

# **An assessment of the trends in international price competitiveness among EMU countries**

Christoph Fischer



Discussion Paper  
Series 1: Economic Studies  
No 08/2007

Discussion Papers represent the authors' personal opinions and do not necessarily reflect the views of the Deutsche Bundesbank or its staff.

**Editorial Board:**

Heinz Herrmann  
Thilo Liebig  
Karl-Heinz Tödter

Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main,  
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-1

Telex within Germany 41227, telex from abroad 414431

Please address all orders in writing to: Deutsche Bundesbank,  
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet <http://www.bundesbank.de>

Reproduction permitted only if source is stated.

ISBN 978-3-86558-286-7 (Printversion)

ISBN 978-3-86558-287-4 (Internetversion)

**Abstract:**

Inflation differentials within European Monetary Union (EMU) are increasingly seen as exerting adverse effects on the price competitiveness of member countries' firms and – given the common monetary policy within EMU – as being detrimental to euro-area economies, in particular to those with relatively high inflation rates. Using three simple measures of international price competitiveness for EMU countries, the paper analyses whether these indicators have displayed distinctive trends since the start of EMU and whether they converge with or diverge from their respective fundamental value. It is found that all three indicators suggest a gain in competitiveness for the German economy and a corresponding loss for Italy, Portugal and Spain. Two of the indicators, however, suggest that these trends reduce former disparities and, thus, contribute to a convergence of competitiveness within EMU while the third would imply the opposite.

**Keywords:** Price competitiveness, EMU, purchasing power parity, productivity approach, panel unit root tests, panel cointegration

**JEL-Classification:** F 36, E 31, F 31

## **Non technical summary**

Inflation differentials within European Monetary Union (EMU) are increasingly seen as exerting adverse effects on the price competitiveness of member countries' firms and – given the common monetary policy within EMU – as being detrimental to euro-area economies, in particular to those with relatively high inflation rates. In order to determine whether this is really the case, the conventional approach, which merely looks at cumulated changes in real effective exchange rates as a measure of the movement in price competitiveness, should be complemented by an equilibrium real exchange rate concept. On the one hand, inflation differentials within the euro area could also reflect price level convergence movements, and thus would represent an innocuous convergence of competitiveness towards a PPP-type equilibrium. On the other hand, where they can be explained in terms of the productivity approach, inflation differentials may themselves represent equilibrium phenomena and therefore leave price competitiveness unchanged.

The paper analyses, in terms of three simple equilibrium concepts of the real exchange rate – relative PPP, absolute PPP and the productivity approach – whether the corresponding indicators of price competitiveness have displayed distinctive trends since the start of EMU and whether they converge with or diverge from their respective fundamental value. It is found that all three indicators suggest a gain in price competitiveness for the German economy and a corresponding loss for Italy, Portugal and Spain. Two of the indicators suggest that these trends merely reduce former disparities and thus contribute to a convergence of price competitiveness within EMU. According to the third, and possibly the most reliable indicator, however, the observed trends in price competitiveness represent an increasing dispersion from equilibrium and therefore justify further attention in the economic policy debate.

## **Nicht-technische Zusammenfassung**

In zunehmendem Maße werden Inflationsdifferenzen innerhalb der Europäischen Währungsunion (EWU) im Zusammenhang mit ihrem Einfluss auf die preisliche Wettbewerbsfähigkeit der Unternehmen in den einzelnen Mitgliedsstaaten betrachtet. Vor dem Hintergrund der gemeinsamen Geldpolitik in der Währungsunion wird vermutet, dass sie sich insbesondere schädlich auf diejenigen Volkswirtschaften in der EWU auswirken, die vergleichsweise hohe Inflationsraten aufweisen. Um einschätzen zu können, ob dies tatsächlich der Fall ist, sollte das übliche Vorgehen, als Maß für die Entwicklung der preislichen Wettbewerbsfähigkeit die kumulierten Änderungen des realen effektiven Wechselkurses zu verwenden, um ein Gleichgewichtskonzept eines realen Wechselkurses erweitert werden. Denn zum einen könnten Inflationsdifferenzen im Euro-Währungsgebiet auch Preisniveauekonvergenz widerspiegeln. Sie wären dann Ausdruck harmloser Konvergenzbewegungen in Richtung eines Gleichgewichts entsprechend der Kaufkraftparitätentheorie. Soweit Inflationsdifferenzen im Rahmen des Produktivitätsansatzes erklärt werden können, könnten sie zum anderen selbst Gleichgewichtsphänomene sein und damit die preisliche Wettbewerbsfähigkeit unbeeinflusst lassen.

Die vorliegende Studie analysiert im Rahmen von drei einfachen Gleichgewichtskonzepten des realen Wechselkurses – relative Kaufkraftparitätentheorie, absolute Kaufkraftparitätentheorie und Produktivitätsansatz –, inwiefern entsprechende Indikatoren der preislichen Wettbewerbsfähigkeit seit Beginn der EWU erkennbare Trends aufweisen und ob im Vergleich zu dem jeweiligen Gleichgewichtswert eine Konvergenz- oder eine Divergenzentwicklung zu beobachten ist. Es stellt sich heraus, dass alle drei Indikatoren der deutschen Volkswirtschaft einen Zuwachs an preislicher Wettbewerbsfähigkeit attestieren und Italien, Portugal sowie Spanien einen entsprechenden Verlust an Wettbewerbsfähigkeit. Zwei der Indikatoren legen nahe, dass diese Entwicklungen lediglich frühere Disparitäten reduzieren und insofern zu einer Konvergenz der preislichen Wettbewerbsfähigkeit innerhalb der EWU beitragen. Dem dritten Indikator zufolge, der möglicherweise der verlässlichste ist, stellen die festgestellten Trends der preislichen Wettbewerbsfähigkeit allerdings

zunehmende Abweichungen vom Gleichgewichtszustand dar und rechtfertigen aus diesem Grund eine weiterhin hohe Aufmerksamkeit in der wirtschaftspolitischen Auseinandersetzung.

## **Contents**

1	Introduction: Inflation differentials within EMU and international price competitiveness	1
2	Three simple concepts of equilibrium exchange rates	4
2.1	Relative PPP	5
2.2	Absolute PPP	8
2.3	The productivity approach	9
3	Results on price competitiveness within the euro area	13
3.1	Competitiveness according to the concept of relative PPP	13
3.2	Competitiveness according to the concept of absolute PPP	15
3.3	Competitiveness according to the productivity approach	16
3.4	Discussion	18
4	Conclusions	20

## **Lists of Tables and Figures**

Table 1	MHDF and PCSE panel unit root tests	27
Table 2	Panel estimation of $\beta$ in the productivity approach	28
Table 3	International price competitiveness based on the concept of relative PPP	29
Table 4	International price competitiveness based on the concept of absolute PPP	30
Table 5	International price competitiveness based on the productivity approach	31
Figure 1	Dispersion of EMU countries' price competitiveness based on the concept of relative PPP	32
Figure 2	Dispersion of EMU countries' price competitiveness based on the concept of absolute PPP	32
Figure 3	Dispersion of EMU countries' price competitiveness based on the productivity approach	33
Figure 4	International price competitiveness of Germany	33



# **An assessment of the trends in international price competitiveness among EMU countries<sup>\*</sup>**

## **1. Introduction: Inflation differentials within EMU and international price competitiveness**

Economic policymakers rarely pay much attention to inflation differentials between regions that share a common currency. The European Monetary Union (EMU), however, represents a notable exception to this general observation. The annual inflation rates of many EMU member countries, measured by the harmonised index of consumer prices (HICP), have deviated by more than half a percentage point annually from the EMU average in most years since the introduction of the euro in 1999. In some cases, the differential to the average exceeded two percentage points (see ECB, 2005b). At first sight, inflation differentials of this magnitude may not appear to be a matter of concern. Indeed, the European Central Bank emphasises that, at the start of the nineties, inflation differentials among current EMU members were much more pronounced and that they have decreased continuously over the following decade. Moreover, it is shown that the dispersion of annual inflation in the euro area since 1999 hardly differs from that of 14 US metropolitan statistical areas for the same period.

The ECB (2003b), however, points out that EMU inflation dispersion is continuously twice as large as that of corresponding measures for German regions, Spanish regions or Italian cities. It suggests that larger geographical distances and a lower degree of policy decentralisation may be the reasons for the higher inflation dispersion in the United States and the euro area compared with EMU member countries. As is highlighted in ECB (2005b), there is, however, also a fundamental difference between inflation differentials within the euro area and those within the

---

<sup>\*</sup> The paper represents the author's personal opinions and does not necessarily reflect the views of the Deutsche Bundesbank. The indicators of international price competitiveness used in this paper are not necessarily those that are officially proposed by the authorities of the countries considered. I would like to thank Jörg Breitung, Willy Friedmann, Ulrich Grosch, Heinz Herrmann, Bernd Schnatz and participants in the Preparatory Workshop for the 3<sup>rd</sup> High-Level Seminar of the Eurosystem and Latin American Central Banks in Mexico for their valuable suggestions and comments. All remaining errors are my own.

E-mail: christoph.fischer@bundesbank.de.

United States. EMU countries' inflation deviations from the euro-area average are much more persistent than those of US metropolitan statistical areas compared with the US average. For the first six years of monetary union, a majority of EMU member states belonged either to the group of countries whose annual inflation rates were continuously above the EMU average or to the group of countries whose inflation rates were continuously below.

In the economic policy debate, the major concern associated with persistent inflation differentials is that firms from high inflation countries may accumulate an increasing competitive disadvantage compared with their competitors from EMU partner countries with persistently lower inflation rates. Relatively high rates of inflation may reflect a rise in the prices of domestic factors that are used in the production of output which is traded in an internationally competitive environment. If not offset by a corresponding increase in productivity, domestic competitiveness suffers inasmuch as the average profitability of domestic firms falls relative to those abroad, and the trade balance tends *ceteris paribus* to deteriorate.<sup>1</sup> In a monetary union, neither national monetary policy nor the exchange rate can be used as a policy instrument to reduce the disparities. The economic adjustment process, therefore, will probably be slow and painful.

