Effective exchange rates from financial market data

Nominal and real effective exchange rates have, to date, been calculated mainly from trade flows and goods market prices both in the academic literature and in economic practice. With increasing financial market integration, however, the importance of international capital transactions has increased, and their value meanwhile far exceeds that of cross-border goods market transactions. This suggests that it would be appropriate to construct real exchange rates based not only on goods market equilibriums but also on capital market equilibriums. Although first approaches in the literature weight the currencies of partner countries that are included in the calculation of effective financial market exchange rates according to financial ties, deflating is still based on goods price indices.

A concept for effective financial market exchange rates will be introduced on the following pages, with both weighting and deflating based on financial variables. The underlying idea is to construct effective financial market exchange rates as an indicator of the relative attractiveness of different countries' assets. It emerges that the indicators of price competitiveness on the goods markets on the one hand and the corresponding financial market indicators on the other may diverge considerably at times. Consequently, they may well provide different information. For instance, historically very high or very low effective financial market exchange rates signal potential over or undervaluation of assets. In the past, such mispricing was at times aggravated by speculative financial market players who expected current developments to continue regardless of fundamentals. This caused "speculative bubbles" that triggered, sometimes severe, turmoil on the financial and goods markets. Establishing effective financial market exchange rates may potentially help identify the emergence of mispricing on national financial markets more quickly.

The concept of effective financial market exchange rates

Concept of effective exchange rates to date generally oriented towards goods economy

In calculating nominal and real effective exchange rates, the focus has, to date, lain mainly on correlations in the goods economy. For instance, the weights used by the European Central Bank to summarise the euro's exchange rates against individual currencies to yield the overall index reflect those currencies' significance for the euro area's external trade. The real effective exchange rates of the euro, which are derived by deflating the nominal effective exchange rate with the appropriate price or cost indices, are used as indicators of international price and cost competitiveness on the goods markets. Temporary deviations of the real effective exchange rates calculated in this manner from their long-term average can be interpreted as the relative price competition advantages or disadvantages of the individual currency areas on the international goods markets, which may affect external trade. The relevant currencies are classed as relatively under or overvalued in such phases.

Basic idea of the law of one price and relative PPP…

The use of long-term averages as a benchmark is compatible with the concept of relative purchasing power parity (PPP).[1] This concept states that the inflation differentials between two countries or regions are offset by opposite changes in the nominal exchange rate, ensuring that relative purchasing power at home and abroad – and thus the real exchange rate – remains constant. Purchasing power parity is based on the law of one price, according to which prices for homogenous tradable domestic and foreign goods on integrated goods markets are the same across borders, provided the nominal exchange rate is used to express national prices in a uniform currency. Geographic price differences tend to be eliminated through goods arbitrage. While trade barriers (eg transport costs or varying levels of import duties) as well as different indirect tax rates may prevent full price equalisation and thus the validity of absolute purchasing power parity, they are compatible with relative purchasing power parity provided they remain constant.[2]

… can also be applied to capital market transactions

Increasing financial market integration has heightened the importance of cross-border capital transactions, whose value far exceeds that of international goods transactions. In order to identify and assess mispricing of currencies, one could therefore conceivably also take capital transactions into account. Based on this underlying idea, it would appear to make sense to construct effective exchange rates proceeding not only from arbitrage equilibriums in goods markets but also on arbitrage equilibriums in capital markets. Some initial approaches have already been published in the literature. In these, the currencies of partner countries that are included in the calculation of effective financial market exchange rates are weighted based on financial ties. However, deflation is still carried out using goods price indices in these models.[3]

1 See Deutsche Bundesbank, Purchasing power parity theory as a concept for evaluating price competitiveness, Monthly Report, June 2004, pp 29-42.
2 See Deutsche Bundesbank (2004), loc cit, pp 32-36.
3 See S Béreau, A López Villavicencio and V Mignon (2008), Nonlinear Adjustment of the Real Exchange Rate Towards its Equilibrium Value: A Panel Smooth Transition Error Correction Modelling, CEPII Working Paper No 2008/23, and P R Lane and J Shambaugh (2010), Financial exchange rates and international currency exposures, American Economic Review 100, pp 518-540.

Correlation with uncovered interest rate parity

It is possible to go a step further and use financial market prices for deflating, too. This reveals the correlation with uncovered interest rate parity (see box on page 20). Uncovered interest rate parity stipulates that the expected returns on comparable investments should be equal in arbitrage equilibrium, provided investors are risk neutral. Based on a state of equilibrium, in which there is uncovered interest rate parity, an isolated relative increase in the price of domestic versus foreign securities causes the expected yield on the domestic investment to drop as compared to the foreign investment, all other things being equal. Uncovered interest rate parity is disturbed, which triggers substitution processes in favour of foreign investments, and yield differences tend to narrow. Adjustment can take place through an alignment of national asset prices or appreciation of the foreign currency. Provided the fundamentals that determine prices – expected earnings prospects and risk assessment – have not changed, all financial variables return to their original levels.

Possible temporary deviations where earnings prospects diverge

When the foreign as compared to the domestic earnings prospects improve – for instance as a result of relatively favourable economic developments or an asymmetric shock – domestic and foreign investors will restructure their portfolios in favour of foreign assets if asset prices are fixed. The resulting restructuring of securities holdings in favour of foreign securities drives up their relative prices. At the same time, as capital flows abroad, the domestic currency tends to depreciate. Given that earnings prospects have changed in this scenario, at least temporarily, the effective financial market exchange rate declines.

