The indicator quality of different definitions of the real external value of the Deutsche Mark

The international competitiveness of the German economy improved perceptibly in 1996 and 1997. During this period exchange rate relations eased distinctly and enterprises made considerable efforts to reduce costs. Bolstered by moderate pay settlements, Germany's competitive position was strengthened from several angles, so that the German economy was able to extend its position in the export markets last year. One indicator in which the aforementioned determinants of price competitiveness are combined is the real external value of the Deutsche Mark. However, the implications for Germany's international economic competitiveness vary greatly depending on how this indicator is defined.

Against this background, this article deals with the indicator quality of various definitions of real external value. It summarises the ideas on this topic published in previous Monthly Reports[1] and supplements them with more recent econometric analyses. The latter suggest that the real external value based on broadly defined macroeconomic price or cost deflators reflects the trends in price competitiveness of the German economy more adequately than the internationally

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1 See in particular Deutsche Bundesbank, Real exchange rates as an indicator of international competitiveness, Monthly Report, May 1994, page 45 ff. and Deutsche Bundesbank, Overall determinants of the trends in the real external value of the Deutsche Mark, Monthly Report, August 1995, page 17 ff.

widespread concept of relative unit labour costs in the manufacturing sector.

The indicator problem

Issue

An economy's international competitiveness depends on various factors which can never all be reflected by a single indicator. Thus, the competitiveness of German suppliers on foreign markets is not determined solely by direct price and cost components but also, for instance, by their ability to supply their products in time and in the quantity ordered, by the nature and maintenance of customer relationships, by the quality and innovativeness of their products, by a quick and flexible response to a changed market environment and by various non-economic influences such as political factors or psychological aspects.[2]

Therefore, real exchange rates merely reflect the development of the relative price or cost position of a country's economy. Hence they relate to only one aspect of international competitiveness, i.e. to the price or cost-related competitive conditions in international trade.

Requirements of an ideal indicator

Ideally, such indicators should satisfy three basic conditions

– they should relate to those sectors of the economy which face international competition, and hence comprise all internationally traded goods;

– they should comprehensively reflect the price or cost situation of these sectors;

– and they should be based on internationally comparable statistics.
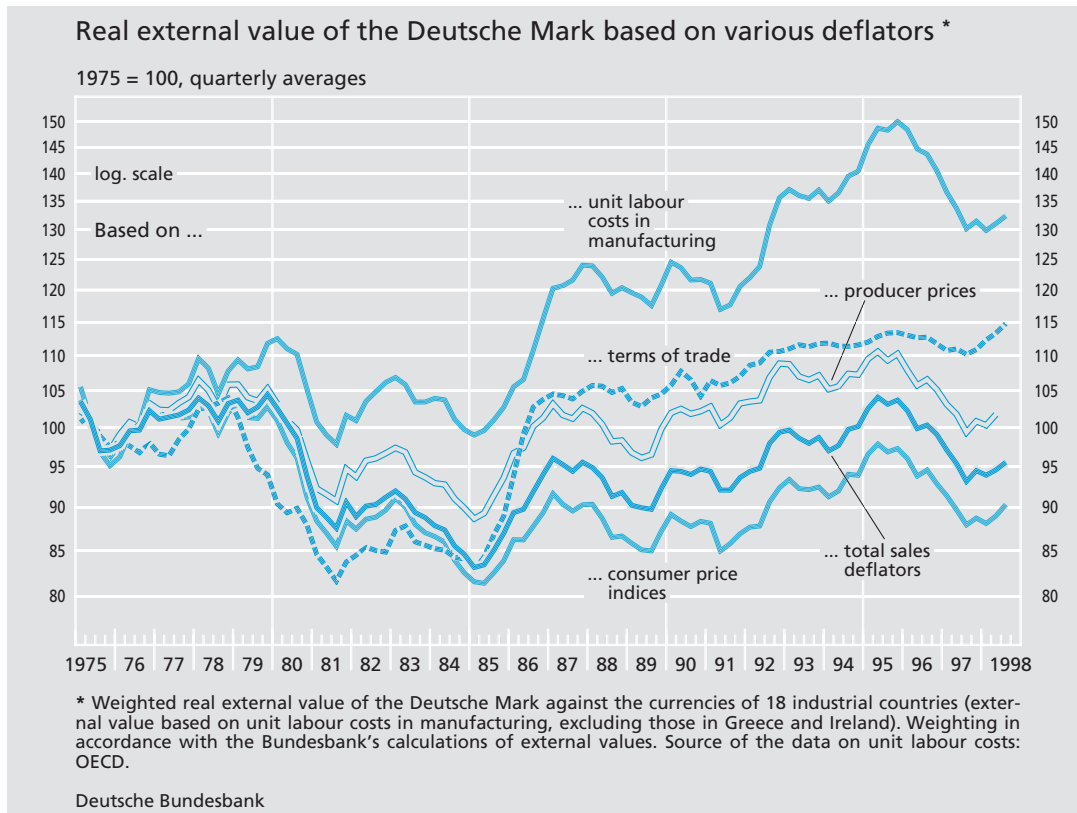
Pragmatic compromises