Inflation differentials, however, may be the consequence of creating the common currency area. After all, EMU founders hoped that the common currency would increase price transparency across euro-area countries, leading to rising competition and, finally, to convergence towards a highly competitive price level of internationally tradable goods (cf European Commission, 1990, p 19, and 1996, p 74 as well as ECB, 2002). Inflation differentials of this sort, which reflect price convergence movements, should – instead of being seen as detrimental – rather be classified as being beneficial for all EMU countries concerned.

---

<sup>1</sup> The relationship between international competitiveness and average profitability is highlighted and discussed in Corden (1994), pp 267-287. Concerning the usage of the term competitiveness, Krugman (1996) holds a much more critical view, which is, to be sure, based on models of a frictionless world without adjustment costs, unemployment or even trade imbalances. His main point, however, to warn against using the term competitiveness in a mercantilist sense (for example, by considering foreign output growth or a deterioration in the trade balance as a threat to domestic welfare, or as reflected by the tendency to react to such developments with the imposition of trade restrictions) is, of course, worth being emphasized.

Studies such as Rogers (2001), Hill (2004), Faber/Stokman (2005) and Goldberg/Verboven (2005) confirm the existence of price level convergence in Europe in the 1990s. Their evidence, however, does mainly apply to the period before the introduction of the euro. Focussing in contrast on price developments in EMU since its inception, Engel/Rogers (2004) found no evidence of price convergence in an analysis of Economist Intelligence Unit data, neither in general nor a specific convergence movement due to the introduction of the euro. Similar results are reported by Lutz (2004), who investigates four alternative datasets of disaggregated prices. Allington et al (2005), by contrast, assert that these conclusions were premature and, using a broad Eurostat dataset, claim to have found robust evidence for price convergence in EMU which was triggered by the introduction of the euro.

A second reason for qualifying the conventional negative assessment of inflation differentials within the euro area is the possibility that they might not be associated with a loss of competitiveness of the high inflation countries' economies. The comparatively high inflation could have been caused by an asymmetric increase in productivity in the respective economy and thus represent a (Balassa-Samuelson type) equilibrium phenomenon. According to the estimations of the German Council of Economic Experts (2001), pp 267-278, as well as those of Gischer/Weiß (2006), for instance, part of intra-EMU inflation differentials are due to Balassa-Samuelson effects. Honohan/Lane's (2003) analysis of 1999-2001 panel data, in contrast, yields the result that during this period the nominal depreciation of the euro against the US dollar affected national inflation rates within the euro area heterogeneously, raising inflation especially in those countries which trade heavily with non-EMU partners. Arnold/Verhoef (2004), however, demonstrate that their results no longer hold either if lagged inflation is added as regressor or as soon as the outlier Ireland is eliminated from the panel.

Conventionally, as seen in Table 2 of Lane (2006) and in ECB (2007), the evolution of price competitiveness within EMU is measured as the cumulative change in a respective real effective exchange rate which, in a monetary union, boils down to a weighted average of inflation differentials. While this measure clearly has its merits, the first part of the discussion so far has shown that movements in such an indicator should be qualified as long as they are due to price level convergence. They would then represent a convergence of competitiveness out of a state of disequilibrium in the base

period towards a PPP-type equilibrium level. The second part of the discussion stressed that EMU inflation differentials may, to a degree, themselves represent equilibrium phenomena which were not detrimental for the competitiveness of the high inflation economies. Both strands of thought imply that an assessment of trends in price competitiveness requires a relevant equilibrium concept for the respective real exchange rate.

The present paper's main contribution consists in the use of three alternative, simple equilibrium concepts of the real exchange rate to determine for each of the EMU economies whether its international price competitiveness improved or deteriorated since monetary union was created in 1999. Focus is especially placed on whether the computed change in competitiveness represents divergence from the respective equilibrium and is, therefore, a genuine matter for concern. It is found that, regardless of the equilibrium concept used, Germany enjoyed a remarkable increase in competitiveness against its trading partners within the euro area while Italy, Portugal, Spain, Ireland and Luxembourg lost price competitiveness. Results concerning competitiveness convergence with (or divergence from) its equilibrium value, however, turn out to depend decisively on the equilibrium concept used.

Section 2 presents three equilibrium concepts for the real exchange rate and shows how they will be used to assess the international price competitiveness of an economy. Results for the three approaches are shown and discussed in section 3. Section 4 concludes the analysis.

## **2. Three simple concepts of equilibrium exchange rates**

For the assessment of euro-area countries' international price competitiveness, relative purchasing power parity (PPP), absolute PPP and a Balassa (1964) and Samuelson (1964) type model have been used as alternative equilibrium concepts. These three concepts have been chosen especially because of their simplicity. More complex models are not only far more difficult to implement, they may also be unsuitable to yield measures of competitiveness and equilibrium values that are comparable across all EMU countries. Moreover, all the approaches used in the present study benefit from being able to provide a theoretically well-founded equilibrium value

which may be much more appealing to policymakers as a normative guideline than, for instance, the commonly used but rather eclectic BEER approaches (see eg MacDonald, 2000, or Driver/Westaway, 2005). Finally, the equilibrium concepts chosen are generally seen as providing particularly long-term equilibrium values which may be the most relevant given that the only adjustment variables in a currency union, relative prices, move rather slowly.

## **2.1 Relative PPP**

Relative purchasing power parity claims that real exchange rates should be mean reverting in the long-run. Since the nominal exchange rate is irreversibly fixed in a monetary union, this implies that the relative price level between the domestic and the foreign economy should converge to some constant value. In a PPP model, changes in the real exchange rate indicate changes in competitiveness and, in a monetary union, a high-inflation economy loses competitiveness. The real exchange rate can thus be used directly as a competitiveness indicator.

While the relative PPP model thus easily allows an assessment of the direction and the magnitude of a change in competitiveness, it is more difficult to use to assess whether such a change represents a convergence movement and, therefore, is desired, or whether some high-inflation economies accumulate potentially highly persistent competitive disadvantages. Since, in a relative PPP model, price indices are used to compute real exchange rates, the calculated relative price level arbitrarily depends on the normalisation of the index. In other words, the real exchange rate converges to some mean in a relative PPP model but the model is silent on the value of the mean.

The theoretical gap may, however, be closed empirically. If the relative PPP hypothesis is confirmed statistically, a long-term average of the real exchange rate should approximate the mean to which the real exchange rate reverts. The empirical validity of relative PPP has in fact been such a prominent issue in recent research that numerous survey studies have been published, for example Froot/Rogoff (1995), Rogoff (1996), Sarno/Taylor (2002), chapter 3, and Taylor/Taylor (2004). Most surveys conclude that relative PPP holds in the long run, and even opponents may admit that relative PPP is at least a comparatively good approximation of reality. The long-term

average of a real exchange rate may, therefore, be interpretable as a rough indication of its equilibrium value.

For the analysis, real effective exchange rates as calculated by the Deutsche Bundesbank are used because price competitiveness should, of course, be defined multilaterally, ie against a group of (EMU) partner countries. They are computed as geometric trade-weighted averages of bilateral rates against all the trading partners in EMU.<sup>2</sup>

For the calculation of these competitiveness indicators, different types of price and cost indices have been used. The appropriateness of different indices in reflecting price competitiveness of an economy has been discussed *inter alia* in Deutsche Bundesbank (1998, 2004) and ECB (2003a, 2005a). According to the Bundesbank studies, a rather broadly defined price index such as the price deflator of total sales should be the most suitable since such indicators are the only ones that reflect price differentials in intermediate inputs that make up a significant part of differences in price competitiveness. As an alternative to the price deflator of total sales, competitiveness indicators based on consumer price indices as well as those based on unit labour costs in the enterprise sector have been used in the present study, bearing in mind that measurement problems should be much more prevalent in unit labour cost indices than in price indices.<sup>3</sup> The price index-based series span the period 1975:1 – 2006:1 at a quarterly frequency. The cost index-based variables differ by starting in 1976:3.

Bearing in mind the possible limitations of their adequacy as expressed in Banerjee et al (2004, 2005) and Fischer/Porath (2006), panel unit root tests of the country panels of real effective exchange rates have been performed. Real exchange rates are often found to be correlated (cf O'Connell, 1998, for example), a property which will obviously also pertain to real effective exchange rates which are just weighted averages of the former. Therefore, it is advisable to apply second generation panel unit root tests in the sense of Breitung/Pesaran (2005) which take heterogeneous cross-sectional correlations into account. More specifically, Harvey/Bates' (2002)

---

<sup>2</sup> The computation methodology follows Buldorini et al (2002).

<sup>3</sup> According to Deutsche Bundesbank (1998, 2004), the occasionally proposed real effective exchange rates based on unit labour costs in the manufacturing sector are less suitable as competitiveness indicators.

multivariate homogeneous Dickey-Fuller (MHDF) test and Breitung/Das' (2005) and Jönsson's (2005) panel corrected standard errors (PCSE) test are used. Denoting  $\tilde{z}_{it}$  as being a pre-whitened series, each of which is computed from the original series  $z_{it}$  using a procedure suggested by Breitung/Das (2005) in order to eliminate possible constant terms and short-run dynamics, the MHDF t statistic is calculated as

$$t_{gls} = \frac{\sum_{t=2+\ell}^T \tilde{z}'_{t-1} \hat{\Omega}_\varepsilon^{-1} \Delta \tilde{z}_t}{\sqrt{\sum_{t=2+\ell}^T \tilde{z}'_{t-1} \hat{\Omega}_\varepsilon^{-1} \tilde{z}_{t-1}}} \quad (1)$$

and the PCSE t statistic as

$$t_{rob} = \frac{\sum_{t=2+\ell}^T \tilde{z}'_{t-1} \Delta \tilde{z}_t}{\sqrt{\sum_{t=2+\ell}^T \tilde{z}'_{t-1} \hat{\Omega}_\varepsilon \tilde{z}_{t-1}}} \quad (2)$$

where  $\tilde{z}_t = [\tilde{z}_{1t}, \tilde{z}_{2t}, \dots, \tilde{z}_{Nt}]'$ ,  $\Delta \tilde{z}_t = [\Delta \tilde{z}_{1t}, \Delta \tilde{z}_{2t}, \dots, \Delta \tilde{z}_{Nt}]'$ ,  $N$  is the number of cross-sectional units in the panel,  $\Omega_\varepsilon$  is the covariance matrix of the system, and  $\ell$  is the number of lags used in the pre-whitening procedure. Harvey/Bates (2002) and Breitung/Das (2005), respectively, provide critical values.

