

The impact of the exchange rate on Germany's balance of trade

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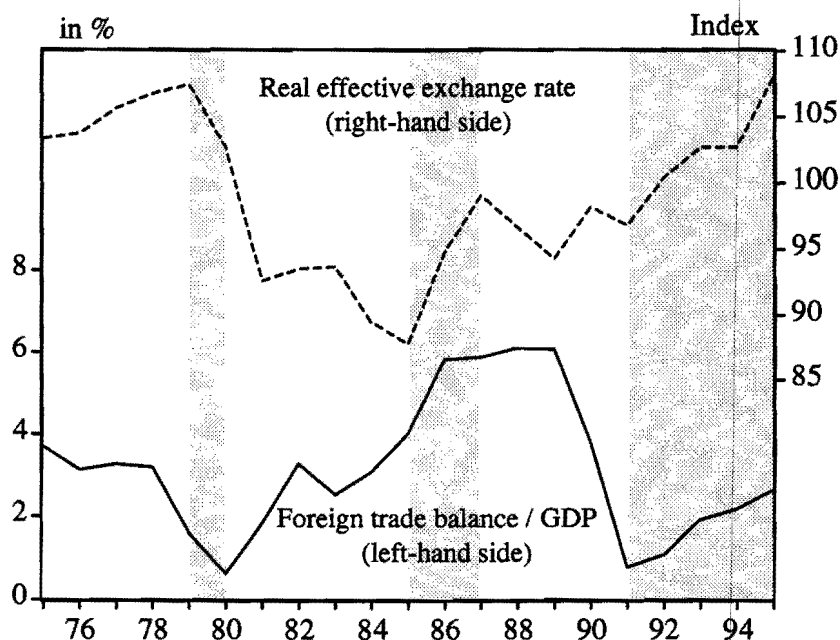
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The impact of the exchange rate on Germany's balance of trade*

I. Introduction

In 1995 a real appreciation of the D-Mark of approximately 5 % was accompanied by an increase of DM 18 billion in the foreign trade surplus. This apparently "anomalous" reaction by the trade balance to exchange rate fluctuations is not unusual in the case of Germany. Similar patterns are also to be found from 1979 to 1980, from 1985 to 1987 and from 1991 to 1994 (see chart 1).

Chart 1: Real effective exchange rate of the D-Mark and German foreign trade balance in relation to gross domestic product



A possible explanation for this phenomenon could be the J-curve theory, which states that normal long-term exchange-rate-induced movements in the trade balance are accompanied in the short to medium term by movements in the opposite direction. As a result, the stylised curve of the trade balance in the case of a currency depreciation resembles a J-curve.¹

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¹ By analogy, in the case of an appreciation, this is known as the "walking stick" effect. See Rose (1986), p. 87.

The theory of the J-curve is based on the assumption of three reaction phases in which the trade balance, expressed in domestic currency, is influenced in different ways by exchange rate variations.² In the short-run contract phase export and import contracts are already fixed. As a result, the quantities and prices remain unchanged if the exchange rate changes. Owing to invoicing practice, however, the foreign trade prices could be "statistically" corrected because a given price in foreign currency is now different in terms of the domestic currency. During the following pass-through phase enterprises take account of the changed circumstances when concluding new contracts by passing on the exchange rate change in the prices now. In the final phase the customer reacts to the changes in export and import prices by altering the quantities he orders.

The J-curve assumes that there are three separate phases of reaction. In practice, however, delays in enterprises' price adjustment and customers' demand reaction may lead to an interplay between the second and third phase. If foreign trade contracts contain different terms of payment, it is likely that the contract phase and the pass-through phase will be mixed. For these reasons the following analysis is not so much concerned with these various phases in isolation as with the identification of the determinants in each of them. The significance of J-curve effects for Germany's foreign trade balance will then be assessed on this basis.

This paper will be broken down as follows: preliminary theoretical considerations will be followed by an attempt to analyse empirically the corresponding determinants in the various phases. For this purpose separate estimates will be made *inter alia* of price and quantity functions for exports and imports, and these will be examined to see how they react to exchange rate movements. The paper will conclude with simulation results on the short and long-term exchange rate effects on Germany's trade balance.

The objective of this paper is to ascertain whether J-curve movements can be identified for Germany's balance of trade.³

² Magee (1973).

³ In this paper we will subsume under the term J-curve the possible phenomenon of an abnormal short-term and a normal long-term reaction of the trade balance both to currency depreciations and currency appreciations.

II. Significance of invoicing practice

II.1 Preliminary theoretical considerations

As already mentioned, invoicing practices are responsible for a short abnormal primary reaction of the trade balance during the contract phase. If one differentiates between invoicing in domestic currency and foreign currency, the balance of trade in domestic currency may be expressed as follows:⁴

$$(1) \quad TB = X \cdot \left[PX \cdot (1 - a_x) + \frac{PX^*}{W} \cdot a_x \right] - M \cdot \left[PM \cdot (1 - a_m) + \frac{PM^*}{W} \cdot a_m \right]$$

TB	= balance of trade (in domestic currency)
X (M)	= export (import) volume
W	= nominal effective exchange rate
PX (PX*)	= export prices in domestic (foreign) currency
PM (PM*)	= import prices in domestic (foreign) currency
a_x (a_m)	= share of the export (import) values invoiced in foreign currency.

If we assume that both foreign trade prices and volumes are constant, the short-term effect of an exchange rate fluctuation is:

$$(2) \quad \frac{\partial TB}{\partial W} = -\frac{X \cdot PX^* \cdot a_x}{W^2} + \frac{M \cdot PM^* \cdot a_m}{W^2}.$$

The following equation will provide us with the condition of an inverse primary reaction of the trade balance:

$$(3) \quad \frac{X \cdot PX^* \cdot a_x}{M \cdot PM^* \cdot a_m} < 1 \quad \text{or} \quad \frac{X \cdot PX \cdot a_x}{M \cdot PM \cdot a_m} < 1. \quad ^5$$

Equation (3) shows that in the case of an appreciation the balance of trade is more likely to improve the greater the proportion of imports invoiced in foreign currency and the smaller the corresponding proportion of exports. If export and import prices are invoiced exclusively in foreign currency ($a_x=1$, $a_m=1$), there can only be an abnormal reaction when the balance of trade is in deficit. By contrast, there is no inverse primary effect if all foreign trade is settled in domestic currency ($a_x=0$, $a_m=0$).⁶ The same is true when exports are invoiced exclusively in

⁴ Regarding the following comments, see Smeets (1985), p. 175 f. and Wood (1991), p. 149 ff.

⁵ The conversion is the same as long as $PX^*/W=PX$ or $PM^*/W=PM$, i.e. the weights of the basket of goods on which the price index is based are identical for the goods invoiced in foreign currency and in domestic currency.

⁶ This conclusion can be drawn from equation (2) because in this case $dTB/dW=0$.

foreign currency but imports are not ($a_x=1, a_m=0$).⁷ The greatest inverse primary effect is achieved when imports are exclusively settled in foreign currency and exports in domestic currency ($a_x=0, a_m=1$).⁸

II.2 Empirical analysis

Because of the significance of invoicing practices in the contract phase, the currency breakdown of Germany's foreign trade is now examined. The data used for this up to 1989 are based on a special evaluation of the invoicing currencies given in the export declarations; from 1990 the figures are based on a survey of German exporters which the ifo institute carries out on behalf of the Deutsche Bundesbank.⁹ On the imports side the Bundesbank uses the actual payments to establish the invoicing currencies.

The examination of the currency breakdown shows that most German exports are invoiced in D-Mark (see table 1). The D-Mark is also the dominant currency on the imports side but to an appreciably smaller extent (see table 2). The invoicing practices of German exporters have been mostly consistent over the years. Changes in weights within the currency breakdown have also been fairly limited. For example, the extent to which the D-Mark was used fell on the exports side from just under 90 % in 1975 to 75 % in 1995, whereas the degree to which imports were invoiced in D-Mark rose from just over 42 % to 53 %. The greatest losses here were incurred by the dollar, whose significance as an invoicing currency for German imports was almost halved.¹⁰ Conversely, the share of exports invoiced in dollars rose by 5 percentage points.¹¹

⁷ See equation (2).

⁸ This simplified model is often assumed. See Sommer (1980), p. 534.

⁹ "Consequently, the data from 1990 are not fully comparable with those for 1989 and earlier. However, the results of comparative calculations for 1989 have shown that there are only slight differences between them." Deutsche Bundesbank (1991), p. 41, footnote 3.

¹⁰ "These ... trends are, above all, a reflection of the declining significance of energy imports during that period, which are almost all invoiced in US dollars." Deutsche Bundesbank (1991) p. 42.

¹¹ This shift within the currency breakdown is essentially a reflection of changes in the regional breakdown of German foreign trade. Deutsche Bundesbank (1991), p. 40.

Table 1: Currency breakdown of German exports

Year	Shares of the export invoicing currencies in %									
	DEM	USD	GBP	FRF	CHF	BEF	NLG	ITL	JPY	Other
1975	89.2	4.4	0.9	1.7	0.5	0.6	0.9	0.7	-	1.1
1976	86.9	5.0	1.2	2.1	0.6	0.7	0.9	1.1	-	1.5
1977	86.0	6.2	1.1	2.1	0.5	0.7	0.9	1.0	-	1.5
1978	83.6	7.4	1.3	2.3	0.5	0.8	1.1	1.0	-	2.0
1979	82.6	7.3	1.5	2.6	0.5	0.8	1.1	1.3	-	2.3
1980	82.5	7.2	1.4	2.8	0.5	0.9	1.2	1.3	-	2.2
1981	82.2	7.8	1.3	2.8	0.5	0.9	1.1	1.3	-	2.1
1982	83.2	6.7	1.3	2.8	0.5	0.9	1.1	1.2	-	2.3
1983	82.6	7.0	1.5	2.8	0.5	0.9	1.2	1.4	-	2.1
1984	79.4	9.7	1.7	2.8	0.5	0.9	1.1	1.5	0.3	2.1
1985	79.5	9.5	1.8	2.7	0.5	1.1	1.1	1.5	0.4	1.9
1986	81.5	7.7	1.7	2.7	0.5	0.7	0.9	1.6	0.4	2.3
1987	81.5	7.4	1.8	2.5	0.6	0.7	0.9	1.7	0.5	2.4
1988	79.2	8.0	2.0	3.2	0.6	1.0	1.0	1.8	0.4	2.8
1989	79.2	7.5	2.5	3.4	0.6	0.9	0.9	1.8	0.4	2.8
1990	77.0	6.5	2.7	3.9	-	-	-	2.2	0.4	7.3
1991	77.5	8.0	2.3	3.3	-	-	-	2.0	0.4	6.5
1992	77.3	7.2	3.2	3.4	-	-	-	2.2	0.6	6.2
1993	74.3	10.3	2.6	3.3	-	-	-	2.0	0.8	6.9
1994	76.7	9.7	2.4	2.9	-	-	-	1.7	0.7	6.1

Source: Deutsche Bundesbank. "-": invoicing share of this currency was not collected separately.

