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TRACKING THE EURO

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ABSTRACT/RÉSUMÉ

During the first two years of monetary union, the euro's weakness surprised most market participants. Explanations proliferated ranging from fundamentals such as differences in growth prospects to psychological factors such as herd behaviour, but no single story fully accounts for the observed exchange rate path. Based on an eclectic approach, this paper offers an empirical analysis showing that terms-of-trade and saving/investment behaviour seem to have driven the euro exchange rate over the medium and longer run. While such econometric estimates ought to be interpreted with due care, they do support the view that towards the end of 2000, the euro was significantly undervalued.

JEL Code: E42, E44, E52, E58, E65, F31, F32, F47.
Keywords: Euro, exchange rates, overshooting, Eurosystem, ECB, intervention, capital flows.

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Pendant les deux premières années de l'union monétaire, la faiblesse de l'euro a surpris la plupart des participants aux marchés. Les explications se sont multipliées allant de fondamentaux tels que les différentiels de croissance anticipés aux facteurs psychologiques tels que les comportements grégaires, mais aucune d'entre elles ne rend compte pleinement à elle seule de la trajectoire du taux de change. Partant d'une approche éclectique, ce papier propose une analyse empirique montrant que les termes de l'échange et les comportements d'épargne/investissement ont apparemment sous-tendu l'évolution du taux de change à moyen et plus long terme. Même si des estimations de ce type doivent être interprétées avec précaution, elles confortent le sentiment que vers la fin de l'année 2000 l'euro était significativement sous-évalué.

Classification JEL: E42, E44, E52, E58, E65, F31, F32, F47.
Mots-clés: Euro, taux de change, surajustement, Eurosystème, BCE, interventions, flux de capitaux.

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The euro puzzle

1. On the eve of its launch in January 1999, most analysts and market participants expected the euro to appreciate. A common fear was that an overly strong euro would exacerbate the slowdown in activity then experienced by the euro area economy. In the event, the currency weakened almost uninterruptedly in 1999 and until late 2000, boosting exports and helping make 2000 the best year for euro area growth in a decade (OECD, 2001). While depreciation was welcomed for a time as a desirable cyclical adjustment, its persistence in 2000 sparked concerns about the implications for inflation. It was also increasingly felt that the exchange rate had lost touch with fundamentals, to the point that in the Autumn of 2000, central bank intervention took place to support the euro.

2. This paper asks to what extent there was indeed "overshooting". It first recalls the evolution of the actual and the expected exchange rate, documenting persistent "disappointment". The path of interest rates is also briefly sketched out. Against this background, the effectiveness of the central bank interventions on the foreign exchange market in September and November 2000 is assessed. The paper then reviews the various explanations of euro weakness that have been put forward, finding that none of them is fully convincing on its own. Some of the econometric studies that jointly take into account several potentially relevant factors track the euro's behaviour better, although most of them suggest that in 2000 the euro was undervalued nonetheless. The eclectic empirical analysis conducted in this paper tends to confirm this finding.

Expected and actual exchange rate developments

3. The euro's weakness in 1999 was generally unexpected, although it was rationalised *ex post* by a number of observers who argued that the new currency may have started from a relatively high level. Its further depreciation in 2000 *vis-à-vis* the euro area's main trading partners came as even more of a surprise (Figure 1).[2] The average forecast among a selection of forecasters at the end of 1999 was for a significant

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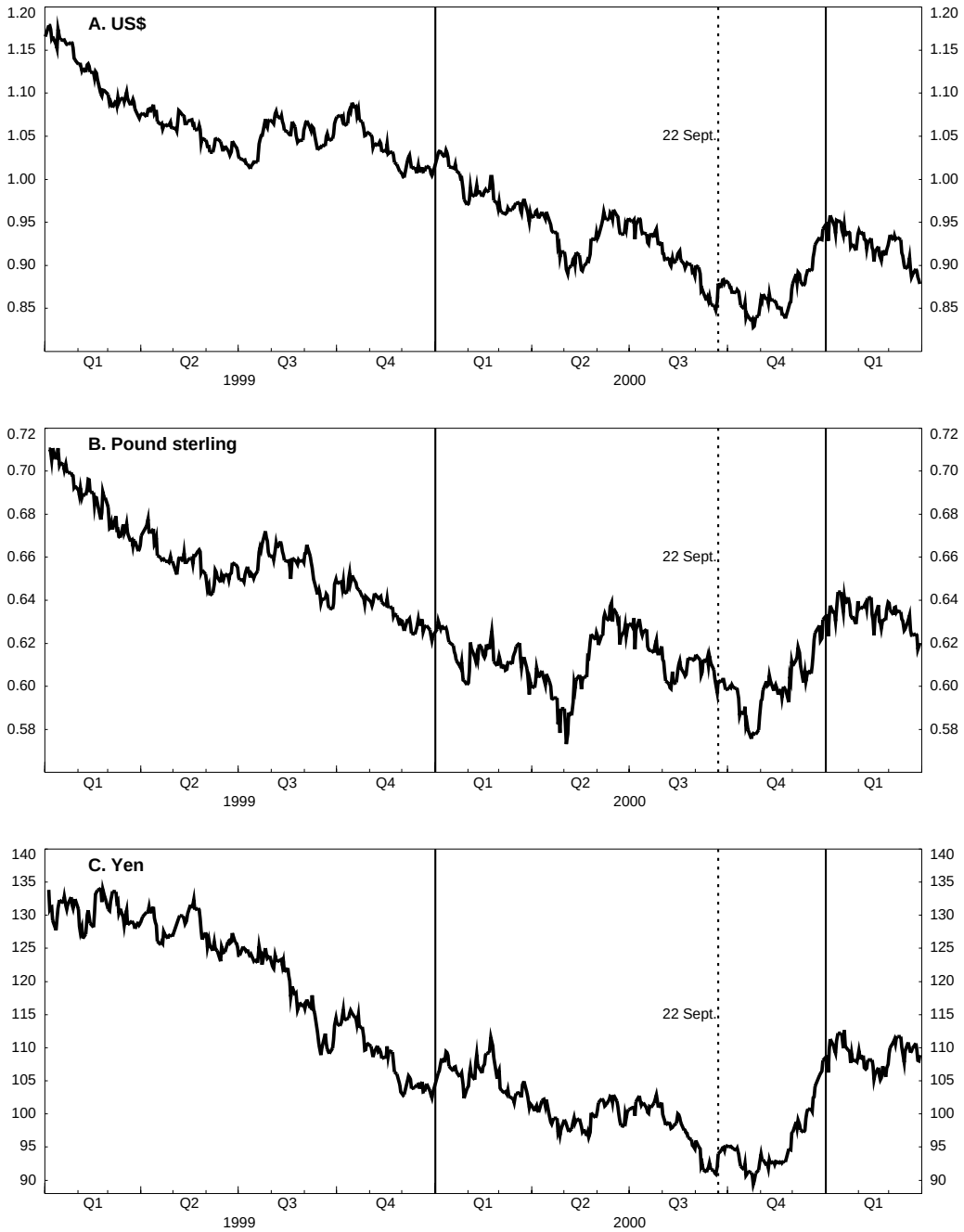
1. An earlier version of this paper served as background for the first OECD *Economic Survey* of the euro area, published in April 2001 under the authority of the Economic and Development Review Committee of the OECD. Vincent Koen is Head of and Laurence Boone Economist on the European Union/United Kingdom Desk in the Economics Department, where Alain de Serres was Economist at the time of writing. Nicola Fuchs is a graduate student at Yale University and was an intern on the Desk in the Summer of 2000. The authors are grateful, among others, to Andrew Dean, Romain Duval, Jorgen Elmeskov, Peter Hoeller, Peter Jarrett, Mike Kennedy, Val Koromzay, Ronald MacDonald, Werner Roeger, Bernd Schnatz, Frank Smets, Niels Thygesen, Angel Ubide, Ignazio Visco and Andreas Woergoetter for helpful exchanges and comments, but the usual disclaimers apply. Special thanks go to Christine de la Maisonneuve for technical support and to Valérie Luccioni-Lassaut for secretarial assistance. As a rule, the cut-off date for the information taken into account in this paper is end-March 2001.