Long-term average as benchmark

Assuming that portfolio adjustment has been concluded in the medium term, and changes to the earnings outlook are primarily the result of cyclical factors, the financial market exchange rate will, after a while, return to its long-term average. When looking at sufficiently long time series, the long-term average should represent a good proxy for the equilibrium value of the financial market exchange rate; it can therefore be regarded as the benchmark. This reveals an important parallel between relative purchasing power parity for goods markets and uncovered interest rate parity for financial markets: while the former implies that the long-term average of the real effective exchange rate can be used as the benchmark on the goods markets, the latter implies the same for the effective financial market exchange rate.[4] In arbitrage equilibrium, ie where interest rate parity holds, the financial market exchange rate remains constant.

Growth lead and risk premiums as potential causes of…

The situation is different where a country's earnings prospects are more favourable than those of other countries over the long term – for instance as a result of a lasting productivity or growth lead.[5] Under these circumstances, capital inflows trigger a trend in-

4 See Deutsche Bundesbank (2004), loc cit, pp 40-42.
5 Temporary differences in the earnings situation, too, can trigger a long-term shift in the level of the equilibrium real financial market exchange rate, provided they are not offset by later, diverging developments. When using long-term averages, this effect is taken into account incompletely and with a time lag. This suggests the advisability of establishing uncertainty margins when identifying mispricing and using variable time windows when calculating longer-term averages.

Financial market exchange rate and interest rate parity

Interest rate parity stipulates that, where investors are risk neutral, the expected returns on homogeneous domestic and foreign assets are equal in arbitrage equilibrium. It therefore holds that

$$(W^e_{t+1} \cdot P^e_{t+1} - W_t \cdot P_t)/W_t \cdot P_t = (P^{*e}_{t+1} - P^*_t)/\, P_t^*, \quad \text{(1a)},$$

where P represents the price or the performance index of a given type of investment (equities on the one hand or bonds on the other) at home and P^* the corresponding price abroad. W is the nominal exchange rate between the home country and the foreign country, expressed as the price of the domestic currency in units of the foreign currency, as is customary for euro exchange rates, for example. The notations t and $t+1$ stand for the point in time of the investment decision and the point in time of unwinding the investment respectively; foreign variables are represented by the symbol * and expectation variables by ^{e}.

After some conversion the following expression is obtained, in reduced notation, for the condition of equilibrium

$$W_t \cdot P_t/\, P_t{}^* = W^e_{t+1} \cdot P^e_{t+1}/P^{*e}_{t+1}, \quad \text{(1b)},$$

where $W \cdot P/P^*$ represents the financial market exchange rate.

Where investor risk neutrality is given, arbitrage equilibrium is achieved at precisely the time when the financial market exchange rate will not, in investors' opinion, change over the investment period. Equation (1b) is fulfilled *ex post* when the real exchange rate is constant, so that the long-term average of the financial market exchange rate should, over time, provide a useful benchmark for equilibrium if the observation period is sufficiently long and there is no indication of structural shifts in the equilibrium price relationship for assets (or in the corresponding returns).

A different situation arises when the domestic and foreign assets are not completely homogeneous due, for example, to differences in risk assessment. If investors attribute an earnings or default risk to securities issued in their home country and therefore demand a yield markup for investing in domestic securities, a risk premium (RP) needs to be added to the condition for arbitrage equilibrium (1a).

$$(W^e_{t+1} \cdot P^e_{t+1} - W_t \cdot P_t)/W_t \cdot P_t = (P^{*e}_{t+1} - P^*_t)/\, P_t^* \; + \; RP \quad \text{(2a)}$$

or

$$W^e_{t+1} \cdot P^e_{t+1}/P^{*e}_{t+1} = \; W_t \cdot P_t/P_t^* + RP\,(W_t \cdot P_t/P^{*e}_{t+1}) \quad \text{(2b)}.$$

Investors receive a risk premium ($RP > 0$) for investing in a domestic asset at precisely the time when the current financial market exchange rate of the domestic currency drops below its expected future value or when the domestic currency is expected to appreciate over the investment period.

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crease in the financial market exchange rate – indirectly through asset price increases and/or nominal appreciation – which means that interest rate parity is not given, even in the medium term, and the long-term average of the financial market exchange rate does not represent a suitable benchmark.

... equilibrium real appreciation

Permanent deviations from interest rate parity can, however, also occur if risk considerations play a role in investment decisions and optimum portfolio composition depends not only on the expected yield structure, but also on the risk structure of international investments. For instance, investors will demand a yield premium – in other words, a risk premium – for investing in domestic assets which they believe have a comparatively high earnings or default risk. A persistently high risk premium is therefore reflected in a lasting increase in the effective financial market exchange rate.

Calculating effective financial market exchange rates

Calculating country weights based on financial ties...

In the following, effective financial market exchange rates – based on the considerations outlined above – will be presented for Germany and the euro currency area. Bilateral exchange rates will be weighted against the currencies of the most important partner countries to reflect existing financial ties. As specific factors may influence investments in equity and long-term fixed interest securities, a distinction is made between stock market prices on the one hand and bond prices on the other hand when establishing effective financial market exchange rates. As when constructing goods market exchange rates, the regional structure of the foreign assets and liabilities of the country in question is taken into consideration when calculating effective stock and bond market exchange rates.

The overall weight at which the bilateral exchange rate of the country under observation – in the following, we will talk of "domestic" – vis-à-vis the individual partner countries is included in the effective exchange rate is calculated as the weighted average of the asset and liability weight (see box on page 22 for an explanation of how this is calculated). The asset weight is determined as the percentage of shares (bonds) of the individual partner country in the overall equity (bond) holdings of all partner countries held domestically by residents. By contrast, the liability weight corresponds to the percentage that the individual partner countries represent of total holdings of domestic shares (bonds) held by investors in the partner countries.