Results are shown in the upper part of Table 1 for panels containing series for each of the 12 EMU members present since the accession of Greece,  $N = 12$ , except in the case of the real effective exchange rates based on unit labour costs in the enterprise sector where  $N = 10$  because no data were available for Greece and Luxembourg. There is strong evidence for the real effective exchange rate based on ULCs to be stationary and reasonable evidence for CPI-based series. Real effective exchange rates based on deflators of total sales, however, appear rather to be non-stationary. The mixed and somewhat inconclusive results adequately reflect the discussion on the validity of relative PPP in the post-Bretton Woods era, although, in general, panel unit root tests are often more supportive of relative PPP, O'Connell (1998) being one of the few exceptions. In spite of the large differences with respect to the panel unit root test results

on stationarity, it will be shown that the assessment of competitiveness levels and trends is hardly affected by the choice of the underlying price or cost index.

Long-term averages of the series have been formed over the entire observation period and thus cover the required long-term span of data. Deutsche Bundesbank (2004) finds that a reduction in the length of the period hardly affects the value of the long-term average of German price competitiveness.

## **2.2 Absolute PPP**

It is common knowledge that it would be very hard to find any empirical evidence in favour of absolute purchasing power parity. Generally, even developed countries' real exchange rates show deviations from absolute PPP values that can last for decades. Such long-run deviations from absolute PPP are usually explained by structural and institutional impediments to adjustment such as regulations, taxes, transport costs or tariffs. These factors, however, usually affect the competitiveness of an economy. If production is expensive because of high real estate prices, decrepit infrastructure, an insufficient education system or high taxes, then competitiveness is low. Absolute PPP may, therefore, be seen as a very long-term normative concept. In any case, absolute PPP is probably the superior macroeconomic concept to investigate whether inflation differentials in EMU are reflections of price level convergence.

As with relative PPP, the real exchange rate can be used as a competitiveness indicator. As opposed to relative PPP, absolute PPP requires the real exchange rate to be calculated with relative price levels. Price indices are insufficient. Relative price levels can be computed from "purchasing power parities", which are provided by the European Commission in their annual macro-economic database (AMECO). The term "purchasing power parity" indicates the amount of national currency which is required for the purchase of that unit of a basket of goods in the domestic country which costs one currency unit in the base country. The common basket of goods consists of several thousand tradable and non-tradable products whose prices are collected by national statistical institutes. Annual data starting from 1960 are available.

The price level in country  $j$  relative to country  $i$  at time  $t$ ,  $P_{i,j,t}$  is computed as



$$P_{i,j,t} = \frac{K_{i,j,t}}{W_{i,j,t}}, \quad (3)$$

where  $K_{i,j,t}$  denotes the “purchasing power parity” of country  $j$  against country  $i$  and  $W_{i,j,t}$  the corresponding nominal exchange rate between these two countries.<sup>4</sup> The trade weights that have already been used for the computation of real effective exchange rates in the relative PPP framework,  $g_{i,j}$ , have been employed to calculate the effective relative price level of country  $i$  against its 11 euro-area trading partners,  $P_{i,t}$ , as

$$P_{i,t} = 1 / \left[ \prod_{j=1}^{11} (P_{i,j,t})^{g_{i,j}} \right] \quad \text{where} \quad \sum_{j=1}^{11} g_{i,j} = 1. \quad (4)$$

A value of  $P_{i,t}$  larger than 1 implies that the price level in country  $i$  is higher than the trade-weighted average price level of its EMU trading partners if all prices are expressed in a common currency. This can be interpreted as country  $i$  having a competitive disadvantage in an absolute PPP framework, where long-term equilibrium would require  $P_{i,t}$  to be 1.

### 2.3 The productivity approach

An important advantage of measures of international price competitiveness based on absolute PPP is that relative price levels allow for an excellent comparability across countries. They may, however, be criticised as being less relevant if domestic prices of internationally non-tradable goods can deviate permanently and significantly from those abroad without triggering adjustment processes. In this context, reference is often made to the productivity approach which goes back to Balassa (1964) and Samuelson (1964) and is usually discussed in a model like that of Froot/Rogoff (1995). Balassa and Samuelson suggest that the relative price level should be higher in those countries which display a higher level of productivity. The productivity approach implies that real exchange rate movements do not necessarily reflect changes in international price competitiveness because they could have been caused by asymmetric changes in productivity. Such real exchange rate movements would represent equilibrium phenomena unrelated to competitiveness issues.

---

<sup>4</sup> Nominal exchange rate movements are relevant for the observation period before the euro was introduced in 1999.

The evidence on Balassa-Samuelson effects in developed countries is mixed (see eg Canzoneri et al, 1999, or DeLoach, 2001). However, one might suspect that the successful catch-up process of countries like Ireland or Spain over the past decades may have resulted in Balassa-Samuelson effects and in corresponding real appreciation tendencies. If this were the case, theories like absolute or relative PPP, which suggest a constant equilibrium real exchange rate, would tend to rate the present international price competitiveness of these countries too low.

Balassa-Samuelson effects can be eliminated by regressing the real exchange rate on relative productivity. It should be stressed that the purpose of such a regression in the present context is not to give a comprehensive explanation of inflation differentials in EMU. Instead, the aim is to adjust the real exchange rates' evolution for movements which do not represent changes in price competitiveness within the framework of the productivity approach.

The choice of the productivity variable has been governed by data availability. Three alternative variables have been considered: nominal GDP per person employed measured in purchasing power parities, nominal GDP per head of population measured in purchasing power parities and real GDP per hour worked. The first two measures are provided by the AMECO database, the third one is available from the Groningen Growth and Development Centre. Annual observations for 1960-2005 are available except in the case of GDP per hour, where observations span the 1968-2004 period. Among the three productivity measures, real GDP per hour may be the closest to the productivity concept of the theoretical approach. This variable, however, suffers from being the only one in which 2002 US dollars (instead of purchasing power parities) are used to convert national values into a common currency. This may negatively affect international comparability. Productivity series, denoted by  $X$ , are normalised on a common non-EMU base country  $c$  which yields measures of relative productivity<sup>5</sup>

---

<sup>5</sup> The normalisation is associated with an additional benefit: two of the productivity variables are expressed in terms of nominal GDP in purchasing power parities while the productivity approach actually requires real values in purchasing power parities. The conversion into purchasing power parities will not only eliminate possible nominal exchange rate movements but also the effect of inflation differentials on the productivity measures. Any remaining average inflation across countries will be cancelled out in the normalisation process.

$$X_{i,c,t} = \frac{X_{i,t}}{X_{c,t}}. \quad (5)$$

Relative price levels are rebased on the same country  $c$ ,

$$P_{i,c,t} = \frac{P_{i,j,t}}{P_{c,j,t}}. \quad (6)$$

Denoting logged values in lower case letters, the effect of relative productivity on relative price levels has been estimated in a panel approach based on the equation

$$p_{i,c,t} = \alpha_t + \beta \cdot x_{i,c,t} + \varepsilon_{i,c,t}. \quad (7)$$

Note that equation (7) includes fixed time effects but not fixed country effects for the individual series of the panel. This is not only in line with the numerous cross section studies on the productivity approach (a cross-section version of (7) had already been estimated by Balassa, 1964),<sup>6</sup> it is also necessary to maintain the relationship between the relative price level of a country and its relative productivity level.<sup>7</sup> The standard cross-section fixed effects approach could yield results on the effect of productivity changes on real exchange rate movements but not on the corresponding levels. The use of time dummies in equation (7), finally, eliminates the effect of (possibly unrepresentative) individual movements of the base country on the estimation

---

<sup>6</sup> A cross-section version of (7) had already been estimated by Balassa (1964). To be sure, the theoretical model assumes an increase in total factor productivity *in the tradables sector* in order to yield the proposed positive value for  $\beta$  in (7). Nevertheless, empirical studies regularly use measures of productivity for the total economy since technological progress is assumed to be concentrated in the tradables sector. In view of the ICT revolution, one might doubt such an assumption. However, with the technological advances in the ICT sector, its products and services have increasingly become internationally tradable. Moreover, since the share of capital is obviously lower in the non-tradables sector,  $\beta$  may even be positive if technological progress is smaller in the tradables sector than in the non-tradables sector; cf equation (3.7) in Froot/Rogoff (1995).

<sup>7</sup> Some institutional conditions, however, may result in deviations of relative price levels from the values determined by productivity levels even in equilibrium. In the case of EMU countries, this pertains in particular to the differing value added tax (VAT) rates which affect relative price levels (but not relative productivity) because the destination principle is applied for intra-euro-area trade. The ensuing differences in price levels, however, are probably rather small. Anyway, they could be eliminated by fixed effects only if the VAT rates had been kept constant in all EMU countries over the last three to five decades, which has clearly not been the case.

results because they should not play any role in the assessment of competitiveness within the euro area. More generally, the time dummies capture homogeneous cross-correlations in the panel.

The second line of Table 2 presents estimates of  $\beta$  obtained with a static fixed time effects approach. The estimated coefficients turn out to be remarkably independent of the productivity variable used. According to the estimated value of  $\beta$ , a relative productivity level of country  $i$  being one percent greater than that of country  $j$  is reflected on average in a 0.55 to 0.59 percent higher value of the relative price level. The Durbin Watson statistics, however, suggest that the residuals are highly positively autocorrelated and that the estimated variances of  $\beta$  are not reliable. Nevertheless, if relative productivity and relative price levels are integrated and cointegrated, the static estimators are superconsistent and thus valid.

Second-generation panel unit root tests (MHDF test and PCSE test) are used to check whether the first of these conditions is fulfilled. The lower part of Table 1 shows that non-stationarity of relative productivity levels can generally not be rejected. For relative price levels, it is found that test results depend on the choice of the numéraire country, a result which is typically found in real exchange rates (cf Coakley/Fuertes, 2000, or Papell/Theodoridis, 2001). A set of panel cointegration tests<sup>8</sup>, however, generally rejects the null of non-cointegration between relative productivity and relative price levels at a five percent significance level, regardless of which test statistic, which numéraire country and which productivity variable is used. The obvious stationarity of the residuals implies that the rejection of non-stationarity in one of the relative price level panels must have been erroneous.<sup>9</sup> A further implication is the validity of the statically estimated  $\beta$  coefficients.

