Rise in energy prices, the exchange rate of the euro and Germany's price competitiveness

Energy prices have risen sharply in 2021 and this year, but especially since the Russian war of aggression against Ukraine. For Germany, the price increase this has caused is particularly pronounced compared with many of its trading partners. At the same time, the euro has depreciated significantly against the US dollar in the year to date. This article examines the impact on Germany's price competitiveness of, first, the relative rise in costs and, second, the depreciation of the euro in 2022.

Estimation results show that the uncertain energy supply situation has itself contributed to the observed depreciation of the euro against the US dollar. However, it is just one of many causes of the depreciation. The swifter tightening of US monetary policy relative to that of the euro area probably played a more important role in the euro's decline. In purely arithmetical terms, the relative rise in energy costs in Germany from the start of the year to September 2022 – a period in which this rise was particularly pronounced – caused Germany's price competitiveness to deteriorate by 0.9%. By contrast, the euro's losses against the US dollar improved price competitiveness by around 1.9% in this period, all other things being equal. This rough calculation illustrates why common indicators of price competitiveness still show it to be fairly favourable for Germany and to have hardly changed since the end of 2021.

However, when interpreting these indicators, it should be noted that price competitiveness is a macroeconomic concept that does not reflect heterogeneities, effects on individual sectors and firms, or distributional effects. Firms for which energy makes up a large proportion of total costs will, for example, inevitably be more affected by the rise in energy prices than is reflected in the macroeconomic indicator of price competitiveness.

Introduction

Rise in energy prices and depreciation of the euro having an impact on price competitiveness

Over the past two years, energy prices have risen sharply worldwide. In addition to the economic recovery following the pandemic-induced downturn, this has been driven first and foremost by shortages in Russian gas supplies and Russia's war of aggression against Ukraine. Compared with other industrial countries, the rise in energy costs has been particularly sharp in Germany in the year to date. Taken in isolation, such a relative increase in costs reduces a country's price competitiveness. At the same time, the euro has depreciated noticeably against the US dollar in the year to date. In US dollar terms, goods exports from Germany therefore became cheaper and thus more competitive.

These considerations raise two questions: to what extent is the observed nominal depreciation of the euro against the US dollar itself related to developments in the energy markets? And what effects on Germany's price competitiveness are the result of the rise in energy prices, on the one hand, and the euro's depreciation, on the other?

Producer price index for energy*

January 2017 = 100, log scale, monthly data

Sources: OECD and Bundesbank calculations. * Total sales (domestic and foreign), average of 24 OECD states, weighted by their share in Germany's trade. Most recent data point: October 2022.

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Uncertainty about the energy supply in the euro area and depreciation of the euro

Euro area energy price increase in the wake of the Russian war against Ukraine …

One of the main reasons for the comparatively sharp rise in energy costs in the euro area is that many Member States previously relied heavily on Russian gas supplies. Even before the attack on Ukraine, Russia had reduced the supply of gas. After the start of the war, Russia further restricted supply, and those countries previously heavily dependent on Russian gas supplies had to obtain gas from other countries. This sent gas prices worldwide, but especially in the euro area, sharply higher.[1]

… weighing on the euro, on balance

Germany, like other European countries, thus had to spend a larger proportion of its economic output on energy imports. At the same time, the uncertain supply situation fuelled fears of a marked economic slowdown in the euro area.[2] According to economic theory, these developments should weigh on the external value of the euro, particularly against the US dollar, as the United States is not hit as hard by the impact of the war and is a net exporter of energy. In addition, demand for US dollar assets is often higher in uncertain times, which is another reason why the US currency is appreciating. The depreciation of the euro could therefore have been driven largely by developments in energy prices.

The bulk of the euro's depreciation against the US dollar in 2022 is probably less a result of the energy crisis …

Bundesbank estimates based on vector autoregressive (VAR) models do, indeed, suggest that higher uncertainty about the supply of gas leads to a nominal depreciation of the euro against the US dollar (see the box on pp. 48 f.). It is not, however, the main reason for the depreciation seen since the beginning of 2022 – of, on balance, 6.8%[3] and at times more than 15%. The bulk of the depreciation against the

1 See Deutsche Bundesbank (2022a). An increase in the gas price can, through substitution effects, also impact the prices of other energy sources and, via the merit order principle, drive up the price of electricity in particular; see German Council of Economic Experts (2022).
2 See Deutsche Bundesbank (2022b).
3 Current as at 9 December 2022.