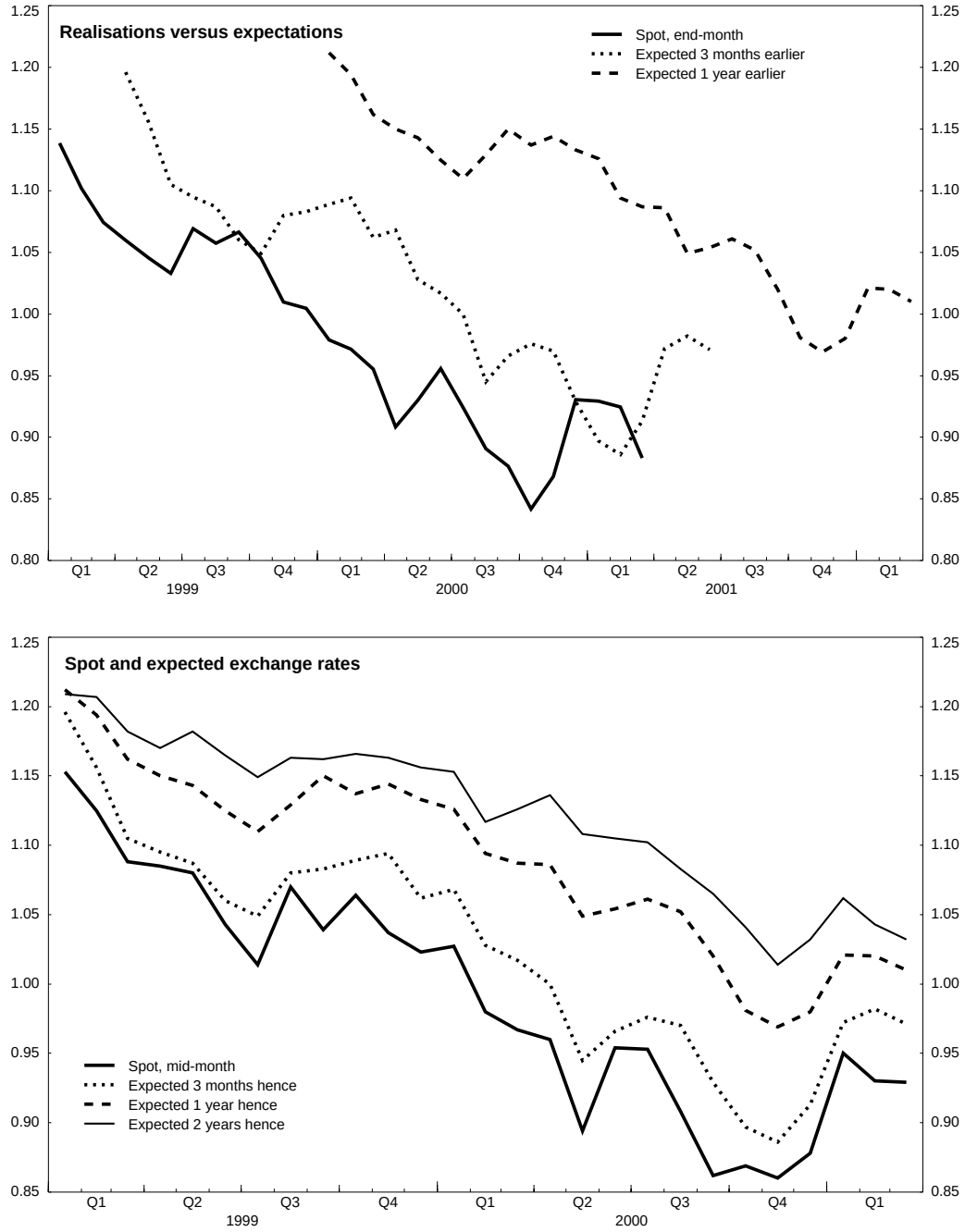
2. In 1999, the United Kingdom, the United States and Japan accounted for 17.1, 15.3 and 5.4 per cent of the euro area's foreign trade, respectively (average of imports and exports of goods).

Figure 1. Main bilateral exchange rates
Nominal bilateral rates per euro



Source: OECD.

Figure 2. The delayed rebound
$ / euro



Source: Consensus Economics and European Central Bank.

appreciation *vis-à-vis* the US dollar, of 4 per cent at a three-month horizon, 11 per cent 12 months hence, and 13 per cent by end-2001 (according to Consensus Economics data). Throughout 2000, the expectation of a rebound persisted, even though it consistently turned out to be overly bullish (Figure 2). In the event, the bilateral dollar exchange rate of the euro ended the year at $/€ 0.93, *i.e.* some 7 per cent below its

end-1999 level, and some 21 per cent below its inaugural level two years earlier, albeit 13 per cent above its end-October 2000 trough (based on the ECB's reference rates). Depreciation *vis-à-vis* the yen was also very pronounced in 1999-2000, amounting to a cumulative 19 per cent despite the 20 per cent recovery of the euro against the yen in the last two months of 2000. Over the same period, the euro lost 12 per cent *vis-à-vis* the British pound, notwithstanding an 8 per cent gain in November-December 2000. During the first quarter of 2001, the euro depreciated by around 5 per cent *vis-à-vis* the dollar but without much of a shift *vis-à-vis* the yen and the pound.

4. At a daily frequency, the volatility of the $/€ rate tended to increase during the first two years of the euro, in spot (Figure 3) as well as in expected terms (Figure 4, top panel), and was fairly high in 2000 in comparison with the $/ecu rate before the launch of the euro. Both on *ex post* and on *ex ante* measures, exchange-rate uncertainty was thus relatively acute.