Table 2: Currency breakdown of German imports

Year	Shares of the import invoicing currencies in %									
	DEM	USD	GBP	FRF	CHF	BEF	NLG	ITL	JPY	Other
1975	42.5	30.9	3.6	4.2	1.7	1.8	2.6	2.7	-	10.0
1976	42.0	31.3	3.2	3.9	1.7	1.7	2.5	3.1	-	10.6
1977	44.2	30.6	3.0	3.7	1.7	1.7	2.3	2.1	-	10.7
1978	46.1	28.5	3.3	3.7	2.1	1.7	2.4	2.4	-	9.8
1979	43.7	30.5	3.2	3.4	1.7	1.7	2.1	2.9	-	10.8
1980	43.0	32.3	3.4	3.3	1.6	1.6	2.0	2.4	-	10.4
1981	43.0	32.3	3.7	3.0	1.6	1.2	1.9	2.0	-	11.3
1982	44.6	31.3	2.5	3.4	1.6	1.0	1.7	2.0	-	11.9
1983	46.1	28.8	2.7	3.5	1.5	1.1	1.6	1.8	-	12.9
1984	47.0	29.2	2.4	3.6	1.5	1.0	1.5	1.7	-	12.1
1985	47.8	28.1	3.0	3.8	1.5	0.9	1.4	1.5	1.8	10.2
1986	51.7	23.1	2.2	4.1	1.7	0.8	1.5	1.5	2.6	10.8
1987	52.4	22.0	2.6	3.9	1.8	0.9	1.4	1.6	2.5	10.9
1988	52.6	21.3	2.4	3.6	1.7	0.8	1.5	1.6	2.5	12.0
1989	52.6	22.3	2.6	4.1	1.7	0.7	1.4	1.8	2.0	10.8
1990	54.3	20.9	2.5	3.6	1.8	0.8	1.4	1.9	1.8	11.0
1991	55.4	20.4	2.3	3.0	1.6	0.7	1.3	1.8	2.0	11.5
1992	55.9	18.4	2.2	3.1	1.6	0.7	1.3	1.7	1.7	13.6
1993	54.1	19.0	2.2	3.0	1.5	0.6	1.2	1.5	2.0	15.1
1994	53.2	18.5	2.0	2.8	1.3	0.7	0.9	1.3	1.7	17.7

Source: Deutsche Bundesbank. "-": invoicing share of this currency was not collected separately.

Table 3: Relationship between exports and imports broken down by invoicing currency

Relationship between exports and imports, both invoiced in foreign currency										
Year	Total	USD	GBP	FRF	CHF	BEF	NLG	ITL	JPY	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1975	0.23	0.17	0.30	0.49	0.35	0.40	0.42	0.31	-	0.13
1976	0.26	0.18	0.43	0.62	0.41	0.48	0.42	0.41	-	0.16
1977	0.29	0.24	0.43	0.66	0.34	0.48	0.46	0.55	-	0.16
1978	0.36	0.30	0.46	0.73	0.28	0.55	0.54	0.49	-	0.24
1979	0.33	0.26	0.50	0.82	0.32	0.51	0.56	0.48	-	0.23
1980	0.32	0.23	0.42	0.87	0.32	0.58	0.62	0.57	-	0.21
1981	0.34	0.26	0.38	1.00	0.34	0.81	0.62	0.70	-	0.20
1982	0.34	0.24	0.59	0.94	0.36	1.02	0.74	0.70	-	0.22
1983	0.36	0.27	0.62	0.89	0.37	0.91	0.83	0.86	-	0.18
1984	0.44	0.37	0.80	0.87	0.37	1.01	0.82	0.99	-	0.20
1985	0.45	0.39	0.69	0.82	0.39	1.42	0.91	1.16	0.26	0.22
1986	0.49	0.42	0.98	0.84	0.37	1.11	0.76	1.36	0.20	0.27
1987	0.50	0.43	0.89	0.83	0.43	1.00	0.83	1.37	0.26	0.28
1988	0.57	0.48	1.08	1.15	0.46	1.61	0.86	1.45	0.21	0.30
1989	0.56	0.43	1.22	1.05	0.45	1.63	0.81	1.25	0.25	0.33
1990	0.59	0.36	1.26	1.26	-	-	-	1.35	0.26	0.77
1991	0.52	0.40	1.03	1.14	-	-	-	1.13	0.21	0.58
1992	0.54	0.41	1.57	1.16	-	-	-	1.36	0.34	0.48
1993	0.62	0.60	1.34	1.22	-	-	-	1.42	0.42	0.51
1994	0.56	0.59	1.38	1.14	-	-	-	1.42	0.43	0.39

Source: Deutsche Bundesbank.

In order to check whether or not the theoretically derived conditions for the existence of an abnormal primary effect in the case of exchange rate changes can be regarded as fulfilled in the short contract phase, ratios were calculated from the export receipts and import expenditure invoiced in foreign currency (using equation (3)).¹² The increase in the various ratios over time is almost exclusively the result of the growing importance of foreign currencies on the exports side and their declining importance as invoicing currencies on the imports side.

If the exchange rate of the D-Mark changes uniformly against all other currencies, the conditions for an abnormal primary reaction of Germany's balance of trade are fulfilled throughout the entire observation period (see table 3 column 2). Although the ratio of export receipts invoiced in foreign currency to import expenditure rose from 0.23 to 0.56, it was still significantly below one. The picture changes to some extent if the bilateral relationships are examined (columns 3 to 10). The relationship between export receipts and import expenditure suggests that since the end of the eighties there had no longer been an inverse primary reaction

¹² Regarding the following comments, see Schäfer (1985), p. 497 f.

of the balance of trade in the case of isolated appreciations against the French franc, the Italian lira and the Pound Sterling. However, the shift in emphasis within the currency breakdown is not only important in this group of European currencies but also in the case of the US dollar. The ratio of the US dollar (see column 3) also rose continuously during the observation period. Even so, the ratio of export receipts invoiced in dollars to import expenditure has remained significantly below one. As the exchange rate of the D-Mark is subject to substantial fluctuations, particularly against the US dollar and to a lesser extent against other European currencies, changes in the exchange rate of the D-Mark can continue to result initially in an inverse primary reaction of the balance of trade, despite recent developments. Nevertheless, the changed currency preferences during the past 20 years have probably had a significant dampening effect on the overall extent of possible anomalous balance of trade reactions during the contract phase.

III. Pricing

III.1 Preliminary theoretical considerations

Traditionally, most foreign trade models have assumed the existence of a complete pass-through.¹³ In the terminology used by Vesala a complete exchange rate pass-through results "when import prices fully reflect movements in the exchange rate and exporters hold their own-currency prices constant".¹⁴ In this case import prices are determined solely by prices abroad (in terms of the respective domestic currencies), and export prices by the domestic price level.

The reason for the weak reaction of the US balance of trade in the eighties, despite the significant fluctuations in the dollar, was seen to lie *inter alia* in the insensitivity of foreign trade prices to exchange rate fluctuations.¹⁵ Since then, there has been a wealth, especially in the United States, of theoretical and empirical analyses of the so-called pricing to market by enterprises. In contrast to the complete pass-through the pricing of exporters and importers is determined less by costs and more - in an attempt to stem losses in market share - by the price set by other suppliers in the same market. Enterprises offset the effects of exchange rate

¹³ See, for example, Gandolfo (1987), appendix to chapter 15.1., p. 232. By contrast, the extent of the pass-through in the partial analytical elasticity approach of the balance of payments theory depends on the supply and demand elasticity. If it is assumed that the elasticity of supply is infinite, the special case of a complete pass-through arises. See Menon (1995), p. 198 f. and Jarchow/Rühmann (1991), case (a), p. 53.

¹⁴ Vesala (1992), p. 9.

¹⁵ See Krugman (1986), Mann (1986), Helkie/Hooper (1987), Moffett (1989), Meade (1988 and 1989), Baldwin (1990) and Koch/Rosensweig (1990).

fluctuations by varying profit margins instead of passing these on to customers through price changes. Pricing to market ultimately leads to different international prices for the same good.¹⁶

There are a number of reasons for pricing to market. The fundamental assumption, which is the basis for all theoretical models, is the segmentation of goods markets.¹⁷ Information and transport costs as well as tariff and non-tariff trade barriers impede effective goods arbitrage, without which any international price differentiation is impossible. If in the event of fully integrated markets an enterprise demanded a lower price for its products abroad than it did at home, reimports, known as "grey" imports, would reduce domestic sales and therefore the profits of the enterprise. The segmentation of the goods markets is therefore the *conditio sine qua non* for international price differentiation.

The substitutability of goods is highlighted as another determinant for pricing to market.¹⁸ The greater the homogeneity of competing products in a market segment, the smaller the price differences. In the extreme situation of absolute homogeneity, for example, in the case of certain raw materials, the supplier is compelled to set the price of his product solely according to the competitor price; in the case of industrial products, which tend to be more heterogeneous, prices are set, by contrast, more in line with costs.

This last point needs to be qualified to some extent if one includes the market structure as a determinant of international price differentiation.¹⁹ Using a model of oligopolistic competition - enterprises, when fixing their prices, take possible counteractions of competitors into account - Dornbusch (1987) shows that heterogeneous goods also encourage pricing to market. Potential losses of market shares force foreign suppliers to include the price of domestic competitor products in their calculations when forecasting their maximum possible profit.²⁰

More recent approaches emphasise the role of exchange rate expectations in the pricing-to-market strategy of enterprises.²¹ Irreversible menu costs - which include all irrecoverable expenditure incurred in price adjustment, such as printing costs for catalogues, and costs

¹⁶ Consequently, pricing to market is in conflict with the purchasing power parity theory. See Faruqee (1995) and Froot/Rogoff (1995).

¹⁷ Knetter (1993), p. 476.

¹⁸ See the empirical study by Engel (1993).

¹⁹ For the case with homogeneous goods see the Cournot model cited by Fuhrmann (1989), p. 589 f. In his theoretical model Fisher (1989) comes to the conclusion that the size of the exchange rate pass-through depends on the level of competition both at home and abroad. See also Feenstra/Gagnon/Knetter (1996).

²⁰ Meckl (1996) points out that exchange rate fluctuations make it more difficult to pursue oligopolistic pricing.