Country selection covers more than 90% of external positions worldwide

Data from the Coordinated Portfolio Investment Survey (CPIS), which comprises asset and liability holdings in equities and bonds in the securities portfolios of investors from currently roughly 75 countries, were used to calculate country weights. The circle of countries (25)[6] used here reflects more than 90% of the global assets and liabilities documented in the CPIS. Looking at the CPIS data, which are available from 2001 onwards, the year 2004

6 Austria, Australia, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, Greece, Hong Kong, Ireland, Italy, Japan, South Korea, Mexico, the Netherlands, Norway, Portugal, Russia, Sweden, Singapore, the United Kingdom and the United States.

Method for calculating weights

When calculating effective financial market exchange rates of country i, the bilateral exchange rates R_t^{ji} must be suitably weighted. In the same way as when constructing goods market exchange rates, the regional structure of the corresponding foreign assets and liabilities of a country are used. Since the weights for the effective stock market exchange rate on the one hand and the effective bond market exchange rate on the other are calculated using the same method, the general procedure will be described in the following. The liability weight of country j in the liabilities portfolio of country i is calculated as its share (w_{ji}^p) of the total holdings of securities of country i held by the N partner countries. Here, the weight for the stock market exchange rate is calculated in respect of holdings of shares and, for the bond market exchange rate, in respect of holdings of bonds.

$$w_{ji}^p = \frac{securities_{ji}}{\sum_{k=1}^{N} securities_{ki}} \tag{1}$$

Thus, the asset weight of country j in the assets portfolio of country i is defined as its share (w_{ji}^a) of the total securities of the N partner countries held by residents of country i.

$$w_{ji}^a = \frac{securities_{ij}}{\sum_{k=1}^{N} securities_{ik}} \tag{2}$$

1 Any third-market effects are not included in this calculation.

$Securities_{ji}$ denotes the value of all securities of the investment type under consideration of country i in the portfolios of country j, $securities_{ij}$ the value of the corresponding securities of country j held by residents of country i and N the number of partner countries. The total weight of partner country j in the effective exchange rate of country i is then derived as the weighted average of the asset and liability weight.[1]

$$w_{ji} = \left[\frac{\sum_{k=l}^{N} securities_{ki}}{\sum_{k=1}^{N} securities_{ki} + \sum_{k=1}^{N} securities_{ik}}\right] w_{ji}^p + \left[\frac{\sum_{k=l}^{N} securities_{ik}}{\sum_{k=1}^{N} securities_{ki} + \sum_{k=1}^{N} securities_{ik}}\right] w_{ji}^a \tag{3}$$

Thus, the weight of country j when calculating the effective financial market exchange rate of base country i contains both assets and liabilities. The geometric mean of the bilateral financial market exchange rates is used to calculate the effective financial market rate of country i.

$$R_t^i = \prod_{k=1}^{N} (R_t^{ki})^{w_{k,i}} \tag{4}$$

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was chosen to calculate weights, as it is associated neither with the new economy bubble nor with the current financial crisis. For simplification, constant country weights for one base year are used, but the CPIS data also allow a chain index with time-variable weights if needed. The tables on pages 23 and 24 show the overall weights at which the individual countries are included in the stock market exchange rate and the bond market exchange rate for Germany and the euro area respectively. From a German perspective, the United States (27.7%), France (15.4%) and the United Kingdom (13.3%) are most important for the stock market exchange rate, while the Netherlands (13.8%), France (12.4%) and Italy (11.7%) have the largest weight in the bond market exchange rate, with the euro-area countries accounting for a percentage of 65.8% overall. In the indices for the euro area, which reflect its financial ties with third countries, the United States and the United Kingdom dominate with a combined weight of around 60% (bond market exchange rate) and just under 75% (stock market exchange rate).

Deflating using relative asset prices

Monthly bilateral euro and D-Mark exchange rates were obtained from the Deutsche Bundesbank's database. For the euro, synthetic exchange rates were calculated for the period 1993 to 1998 based on dollar exchange rates and the synthetic euro-dollar exchange rate. Similarly, for the period from 1999 onwards, hypothetical DM exchange rates were derived for the D-Mark based on euro-dollar rates. The nominal bilateral exchange rates are deflated using broad-based performance indices

Weighting for Germany's effective financial market exchange rates

In per mill

Country	Stock market exchange rate	Bond market exchange rate
Austria	22.2	58.6
Australia	6.9	4.7
Belgium	18.0	28.7
Canada	11.7	5.0
Switzerland	71.6	35.8
Denmark	6.3	19.8
Spain	42.8	75.9
Finland	17.4	15.5
France	153.6	123.9
Greece	2.5	17.5
Hong Kong	2.7	5.2
Ireland	44.6	64.3
Italy	47.2	117.4
Japan	38.3	81.3
South Korea	2.4	0.4
Mexico	0.3	1.4
Netherlands	71.7	138.4
Norway	7.8	18.8
Portugal	2.6	17.2
Russia	1.8	1.0
Sweden	16.6	15.4
Singapore	1.6	2.8
United Kingdom	132.6	80.3
United States	276.9	70.6

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Weighting for the euro area's effective financial market exchange rates

In per mill

Country	Stock market exchange rate	Bond market exchange rate
Australia	12.8	21.5
Canada	23.6	20.1
Switzerland	69.0	59.6
Denmark	8.7	32.4
Hong Kong	11.2	10.1
Japan	80.7	167.1
South Korea	9.2	2.9
Mexico	2.4	3.6
Norway	12.0	29.9
Russia	3.4	2.8
Sweden	27.4	42.3
Singapore	4.1	6.5
United Kingdom	237.3	303.7
United States	498.2	297.6

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for shares or bonds.[7] The bond indices for some countries are incomplete. Where datapoints lacked meaningful performance indices,[8] the yields on ten-year government bonds were used instead.

