Effects of exchange rates on German foreign trade

Prospects under the conditions of European monetary union

It is widely expected that with the planned introduction of the euro the external disruptive influences on German business will diminish discernibly. Essentially, this assumption is based on the fact that the significance of exchange rate risks for the foreign trade of the participating countries will decline with the enlargement of the currency area. The present article attempts to convey some idea of the magnitude of the foreseeable changes in the effects of exchange rates on the German economy. It emerges that the susceptibility of German foreign trade to exchange rate disturbances will probably decline, in principle; however, the "immunising" effects with respect to exchange rate fluctuations should not be overrated. What matters in the end is not least how the exchange rates will develop against other major currencies.

Introduction and preliminary remarks

EMU increases "domestic-market orientation" ...

At the start of European monetary union (EMU) the countries taking part will irrevocably fix their bilateral exchange rates. This means that, despite the parallel circulation of the member states' national currencies for a limited period, the economic area in which a single currency is legal tender will be larger *de facto* from the first day of monetary union. In a way each country participating in EMU will therefore be forced to become more "domestic-market oriented", provided

trade within the then common currency area is seen as domestic trade, because exchange rate risks will no longer exist – as had been the case in the real domestic trade of the participating countries until that point.

... and reduces the proportion of foreign trade affected by exchange rates

An initial indication of how significant the change in the monetary policy system will be is therefore obtained from estimating the change in the proportion of foreign trade affected by exchange rates and occurring in the present regional breakdown of German foreign trade as a result of the introduction of monetary union. The precise outcome depends on the eventual selection of the countries which are to take part. The larger the number of participating countries, the smaller the proportion of foreign trade remaining with countries outside monetary union. In the hypothetical case of a monetary union in which all EU countries were to participate the proportion of foreign trade affected by exchange rates in relation to Germany's gross domestic product (GDP), based on the figures on the regional breakdown of German trade in goods in 1996, would decline from just under 21% to 9% of GDP. If cross-border service transactions are included, the change is equally significant with a fall from almost 25½% to approximately 11%. That means that these percentages would actually be somewhat below the corresponding foreign trade ratios for the United States. It is therefore likely that the potential for exchange-rate-related disturbances in German business will diminish markedly. Although the corresponding changes would be less significant in the event of a smaller group of participants, the fact remains that the proportion of German foreign trade affected by exchange rates will fall with the start of EMU.

German foreign trade shares in 1996

as a percentage of GDP

Item	Total	of which Non-EU countries
Exports		
of goods	22.1	9.5
of goods and services	25.7	11.2
Imports		
of goods	19.4	8.5
of goods and services	24.8	10.9
Foreign trade 1		
in goods	20.8	9.0
in goods and services	25.3	11.1

1 Average of exports and imports.

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Exchange rate fluctuations against third currencies continue

These simple comparisons therefore provide at least some idea of the type and direction of the coming changes; however, they enable one to draw only very limited conclusions about the exact extent of the effects on the interrelationship between exchange rate trends and cross-border trade and payment flows. What the actual significance of the reduced exchange rate effects on German business after the start of EMU will be also depends, for example, on the corresponding export and import elasticities. Furthermore, one needs some idea of the remaining exchange rate fluctuations against third currencies in order to assess the implications of the

larger currency area for German foreign trade and for the economy as a whole.

Very short-term volatility less problematic ...