²¹ See Dohner (1984), Giovannini (1988), Delgado (1991) and Kasa (1992).

incurred in informing customers - delay regular price adjustments in the event of exchange rate fluctuations. When there is an exchange rate change, selling prices will not be adjusted until the expected losses that would result from maintaining prices exceed the menu costs. Price rigidities are therefore directly linked to exchange rate volatility. In the event of sharp and frequent exchange rate fluctuations there is an increasing likelihood that exchange-rate-related price changes will have to be reversed later. Enterprises alter their prices only when an exchange rate movement is expected to last.²² As long as enterprises regard an exchange rate movement as temporary, however, they will pursue a so-called wait-and-see strategy and leave prices unchanged.²³

III.2 Empirical analysis

III.2.1 Estimating specifications

We derive export and import price equations by using a mark-up model also applied in other empirical studies.²⁴ It is assumed here that enterprises offset a deterioration in price competitiveness by reducing their mark-up. This makes it possible to subject the extent of pricing to market to an empirical analysis and to estimate it direct by price equations.

The mark-up model is based on an exporting enterprise which set its export price (in domestic currency) by adding a profit margin to its unit costs:²⁵

$$(6) \quad PX = (1 + \pi) \cdot C$$

PX	= export price (in domestic currency)
π	= mark-up
C	= domestic cost level.

The mark-up, in turn, is a function of the ratio between the competitor price and the enterprise's own price:

²² Delgado (1991). Kasa comes to a similar conclusion (1992): "Finally, the model demonstrates that the critical factor affecting the degree of pricing to market is the relative importance of the transitory component of exchange rate fluctuations." See also Dohner (1984), p. 95 and Krugman (1989), p. 47.

²³ See also Dixit (1989), p. 227.

²⁴ Helkie/Hooper (1987), p. 12, Athukorala (1991), p. 80, Athukorala/Menon (1994), p. 273 and Menon (1996), p. 438.

²⁵ The theoretical basis for this is the "Extended Dixit-Stiglitz model". Dornbusch (1987), p. 99 ff.

$$(7) \quad (1 + \pi) = \left(\frac{P^*}{W \cdot PX} \right)^\beta, \beta \geq 0$$

P^* - competitor price abroad (in foreign currency)
 W - nominal effective exchange rate.

(7) inserted into (6) we obtain in logarithmic form:²⁶

$$(8) \quad px = \gamma \cdot (p^* - w) + (1 - \gamma) \cdot c, \quad \gamma = \frac{\beta}{1 + \beta}.$$

By analogy, the import prices are given by:

$$(9) \quad pm = \lambda \cdot p + (1 - \lambda) \cdot (c^* - w)$$

pm - import price (in domestic currency)
 p - competitor price at home (in domestic currency)
 c^* - cost level abroad (in foreign currency).

The coefficient γ or λ measures the extent to which enterprises follow the prices of other suppliers abroad when fixing their prices. If $\gamma = 1$ ($\lambda = 1$), the exporters (importers) are pursuing a 100 % pricing-to-market policy.²⁷ If they gear their pricing exclusively to their costs ($\gamma = 0$, $\lambda = 0$), then a 100 % exchange rate pass-through exists. The import price (PM) or export price, calculated in foreign currency ($PX \cdot W$),²⁸ moves in line with the exchange rate fluctuations. Between these two extremes ($0 < \gamma < 1$, $0 < \lambda < 1$) exchange rate fluctuations lead to the simultaneous variation in profit margins and reaction of the selling prices. A value of 0.3 for the pricing-to-market coefficient γ means that the exporter is reducing his mark-up by 3 % if there is a 10 % appreciation in his home currency and is raising his selling prices abroad by 7 %.

According to equations (8) and (9), the coefficients of the competitor price level and the cost variable must add up to one. This theoretical restriction ensures that a proportional change in the domestic and foreign price or cost level - i.e. the real effective exchange rate remains constant - does not effect real foreign trade.²⁹

²⁶ Small letters signify logarithmic variables.

²⁷ The marginal value of γ and λ if $\beta \rightarrow \infty$ is one.

²⁸ In conjunction with the equation for the export price in domestic currency (equation (8)) one obtains for the export price in foreign currency: $(px + w) = \gamma \cdot p^* + (1 - \gamma) \cdot (c + w)$.

²⁹ The degree to which real exports depend on the relationship between the export price and the competitor price may be shown by the (logarithmic) equation $x = \alpha \cdot (p^* - w - px)$. In conjunction with equation (8) and

As we are not estimating the price function of a single enterprise but rather of an entire economy and must therefore resort to highly aggregated price and cost indices, we are confronted here with what is known as the index aggregation problem. Any structural shifts resulting from differences in the baskets of goods will therefore lead in most cases to a rejection of the theoretical restriction of the coefficients in equations (8) and (9).³⁰ For that reason a trend variable is added to the price equations to take account of the different weighting pattern of the price indices being used.³¹

III.2.2 Estimation technique

Cointegration analysis has been applied to examine the export and import price equations. This technique is particularly suitable for checking the long-term equilibrium relationships on which the theoretical considerations are based. After the necessary order of integration of the relevant time series has been examined, the next step is to check the existence of a cointegration relationship by means of a so-called error correction model which uses variables in the form of first differences. In the two-step procedure developed by Engle and Granger (Engle/Granger, 1987) the one-quarter lagged residuals of the long-term regression separately estimated in level form are also included as an error correction term, whereas in the one-step approach used by Stock (1987) the cointegration relationship is estimated simultaneously in the error correction model. In this way the long-term equilibrium relationship is connected with the short-term adjustment process. An error correction term which is significantly negative³² (α_1 in equation (10)) shows the existence of a stable long-term equilibrium and at the same time indicates that existing disequilibria will be reduced over time.³³

$$(10) \quad \text{Error correction equation:} \quad \Delta y_t = \alpha_0 \cdot \Delta x_t + \alpha_1 \cdot \overbrace{(y_{t-1} - \beta_1 \cdot x_{t-1})}^{\text{Error correction term}}$$

y_t = dependent variable
 x_t = independent variable.

A disadvantage of the Engle/Granger approach is that particularly in small samples the estimated coefficients of the long-term regression (β_1 in equation (10)) are distorted despite

assuming that the domestic cost level (c) moves in proportion to the domestic price level (p), one obtains $x = \alpha \cdot (\gamma - 1) (p + w - p^*)$. Accordingly, the real exports or imports and the real balance of trade are functions of the real effective exchange rate.

³⁰ Athukorala/Menon (1995), p. 536.

³¹ Ketelsen/Kortelainen (1996), p. 17.

³² As there is no standard normal distribution of the coefficient of the error correction term, the critical t-values generated by MacKinnon (1991) are to be used.

³³ Kremer/Ericsson/Dolado (1992).

the superconsistency of the distribution and do not follow any normal asymptotical distribution (so-called "small sample bias").³⁴ This disadvantage is avoided in the Stock method because the long-term equilibrium relationship and the short-term adjustment dynamics are estimated simultaneously. In practice, however, this method is sometimes highly susceptible to multicollinearity problems.³⁵ To assess how much these problems affect the results of the regression we show the results of both methods.³⁶ We also calculate the t-statistics using the transformation by Bewley³⁷ for the long-term coefficients (β_1 in equation (10)) of the Stock approach because the usual significance tests cannot be used for the t-values of the Engle/Granger method and the Stock method owing to the lack of stationarity in the regressors.³⁸

III.2.3 Export prices

In table 4 the estimated results of the export price equation for the period from the first quarter of 1975 to the fourth quarter of 1995 derived by the Stock/Bewley method are compared with the results obtained on the basis of the Engle/Granger method. The long-term coefficients of the domestic cost level and of the foreign competitor price level (in terms of domestic currency) are restricted in line with the theoretical considerations outlined in chapter 3.2.1. The quarterly seasonally adjusted³⁹ data for western Germany have been used up to the fourth quarter of 1990 and the corresponding figures for Germany as a whole from the first quarter of 1991. The dependent variable is the German export price based on the Laspeyres index; the German total sales deflator is used for the domestic cost level⁴⁰, and the ratio of the foreign total sales deflator and the nominal effective exchange rate of the D-Mark for the foreign competitor price level.⁴¹ The estimated results of both methods are almost identical, which is an indication of the stability of the relationships established here. Accordingly, in the long term German exporters largely pursue an exchange rate pass-through policy. 89 % of a given

³⁴ Considerable distortions are discernible even in a sample involving 50 observation points. See Kim (1994).

³⁵ See Gerdesmeier (1996), p. 24.

³⁶ A vector error correction model along the lines of the Johanson procedure is not used because the results of this method have been very sensitive to the variables on which they are based and the lag structure chosen. On this issue see also the discussion in Hansen/Kim (1996).

³⁷ Scharnagl (1996), p. 18.

³⁸ West (1988).

³⁹ The seasonal adjustment was made using Eviews' "Ratio to Moving Average - Multiplicative" procedure (version 2.0).

⁴⁰ Regressions using unit labour costs in the economy as a whole or unit labour costs in manufacturing provide virtually identical figures on the costs incurred by exporters, owing to the fact that they run nearly parallel to the total sales deflator.

⁴¹ The foreign total sales deflator is established as a geometric mean for the group of 18 industrial countries, using the weights applied for calculating the effective DM-exchange rate. For more detailed information on the calculation method see Deutsche Bundesbank (1989).

appreciation of the D-Mark is passed on in the selling prices abroad, and only 11 % is absorbed by reducing profit margins. This means that in the long run pricing to market is not widely practised by German exporters.⁴²

Table 4: Estimates for the export price (I/1975 - IV/1995)
(Competitor price = foreign deflator of total sales / eff. exchange rate)

Long-term regression*	Stock/Bewley		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	4.64	(182.29)	4.64	-
Domestic deflator of total sales	0.89	(23.27)	0.89	-
Foreign defl. of tot. sales/eff. ex. rate	0.11	(3.02)	0.11	-
Trend	-0.00	(9.41)	-0.00	-
Dummy1	-0.07	(6.93)	-0.07	-
Short-term regression				
	Stock		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	-	-	0.00	(0.74)
d(Export price(-1))	0.31	(3.95)	0.32	(4.38)
d(Dummy1)	-0.03	(2.47)	-0.04	(3.06)
d(Domestic deflator of total sales)	0.35	(3.91)	0.37	(4.26)
d(Foreign defl. of tot. sales/eff. ex. rate)	0.10	(4.14)	0.10	(4.33)
Error correction term	-0.22	(3.52)	-0.23	(3.62)
Test statistics				
Adj. R2	0.70		0.71	
SEE	0.00		0.00	
DW	1.96		1.98	
AR(4)	0.42		0.31	
ARCH(4)	5.38		4.62	
JB	16.17		19.39	
Cusum	stable		stable	
Cusum square	stable		stable	

* Long-term coefficients of the two price variables are restricted to one.

Same-period values of the exogenous difference variables and the first lag of the difference endogenous variable are taken into account when formulating the error correction equation. As table 4 shows, pricing to market, as expected, is of relatively greater importance in the short term.⁴³ While only 35 % of the changes in costs are reflected here in the export prices, pricing to market has already reached almost its long-term level, at 10 % within a quarter.⁴⁴

⁴² Willmann (1994) has similar results in his sectoral breakdown of export price estimates for Germany.

