Purchasing power parity theory as a concept for evaluating price competitiveness

Since the start of monetary union, the euro's exchange rate has been subject to sharp fluctuations. Although the single currency lost considerable ground against most currencies in 1999 and 2000 in particular, a strong countermovement followed. As a weighted average against the currencies of the euro area's most important trading partners, at the beginning of 2004 the euro – at times – was trading above its debut level of early 1999.

Against the background of fairly moderate export growth up to the middle of 2003, the euro's strength has prompted questions about the impact on Germany's price competitiveness. However, the relevant competition indicators show that the price competitiveness of German producers remains within limits which are fully in line with long-term empirical values. This evaluation is ultimately based on the theoretical concept of purchasing power parity in its "relative" construct. This article explains this and, at the same time, sets it in a broader perspective by also presenting indicators of stricter, absolute purchasing power parity. These largely confirm the previous assessments of Germany's competitive position.

The exchange rate of the euro and Germany's price competitiveness

The effect of the euro's exchange rate on Germany's competitiveness

In the past two years, the euro has appreciated strongly against most currencies. It went up by almost 20% as a weighted average against the currencies of the euro area's 12 most important trading partners between the first quarter of 2002 and the first quarter of 2004. This was due mainly to considerable gains against the US dollar. Viewed in isolation, the euro's appreciation involved a loss of price competitiveness for the German economy. In this respect, the view was often expressed that the exchange rate parities were inappropriate and no longer in a state of equilibrium.

However, this can be countered with the argument that the euro had depreciated at almost the same rate in the years preceding its appreciation. In this sense, the recent appreciation merely constituted a correction. Moreover, an economy's competitiveness is also influenced by factors other than the exchange rate, in particular, by price developments in the countries in question.

The real exchange rate as an indicator of price competitiveness

One indicator of price competitiveness which combines exchange rate and price movements is the real exchange rate (see also the adjacent box). In contrast to the nominal exchange rate, which reflects the relative price of two currencies, the real exchange rate represents the relative price between a domestic basket of goods and a foreign basket of goods. A real currency appreciation usually equates to a deterioration in the price competitiveness of the domestic economy. This

Purchasing power parity theory and real exchange rate

The absolute purchasing power parity theory suggests that, in the long run,

$$P = P^*/W, \tag{1}$$

whereby P denotes the price of a given basket of goods in the domestic country and P^* denotes the corresponding price abroad; W is the nominal exchange rate between the domestic country and the foreign country, expressed as the price of the domestic currency in units of the foreign currency, as is usually the case for euro exchange rates for example. A nominal appreciation of the domestic currency is therefore reflected by a rise in W.

The relative purchasing power parity theory, however, is characterised by the long-run validity of

$$P = c(P^*/W) \tag{2}$$

whereby c represents a constant. If growth rates are flagged with a "^", (2) results in

$$\hat{W} = \hat{P}^* - \hat{P}. \tag{3}$$

According to (2), the purchasing power ratio between the domestic country and the foreign country is constant if the relative purchasing power parity theory holds. According to (3), the rate of change in the nominal exchange rate is equal to the inflation differential.

If the countries in question are members of a monetary union, the nominal exchange rate is permanently fixed at $W = 1$. In such cases, the absolute purchasing power parity theory implies that domestic and foreign price levels should be identical in the long run, $P = P^*$ according to (1), and the relative purchasing power parity theory suggests that the inflation differentials according to (3) cancel out in the long run, $\hat{P}^* = \hat{P}$.

In the majority of cases, the real exchange rate R is used as an indicator of an economy's price competitiveness. This may be defined as
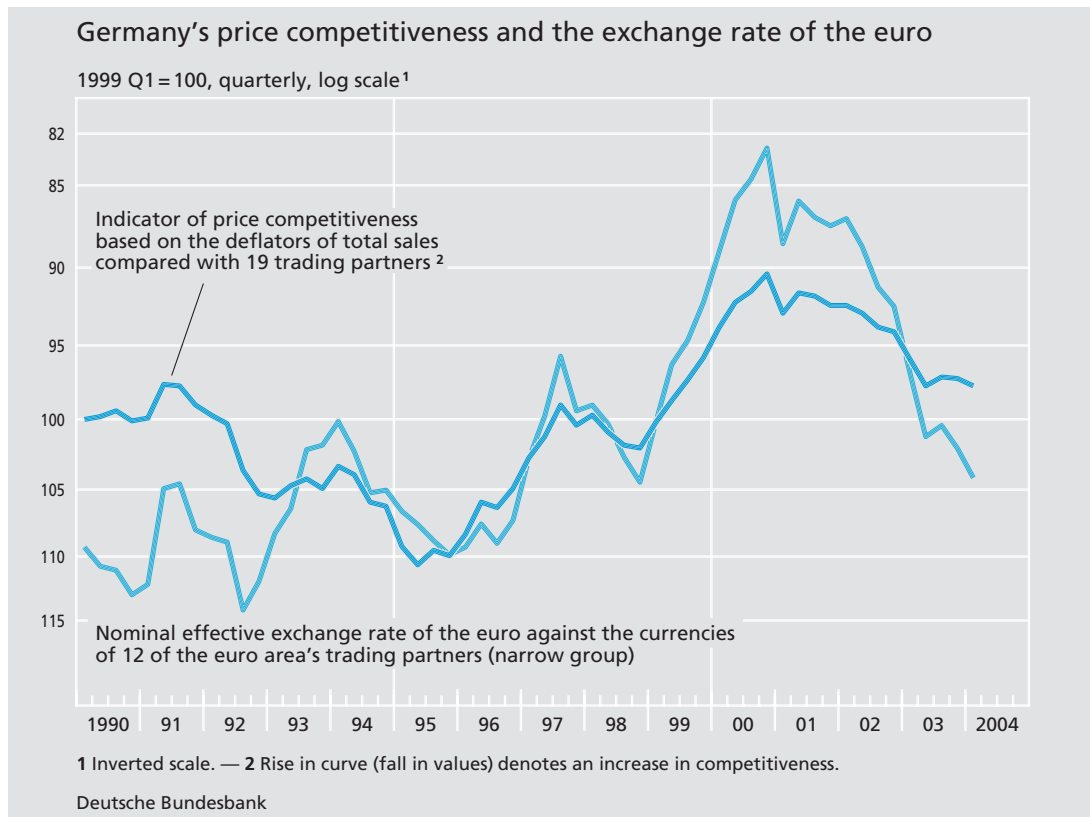
$$R = W (P/P^*) \tag{4}$$

