthly contract wages of all employees in the specific sector, Source A. For Italy we used average monthly earnings inclusive of all allowances, Source C.

For Italy the index of productivity was constructed using the ratio of the index of industrial production in each sector (Source B) to the index of hours worked; the latter was constructed using information on average hours worked per worker and on total employment in each sector, both from Source C.

Price of Basic Materials

For both Countries we used the domestic wholesale price index of basic materials, from Source A and B respectively.

Capital

For Germany, disaggregated estimates of the capital stock appear in Source D, at intervals of five years. Using these estimates and data on investment (Source E), we were able to calculate the implicit rates of depreciation. The captial stock series was then built combining the estimates of the capital stock with the series of net investment.

For Italy, the series of potential output, which we used as a proxy for capital under the assumptions explained in the text, were constructed using the indices of industrial production from Source B.

Sales

For Germany an index of sales on the domestic and the foreign market at constant prices was built deflating nominal sales (net of taxes) (Source A) with producers' and export prices. For Italy quarterly data on sales are available only after 1973. Neglecting inventory accumulation we therefore used the index of industrial production in the sector as a proxy for total sales at constant prices. Separate estimates of sales on the domestic and the foreign market were constructed subtracting the value of exports (Source B) from an estimate of total nominal sales. The latter was built combining the index of industrial production in the sector with yearly information on the value of sales (Source F).

Domestic and Foreign Activity

For Germany industrial production was used as a proxy for the domestic activity variable. In Italy we used domestic real GNP. An index of foreign activity was built using industrial production in the eight countries considered in building competitors' prices. As a proxy for activity in the LDC's, we used industrial production in India, South Africa, Venezuela, Greece, Yugoslavia, Israel and South Korea, from Source G.

Exchange Rates

Exchange rates used in building the effective exchange rate index were taken from Source H.

LIST OF SOURCES

Source A: Statistiches Bundesamt Wirtschaft und Statistik Verlag.

Source B: ISTAT, Bollettino Mensile di Statistica.

Source C: CONFINDUSTRIA, Rassegna di Statistiche del Lavoro.

Source D: Deutsches Institut fur Wirtschaftsforschung, Bulletin.

Source E: Deutsche Bundesbank,Bulletin.

Source F: ISTAT, Annuario di Statistiche Industriali.

Source G: U.N., Monthly Bulletin of Statistics.

Source H: I.M.F., International Financia- Statistics.

FOOTNOTES TO CHAPTER 3

1. The industry producing Machinery and Transport Equipment corresponds to SITC category 7, and the three components to SITC categories 71, 72, and 73, respectively; the restriction of Transport Equipment to only Road Motor Vehicles corresponds to SITC category 732. Category 71 includes power generating machinery, agricultural machinery, office machinery, metalworking machinery, textile machinery, and machinery for special industries. Category 72 includes electrical power machinery, equipment for distributing electricity, telecommunications apparatus, domestic electrical equipment, electrical apparatus for medical purposes and other electrical machinery. For the correspondence between the SITC classification and the data available from the national sources, see the Data Appendix.

2. The shares refer to 1975.

3. Tables B1, B2, and B3 show price and unit value indices with base 1970 = 100. These indices can therefore only show differences in the rates of change, not in the level of domestic and export prices.

4. For a derivation of equations (13') and (14)' see Appendix A to Chapter 2.

5. For a description of the method used to build the capital stock series, see the Data Appendix.

6. In order to build competitors' prices on the foreign market we first considered separately the eight most relevant foreign markets for Italian and German products in these categories: U.S., U.K., France, Belgium, Switzerland, Netherlands, Austria, LDC's and alternatively Italy or Germany. On each market we built an index of competitors' prices considering the country's main foreign suppliers and domestic producers: foreign suppliers' prices (export prices where available, producers' prices where not) were weighted among them by import shares, and then weighted with domestic producers' prices using the share of imports over total sales on the domestic market. Finally the indices built for the eight markets were weighted by the share of exports of Italy or Germany towards each market. Direct export shares were used to build the effective exchange rate index.