In order to corroborate these results, on the one hand, and to obtain valid estimates of the variances, on the other, equation (7) has been re-estimated in a dynamic setting. Two alternative panel cointegration estimation methods are used, Pedroni's (1996)

---

<sup>8</sup> The four DF and the ADF panel cointegration test statistics of Kao (1999) have been used as well as three (tests 2-4 of his Table 1, p 660) of those developed by Pedroni (1999).

<sup>9</sup> This could be due to biases which typically arise in real exchange rate series, as suggested by Fischer/Porath (2006).

fully-modified OLS (FMOLS) and the dynamic OLS (DOLS) estimator suggested by Kao/Chiang (2000). The common cross-section intercept and fixed time effect setting of the static approach is retained. In the DOLS specification, two leads and two lags are employed. As might have been expected given the panel cointegration test results, all the dynamically estimated  $\beta$  coefficients shown in Table 2 deviate only very slightly (and insignificantly) from those obtained in the static estimation. The t-values imply that the  $\beta$  coefficients are statistically significant.

The residuals of equation (7) may be interpreted as (logged) deviations of the relative price level from the value which is fundamentally justified by the corresponding relative productivity level. Therefore, they are Balassa-Samuelson type competitiveness indicators. As usual, they are combined into an effective indicator,

$$\hat{\varepsilon}_{i,t} = \frac{\exp(\hat{\varepsilon}_{i,c,t})}{\prod_{j=1}^{11} [\exp(\hat{\varepsilon}_{j,c,t})]^{g_{i,j}}}. \quad (8)$$

### 3. Results on price competitiveness within the euro area

#### 3.1 Competitiveness according to the concept of relative PPP

Table 3 presents the results obtained by applying the concept of relative PPP. Columns (2) to (4) are concerned with the accumulated change in competitiveness since the start of EMU in January 1999. In a PPP framework, such a change in competitiveness is entirely due to inflation differentials in a monetary union. The movements of competitiveness based on consumer price indices as shown in column (4) correspond conceptually more or less with those in the middle column of Lane's (2006) Table 2 and in ECB (2007).<sup>10</sup>

Table 3, in line with the observations by the ECB (2005b), corroborates the view that, in spite of their rather small size in a given year, the persistence of inflation differentials has led to remarkable changes in competitiveness in the euro area within

---

<sup>10</sup> They refer, however, to a slightly different observation period. Moreover, the ECB's (2007) figures are not confined to intra-EMU trade partners. Nevertheless, the emerging competitiveness trends are generally very similar.

just seven years, which in some cases can reach double-digit percentage rates. For the majority of countries, the computed direction of the accumulated change in competitiveness is robust with respect to the choice of the price or cost index.

It turns out that it is especially Germany which, according to all measures, has been able to improve significantly on its price competitiveness. According to some measures, this may also apply to Austria, Finland and France, albeit to a much lower degree. Price competitiveness in all of the other EMU countries has been deteriorating more or less. To some degree, this reflects the fact that Germany is the most important trading partner for most euro-area economies. Thus German competitiveness receives a high weight in the calculation of their respective real effective exchange rates.<sup>11</sup>

From columns (5) to (7) it can be seen that today's price competitiveness exceeds its long-term average especially in Finland and Germany but also in France. Again, only in a minority of cases, competitiveness measures based on different price or cost indices display different directions of deviation from the long-term average. Austria, Belgium, Ireland, and the Netherlands belong to this group of countries.<sup>12</sup> Indicators based on the concept of relative PPP unanimously judge the competitiveness of Greece, Italy, Luxembourg, Portugal and Spain as rather low.

The fact that countries like Greece, Portugal and Spain, which were catching up over the past decades, are rated as being rather uncompetitive if a relative PPP measure

---

<sup>11</sup> Similar results are reported in Feletigh et al (2006). Farina (2001) is one of the few economists who warned against possible persistent inflation differentials within the emerging EMU and its consequences for national competitiveness developments. Interestingly, however, he predicted high inflation and a loss in competitiveness for Germany and low inflation and the concomitant competitiveness gains for EMU's "periphery", eg for Italy.

<sup>12</sup> For the Irish economy, the deviation of unit labour cost-based from other indicators of competitiveness is particularly pronounced. Taking note of the fact that the denominator of unit labour costs is labour productivity, this is probably due to a severe upward bias in the measurement of Irish labour productivity, which is identified by Honohan/Walsh (2002). They reveal that the high Irish labour productivity figures can be traced back to a small number of multinational corporations which apparently took advantage of low taxes and standard transfer pricing rules to locate "... a very high fraction of the enterprise's global profits in Ireland" (Honohan/Walsh, 2002, p 40).

For the Italian economy, Gros (2007) presumes that unit labour cost-based indicators overstate the loss of competitiveness. He argues that Italian productivity growth has been higher than recorded because the recent increase in measured Italian employment is largely due to the regularisation of formerly informal work while Italian output already contained a large allowance for the underground economy. The change in price-based measures of competitiveness shown in columns (2) and (4), however, is unaffected by such measurement problems, and one of them displays a loss of Italian competitiveness which is comparable to the unit labour cost-based figure. Any mismeasurement of productivity would, of course, also affect indicators of price competitiveness based on the productivity approach.

is applied, may indicate that a long-term average might fail to take sufficient account of the low price levels which prevailed in these countries in earlier years. This points to the relevance of the absolute PPP concept and the productivity approach for assessing price competitiveness.

Turning to the fundamental question of whether the intra-EMU movements in competitiveness represent a convergence process and thus should not be regarded as problematic, Table 3 conveys a sobering picture. Apart from Austria, Belgium and the Netherlands, where the corresponding results are rather mixed, competitiveness of all countries must be classified as diverging from the equilibrium value provided by relative PPP. This is illustrated vividly in Figure 1 which depicts the unweighted coefficient of variation of EMU countries' price competitiveness. Instead of diminishing, the dispersion of price competitiveness increased obviously from a value between 0.05 and 0.07 at the end of 1998 to around double the figure in early 2006. From a long-run perspective, the dispersion of price competitiveness was low at the start of monetary union and thus the time to introduce the euro appeared well chosen. Today, on the contrary, competitiveness dispersion is high even for pre-EMU standards.

### **3.2 Competitiveness according to the concept of absolute PPP**

Table 4 displays the results obtained when applying the concept of absolute PPP. Column (2) reveals a pattern of movements in competitiveness similar to that found using the concept of relative PPP. Again, it is in particular Germany which has been able to improve its competitiveness relative to its trading partners since the introduction of the euro. A group of countries comprising Austria, Belgium, Finland and France has not been subject of any significant change in competitiveness within this period. All other EMU countries have suffered from a loss of competitiveness, a tendency which applies especially to Ireland, Italy, Spain and Portugal.

Contrary to the quite similar assessment of recent movements in competitiveness, indicators based on absolute PPP judge the current level of EMU countries' competitiveness quite differently than indicators based on relative PPP. Column (3) of Table 4 shows that Ireland, Luxembourg, Germany and Finland have rather low levels of competitiveness in the sense that relative price levels in these countries are distinctly higher than in their trading partner countries within the euro area. While the price

competitiveness of Austria, Belgium, France and the Netherlands is rather close to its equilibrium absolute PPP level, Portugal, Greece, Spain and Italy still benefit from a relatively low price level.

It is striking that these countries are exactly those whose current competitiveness is assessed as being rather unsatisfactory when relative PPP measures are applied. For the past decades, Greece and Portugal, being typical catch-up countries within the euro area, have had low price levels which have been increased only slightly by the recent comparatively modest losses in competitiveness. In Italy and Spain, relative price levels started rising much earlier, in the late 1970s. This development was reversed, however, in the first half of the 1990s when both the Italian lira and the Spanish peseta depreciated significantly in the turmoil of the European ERM I crisis. Although relatively high inflation started eroding the newly gained competitiveness again, current relative price levels are still favourable in these countries. As a reflection of these developments, Germany lost competitiveness when the D-Mark appreciated during the ERM I crisis, and it has since steadily been regaining lost ground through relatively low inflation rates.

The opposing results of relative and absolute PPP concepts concerning current competitiveness of EMU countries also entail an opposing assessment of whether competitiveness in the euro area is converging or not. Figure 2 shows the dispersion of EMU countries' price competitiveness based on absolute PPP indicators. As before, the dispersion is calculated as the coefficient of variation. This variable has obviously been on a decreasing long-term trend for decades, and it continued on this course after the start of monetary union, reflecting converging price levels and thus, in an absolute PPP interpretation, converging competitiveness. The concept of absolute PPP, therefore, suggests that the inflation differentials in the euro area, in spite of being persistent, are hardly a reason for concern.

### **3.3 Competitiveness according to the productivity approach**

As is shown in Table 5, results for the competitiveness of EMU countries based on the productivity approach depend on the productivity variable used in the regression. The sign of the calculated values, however, is in most cases robust to the choice of the productivity regressor. Columns (2) to (4) reveal that Germany, Greece, Belgium,



Finland and France gained competitiveness since the start of EMU by all productivity measures, ie these countries' relative price levels fell by more than one would expect from their increase in productivity. Germany and Greece displayed especially pronounced improvements. Interestingly, Germany, Belgium, Finland and France are those countries for which the indicator based on absolute PPP also displayed gains in competitiveness. Therefore, developments in productivity did not overcompensate the movements in relative prices except in the case of Greece. A severe loss in competitiveness is found, in particular, for Italy and Ireland but also for Spain, Portugal and the Netherlands by some measures. The results are comparable to those obtained with the concept of relative PPP, except in the cases of Greece, Belgium and Luxembourg.

According to columns (5) to (7), competitiveness has recently been rather high, at least by one of the measures, in Belgium, Greece, Spain, France, Luxembourg and, possibly, in Italy and Austria. In these countries, relative price levels are low compared with at least some of their productivity levels. Germany, Finland, Ireland and, according to one productivity measure, also Portugal suffer from a rather low competitiveness defined by posting high relative price levels compared to their productivity levels. Apart from Luxembourg, where high productivity levels apparently make up for the high relative prices, and Portugal, where low relative price levels can be accounted for by low productivity levels, the picture is quite similar to the one that emerges when the absolute PPP concept is applied, and thus competitiveness levels are distinctly different in many cases from those obtained with the concept of relative PPP.