Equation (4) shows that the concept of a real exchange rate may also be applied to countries within a monetary union, where it is defined as the price ratio between the domestic country and the foreign country ($R = P/P^*$). [1]

Equations (1), (2) and (4) show that absolute purchasing power parity is achieved if the real exchange rate is $R = 1$ or $\ln(R) = 0$ and that relative purchasing power parity is achieved if $R = c$ or $\ln(R) = \ln(c)$. Since the purchasing power parity theory is a long-run concept, it only applies if $\ln(R)$ is stationary (relative version) or if $\ln(R)$ is stationary at 0 (absolute version).

[1] The indicator of the price competitiveness of the German economy is essentially no more than a trade-weighted real exchange rate whereby the weights of individual trading partners correspond to their significance in German foreign trade.

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Germany's price competitiveness and the exchange rate of the euro

1999 Q1 = 100, quarterly, log scale [1]

Indicator of price competitiveness
based on the deflators of total sales
compared with 19 trading partners [2]

Nominal effective exchange rate of the euro against the currencies
of 12 of the euro area's trading partners (narrow group)

1990 91 92 93 94 95 96 97 98 99 00 01 02 03 2004

1 Inverted scale. — **2** Rise in curve (fall in values) denotes an increase in competitiveness.

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occurs if the domestic currency appreciates in nominal terms even though the domestic and foreign inflation rates are the same or if domestic prices rise more sharply than foreign ones despite a constant exchange rate.

Developments in Germany's price competitiveness in comparison with the euro's exchange rate

A useful indicator of Germany's price competitiveness can be ascertained, for instance, by using appropriate price or cost indices to illustrate price developments in the countries in question. In this respect, the Bundesbank generally uses the deflators of total sales as defined in the national accounts. These cover the spectrum of goods more comprehensively than, for example, consumer prices. To obtain a representative picture of German foreign trade in regional terms, the indicator is calculated as a weighted average against 19 of Germany's major trading partners. When

considering the developments in this indicator of Germany's price competitiveness it becomes clear that, although the indicator tends to reflect developments in the effective (nominal) exchange rate of the euro, it is itself somewhat more subdued by comparison. For example, it indicated that Germany's competitiveness deteriorated by only 5¾% between the first quarter of 2002 and the first quarter of 2004. This contrasts with an improvement in Germany's competitiveness of around 10% from the first quarter of 1999 to the fourth quarter of 2000. The changes in the indicator were less severe than the fluctuations in the euro as Germany trades largely with other countries participating in monetary union. Therefore, the single currency limits the impact of exchange rate fluctu-

ations on Germany's competitiveness in no small measure.

A reference value is needed to assess competitiveness

Although these considerations put the influence of the euro's exchange rate on Germany's competitiveness into perspective, they do not yet allow an opinion to be formed about the appropriateness of exchange rate parities. In order to be able to assess the extent to which a change in price competitiveness also appears economically justified, a sound reference value for the indicator of price competitiveness is needed. The following section will examine the extent to which purchasing power parity theory enables such reference values to be calculated and how Germany's price competitiveness is to be assessed in this context.

Purchasing power parity theory as a theoretical concept

Absolute purchasing power parity theory...

There are two versions of purchasing power parity theory – an absolute and a relative one. Absolute purchasing power parity theory states that a basket of goods costs the same domestically and abroad if the goods prices are converted into a common currency. In other words, absolute purchasing power parity theory postulates that the purchasing power of money is equal between countries. By contrast, relative purchasing power parity theory does not compare domestic and foreign levels of purchasing power, but rather focuses on changes in this purchasing power. Relative purchasing power parity theory therefore states that the inflation rate differentials between two countries or regions are

...and relative purchasing power parity theory

offset through inverse changes in the nominal exchange rate so that the purchasing power ratio between the two remains constant. It therefore follows that the validity of absolute purchasing power parity theory implies the validity of relative purchasing power parity theory, but not vice versa.

Purchasing power parity theory is based on the law of one price. According to this law, a single homogeneous good should have the same price everywhere – excluding any transportation costs – under conditions of perfect competition if the relevant national prices are expressed in a common currency. If this law holds true for all goods prices then, under certain conditions, purchasing power parity theory applies in both its absolute and its relative form. One mechanism which, in theory, upholds the law of one price and thus purchasing power parity theory is goods arbitrage, which has a tendency to even out geographical price differences. Trade barriers (eg transportation costs or varying import duties) as well as different indirect tax rates may prevent total price equalisation, but would be compatible with an appropriately modified form of absolute purchasing power parity theory or at least with the relative version.

The law of one price

However, the described price equalisation effects can be expected only in the long term according to both versions of the purchasing power parity theory. In the shorter term, the influence of international goods arbitrage is eclipsed by other factors.