⁴³ Surveys undertaken by the HWWA Institute have shown that German exporters are less willing to accept an exchange-rate-related reduction in their profit margins the longer the D-Mark appreciation lasts. Scharrer/Langer (1988), p. 475.

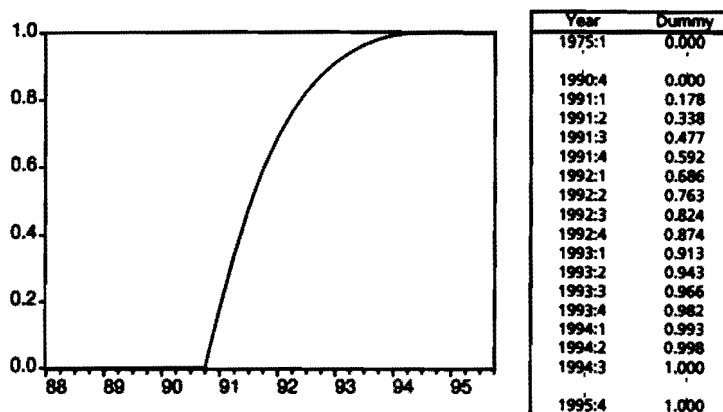
⁴⁴ In reality, however, the "effective" pricing-to-market system may be even more pronounced because the price statistics - although based on effective prices - do not always take account of price concessions negotiated later and other ancillary services.

The coefficient of the error correction term is negative and significant at the 10 % level, with the result that in the long term the coefficients of the cointegration relationship take effect.

The informative value of the "short-term equation" is relatively high at an adjusted R-square of approximately 70 %. Each of the equations is free of first to fourth-order autocorrelation (Durbin-Watson statistics and Breusch-Godfrey test (AR(4)). The standard error (SEE) in the estimates is under 0.5 %. The Cusum and Cusum square test indicate the stability of the regression coefficients (significance level < 10 %). Nevertheless, the test statistics used indicate heteroscedastic (ARCH effects) and not normally distributed (Jarque-Bera test) residuals. These violations of the model assumptions, however, are due exclusively to an underestimation of export price fluctuations during the second oil price shock at the beginning of the eighties. If these extreme outliers are excluded, the test statistics show that the residuals are consistent with the assumptions. In "normal" times this estimating approach therefore seems to be suitable for estimating export prices.⁴⁵

The significant dummy in the estimates represents the unification-related break in export prices and in the domestic total sales deflator. The "unification dummy" is not modelled here as a pure (0/1) variable but as a "moving" variable in order to take account of the successive price adjustments in eastern Germany. The value of the dummy is zero from the first quarter of 1975 up to the fourth quarter of 1990. From then until the third quarter of 1994 it is raised logarithmically to the value one (see chart 2), which assumes that the price adjustment in eastern Germany was largely complete by mid-1994.

Chart 2: "Moving" dummy curve



⁴⁵ For an account of the test statistics used here see Krämer (1995), chapter 3.3.

However, one objection that may be made to the choice of a broadly defined price index such as the foreign total sales deflator is that it does not differentiate between traded and nontraded goods, especially with respect to its suitability as a competitor price for German export products. If the foreign producer prices are taken as an indicator of the competitor price level, there is surprisingly little change in the regression figures for the export price (see table 5). Apparently the significant negative trend variable in the long-term regression takes due account of the different weighting of the traded goods in the basket of goods used for the foreign total sales deflator and the one used for the foreign producer price.⁴⁶

Table 5: Estimates for the export price (I/1975 - IV/1995)
(Competitor price = foreign producer price / eff. exchange rate)

Long-term regression*	Stock/Bewley		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	4.65	(171.73)	4.64	-
Domestic deflator of total sales	0.90	(24.66)	0.91	-
Foreign producer price/eff. ex. rate	0.10	(2.73)	0.09	-
Trend	-0.00	(8.04)	-0.00	-
Dummy1	-0.07	(5.95)	-0.07	-
Short-term regression				
	Stock		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	-	-	0.00	(1.73)
d(Export price(-1))	0.26	(3.41)	0.29	(4.03)
d(Dummy1)	-0.02	(1.83)	-0.03	(2.60)
d(Domestic deflator of total sales)	0.29	(3.22)	0.32	(3.65)
d(Foreign prod. price/eff. ex. rate)	0.11	(5.15)	0.11	(5.19)
Error correction term	-0.19	(3.09)	-0.19	(3.15)
Test statistics				
Adj. R2	0.73		0.73	
SEE	0.00		0.00	
DW	1.94		1.97	
AR(4)	0.42		0.43	
ARCH(4)	3.91		2.99	
JB	17.08		22.28	
Cusum	stable		stable	
Cusum square	stable		stable	

* Long-term coefficients of the two price variables are restricted to one.

As already mentioned, the order of integration of the time series used has to be examined prior to the cointegration analysis. As table 6 shows, all variables of the export price estimates are integrated of the order of 1 (significance level < 5 %), i.e. they are stationary. Thus the basic precondition for using the methods applied here is fulfilled.

⁴⁶ For establishing the trend variables see chapter III.2.1, p. •.

Table 6: ADF test for the variables of the export price equation

Variable (I/1975 - IV/1995)	Specification 1)	Lag	t-value 2)
Export price	C	1,2	-2.48
Domestic deflator of total sales	C	1,2,3	-1.73
Foreign deflator of total sales/effective exchange rate	C	1	-2.12
Foreign producer price/effective exchange rate	C	1	-1.85
d(Export price)	C	0	-4.10
d(Domestic deflator of total sales)	C	0	-6.79
d(Foreign deflator of total sales/effective exchange rate)	C	0	-5.87
d(Foreign producer price/effective exchange rate)	C	0	-3.61

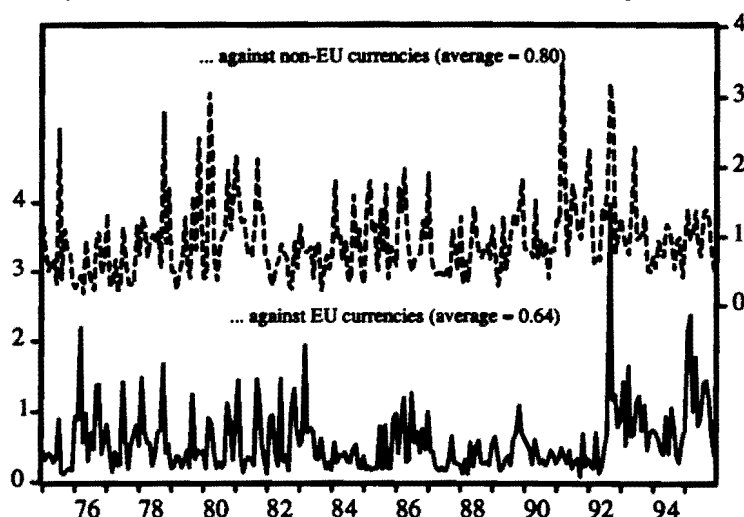
1) C = Constant.- 2) For the critical values see MacKinnon (1991).

III.2.3.1 Export prices for specific regions

According to Delgado (1991), the pricing-to-market strategy of enterprises is linked directly to exchange rate volatility. When exchange rates fluctuate sharply and frequently, there is a greater likelihood that any exchange-rate-related price change will have to be reversed later. Enterprises will therefore not change their prices unless they think that an exchange rate change is going to last, especially if these changes are always associated with costs. The effective exchange rate of the D-Mark is more volatile on average against the currencies of non-EU countries (significance level < 1 %) than it is against those of EU countries (see chart 3). This would suggest that the pricing to market observed for exports to countries outside the EU is more common than it is within the Community.

Chart 3: Volatility of the effective exchange rate of the D-Mark

Monthly standard deviation of the daily values for the effective exchange rate of the D-Mark ...



Theories which take the competitive behaviour of enterprises as the decisive determinant of pricing to market would lead one to believe that the opposite should be true. According to this theoretical consideration, oligopolistic pricing, i.e. the expected price reactions of competitors are taken into consideration when an enterprise is setting its own prices, encourages pricing to market.⁴⁷ Oligopolistic behaviour is, in turn, the result of experience. The greater transparency of market conditions is making it easier to identify the way in which different competitors will act and react with each other.⁴⁸ However, the transparency of foreign markets is limited, not least as a result of exchange rate movements. The greater exchange rate fluctuations are, the more difficult it is for enterprises to evaluate the extent to which actions by competitors are really reactions to one's own pricing policy.⁴⁹ This argument therefore can explain why pricing to market tends to be more common in the case of exports to other EU countries than in the case of exports to non-EU countries.

Table 7: ADF test for the variables of the regionally specific export price equations

Variable (I/1975 - IV/1995)	Specification 1)	Lag	t-value 2)
EU export price	C	1	-2.14
Non-EU export price	C	1	-2.05
Domestic deflator of total sales	C	1,2,3	-1.73
EU deflator of total sales/EU effective exchange rate	C	1	-1.83
Non-EU deflator of total sales/Non-EU effective exchange rate	C	1	-2.07
d(EU export price)	C	0	-3.90
d(Non-EU export price)	C	0	-4.75
d(Domestic deflator of total sales)	C	0	-6.79
d(EU deflator of total sales/EU effective exchange rate)	C	0	-6.20
d(Non-EU deflator of total sales/Non-EU effective exchange rate)	C	0	-5.66

1) C = Constant.- 2) For the critical values see MacKinnon (1991).

To test these two competing hypotheses the prices of Germany's exported goods to countries within the EU⁵⁰ and to countries outside the EU have been estimated separately (using the Stock/Bewley method)⁵¹ (see table 8). (A European currency group of a more homogeneous nature, such as one restricted to EMS currencies, could not be formed as the Federal Statistical Office does not issue an export price series so defined.) Here, too, the same-period values of the exogenous variables and the first lag in the endogenous variable have not been taken into

⁴⁷ Dornbusch (1987).

⁴⁸ Heuss (1966).

⁴⁹ Meckl (1996).

⁵⁰ For this purpose the EU comprises the following group of countries: Belgium, Spain, France, the United Kingdom, the Netherlands, Italy, Denmark, Greece, Portugal and Ireland; non-EU countries are all other countries.

⁵¹ The results of the two-step Engle/Granger method are not shown separately because the estimated coefficients are virtually identical with the parameters listed in table 8.

account when formulating the error correction equation. (The relevant results of the stationarity test are shown in table 7.)