Germany's attractiveness on the financial markets

Differences between price competitiveness on goods markets and attractiveness of German shares

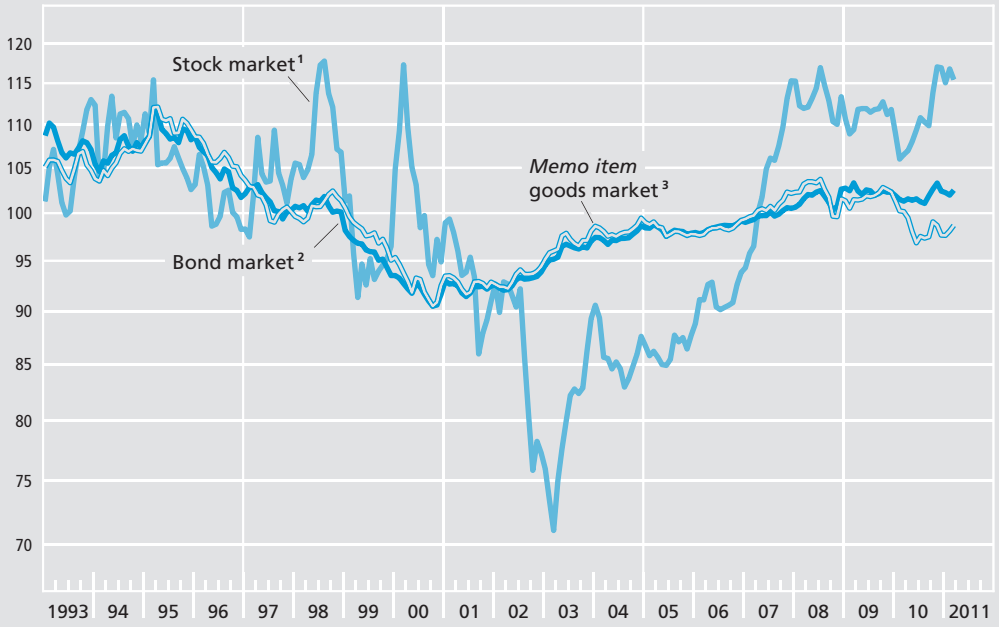
The effective exchange rate based on stock market weights and prices, a rate that can be interpreted as an indicator of Germany's (relative) attractiveness on the international stock markets, shows no clear trend over the observation period (for the period from 1993) (see chart on page 25). Deviations from its long-term average were largely temporary. Comparison with the indicator of price competitiveness on the goods markets shows that while the two indicators display fairly similar developments in the medium term, the share price-based indicator is significantly more volatile in the short term than its counterpart, which is calculated based on goods prices.[9] The indicator of Germany's attractiveness on the international equity markets marked highs for a short period leading up to July 1998 and to end-February 2000, ie immediately before the onset of the Russia crisis and the bursting of the new economy bubble respectively, while the indicator of price competitiveness – as measured by its long-term average – indicates a neutral or favourable competitive position on the goods markets. When the effective financial market exchange rate reaches high levels, this indicates – like the indicator of price competitiveness – that domestic assets (goods) are comparatively expensive and thus less attractive (competitive) internationally.

As measured against its long-term average, the German economy has recently also enjoyed a slight price competitive advantage on

7 Morgan Stanley Capital International (MSCI) indices were used for equities, while Datastream indices across all maturities were used for bonds. The use of performance indices is intended to improve the comparability of domestic and foreign securities as this eliminates the effect, for instance, of different dividend distribution practices, which may in turn affect yield.
8 This applies to Greece up until March 1999, Hong Kong and South Korea up until December 2004, Mexico up until December 2001, Russia up until December 1996, Singapore up until December 1999 and the euro area up until December 1998.
9 The Pearson correlation coefficient for both time series is p = 0.5 in the period described. This was based on the indicator of price competitiveness against 19 countries as determined by consumer prices for which monthly data are available. This indicator represents a good proxy for the circle of countries used (24 countries), as they make up a percentage weight of just over 98% in the effective financial market exchange rates.

Effective financial market exchange rates for Germany

Average since 1993 = 100, monthly, log scale



1 Based on share prices against 24 countries. — **2** Based on bond prices against 24 countries. — **3** Based on consumer prices against 19 countries.

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the goods markets, while German equity valuations are relatively high. The increase in prices for domestic shares before the economic and financial crisis was driven by strong global economic growth, which German stock corporations with their international focus were in a particularly good position to exploit. Additional factors were the economic revival in Germany and the sharp rise in the euro until into the summer of 2008. Following a marked decline – German enterprises were particularly hard hit by the global economic downturn, and the euro, too, fell sharply during the crisis – the effective stock market exchange rate has rallied since March 2010. In fundamental terms, this recent firming can be attributed to lively German economic growth and has, since mid-2010, also been buoyed by the revival of the euro.