Purchasing power parity theory as a long-term concept

According to the absolute purchasing power parity theory, an economy's competitiveness

Derivation of a reference value

is considered to be neutral if the domestic price level is equal to the foreign price level. In the case of the relative purchasing power parity theory, the average level of the real exchange rate should, over time, provide a useful benchmark for a balanced competitive position provided that the observation period is sufficiently long and there are no indications of structural shifts in the equilibrium price relationships.

Indicators of Germany's price competitiveness compared with their long-term average

Evaluation of Germany's competitiveness in the winter of 2003-04 using the standard indicator

If – in keeping with these considerations – the long-term average is taken as an underlying benchmark, then an assessment of the current competitive position of Germany's economy is primarily dependent on three determinants. These are the period over which the long-term average is calculated, the price or cost index used to calculate the indicator and the group of countries against which the level of competitiveness is to be gauged. Firstly, by way of a benchmark, the aforementioned indicator of Germany's price competitiveness based on the deflators of total sales – which is calculated against 19 major trading partners – is to be compared with its average ascertained as of 1975. This shows that, in the first quarter of 2004, the German economy still had a slight competitive advantage over its trading partners despite the noticeable deterioration in its price competitiveness in the past two years (see the chart on page 34).
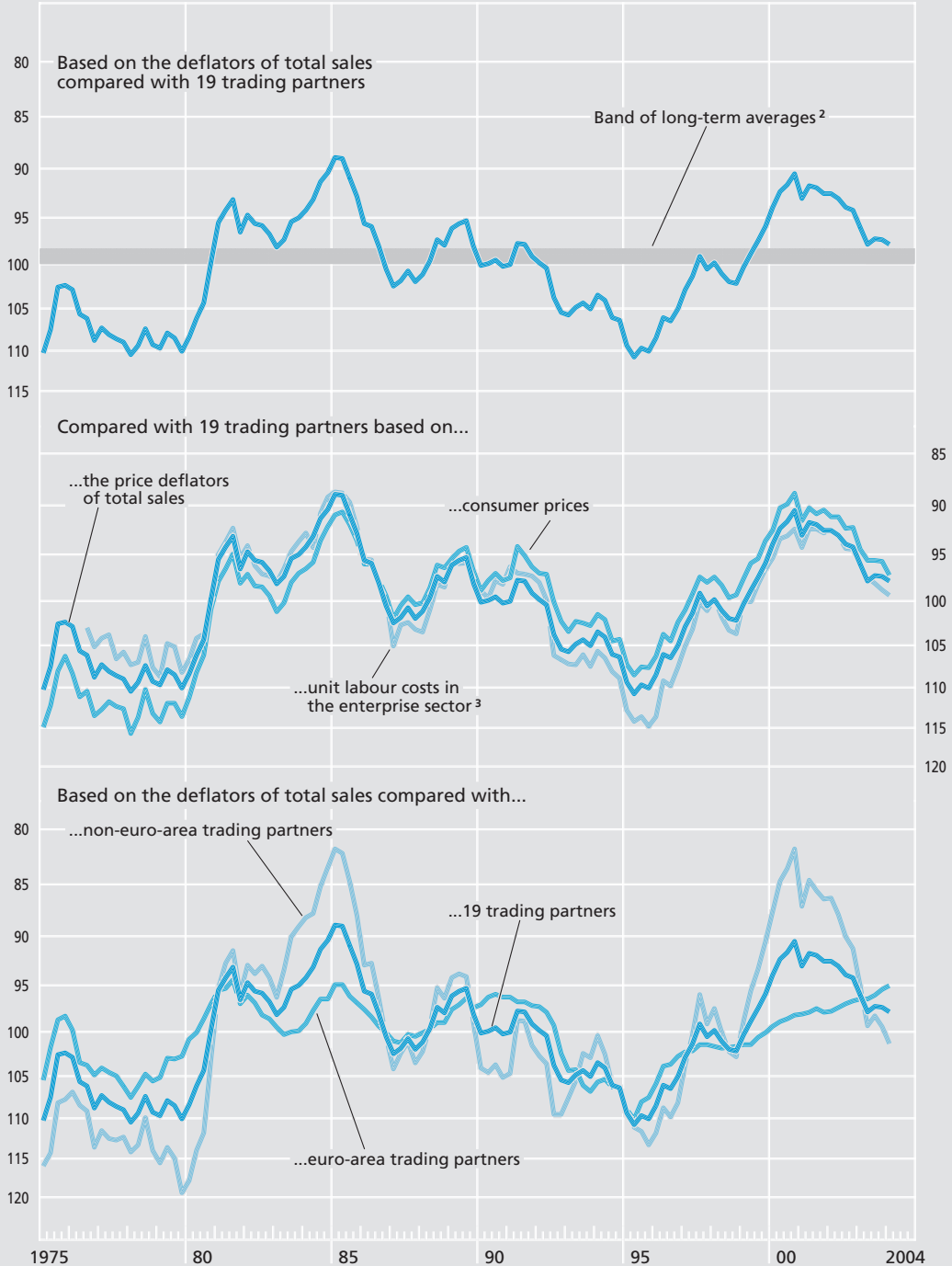
Average calculation across alternative time periods

An evaluation of this kind is generally confirmed if other periods are used to calculate the average. Owing to the regime shift from fixed to more flexible exchange rate arrangements and the turmoil accompanying this change, it would be inappropriate to extend the observation period to include the years prior to 1975. Moreover, an average calculated in this way would tend to result in an even more favourable assessment of Germany's current competitive situation. A shorter observation period would be possible, in principle. However, as purchasing power parity theory is a long-term concept, overly short observation periods are not really economically justified for calculating the average. If the average values calculated over all possible observation periods from the period 1975 to 2004 to the period 1990 to 2004 are plotted on a chart as a straight line, the result is a band of average values (see chart on page 34). The mean over the period starting in 1975 with a comparatively high reference value is at the lower edge of the band on the chart. Thus, according to this reference value, Germany's current competitiveness is judged to be comparatively positive owing to the unfavourable price and exchange rate pattern in the second half of the 1970s. However, the band is fairly narrow. If averages are calculated over other periods, therefore, the conclusion reached on the competitiveness of the German economy is quite similar. Even if the most unfavourable mean for Germany's competitiveness is used as a basis, the assessment is still valid and indicates that the German economy retained a slight competitive edge up to the end of the observation period.