However, none of the measuring concepts actually used satisfies all of these conditions simultaneously and completely. Hence it is not surprising that in the literature there is broad agreement that no measuring concept exists which could uniformly be recommended as the "best" indicator for all countries and all times.[3] The customary measures of the real external value (or exchange rate) therefore represent compromises compared with the theoretical ideal. The use of more or less broadly defined price or cost variables to deflate the nominal external value – and hence to define the real external value – affects the latter's informative value as an indicator of international competitiveness. Thus for Germany different indicators sometimes show strongly deviating trends. This applies both to the longer-term trend and to the perceptible decline over the last two years, which amounted to between 10 % and 16 % depending on which definition of the real external value is used.[4]

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2 In the literature competitiveness is often conceived in terms of the "ability to sell" (following B. Balassa's definition), which is determined by the development of relative costs and prices, at least in the long run.
3 See Marsh, I. W., Tokarick, S. P. (1996), An Assessment of Three Measures of Competitiveness, Weltwirtschaftliches Archiv (Review of World Economics), Vol. 132, No. 4, page 719.
4 For the calculations presented in this article the weighting pattern which is based on the foreign trade structure of the period between 1984 and 1986 was used. An updated version of the weighting scheme is presented in the following article in this Monthly Report. The shifts resulting from that are small, however.

Real external value of the Deutsche Mark based on various deflators *

1975 = 100, quarterly averages

log. scale

Based on ...

... unit labour costs in manufacturing

... producer prices

... terms of trade

... total sales deflators

... consumer price indices

1975 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 1998

* Weighted real external value of the Deutsche Mark against the currencies of 18 industrial countries (external value based on unit labour costs in manufacturing, excluding those in Greece and Ireland). Weighting in accordance with the Bundesbank's calculations of external values. Source of the data on unit labour costs: OECD.

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Different measuring concepts for the real external value

Relative unit labour costs in manufacturing

Real external values based on unit labour costs in manufacturing are internationally widespread. An advantage of this indicator is that it covers a broad range of internationally traded goods, which in 1997 accounted for almost 98 % of German exports and 89 % of imports. Another advantage lies in the fact that it is a cost indicator. Unlike price indicators, cost indicators also reflect short-term deteriorations in the relative cost position which result in correspondingly lower profit margins for enterprises ("pricing-to-market" behaviour).[5]

One drawback, however, is that labour cost only covers a part of the total costs of indus-

try. Thus the share of labour cost in the total value of production in the German manufacturing sector, if looked at in isolation, "only" amounts to roughly one-quarter of the overall costs of this sector; this does not take into account the labour cost included indirectly in the intermediate products purchased from other domestic and from foreign sectors. In other words, the prices of intermediate goods (and the labour cost included therein) purchased from other domestic and from foreign sectors, capital cost and prices of imported energy and raw materials, taken together, have a far greater weight in the manufacturing sector's competitiveness in foreign trade than the labour cost incurred directly by industry. However, the picture changes if we

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

International comparison of unit labour costs

1975 to 1997

| Country | Unit labour costs 1997 (1975 = 100) | | Quotient |
	Manufac- turing	Total economy	
	(1)	(2)	=(1):(2)
Germany (West)	187.0	177.8	1.1
France	246.7	328.6	0.8
United Kingdom	368.7	391.3	0.9
Italy	417.5	676.8	0.6
Japan	117.8	170.2	0.7
Canada	238.1	258.7	0.9
United States	196.1	266.6	0.7
Memorandum item			
18 industrial countries (excluding Germany)	222.8	303.1	0.73

Source: OECD

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look at all the sectors, i.e. the economy as a whole: measured as a percentage of total domestic value added (GDP), labour cost is by far the most important cost component, with a share of over half.

Under these circumstances the development of the manufacturing sector's relative labour cost position only permits inferences about its competitiveness in terms of costs if the structure of the unit labour costs of the total economy remains unchanged both in the domestic economy and in partner countries. However, if shifts occur in the relative cost structures of the countries involved, such unit labour cost comparisons, taken by themselves, permit only limited inferences to be drawn concerning the development of total unit costs and hence concerning industry's competitiveness.

Thus a change towards more capital-intensive production methods could lead to a reduction in unit labour costs which would, however, be offset by a rise in capital cost. This would limit the informative value of unit labour costs.[6]

Special features of the structure of unit labour costs ...