These similarities and differences are reflected in the development of dispersion of EMU countries' price competitiveness based on the productivity approach, as can be seen from Figure 3. Competitiveness converged in the 1960s, remained more or less constant in the 1970s and 1980s and has been converging again since the start of the 1990s. Inflation differentials in the euro area would thus be qualified as rather innocuous in the framework of the productivity approach.

### **3.4 Discussion**

Since they are coefficients of variation, the calculated levels of dispersion can be compared across concepts. The dispersion based on the concept of relative PPP turns

out to be almost continuously lower than the dispersion based on either of the other two concepts. This may, however, be a quite natural outcome because the procedure of assigning the role of the equilibrium value to the long-term average of the real effective exchange rate entails a kind of minimisation of deviations of competitiveness against EMU trading partners for every EMU country. The use of country-specific fixed effects in the productivity approach regression would have had a similar effect.

In a comparison of the development of competitiveness dispersion over time, several similarities between the dispersion measures based on different concepts attract attention. Up to the start of the 1970s, competitiveness dispersion declined. The turmoil of the collapse of the Bretton Woods system, however, was again associated with relatively high dispersion rates. The formation of the European Monetary System in the late 1970s was able, apparently, to soothe dispersion further. According to all measures of dispersion, competitiveness converged rapidly within today's euro area at the start of the 1990s. This process, however, was interrupted by the EMS crisis in late 1992. All measures displayed a local maximum of dispersion in 1995 when the Italian lira, the Greek drachma and the Spanish peseta depreciated considerably against most of the other currencies of today's EMU countries. This observation possibly indicates overshooting phenomena at work. Sharp exchange rate adjustments such as this one and the one in the 1970s are obviously not associated with a reduction in possible misalignments but instead with an increasing dispersion from equilibrium rates.

All these similarities between different concepts of equilibrium real exchange rates contrast starkly with the period since the formation of EMU in January 1999 which is characterised by a steadily increasing dispersion according to relative PPP measures while both the concept of absolute PPP and the productivity approach diagnose a decrease in competitiveness dispersion. This raises the issue of which of the three concepts may be the most plausible.

From a theoretical point of view, the productivity approach, being the most comprehensive, realistic and elaborate argument, may appear to be the most appealing of the three equilibrium concepts used. It turns out, however, that this approach yields rather curious results, while especially results from the concept of relative PPP are mostly rather intuitive. As an example, Figures 4 shows the development of the price

competitiveness of the German economy based on the productivity approach, where productivity per hour worked is used in the regression. This indicator suggests that Germany's price competitiveness has continuously been below equilibrium since the start of the 1970s, ie the German relative price level has been higher than productivity would justify for more than thirty years. This contrasts starkly with the persistently high trade surpluses of Germany in (extra and) intra-EMU trade.

Of course, it is not only price competitiveness which determines the trade balance. Movements in relative demand and non-price competitiveness factors, for instance, affect the trade balance as well. These factors, however, can hardly explain the persistence of the discrepancy between the apparent low competitiveness, as indicated by this particular productivity measure, and the trade surplus of Germany. Similar inconsistencies can be found for many other countries in the sample. Such inconsistencies could arise, in principle, if measurement errors biased the calculations. In the present case, the collection of prices as well as the computation of GDP and of the total number of man-hours worked could have been affected by measurement errors, especially as far as international comparability is concerned.

If the total number of man-hours worked were the culprit, however, one would be left to explain why the two alternative productivity measures (GDP per head of population and GDP per person employed) that do not use the total number of man-hours worked yield rather similar results concerning, for instance, the apparent low competitiveness of the German economy. These two productivity measures, in turn, use GDP values in purchasing power parities. Honohan (1998), however, claims that using GDP based on purchasing power parities biases upwards the productivity of poorer economies. In fact, the productivity approach assesses the competitiveness positions of the less wealthy EMU countries Greece, Portugal and Spain much more positively than the concept of relative PPP. The argument is still not particularly convincing because the highly wealthy Luxembourg economy displays the same pattern and because absolute PPP yields even more upbeat competitiveness values for Greece, Portugal and Spain than the productivity approach. This may imply that quality of some sort has not been adequately taken into consideration in the price variables.

According to some observers, the methodological treatment of German unification may account for the rather implausible results of the productivity approach calculations. In the early 1990s, West German data were replaced by unified German data which noticeably reduced productivity but did not affect the relative price level. In order to check for the effect of German unification, the calculations were reperformed by using West German productivity for the entire observation period.<sup>13</sup> The modified and the original panel regression results are virtually the same. They deviate, however, in that the estimated residuals for West Germany after unification decrease markedly. A competitiveness indicator, constructed from these residuals along the lines described in section 2.3, assesses recent German competitiveness as being more or less neutral, ie relative price levels hardly deviate from the estimated equilibrium value. The corresponding deviations from equilibrium of the other euro-area countries show a 2 to 4 percentage point fall in competitiveness depending on the weight of Germany in their external trade. From our point of view, however, it is generally questionable whether it is sensible to still ignore the eastern part of Germany 16 years after reunification.

#### **4. Conclusions**

The persistent inflation differentials between countries of the euro area raise concerns that they may constitute a continuous divergence of competitiveness of EMU member countries. The present study addresses this issue by using three different concepts of equilibrium real exchange rates to assess trends in international price competitiveness among EMU countries. Relative PPP, absolute PPP and the productivity approach are chosen as equilibrium concepts especially because they are simple and enable a straightforward comparison between different economies.

It is found that the choice of the equilibrium concept has hardly been affecting the direction of change of price competitiveness since the start of monetary union in January 1999. Regardless of the concept used, the analysis reveals that the German economy was able to improve its price competitiveness compared with the euro-area trading partners while Italy, Portugal, Spain, Ireland and Luxembourg lost

---

<sup>13</sup> A West German series for GDP per hour worked is available up to 1997. More recent observations have been constructed through extrapolation under the assumption of equal productivity growth in East and West Germany. This assumption is, of course, debatable.

competitiveness to varying degrees. The results concerning the current level of competitiveness, however, depend heavily on the equilibrium concept used. Relative PPP, for instance, suggests a relatively high competitiveness of the German economy and a rather low one for Italy, Greece and Spain. Absolute PPP and the productivity approach suggest exactly the opposite.

The fact that different concepts assess the development of competitiveness similarly but the level of competitiveness differently entails a different judgement of recent developments in the dispersion of competitiveness among EMU countries. While measures based on relative PPP show a continuous increase in dispersion since the start of EMU, competitiveness in the euro area converges according to measures based on absolute PPP or the productivity approach. Compared with pre-EMU standards, current competitiveness dispersion is very high if judged from a relative PPP point of view but it is very low in the framework of the two alternative concepts. The differences are all the more puzzling as the movements of all the dispersion measures, including those based on relative PPP were broadly similar in pre-EMU times.

In sum, the persistent inflation differentials between current EMU member countries could be considered rather innocuous when judged from an absolute PPP or productivity approach perspective. According to these two concepts, inflation differentials simply reflect price convergence movements which are an intended consequence of the formation of monetary union and which should level out as soon as convergence is completed. From a relative PPP perspective, however, intra-euro-area inflation differentials are a genuine reason for concern because, in this framework, some euro-area countries accumulate a continuously increasing competitive advantage compared with their trading partners within EMU. In such a case, the absence of national monetary policy instruments could make the necessary adjustment process slow and painful for euro-area economies that suffer from a low competitiveness.

While the productivity approach may be theoretically most appealing, it yields less plausible results than a relative PPP-based approach. Trade balance movements, for instance, are much more in line with results based on relative PPP. The use of more complex equilibrium concepts of the real exchange rate does not appear to be a particularly promising way to solve the puzzle since complexity would probably reduce

international comparability. Instead, the puzzle may have its origin in systematic measurement errors in the variables used for the calculation of the competitiveness indicators. A careful investigation of the potential presence of measurement errors, possibly by using much more disaggregated price data, as well as an in-depth analysis of the relationship between different measures of competitiveness and the movements in foreign trade variables may thus be the obvious next steps in the assessment of competitiveness trends in the euro area.

## References

- Allington, N F B, P A Kattuman and F A Waldmann, 2005, One market, one money, one price?, *International Journal of Central Banking*, 1 (3), 73-115.
- Arnold, I J M and B A Verhoef, 2004, External causes of euro zone inflation differentials: a re-examination of the evidence, *Intereconomics*, 39, 254-263.
- Balassa, B, 1964, The purchasing-power parity doctrine: a reappraisal, *The Journal of Political Economy*, 72, 584-596.
- Banerjee, A, M Marcellino and C Osbat, 2004, Some cautions on the use of panel methods for integrated series of macroeconomic data, *Econometrics Journal*, 7, 322-340.
- Banerjee, A, M Marcellino and C Osbat, 2005, Testing for PPP: Should we use panel methods?, *Empirical Economics*, 30, 77-91.
- Breitung, J and S Das, 2005, Panel unit root tests under cross sectional dependence, *Statistica Neerlandica*, 59, 414-433.
- Breitung, J and M H Pesaran, 2005, Unit roots and cointegration in panels, Deutsche Bundesbank Discussion Paper Series 1, No 42/2005.
- Buldorini, L, S Makrydakis and C Thimann, 2002, The effective exchange rates of the euro, ECB Occasional Paper No. 2.
- Canzoneri, M B, R E Cumby and B Diba, 1999, Relative labour productivity and the real exchange rate in the long run: evidence for a panel of OECD countries, *Journal of International Economics*, 47, 245-266.
- Coakley, J and A-M Fuertes, 2000, Is there a base currency effect in long-run PPP?, *International Journal of Finance and Economics*, 5, 253-263.
- Corden, W M, 1994, *Economic Policy, Exchange Rates, and the International System*, Oxford University Press.
- DeLoach, S B, 2001, More evidence in favor of the Balassa-Samuelson hypothesis, *Review of International Economics*, 9, 336-342.
- Deutsche Bundesbank, 1998, The indicator quality of different definitions of the real external value of the Deutsche Mark, *Monthly Report*, November 1998, 39-52.
- Deutsche Bundesbank, 2004, Purchasing power parity theory as a concept for evaluating price competitiveness, *Monthly Report*, June 2004, 29-42.
- Driver, R L and P F Westaway, 2005, Concepts of equilibrium exchange rates, in R Driver, P Sinclair and C Thoenissen (eds.), *Exchange Rates, Capital Flows and Policy*, Routledge, 98-148.
- ECB, 2002, Price level convergence and competition in the euro area, *Monthly Bulletin*, August 2002, 39-49.
- ECB, 2003a, Developments in the euro area's international cost and price competitiveness, *Monthly Bulletin*, August 2003, 67-74.