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Indicators of Germany's price competitiveness on a long-term comparison

Average since 1975 = 100, quarterly, log scale[1]

Based on the deflators of total sales compared with 19 trading partners

Band of long-term averages[2]

Compared with 19 trading partners based on...

...the price deflators of total sales

...consumer prices

...unit labour costs in the enterprise sector[3]

Based on the deflators of total sales compared with...

...non-euro-area trading partners

...19 trading partners

...euro-area trading partners

1 Inverted scale: rise in curve (fall in values) denotes an increase in competitiveness. — **2** Covers the average values accumulated successively over all periods from the period 1975 Q1 to 2004 Q1 to the period 1990 Q4 to 2004 Q1. — **3** Estimated average as of 1975.

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Alternative price and cost indices

The price or cost index chosen to calculate the indicator can also affect the assessment of competitiveness. The deflator of total sales has the advantage of covering price developments in all of the goods in demand in an economy as broadly as possible.[1] Similar indicators can also be calculated, for example, on the basis of consumer prices or unit labour costs in the enterprise sector. However, it emerges that the different calculation methods have only a very minor effect on the competitiveness of the German economy (see chart on page 34). The indicators based on consumer prices and unit labour costs in the enterprise sector form very similar curves to the indicator based on the deflators of total sales, which is also reflected in the relevant correlation coefficients (0.93 and 0.95). There is also only a very small difference in their level compared with the relevant long-term average. Correspondingly, these two indicators also confirm the conclusion described earlier, namely that Germany's competitiveness is currently to be evaluated as being neutral or somewhat more favourable than that of its trading partners.[2]

Alternative group of countries

Finally, it should be examined whether the indicators dealt with up to now – which consider Germany's competitiveness "only" in comparison with 19 trading partners – are sufficiently broadly based in their definition of foreign countries. To settle this question, it is possible to resort to an indicator of the German economy's price competitiveness which includes another 30 trading partners. The data required to calculate an indicator of this kind are available only for the past ten years, which means that it is not possible to work

out a real long-term average. However, the very high correlation between this indicator and a comparable indicator calculated against 19 countries (correlation coefficient of 0.99) suggests that limiting the calculation to a narrower group – which nonetheless accounts for 71% of total German foreign trade – does not lead to any bias, at least for the recent past.

In conclusion, it can be stated that Germany's price competitiveness in the winter of 2003-04 can be assessed as having been neutral or slightly positive in comparison with long-term averages. This finding applies irrespective of the calculation method used. It does not change if the time period on which the calculation of the long-term average is based is altered, nor if other price or cost indices are

Germany's price competitiveness was at worst neutral in the winter of 2003-04

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1 The advantages and disadvantages of various cost and price indices with respect to their suitability for calculating an indicator of price competitiveness are discussed in Deutsche Bundesbank, The indicator quality of different definitions of the real external value of the Deutsche Mark, *Monthly Report*, November 1998, pp 39-52, and European Central Bank, Developments in the euro area's international cost and price competitiveness, *Monthly Bulletin*, August 2003, pp 67-74.
2 Only an indicator of Germany's competitiveness calculated on the basis of unit labour costs in manufacturing suggests a different evaluation. According to this assessment, the current competitiveness of the German economy is considerably more unfavourable. Furthermore, this indicator is only slightly correlated with the standard indicator based on the deflators of total sales (correlation coefficient of 0.28). However, it has already been stressed previously that this indicator in particular is unsuitable for evaluating Germany's competitive situation as the labour costs in manufacturing account for a much smaller share of total output than the input from other sectors and from abroad. The labour costs in other sectors, which are reflected in the input prices, have developed rather favourably in Germany by international comparison, which means that failure to consider this component would lead to an overly unfavourable assessment of Germany's competitiveness. See Deutsche Bundesbank, The indicator quality of different definitions of the real external value of the Deutsche Mark, *Monthly Report*, November 1998, pp 39-52.

used, nor if a broader group of countries is considered.

Euro-area competitiveness less favourable

This robustness in the assessment of current competitiveness in relation to the calculation methods is not a feature particular to Germany, but is also reflected in a corresponding indicator of the euro area's price competitiveness (ie the euro's real exchange rate).[3] However, the current competitiveness of the whole euro area is – according to these calculations – consistently more unfavourable than Germany's situation. This is due mainly to the fact that, since the beginning of monetary union, the German economy has been steadily becoming more competitive in comparison with its euro-area trading partners owing to the comparatively low level of domestic price increases (see chart on page 34).