It is not so much the very short-term exchange rate movements – the ones observed from day to day, so to speak – that are important here. Generally speaking, enterprises can use hedging operations to cover the currency risks arising from these movements. They can do so over time horizons of several months and without much difficulty. At all events, a broad range of short-term hedging facilities (such as forward exchange contracts) are available on the financial markets, and these facilities are both cheap and tailored to the specific needs of customers. Consequently, many empirical studies on the impact of temporary exchange rate volatility on foreign trade have found that this impact is very slight – provided a statistically significant connection could be established at all.[1]

... than lengthier shifts in exchange rate patterns

By contrast, lengthier shifts in exchange rate patterns are of greater significance. The most recent example of such a shift occurred in the spring of 1995 when, as a knock-on effect of the weakness in the dollar at that time, some European currencies lost considerable ground against the Deutsche Mark. This resulted in a temporary but distinct deterioration in the price competitiveness of German exporters. Generally speaking, it used to be such relatively lengthy systemic deviations in exchange rate movements from the path indicated by inflation differentials that put the international price competiveness of German exporters to a severe test of endurance at times. Distortions in competition between Germany and its major European trading partners arising from such shifts in exchange rate patterns would be eliminated by the irrevocable fixing of currency parities within EMU.

Advantages of fixing rates should not be overstated

Nevertheless, the positive effects of the associated reduction in exchange rate risks in trade within the monetary union should not be overrated because this reduction will eliminate not only completely unproductive exchange rate disturbances but also exchange rate adjustments to take account of changes in economic fundamentals or emerging disparities between the participating countries. Fundamentally justified – non-monetary – adjustment requirements of this nature would be reflected under such conditions in other ways, just as the consequent uncertainties would not disappear simply through the definitive fixing of rates with the countries participating in monetary union. While external disturbances which affect the domestic economy via the "exchange rate channel" will become less important, any adjustments necessitated by fundamental imbalances between the various participating countries must then be made through other macroeconomic variables. Effective precautions against this can only be taken if all participants make a determined effort to converge. But even then the question still remains as to how the currency relations of the euro area will move against the currencies of third countries. Reliable and sufficiently concrete answers are still not available.

1 See, for example, International Monetary Fund (1984), Exchange Rate Volatility and World Trade, Occasional Paper 28; European Commission (1995), The Impact of Exchange-Rate Movements on Trade within the Single Market, European Economy, No. 4; Clark, P.B./Faruqee, H. (1997), Exchange Rate Volatility, Pricing to Market and Trade Smoothing, IMF Working Paper 97/126.

Exchange rate fluctuations and real foreign trade flows

Export and import elasticities

What the significance of the reduced effect of exchange rates will be will largely depend on the corresponding degrees of export and import elasticities. In order to gain some idea of the magnitude of the variables on which they are based the relevant exchange rate elasticities were estimated econometrically by means of correspondingly differentiated export and import functions. Details of the methodology used here and the results obtained are given in the annex. In principle, the method used was similar to the one used by the Bundesbank in earlier analyses on the impact of exchange rates on Germany's foreign trade.[2] By contrast, regionally differentiated exchange rate elasticities were estimated in the work presented here. These enable a distinction to be made between the exchange rate influences emanating from trade with other EU countries and with countries outside the EU.

EMU changes exchange rate effects on exports ...

According to these calculations, a real appreciation of the Deutsche Mark, as expected, curbs the growth rate of German exports (in real terms). If there is a lasting real appreciation of 1% in the Deutsche Mark against (the weighted average of) all the currencies (of 18 industrial countries) included in the calculation, there is a longer-term decline of approximately 0.7 % in German exports provided all other things remain the same. If the appreciation of the Deutsche Mark is restricted to the currencies of third countries (outside the EU), by contrast, the curb in Germany's total exports – including those to EU countries whose exchange rates are assumed to have remained unchanged – is less pronounced, as expected. According to the estimates, a 1% appreciation in real terms reduces German exports by no more than just under 0.3 %. Provided the underlying patterns could be extended into the future and applied to the conditions obtaining under monetary union, German exports would therefore be substantially less susceptible to exchange rate fluctuations because under these conditions a large number of Germany's export markets would be regarded, as it were, as a "domestic market" within the enlarged currency area. At least at first sight, these findings are fairly consistent with the figures which were obtained from the integration ratios mentioned at the beginning of this article. Assuming a monetary union with all EU countries participating, that is to say, a country group which accounts at present for almost 60 % of German exports, the exchange rate elasticity on the export side would decline by a similar amount, according to these estimates.