7. This result, although consistent with our findings in the reduced form price equations, disagrees with the conclusions of Dornbusch and Krugman (see D. and K., 1976, p. 562). Our approach, however,

differs in three respects: (i) their results cover all manufactured goods; (ii) they use export unit values also in the case of Germany, while we use export contract prices; (iii) they build their relative price index using bilateral trade shares which may be a strongly biased index of competitiveness: for example, if trade flows between Germany and Japan are relatively small, this would downwards bias the role of Japanese goods as competitors in the world market. The same point has been made by W. S. Salant in the General Discussion of the paper by Dornbusch and Krugman (see D. and K., 1976, p. 583).

8. It should be noticed, however, that in the case of cars, competitiveness should be measured in terms user cost rather than of market selling price. No attempts were made in this direction, and this may explain the wrong sign we obtained in the point estimate of the relative price elasticity in the volume of exports equation. Our index of relative prices is likely to underestimate the competitiveness of Italian cars (usually of small dimensions and relatively efficient) whose relative user cost has decreased as an effect of the increase in the price of oil.

9. This may depend on our choice of the index of competitiveness, which does not consider user cost (see previous footnote). Me tried to correct this result using an ad hoc dummy variable, under the hypothesis that the relative user cost of Italian road motor vehicles decreased after the increase in the price of oil: the dummy was set to 1 starting in 1974:2 and is equal to zero elsewhere. The point estimate of the coefficient on this new variable is positive as expected; the estimate of the relative price elasticity improves only slightly (the sign is still wrong):

Relative Prices on the Foreign Market	Foreign Income	c	D694	DOIL	D.W.	SER
-.834***	.597	4.41	-.237	.107	1.89	.115
(1.070)	(.314)	(1.45)	(.129)	(.068)		

10. Artus and Soza investigate the effects of relative prices on exports of non-electrical machinery for the U.S., U.K., and Germany. Their results indicate that the substitution elasticities between Germany and U.K. products and between German and U.S. products may be lower than the elasticity between U.S. and U.K. products. Their point estimate of the long run (with lags up to three years) own price elasticity is -.50 (s.e. .12) for German goods, -2.13 (s.e. .39) for British goods and -1.06 (s.e. .20) for U.S. goods. They estimate the substitution elasticities between German, U.S. and U.K. products in three different markets: the EEC countries, the rest of OECD countries and the developing countries; the following are their estimates of the short-run (one to four quarters) own and cross-price elasticities of German products:

Elasticities (Short-run)

Exports to	Own	Subst. With U.K.	Subst. With U.S.
EEC	-.138	.056	.082
	(.039)	(.022)	(.032)
Other OECD	-.032	.009	.023
	(.068)	(.024)	(.064)
Devel. Count.	.000	.000	.000
	(.106)	(.042)	(.097)
Total of Three Markets	-.070	.027	.043
	(.017)	(.015)	(.027)

Although their results are not directly comparable with ours (both because we estimate the substitution elasticity between German products and products of all other major exporters in this category, and because we estimate the lag response introducing five free lags), they point in the same direction. Notice in particular that their point estimates of the cross-price elasticities for the aggregate of the three markets, are very close to the estimate we have obtained when estimating our model using a full-information estimator: .17 (s.e. .035). We both use consistent estimators; our estimator is more efficient (see the discussion and the results in Section 4 of this chapter).

11. See Table 4'.

12. For a complete description of the FIML estimator, see Berndt, Hall, Hall, and Hausman, 1974. Notice also that contrary to the procedure followed in the TSLS estimation, in FIML we have not treated the capital stock series as measured with error, because of lack of degrees of freedom; this omission may explain the wrong sign of the coefficient on capital in the sector of NEM. For a discussion of errors in variables in simultaneous equations models, see Hausman, 1978.

13. In the case of Italy we used a Three Stage Least Square Estimator.

CHAPTER 4

IS THE U.S. INCOME ELASTICITY OF DEMAND FOR IMPORTS REALLY "SURPRISINGLY HIGH"?

1. This paper makes an attempt at clarifying an issue which has[1/] recently been the cause of some concern in the area of international trade. The disturbing result is the apparent persistence of Houthakker and Magee's[2/] empirical finding that the income elasticity of demand for U.S. imports is substantially higher than that of demand for U.S. exports. Recent empirical findings by Humphrey (1976) suggest that the same is true in the case of U.K. imports, particularly for imports of finished manufactures[3/]. The persistence of this result is troublesome since, as Houthakker and Magee have pointed out, a country with a high income elasticity of demand for imports and a relatively lower income elasticity of demand for its exports is constrained to grow at a slower rate than its trading partners, if it is to maintain external balance.