Indicators of Germany's price competitiveness based on the absolute purchasing power parity theory

Indicators of competitiveness calculated on the basis of relative price levels rather than price indices

The indicators of price competitiveness described up to now do not allow any conclusions to be drawn about a country's competitiveness in accordance with absolute purchasing power parity theory. This is because price or cost indices, which ultimately do not allow any insight into the appropriate relative price and cost levels, were used to calculate these indicators. An evaluation of competitiveness based on the absolute purchasing power parity theory, however, calls for appropriate level comparisons. This can be achieved, for example, with the help of the relative price levels for a given basket of goods at home and abroad, which can be expressed in a common currency using the relevant (nominal) exchange rate.

Calculation of the price of a broad basket of goods

The relative price levels for the very broad baskets of goods – which are geared to gross domestic product (GDP) – of the OECD members and other European countries are provided by the OECD-Eurostat "Purchasing Power Parity Programme." The World Bank, for example, makes available data for a larger group of countries based on the findings of the "International Comparison Programme". In recording prices, these projects consider both the representativeness and the international comparability of the goods and services.

It may at first not seem particularly suitable to use such broad baskets of goods for comparisons of price competitiveness as it can be assumed that a relatively high percentage of – in particular – the services in these baskets of goods are not traded internationally and are thus not directly exposed to international competition. However, as in the case of using deflators of total sales, an argument in favour of broad baskets of goods is that goods which are not traded internationally are employed in the production of tradable goods and that the corresponding relative price levels thus reflect fairly well the general domestic cost pressures to which enterprises are exposed.

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3 See European Central Bank, Developments in the euro area's international cost and price competitiveness, *Monthly Bulletin*, August 2003, pp 67-74.

Germany's price competitiveness based on relative price levels

Based on these data, it is also possible to calculate an indicator of the German economy's price competitiveness as a weighted average against 19 of Germany's major trading partners. Two such indicators – one calculated using data from Eurostat and the other using data from the World Bank – are shown in the adjacent chart. At a value of 100, the prices in Germany are, on average, equal to those abroad; at higher values, the price level in Germany is above that of its trading partners. The most recent values are estimated.

Comparison with the standard indicator

The developments in both indicators are largely in parallel with one another and with the indicator based on the deflators of total sales described above. The correlation coefficients are between 0.96 and 0.996. Therefore, these three indicators reflect changes in price competitiveness in a very similar way. However, they differ somewhat in their assessment of Germany's competitive position. Evidently the level of prices in Germany was usually slightly higher than that of the country's main trading partners – not least owing to the advanced degree of development and thus prosperity – in the last 30 years.[4] This has changed recently, however, as a result of the catching-up process, which a number of partner countries have successfully completed in recent decades, and the price increases which this has involved. For example, for 2000, both baskets of goods show a price level for Germany which is 5% to 6% lower than the average. Estimates suggest that Germany's competitive situation has deteriorated

[4] Empirically, it is possible to prove that there is a connection between the productivity or income level and the relative price level of a country. See also page 40 ff.

Indicators of Germany's price competitiveness based on relative price levels

Annual figures, log scale[1]
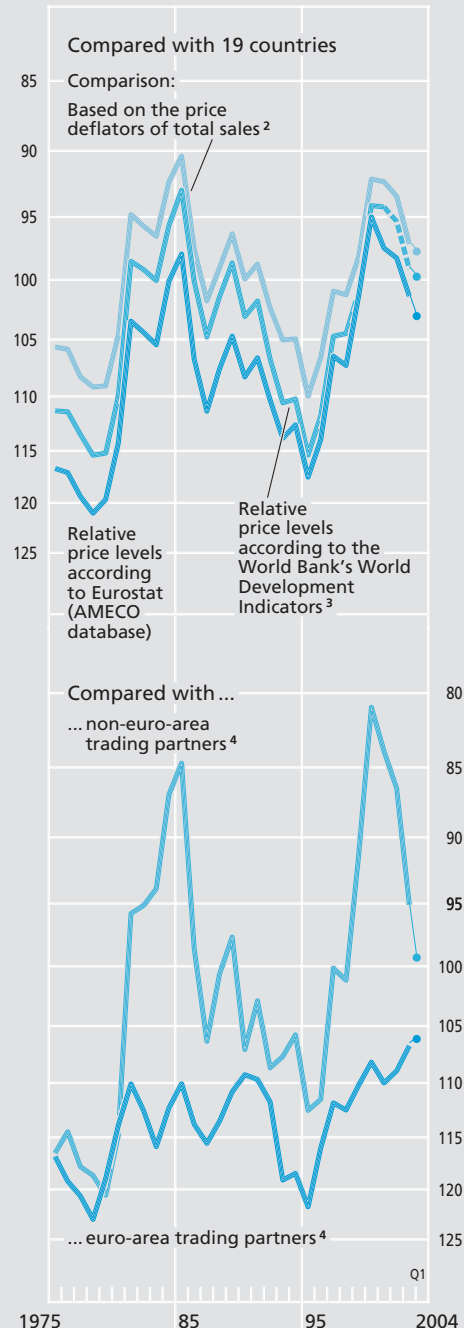
1 Inverted scale: rise in curve (fall in values) denotes an increase in competitiveness. — **2** Average since 1975 = 100. — **3** Estimated as of 2001. — **4** Relative price levels according to Eurostat (AMECO database).

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The academic debate on the validity of the purchasing power parity theory

Over the last one and a half decades, much academic research has examined the empirical validity of the purchasing power parity theory.[1] As mentioned at the beginning of this article, this theory implies that the real exchange rate is stationary, ie it shows neither a deterministic nor a stochastic trend over time. The stationarity of a time series can be analysed using unit root tests. If such tests are performed on individual time series of real exchange rates, which, for such analyses, are generally calculated on the basis of price indices, in most cases stationarity is rejected for the period after the collapse of the Bretton Woods system. Given this result, the validity of the purchasing power parity theory in its simple and unmodified form cannot be confirmed, at least not from an empirical point of view.