… than of the relative pace of monetary policy tightening in the two currency areas

US currency can consequently be attributed to other factors. These include, in particular, the Federal Reserve's monetary policy tightening: the faster rise in interest rates across the entire maturity spectrum there compared with the euro area made portfolio reallocations to the United States comparatively attractive and thereby exerted downward pressure on the euro.

International price competitiveness: indicators and current assessment

Euro depreciation should, all other things being equal, increase Germany's price competitiveness

Irrespective of what has caused the euro's depreciation against the US dollar, the question is: to what extent has it contributed to improving Germany's price competitiveness? Nominal depreciation makes imports more expensive in the domestic currency and renders foreign currency exports cheaper, and should therefore cause a shift in demand for goods towards those produced domestically. However, Germany's price competitiveness is driven not only by the exchange rate against the US dollar, but also by the exchange rate against Germany's other major trading partners and, in particular, by the relative development of prices and costs at home and abroad.

Indicator of price competitiveness based on long-term averages …

The Bundesbank mainly uses two indicators to assess international price competitiveness.[4] First, it tracks an indicator in which the current value of a real effective exchange rate is compared with its long-term average.[5] In addition to the nominal effective exchange rate, the real effective exchange rate used here also includes the deflator of total sales at home and abroad. It has the advantage of taking into account not only domestic value added but also the prices of imported goods and services, which represent a cost component of domestic production where intermediate goods are imported. Moreover, real exports can be forecast better on the basis of broadly defined price and cost indicators, such as the deflators of total sales, than using narrowly defined ones.[6]

Historical decomposition of the euro-US dollar exchange rate in the year to date

Daily data, percentage change versus 31 December 2021

1 (Median) contributions of an uncertainty shock relating to European gas supply to the rate of change in the euro's exchange rate against the US dollar in a proxy VAR model. **2** Values in % as the difference between logarithmic values. An increase indicates an appreciation of the euro.

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… broadly unchanged on balance since the beginning of the year

The chart on p. 50 shows the development of this indicator for Germany compared with 26 selected industrial countries since 1975. Two key conclusions can be drawn from its course. First, Germany's price competitiveness can currently still be regarded as fairly favourable by historical standards. Second, as compared with the final quarter of 2021, it has hardly changed overall despite the (relative) rise in energy prices. The reason why price competitiveness as measured by this indicator has so far not deteriorated despite an increase in aggregate relative prices is the euro's nominal performance, which has seen the single currency lose around 1.6% of its value in trade-weighted terms from Germany's perspective since the last quarter of 2021.[7]

4 See Deutsche Bundesbank (2013) for a detailed overview of the various approaches and their respective pros and cons.
5 According to the relative purchasing power parity theory, nominal exchange rate movements balance out relative inflation differentials over the long term. This implies that the real effective exchange rate would have to fluctuate around a constant mean.
6 See Fischer et al. (2018).
7 The exchange rate movements against the currencies of industrial countries which are part of the above group of countries but do not belong to the euro area are considered here. In some cases, the above-mentioned aggregate relative price increase will already reflect the fact that the relative increase in energy prices in Germany vis-à-vis its partner countries is passed on as a relative increase in the prices of other products.

Uncertainty about European energy supply and the external value of the euro in a proxy VAR model

A large number of factors influence financial market variables like the exchange rate of the euro against the US dollar. The following analysis uses a structural vector autoregressive (SVAR) model to identify and isolate one of these determinants: uncertainty about the future supply of Russian gas to Europe.

A VAR model consists of n variables that interact with one another over time. Expressed mathematically, the reduced form of the model to be estimated using data is

$$y_t = c + B_1 y_{t-1} + B_2 y_{t-2} + ... + B_p y_{t-p} + u_t,$$

where y and c are (n x 1) vectors of the endogenous model variables and constants, respectively, and p is the number of lags included. The (n x n) matrices B_i (where $i = 1, \dots, p$) contain the estimated regression coefficients, which indicate how the variables are dependent on one another over time. Finally, u_t represents an (n x 1) vector of errors terms.