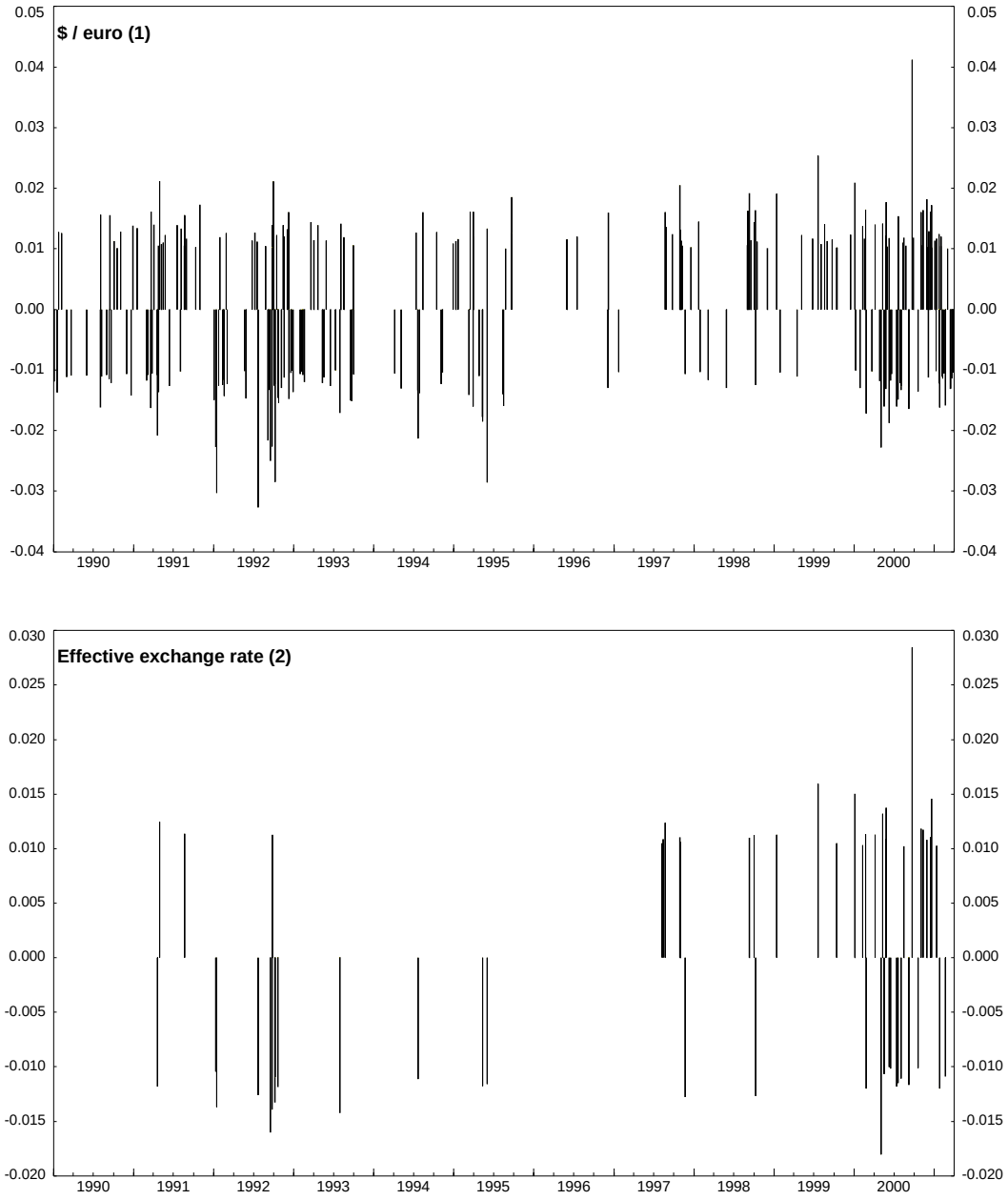
5. In multilateral and nominal terms, the euro depreciated less than *vis-à-vis* the dollar alone, but the decline of the currency during the first two years nonetheless amounted to between 13 and 17 per cent, depending on the set of comparator countries (it being less pronounced *vis-à-vis* a broader set of trading partners). Given low cost and price inflation in the euro area, this translated into an even more substantial depreciation of the real effective exchange rate (Figure 5). Based on consumer prices, the latter depreciated by around 16 per cent. The magnitude of the depreciation was only slightly less based on producer prices or unit labour costs. Hence, even compared with the sizeable real effective exchange rate swings witnessed in the past, this one was large. As a result, the euro area's cost competitiveness was more favourable in late 2000 than at any time in the 1990s.

6. Although euro area Members obviously share the same bilateral exchange rates *vis-à-vis* all the other countries, the importance of the exchange rate channel varies a lot. Indeed, taking into account the geographical composition of foreign trade, the evolution of the effective exchange rates was far from uniform: the depreciation in Belgium for instance was far less pronounced than in Ireland, because Belgium trades much more with other euro area countries, whereas Ireland trades a lot with the United Kingdom and the United States (Figure 6). Since in addition cyclical conditions are far from homogeneous, this implies that policymakers in different countries may have different views on how welcome or unwelcome the trajectory of the euro on the foreign exchange rate market is. In the case illustrated in Figure 6, the boost associated with exchange rate depreciation was more of a problem for Ireland than for Belgium because it was larger and because Ireland was ahead in the cycle. Estimates of the euro's "equilibrium" effective exchange rate such as those discussed below therefore clearly do not carry over to the euro area country level.

Policy and market interest rates

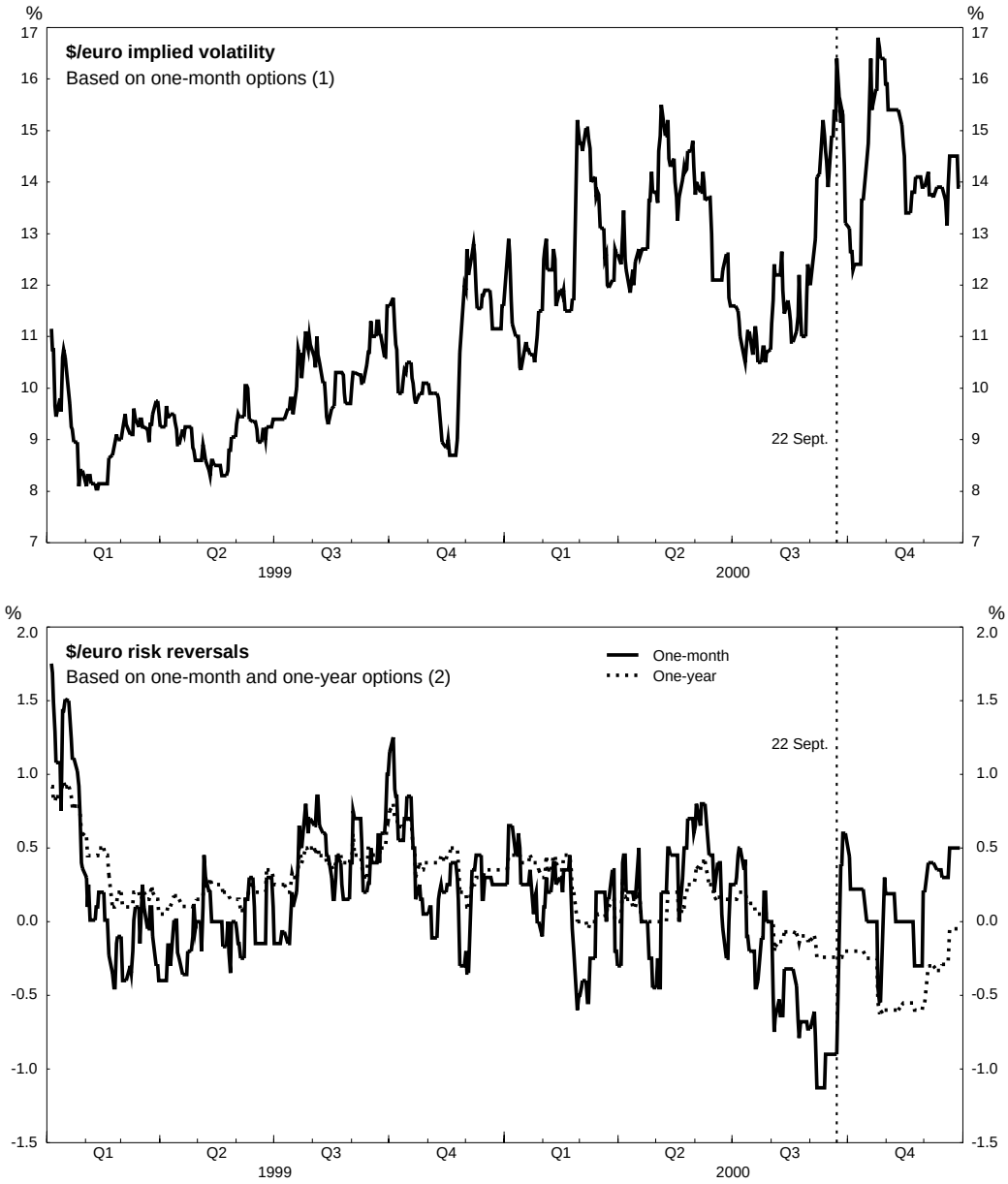
7. Since the Eurosystem has no exchange rate target, policy interest rates have not been set as a function of the euro's movements on the foreign exchange market but with a view to meeting the primary objective of maintaining internal price stability, defined as keeping euro area-wide headline HICP inflation below 2 per cent over the medium term. Insofar as exchange rate swings influence inflation, however, the decisions on the policy interest rate may have been influenced by them. To what extent internal price stability has been successfully achieved thus far is discussed elsewhere (OECD, 2001). But it is important to recall how interest rates evolved during the euro's first two years, given their importance for exchange rate behaviour.