Table 8: Estimates for regionally specific export prices (I/1975 - IV/1995)

Long-term regression*	EU export price		Non-EU export price	
(Stock/Bewley)	Coefficient	t-value	Coefficient	t-value
Constant	4.68	(396.48)	4.63	(128.63)
Domestic deflator of total sales	0.91	(53.27)	0.89	(16.19)
Foreign defl. of tot. sales/eff. ex. rate	0.09	(5.27)	0.11	(2.00)
Trend	-0.00	(15.58)	-0.00	(6.80)
Dummy1	-0.08	(12.62)	-0.06	(4.89)
Short-term regression				
(Stock)	Coefficient	t-value	Coefficient	t-value
d(Export price(-1))	0.41	(5.62)	0.27	(3.08)
d(Dummy1)	-0.03	(1.95)	-0.03	(1.86)
d(Domestic deflator of total sales)	0.45	(4.90)	0.31	(2.84)
d(Foreign defl. of tot. sales/eff. ex. rate)	0.04	(2.85)	0.09	(2.65)
Error correction term	-0.31	(5.16)	-0.24	(3.86)
Test statistics				
Adj. R2	0.70		0.59	
SEE	0.00		0.00	
DW	2.16		1.95	
AR(4)	0.52		0.50	
ARCH(4)	0.94		1.80	
JB	3.07		0.54	
Cusum	stable		stable	
Cusum square	stable		stable	

* Long-term coefficients of the two price variables are restricted to one.

The estimates for the two long-term regionally specific export price equations do not show any appreciable differences either between each other or in comparison with the results for the total export price (see table 8). Irrespective of the regional breakdown, approximately 90 % of the increased costs are passed on in export prices while only 10 % are absorbed by reducing profit margins.

Regionally specific behaviour is to be observed in the short term only. Non-EU exporters appear to be much more sensitive here to exchange rate movements than their EU counterparts. They offset a 10 % appreciation by a 1 % reduction in profit margins whereas EU exporters react to the same appreciation by reducing their margin by only 0.5 %. These two groups also pursue a different pricing policy to counteract a change in costs. A 10 % increase in costs results in a 4.5 % increase in the prices of EU exported goods in the quarter

immediately after, whereas the prices for customers outside the EU rise by only 3 % approximately. Moreover, EU exporters react more quickly to the long-term "equilibrium" price which is primarily determined by costs. Disequilibria between the actual selling price and the long-run price are reduced here by approximately 30 % per quarter; in the case of non-EU exporters this adjustment amounts to only 25 % approximately.

There appear to be striking differences in the short-term pricing of both groups when compared with each other. One would "overstress" these estimates, however, if one interpreted this as a confirmation of the hypothesis discussed above, namely, that there is a positive link between pricing to market and exchange rate volatility. Statistically, the difference in pricing is not to be regarded as significant and cannot be used as a basis for the hypothesis tests based on it. The EU definition applied here apparently comprises currency movements which are still too heterogeneous. Owing to this limited regional differentiation, the export price function is not broken down regionally for the simulation of reactions by the trade balance to exchange rate movements; total export price functions have been used instead (see tables 4 and 5).

III.2.4 Import prices

As in the case of export prices, the theoretical approach outlined in chapter III.2.1 (equation (9)) was used to estimate Germany's import prices. According to this method, the import price is a function of the foreign cost level (calculated in terms of the domestic currency) and of the domestic competitor price level. However, the estimates resulting from this approach did not indicate any stable cointegration relationship. Furthermore, irrespective of the price series used, the coefficient of the domestic competitor price in all cases was not significantly different from zero and the parameter of the foreign cost level was not significantly different from one. Importers apparently do not pursue a pricing-to-market policy but, instead, base their pricing policy entirely on costs. These figures possibly illustrate the intense competition German exporters face on the world market, which is a reason why they tend to be more prepared to make price concessions than the importers are in the German market. For this reason the following method has been chosen for estimating German import prices (in logarithmic form):⁵²

⁵² Small letters signify logarithmic values.

$$(11) \quad pm = \alpha \cdot (c^* - w) + \beta \cdot (roh - w_s)$$

- pm - import price (in domestic currency)
 c* - cost level abroad (in foreign currency).
 w - nominal effective exchange rate.
 w_s - nominal external value of the D-Mark against the US dollar
 roh - price of energy sources denominated in dollars.

In the estimating approach the long-term coefficient of the foreign cost level (α) is restricted to one. We therefore assume that there is a long-term proportionality between the cost level abroad and the import price. At the same time a non-stationary "raw material" variable, which stands for the dependence of German import prices on price trends on the energy markets, is included in the cointegration relationship.⁵³

Table 9: ADF test for the variables of the import price equation

Variable (I/1975 - IV/1995)	Specification 1)	Lag	t-value 2)
Import price	C	1	-2.46
Energy price (in DEM)	N	1	-1.47
Foreign deflator of total sales/effective exchange rate	C	1	-2.12
d(Import price)	N	0	-4.60
d(Energy price (in DEM))	N	0	-7.01
d(Foreign deflator of total sales/effective exchange rate)	C	0	-5.87

1) N= No constant, C = Constant.- 2) For the critical values see MacKinnon (1991).

As table 9 shows, all variables are stationary (significance level < 5 %). As in the estimate of export prices, same-period values of the exogenous variables and the first lag of the endogenous variable are taken into account when formulating the error correction equation. Further significant endogenous and exogenous variables up to the maximum fourth lag are then included in the regression until the autocorrelation in the residuals is eliminated.

The seasonally adjusted⁵⁴ time series on which the estimate is based are the German import price according to the Laspeyres index for the dependent variable, the ratio between the foreign total sales deflator and the weighted nominal external value of the D-Mark for the foreign cost level and the ratio between the HWWA index for energy sources in US dollars and the nominal external value of the D-Mark against the US dollar for the "raw material

⁵³ Estimates with more broadly defined raw material price indices gave similar results. See also Deutsche Bundesbank (1988), p. 35.

⁵⁴ The seasonal adjustment was made using Eviews' "Ratio to Moving Average - Multiplicative" procedure (version 2.0).

variable". The domestic total sales deflator was used in the short-term regression as an indicator of the competitor price level in order to identify short-term pricing-to-market behaviour.

The estimates are shown in table 10. The Stock/Bewley and Engle/Granger methods, in turn, provide almost identical results. 80 % of the total distribution can be explained in both cases. The test statistics confirm the existence of uncorrelated, homoscedastic and normally distributed residues and the structural consistency of the estimating approach.

Table 10: Estimates for the import price (I/1975 - IV/1995)

Long-term regression	Stock/Bewley		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	4.23	(140.21)	4.20	-
Foreign deflator of total sales/effective exchange rate	1.00	(restricted)	1.00	(restricted)
Energy price (in DEM)	0.09	(5.22)	0.10	-
Trend	-0.00	(9.67)	-0.00	-
Dummy1	0.05	(1.69)	0.02	-
Short-term regression				
	Stock		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	-	-	0.00	(0.54)
d(Import price(-1))	0.46	(5.44)	0.46	(5.46)
d(Import price(-3))	0.12	(2.00)	0.12	(2.10)
d(Dummy1)	-0.06	(1.54)	-0.07	(2.17)
d(Energy Price)	0.09	(6.66)	0.09	(7.24)
d(Foreign defl. of tot. sales/eff. ex. rate)	0.47	(6.24)	0.46	(6.32)
d(Foreign defl. of tot. sales(-1)/eff. ex. rate(-1))	-0.17	(2.06)	-0.19	(2.38)
d(Foreign defl. of tot. sales(-4)/eff. ex. rate(-4))	-0.25	(3.88)	-0.26	(4.28)
d(Domestic deflator of total sales)	0.60	(2.12)	0.71	(2.72)
d(Domestic deflator of total sales(-1))	-0.61	(2.19)	-0.52	(1.99)
Error correction term	-0.18	(3.40)	-0.19	(3.41)
Test statistics				
Adj. R2	0.83		0.84	
SEE	0.01		0.01	
DW	1.78		1.76	
AR(4)	0.46		0.43	
ARCH(4)	2.62		1.71	
JB	0.35		0.03	
Cusum	stable		stable	
Cusum square	stable		stable	

The trends in energy prices and costs abroad are the dominant explanatory variables of German import prices in both the short and long term. The significantly positive coefficient of the domestic total sales deflator in the short-term regression indicates that importers initially

offset most exchange rate fluctuations by varying their profit margins. Although, in absolute terms, this coefficient is significantly greater than its counterpart in the export price equation, they are not significantly different statistically (significance level < 5 %). It appears that in the short term the significance of pricing to market is similar for both exports and imports.

As mentioned above, the long-term coefficient of the foreign price level has been given an *a priori* value. This implies that in the long term there is a 100 % exchange rate pass-through, i.e. importers pass on increased costs fully in their prices over the long term. This assumption is confirmed by unrestricted estimates. Statistical tests show that the "freely" estimated coefficient is not significantly different from one.

If domestic producer prices are taken instead of the total sales deflator as an indication of the competitor price level, there are only minor changes in the estimates in the short-term equation. As in the case of export prices, no additional information is obtained from a breakdown by region either. The results are therefore not shown separately.

IV. Impact on volumes

IV.1 Preliminary theoretical considerations

Theoretically, the determinants of imported and exported heterogeneous goods can be derived from production models.^{55,56} The following CES production function⁵⁷ may be assumed which creates a functional link between the domestic and imported input quantities (H, M) and the output Y:⁵⁸

$$(12) \quad Y = (\alpha_1 \cdot H^{-\sigma} + \alpha_2 \cdot M^{-\sigma})^{-\frac{1}{\sigma}}.$$

⁵⁵ See Sandermann (1975), p. 41 ff. For the utility foundation of import demand see, for example, Armington (1969) and Gregory (1971). Given certain assumptions, one comes to similar conclusions here as in the production-theoretical explanation of import demand. See Sandermann (1975), p. 45 ff.

⁵⁶ For a discussion of import demand functions in the case of homogeneous goods see Goldstein/Khan (1985), p. 1050 ff.

⁵⁷ This production-theoretical foundation using a CES production function is not based on potential variables here like, for example, the production potential estimate of the Deutsche Bundesbank (1995). A meaningful interpretation of the derived import demand would not be possible in this case because "potential" imports cannot be recorded statistically.

⁵⁸ This theoretical approach establishes not only a demand for imported primary products but also a demand for imported finished products if one regards the latter as primary products of the distribution sector.