An international comparison of the development of unit labour costs in manufacturing and in the economy as a whole shows how significant such structural aspects are in the case of Germany. Unlike most other industrialised countries, Germany exhibits an unusual development of the unit labour cost structure. Whereas in many countries unit labour costs in the manufacturing sector increased less than those in the other sectors of the economy on average over the past two decades, Germany showed precisely the opposite trend: in the last two decades, unit labour costs in manufacturing rose more sharply than in the other sectors of the German economy. So compared with most of Germany's trading partners, the relative unit labour cost position of the German manufacturing sector has developed less favourably than the relative unit labour costs in other sectors of the German economy. However, the manufacturing sector's relative (total) cost position, and hence the competitiveness of its products on the world markets, improves over time to the extent that it uses intermediate products purchased from other domestic and from foreign sectors in production. By contrast, the

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6 Lipschitz and MacDonald demonstrate that very restrictive assumptions are required if unit labour costs are to reflect international competitiveness adequately. See Lipschitz, L., MacDonald, R. (1992), Real Exchange Rates and Competitiveness, Empirica, Vol. 19, No. 1, pages 37 to 69.

relative competitiveness of foreign competitors diminishes with the use of intermediate products purchased from other sectors.

... lead to distortions

Therefore, real external values based on unit labour costs in manufacturing can easily lead to misinterpretations. On the whole, the trend in the real external value based on unit labour costs in the manufacturing sector constantly increased in Germany over the last two decades. But exporters were not affected by corresponding losses in profitability or poorer market performance.[7] This apparently contradictory phenomenon can be explained by the specific cost trend in the individual sectors of the German economy, which is rather unusual by international standards.

Measuring and definitional problems

The reasons for this statistical deficiency are not easy to identify. There is some evidence that measuring and definitional problems regarding the manufacturing sector play a role, hampering the international comparability of data. They might be attributable to the fact that the degree of outsourcing of certain supply and service functions by the manufacturing sector in this country differs considerably from that in the majority of Germany's partner countries. Another significant factor could be the different national statistical treatment of wages and salaries; particularly with regard to the inclusion of non-wage labour costs, which are more substantial in manufacturing than in the services sector, definitions differ from one country to another. The shortening of weekly working hours, which is more advanced in Germany than in many other countries and which is largely concentrated on the manufacturing

sector, may likewise have contributed to the internationally differing trends.

Relative unit labour costs of the total economy

The quantitative significance of the aforementioned factors cannot be assessed in detail on the basis of the available information. However, it is possible to demonstrate that the significance of the distorting factors diminishes if the "cost base" is broadened. This applies, for instance, to the development of real external values based on unit labour costs of the total economy. Real external values calculated in this way exhibit a different trend than the more narrowly defined indicator and hence are more plausible in the context of overall external economic development.[8]
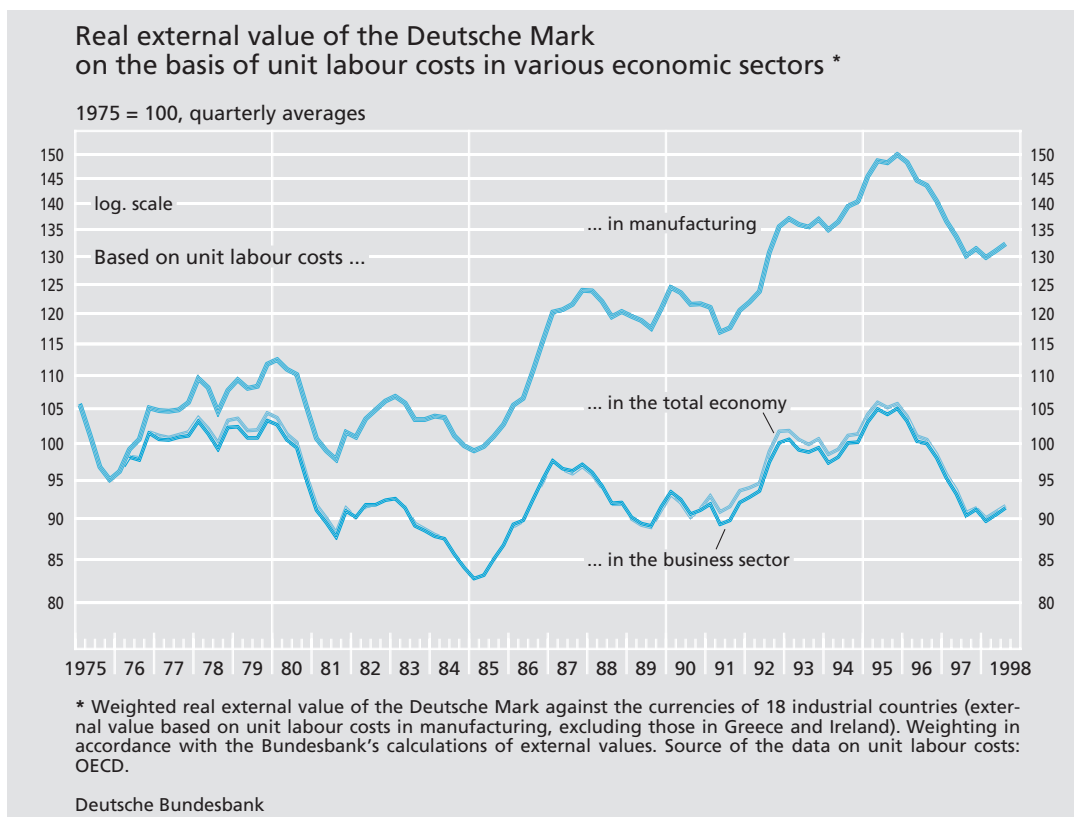
Macroeconomic cost and price deflators