Figure 3. High-frequency exchange rate volatility
(daily changes exceeding 1 percentage point)



1. Prior to 1999, ecu.
2. For a narrow group of trading partners.
Source: European Central Bank.

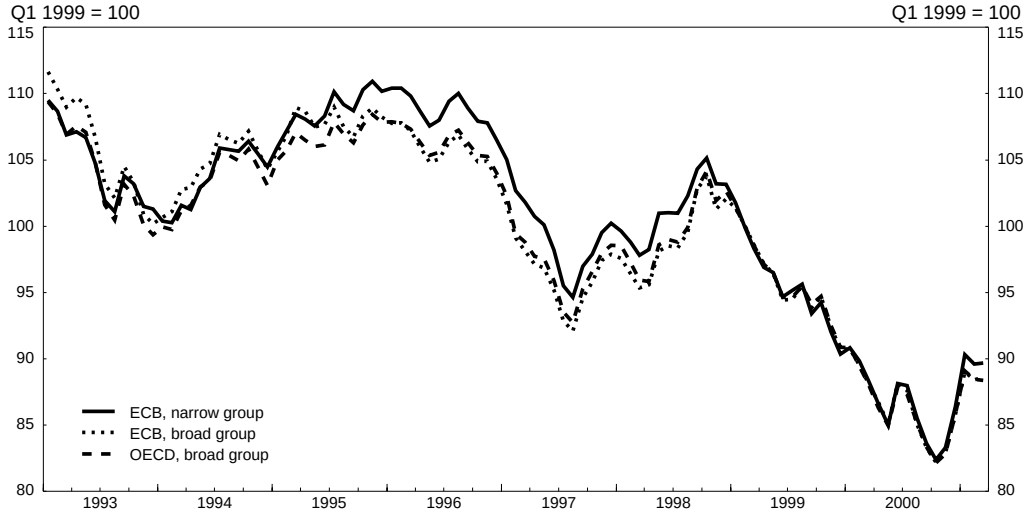
Figure 4. Exchange rate expectations



1. Annualised volatilities derived from at-the-money (ATM) option prices. ATM implied volatility typically understates expected volatility insofar as the market tends to price volatility of in-the-money and out-of-the-money options higher (an empirical regularity dubbed the "volatility smile").
2. Risk reversals measure the skewness of the distribution of expectations compared with a lognormal distribution. They correspond to the difference between the price of a call and a put that are equally distant (here 25 delta on each side) from an ATM option. A positive value means that the call option, which gives the right to purchase euros at a pre-specified exchange rate, is more expensive than the put option, which gives the corresponding selling right. In general, the larger the difference, the higher the perceived probability of a euro appreciation.

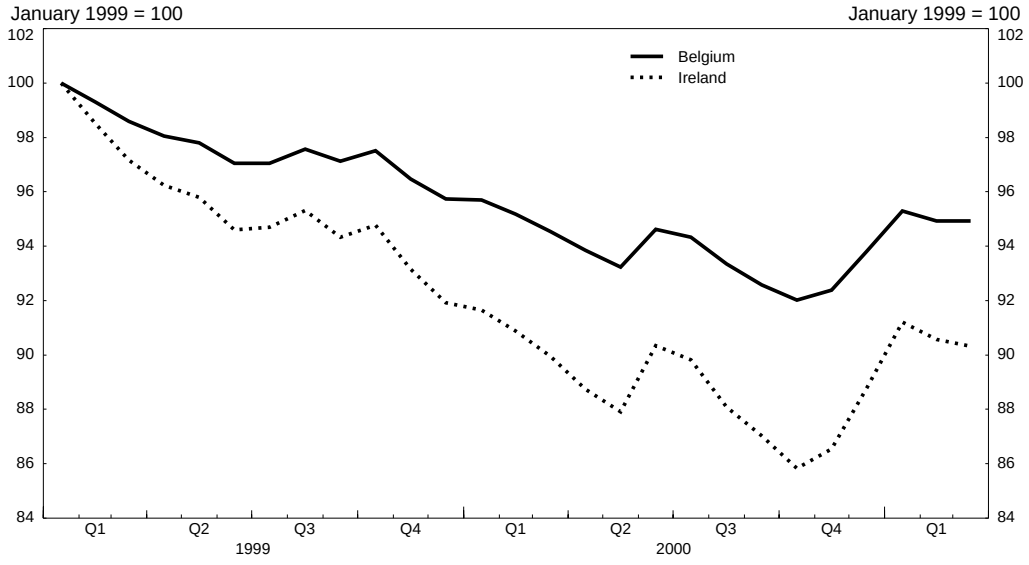
Source: Lehman Brothers, J.P.Morgan.

Figure 5. Alternative real effective exchange rate measures (1)



1. Deflated by the CPI.
Source: European Central Bank and OECD.

Figure 6. Identical bilateral but different multilateral exchange rates
Nominal effective exchange rates vis-à-vis 41 trading partners



Source: OECD.

8. At the short end of the term structure, the ECB's main refinancing rate was cut from 3 per cent to the historically low level of 2½ per cent in April 1999, at a time when annual headline inflation as captured by the harmonised index of consumer prices (HICP) was running at barely 1 per cent and the risk of deflation loomed large in some observers' minds (Figure 7). This move was reversed in November 1999, as the balance of risks had shifted. With growth and inflation picking up and the euro weakening, the monetary authorities raised policy rates by another 175 basis points between February and October 2000. The three-month euribor followed a broadly similar albeit generally slightly more elevated path. In real terms, using contemporaneous HICP inflation as a deflator, short-term market interest rates thus fluctuated between 1½ and 2½ per cent during the euro's first two years.

9. Nominal long-term interest rates as measured by 10-year benchmark government bonds rose in the course of 1999 from below 4 per cent to around 5½ per cent. During the euro's second year, they edged back down to close to 5 per cent. In real terms, long rates declined from a relatively high 4 per cent in the Autumn of 1999 to around 2½ per cent towards the end of 2000. The spread between real long-term interest rates in the euro area and in the United States widened somewhat during the euro's first two years, to around ¾ of a percentage point on average during the second half of 2000.

Did intervention help?

10. The euro's seemingly inexorable slide prompted central bank intervention in late September and again in early November 2000. In general, the merits of central bank intervention in the foreign exchange market are controversial. Proponents of intervention among other things emphasised that its effectiveness would be enhanced by the fact that, at well over €250 billion, the reserves of the Eurosystem are among the highest in the world, just under Japan's and dwarfing the amount held in the United States. During the first 20 months following the euro's launch, however, no official intervention was undertaken.[3] Instead, there were attempts to "talk up" the currency, with senior ECB, national central bank (NCB), Commission and national government officials declaring on numerous instances that it was undervalued in view of the fundamentals, including internal price stability, and warning that intervention might be used at some point. On 5 May 2000, the President of the ECB issued a statement to reassure euro area citizens that the ECB monitored the exchange rate very closely, contrary to what may have been perceived earlier on by some as "neglect", benign or otherwise. On 8 May and again on 8 September 2000, the ministers of finance of the euro area[4] published *communiqués* stressing that the euro's exchange rate did not reflect the underlying strength of the economy and governments' resolve to address remaining structural problems. However, such pronouncements were occasionally undermined by statements, including on the part of prominent policy-makers, suggesting that a weak euro was more a solution (to boost activity) than a problem (on the inflation front).