The coefficients α_1 and α_2 represent the distribution parameters of the two input factors. The scale elasticity is ϕ , and the substitution elasticity equals $(-1/(1+\sigma))$. If the economy is regarded as a "representative firm" which maximises its profit, we obtain:

$$(13) \quad P \cdot \frac{\delta Y}{\delta M} = PM, \text{ or } \quad P \cdot \frac{\delta Y}{\delta H} = PH.$$

Equation (13) in conjunction with equation (12) gives the following logarithmic import demand function:⁵⁹

$$(14) \quad m = \epsilon_0 + \epsilon_1 \cdot y - \epsilon_2 \cdot (pm - p),$$

$$\text{with } \epsilon_0 = \frac{1}{1+\sigma} \cdot \log(\alpha_2 \cdot \phi), \quad \epsilon_1 = \frac{\phi + \sigma}{\phi \cdot (1+\sigma)}, \quad \epsilon_2 = \frac{1}{1+\sigma}.$$

Accordingly, the (real) imports are a function of the (real) domestic activity and the relation between the import price and the domestic price level.⁶⁰ By analogy, the (logarithmic) domestic export demand is formulated as follows:

$$(15) \quad x = \eta_0 + \eta_1 \cdot y^* - \eta_2 \cdot (px - (p^* - w))$$

- x - exports (real)
- y* - foreign activity variable (real)
- px - export price
- p* - foreign price level
- w - nominal effective exchange rate of the domestic currency.

The price equations estimated in the previous chapter imply an infinite price elasticity in the export-import supply because the export-import prices are solely determined by the costs and the competitor prices and consequently are independent of the volume supplied. This assumption enables us to regard export and import volumes as being determined exclusively by demand and to specify and estimate them by means of a demand function.⁶¹ The export-import demand in conjunction with the appropriate price-conditional equation therefore assumes the following (recursive) market model: the supplier fixes his selling prices on the basis of his costs and the competitor prices and produces the quantities he expects to sell. If the quantity actually demanded is higher (lower) than expected, he reacts in the short term by

⁵⁹ Small letters signify logarithmic variables.

⁶⁰ This type of aggregated import function assumes that the import shares of the sectors are constant in terms of the period observed. For modelling the import demand with variable import shares of the sectors, see Schleiper (1984).

⁶¹ Orcutt (1959), p. 120 and Goldstein/Khan (1985), p. 1071 f.

reducing (increasing) his stocks or increasing (reducing) his delivery periods; in the long term, however, he always adjusts his capacity to the demand.⁶²

IV.2 Empirical results

As in the case of estimating the price equations, we examine the import/export demand using an error correction model according to the Engle/Granger and the Stock/Bewley methods. Up to the fourth quarter of 1990 we draw on the seasonally adjusted⁶³ quarterly data for western Germany and from the first quarter of 1991 the corresponding series for Germany as a whole.

The same-period values of the exogenous variables and the first lag of the endogenous variable are taken into account when formulating the error correction equation. Other significant endogenous and exogenous variables up to the maximum fourth lag order are then incorporated into the regression, and insignificant variables are removed until the autocorrelation in the residuals is eliminated.

IV.2.1 Import demand

Germany's imports of goods as defined in special trade (c.i.f.) are used as an explanatory variable for estimating import demand. They are price-adjusted on the basis of German import prices (according to the Laspeyres index). Real gross domestic product represents the domestic activity variable,⁶⁴ and the price competitiveness of imported products is obtained from the relationship between the import price and the domestic total sales deflator. As the total sales deflator includes the prices of non-traded goods as well, which may compete less with imported goods, import demand is estimated, alternatively, using the ratio between the import price and the domestic producer price as a measure of price competitiveness. In view of the unification-induced break in German imports and GDP, a dummy variable is included in the equations which has the value zero up to the fourth quarter of 1990 and the value one thereafter. An additional dummy is also used for the statistical break in German imports following the realisation of the single European market at the beginning of 1993.⁶⁵ The value of this "single market" dummy is zero up to fourth quarter of 1992 and one thereafter.

⁶² Hammersland (1996), p. 4.

⁶³ The seasonal adjustment was made by using Eviews' "Ratio to Moving Average - Multiplicative" procedure (version 2.0).

⁶⁴ For the discussion on the appropriate activity variable see Fischer (1995), p. 433.

⁶⁵ Deutsche Bundesbank (1993), p. 64.

Table 11: Estimates for the import demand (I/1975 - IV/1995)
 (Price variable = import price / domestic deflator of total sales)

Long-term regression	Stock/Bewley		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	2.68	(6.58)	2.53	-
Dummy1 (unification)	-0.11	(7.01)	-0.11	-
Dummy2 (single market)	-0.07	(5.48)	-0.09	-
Import price/domestic deflator of total sales	-0.18	(4.52)	-0.17	-
Gross domestic product (real)	1.90	(43.11)	1.92	-
Short-term regression				
	Stock		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
d(Imports in real terms(-2))	0.21	(2.84)	0.19	(2.85)
d(Imports in real terms(-4))	0.13	(1.89)	0.12	(1.80)
d(Dummy1)	-0.05	(1.81)	-0.05	(2.01)
d(Dummy2)	-0.09	(4.23)	-0.10	(5.01)
d(Gross domestic product (real))	1.51	(7.49)	1.51	(8.76)
Error correction term	-0.76	(6.49)	-0.77	(6.89)
Test statistics				
Adj. R2	0.63		0.65	
SEE	0.02		0.02	
DW	2.17		2.09	
AR(4)	1.09		0.44	
ARCH(4)	0.60		0.82	
JB	0.56		0.53	
Cusum	stable		stable	
Cusum square	stable		stable	

Tables 11 and 12 show the estimates for German import demand. Irrespective of the method chosen and the price competition indicator applied, the results are largely the same. The long-term price elasticity, at approximately - 0.2, is significant though surprisingly low. In the short term, however, there is no evidence of a significant change in import demand in response to prices. The "driving" force behind import demand is domestic activity. In the long term a 1 % growth in real gross domestic product results in an almost 2 % rise in real imports. This value reflects Germany's increasing integration into the international division of labour. The highly informative value of gross domestic product, even in the short term, indicates the dependence of German import trends on the domestic economic situation.

Table 12: Estimates for the import demand (I/1975 - IV/1995)
(Price variable = import price / domestic producer price)

Long-term regression	Stock/Bewley		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	1.62	(6.13)	1.52	-
Dummy1 (unification)	-0.12	(6.85)	-0.11	-
Dummy2 (single market)	-0.06	(4.86)	-0.08	-
Import price/domestic producer price	-0.22	(4.32)	-0.20	-
Gross domestic product (real)	1.92	(43.64)	1.94	-
Short-term regression				
	Stock		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
d(Imports in real terms(-2))	0.20	(2.74)	0.19	(2.78)
d(Imports in real terms(-4))	0.13	(1.91)	0.12	(1.84)
d(Dummy1)	-0.05	(1.77)	-0.05	(1.99)
d(Dummy2)	-0.09	(4.12)	-0.10	(4.88)
d(Gross domestic product (real))	1.49	(7.36)	1.50	(8.67)
Error correction term	-0.75	(6.40)	-0.75	(6.78)
Test statistics				
Adj. R2	0.63		0.64	
SEE	0.02		0.02	
DW	2.18		2.10	
AR(4)	1.31		0.54	
ARCH(4)	0.64		0.78	
JB	0.55		0.56	
Cusum	stable		stable	
Cusum square	stable		stable	

Table 13: ADF test for the variables of the import demand equation

Variable (I/1975 - IV/1995)	Specification 1)	Lag	t-value 2)
Imports in real terms	C	2	-0.66
Gross domestic product (real)	C	1	-0.18
Import price/domestic deflator of total sales	C	2	-0.64
Import price/domestic producer price	C	2	-0.89
d(Imports in real terms)	C	1	-5.57
d(Gross domestic product (real))	C	1	-6.60
d(Import price/domestic deflator of total sales)	N	2	-3.15
d(Import price/domestic producer price)	N	2	-3.66

1) N= No constant, C = Constant.- 2) For the critical values see MacKinnon (1991).

60 % of the total distribution can be explained in all cases. According to the Cusum and Cusum square test, the regression coefficients are stable over time. Moreover, the test statistics confirm the existence of uncorrelated residuals with similar variances and a normal distribution. At the same time all variables are stationary, as may be seen from table 13.

IV.2.2 Export demand

Germany's exported goods as defined for special trade (f.o.b.), deflated by the German export price (according to the Laspeyres index), are used as a dependent variable for estimating export demand. It would seem appropriate to use a weighted index of the foreign gross domestic product - as in the case of import demand - as a foreign activity variable. To avoid the aggregation problems associated with this method, however, we use the world trade volume instead; during the observation period this volume grew roughly twice as fast as Germany's real gross domestic product. As in the case of import demand, we form the price competition indicator. In the regression, therefore, the (logarithmic) ratio between the export price (according to the Laspeyres index) and the foreign total sales deflator or, alternatively, the relationship between the export price and the foreign producer price is applied. As in the case of German import demand a "unification" dummy and a "single market" dummy are included in German export demand estimations. All variables meet the precondition of non-stationarity (see table 14).

Table 14: ADF test for the variables of the export demand equation

Variable (I/1975 - IV/1995)	Specification 1)	Lag	t-value 2)
Exports in real terms	C	1	-1.76
World trade volume	C	1	0.52
Export price/foreign defl. of tot. sales/eff. ex. rate	C	1	-2.00
Export price/foreign producer price /eff. ex. rate	C	1	-1.72
d(Exports in real terms)	C	1	-6.47
d(World trade volume)	C	1	-5.31
d(Export price/foreign defl. of tot. sales/eff. ex. rate)	N	0	-6.49
d(Export price/foreign producer price /eff. ex. rate)	N	0	-6.60

1) N= No constant, C = Constant.- 2) For the critical values see MacKinnon (1991).

In estimating the export demand, the various test statistics confirm the statistically necessary qualities of the residuals (see tables 15 and 16). In all cases the error correction term is sufficiently negative to ensure that the equilibrium remains stable in the long term (significance level < 1 %). At the same time the speed with which it adjusts to the long-term state of equilibrium is very high, at a value of more than 0.5. The long-term price elasticity of export demand depends on the estimating method and the choice of price variables and ranges between -0.7 and -0.9.⁶⁶ In the short term, by contrast, no significant reaction of exports to price changes is discernible. This means that in the long term exports are significantly more

⁶⁶ Döpke/Fischer (1994) were unable to determine any long-term impact of the price variables.

sensitive to price than imports (significance level < 1 %). One explanation of this observation could be Germany's dependence on raw materials. The more limited opportunity for finding substitutes for raw materials can be seen in the fact that import demand here is less elastic with respect to prices. However, a separate estimate of import demand for the goods categories raw materials and finished products does not confirm this assumption. Although the price elasticity of demand for imported finished products is greater in absolute terms than the price elasticity of demand for imported raw materials, the parameters of the price variables in both categories do not differ significantly from each other.