Indicator of the attractiveness of German bonds…

By contrast, the performance of the indicator measuring Germany's attractiveness on the bond markets is fairly similar to that of the indicator for price competitiveness on the goods markets in the shorter term, too. Deviations are limited. This is because risk premiums and nominal interest rate changes on the international bond markets of the countries observed, and particularly those within the euro area, were long relatively unimportant. Like deviations from relative purchasing power parity on the goods markets, deviations from uncovered interest rate parity can therefore mainly be attributed to inflation differentials that are not matched by changes in nominal exchange rates. Developments have

diverged somewhat only recently. During the financial crisis, the nominal depreciation of the euro enhanced the German economy's competitiveness on the goods market overall as compared to mid-2008.

... above benchmark of late

Valuations for German bonds, by contrast, appear to be relatively high as measured by the long-term average of the indicator for the attractiveness of German bonds. This is because Bunds are seen as safe and given preference in times of crisis, and investors are willing to pay a premium for safety. By contrast, the government bonds of peripheral euro countries, whose default risk is seen as higher by the markets given serious fiscal problems, came under pressure, and prices fell.

Although economically plausible explanations can be found for the deviation of the two effective financial market exchange rates presented here from their long-term averages, caution should be applied before reaching any sweeping conclusions. Financial market prices are determined by a wide range of factors that are not explicitly considered here. Long-term averages are therefore only partially suitable as a benchmark, as outlined above. This is evident in the numerous studies dealing with the uncovered interest rate parity's lack of empirical validity.[10]

Attractiveness of the euro area on the financial markets

From a euro-area perspective, the effective exchange rates for goods and financial markets are more volatile than from a German perspective (see chart on page 27). This is particularly true of the indicator for price competitiveness, which in the short term tracks the movements in nominal exchange rates almost one to one given the stickiness of goods prices. The fact that the indicator for Germany is comparatively smooth can be explained by the fact that a large percentage of German external trade is conducted with other euro-area member states and is not, therefore, affected by changes in nominal exchange rates.[11]

Indicators for the euro area somewhat more volatile than those for Germany

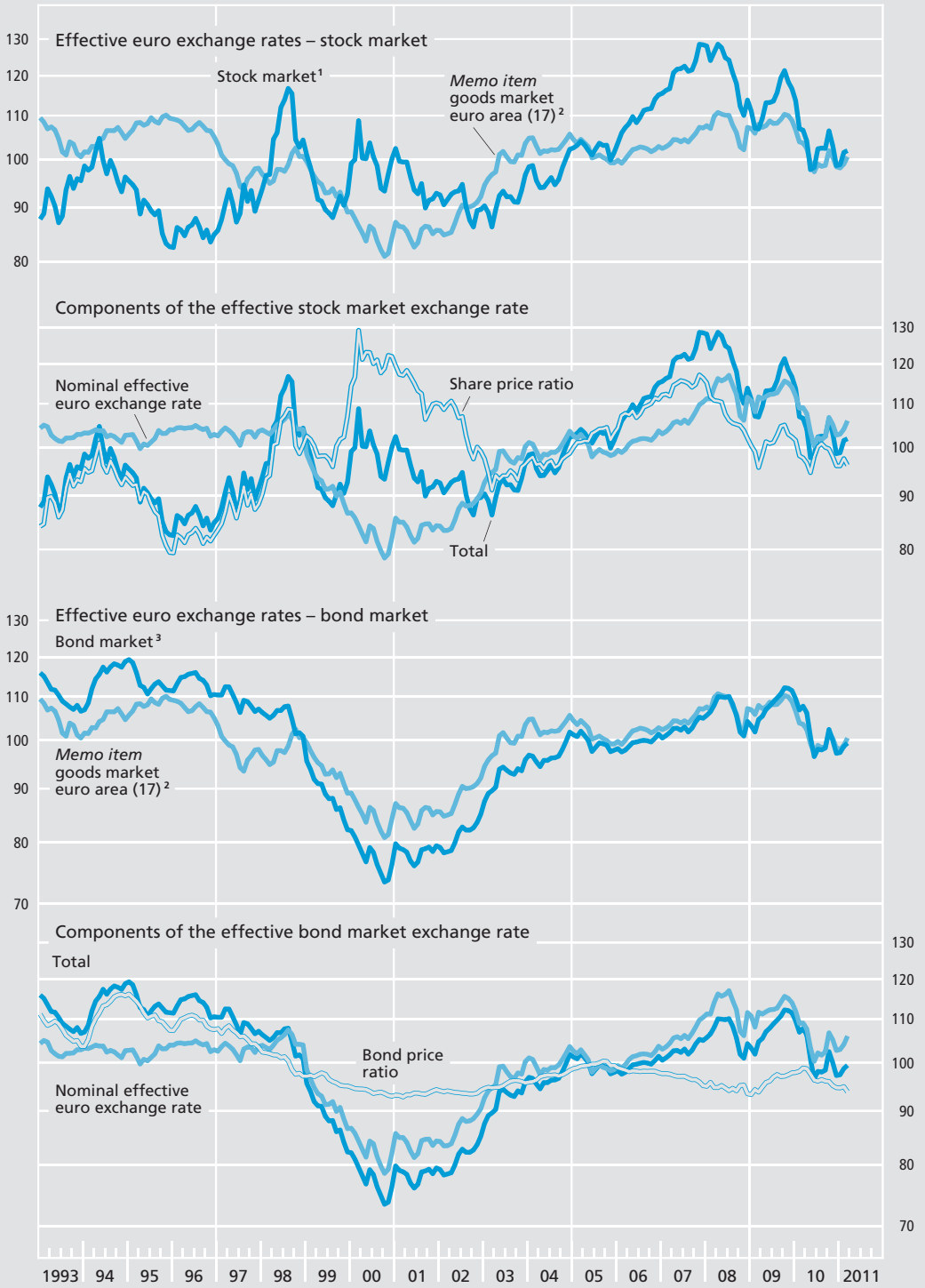
Share prices react more quickly than goods prices