11. On 14 September 2000, the ECB announced that the interest income accrued since the start of 1999 on its foreign reserve assets (an amount on the order of €2.5 billion) would be sold against euros over a period of several days, and that henceforth, such income would normally be sold on a regular basis. This move was briefly perceived by some as a trial intervention. While admitting that its timing was not accidental, the ECB denied that it should be seen as such. The move did not arrest the euro's ongoing depreciation *vis-à-vis* the US$ for more than a few hours.

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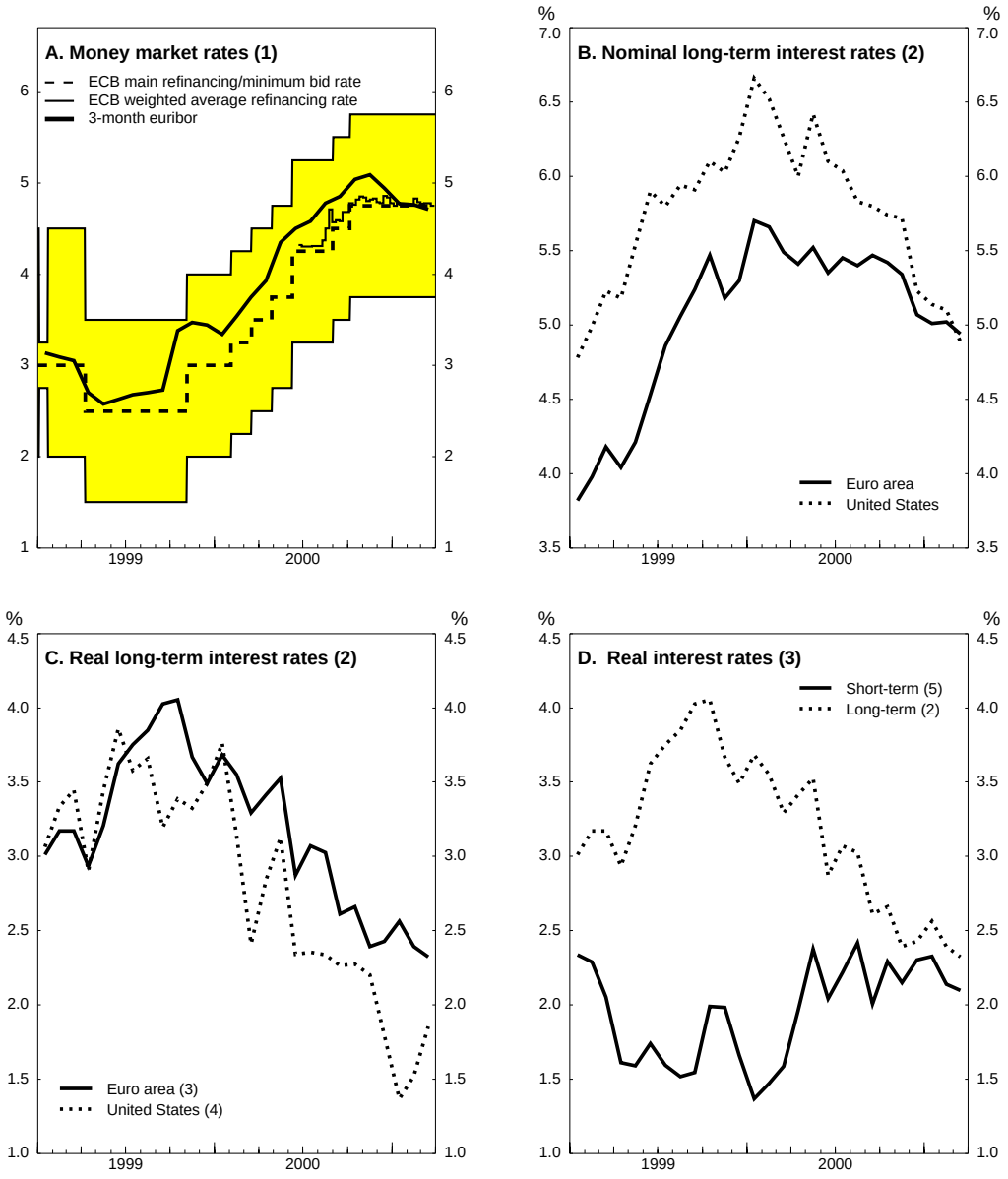
3. In mid-June 1999, the Eurosystem entered the market to sell yen against euros, but this was on behalf of the Bank of Japan, in the context of the activation of an agency agreement at the latter's request.

4. This formation was called the Euro-X or Euro-11 until mid-2000, and is since known as the Eurogroup. For details, see Box 8 in OECD (2001).

Figure 7. Interest rates
EU-11



1. The boundaries of the shaded "corridor" correspond to the ECB's standing lending and deposit facility rates.
2. 10-year government bond rates.
3. Deflated by HICP inflation over the last 12 months.
4. Deflated by CPI inflation over the last 12 months.
5. 3-month Euribor.
Source: European Central Bank.

12. On 22 September 2000, and following up on the *communiqué* issued by the Eurogroup in Versailles on 8 September, the ECB announced a joint G-7 intervention in the foreign exchange markets on account of their "shared concern about the potential implications of recent movements in the euro exchange rate for the world economy". This was the first transatlantic co-ordinated intervention since 1995. The timing (before the Prague G-7 meeting rather than after) and the participation of the United States (during the run-up to presidential elections) surprised most market participants. At the ECB's initiative, the monetary authorities of the United States, Japan, Canada and the United Kingdom joined to buy euros. The amounts purchased were not immediately known to market participants, whose early guesses ranged widely, reportedly from €2 billion to €12 billion. In the event, it turned out that a total of around €6 billion was probably bought. In the case of the ECB, intervention data are not published, but the consolidated weekly financial statements of the Eurosystem suggest that it may have contributed about half of the total. More precisely, the G-7 partners contributed to the tune of €1.5 billion for the United States, ¥143.5 billion for Japan, US$97 million for Canada and €85 million for the United Kingdom. Within a few hours, the bilateral rate *vis-à-vis* the US dollar jumped from 85 to 90 US cents (Figure 8).[5] It then settled around 88 US cents for about a week, without reacting significantly to the decision of Danish voters, on 28 September, not to adopt the euro. On the derivatives markets, euro call options became more expensive than the corresponding euro put options, denoting greater confidence that the euro would appreciate (Figure 4, lower panel). Soon, however, depreciation resumed and by mid-October the euro had dropped below its previous lows.[6]

13. A subsequent round of unilateral interventions by the Eurosystem was undertaken in early November, spread over three trading days (3, 6 and 9 November), with all euro area NCBs stepping in. The cumulative amount of euro purchases was apparently somewhat but not much larger than what the Eurosystem had bought on 22 September. Again, the ECB publicly confirmed the intervention. The euro reacted less markedly this time (Figure 8). It depreciated anew until late November, albeit without reaching the October trough, and subsequently started to appreciate.