Table 15: Estimates for the export demand (I/1975 - IV/1995)
(Price variable = export price / dom. defl. of tot. sales / eff. ex. rate)

Long-term regression	Stock/Bewley		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	13.73	(31.42)	13.22	-
Dummy1 (unification)	-0.08	(4.52)	-0.07	-
Dummy2 (single market)	-0.08	(4.04)	-0.10	-
Export price/foreign defl. of tot. sales/eff. ex. rate	-0.87	(10.48)	-0.79	-
World trade volume	0.80	(25.23)	0.83	-
Short-term regression				
	Stock		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
d(Exports in real terms(-1))	-0.20	(2.48)		
d(Exports in real terms(-2))			0.14	(1.89)
d(Dummy2)	-0.06	(2.23)	-0.07	(2.86)
d(World trade volume)	0.68	(4.26)	0.69	(5.61)
Error correction term	-0.59	(6.38)	-0.64	(7.18)
Test statistics				
Adj. R2	0.55		0.54	
SEE	0.02		0.02	
DW	1.99		2.19	
AR(4)	0.80		1.60	
ARCH(4)	0.63		0.80	
JB	1.42		2.11	
Cusum	stable		stable	
Cusum square	stable		stable	

Table 16: Estimates for the export demand (I/1975 - IV/1995)
 (Price variable = export price / dom. producer price / eff. ex. rate)

Long-term regression	Stock/Bewley		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
Constant	12.81	(32.01)	12.18	-
Dummy1 (unification)	-0.07	(3.45)	-0.06	-
Dummy2 (single market)	-0.08	(3.86)	-0.10	-
Export price/foreign producer price /eff. ex. rate	-0.84	(9.25)	-0.71	-
World trade volume	0.97	(33.83)	0.99	-
Short-term regression				
	Stock		Engle/Granger	
	Coefficient	t-value	Coefficient	t-value
d(Exports in real terms(-1))	-0.23	(2.91)	-0.19	(2.63)
d(Dummy2)	-0.04	(1.75)	-0.06	(2.53)
d(World trade volume)	0.87	(5.43)	0.87	(7.25)
Error correction term	-0.52	(6.23)	-0.54	(6.35)
Test statistics				
Adj. R2	0.54		0.54	
SEE	0.02		0.02	
DW	1.97		1.88	
AR(4)	0.62		0.78	
ARCH(4)	0.84		1.69	
JB	1.77		2.68	
Cusum	stable		stable	
Cusum square	stable		stable	

Sensitivity analyses, on the other hand, show that the data on which the analysis is based are also consistent - from a statistical point of view - with greater degrees of price elasticity in import demand. If the price elasticity of import demand is restricted to various values, a valid cointegration relationship is also obtained with coefficient values of the price variables of up to - 0.5. At the same time the parameters of other variables remain almost unchanged as a result of the restriction introduced. Since there is no theoretical justification in fixing the price elasticity *a priori* at a certain value, we should use freely estimated coefficients for the later simulations.

As in the case of import demand the activity variable of export demand is the dominant explanatory variable both in the short term and the long term.⁶⁷ Depending on the indicator used for estimating price competitiveness, the long-term coefficient of world trade volume is either 0.8 or 1.0. However, these significantly different values suggest a different conclusion. If the total sales deflator is used as a time series for the foreign price level, the results imply that in the long term the growth of German exports is below average when compared to world

⁶⁷ Lapp/Scheide/Solveen (1995) come to the same conclusion in this respect.

trade in general. As the developing countries, newly industrialising countries and recently also the countries in transition are regularly making an above-average contribution to world trade growth, this conclusion is not implausible for an industrial country such as Germany. It is therefore likely that using a price variable based on producer prices will probably tend to overstate Germany's long-term share in world exports.⁶⁸ More detailed analyses of the factors determining German world trade shares are necessary, however, for assessing which coefficient value of the world trade volume gives the most accurate picture of the "true" trend in the world market share of German exports.⁶⁹ It is obvious, however, that, when assessing the long-term correlation between export growth and world trade growth, the choice of price variables is of paramount importance.

V. Overall effect of exchange rate changes on the balance of trade

In the previous chapters various channels through which exchange rate changes can influence the balance of trade were identified. The effect of exchange rate fluctuations on import prices as a result of the exchange rate pass-through and on the export prices as a result of pricing to market is worth noting. Exchange rate movements also affect the demand for imported and exported goods through changes in their relative prices. The aim of this chapter is to estimate both the individual effects and the overall effect of exchange rate changes over time.

V.1 Theoretical solution

The Marshall-Lerner condition states that the foreign balance declines in the event of an appreciation (normal reaction of the balance of trade) if the sum of the (absolute) price elasticities of imports and exports is greater than one. This condition presupposes *inter alia* that there is a complete exchange rate pass-through, i.e. the import price level corresponds to the foreign price level calculated in domestic units and the export price level corresponds to the domestic price level.⁷⁰ However, this assumption does not completely apply in the event of pricing to market. If we take this aspect into consideration, we obtain a more general

⁶⁸ Constant market share analyses also show that price competition indicators based on broader price indices - for example, total sales deflators - provide a more accurate picture of Germany's competitive situation, Feldman (1995).

⁶⁹ For the impact of German unification on world market share trends see Deutsche Bundesbank (1996), p. 55 f.

⁷⁰ Compared with the more generally worded Robinson condition, the Marshall-Lerner condition assumes that there are not only infinite export-import supply elasticities but also that the balance of payments starts off in equilibrium. See Willms (1995), p. 43.

condition for a normal reaction of the balance of trade if we reduce the behavioural equations estimated above to the price and exchange rate effects alone,

$$(16) \quad PX = P^{\alpha_1} \cdot \left(\frac{P^*}{W}\right)^{\alpha_2}, \quad PM = \left(\frac{P^*}{W}\right)^{\beta_1} \cdot P^{\beta_2}, \quad X = \left(\frac{PX \cdot W}{P^*}\right)^{-\eta}, \quad M = \left(\frac{PM}{P}\right)^{-\varepsilon},$$

and link them with the assumption that the balance of trade starts off in equilibrium:

$$(17) \quad -\eta \cdot \alpha_2 + \eta + \alpha_2 + \varepsilon \cdot \beta_1 - \beta_1 > 0. \quad ^{71}$$

If the coefficients are chosen analogously to the short-term estimates in tables 4, 8, 11 and 15 (Stock/Bewley method, $\alpha_2=0.10$, $\beta_1=0.47$, $\eta=0$ and $\varepsilon=0$), the inequation (17) is not fulfilled, i.e. the balance of trade reacts anomalously in the short term. In the long run ($\alpha_2=0.11$, $\beta_1=1.00$, $\eta=0.87$ and $\varepsilon=0.18$), however, the trade balance of Germany reacts normally. This means that for Germany the balance of trade in the event of exchange rate changes seems to show the movements typical of the J-curve. The following simulation studies should provide more information on the exact movement of the balance of trade over time.

V.2 Simulation studies

The following simulation studies are based on the Stock/Bewley regressions, where the domestic and foreign price levels are each represented by the total sales deflator. The partial analytical price and quantity reaction equations constitute the entire system. Any interactions between the price differential and the nominal effective exchange rate are not taken into consideration, i.e. the exchange rate is regarded as an exogenous variable. Consequently, any nominal appreciation is always also a real appreciation of the D-Mark. The following two scenarios are assumed:

- A permanent 1 % appreciation of the D-Mark and
- a 1 % appreciation of the D-Mark lasting one year.

⁷¹ If $\alpha_2=0$ and $\beta_1=1$, we immediately obtain the Marshall-Lerner condition: $\eta+\varepsilon > 1$.

V.2.1 Permanent 1 % appreciation of the D-Mark

The simulation results of a permanent appreciation of the D-Mark are given in chart 4.⁷² This means that on the export side volume reactions dominate in the long term, as a result of the high degree of price elasticity of export demand, while export price movements appear to be only of a minor nature, owing to the limited extent of pricing to market. By contrast, the import value in the event of an appreciation of the D-Mark is mostly determined by the change in import prices because in the long term importers pass on exchange rate fluctuations fully in their selling prices. The modest reaction of import volumes is due here to the low degree of price elasticity of import demand. The chart also shows that in the case of imports the adjustment process is faster in the short term. The difference in the reaction pattern between exports and imports is also apparent here. Initially, export volumes are fully insensitive to exchange rates (price elasticity = 0), whereas in the case of imports the appreciation results in considerable price reductions even in the short term (owing to the exchange rate pass-through).

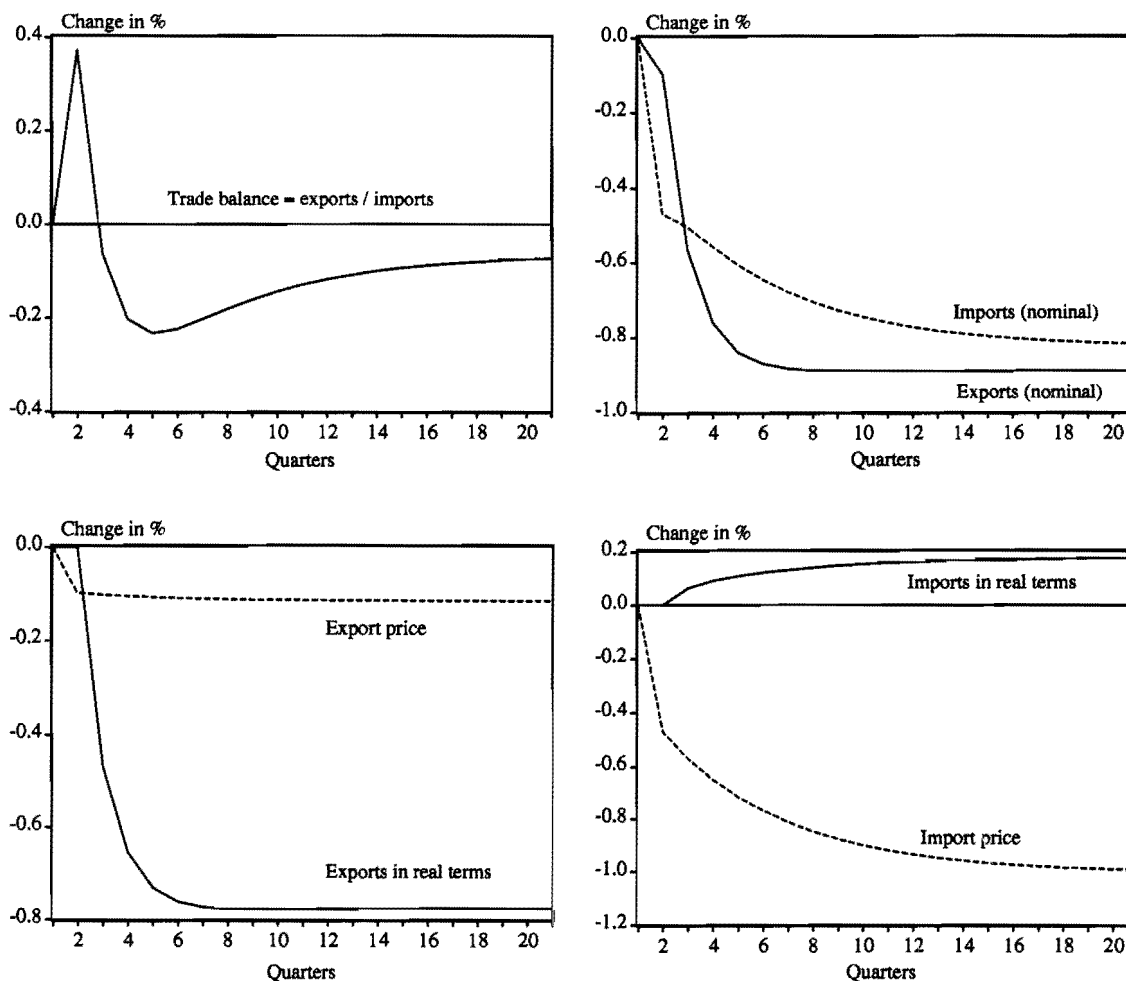
The behavioural pattern on both the export and import sides is very much in line with the theoretical shape of the J-curve. Overall, then, an (inverted) J-curve can be identified for the German balance of trade. However, the long-term exchange rate impact on the nominal balance of trade has to be regarded as rather moderate, as can be seen from the chart. (The real balance of trade declines, however.) By contrast, the short-term reactions of the nominal balance of trade are significantly more pronounced. As a result of the 1 % appreciation, the balance of trade (defined here as the ratio of the export value to the import value)⁷³ rises in the first quarter by 0.4 %. In the next three quarters it declines by a total of almost 0.6 percentage point, with the result that at the end of a year there is a 0.2 % reduction in the balance of trade. Owing to further falls in import prices, however, the balance of trade rises again, so that in the long term a total effect of only - 0.1 % approximately remains. In view of the fluctuation margins of the coefficients as a result of the estimating method chosen and the price variables on which they are based, however, this result can be quickly reversed. It is therefore impossible to say with absolute certainty whether in the long term the German balance of trade reacts normally or abnormally. The result shows, however, that exchange rates probably