- ECB, 2003b, Inflation differentials in the euro area: potential causes and policy implications, Mimeo.
- ECB, 2005a, Indicators of euro area cost and price competitiveness: similarities and differences, *Monthly Bulletin*, June 2005, 71-74.
- ECB, 2005b, Monetary policy and inflation differentials in a heterogeneous currency area, *Monthly Bulletin*, May 2005, 61-77.
- ECB, 2007, The introduction of harmonised competitiveness indicators for euro area countries, *Monthly Bulletin*, February 2007, 53-55.
- Engel, C and J H Rogers, European product market integration after the euro, *Economic Policy*, 19, 347-384.
- European Commission, 1990, One market, one money: an evaluation of the potential benefits and costs of forming an economic and monetary union, *European Economy*, 44.
- European Commission, 1996, The 1996 single market review: background information for the report to the Council and European Parliament, Commission Staff Working Paper, SEC (96) 2378.
- Faber, R P and A C J Stokman, 2005, Price convergence in Europe from a macro perspective: product categories and reliability, DNB Working Paper No 34.
- Farina, F, 2001, Monetary policy and competitiveness in the euro area, in M Franzini and F R Pizzuti (eds.), *Globalization, Institutions and Social Cohesion*, Springer, 283-309.
- Feletigh, A, R Lecat, B Pluyaud and R Tedeschi, 2006, Market shares and trade specialisation of France, Germany and Italy, in O de Bandt, H Herrmann and G Parigi (eds.), *Convergence or Divergence in Europe? Growth and Business Cycles in France, Germany and Italy*, Springer, 291-323.
- Fischer, C and D Porath, 2006, A reappraisal of the evidence on PPP: a systematic investigation into MA roots in panel unit root tests and their implications, Deutsche Bundesbank Discussion Paper Series 1, No. 23/2006.
- Froot, K A and K Rogoff, 1995, Perspectives on PPP and long-run real exchange rates, in G M Grossman and K Rogoff (eds.), *Handbook of International Economics*, Vol. 3, Elsevier, 1647-1688.
- German Council of Economic Experts (Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung), 2001, *Für Stetigkeit – gegen Aktionismus*, Bundesanzeiger Verlagsgesellschaft.
- Gischer, H and M Weiß, 2006, Inflationsdifferenzen im Euroraum – Zur Rolle des Balassa-Samuelson-Effekts, *List Forum für Wirtschafts- und Finanzpolitik*, 32, 16-37.
- Goldberg, P K and F Verboven, 2005, Market integration and convergence to the Law of One Price: evidence from the European car market, *Journal of International Economics*, 65, 49-73.
- Gros, D, 2007, Italy may be sick, but its condition is far from terminal, *Financial Times*, 07.02.2007.



- Harvey, A and D Bates, 2002, Multivariate unit root tests and testing for convergence, DAE Working Paper No. 0301.
- Hill, R J, 2004, Constructing price indexes across space and time: the case of the European Union, *The American Economic Review*, 94, 1379-1410.
- Honohan, P, 1998, Does PPP-adjusted data exaggerate the relative size of poor economies, CEPR Discussion Paper, No. 1865.
- Honohan, P and P R Lane, 2003, Divergent inflation rates in EMU, *Economic Policy*, 18, 357-394.
- Honohan, P and B Walsh, 2002, Catching up with the leaders: the Irish hare, *Brookings Papers on Economic Activity*, 2002 (1), 1-77.
- Jönsson, K, 2005, Cross-sectional dependency and size distortion in a small-sample homogeneous panel data unit root test, *Oxford Bulletin of Economics and Statistics*, 67, 369-392.
- Kao, C, 1999, Spurious regression and residual-based tests for cointegration in panel data, *Journal of Econometrics*, 90, 1-44.
- Kao, C and M-H Chiang, 2000, On the estimation and inference of a cointegrated regression in panel data, in B. Baltagi (ed.), *Nonstationary Panels, Panel Cointegration and Dynamic Panels*, Advances in Econometrics, Vol. 15, Elsevier, 179-222.
- Krugman, P R, 1996, Making sense of the competitiveness debate, *Oxford Review of Economic Policy*, 12 (3), 17-25.
- Lane, P R, 2006, The real effects of European Monetary Union, *Journal of Economic Perspectives*, 20 (4), 47-66.
- Lutz, M, 2004, Price convergence under EMU? First estimates, in A V Deardorff (ed), *The Past, Present and Future of the European Union*, Palgrave MacMillan.
- MacDonald, R, 2000, Concepts to calculate equilibrium exchange rates: an overview, Deutsche Bundesbank Discussion Paper, No 3/00.
- O'Connell, P G J, 1998, The overvaluation of purchasing power parity, *Journal of International Economics*, 44, 1-19.
- Papell, D H and H Theodorides, 2001, The choice of numeraire currency in panel tests of purchasing power parity, *Journal of Money, Credit, and Banking*, 33, 976-993.
- Pedroni, P, 1996, Fully modified OLS for heterogeneous cointegrated panels and the case of purchasing power parity, Working Paper in Economics 96-020, Indiana University.
- Pedroni, P, 1999, Critical values for cointegration tests in heterogeneous panels with multiple regressors, *Oxford Bulletin of Economics and Statistics*, 61, 653-670.
- Rogers, J H, 2001, Price level convergence, relative prices, and inflation in Europe, International Finance Discussion Papers No 699.
- Rogoff, K, 1996, The purchasing power parity puzzle, *Journal of Economic Literature*, 34, 647-668.

Samuelson, P A, 1964, Theoretical notes on trade problems, *The Review of Economics and Statistics*, 46, 145-154.

Sarno, L and M P Taylor, 2002, *The Economics of Exchange Rates*, Cambridge University Press.

Taylor, A M and M P Taylor, 2004, The purchasing power parity debate, *Journal of Economic Perspectives*, 18, 135-158.

**Table 1: MHDF and PCSE panel unit root tests**

	$T$	lags	MHDF	PCSE
Real effective exchange rate based on deflators of total sales (DTS)	125	1	-0.28	-1.49
		3	-0.74	-1.51*
		5	-0.77	-1.27
Real effective exchange rate based on ULCs in the enterprise sector	119	1	-1.98**	-1.31
		3	-2.21**	-1.80*
		5	-2.54***	-2.02**
Real effective exchange rate based on CPIs	125	1	-0.60	-1.97**
		3	-1.64*	-2.36**
		5	-1.07	-2.08**
$p_{i,Australia,t}$	46	1	-1.40	-0.93
		3	-0.67	-0.53
		5	1.41	0.33
$p_{i,NewZealand,t}$	37	1	-4.06***	-3.25***
		3	-6.24***	-3.05***
		5	-2.12**	-1.61*
$x_{i,Australia,t}$ (in GDP per head)	46	1	2.15	1.02
		3	1.13	0.79
		5	1.72	0.86
$x_{i,Australia,t}$ (in GDP per person employed)	46	1	2.09	1.22
		3	0.13	0.38
		5	-1.61*	-0.27
$x_{i,NewZealand,t}$ (in GDP per hour worked)	37	1	2.44	1.48
		3	1.71	1.78
		5	2.28	1.83

Significant at the \*\*\* 1% level, \*\* 5% level, \* 10% level. All variables in logs;  $x_{i,c,t}$  and  $p_{i,c,t}$  as in equations (5) to (7).  $N = 12$  series per panel except for the real effective exchange rates based on ULCs where  $N = 10$ .  $T =$  number of observations per series. Column “lags” shows the number of lags in the test equation.

**Table 2: Panel estimation of  $\beta$  in the productivity approach equation (7)**

Measure of productivity	GDP per head	GDP per person employed	GDP per hour
Static FE estimation	0.58 [DW: 0.09]	0.55 [DW: 0.07]	0.59 [DW: 0.10]
FMOLS	0.59 (6.69)	0.55 (5.60)	0.60 (4.69)
DOLS	0.61 (6.38)	0.56 (5.22)	0.63 (4.38)
<i>T</i>	46	46	37

$N = 12$  cross section units (countries) in all panels. In all estimations, the constant is generally restricted to be common across countries. Time effects, which eliminate the influence of the chosen base country  $c$ , are generally included. In the DOLS estimation, two lags and two leads are used.  $t$ -values are shown in brackets. DW, given in square brackets, denotes the Durbin Watson statistic.

**Table 3: International price competitiveness against trade partners in EMU as of 2006 Q1; calculations based on the concept of relative PPP**

Column	Accumulated change since start of EMU (1998 Q4)			Deviation from long-term average		
	Indicator based on			Indicator based on		
	DTS	ULC	CPI	DTS	ULC	CPI
	(2)	(3)	(4)	(5)	(6)	(7)
Austria	0.0	-3.7	-0.8	3.6	-3.2	3.4
Belgium	7.8	0.5	0.2	3.9	4.5	-1.6
Finland	-2.9	2.1	-2.9	-7.6	-9.0	-10.8
France	-4.1	0.6	-2.0	-5.4	-5.6	-2.4
Germany	-9.8	-12.8	-5.2	-8.8	-9.2	-5.1
Greece	6.4	-	5.4	13.2	-	12.9
Ireland	2.6	1.5	11.1	4.5	-8.0	11.2
Italy	11.0	12.5	2.8	14.8	9.4	3.4
Luxembourg	15.2	-	6.8	16.1	-	4.0
Netherlands	2.3	10.2	4.7	-4.5	6.3	2.4
Portugal	5.2	15.3	5.4	14.9	26.4	14.6
Spain	13.4	11.4	9.1	12.8	16.2	8.1

Values expressed in percent.

Negative values in columns (2)-(4) indicate an improvement in price competitiveness.

Negative values in columns (5)-(7) indicate superior price competitiveness compared with its long-term average. Long-term averages are computed starting from 1Q1975 and 3Q1976 (in the case of ULC), respectively.