... and on imports ...

Imports provide a second channel for transmitting the effects of exchange rate fluctuations to the real economy. It is generally assumed that a real appreciation alone makes foreign goods relatively cheaper and therefore increases the demand for imported goods. The results of the test calculations carried out on the basis of the real external value of the Deutsche Mark (weighted with the corresponding import shares) support this hypothesis. The (partial) effect is positive,

2 See Deutsche Bundesbank, Exchange rate and foreign trade, Monthly Report, January 1997, page 41 ff.

Exchange rate elasticities in German foreign trade *

Item	Elasticities in terms of the real external value of the Deutsche Mark 1		
	Total	Compared with non-EU currencies	Relative difference in %
Exports 2	– 0.70	– 0.28	– 60.0
Imports 2	0.25	0.07	– 72.0
Trade balance 2, 3	– 0.95	– 0.35	– 63.2

* The elasticity shows by what percentage the (real) exports and imports or the balance of trade change as a result of a 1% real appreciation of the Deutsche Mark. The figures are based on the estimated export and import functions, which are explained in more detail in the annex. The period used for the estimates is from the first quarter of 1975 to the second quarter of 1997. — **1** Weighted external values calculated with the relevant export or import weights. — **2** Deflated by the corresponding index for foreign trade prices. — **3** Defined here as the proportion of (real) exports to imports.

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judging by the plus sign; with a value of 0.25, however, it is distinctly smaller than in the case of exports. This lesser exchange rate elasticity of (real) imports could be a reflection of Germany's relatively inelastic demand for raw materials owing to the country's dependence on imported raw materials. Regardless of that, the low elasticity could also indicate that the income and substitution effects of real appreciations or depreciations interact differently on the import side than on the export side.

As far as the significance of monetary union for the exchange rate effects on the demand for imports is concerned, the main point of interest is the elasticity of imports in terms of the currencies of third countries outside the future single currency area. Owing to the same absence of more precise information about the group of participating countries that emerged in the case of exports, this currency area is assumed here to be the entire area of the EU countries. According to the estimated figures detailed in the annex, the elasticity is reduced to less than 0.07; this means that a real appreciation of 1% (against the currencies of third countries) will result in the long term in a rise of 0.07% in the German demand for imports. Thus, the response of imports to exchange rate changes would be only just over one-quarter of what it is now. This means, in turn, that on the import side, too, the picture conveyed by the simple comparison mentioned at the beginning of this article and made on the basis of the regional breakdown of German foreign trade is more or less confirmed. Although the accuracy of the estimated results should not be overrated, the exchange rate elasticities actually tend to suggest a somewhat greater stabilising effect than expected at first sight from the changes in foreign trade shares.

... and on the trade balance

If the results of the two regressions for export and import flows are taken together, conclusions may also be drawn on the direct effect of a real appreciation on the balance of trade (in real terms).[3] Assuming all other conditions remain the same and disregarding any other secondary factors, the balance of trade likewise deteriorates by approximately 1% over the longer term if there is a (lasting) 1% appreciation of the Deutsche Mark against the currencies of the 18 major industrial countries. In the event of a monetary union this ef-

3 Defined here as the proportion of real exports to imports.

fect, depending on the size of the participator group, will decline to roughly one-third of the response level originally calculated. In short, it can therefore be said here, too, that in view of the elasticities established the reduction in the exchange rate effects on German foreign trade will be somewhat greater than what would have been expected on the strength of the change in the exchange rate effects on foreign trade shares mentioned at the beginning.

Disturbance potential on the exchange rate side

Greater fluctuations in non-European currencies ...