Unlike German equities, European shares are only slightly dearer than their long-term average in an international comparison. A breakdown of the euro's effective exchange rate based on share prices into its components demonstrates that movements in share prices have a considerable impact on index performance.[12] The sovereign debt crisis in several euro-area countries has therefore driven down not only the nominal euro exchange rate but also share prices – in particular of banking stock – in the euro area, thereby weighing on the euro's effective financial market exchange rate from the price side. By contrast, the relative increase in euro-area share prices at the end of 1999/beginning of

10 See Deutsche Bundesbank, Exchange rates and interest rate differentials: recent developments since the introduction of the euro, Monthly Report, July 2005, pp 27-42.
11 More than 40% of Germany's foreign trade is conducted with euro-area partner countries.
12 Given strong capital ties within the euro area – where exchange rate movements are irrelevant – the attractiveness of German as compared to European investments is very largely dependent on share price movements. Effective financial market prices were therefore not broken down into a price and an exchange rate component for Germany.

Effective financial market exchange rates for the euro area

Average since 1993 = 100, monthly, log scale



1 Based on share prices against 14 countries. — **2** Based on consumer prices against 20 countries. — **3** Based on bond prices against 14 countries.

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2000 caused the single currency's effective financial market exchange rate to appreciate perceptibly, although the euro has fallen in nominal terms. This represents a major difference as compared to the index of price competitiveness on the goods markets, which is – as already mentioned – driven mainly by changes in nominal exchange rates in the short term.

Bond prices and goods prices similarly sticky

Unlike German bonds, the valuations of European bonds are, on balance, virtually neutral at present, as measured by the long-term average. Breaking down the effective euro exchange rate based on bond prices into its individual components shows that it is – like the indicator of price competitiveness – mainly driven by changes in nominal exchange rates. The bond price ratio displays major volatility only in the first phase of the observation period, roughly until 1999. During this period, yields in the individual euro-area countries still moved independently of one another, which led to the interest rate convergence process before the euro was introduced. It is, moreover, noteworthy that in the period after the launch of the euro, bond portfolios in the euro area underperformed those in the other countries under observation, as bond prices fell as compared to partner countries and the euro eased. By contrast, between 2006 and 2008, when talk of carry trades frequently dominated the markets, the bond price ratio and nominal exchange rates moved in opposite directions. With the onset of the government debt crisis in several euro-area countries and widening intra-euro-area spreads, the curves re-converged.

Effective financial market exchange rate and net external position

Relationship between capital transactions and exchange rates

The correlation between the effective financial market exchange rate and important fundamental variables is particularly interesting as an indicator of possible imbalances. Cross-border capital flows are especially relevant. The increase in international capital transactions in recent decades has caused a shift in the factors influencing exchange rates, which probably goes some way to explaining the often observed persistent deviation of the real effective exchange rate from its fundamentals-driven equilibrium value.[13] The concept of effective financial market exchange rates could help to bridge the gap between short-term technical analyses of nominal exchange rate movements and long-term approaches that examine the goods markets to determine real effective exchange rates. The fact that changes in the effective financial market exchange rate reflect deviations from uncovered interest rate parity is helpful in this context. These can be explained, for instance, by the existence of risk premiums; but they could also be caused by changed earnings prospects in combination with capital in and outflows.

Earlier studies…

The correlations between capital flows, share prices and nominal exchange rate fluctuations have already been analysed by Heimonen (2009) and Hau and Rey (2006).[14] A tendency

13 See S Béreau et al (2008), loc cit.
14 See K Heimonen (2009), The euro-dollar exchange rate and equity flows, Review of Financial Economics 18, pp 202-209, and H Hau and H Rey (2006), Exchange Rates, Equity Prices and Capital Flows, Review of Financial Studies 19, pp 273-317.

was found for the currency of the country receiving capital flows to appreciate and the currency of the country of origin to depreciate. Moreover, both studies concluded that there was a negative correlation between domestic share price movements and capital inflows. It was, however, left open to what extent this mechanism actually helps bring down international yield spreads. A comparison of price trends on the currency markets and on national securities exchanges is needed to assess that question.

... not necessarily representative

The above-mentioned studies use bilateral data for the United States and its partner countries, and are therefore not necessarily representative of the global capital markets. In addition, they are based on estimates in differences (capital flows, exchange rate and share price changes) and therefore allow no conclusions regarding the long-term equilibrium relationships of level variables, which may also be relevant for assessing the sustainability of the current competitive and debt situation. Here, an empirical analysis of the correlation between a country's financial market exchange rate and its net external position may be useful.

Meaning of risk premium

In line with the above-mentioned papers on equity prices, capital flows and exchange rate developments, Bundesbank estimation results indicate a positive correlation between foreign debt and financial market exchange rate (see box on pages 30 and 31). That means that the financial market exchange rate for countries with a positive external position is relatively low, whereas countries with a negative external position (ie foreign debt) tend to have fairly high financial market exchange rates. The fact that (high) foreign debt in relation to gross domestic product tends to be associated with an above-average risk premium for investments in that country is likely a factor. The existence of a risk premium can, as already mentioned, also help explain persistent deviations from uncovered interest rate parity that has not been adjusted for risk aspects as used in the concept of the effective financial market exchange rate.