DTS = deflator of total sales, ULC = unit labour costs in the enterprise sector, CPI = consumer price index.

**Table 4: International price competitiveness against trade partners in EMU as of 2005; calculations based on the concept of absolute PPP**

	Accumulated change since 1998	Deviation from absolute PPP
Austria	1.3	0.7
Belgium	-2.5	-1.5
Finland	-0.1	5.5
France	-1.4	2.5
Germany	-8.2	5.9
Greece	3.9	-20.2
Ireland	20.9	15.4
Italy	9.9	-4.8
Luxembourg	3.8	11.7
Netherlands	3.4	0.6
Portugal	5.1	-22.8
Spain	8.0	-12.5

Values expressed in percent.

Negative values in column (2) indicate a decline in the relative price level and thus an improvement in price competitiveness.

Negative values in columns (3) indicate lower relative price levels and thus a superior price competitiveness compared with euro-area trading partners.

**Table 5: International price competitiveness against trade partners in EMU; calculations based on the productivity approach**

Column	Accumulated change since 1998			Deviation from estimated equilibrium value		
	Regression on GDP per			Regression on GDP per		
	HW	PE	HP	HW	PE	HP
	(2)	(3)	(4)	(5)	(6)	(7)
Austria	0.4	-0.6	0.1	-0.7	1.1	-6.0
Belgium	-4.3	-5.7	-5.7	-7.7	-11.1	-5.5
Finland	-1.6	-2.4	-3.9	11.3	2.2	1.5
France	-4.4	-1.6	-1.3	-7.8	-4.8	0.9
Germany	-9.0	-7.0	-5.3	7.1	12.5	8.7
Greece	-5.0	-7.7	-7.5	-2.8	-16.6	-7.2
Ireland	10.1	13.4	8.0	10.4	4.0	1.2
Italy	14.0	16.3	14.9	-0.6	-5.2	-2.2
Luxembourg	2.7	3.0	-5.4	-2.4	-2.5	-24.8
Netherlands	9.4	1.6	2.6	0.3	3.5	-4.2
Portugal	6.1	4.0	6.6	7.6	-0.1	-3.2
Spain	11.0	4.5	-0.5	-0.7	-10.4	-7.8

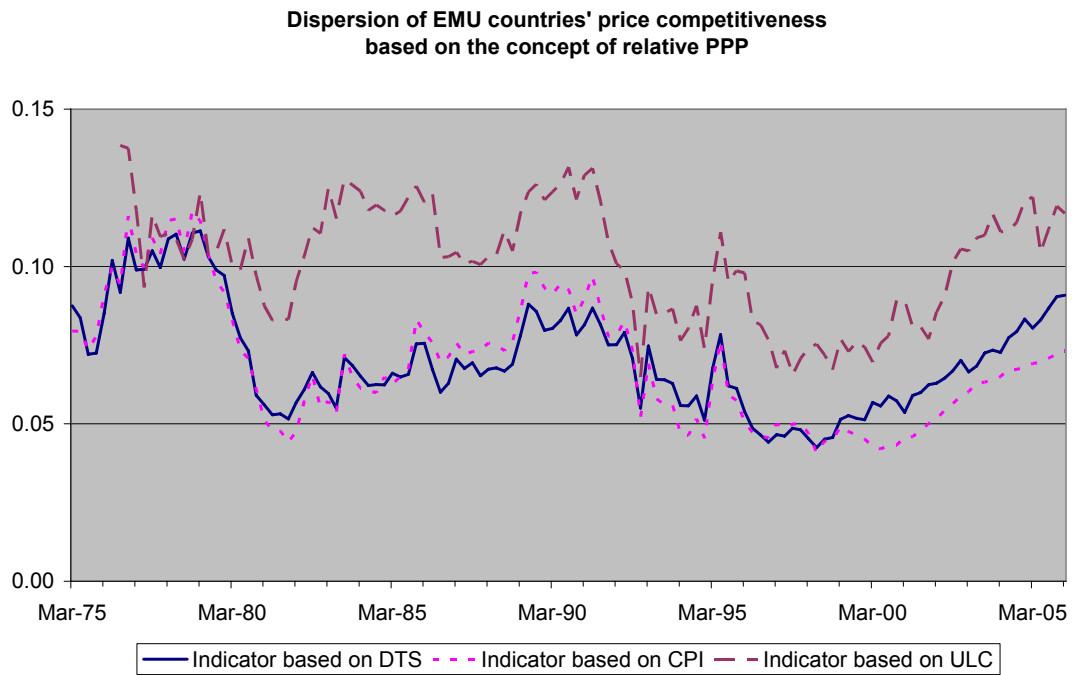
Values expressed in percent. Values based on regression on GDP per HW as of 2005, values based on regression on GDP per PE or HP as of 2004.

Negative values in columns (2)-(4) indicate an improvement in price competitiveness that takes productivity movements into account.

Negative values in columns (5)-(7) indicate superior price competitiveness compared with the estimated equilibrium value.

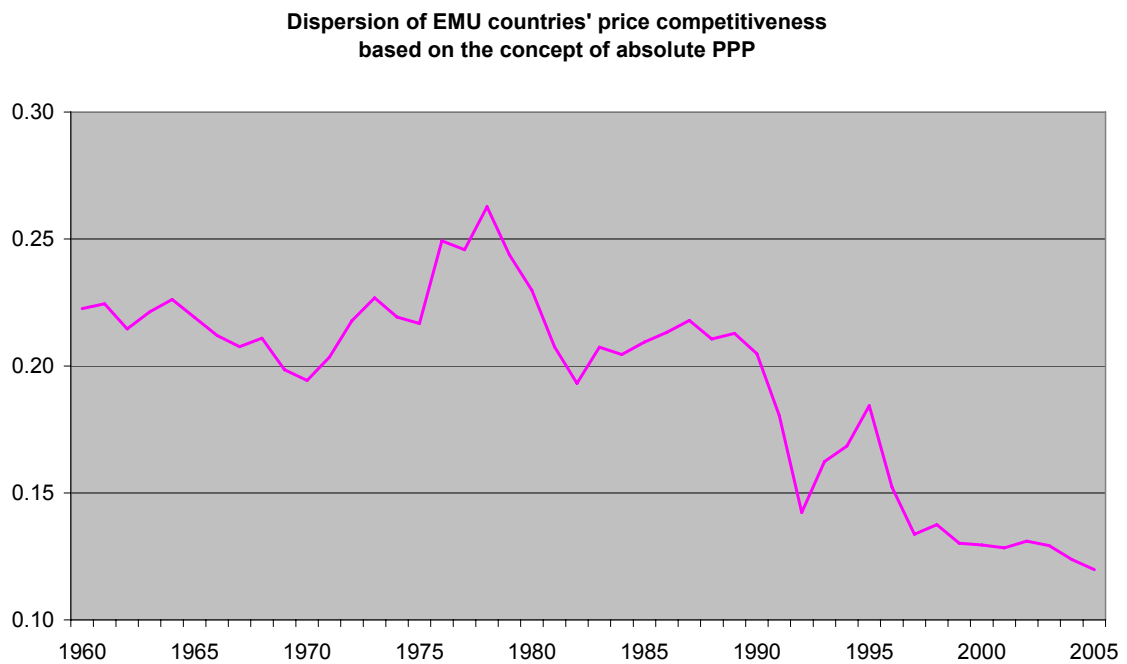
HW = hour worked, PE = person employed, HP = head of population.

**Figure 1:**



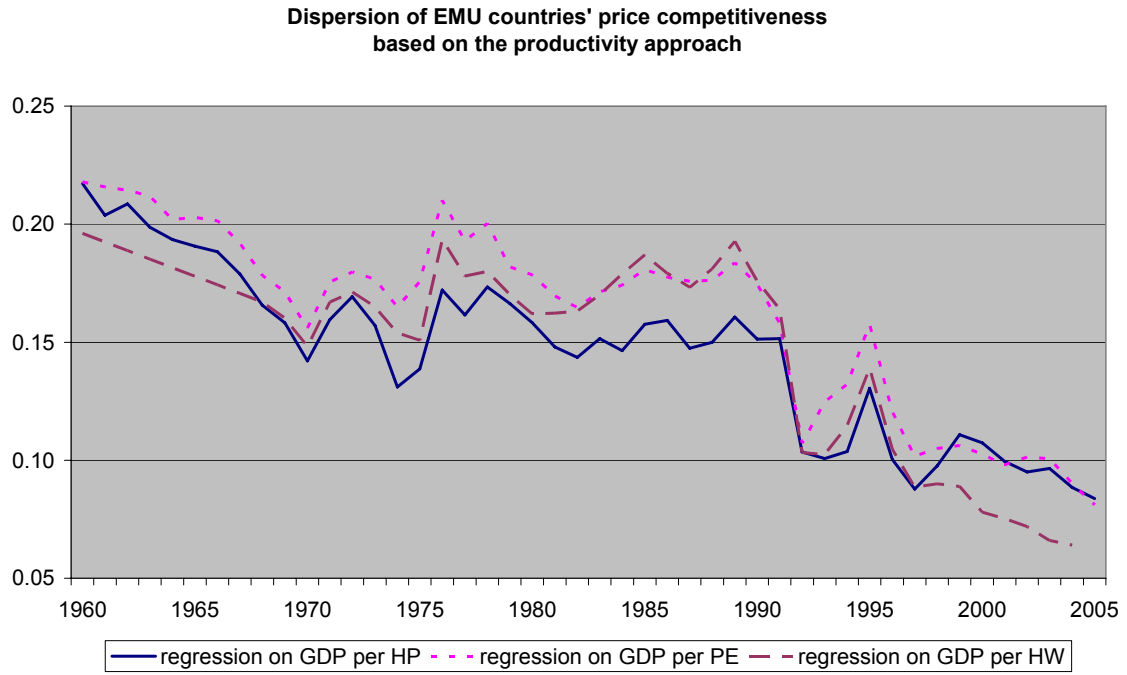
Notes: DTS = deflator of total sales, ULC = unit labour costs in the enterprise sector (no data for Greece and Luxembourg), CPI = consumer price index.

**Figure 2:**





**Figure 3:**



Notes: HW = hour worked, PE = person employed, HP = head of population.