14. These episodes raise questions regarding the effectiveness of such operations. The literature on this subject is fairly inconclusive, not least because information on intervention occurrence, timing and size is often incomplete (Sarno and Taylor, 2001). Mundell (2000), for instance, argued that intervention has more chances of being successful if it is carried out jointly rather than unilaterally, if it takes place both in the spot and in the forward markets, and if it is not sterilised. Others found that even sterilised intervention can be effective, at least in the short run and on a small scale, because it influences the expectations of market participants regarding future economic developments and policies, including interest rate changes, and can act as a signal to stem bandwagon effects and anchor exchange rate expectations along a different path (Ramaswamy and Samiei, 2000).[7] The likelihood of success also seems to be higher if intervention is relatively infrequent (Fatum, 2000). Relatedly, it is often argued that intervention is more effective if the markets are taken by surprise, and if it leans with rather than against the wind. Furthermore, official commentary accompanying intervention should obviously be consistent with the intended signals.

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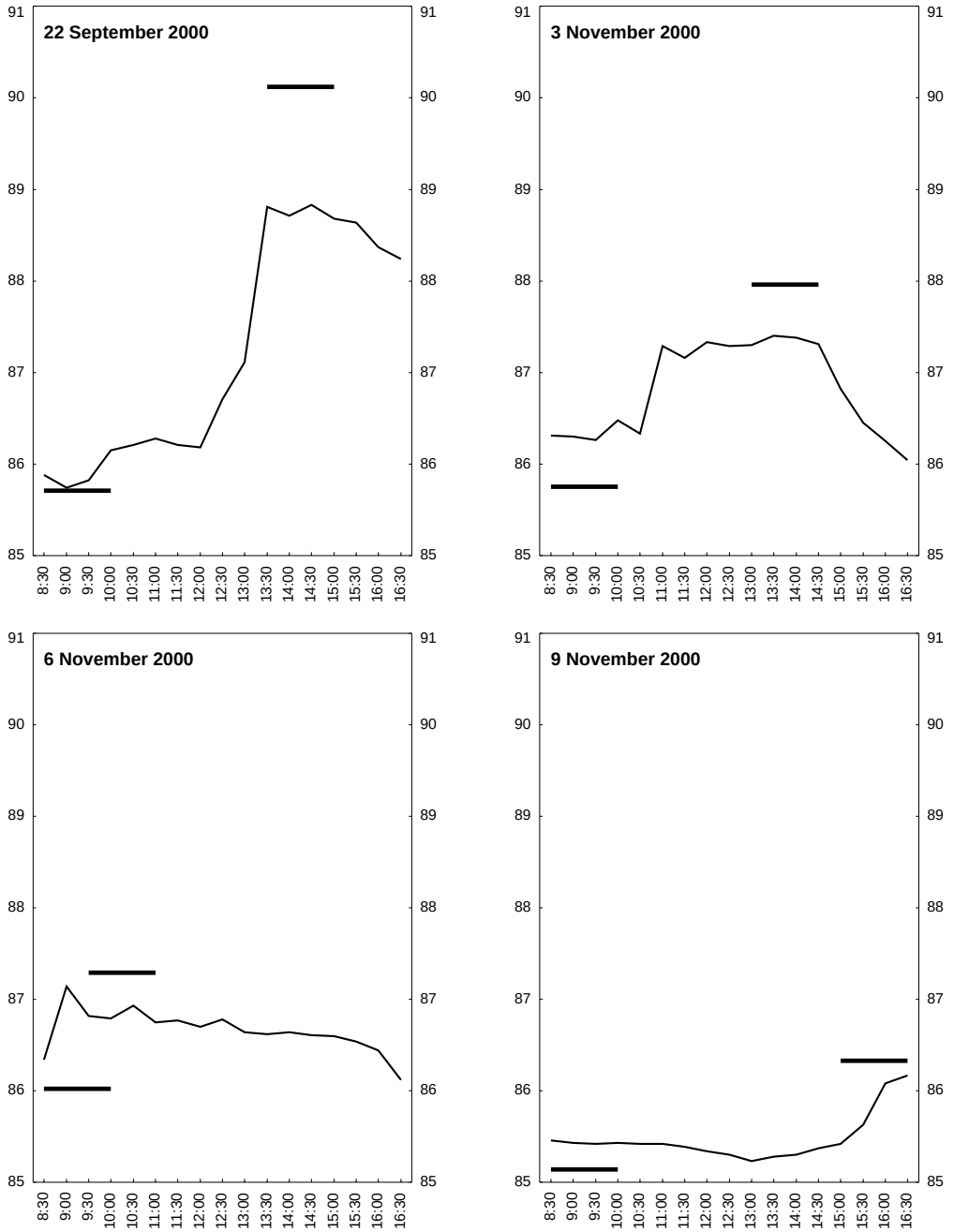
5. The line in Figure 8 is based on discrete half-hourly observations and therefore fails to show that the euro actually peaked at slightly over 90 US cents in the course of the trading day.

6. Among the factors that drove down the euro was the market's interpretation of an interview given by President Duisenberg with a British newspaper in which he seemed not to favour further co-ordinated intervention in the hypothetical event of an intensifying political crisis in the Middle East.

7. Drawing on a somewhat different approach focusing on order flows and portfolio effects at the micro level, Lyons and Portes (2000) argued that selling about half of what they consider as the Eurosystem's €75 billion or more excess foreign exchange reserves would allow the euro to climb back to around parity with the US dollar, even if intervention were to be sterilised.

Figure 8. Intra-day $/euro rate on intervention days
US cents per euro, half-hourly observations (1)



1. Bars denote intra-day minimum and maximum.
Source: Bundesbank, Exchange Rate Statistics Supplement to the Monthly Bulletin.

15. Not all of these conditions were met in September and November 2000. The participation of the United States was secured in September but granted only reluctantly and perceived as a one-off event.[8] Intervention was of the sterilised kind. Also, market reports in the wake of the September intervention suggested that the Bank of England sold the bulk of the euros it bought later the same day, at a profit, which may not have reinforced the intended signal. The September intervention was followed by a 25 basis point interest rate hike in early October, but interest rates remained unchanged in the wake of the November interventions.

16. Assessing the effectiveness of these interventions is difficult, even with the benefit of (limited) hindsight, as the counterfactual is bound to remain controversial. It can nonetheless be argued that they succeeded in instilling some uncertainty in market participants' minds. They also showed that the Eurosystem can intervene either multilaterally or bilaterally and without having to wait for specific governmental instructions (which distinguishes the euro area set-up from those in the United States and Japan). Market reports in subsequent weeks indeed conveyed the sense that the Eurosystem could step in unannounced, thus effectively counteracting the prior feeling that the euro was a one-way bet.[9] A broader assessment of intervention effectiveness, however, ought to take into account the operations conducted in 1999 and earlier in 2000 by the Japanese government, which intervened, on occasion in large amounts, to try and bring the yen down. As well, it should factor in other developments which may also have influenced the exchange rate such as, for instance, the news, in late October 2000, that Iraq would bill its oil exports in euros and might even convert part of the proceeds from previous oil sales deposited in an escrow account held in New York into euros.

Casual explanations aplenty

17. The euro's slide in 2000 was viewed with increasing concern by euro area policy-makers. Most analysts shared the view that the exchange rate was clearly "overshooting" and that there was a growing margin for appreciation. They came up with a variety of explanations for the euro's anaemia, which were obviously linked to what they perceived as the euro's short, medium or long-run "equilibrium" level. On this score, observers are far from unanimous, and the Eurosystem is rather reserved, refraining from putting forward any quantitative estimate of what would be an appropriate level.