Some authors[4/] have recognized that the result may depend on an incorrect specification of the import demand function which, if correctly specified, should include variables representing changes in foreign producers' capacity together with variables representing capacity in the domestic import-competing industry. Gregory (1971) has formalized and successfully implemented the use of nonprice rationing variables to capture the impact on U.S. imports of cyclical fluctuations in domestic supply conditions that are not adequately reflected in

relative price movements. The results obtained when imports are disaggregated according to area of origin give a hint towards the effect on imports of changes in foreign suppliers' capacity; recent results by G. Grossman[5/] indicate that at least for a number of commodities, the income elasticity of imports from LDC's is consistently higher than for imports from DC's. Looking at the specific commodities[6/], one discovers that the result is particularly strong wherever the LDC's have benefited from the spread of technology which has accompanied extraordinary increases in capacity. A common result is that the inclusion of a time trend as a proxy for foreign capacity always reduces the estimated income elasticity. This approach, however, fails to recognize that the foreign supply function is often an excess-supply function as foreign producers may allocate their output between their home market and different foreign markets. In the short run, an increase in domestic demand in the suppliers' country will shift output towards that market, therefore reducing the total volume of exports. Relative changes in demand among different foreign importers will similarly be reflected in changes in relative export flows.

In this paper we try to incorporate all of these characteristics in a simple model of the demand and excess-supply of imports which assumes as a starting point our previous results on the behavior of firms operating in the exportables sector. The plan of the paper is as follows. In Section 2 we develop a model of the demand and excess-supply functions for imports. In Section 3 we use our model to investigate the response of U.S. imports of a specific category of

steel products to changes in U.S. domestic activity. The empirical findings support the predictions of our model; we show in particular that, at least for this specific group of commodities, disturbingly high estimates of the income elasticity of U.S. imports are essentially the result of mispecified equations.

2. There are two goods which are close substitutes. One is produced at home, the other is imported [7/]. Domestic demand for the foreign good - the import demand function - is a function of the price of the foreign good relative to the home good and of a domestic activity variable. Assuming a log-linear specification:

$$(1) \qquad x_2 = b_o + b_1(p_1 - e - p_2^*) + b_2 y$$

where:

x_2 is the log of domestic demand for the foreign good,

p_1 is the log of the price of the home good,

$e + p_2^*$ is the log of the domestic currency price of the foreign good,

y is the domestic activity variable.

Producers of the foreign good may sell it either at home or abroad. Since we are primarily interested in customer goods, and consistently with our previous discussion of the behavior of a firm which operates in the exportables sector of an open economy, we assume that in each market they operate under conditions of imperfect competition, facing

downward sloping demand schedules;we also assume,for simplicity, that our home country is the only "foreign market" for foreign producers,and that the two markets are separated,at least in the short run,in the sense described in chapter 2 [8/].In the short run, and in the absence of uncertainty,foreign suppliers will maximize profits allocating their output between the two markets so as to equate marginal revenue in each market to marginal cost of total output. Given our import demand function (1) and assuming a constant elasticity specification for the demand function in the home market of foreign producers [9/],the optimal allocation of output to our market may be derived from the reduced form of the model we developed in chapter 2,and has the following form:

$$(2)\quad x_2 = g_o + g_1 y + g_2 p_1 - g_3 y^* - g_4 p^* + g_5 \psi(\bar{K}^*) - g_6 \phi(w^*, z^*) \quad [10/].$$

Equation (2) is the flow of imports to our domestic market. Notice that since we have not assumed perfect competition,there is no such thing as an excess-supply function,and therefore the flow of imports cannot be determined by consistent estimates only of the parameters of the demand function. In (2) the flow of imports is determined by the amount of the exportable good that foreign producers will allocate to our market,given the demand functions in our market and in their home market,so as to maximize profits.

In (2) imports are function of three distinct elements:

(i) the exogenous variables entering the domestic import demand function: domestic activity and the price of home goods;

(ii) the exogenous variables entering the demand for exportables in the suppliers' domestic market; and

(iii) the exogenous variables entering the suppliers' marginal cost function: the stock of capital, assumed constant in the short-run, wages and the unit price of basic materials.