These analyses were increasingly criticised, however, on the grounds that, owing to a possibly very slow adjustment process of the real exchange rate to its long-run average, the specified examination period is too short to statistically determine whether this variable is trend-bearing or not. This problem can be solved in one of two ways. In some studies, the observation period is extended considerably, with some time series of real exchange rates stretching back for over a century.

Another possible way to get round the problem of very short time series is to test several series of real exchange rates simultaneously in one panel for stationarity thereby combining all the information contained. Such analyses often come to the opposite conclusion, ie that the stationarity of real exchange rates over the last 30 years cannot be rejected. In essence, this result supports the validity of at least the relative purchasing power parity theory. Nevertheless, the speed of adjustment to the long-run average derived from these analyses is often so slow (half lives of deviations of three to five years are entirely normal) that it is no longer considered plausible.

1 For an overview, see L Sarno, M P Taylor (2002), *The economics of exchange rates*, Cambridge University Press, pp 51-96; K Rogoff (1996), The purchasing power parity puzzle, *Journal of Economic Literature*, 34, pp 647-668; K A Froot, K Rogoff (1995), Perspectives on PPP and long-run real exchange rates, in G M Grossman, K Rogoff, (ed.), *Handbook of international economics*, 3, S Elsevier, pp 1647-1688. See also Deutsche Bundesbank, Trends and determining factors of the external value of the Deutsche Mark, *Monthly Report*, November 1993, pp 41-60; Deutsche Bundesbank, Overall determinants of the trends in the real external value of the Deutsche Mark, *Monthly Report*, August 1995, pp 17-37.

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since that time, above all as a result of the euro's appreciation. However, it may be assumed that, even in the first quarter of 2004, the price level in Germany, on average, either corresponded to that of its trading partners or, at most, was marginally higher depending on the basket of goods used.

The composition of the basket of goods has quite a big effect on the findings with regard to relative competitiveness. A basket of goods which gives a fair reflection of domestic consumption habits but not foreign consumption habits will tend to show a lower domestic price level and thus overestimate any domestic competitive advantages. In order to eliminate such bias, the Eurostat price data used here are for a basket of goods which is typical – at least to a similar extent – for all of the countries examined.[5] It is possible to get an idea of the robustness of the findings with regard to the choice of basket by comparing the relative price level calculated using the Eurostat data with the relative price level calculated using the Federal Statistical Office's price data which are, however, based on the German basket of goods owing to a different objective.[6] At the beginning of 2004, the price of the German basket of goods calculated in this way was one-eighth lower than on a weighted average against the 19 trading partners considered. This shows that, even when absolute purchasing power parity is used to assess competitiveness, allowances must be made for a margin of uncertainty.

Composition of the basket of goods

5 Regarding calculation methods, see eg Eurostat (2000), Purchasing power parities and related economic indicators – results for 1998.
6 See Federal Statistical Office, Internationaler Vergleich der Verbraucherpreise, *Fachserie 17, Reihe 10.*

Is the real exchange rate stationary?

Results of a study using disaggregated price data

The box "Purchasing power parity theory and real exchange rate" on page 30 shows that the relative purchasing power parity theory is fulfilled if the (logarithmic) real exchange rate is stationary. Alongside the Balassa-Samuelson hypothesis, another reason is occasionally suggested as to why this may not be the case, [1] namely that if there are differences in the production structures or consumption habits of the countries in question, there will be discrepancies in the weight distribution of the national baskets of goods. In such cases, shifts in the price structure vary in their overall impact on price indices. For example, rising oil prices have more of an effect on the consumer price indices of those countries that consume relatively large amounts of oil. If such changes in price structure, which may also be brought about by technical progress, for example, are of a permanent nature, it must be assumed that the real exchange rate is not stationary. This would apply even if the law of one price is upheld on a permanent basis.

The argument is formalised below based on the definition of the real exchange rate [2],

$$r_{it} \equiv s_{it} - p_{it} + p_{jt} \qquad (1)$$

whereby s_{it} denotes the nominal exchange rate between country i and country j (expressed as the price of the currency of country j in currency units of country i), at time t and p_{it} (p_{jt}) is the price index of country i (j). Lower-case letters denote the logarithmic values. If in equation (1) one uses

$$p_{it} \equiv \sum_{k=0}^{m} \alpha_{ik}\, p_{ikt} = p_{i0t} + \sum_{k=1}^{m} \alpha_{ik}\, (p_{ikt} - p_{i0t}) \qquad (2)$$

as the definition of a price index and

$$r_{i0t} \equiv s_{it} - p_{i0t} + p_{j0t} \qquad (3)$$

as the definition of the real exchange ratio of any particular good $k = 0$ between the two countries, the result is

$$r_{it} = r_{i0t} + \sum_{k=1}^{m} \left[\alpha_{jk}\, (p_{jkt} - p_{j0t}) - \alpha_{ik}\, (p_{ikt} - p_{i0t}) \right]. \qquad (4)$$

In these equations, for example, p_{ikt} denotes the price of good k in country i at time t, and α_{ik} stands for the weight of good k in the basket of goods of country i. According to equation (4), the real exchange rate r_{it} comprises two components, namely the real exchange ratio of good 0 and a weighted sum. The expression in the round brackets shows the relative price between good k and good 0 in country j and country i, respectively. A permanent shift in the price structure should result in the non-stationarity of these bracketed terms. If the weights in both countries, α_{ik} and α_{jk}, are not identical, the expression in the square brackets will likewise not be stationary in the event of an identical relative price change in the domestic and foreign country. Furthermore, if there are no cointegration relationships, this will also mean that non-stationarity cannot be rejected for the real exchange rate.