⁷² To achieve a smoothed adjustment curve the conditional equations on which the simulations are based contain only the unlagged exogenous variables and the error correction term. The reaction in the first quarter and the long-term result remain unaffected by this modification.

⁷³ This "redefinition" of the balance of trade makes it possible to depict it in terms of the rates of change. The characteristic of the curve is not altered as a result of this definition of the balance of trade.

tend to play a subordinate role as far as the long-term trend in the nominal balance of trade is concerned.

Chart 4: Simulation results assuming a permanent 1% appreciation of the D-Mark

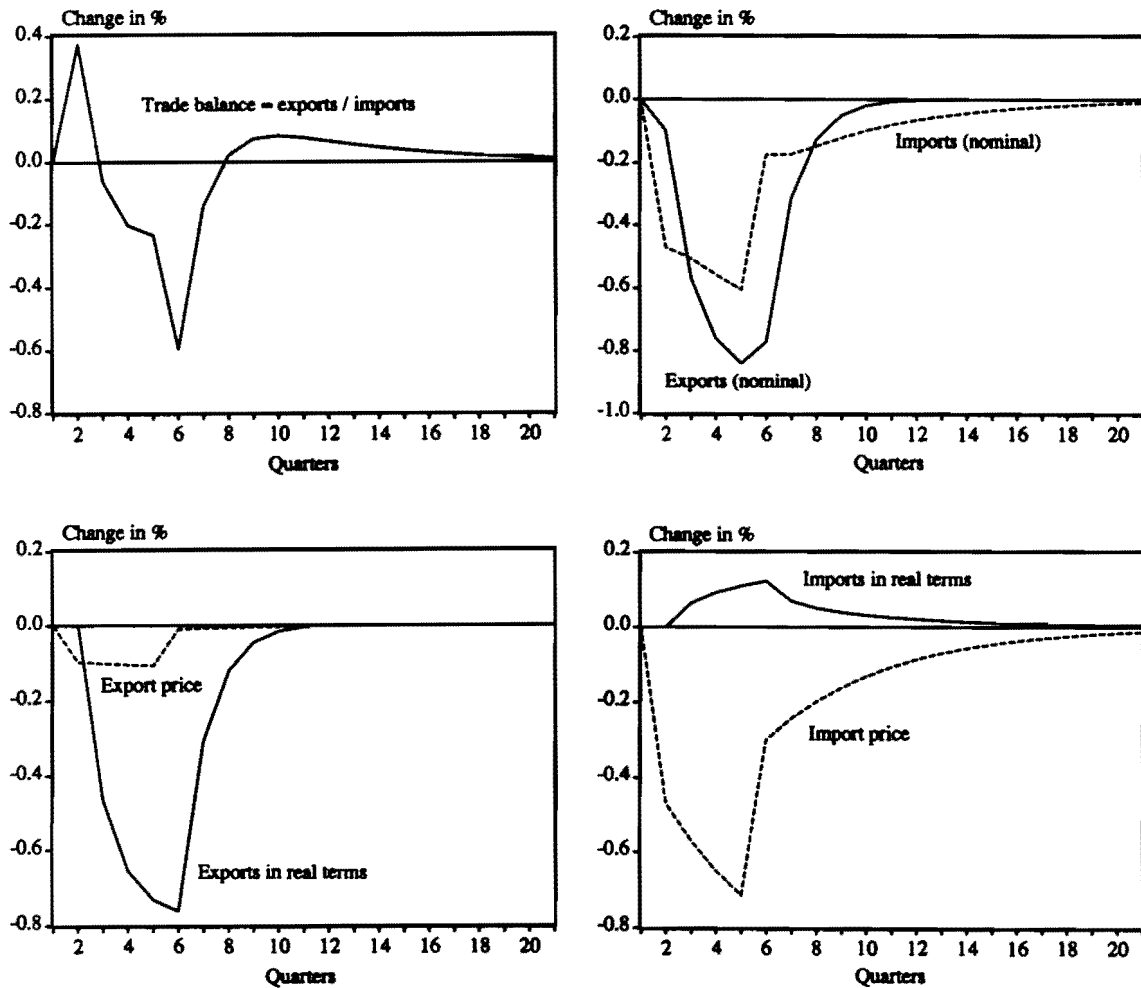


V.2.2 A 1 % appreciation of the D-Mark lasting one year

If one assumes that there is only a temporary appreciation, these simulation results (see chart 5) will suggest conclusions similar to those mentioned above. The export trend is determined to a very considerable extent by exchange-rate-induced volume reactions, while on the import side it is almost exclusively price movements that dominate. Here, too, the balance of trade is in the form of an (inverted) curve similar to a J-curve. While in the short term the appreciation-induced import price reductions improve the balance of trade, falling demand as a result of the increased prices of German export goods leads in the medium term

to a trade deficit. After about two years - one year after the reversal of the temporary appreciation - the balance of trade regains its initial level.

Chart 5: Simulation results assuming a 1% appreciation of the D-Mark lasting one year



The even greater short to medium-term fluctuations in the balance of trade compared with the scenario mentioned before result from the temporal overlapping of the "walking-stick" and J-curve effects. Consequently, pronounced exchange rate movements are accompanied by greater volatility in export volumes and import prices. This analysis shows that exchange rate volatility possibly affects the transmission mechanism of monetary policy in that export volumes and import prices influence the link between the money stock and prices through capacity utilisation and price trends.

VI. Summary and outlook

Germany's balance of trade reacts to a large extent "classically" to exchange rate movements. In the long run, importers and, to a very large extent, exporters, too, pursue a policy of exchange rate pass-through. In this, importers pass on fluctuations in the exchange rate fully in their selling prices, which results in exchange-rate-induced changes in import prices. On the export side, this "rolling-over" strategy leads to German products becoming dearer for foreign customers in the event of an appreciation of the D-Mark. The export price therefore remains largely unchanged when invoiced in domestic currency. In contrast to importers, however, exporters are prepared, even in the longer term, to neutralise a small part of the exchange rate fluctuations by varying their margins. In the short run, this pricing to market may be observed quite clearly both on the import and on the export side. The conclusion implied by these results is that, in line with the classical view, prices are mainly cost-determined in the long run and hence that the law of one price may claim a certain validity. By contrast, a more or less marked international differentiation in prices for the same good may be observed over the shorter term.

In the long run, trends in the volume of imports and exports are chiefly determined by the growth of domestic and external markets; in the short term, the correlations that have been found document the cyclical sensitivity of Germany's foreign trade. Price competitiveness plays only a secondary role in explaining trends in exports and imports over the shorter term. A sustained deterioration in the competitive situation in terms of prices, on the other hand, results in a loss of shares in the world market. Compared with exports, imports are less sensitive to the exchange rate in the long run. The reason for this could be Germany's dependence on imports of raw materials.

In the final analysis, exchange-rate-related fluctuations in import values are chiefly due to changes in the prices of imports, whereas exchange-rate-related fluctuations in export values are mainly caused by changes in their quantities. Since, in the short term, movements in import prices exceed the change in the volume of exports and, on the other hand, this ratio is reversed in the long run, exchange-rate-induced movements in Germany's trade balance are characterised by an initially anomalous reaction which subsequently gives way to a normal balance of trade reaction. The balance of trade curve thus resembles a J-curve. Even the conclusion suggested by the analyses of the invoicing practices in Germany's foreign trade was, in fact, that of an inverse primary reaction of the balance of trade to changes in the exchange rate. Furthermore, the simulation studies show that temporary exchange rate

movements are associated in the short term with significant fluctuations in the balance of trade.

Any possible criticism of this investigation lies in its partial analytical character.⁷⁴ Interactions, for example, between the price differential or the domestic business cycle and the exchange-rate have not been taken into consideration. As the objective of the analysis is to identify the possible existence of a J-curve in the balance of trade and as the short-term exchange rate-induced reactions of the balance of trade are therefore of primary importance, the restriction to a partial analytical approach is justified. To provide additional confirmation of the conclusions for the medium to long term, it would perhaps be appropriate to put less trust in some aspects of the partial analytical approach and, accordingly, to supplement it with, for example, conditional equations for the exchange rate or the output gap.

Furthermore, it is left to further research to formulate a similar approach for assessing Germany's services account and to ascertain whether or not a comparable reaction pattern exists here. This could help to improve our understanding of the short-term reaction of the current account to exchange rate changes and our ability to forecast this reaction.

⁷⁴ For the problems involved in a partial analytical approach, see Tichy (1979).

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The following papers have so far been published:

May	1995	The Circulation of Deutsche Mark Abroad	Franz Seitz
June	1995	Methodology and technique for determining structural budget deficits	Gerhard Ziebarth
July	1995	The information content of derivatives for monetary policy – Implied volatilities and probabilities	Holger Neuhaus
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* Forthcoming.