The real external value's explanatory value is enhanced even more if total costs are taken into account rather than just labour cost. In this context, the price deflator of total sales is a comprehensive indicator which includes the costs of imported goods and services as well as the (unit) costs of the value added in the whole domestic economy. One disadvantage of using it, however, is the fact that there is a considerable time-lag before the necessary raw data become available from the national accounts of a number of countries. Another disadvantage is that these figures can be subject to fairly substantial revision.

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7 Feldman, A. (1994), Measures of External Competitiveness for Germany, International Monetary Fund, Working Paper 94/113, and OECD (1995), Economic Surveys, Germany, Paris, page 31 ff.
8 A broadly similar result is obtained by tracking unit labour costs in the business sector.

Real external value of the Deutsche Mark
on the basis of unit labour costs in various economic sectors *

1975 = 100, quarterly averages

* Weighted real external value of the Deutsche Mark against the currencies of 18 industrial countries (external value based on unit labour costs in manufacturing, excluding those in Greece and Ireland). Weighting in accordance with the Bundesbank's calculations of external values. Source of the data on unit labour costs: OECD.

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Relative consumer prices

One alternative permitting the timely calculation of current-end data which are much less subject to retrospective adjustment is to calculate the real external value based on consumer prices. For this reason, the real external value established in this way is relatively well suited for international comparisons. However, several conceptual problems must be taken into account when interpreting a real external value calculated on the basis of the consumer price index to be used as a measure of international competitiveness. For example, goods which are not traded internationally and are not in direct competition with comparable products from foreign suppliers have a great weight in the relevant baskets of goods. On the other hand, price movements in capital goods, which account for a large part of Germany's foreign trade,

Conceptual deficiencies

are, of course, not taken into account in consumer prices. Indirect taxes, which are partly refunded when domestic goods are exported, may also distort this indicator.

For theoretical reasons the failure to differentiate between internationally traded and non-traded goods when calculating real external values based on highly aggregated macroeconomic indicators, such as the deflator of total sales or unit labour costs of the entire business sector, is often deemed to be a serious deficiency. One way this might be avoided would be to use the prices of the actually traded goods instead of more cost-oriented indicators. For this purpose, real external values based on foreign trade prices or the terms of trade could be used.

Foreign trade prices and terms of trade

Producer prices of industrial products

However, the use of these variables as deflators also has its limitations, since, for instance, it is based exclusively on products which are successful in international competition, while the uncompetitive sectors of the domestic economy are disregarded. This objection could be overcome by using real external values based on producer prices of industrial products. However this method would, by definition, exclude non-industrial goods and, more importantly, disregard international trade in the services sector, which has gained increasing importance over the last few years and will continue to do so as liberalisation advances further in this field.

But actually the indicators specified above all show a pattern of development which is quite similar to that of the real external value based on the price deflators of total sales or on unit labour costs in the business sector. This is a further indication that the pronounced real appreciation obtained in the long run when using unit labour costs in manufacturing as a measure appears to be misleading.

Summary

If we summarise the arguments outlined above, there is quite a lot of evidence suggesting that broadly defined price and cost indicators are superior as measures of the German economy's international competitiveness. Contrary to practically all the other indicators, the internationally widespread definition based on relative unit labour costs in the manufacturing sector, in particular, would lead in the long run to considerable misinterpretations in the case of Germany. Therefore, the Bundesbank has always preferred to use

the more broadly defined indicators, particularly those based on the price or cost deflator of total sales, in its analyses – in spite of the difficulties and disadvantages connected with this concept. Alternatively, the Bundesbank uses real exchange rates based on consumer prices for reasons of international comparability.