An increase in domestic activity or in the relative price of import-competing goods will increase imports via a price and a substitution effect respectively. An increase in foreign suppliers' capacity shifts the short run supply schedule and increases output allocated to each of the markets, while an increase in wages or in the unit price of basic materials has the opposite effect. An increase in domestic activity in the home country of foreign suppliers or an increase in the relative price of goods competing with the exportables on the same market will shift the allocation of output away from our market. The same will be the effect of an increase in domestic activity or in the relative price of competing goods in other "foreign markets". Finally, notice that the response of imports to shifts in the foreign supply function and in the demand functions in other markets will be higher, the higher the relative price elasticity of domestic demand for the imported good [11/].

Equation (2) provides microfoundations for an imports function which includes suppliers' capacity and foreign activity. Omission of either independent variable will bias the estimated coefficient of domestic activity. The direction of the bias depends on the sign of the coefficient of the omitted variable and on its correlation with domestic activity: either a positive correlation between domestic activity and the exogenous variables in the foreign supply schedule,or a negative correlation between domestic and foreign activity will upwards bias the estimated income elasticity. If the prevailing effect is an upwards bias,our theory predicts that the inclusion of both variables in the import function should reduce the estimated income elasticity,and that imports should respond positively to an increase in foreign capacity and negatively to an increase in foreign relative to domeastic activity. Next we provide some empirical evidence on these propositions.

3. As we have observed in Section 1.,the disaggregation of U.S. imports of manufactures between imports from DCs and LDCs shows that income elasticities are much higher in the case of LDCs. We have argued that this result may depend on the omission of a variable which represents shifts in the foreign supply function: the bias may be particularly serious in the case of imports from LDCs,in sectors which have experienced extraordinary increases in capacity. We have therefore chosen,for our empirical example,a specific sector within U.S. imports of manufactures, which has been characterized by very large increases in capacity among the major LDC suppliers,and in which LDCs represent a relevant share

of the U.S. imports. The choice of steel products was suggested by observing the rate of growth of steel production in the major U.S. suppliers over the past ten years (see Table 1). Among steel products (SITC categories 672 through 678) we decided to choose a specific group of commodities in which the share of LDCs over total U.S. imports has substantially increased over the last ten years (see Table 2): the choice was schedule A category 6786005,i.e. welded steel pipe tubes of small diameter which,in 1977,represented 5.1% of total U.S. imports of iron and steel products. Over the period considered Japan supplied about one half of total imports of these commodities,while the remaining share shifted almost entirely from EEC countries -mainly Germany,France and the U.K. (Italy was the only EEC country to maintain a relevant share)- to a small group od LDCs.

We estimated various specifications of the U.S. import function for these commodities using quarterly data for the period 1968:4 - 1977:4,and disaggregating imports according to the main areas: LDCs, EEC countries plus Canada,and Japan. Our results appear in Table 3.

We first estimated by OLS the common import demand function (see for instance Houthakker and Magee,1969),which implicitly assumes a perfectly elastic foreign supply function.As a proxy for the activity variable we used alternatively total income in the U.S. (real GNP) and the relevant component of income: total investment in construction at constant prices. For the price of home produced competing goods

we used the wholesale price index of pipes and tubes in the U.S.: notice that the reliability of this variable depends upon the share of imports over total sales in the domestic market (see Table 2), since the wholesale price index covers all transactions that take place in the domestic market,hence including sales from importers. For the price of imported goods we used the unit value of imports. The relevant finding (see equations 1,2,4 and 5 in Table 3) is the persistence of Houthakker and Magee's result of a very high income elasticity of the demand for imports: even when we used,as activity variable,the relevant component of GNP the point estimates of the income elasticities for imports from LDCs are always above 3.0 . Notice that following recent discussions in the literature (see for instance G.Grossman,1978), in the estimation of the simple import demand function,we have not imposed homogeneity of degree zero in prices.Estimates of the cross price elasticity between imported and import competing goods have always the sign predicted by theory,while attempts at estimating the cross price elasticity between imports from different countries,in the case of LDCs resulted in the doubtful finding that LDC and Japanese products in this sector were complementary goods.