A total of seven variables are included in the estimation of the model under consideration here in order to capture developments in the financial markets as comprehensively as possible: the European gas price (Dutch TTF natural gas) as a spot price and one-month future, the Brent crude oil price, the Euro STOXX 50 index, the VIX (a measure of implied stock market volatility derived from option prices), the yields on ten-year German government bonds and, finally, the euro-US dollar exchange rate.[1] The reduced form of the model shown above is estimated using Bayesian methods based on daily data from the start of April 2020 to mid-December 2022.[2]

The resulting model residuals $\hat{u}_t$ are deviations of the observed data from the values predicted by the model. In terms of the model, the residuals therefore represent surprising changes in the individual variables. In the model residuals, the underlying driving forces are mixed, meaning the model residuals themselves are correlated. In order to be able to make statements about the explanatory contribution of individual influencing factors, it is assumed in the context of SVARs that the residuals can be broken down into mutually uncorrelated impulses – referred to as structural shocks – permitting a causal interpretation. Proxy VAR models, for example, draw on information from outside the model itself in the form of instrumental variables for this purpose.[3] A suitable instrument would be correlated with the shock to be identified – here increased uncertainty regarding energy supply – but not with other potential structural shocks.

In the case at hand, an indicator variable (i.e. a time series consisting of only zeros and ones) is used as an instrument. To this

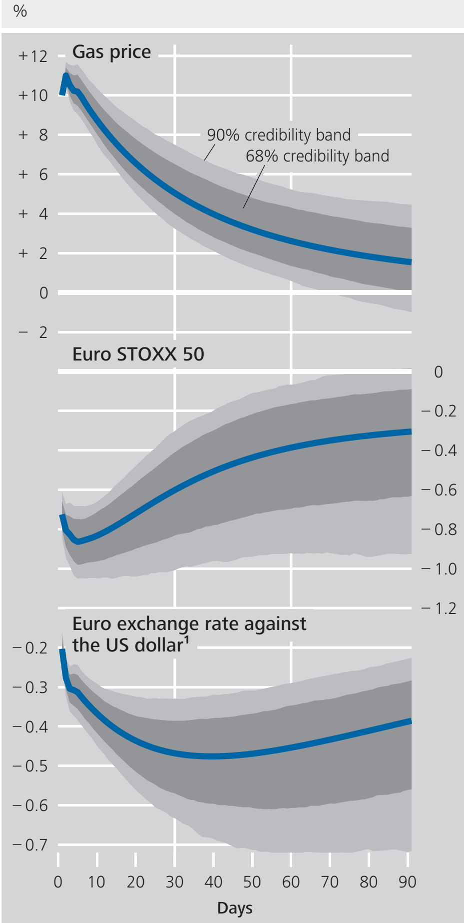
1 All of the variables except for yields are included in the model in logarithmic form.
2 The financial markets experienced sharp price declines in March 2020 with the onset of the COVID-19 pandemic. The estimation period has been chosen so as to deliberately exclude this exceptionally volatile period. The number of lags is set to $p = 5$, which is equivalent to one week for data available on trading days. However, this specific choice has hardly any impact on the results. Bayesian methods are often used in the literature to estimate VAR models. In this context, certain assumptions are made about the coefficients (priors). The actual estimated coefficients are then derived from a combination of the priors with information derived from the data. If, alternatively (as in classical frequentist statistics) only data are used for the estimation, the results presented here change only marginally.
3 See Stock and Watson (2012) and Mertens and Ravn (2013).

end, various events are identified which could be plausibly interpreted as actual or perceived exogenous changes in the supply situation and which should have led to an immediate increase in the price of gas. These include, in particular, Russian announcements concerning limitation or discontinuation of gas supplies.[4] The events generally increased uncertainty about whether the necessary gas supply for euro area consumers would be safeguarded going forward.

Once the shock is identified using the instrument, impulse response functions can be calculated. These show how the shock affects the individual variables in the system over time. The adjacent chart shows the effect of an increase in uncertainty about gas supply which increases the price of gas by 10%. A shock of this kind directly reduces the market valuation of European equities by around 0.7% and leads to a persistent depreciation of the euro against the US dollar of between 0.4% and 0.5%.