Price indices of sectors, rather than the prices of individual goods, are used to analyse the time series characteristics of individual terms. The time series of price indices for 18 economic sectors are available for eleven OECD countries (including the USA, Japan, Germany and the United Kingdom) starting from 1977 up to 1999, providing not only country data panels but also sector panels for individual countries. Various panel unit root tests are performed.

The test results indicate that the second-term sum in equation (4) indeed largely consists of non-stationary components. This applies both to the relative prices in the round brackets and to the expressions in the square brackets as a whole. From this, it can be concluded that there have been permanent relative price shifts between the sectors in the economies analysed. The effects of these on the real exchange rate can also not be eliminated owing to the different weight distribution in the various countries. Accordingly, the second-term sum as a whole turns out to be regularly non-stationary.

If the same panel unit root tests, however, are applied to the real exchange rate r_{it}, the results point conversely to stationarity and thus confirm the results of other studies. However, since cointegration between the first and second components of the real exchange rate in equation (4), ie between r_{i0t} and the second-term sum, cannot be assumed – if only because r_{i0t} often appears to be stationary [3] – the results are often clearly at variance with each other. There are two hypotheses that could resolve this conflict. Firstly, the variance (of the differences over time) of the second component in comparison to the first is relatively small. It could be, for example, that the non-stationarity of the real exchange rate is masked by a relatively large, potentially stationary first component. Secondly, the test result, which indicates that the real exchange rates are stationary, could be based on a bias. This is because results from unit root tests are always biased in favour of the rejection of non-stationarity if the time series that is being analysed comprises two components, one of which is stationary and the other non-stationary. The results of the study indeed suggest that the real exchange rate consists of two such components. [4] Both hypotheses suggest that, contrary to largely established opinion, real exchange rates are not stationary and that, from this point of view, the purchasing power parity theory also does not hold.

1 See, for example, D A Hsieh (1982), The determination of the real exchange rate: the productivity approach, *Journal of International Economics*, 13, pp 355-362. — **2** For more information on this as well as on empirical analysis, see C Fischer, (2004), PPP: a Disaggregated View, Discussion Paper, Economic Research Centre of the Deutsche Bundesbank, No 07/2004. — **3** As r_{i0t} denotes the real exchange ratio of a good in two different countries, stationarity implies that for this good the law of one price has been fulfilled. — **4** This had already been suggested for the real exchange rate by C Engel (2000), Long-run PPP may not hold after all, *Journal of International Economics*, 57, pp 243-273. Engel, however, derived this hypothesis from another context, namely the Balassa-Samuelson model.

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Competition indicators based on relative price levels can also be divided up into indicators against individual groups of countries. The chart on page 37 shows the developments in such indicators of Germany's competitiveness compared with the other euro-area countries on the one hand and further major trading partners on the other. It reveals that the level of prices in Germany has always been relatively high, especially in comparison with the country's euro-area trading partners. In recent years, however, a trend towards convergence of the price levels is evident. By contrast, the price level in Germany has been lower than that of its non-euro-area trading partners in the past few years. However, the competitive edge which Germany gained owing to the weakness of the euro in 1999 and 2000 has now diminished again.

The Balassa-Samuelson effect and Germany's competitiveness

There have been various attempts in the past to empirically test the purchasing power parity theory. These have produced different results depending on the methodology applied (see boxes on pages 38 and 39). The Balassa-Samuelson effect is one possible reason why the theory is comparatively difficult to prove. According to this hypothesis, the purchasing power parity theory applies only to some goods, namely to internationally tradable ones. If the productivity level in a country's tradables sector increases, according to the Balassa-Samuelson hypothesis the prices of these goods will not fall as they are determined by the conditions of competition on

the world market. Instead, this productivity growth will lead to wage increases in this sector. However, the non-tradables sector will then fear a migration of its labour force to the tradables sector and, thus, there will also be wage increases in this sector. This will lead to price increases in non-tradable goods, which will ultimately raise the average price level in the whole economy.[7]
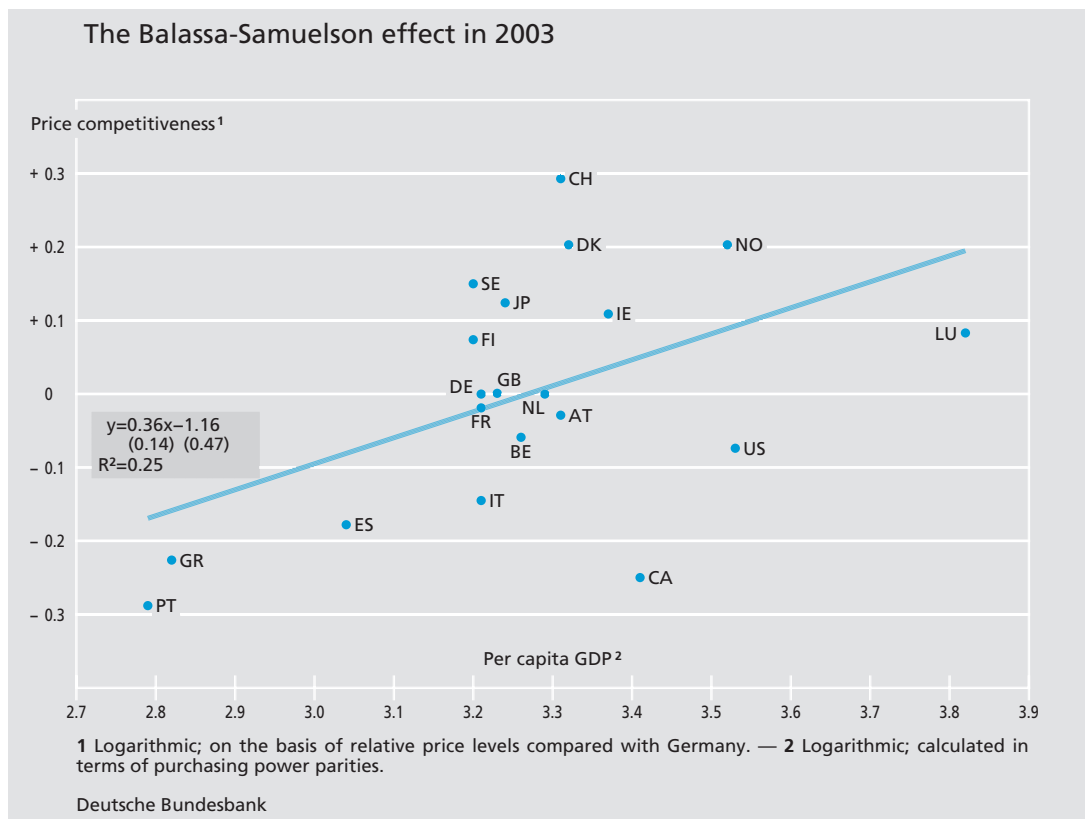
Within the framework of this model, it is usually assumed that productivity gains accrue mainly in the tradables sector. This implies that countries which have already achieved high levels of productivity will also have comparatively high price levels. This hypothesis can be confirmed by comparing the average price levels of countries with substantially different per capita GDP. Above all services – which are mostly equated with internationally non-tradable goods – are very reasonably priced in countries with low per capita income.