Next we have estimated equation (2) which explicitly considers the simultaneous effect upon the flow of imports of domestic and foreign demand and foreign supply. In the case of LDCs,no direct information was available on the exogenous variables entering the supply function:

we used potential output of steel [12] as a proxy for the stock of capital,and prices -unit values of imports to the U.S.- as a proxy for domestic costs [13]. Notice that since unit value of imports is a proxy for domestic costs in the supplying countries,and hence enter (2) with a different coefficient from competitors' prices, we have not constrained the coefficients on this variable and on the price of home produced competing goods to be equal in absolute value. Equation (2) predicts that an increase in foreign relative to domestic demand will shift the allocation of output away from our market and hence reduce the flow of imports. This prediction implies a negative coefficient for the response of the flow of imports to an increase in foreign activity.In the case of LDCs we have assumed that all goods produced are exported: the relevant foreign activity variable was therefore built using a weighted average of industrial production in the major foreign markets for the LDCs,except the U.S. (Canada, Japan and the EEC). The prediction of our model is confirmed in each of the estimated equations: the elasticity of imports with respect to a decline in foreign demand is particularly high in the case of LDCs: this result may depend upon the shift towards the U.S. market of the allocation of LDCs exports which followed the introduction of import restrictions in the EEC.In the case of U.S. imports from the EEC,Canada and Japan,the effect is still significant,but the elasticity is lower. Notice that the introduction of the foreign activity variable

lowers significantly the estimated response of the flow of imports to domestic activity:when both cross price effects are introduced (equation 7),the estimated elasticity is not significantly greater than 1.0 .

Finally we tested the hypothesis that cyclical fluctuations in domestic supply conditions result in non-price rationing practices -increase in domestic waiting times,worsening of credit conditions,etc.- which go beyond their effect on relative prices. As a proxy for domestic demand pressure we used deviations of output from potential output in the U.S. industry producing pipes and tubes. In the case of imports from LDCs,this excess-demand effect is significant and reduces the response of import flows to domestic activity.

Throughout we used one lag on the activity variables,both domestic and foreign,three free lags on the U.S. domestic price variable and four free lags on unit value of imports. This last choice is consistent with our previous discussion of the relation between contract prices and unit values (see chapter 3) .

The effect of U.S. dock strikes is taken into account using,rather than a simple dummy variable,a correction for the deviation of import flows from the level at which import flows "would have been in the absence of strikes", as estimated by Isard (1975). The estimation technique used was OLS or Cochrane-Orcutt,for the import equations from LDCs,and TSLS for the import equations from Japan and the EEC plus Canada. Notice that only in the latter case we have attempted to correct for the simultaneity introduced using unit values as a proxy for the foreign cost variables.

The lesson from our example is the following:

- estimates of the common import demand function show the persistence ot the finding of a very high elasticity of import flows from LDCs with respect to domestic activity in both its definitions ;
- the correct specification of the import equation (equations 3 and 6) results in:

(i) a significant reduction in the income elasicity;

(ii) a response of import flows to changes in foreign capacity which is significant and confirms our predictions;

(iii) a response of import flows to the U.S., to demand conditions in the other major foreign markets for the LDCs which is also high and significant and confirms our predictions;

(iv) attempts at testing for the presence of non-price rationing effects (equation 8) provide the best results: import flows respond positively to domestic demand preassure,and when this factor is explicitly

taken into account, the short run income elasticity is significantly smaller than 1.0;

- the response of import flows to foreign demand is significant also in the case of imports from Japan and the EEC plus Canada. In this case however domestic demand pressure seemed to have no effect on imports[14/];

- the income elasticity in the correctly specified equations for U.S. imports from the EEC + Canada is not significantly different from 1.0, while in the case of imports from Japan the estimated elasticity has the wrong sign and is not significantly different from zero.

TABLE 1

Growth of steel production in major LDCs suppliers and in Japan (index numbers 1968=100)

	South Korea	Taiwan	Mexico	Japan
1968	100	100	100	100
1969	100	97	106	123
1970	129	121	118	140
1971	126	122	116	132
1972	158	223	135	145
1973	310	221	143	178
1974	519	372	155	175
1975	542	417	159	153
1976	726	672	157	161
1977	777	730	165	153
1978:I	1068	-	195	145

Source: U.N. Monthly Bulletin of Statistics, except for Taiwan, American Iron and Steel Institute, Annual Report, various issues.