Recent studies on the indicator quality of selected measures of the real external value

Recent studies regarding the indicator quality of various indicators of the real external value support this position.[9] They are mainly based on an analysis by Marsh and Tokarick[10], who proceeded from the assumption that – as described above – certain compromises must be accepted in the case of all the indicators, i.e. that there is no single indicator which would satisfy all the requirements of the ideal measure. The decisive criterion applied to the different competing indicators was the "explanatory power" of the relevant real exchange rates as to the movements of real exports and imports or the respective market shares. First, export and import functions were estimated, which describe real exports as a function of the world trade volume and the real external value of the Deutsche Mark,

Systematic comparisons of the indicator quality

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9 See 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, and by the same author (1997): The real effective D-Mark exchange rate as a measure of Germany's competitiveness, address to the 23rd Ciret conference in Helsinki from July 30 to August 1, 1997. These papers can be obtained by interested parties upon request.
10 Marsh, I. W., Tokarick, S. P. (1996), loc. cit.

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and real imports as a function of the real gross domestic product and the real external value. These estimations were carried out for five competing indicators of the Deutsche Mark's real external value based on the following price and cost indices:

– unit labour costs in manufacturing,

– price or cost deflator of total sales,

– consumer prices,

– producer prices of industrial products,

– terms of trade.

In addition to the indicators studied by Marsh and Tokarick, our analysis included the external value based on the total sales deflator and on the terms of trade. Furthermore, the estimation period was extended to cover the first quarter of 1975 to the fourth quarter of 1996, whereas the data available to Marsh and Tokarick only went up to the end of the fourth quarter of 1991. However, sensitivity calculations showed that the estimation results are relatively insensitive to the choice of the estimation period.

Estimation results

The results[11] of these estimations are remarkable in various ways. At first sight, they do not seem to indicate any marked differences between the different indicators with regard to their suitability; all the measures of the Deutsche Mark's real external value studied in this article show an explanatory correspondence with real exports and imports that is statistically significant and has a plausible

sign. In the case of the export function, however, the estimations provide a slightly better fit for the real external value based on the total sales deflator than on unit labour costs in manufacturing or the terms of trade.

The different indicators can also be differentiated as regards the estimated long-run elasticities of the export function and the resulting implications for the development of German world market shares. Thus the use of real exchange rates based on unit labour costs in manufacturing yields an elasticity in relation to the volume of world trade which is clearly higher than unity (roughly 1.2), whereas the corresponding parameters of the indicators based on the total sales deflator and on consumer prices are distinctly below unity (roughly 0.8). In view of the fact that German world market shares, like those of other industrial countries, have tended to decrease slightly with the growing importance of developing countries and – more recently – of the countries in transition, the lower elasticities yielded by the more broadly defined indicators are more plausible, since they imply decreasing world market shares for the German economy in the long run. By contrast, only a trend showing increasing German market shares would be consistent with the estimation based on unit labour costs in manufacturing. These considerations thus likewise argue in favour of relatively broadly defined indicators based on the total sales deflator or on consumer prices, although the differences are not that great in purely statistical terms.

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11 For the complete estimation results see the Annex.

However, given that the different indicators produce similar results in explaining trade flows, it appears justified to assume that they contain very similar information regarding the long-run trend in German foreign trade. This possibility was examined using cointegration tests based on the Johansen approach. No cointegration was found between the five indicators studied. Therefore, we must assume that, to some extent, the indicators contain different long-run information. This could provide a basis for ranking the indicators, at least if two indicators contained different information but one of them covered all the information of the other indicator plus additional competition-related information.

Information content of the competing indicators

To test this, a second, stricter test method was applied which sought to differentiate the different measuring concepts quite generally by their respective information content. Specifically, this entailed determining for all of the real exchange rate indicators under consideration whether the estimation of the export function using the indicator of the real external value X could be significantly improved by additionally including a second indicator Y. This comparative calculation was carried out for all the conceivable combinations of the five measuring concepts of the real external value considered in this article. The test showed that the real external value based on the total sales deflator, as described above, was superior to all the other indicators under consideration. None of the indicators was able to significantly improve on the explanation of German export trends through

the real external value based on the total sales deflator. For all the other indicators, there was at least one other indicator that contained important additional information – and this invariably included the real external value based on the total sales deflator. Real external values based on consumer and producer prices came second in this study, whereas the narrowly defined real external value based on unit labour costs in manufacturing or the terms of trade were the "losers".

Similar tests were carried out to determine the information content of the different indicators of external value with regard to import trends. The results largely matched those described for the trend in exports. In this case, too, the real external value based on the total sales deflator, as also the indicators based on consumer and producer prices, proved superior to an approach based on the unit labour costs in manufacturing or on the terms of trade. In contrast to the test results for the export trend, however, the broadly defined indicators based on the total sales deflator, consumer or producer prices were largely equivalent in terms of their information content.

On the whole, the econometric analyses presented in this article support the view that the real external value based on the total sales deflator, in particular, is a more accurate measure of the price competitiveness of the German economy than is the internationally widespread concept of relative unit labour costs in the manufacturing sector.