These results should be interpreted with care, however. After all, the differences in elasticities in isolation provide only a limited amount of information on the significance of exchange rate movements for German economic trends under the conditions of a monetary union. Experience shows that there are sometimes considerable differences in the extent of the disturbance potential when various currencies are involved. These differences can greatly influence the variations shown between the elasticities concerned. For that reason, lesser exchange rate elasticities are not necessarily regarded as more desirable than greater elasticities if it is likely that the lesser elasticities apply to currencies with a relatively pronounced exchange rate volatility and the greater elasticities to currencies with relatively stable exchange rates. It is only the combined effect of the exchange rate volatility of the given currency and the elasticity with which the economy concerned responds to it that enables a comparison to be made between the two sets of circumstances with respect to external disturbances.

... in contrast to a more stable real external value against EU currencies ...

On an average of the past 20 years the variability of the real external value of the Deutsche Mark against the other EU currencies was actually much less pronounced than it was against other (non-European) currencies. In terms of the standard deviation, the degree of fluctuation of the real external value of the Deutsche Mark against the currencies outside the EU currency area is almost twice as high as it is against EU currencies. There are good reasons for the greater cohesion of the European currencies. The much closer real economic integration of the European industrial countries is a factor here whereas in respect of the dollar the transactions on the more volatile financial markets are of far greater importance for exchange rate trends. However, it is notably the progress in convergence made in Europe over the past two decades and the greater similarity in the economic cycle of European partner countries that are reflected in the greater exchange rate stability against other European currencies. In a sense, the German economy, like that of the other EU partner countries, is already benefiting in the run-up to European monetary union from the joint efforts at improving the fundamentals in the form of greater exchange rate stability. Consequently, the actual entry into monetary union will remove fewer exchange rate uncertainties than one might possibly have thought at first sight.

The "benefit" of a reduction in the effects of exchange rates arising solely from the lesser

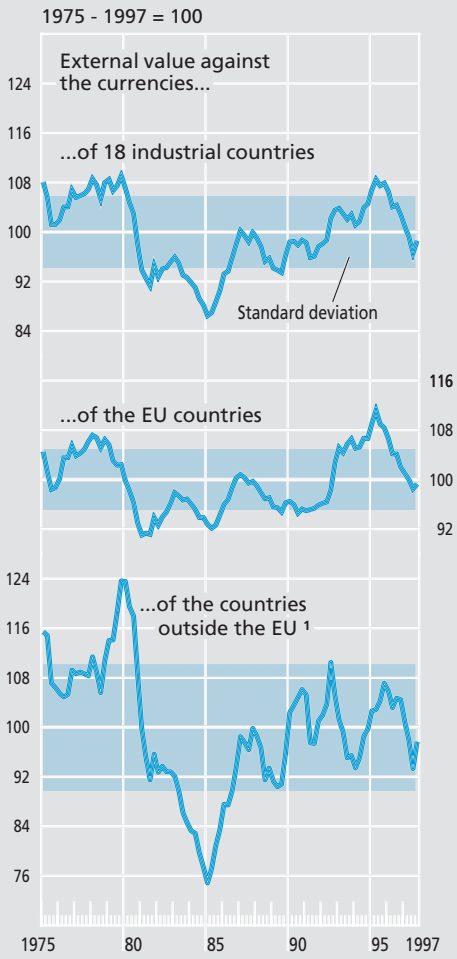
... qualify reduced effects of exchange rates

foreign trade elasticities is therefore subject to qualification in view of the greater degree of volatility of currencies outside the EU. If the various influences are condensed into one overall effect, the stabilising effects of a lesser degree of exchange rate susceptibility, which stems in purely arithmetical terms from the greater currency area, are substantially reduced by the greater volatility of the non-EU currencies. In any case, the overall effect is ultimately less than had been suggested by the elasticities originally calculated without taking account of the different exchange rate volatilities.