Finally, the model can be used to estimate the extent to which the historical development of individual variables can be attributed to the identified shock. The chart on p. 47 shows that uncertainty about energy supply at the beginning of the war was the main reason for the short-term depreciation of the euro at that time, but also that the impact of the shock subsequently lessened again for some time. At the beginning of the summer months, supply uncertainty gradually increased again, but even in late summer it accounted for no more than around one-third of the euro's depreciation.[5]

Impulse response functions to increased uncertainty about European gas supply*



*Response in the proxy VAR model to an uncertainty shock which increases the gas price (wholesale spot price, Dutch TTF) by 10%. Values in % as the difference between logarithmic values. **1** An increase indicates an appreciation of the euro.
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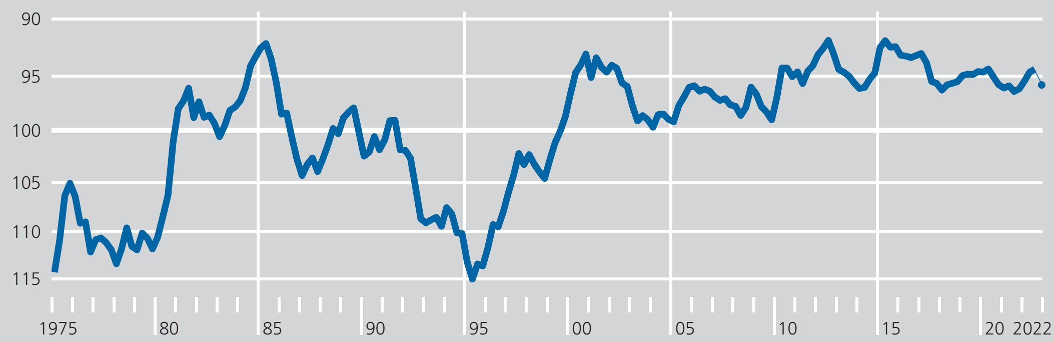
4 The events are: 7 March 2022 (Russia threatens to halt gas supply via Nord Stream 1), 23 March 2022 (Russia requires Russian gas to be paid in Russian roubles in future), 14 June 2022 (Russia announces that it will cut gas supply via Nord Stream 1 by 40%), 26 July 2022 (Russia announces that it will cut gas supply via Nord Stream 1 to 20%), 22 August 2022 (Russia announces an unscheduled temporary closure of Nord Stream 1 for maintenance, fuelling fears of a delivery stoppage), 5 September 2022 (Russia ends gas supply via Nord Stream 1 for an indefinite period), 27 September 2022 (suspected sabotage of Nord Stream pipelines). On each of these dates, the European gas price rose by more than 10% compared to the previous day. To construct the instrument, these identified dates are assigned a value of 1, while all other dates are assigned a value of 0.
5 Estimates based on other structural models tend to suggest even smaller contributions.

Indicator of the price competitiveness of the German economy as compared to selected industrial countries*

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



* Based on the deflators of total sales. Group of countries: Austria, Belgium, Cyprus (from 2008), Denmark, Estonia (from 2011), Finland, France, Greece (from 2001), Ireland, Italy, Latvia (from 2014), Lithuania (from 2015), Luxembourg, Malta (from 2008), the Netherlands, Portugal, Slovakia (from 2009), Slovenia (from 2007), Spain, Sweden, the UK, Norway, Switzerland, Japan, Canada and the United States. **1** Rise in the curve (decline in values) indicates an increase in competitiveness. • = Last data point: 9 December 2022.
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Indicator based on the productivity approach suggests that Germany is in a favourable competitive position

A second indicator of price competitiveness which is frequently used at the Bundesbank is based on the productivity approach.[8] This indicator is particularly suitable when assessing price competitiveness against a broad group of countries that also includes emerging market economies which are in the process of catching up. To calculate indicators based on the productivity approach, real exchange rates are adjusted for productivity effects using econometric estimates.[9] The approach consequently takes account of the fact that a higher relative price level is not accompanied by a loss of competitiveness if it is due to an increased relative productivity level. The Bundesbank calculates such an indicator of the German economy's price competitiveness compared with a broad group of currently 56 partner countries. This indicator, too, at present suggests a favourable competitive position.

Indicators not distorted by high inflation rates

One might now ask whether the indicators of price competitiveness described here are distorted by the sharp rise in energy prices or, more generally, by the high inflation rates. This could be the case, in particular, because daily values are derived from real exchange rates, which are only available at a quarterly or annual frequency, by extrapolation using nominal effective exchange rates available at a daily frequency. Since such an extrapolation does not take into account relative price developments, very different inflation rates could, in principle, lead to a distortion of the indicators. However, rough calculations show that such distortions are also currently still very small and do not change the general finding that Germany's competitive position is fairly favourable at present.[10]