18. A number of stories have been told since early 1999, but none in isolation is fully convincing. One of the most popular interpretations was put forward by Corsetti and Pesenti (1999) and presented in *EMU One Year On* (OECD, 2000) as well as by Coppel *et al.* (2000). It relates the evolution of the bilateral exchange rate of the euro *vis-à-vis* the dollar and other major trading partner currencies to that of the expected growth differential between the corresponding economies (which over the period under consideration differed significantly from the gap observed *ex post*). The correlation is indeed quite striking over certain sub-periods, although it weakened dramatically in late 2000 and early 2001 *vis-à-vis* the dollar

8. Following both the September and the November interventions, the US Secretary of the Treasury reaffirmed that the longstanding strong dollar policy of the United States remained unchanged. The minutes of the Federal Open Market Committee meeting held on 3 October 2000 indicated that "the action was not intended to signal an increased willingness by the Committee to intervene in foreign exchange markets. In the current instance, the intervention transactions were undertaken in a spirit of co-operation with the international financial community and at the express request of the ECB. Members commented that historical experience suggested that foreign exchange market interventions generally had not had lasting effects when not accompanied by supporting changes in macroeconomic policies".

9. In early September, Chase Securities (2000) for instance wrote: "Now that the euro has broken through the old lows, we anticipate an adjustment in investor positions that could take the currency sharply lower — to 80 cents or weaker. (…) We do not anticipate co-ordinated intervention to slow the euro's decline".

(Figure 9).[10] Interestingly, it is on the whole tighter *vis-à-vis* the United Kingdom and especially Japan than *vis-à-vis* the United States, although the interpretation of these correlations may be less straightforward, given that to some extent the £/€ and ¥/€ rates are implied cross-rates reflecting the evolution of the three currencies *vis-à-vis* the dollar. Somewhat surprisingly, as regards the bilateral exchange rate of the euro *vis-à-vis* the dollar, the correlation is much tighter when the latter is compared with the consensus forecast for growth in the United States alone (Figure 9, panel B), as if markets focussed exclusively on cyclical conditions there and not on the growth differential. One explanation for this asymmetry might be that the longer lags for the publication of euro area statistics may cause good news to make a bigger impact when it concerns US performance than when it pertains to the euro area.[11]

19. Partly related to cyclical divergences are interest rate differentials. Focusing on the transatlantic relationship, it appears that in the course of 1999, the exchange rate and the spread between euro area and US short-term interest rates moved in tandem (Figure 10). Through the summer of 1999 at least, it may also have appeared that long-term interest rate differentials were driving the exchange rate. But in 2000 the correlation between interest rates — be it at the short or at the long end of the spectrum — and the exchange rate, unravelled.[12] This may partly reflect a countervailing impact of interest rates on exchange rates via growth expectations.

20. Another set of explanations has concentrated on equity markets. It has been argued that higher rates of return in the United States drew investment out of the euro area in net terms (Table 1), contributing to weaken the euro (IMF, 2000*a*). While it is possible to find periods, such as the first half of 1999, when the relative performance of the US and European stock markets paralleled the evolution of the exchange rate, this does not hold throughout. In fact, since the launch of the euro, European stock markets distinctly outperformed US stock markets in own-currency terms (Figure 10). A better test would be to compare expected returns with exchange rate developments, but the former are difficult to capture. The bivariate relationship between stock prices and exchange rates is in any event hard to interpret since both react to interest rate movements. Moreover, stock market returns — while monitored in real time — are arguably not a proper proxy for returns on investment.[13]

21. A rationale provided by some for the large net capital outflows from the euro area pertains to "eurosclerosis". However, invoking this factor to rationalise short-run exchange rate developments is odd. Market rigidities and high tax levels have been more prominent in Europe than in the United States for a long time, and there is little evidence that they have become relatively worse as of late. If anything, and notwithstanding some occasional causes for disappointment, structural news since the launch of the euro might on the whole even have worked in the opposite direction, and has presumably not been worse than

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10. In contrast with earlier studies, Figure 9 is drawn using a moving horizon.

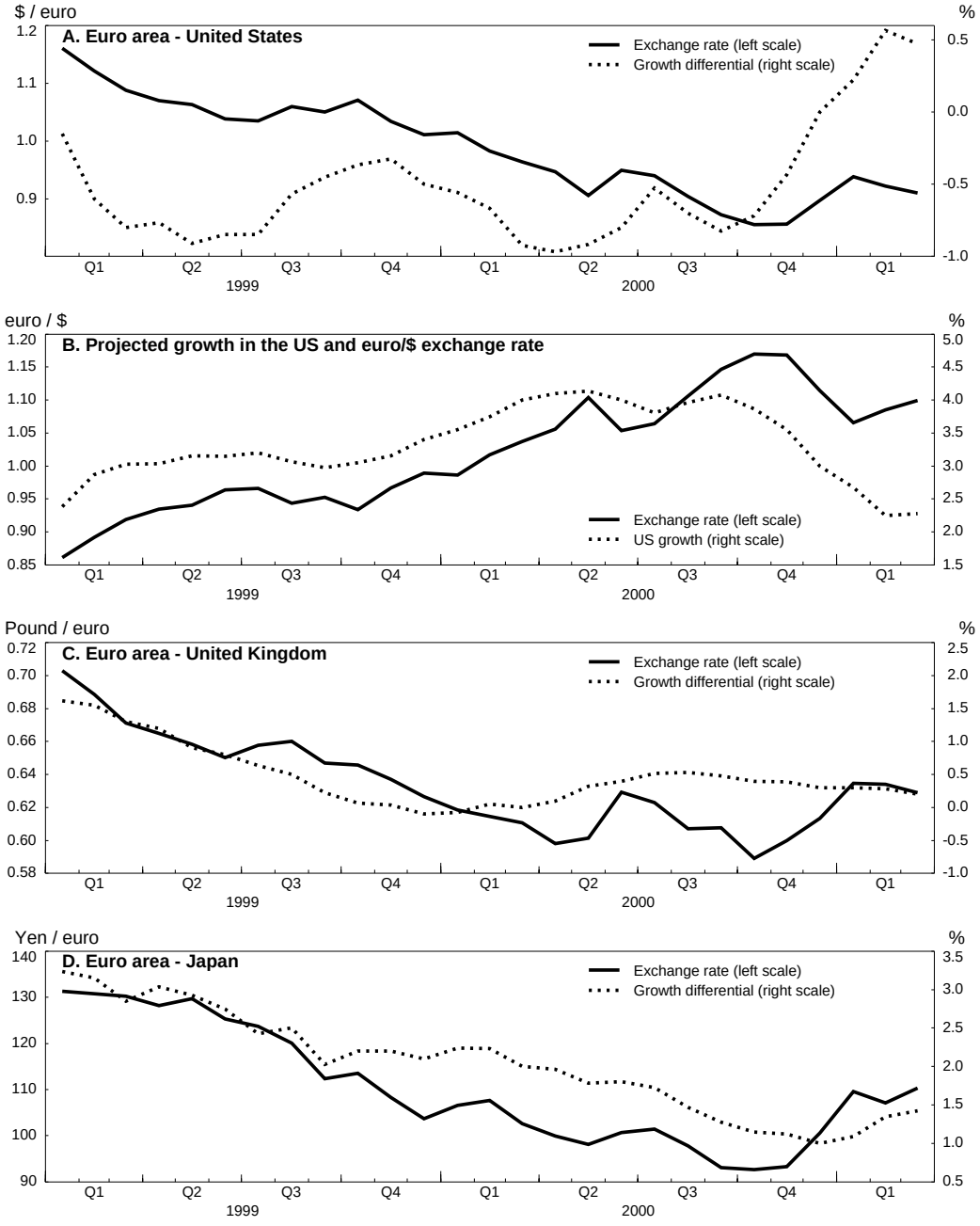
11. Efforts are underway at Eurostat to produce more timely statistics, including a set of preliminary quarterly GDP estimates to be published within one and a half month or so after the end of the quarter. Besides quarterly national accounts, priority areas for improvement encompass quarterly public finance statistics, labour market statistics, conjunctural statistics and statistics on trade outside the euro area. To a large extent, however, the onus is on some of the national authorities to speed up the production of data. At the same time, the European Commission is developing various new indicators to better monitor the euro area conjuncture, including a turning point indicator, a monthly GDP forecast and a service sector indicator.