Result

Annex

Various indicators of real external value in econometric tests: results [12]

Approach

For the purpose of discriminating between different real external value indicators, export and import functions were first estimated using alternative real external value indicators (Q) as an explanatory variable (besides the respective variables of macroeconomic activity or income). The approach chosen was modelled on earlier empirical studies by the Bundesbank on German foreign trade. [13] The calculations were carried out using five different indicators of real external value based on

– unit labour costs in the manufacturing sector, Q(ulc),

– consumer prices, Q(cpi),

– producer prices, Q(pp),

– terms of trade, Q(tot),

– total sales deflators, Q(exp).

The sample period runs from the first quarter of 1975 to the end of the fourth quarter of 1996. In line with usual practice, (real) exports (EXR) and (real) imports (IMR) were measured according to the special trade definition (fob/cif) and deflated using the export and the import price index, respectively. The activity variable used in the export equations was the volume of world trade (WHV); in the import functions this variable was German (real) gross domestic product (YR). The estimations were carried out using one-step error correction models according to the Stock method. [14] The lag structure of the variables of the short-run relation

expressed in first differences was calculated by starting with four lags for each variable and then excluding non-significant variables from the estimation by iteration. [15]

Due account of statistical breaks in the time series was taken in the estimations by including two dummy variables. One shift dummy (D1) covers the break in the statistical coverage of German foreign trade due to German unification; it was given the value 1 from the first quarter of 1991 onwards and 0 prior to that. The second dummy variable (D2) has been added to recognise the effect of the statistical break which occurred in connection with reclassifications in foreign trade statistics and was set at 0 up to the end of the fourth quarter of 1992 and subsequently at 1.

Statistical breaks in the time series

The table on page 49 summarises the estimation results. At first sight, at least, the estimation results appear to be quite similar, both for the export and the import functions, irrespective of which indicator of the Deutsche Mark's real external value the calculations were based on. The activity variables and the real external values each have the expected signs, the error correction terms (ECT) are negative and highly significant and thus demonstrate a stable long-run relationship of the specified variables. The residuals are normally distributed and uncorrelated.

Estimation results

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12 For a more detailed description and explanation of the test results see Clostermann, J. (1997), loc. cit.

13 See Deutsche Bundesbank, Exchange rate and foreign trade, Monthly Report, January 1997, page 55 ff.; Deutsche Bundesbank, Effects of exchange rates on German foreign trade, Monthly Report, January 1998, page 49 ff.; Clostermann, J. (1996), loc. cit.

14 ADF tests showed that the variables were integrated of the order of one. The t-values of the long-run coefficients were calculated in the error correction equations by using the Bewley transformation.

15 These estimations were carried out using the stepwise method of the software program RATS 4.20.

Export function

Variable	Q(cpi)		Q(exp)		Q(pp)		Q(tot)		Q(ulc)	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Long-run regression										
WHV	0.78	28.96	0.85	36.75	0.92	31.64	1.02	16.93	1.17	23.91
Q	− 0.73	− 10.90	− 0.74	− 11.25	− 0.97	− 8.24	− 0.65	− 3.79	− 0.87	− 6.35
D1	− 0.05	− 3.54	− 0.05	− 3.24	− 0.04	− 1.95	− 0.11	− 2.65	− 0.09	− 3.74
D2	− 0.03	− 2.02	− 0.05	− 3.30	− 0.06	− 3.04	− 0.11	− 2.60	− 0.05	− 1.99
Constant	12.57	31.77	12.32	33.91	13.10	22.31	11.16	14.58	11.48	22.37
Short-run regression										
Δ D1	0.02	0.79	0.02	0.96	0.03	1.42	0.03	1.23	0.02	0.94
Δ D2	− 0.04	− 1.84	− 0.05	− 2.27	− 0.04	− 1.84	− 0.05	− 1.72	− 0.03	− 1.18
Δ EXR_{-1}	–	–	− 0.15	− 2.10	− 0.23	− 3.19	− 0.23	− 2.76	− 0.26	− 3.29
Δ WHV	0.76	4.91	0.78	5.38	0.87	5.92	1.02	5.75	0.91	5.80
ECT	− 0.72	− 7.26	− 0.69	− 7.14	− 0.52	− 6.41	− 0.30	− 3.84	− 0.43	− 5.40
Test statistics [1]										
$\bar{R}^2$	0.558		0.608		0.592		0.460		0.544	
LM (4)	1.745		0.738		0.819		0.298		0.195	
ARCH (4)	0.947		0.869		0.490		0.681		0.906	
JB	2.802		1.477		1.607		1.517		1.499	

1 $\bar{R}^2$: adjusted goodness of fit, LM (4): Breusch/Godfrey test for serial autocorrelation with four lags, ARCH (4): autoregressive conditional heteroscedasticity test with four lags, JB: Jarque/Bera test for normal distribution of residuals.