8 The problem with competitiveness indicators based solely on real effective exchange rates is that they result in a distorted representation of international price competitiveness when there are diverging productivity developments at home and abroad and associated Balassa-Samuelson effects occur. According to the Balassa-Samuelson model, productivity gains in the tradable goods sector are accompanied by corresponding wage increases not only in this sector itself, but also in the non-tradable goods sector. This results in an increase in prices in the domestic sector, a rise in the aggregate inflation rate and real currency appreciation. However, this does not reflect deteriorated competitiveness, as the export sector is not affected by the price increase. See Deutsche Bundesbank (2002), Balassa (1964) and Samuelson (1964).
9 See Fischer and Hossfeld (2014).
10 The price differential between Germany and the weighted average of its trading partners based on consumer price indices can provide an indication of the extent of the distortion. For example, from the second quarter of 2022 through to the quarter for which the data needed to calculate the productivity proxy are available, consumer prices in Germany have risen by roughly the same magnitude as the average of the partner countries. This suggests that, at present, the extrapolation does not significantly distort the indicator.

Rise in energy costs and price competitiveness: a rough calculation

Relative rise in energy costs in Germany in 2022, …

How are the relative rise in energy prices in Germany, on the one hand, and the nominal depreciation of the euro against the US dollar, on the other, now being reflected in the price competitiveness indicators described above? If we first look at the impact of the rise in energy costs on price competitiveness, we need to determine the extent to which this leads to an increase in aggregate prices relative to other countries.

… taking energy intensity into account, …

It should be borne in mind that energy costs account for only part of production costs, meaning that the response of the deflator in question will be disproportionately small even if the costs are passed on in their entirety. The lower the energy cost share, the smaller the effect on the aggregate price level. Using input-output tables, the share of energy costs in total costs for Germany can be roughly estimated at a little over 2%.[11]

… led to a deterioration in Germany's price competitiveness of around 0.9% by September

The actual increase in relative energy costs can be assessed, for example, using an energy-specific producer price index published by the Organisation for Economic Co-operation and Development (OECD) for industrial economies.[12] For Germany, this index rose by just under 30% from the beginning of the year to September relative to a trade-weighted average of 24 partner countries.[13] Taking the energy cost share calculated above of a little over 2% as the basis, the relative increase in said energy costs is reflected in a deterioration of 0.9% in Germany's aggregate price competitiveness.[14]

By contrast, domestic competitiveness improved by 1.9% in the same period due to euro depreciation against US dollar

This deterioration was counteracted by the euro's depreciation against the US dollar over the course of the year, which, when taken in isolation, improved Germany's price competitiveness.[15] If we consider a group of 26 of Germany's trading partners in broad analogy to the OECD energy-specific producer price index used above, the trade weight of the United States amounts to just under 15%.[16] The euro's nominal depreciation against the US dollar of 12.5% observed between January and September thus results in an improvement of 1.9% in Germany's price competitiveness compared with the group of countries under analysis.[17]

The improvement in Germany's price competitiveness as a result of the euro's nominal depreciation against the US dollar in the period under review from January to September was thus markedly larger in purely arithmetical terms than its deterioration as a result of the relative rise in energy prices in Germany as measured by the OECD's energy-specific producer price index.[18] Similarly, based on the

11 The input-output tables of 2019 serve as the basis for this estimate. If an aggregate energy component is defined in simplified terms as consisting of intermediate inputs of different categories of goods, the share of the corresponding expenditure in total costs ("production value") is 2¼%. Relative to gross value added, this would be around 4½%.
12 See also the chart on p. 46.
13 According to this index, the rise in energy costs between January (before the start of the war) and September amounted to 77% for Germany and 36% for the weighted average of partner countries. Energy prices in Germany thus rose by just under 30% relative to these trading partners. In October, however, energy prices in Germany fell again.
14 For the sake of simplicity, this rough calculation assumes that energy costs as a share of total costs do not differ significantly between the partner countries and Germany. If, for example, it were only 1% in the partner countries, Germany's price competitiveness would have deteriorated by 1.4%. If energy intensity abroad were higher at 3%, the deterioration would only amount to 0.6%. In addition, for the sake of simplicity it is assumed that country-specific energy prices do not differ in terms of their starting level.
15 The following analyses therefore assume, for the sake of simplicity, that the euro's exchange rate against the currencies of all other trading partners has not changed. In reality, the external value of the euro increased slightly in trade-weighted terms over the period under review if the depreciation against the US dollar is excluded.
16 See Deutsche Bundesbank (2020). Among the 26 trading partners considered here, Japan and Canada were not included in the calculation of the relative increase in energy costs in Germany compared with 24 countries owing to a lack of data.
17 To harmonise the calculation of the depreciation with the relative increase in energy prices calculated above, the change in monthly averages of the euro-US dollar exchange rate between January and September 2022 was used.
18 It should be noted that a rough calculation of this kind is highly simplified. For example, no second-round effects of the rise in energy prices on other cost components are taken into account, and adjustment effects such as a substitution of energy sources in production or in the demand for final products are also disregarded, as are international differences in the starting level of energy costs.