TABLE 2

Share of Major Suppliers in Total U.S. Imports, Category 6786005[1]

	S.Korea	Taiwan	Mexico	Other LDC[2]	Total LDC	Japan	Canada	EEC	Others
1968	-	.85	3.1	3.7	7.7	54.5	1.3	32.6	4.0
1977	19.7	6.7	8.2	2.3	36.9	42.1	9.1	9.7	2.1

[2] Brazil, Argentina, India, Yugoslavia.

Source: U.S. Department of Commerce, Bureau of the Census, FT135, U.S. General Imports, Schedule A Commodity by Country, various issues.

[1] Pipes tubes and blanks therefor, steel, welded, not alloyed, not over 4.5 inches in out diameter (5.1% of total imports of iron and steel products in 1977.

Share of Imports in Total Sales in the Domestic Market

	imports	sales of domestic producers
1968	17.6%	82.4%
1977	33.0%	77.0%

TABLE 3

Reduced Form Imports Equations* by Areas: 1968:4 - 1977:4

U.S. Imports of Schedule A category 6786005.

		ΣP_{LDC}	ΣP_{us}	ΣP_{DC}	ΣACT_{us}	ΣACT^*	K_{LDC}	C gap$_{us}$	C	Strike d.	Summary Statistics SER	$\hat{\rho}^*$	DW
Imports from LDC; ACT_{us}: Real GNP.	(1)	-.272	.454		7.30				-49.8	1.31	.229	.44	1.64
		(.486)	(1.68)		(1.97)				(10.8)	(1.16)		(.15)	
	(2)	-.100	.954	-.355	6.81				-49.6	1.35	.212	.67	1.45
		(.212)	(.806)	(1.23)	(1.75)				(10.3)	(1.19)		(.12)	
	(3)	-1.310	.220		2.70	-5.53	2.40		9.94	.95	.180		1.98
		(.370)	(.680)		(1.27)	(2.30)	(.651)		(12.2)	(1.36)			
Imports from LDC; ACT_{us}: Real Investment in Construction	(4)	-.683	3.150		3.54				-24.5	1.35	.220	.67	1.96
		(.668)	(.827)		(1.79)				(7.88)	(1.04)		(.12)	
	(5)	-.491	2.750	-.210	3.40				-31.25	1.27	.212	.67	1.45
		(.502)	(.985)	(.432)	(1.18)				(6.64)	(.96)		(.12)	
	(6)	-.450	.747		2.832	-5.36	1.94		12.96	3.10	.198	-.33	2.00
		(.254)	(.504)		(1.56)	(2.45)	(.546)		(9.17)	(1.49)		(.15)	
	(7)	-.080	.215	-.190	1.29	-2.72	1.57		9.1	.75	.173	-.38	1.90
		(.801)	(.450)	(.522)	(.631)	(1.15)	(.617)		(12.7)	(1.62)		(.15)	
	(8)	-1.130	.260		.390	-5.88	2.49	1.40	26.6	1.61	.164	-.38	2.25
		(.346)	(.490)		(.146)	(1.99)	(.471)	(.419)	(8.4)	(1.33)		(.15)	
Imports from Japan; ACT_{us}: Real Investment in Construction	(9)	1.35	1.07	-2.74	-1.49	-2.28	.48		16.3	4.74	.150		2.20
		(1.34)	(1.53)	(1.20)	(1.51)	(.860)	(.22)		(10.6)	(1.78)			
Imports from EEC; ACT_{us}: Real Investment in Construction	(10)	1.311	1.237	-2.50	1.70	-2.32			-3.55	4.54	.408		1.30
		(1.05)	(.822)	(2.15)	(.923)	(1.21)			(26.8)	(3.38)			

Footnotes to Table 3:

* Estimation: equations 1 through 8: OLS estimates, except where a value for $\hat{\rho}$* appears, which indicates estimates corrected for first order serial correlation using the Cochrane-Orcutt technique. Equations 9 and 10: TSLS estimates; the instrument used was real GNP in the exporting countries.

Definition of variables:

P_{LDC} : unit value of imports from LDCs;

P_{us} : U.S. wholesale price index for a comparable category of commodities, Burreau of Labor Statistics, Wholesale Price and Price Indeces, various issues;

P_{DC} : unit value of imports from Japan;

ACT_{us} : activity variable for the U.S. as specified on the first column on the left;

ACT* : index of industrial production in other major markets to which the supplying country exports this commodities; in the case of Japan and the EEC plus Canada, this variable takes into account also demand in the home market of foreign production.