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Export demand

In the long-run relation the estimated elasticities of (real) exports in relation to the real external value are between − 0.73 and − 0.97, depending on the deflator chosen. Although all the t-values are statistically significant between each of the real exchange rate indicators and real exports, a simple comparison of these values shows that the use of real external values based on the total sales deflator or on consumer prices tends to be slightly more highly significant than calculations using the terms of trade or the real external value based on unit labour costs.

The (long-run) elasticities of real exports in relation to the volume of world trade range from 0.78 to 1.17, depending on the external value chosen. Elasticities greater than unity indicate that exports tend to grow more strongly than the volume of world trade. Accordingly, German exporters would have to gain world market shares. In view of the growing participation of developing countries and countries in transition in world trade, this implication does not seem very plausible and, what is more, it contradicts the observed long-run trend towards lower world market shares for Germany. Hence, export elasticities in relation to world trade that are smaller than unity appear to be more convincing, which also explains a certain preference for the corresponding external value indicators (based on the total sales deflators and consumer prices) and, in particular, makes the external value based on unit labour costs in manufacturing appear not as well suited.

Import demand

On the imports side the partial exchange rate elasticities of (real) imports in relation to the real external value amounted to between 0.18 and 0.25 in the long-run relation. The response of real imports

Import function

Variable	Q(cpi)		Q(exp)		Q(pp)		Q(tot)		Q(ulc)	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Long-run regression										
YR	2.12	48.69	2.07	56.49	2.03	56.41	1.97	42.52	1.91	35.56
Q	0.22	4.26	0.21	4.38	0.25	3.99	0.20	3.74	0.18	2.84
D1	− 0.14	− 9.09	− 0.13	− 9.12	− 0.13	− 8.45	− 0.11	− 5.99	− 0.11	− 5.99
D2	− 0.06	− 4.52	− 0.05	− 4.42	− 0.05	− 3.77	− 0.04	− 2.64	− 0.05	− 3.18
Constant	− 1.63	− 3.56	− 1.31	− 3.41	− 1.21	− 3.06	− 0.58	− 1.87	− 0.14	− 0.55
Short-run regression										
Δ D1	− 0.07	− 2.77	− 0.07	− 2.71	− 0.06	− 2.46	− 0.04	− 1.63	− 0.05	− 1.94
Δ D2	− 0.09	− 4.38	− 0.09	− 4.37	− 0.09	− 4.41	− 0.10	− 4.72	− 0.09	− 4.24
Δ IMR$_{-2}$	0.23	3.25	0.24	3.33	0.24	3.30	0.18	2.54	0.26	3.47
Δ IMR$_{-3}$	0.17	2.03	0.17	2.13	0.17	2.05	–	–	0.19	2.16
Δ IMR$_{-4}$	0.23	3.28	0.24	3.35	0.24	3.40	0.19	2.73	0.25	3.45
Δ YR	1.61	8.24	1.60	8.25	1.53	7.96	1.34	6.94	1.47	7.45
ECT	− 0.84	− 6.84	− 0.85	− 6.90	− 0.80	− 6.78	− 0.66	− 6.32	− 0.73	− 6.17
Test statistics [1]										
$\bar{R}^2$	0.637		0.639		0.634		0.617		0.607	
LM (4)	1.361		1.329		1.476		2.245		1.163	
ARCH (4)	1.118		1.057		1.031		0.281		0.817	
JB	1.078		1.042		0.842		0.044		1.146	

1 $\bar{R}^2$: adjusted goodness of fit, LM (4): Breusch/Godfrey test for serial autocorrelation with four lags, ARCH (4): autoregressive conditional heteroscedasticity test with four lags, JB: Jarque/Bera test for normal distribution of residuals.

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to changes in German real gross domestic product ranged from 1.91 to 2.12. However, as in the results for the export functions, both the t-values and the (adjusted) goodness of fit ($\bar{R}^2$) indicate that the coefficients of the real external values based on broad deflators (consumer prices, total sales prices) are slightly more statistically significant.

Analysis of the indicator quality …

However, a simple comparison of parameters and their significance level is not sufficient to draw definitive conclusions concerning the quality of the competing indicators,[16] whereas approaches which analyse the information content of the different variables would appear to be better suited. The question examined in the test carried out for this purpose was, whether the respective competing indicators are able to contribute additional information to the external value indicator speci-

fied.[17] To determine this, another indicator variable was added to the export and import equations so that each of the estimation equations now included two different real external values. Subsequently, the significance of their coefficients was analysed.[18]

16 On the following explanations see, in particular, Clostermann, J. (1997), loc. cit., and on the chosen approach Marsh, I. W., Tokarick, S. P. (1996), loc. cit.
17 The reason why this analysis only takes long-run elasticities into account is that the short-run elasticities do not help to differentiate between alternative external value indicators, since they regularly turned out to be insignificant in the test calculations. Marsh, I. W., Tokarick, S. P. (1996) arrived at similar results.
18 By contrast, Marsh, I. W., Tokarick, S. P. (1996) used the J-test designed by Davidson, R., MacKinnon, J. (1981) to assess the information content of additional variables. Alternative calculations showed that our results were insensitive to the two methods and to different observation periods. On the J-test see Davidson, R., MacKinnon, J. (1981), Several Tests of Model Specification in the Presence of Alternative Hypotheses, Econometrica, Vol. 49, No. 3, pages 781 to 793.