Movement along the equilibrium path

The empirical correlation between the financial market exchange rate and the external position – in econometric terms, the long-term equilibrium relationship between these two variables – can also be interpreted in terms of economies' growth path. Thus, rapidly growing economies should initially see an increase in foreign debt combined with above-average capital gains. As international capital allocation adapts, this process should, however, come to a halt over time, and could potentially even reverse. According to the theory of intertemporal balance of payments adjustment, the economic catching-up process in emerging markets is associated with high capital inflows, followed later by profit repatriation by the creditor countries. Mature economies would therefore tend to have a positive external balance and comparatively low yields on domestic assets.[15]

15 This hypothesis is supported by the empirical study by Lane and Milesi-Ferretti, which finds a negative correlation between per capita income and net external assets for emerging markets, but a positive correlation for advanced economies. See P R Lane and G M Milesi-Ferretti (2002), Long-Term Capital Movements, NBER Macroeconomics Annual 2001, 16, pp 73-116.

Cointegration estimate of effective financial market exchange rate and net external position

The correlation between the effective financial market exchange rate and important fundamental variables is particularly interesting as an indicator of possible imbalances. The following cointegration analysis examines the relationship of the effective financial market exchange rate with a country's net external position. The interplay of capital flows and changes in the nominal exchange rate has already been analysed in numerous studies, although the external position's valuation effects, as well as domestic and foreign relative price developments, were not taken into consideration.[1] The estimate presented here incorporates these factors by using the indicator described in the main text.

The panel study is based on the net external position and the effective financial market exchange rates of 25 countries, which account for more than 90% of the global securities positions documented in the IMF's Coordinated Portfolio Investment Survey (CPIS).[2] The observation period covers the years 1993 to 2009. To calculate the effective financial market exchange rates ($fineer$), the weights from the 2004 CPIS were applied, and partner countries were differentiated from one another, as were equities and bonds.[3] The nominal bilateral exchange rates have been deflated based on the MSCI performance indices for shares and bonds. The net external positions in relation to gross domestic product (iip) are taken from the International Financial Statistics of the IMF and the External Wealth of Nations database by Lane and Milesi-Ferretti (2006).[4]

Panel unit root tests indicate that all variables used are integrated of order one. $fineer$ and iip have a cointegration relationship.[5] Taking the determined cointegration relationships as a basis, a pooled mean group (PMG) estimate was carried out using Stata 11.0, as described by Pesaran et al (1999).[6] The program defined and developed by Blackburne and Frank (2007) called xtpmg was used for the estimate.[7]

The estimate was premised on an autoregressive distributed lag (ARDL) specification with one lag of the dependant and independent variables (ARDL(1,1)). The corresponding error correction equation is

$$\Delta fineer_{i,t} = \alpha_i \left(fineer_{i,t-1} - \theta_0 - \theta_1\, iip_{i,t-1}\right) + \delta_j \Delta iip_{i,t} + \varepsilon_{i,t} \quad (1).$$

The PMG estimator implicitly assumes that iip is exogenous in terms of $fineer$. The adjustment after a disruption to the long-term equilibrium can therefore only be modelled by a response by the financial market exchange rate. Therefore, additional estimates in accordance with the Engle-Granger procedure are used as a robustness test. In this estimate, the long-term relationship was carried out with DOLS including one lead and one lag from iip and fixed country effects. The estimates of the adjustment processes also take into consideration one lagged value of $\Delta fineer$ and Δiip.[8] The estimated adjustment of the asset position is based on the same error correction term as the exchange

1 See, for example, K Heimonen, (2009), The euro-dollar exchange rate and equity flows, Review of Financial Economics 18, pp 202-209, and H Hau and H Rey (2006), Exchange Rates, Equity Prices and Capital Flows, Review of Financial Studies 19, pp 273-317. — **2** Austria, Australia, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, Greece, Hong Kong, Ireland, Italy, Japan, South Korea, Mexico, the Netherlands, Norway, Portugal, Russia, Sweden, Singapore, the United Kingdom and the United States. The People's Republic of China is merely listed as a debtor country in the CPIS, while it does not report the regional structure of its own asset holdings to the IMF. For this reason, China is not taken into consideration in the following analyses. — **3** The indicator thus combines the financial market exchange rates for shares and bonds presented in the main text. — **4** P R Lane and G M Milesi-Ferretti (2006), The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970-2004, IMF Working Paper 06/69. — **5** All tests were conducted using EVIEWS 6.0. The probability of an error of the first type of less than 5% is taken as a basis for the level of signifi-

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rate adjustment estimate. The results are shown in the table overbelow.

Cointegration estimates for $fineer$ and iip

Item	(1) PMG	(1a) DOLS	
	Long-term relationship		
	$fineer_{t-1}$	$fineer_{t-1}$	
	– 0.369***	– 0.136**	
iip_{t-1}	(0.049)	(0.066)	
	Adjustment process		
	$\Delta fineer_t$	$\Delta fineer_t$	Δiip_t
	– 0.167***	– 0.322***	– 0.005
ec_{t-1}	(0.040)	(0.056)	(– 0.170)
	0.058		
Δiip_t	(0.123)	–	–
		– 0.098***	– 0.036
Δiip_{t-1}	–	(0.035)	(– 0.319)
		0.369***	0.032
$\Delta fineer_{t-1}$	–	(0.050)	(0.273)

Standard errors (in parentheses); *** (**) [*] signifies significance at the 1% (5%) [10%] level.

Both estimates demonstrate a significant negative correlation between the net external position and the effective financial market exchange rate. An inflow of foreign capital which causes liabilities vis-à-vis other countries to rise is thus accompanied by an appreciation of the domestic currency or a rise in domestic asset prices in relation to other countries.