K_{LDC} : potential output of steel in the LDCs, except for equation 9, where the variable used was potential output of steel in Japan;

$C\ gap_{us}$: deviations of output from potential output in the U.S. industry producing pipes and tubes;

C : constant;

Strike d. : stike correction variable, as defined in the text.

FOOTNOTES TO CHAPTER 4:

1. See, for instance, Hooper (1978).

2. Houthakker and Magee (1969).

3. For imports of finished manufactures, the point estimates of the income elasticity, using annual data for the period 1955-1972, range between 3.10 (s.e. .41) and 4.57 (s.e. .33).

4. Most recently, Hooper (1978).

5. G. Grossman (1978).

6. For example, iron and steel products, television receivers and typewriters.

7. Since we are primarily interested in customer goods, we assume that foreign goods and domestic import-competing goods are imperfect substitutes. If they were perfect substitutes, as in the case of auction goods, the import demand function would be an excess-demand function and the "law of one price" would hold. It should be noticed that while in the case of imperfect substitutes domestic supply of the import-competing good enters the import demand function only via the substitution effect, an excess-demand function directly depends on all the variables assumed exogenous in the domestic demand and supply functions.

8. The results we obtain are easily extended to the case in which foreign producers face many different foreign markets, among which ours is only one. In this case the foreign excess-supply function would include prices and activity variables in all the other markets and not only in the home market of foreign suppliers.

9. We assume that the demand function for the foreign good in the suppliers' home country has the form:

$$x_1 = a_o + a_1(p^* - p_1^*) + a_2 y^*$$

where x_1 is the log of demand for the foreign good in the suppliers' home country,

p^* is the price of goods competing with exportables in the suppliers' home country,

p_1^* is the price of exportables in the same market,

y^* is the activity variable in the suppliers' home country.

We also assume that firms operating in the exportables sector of the foreign country have a short run restricted marginal cost function of the following form:

$$MC_s = \ell \cdot X^{\ell-1} \cdot \psi(\bar{K}^*) \cdot \phi(w^*, z^*)$$

For the derivation, see Chapter 2.

11 . Notice that the assumption of constant elasticity demand functions in both markets implies that in (2) the coefficients of the activity and relative price variables in the home market of foreign suppliers depend upon the slope on the short run marginal cost schedule, and they are both equal to zero for $\ell=1$, i.e., if the short run marginal cost function is flat. This however is only a special case which depends on the fact that with constant elasticity demand functions price and marginal cost only differ by a constant term. See Chapter 2 for a discussion of the results in the case of different specifications of the domestic and foreign demand function.

12 . The index of potential output was built by peak-to-peak interpolationof an index of industrial production of steel in each of the countries.For the problems associated with using this variable as a proxy for the stock of capital,see our discussion in chapter 3. The indeces of potential output for each of the LDCs were then weighted using import shares.

13 . This may be the most critical assumption,since it reintroduces an endogenous variable,prices,in (2) which is a reduced form and should therefore include only exogenous variables.The choice,although causing serious econometric problems which were only partially solved,allows for a comparaison of our results with the common estimates of import demand functions,which include activity and relative prices as independent variables.

14 . These equations were omitted from Table 3.

10 . Where,in terms of the parameters of the supply function and the domestic and foreign demand functions,the coefficients have the following interpretation:

$$x_2 = \frac{1}{\Delta}\left\{ b_2\left[1 + a_1 k_1 (\ell - 1)\right]y + b_1\left[1 + a_1 k_1 (\ell - 1)\right] p_1 + \right.$$

$$\left. - b_1\left[k_1 (\ell - 1)(a_2\ y^* + a_1\ p^*) + c_0 + \psi(\bar{K}^*) - \phi(w^*, z^*)\right]\right\}$$

where $\Delta = 1 + (\ell - 1)(a_1 k_1 + b_1 k_2) > 0$,

and k_1 and k_2 are the sample means of x_1 and x_2 respectively.

Notice that the response of the flow of imports to changes in domestic activity coincides with the domestic income elasticity only if there is no interaction between the domestic and the foreign markets,which,in our model coincides with the case of a perfectly elastic supply function. If foreign supply is not perfectly elastic,the response will also depend on the slope of the supply function and on the elasticity of demand in the other markets.

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