... by "bilateral" comparison ...

This approach permits a comparison of a pair of real external value indicators with three possible results. If both indicators turn out to be significant in the estimation, they both make a useful contribution to explaining German foreign trade, but it is impossible to clearly rank the two indicators in this case. Similarly, no distinction can be made between the information content of two indicators if both coefficients turn out to be insignificant in an estimation. By contrast, the indicators can be ranked if only one of the two external values is significant. In that case, this significant indicator contains all the important information required to explain German foreign trade and hence is superior to the second (insignificant) variable.

... supports total sales deflator

The table above shows the combinations for the export and import functions assessed by this method. A particularly notable feature in respect of the export functions is that the real external value based on the total sales deflator Q(exp) was the only indicator that contributed additional information to explaining German export trends to each of the alternative indicators (see the statistics in the respective line of the table). By contrast, none of the other indicators contained any information which was not already included in this variable (see the respective column of the table). According to these calculations it can thus be said that the external value based on the total sales deflator Q(exp) is superior to all the other alternative indicators. Judged by this criterion, real external values based on producer prices Q(pp) and on consumer prices Q(cpi) rank second. The terms of trade Q(tot) and the real external value based on unit labour costs in manufacturing Q(ulc) rank last; in their case most of the alternative indicators were significant, whereas they themselves only produced non-significant results in most cases.

Comparison of pairs of alternative indicators of real external value

Additional indicator	Original indicator				
	Q(cpi)	Q(exp)	Q(pp)	Q(tot)	Q(ulc)
Export demand					
Q(cpi)	–	1.21	– 1.11	**1** – 6.90	**1** – 4.20
Q(exp)	**2** – 2.47	–	**2** – 2.18	**1** – 7.90	**1** – 4.80
Q(pp)	– 1.20	– 0.49	–	**1** – 6.00	**1** – 3.20
Q(tot)	– 1.02	– 0.11	1.11	–	– 0.49
Q(ulc)	**3** – 1.67	– 1.04	– 0.58	**1** – 4.00	–
Import demand					
Q(cpi)	–	– 0.20	0.87	**2** 2.13	**2** 2.62
Q(exp)	0.75	–	1.03	**3** 1.95	**1** 2.93
Q(pp)	0.53	0.14	–	1.33	**2** 2.61
Q(tot)	**3** 1.71	1.43	1.12	–	**2** 2.11
Q(ulc)	– 0.45	– 0.93	– 1.11	– 0.06	–

1 Rejection of the null hypothesis (indicator contains no additional information) at a 1% significance level. — **2** Rejection of the null hypothesis (indicator contains no additional information) at a 5% significance level. — **3** Rejection of the null hypothesis (indicator contains no additional information) at a 10% significance level.

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Multiple comparison ...

A "multiple" approach based on this "bilateral" comparison corroborates these findings. Basically, this multiple method tests all the indicators of the real external value in the export and import functions simultaneously. Subsequently, it examines by means of a Wald test whether a particular indicator already contains all the information required or whether the four alternative indicators, taken together, make an additional explanatory contribution. This tests the null hypothesis that the group of the four alternative variables contains no additional information compared with the specified indicator. If the test result is significant, the null hypothesis is rejected, which means that the inclusion of the other variables does contribute additional relevant information for explaining German export or import trends to the estimation. The Wald coefficient tests and the

Wald test of alternative indicators of the real external value for explaining trends in German exports and imports

Indicator	Exports		Imports	
Q(cpi)		1.88		1.82
Q(exp)		0.51		1.66
Q(pp)		1.87	**3**	2.12
Q(tot)	**1**	5.79	**1**	3.93
Q(ulc)	**1**	14.62	**2**	2.97

1 Rejection of the null hypothesis at a 1% significance level. —
2 Rejection of the null hypothesis at a 5% significance level. —
3 Rejection of the null hypothesis at a 10% significance level.

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corresponding significance level are shown in the adjacent table.

If real external values based on consumer prices and based on total sales prices are used as the original variables, the results at least rule out the inference that an additional explanatory contribution can be expected from the other indicators. Conversely, the test calculations both for the terms of trade and for the real external value based on unit labour costs in manufacturing indicate, at a level of significance of less than 1%, that the alternative indicators, taken together, do contain additional information and hence have additional explanatory power. Essentially, these results apply irrespective of whether the export or the import function is considered.

... also supports "broad" deflators