**Figure 4:**



## The following Discussion Papers have been published since 2006:

### Series 1: Economic Studies

1	2006	The dynamic relationship between the Euro overnight rate, the ECB's policy rate and the term spread	Dieter Nautz Christian J. Offermanns
2	2006	Sticky prices in the euro area: a summary of new micro evidence	Álvarez, Dhyne, Hoeberichts Kwapil, Le Bihan, Lünnemann Martins, Sabbatini, Stahl Vermeulen, Vilmunen
3	2006	Going multinational: What are the effects on home market performance?	Robert Jäckle
4	2006	Exports versus FDI in German manufacturing: firm performance and participation in international markets	Jens Matthias Arnold Katrin Hussinger
5	2006	A disaggregated framework for the analysis of structural developments in public finances	Kremer, Braz, Brosens Langenus, Momigliano Spolander
6	2006	Bond pricing when the short term interest rate follows a threshold process	Wolfgang Lemke Theofanis Archontakis
7	2006	Has the impact of key determinants of German exports changed? Results from estimations of Germany's intra euro-area and extra euro-area exports	Kerstin Stahn
8	2006	The coordination channel of foreign exchange intervention: a nonlinear microstructural analysis	Stefan Reitz Mark P. Taylor
9	2006	Capital, labour and productivity: What role do they play in the potential GDP weakness of France, Germany and Italy?	Antonio Bassanetti Jörg Döpke, Roberto Torrini Roberta Zizza

10	2006	Real-time macroeconomic data and ex ante predictability of stock returns	J. Döpke, D. Hartmann C. Pierdzioch
11	2006	The role of real wage rigidity and labor market frictions for unemployment and inflation dynamics	Kai Christoffel Tobias Linzert
12	2006	Forecasting the price of crude oil via convenience yield predictions	Thomas A. Knetsch
13	2006	Foreign direct investment in the enlarged EU: do taxes matter and to what extent?	Guntram B. Wolff
14	2006	Inflation and relative price variability in the euro area: evidence from a panel threshold model	Dieter Nautz Juliane Scharff
15	2006	Internalization and internationalization under competing real options	Jan Hendrik Fisch
16	2006	Consumer price adjustment under the microscope: Germany in a period of low inflation	Johannes Hoffmann Jeong-Ryeol Kurz-Kim
17	2006	Identifying the role of labor markets for monetary policy in an estimated DSGE model	Kai Christoffel Keith Küster Tobias Linzert
18	2006	Do monetary indicators (still) predict euro area inflation?	Boris Hofmann
19	2006	Fool the markets? Creative accounting, fiscal transparency and sovereign risk premia	Kerstin Bernoth Guntram B. Wolff
20	2006	How would formula apportionment in the EU affect the distribution and the size of the corporate tax base? An analysis based on German multinationals	Clemens Fuest Thomas Hemmelgarn Fred Ramb

21	2006	Monetary and fiscal policy interactions in a New Keynesian model with capital accumulation and non-Ricardian consumers	Campbell Leith Leopold von Thadden
22	2006	Real-time forecasting and political stock market anomalies: evidence for the U.S.	Martin Bohl, Jörg Döpke Christian Pierdzioch
23	2006	A reappraisal of the evidence on PPP: a systematic investigation into MA roots in panel unit root tests and their implications	Christoph Fischer Daniel Porath
24	2006	Margins of multinational labor substitution	Sascha O. Becker Marc-Andreas Münder
25	2006	Forecasting with panel data	Badi H. Baltagi
26	2006	Do actions speak louder than words? Household expectations of inflation based on micro consumption data	Atsushi Inoue Lutz Kilian Fatma Burcu Kiraz
27	2006	Learning, structural instability and present value calculations	H. Pesaran, D. Pettenuzzo A. Timmermann
28	2006	Empirical Bayesian density forecasting in Iowa and shrinkage for the Monte Carlo era	Kurt F. Lewis Charles H. Whiteman
29	2006	The within-distribution business cycle dynamics of German firms	Jörg Döpke Sebastian Weber
30	2006	Dependence on external finance: an inherent industry characteristic?	George M. von Furstenberg Ulf von Kalckreuth
31	2006	Comovements and heterogeneity in the euro area analyzed in a non-stationary dynamic factor model	Sandra Eickmeier

32	2006	Forecasting using a large number of predictors: is Bayesian regression a valid alternative to principal components?	Christine De Mol Domenico Giannone Lucrezia Reichlin
33	2006	Real-time forecasting of GDP based on a large factor model with monthly and quarterly data	Christian Schumacher Jörg Breitung
34	2006	Macroeconomic fluctuations and bank lending: evidence for Germany and the euro area	S. Eickmeier B. Hofmann, A. Worms
35	2006	Fiscal institutions, fiscal policy and sovereign risk premia	Mark Hallerberg Guntram B. Wolff
36	2006	Political risk and export promotion: evidence from Germany	C. Moser T. Nestmann, M. Wedow
37	2006	Has the export pricing behaviour of German enterprises changed? Empirical evidence from German sectoral export prices	Kerstin Stahn
38	2006	How to treat benchmark revisions? The case of German production and orders statistics	Thomas A. Knetsch Hans-Eggert Reimers
39	2006	How strong is the impact of exports and other demand components on German import demand? Evidence from euro-area and non-euro-area imports	Claudia Stirböck
40	2006	Does trade openness increase firm-level volatility?	C. M. Buch, J. Döpke H. Strotmann
41	2006	The macroeconomic effects of exogenous fiscal policy shocks in Germany: a disaggregated SVAR analysis	Kirsten H. Heppke-Falk Jörn Tenhofen Guntram B. Wolff

42	2006	How good are dynamic factor models at forecasting output and inflation? A meta-analytic approach	Sandra Eickmeier Christina Ziegler
43	2006	Regionalwährungen in Deutschland – Lokale Konkurrenz für den Euro?	Gerhard Rösl
44	2006	Precautionary saving and income uncertainty in Germany – new evidence from microdata	Nikolaus Bartsch
45	2006	The role of technology in M&As: a firm-level comparison of cross-border and domestic deals	Rainer Frey Katrin Hussinger
46	2006	Price adjustment in German manufacturing: evidence from two merged surveys	Harald Stahl
47	2006	A new mixed multiplicative-additive model for seasonal adjustment	Stephanus Arz
48	2006	Industries and the bank lending effects of bank credit demand and monetary policy in Germany	Ivo J.M. Arnold Clemens J.M. Kool Katharina Raabe
01	2007	The effect of FDI on job separation	Sascha O. Becker Marc-Andreas Müндler
02	2007	Threshold dynamics of short-term interest rates: empirical evidence and implications for the term structure	Theofanis Archontakis Wolfgang Lemke
03	2007	Price setting in the euro area: some stylised facts from individual producer price data	Dias, Dossche, Gautier Hernando, Sabbatini Stahl, Vermeulen
04	2007	Unemployment and employment protection in a unionized economy with search frictions	Nikolai Stähler

05	2007	End-user order flow and exchange rate dynamics	S. Reitz, M. A. Schmidt M. P. Taylor
06	2007	Money-based interest rate rules: lessons from German data	C. Gerberding F. Seitz, A. Worms
07	2007	Moral hazard and bail-out in fiscal federations: evidence for the German Länder	Kirsten H. Heppke-Falk Guntram B. Wolff
08	2007	An assessment of the trends in international price competitiveness among EMU countries	Christoph Fischer

## Series 2: Banking and Financial Studies

01	2006	Forecasting stock market volatility with macroeconomic variables in real time	J. Döpke, D. Hartmann C. Pierdzioch
02	2006	Finance and growth in a bank-based economy: is it quantity or quality that matters?	Michael Koetter Michael Wedow
03	2006	Measuring business sector concentration by an infection model	Klaus Düllmann
04	2006	Heterogeneity in lending and sectoral growth: evidence from German bank-level data	Claudia M. Buch Andrea Schertler Natalja von Westernhagen
05	2006	Does diversification improve the performance of German banks? Evidence from individual bank loan portfolios	Evelyn Hayden Daniel Porath Natalja von Westernhagen
06	2006	Banks' regulatory buffers, liquidity networks and monetary policy transmission	Christian Merkl Stéphanie Stolz
07	2006	Empirical risk analysis of pension insurance – the case of Germany	W. Gerke, F. Mager T. Reinschmidt C. Schmieder
08	2006	The stability of efficiency rankings when risk-preferences and objectives are different	Michael Koetter
09	2006	Sector concentration in loan portfolios and economic capital	Klaus Düllmann Nancy Masschelein
10	2006	The cost efficiency of German banks: a comparison of SFA and DEA	E. Fiorentino A. Karmann, M. Koetter
11	2006	Limits to international banking consolidation	F. Fecht, H. P. Grüner



12	2006	Money market derivatives and the allocation of liquidity risk in the banking sector	Falko Fecht Hendrik Hakenes
01	2007	Granularity adjustment for Basel II	Michael B. Gordy Eva Lütkebohmert
02	2007	Efficient, profitable and safe banking: an oxymoron? Evidence from a panel VAR approach	Michael Koetter Daniel Porath
03	2007	Slippery slopes of stress: ordered failure events in German banking	Thomas Kick Michael Koetter
04	2007	Open-end real estate funds in Germany – genesis and crisis	C. E. Bannier F. Fecht, M. Tyrell
05	2007	Diversification and the banks' risk-return-characteristics – evidence from loan portfolios of German banks	A. Behr, A. Kamp C. Memmel, A. Pfingsten
06	2007	How do banks adjust their capital ratios? Evidence from Germany	Christoph Memmel Peter Raupach



## **Visiting researcher at the Deutsche Bundesbank**

The Deutsche Bundesbank in Frankfurt is looking for a visiting researcher. Among others under certain conditions visiting researchers have access to a wide range of data in the Bundesbank. They include micro data on firms and banks not available in the public. Visitors should prepare a research project during their stay at the Bundesbank. Candidates must hold a Ph D and be engaged in the field of either macroeconomics and monetary economics, financial markets or international economics. Proposed research projects should be from these fields. The visiting term will be from 3 to 6 months. Salary is commensurate with experience.

Applicants are requested to send a CV, copies of recent papers, letters of reference and a proposal for a research project to:

Deutsche Bundesbank  
Personalabteilung  
Wilhelm-Epstein-Str. 14

60431 Frankfurt  
GERMANY