Conclusions

The modification described does not change the basic finding, namely that the sensitivity of the German economy to exchange rate fluctuations will decline after the introduction of the euro – at least, that will be the case if the fluctuation bands observed during the past two decades are reliable. The possibility that the relationships observed may be altered to some extent by the systemic change that the introduction of EMU entails cannot be ruled out, however. The main uncertainty is how the exchange rate of the euro will develop in relation to the third currencies, especially the dollar. This will depend on a number of factors whose significance is still difficult to assess. How successful the new European currency is in taking over the present functions of the Deutsche Mark as an international investment and reserve currency and as an international transactions medium will be crucial here. The conditions for this are favourable in many respects. Nevertheless, the disturbance potential associated with the expected restructuring of portfolios and redistribution of assets on the part of international investors cannot be overlooked. Unless there is a credible European monetary policy which leads market participants to expect the necessary anti-inflationary stance, the advantages of the reduced effects of exchange rates could be considerably impaired under the conditions of monetary union.

Real external value of the Deutsche Mark *



* Nominal external value after adjustment for the differing movements in overall prices (as measured by the price indices of total sales). — 1 Canada, Japan, Switzerland and the United States.

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Regardless of that, it must also be remembered that with the disappearance of exchange rate fluctuations within the euro area the possibility of fundamental tensions and diversions which would have led to exchange rate adjustments under other conditions does not automatically disappear at the same time. The uncertainties and competition risks which ultimately arise from this can be limited to the necessary minimum in all monetary systems only by satisfactorily functioning market structures and sound monetary and fiscal policies.

Annex

Econometric analysis of different regional exchange rate elasticities in German foreign trade

Method

The usual hypotheses on the patterns of export and import demand which are generally explained as functions of an activity variable (such as world trade in the case of exports) that has to be defined more accurately and of a measure for the real exchange rate as a relative price variable form the basis for the empirical assessment of the effects of exchange rates on German foreign trade. The precise specification of export and import functions here draws on previous empirical studies on the relationship between exchange rates and foreign trade.[4]

Specification of export demand

The (real) export volume (x) is explained by a foreign activity variable (y^W) and the real external value of the Deutsche Mark (rax):

(1) $x = f(y^W, rax)$.

The (real) export volume is measured here in terms of German exported goods as defined in special trade (f.o.b.), deflated by the export price index. The world trade volume is used as the foreign activity variable. The real external value of the Deutsche Mark is weighted with the corresponding export shares taking account of third market effects and calculated on the basis of the price index of total sales.[5]

Regional differentiation

Regarding the specific question of the elasticities of exchange rate changes within and outside the group of EU countries, however, two sub-indices are used here instead of the total real external value (rax), namely the real external value against the currencies of the countries within the monetary union (rax^{WU}) and outside it (rax^{XWU}); it is assumed that there is a monetary union involving all EU countries:[6]

(2) $x = f(y^W, rax^{WU}, rax^{XWU})$.

4 See Deutsche Bundesbank, Exchange rate and foreign trade, Monthly Report, January 1997, page 55 ff.; Deutsche Bundesbank, Real exchange rates as an indicator of international competitiveness, Monthly Report, May 1994, page 56 f.; and Clostermann, J. (1996), The impact of the exchange rate on Germany's balance of trade, Discussion paper 7/96, Economic Research Group of the Deutsche Bundesbank, August 1996.
5 For a discussion of alternative methods of measuring the real external value of the Deutsche Mark see Deutsche Bundesbank, Real exchange rates as an indicator of international competitiveness, Monthly Report, May 1994, page 45 ff.; for the weighting system see Deutsche Bundesbank, Revision of the method of calculating the external value of the Deutsche Mark and foreign currencies, Monthly Report, April 1989, page 43 ff.
6 Alternatively, regionally disaggregated export and import functions could also be estimated. However, this method was not used here.