The question now arises as to whether the Balassa-Samuelson effect can also be demonstrated for the group of countries comprising Germany and its trading partners (ie countries whose per capita income is comparatively similar) and to what extent this effect alters the assessment of Germany's competitiveness. In order to analyse this question, the real exchange rate calculated on the basis of

7 For detailed descriptions of the Balassa-Samuelson effect, see Deutsche Bundesbank, Fundamental determinants of real exchange rate movements in the central and east European accession countries, *Monthly Report*, October 2002, pp 47-59 and Deutsche Bundesbank, Overall determinants of the trends in the real external value of the Deutsche Mark, *Monthly Report*, August 1995, pp 17-37.

The Balassa-Samuelson effect in 2003

Price competitiveness[1]

y=0.36x−1.16
(0.14) (0.47)
R²=0.25

Per capita GDP[2]

1 Logarithmic; on the basis of relative price levels compared with Germany. — **2** Logarithmic; calculated in terms of purchasing power parities.

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relative price levels can be regressed on a productivity variable. The above chart shows the results of a cross-section regression for 2003.[8]

Each point on this chart represents a given country and indicates the ratio in 2003 of that country's relative price level compared with Germany's level to the country's per capita GDP. In 2003, countries whose dot is in the upper part of the chart were more "expensive" and had a higher per capita GDP the further their dot is to the right. The regression line marked on the chart shows the estimated relationship between the two variables.

Results

According to this estimation, if the per capita GDP of a country is 10% higher, then its relative price level is 3.6% higher. The standard

deviation indicated suggests that this result is statistically significant. The Balassa-Samuelson effect can therefore be confirmed in this case. Moreover, the results support the earlier assessments of competitiveness: in 2003, Germany's price competitiveness corresponded approximately to the level which would have been expected on the strength of Germany's per capita income.

Similarly, these connections can also be examined for other time periods and with alternative productivity variables, for example, GDP per person employed. In doing so, however, it becomes apparent that, in many cases, it is

The Balassa-Samuelson effect cannot always be demonstrated...

8 The group of countries still comprises 19 of Germany's most important trading partners. Per capita GDP measured in terms of purchasing power parity was used as the explanatory variable. Dependent and independent variables were in logarithmic form.

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…but the findings regarding Germany's competitiveness are robust

not possible to demonstrate a link between the real exchange rate and productivity.[9] Indicators based on the Balassa-Samuelson hypothesis are, therefore, not generally preferable to the other indicators described here. However, all of the productivity variables used produced the same result, namely that Germany's price competitiveness is to be classified at least as neutral at the current end.

The analysis can also be extended from a purely cross-sectional view to take account of the time dimension. Although the real exchange rate and the measure of productivity used turn out to be integrated and co-integrated if panel integration and co-integration tests are applied – which, in principle, suggests a Balassa-Samuelson effect –, three different panel estimation methods provide quite disparate estimates of the suggested connection. In this sense, the inclusion of the time dimension likewise does not provide a robust confirmation of the Balassa-Samuelson hypothesis for this group of countries although the results are often significant.

Conclusion

In view of the relatively major uncertainties regarding the assessment of an economy's price competitiveness, it is advisable to base an evaluation on several indicators. The purchasing power parity theory provides a framework from which different indicators can be derived. Although various measures were used here, they largely come to the same conclusion for Germany, namely that Germany's price competitiveness in 2003 and the first quarter of 2004 is, by and large, to be classified as neutral – or somewhat better – in spite of the euro's strength.

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9 Furthermore, this result corresponds to the outcome of earlier analyses carried out by the Bundesbank in which no evidence was found to suggest that the Balassa-Samuelson effect had a significant influence on movements in the real external value of the Deutsche Mark. See Deutsche Bundesbank, Overall determinants of the trends in the real external value of the Deutsche Mark, *Monthly Report*, August 1995, pp 22-37.