The estimated parameters do vary considerably between both estimates, however. It is not possible to make a direct comparison with the studies by Heimonen (2009) or Hau and Rey (2006) cited above as the overall effect of internationally diverging share prices and an exchange rate reaction triggered by capital movements remains undefined in their work.

Adjustment after a disruption of the equilibrium takes place with somewhat of a time lag. According to the PMG estimator, the loading coefficient of the financial market exchange rate is below 20%. The error correction based on the DOLS regression does take place more quickly, but the estimated return of the financial market exchange rate to its long-term equilibrium is still considerably slower, at barely a third of the previous year's deviation *per annum*, than the high responsiveness of the capital markets would suggest. This discrepancy can be interpreted as an indication that fundamental adjustment processes are frequently overshadowed by short-term factors.

The lack of significance of a reaction of the external position to existing over or undervaluations of the effective financial market exchange rate is possibly due to the fact that transaction-related adjustments to net foreign assets are accompanied by a change to the current account. This only takes place if the real effective exchange rate for goods and services also favours such a correction. As this condition is not always met, capital inflows in connection with the co-integration relationship presented here must be regarded as exogenous.

cance. The degree of integration of the individual variables was determined by the unit root test by K S Im, M H Pesaran and Y Shin (2003), Testing for Unit Roots in Heterogeneous Panels, Journal of Econometrics 115, pp 53-74. The cointegration tests applied by Pedroni (2004) and Kao (1999) are based on the Engle-Granger procedure and ADF residuals. See P Pedroni (2004), Panel Cointegration; Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis, Econometric Theory 20, pp 597-625 as well as C Kao (1999), Spurious Regression and Residual Based Tests for Cointegration in Panel Data, Journal of Econometrics 90, pp 1-44. — **6** M H Pesaran et al (1999), Pooled Mean Group Estimation of Dynamic Heterogeneous Panels, Journal of the American Statistical Association 94, pp 621-634. — **7** E F Blackburne and M W Frank (2007), Estimation of Nonstationary Heterogeneous Panels, The Stata Journal 7, pp 197-208. — **8** The correction terms were used very sparingly in both the long and short-term relationships due to the relative shortness of the time series. The variance-covariance matrix was estimated robustly for each (White period).

Adjustment process fairly sluggish

According to estimates, adjustment after a disruption of the equilibrium between external position and financial market exchange rate tends to take place with somewhat of a time lag. The estimated return of the financial market exchange rate to its long-term equilibrium is considerably slower, at less than a third of the previous year's deviation *per annum*, than the high responsiveness of the capital markets would suggest. This discrepancy can be interpreted as an indication that fundamental adjustment processes are frequently overshadowed by short-term factors, particularly as data on the external position, which could influence investors' decisions, are only available with a considerable delay.

Adjustments of net external assets to an existing over or undervaluation of the effective financial market exchange rate cannot be derived from estimates; the relevant coefficient is not significant. This is presumably because the reaction of the external position presupposes a change in the current account, which will only take place if the real effective exchange rate for goods and services also favours such a correction. As this condition is not always met, capital inflows in connection with the co-integration relationship presented here must be regarded as exogenous.

Stubborn persistence of imbalances

This correlation between the financial market exchange rate and external position makes it more difficult to reduce pronounced current account deficits, particularly if they are associated with high net external liabilities. As capital inflows will, *ceteris paribus,* cause the effective financial market exchange rate to rise, the price competitiveness of the country in question should tend to deteriorate provided not only asset prices respond, which would be indirectly reflected in a further worsening of the current account balance and additional capital inflows. However, such a development increases the risk of an abrupt reversal of capital flows if investors start to doubt the sustainability of the current account deficits. The risks to the real economy and the financial system associated with such a sudden adjustment suggest that implementing stability-oriented national economic policies at an early stage is recommendable.

Conclusion

The concept of real effective exchange rates, which has proved a useful instrument for analysing price competitiveness on the goods markets, can also be used as an instrument to evaluate international asset prices. With this objective in mind, the IMF's CPIS database allows the exchange rates of partner countries to be weighted in line with the international structure of foreign portfolios. The approach presented here expands on this option, which has been described in the literature, by deflating effective exchange rates using asset prices rather than goods prices. Therefore, the effective financial market exchange rate calculated in this manner reflects even better the character of a relative asset price.

It becomes evident that effective financial market exchange rates (particularly on the equity markets) differ at times quite considerably – not only methodologically, but also in

terms of their movements – from the usual indicator of price competitiveness on the goods markets. Looking at the past 20 years, the effective exchange rate for shares has, for instance, at times even been inversely correlated to its counterpart for goods and services. Moreover, it responds considerably more quickly to new information than the equivalent metric based on much more sticky goods prices. The effective exchange rate for bonds is virtually in sync with the usual competition indicator over large stretches. However, it shows reassessments of country risk and changes in investors' risk appetite, which the other indicator does not. Overall, the effective financial market exchange rate is a useful additional instrument with which to analyse asset prices. Moreover, it could, in combination with other early warning indicators, also help to identify at an early stage fundamental mispricing which is aggravated by speculation on the financial markets.

Furthermore, a long-term (negative) correlation between the net external position and a country's effective financial market exchange rate was demonstrated. Adjustment to the long-term equilibrium after temporary disruptions is fairly sluggish – as measured against the marked short-term responsiveness of the international capital markets. In addition, corrections appear to come about largely through changes in nominal exchange rates and international asset prices, while cross-border capital flows should be regarded as more exogenous according to the test variables in the estimates. This phenomenon is consistent with the observation of stubborn external imbalances.