Export function

Variable	Coefficient	t-value	Coefficient	t-value
	Long-term regression			
y^w	0.88	43.32	0.88	44.27
rax	– 0.70	– 11.36		
rax^{WU}			– 0.36	– 3.41
rax^{XWU}			– 0.28	– 7.39
D1	– 0.07	– 4.46	– 0.06	– 4.44
D2	– 0.06	– 3.82	– 0.07	– 3.69
	Short-term regression			
ECT	– 0.70	– 7.48	– 0.73	– 7.27
Δy^w	0.94	7.53	0.93	7.37
Δx_{-1}	– 0.13	– 1.91	– 0.12	– 1.78
DS1	0.02	0.93	0.01	0.82
DS2	– 0.03	– 3.13	– 0.02	– 3.00
DS3	– 0.02	– 1.25	– 0.01	– 1.34
Constant	8.43	7.71	8.57	7.73
	Test statistics [1]			
$\bar{R}^2$	0.89		0.89	
LM (1)	0.40	[0.53]	0.25	[0.62]
LM (4)	1.31	[0.86]	0.94	[0.92]
ARCH (4)	1.96	[0.74]	1.18	[0.88]
JB	2.50	[0.29]	2.20	[0.33]

1 Error probability in brackets after the values. $\bar{R}^2$: adjusted coefficient of determination, LM (i): Breusch-Godfrey test on auto correlation with i lags, ARCH (4): autoregressive conditional heteroscedasticity with four lags, JB: Jarque-Bera test on normal distribution of residuals.

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Analogous specification of the import function

Strictly in line with the specification of the export equation, the import equation gives the imports as a function of an activity variable and of the real exchange rate. To estimate the (real) import demand (m) German imports of goods as defined in special trade (c.i.f.) are used and deflated on the basis of German import prices. In this case Germany's (real) GDP (y^D) is used as an activity variable. The real external value of the Deutsche Mark (ram) is calculated here on the basis of the import weights using the appropriate regional definition. On the basis of the regional breakdown of the real external value, this gives the following import function:

$$(3)\quad m = f(y^D, ram^{WU}, ram^{XWU}).$$

Data and method

To ascertain the export and import elasticities the export and import equations are estimated by using (logarithmic) quarterly data. The observation period lasts from the first quarter of 1975 to the second quarter of 1997. For the German time series data for western Germany were used until the fourth quarter of 1990 and thereafter data for Germany as a whole. All of the variables used are integrated of order 1 with the result that from the methodological side the cointegration approach could be used, thus taking account of both the short-term and long-term transmission mechanisms.[7] One-tier error correction models estimated in line with the Stock method are used as a basis for this.[8] The t-values of the long-term coefficients are established by means of the equation modified by Bewley.

This means, then, that in the first concrete step on the export side (after eliminating insignificant variables) the following functional relationship was estimated:

$$(4)\quad \Delta x_t = a_0 + a_1 [x_{t-1} - (a_2\, y^w_{t-1} + a_3\, rax_{t-1})] + a_4\, \Delta y^w_t + a_5\, \Delta x_{t-1} + \mu_t.$$

In the second step the real external value was broken down regionally and substituted. Technically,

$$a_3\, rax_{t-1} = a_6\, rax^{wu}_{t-1} + a_7\, rax^{xwu}_{t-1}$$

is inserted in (4).

By analogy, the following relationship arises on the import side:

$$(5)\quad \Delta m_t = b_0 + b_1 [m_{t-1} - (b_2\, y^D_{t-1} + b_3\, ram_{t-1})] + b_4\, \Delta y^D_t + b_5\, \Delta m_{t-2} + b_6\, \Delta m_{t-3} + b_7\, \Delta m_{t-4} + \mu_t$$

7 However, the results of the estimates should be seen in the light of the fact that the activity variables are more heavily trend-bearing than the real external value.
8 See Stock, J. H. (1987), Asymptotic Properties of Least Squares Estimators of Cointegrating Vectors, in Econometrica, Vol. 55, page 1035 ff. The robustness of the estimates is confirmed by alternative calculations using the method devised by Engle and Granger.