aforementioned group of 26 trading partners, in purely arithmetical terms a 1% nominal depreciation of the euro against the US dollar would improve Germany's price competitiveness to around the same extent as – in purely hypothetical terms – its price competitiveness would deteriorate owing to a 6% increase in relative energy costs against these countries.[19]

Classification: price competitiveness as a macroeconomic concept

Price competitiveness as a macroeconomic concept

How can we now assess the finding that Germany's price competitiveness is currently fairly favourable according to our indicators, given the fears voiced by many that the rise in energy prices poses enormous challenges to parts of Germany's industrial base? To answer this question, it should first be borne in mind that the exchange rate is a macroeconomic variable and that the price competitiveness indicators based on it are therefore necessarily a macroeconomic concept as well. Such a concept does not capture heterogeneities, the effects on individual sectors and firms or the distributional effects between them. For example, if one particular sector has a distinctly higher energy cost share than the average of the economy as a whole, it will be more strongly affected by the relatively pronounced rise in energy prices in Germany. In addition, a depreciation of the euro against the US dollar alone does not necessarily reduce the price of exports with sales markets located in currency areas other than the United States.[20] Exporters to the United Kingdom and Japan, for example, have been particularly affected, with their exports invoiced in euro even becoming more expensive owing to the depreciation of the pound and the yen against the euro over the period under review. By contrast, exporters to the United States with a low energy cost share benefited all the more from the depreciation against the US dollar.[21]

Depreciation against the US dollar can have a price-driving effect

Moreover, it should be borne in mind that intermediate goods – especially a number of energy sources – are often themselves invoiced in US dollars.[22] A depreciation of the euro against the US dollar is therefore itself likely to have a price-driving effect on energy costs. If, in an extreme case, all intermediate goods are invoiced in US dollars, but export revenues come from a third currency area and are denominated in euro, the profit of an affected firm would not increase as a result of the euro's depreciation, but would actually decrease further.

Germany's currently fairly favourable price competitiveness despite the relative rise in energy costs should therefore be interpreted in macroeconomic terms. The result certainly does not mean that, just because of the euro's depreciation against the US dollar, the rise in energy prices is unproblematic for all domestic sectors or firms. Rather, exchange rate movements by their very nature as macroeconomic variables affect different sectors or firms in different ways.

Euro depreciation may be temporary

Finally, as described here, the depreciation of the euro against the US dollar should not be seen primarily as a response to the energy crisis itself. Instead, it is largely due to other circumstances, such as the relatively strong tightening of US monetary policy. If these circumstances prove to be temporary,[23] the exchange rate ef-

19 This result is approximated by (1/(2¼%))*14.6% ≈ 6.5. If a broader group of 56 partner countries is considered, the US dollar would have a weight of just over 9%, which would result in a value of (1/(2¼%))*9.4% ≈ 4.2.
20 In such a scenario, exporters can still benefit from a depreciation of the euro against the US dollar if exports are invoiced in US dollars. This is actually the case for many goods in global trade, even when the United States is not one of the two trading partners (see Gopinath (2015) and Gopinath and Itskhoki, (2021)). In such a case, exporters' profit margins would rise if viewed in isolation, provided intermediate goods and other cost components are not also invoiced in US dollars. If exporters subsequently lowered their prices, demand effects would also arise.
21 A demand effect results directly if exports are invoiced in euro and thus become cheaper for US importers. If export goods are invoiced in US dollars, exporters' profit margins increase, all other things being equal.
22 However, this does not necessarily apply to trade in natural gas, for which contracts are often invoiced in euro, at least in Europe.
23 For example, the euro has already appreciated again against the US dollar since the period up to September considered in the calculation.

fect improving price competitiveness would also disappear in the future. This would then worsen Germany's price competitiveness if the sharp rise in energy costs compared with other countries were to also prove persistent at the same time. In this respect, therefore, it cannot be assumed that relative price shifts emanating from the energy market, which may be structural in nature, will always and permanently be absorbed by nominal exchange rate changes.

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