Import function

Variable	Coefficient	t-value	Coefficient	t-value
	Long-term regression			
y^D	2.07	53.41	2.07	53.05
ram	0.25	3.67		
ram^{WU}			0.18	1.72
ram^{XWU}			0.07	1.81
D1	– 0.13	– 8.29	– 0.13	– 8.11
D2	– 0.05	– 3.28	– 0.04	– 2.56
	Short-term regression			
ECT	– 0.80	– 7.21	– 0.80	– 7.14
ΔD1	– 0.07	– 2.62	– 0.07	– 2.59
ΔD2	– 0.10	– 4.28	– 0.10	– 4.12
Δy^D	1.57	8.84	1.57	8.77
Δm_{-2}	0.20	2.99	0.21	2.92
Δm_{-3}	0.17	2.20	0.17	2.16
Δm_{-4}	0.27	4.03	0.27	3.99
DS1	0.08	4.33	0.08	4.28
DS2	0.03	2.25	0.03	2.24
DS3	– 0.01	– 0.90	– 0.01	– 0.88
Constant	– 1.20	– 2.77	– 1.18	– 2.51
	Test statistics [1]			
$\bar{R}^2$	0.87		0.86	
LM (1)	2.02	[0.16]	2.00	[0.16]
LM (4)	4.63	[0.33]	4.66	[0.32]
ARCH (4)	3.57	[0.47]	3.51	[0.48]
JB	0.83	[0.66]	0.86	[0.65]

1 Error probability in brackets after the values. $\bar{R}^2$: adjusted coefficient of determination, LM (i): Breusch-Godfrey test on auto correlation with i lags, ARCH (4): autoregressive conditional heteroscedasticity with four lags, JB: Jarque-Bera test on normal distribution of residuals.

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and in the regionally differentiated estimate the following substitution is made in (5), again in line with the specification on the export side:

$$b_3\, ram_{t-1} = b_8\, ram^{wu}_{t-1} + b_9\, ram^{xwu}_{t-1}.$$

Statistical breaks in the time series

A jump dummy (D1), which assumes the value zero up to and including the fourth quarter of 1990 and the value 1 thereafter, takes account of the unification-related break in the German export data. The statistical break as a result of the change in recording Germany's trade in goods within the EU is likewise taken care of by means of a dummy variable (D2), whose value is zero up to and including the fourth quarter of 1992 and 1 thereafter. As the estimate is based on unadjusted data, the regressions also contain seasonal dummies (DS1 to DS3).

Estimates

The estimated results are summarised in the tables on this page and on page 57. They have a high explanatory value both for the export and for the import functions, and the parameters have the expected plus and minus signs. The residuals are uncorrelated and normally distributed. The error correction terms (ECTs) show in all equations the significantly negative sign necessary for a stable equilibrium over the long term and suggest a fairly high adjustment speed.

After elimination of the insignificant variables German gross domestic product and the import demand lagged by two to four periods remain, in addition to the dummies, in the short-term relationship of the import function. In the export function the short-term effects are determined by the world trade volume and the export demand lagged by one period.

As far as the long-term relationship is concerned, both the indices for the real external value and the activity variables are significant, each showing an error probability of 1%. These estimates are not broken down by region. The (long-term) elasticity of real exports in terms of the real external value amounts to – 0.7, according to these calculations. A 1% appreciation is therefore reflected in a 0.7 % reduction in exports. The partial exchange rate elasticity of the real external value against non-European currencies is just under – 0.3. By analogy, the exchange rate elasticity of German imports dimishes from 0.25 to 0.07 on entry into EMU. The coefficients of the exchange rate elasticities, however, are only slightly significant in the regionally differentiated estimate. Nevertheless, the similarity of the sum of the two regionally estimated elasticities to the total elasticity indicates a certain degree of reliability of the results.