12. It may also be noted that uncovered interest rate parity failed to hold in 1999-2000 (as it did elsewhere too, *e.g.* in the United Kingdom).

13 . Breedon and Fornasari (2000) applied an event study methodology to large cross-border M&A deals effected in 1997-99 and found that such deals tend to push up the currency of the country of the targeted company.

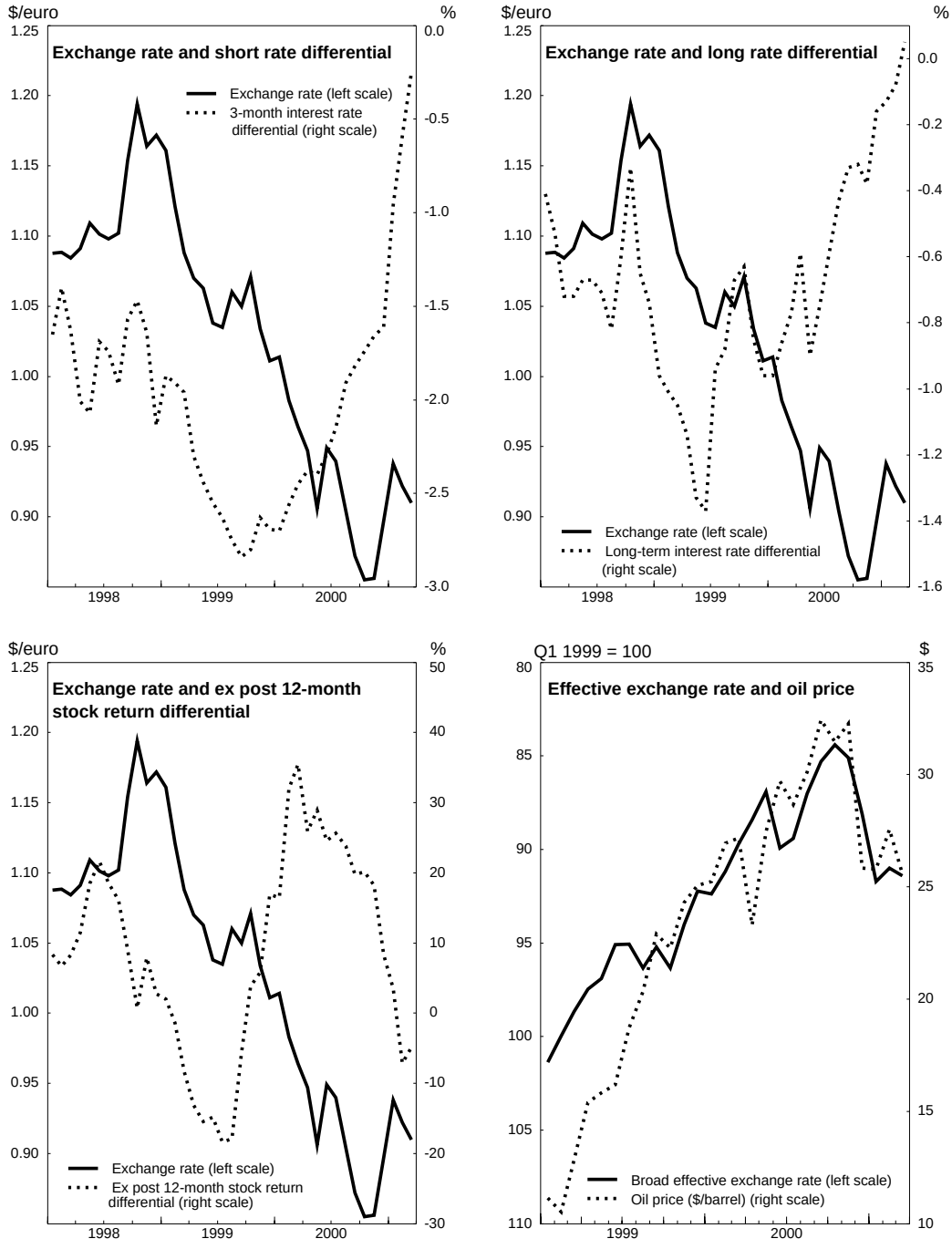
expected *ex ante*. Furthermore, it ought to be borne in mind that the sharp increase in FDI outflows from the euro area countries in the late 1990s was accompanied by an equally spectacular rise in FDI inflows,

Figure 9. Cyclical conditions and exchange rates
Average monthly exchange rates and consensus GDP growth forecast (1)



1. Difference between the euro area and the comparator for panels A, C and D. For month i, the weight on the forecast for the current year is (12-i)/12 and the weight on the forecast for the following year is i/12.
Source: Consensus Economics and OECD.

Figure 10. Selected correlations



Source: European Central Bank.

Table 1. **Euro area balance of payments**

EU11, in billions of euros[1]

	1997	1998	1999	2000
Current account	**61.5**	**31.1**	**-5.8**	**-34.4**
Goods	115.7	109.3	83.4	53.0
Exports	749.1	779.2	814.5	978.1
Imports	633.4	669.9	731.1	925.1
Services	3.1	-2.0	-11.8	-15.9
Exports	214.2	229.8	241.5	269.4
Imports	211.0	231.9	253.3	285.4
Net investment income	-15.2	-28.8	-32.4	-19.7
Current transfers	-42.2	-47.4	-45.0	-51.8
Capital account	**13.0**	**12.4**	**13.5**	**10.2**
Financial account[2]	**..**	**-61.2**	**19.1**	**1.3**
Direct investment	-44.5	-83.2	-120.6	-21.5
Abroad	-93.1	-175.0	-286.8	-335.8
In the euro area	48.6	91.8	166.2	314.3
Portfolio investment[3]	-24.3	-99.7	-41.7	-136.4
Assets	..	-327.6	-309.6	-403.9
Liabilities	..	227.9	267.8	267.5
Financial derivatives[3]	..	-7.5	8.1	-2.0
Other investment[3]	..	120.9	163.1	143.5
Reserve assets[3]	..	8.2	10.2	17.5
Errors and omissions[3]	..	**17.8**	**-26.8**	**22.9**
Memorandum item:				
Current account balance in per cent of GDP	1.1	0.5	-0.1	-0.5

1. Ecu billions through end-1998.
2. Inflows (+), outflows (-). Reserve assets: increase (-); decrease (+).
3. 1999-2000 data are not strictly comparable to 1997-98 data.

Source : European Central Bank, OECD Secretariat.

and that in 2000 FDI inflows almost matched FDI outflows (although the sharp FDI inflow increase in 2000 largely reflected one very large transaction related to the Vodaphone-Mannesmann take-over). Gross outflows may thus be driven less by disaffection for the euro area than by the efforts of European companies to expand on a global scale, which in sectors at the forefront of M&A activity such as telecommunications and finance were facilitated by relatively high European price-earnings ratios (Garnier, 2001). On the other hand, it should be acknowledged that the surprisingly vigorous performance of the US economy prompted many to raise their estimates of US potential growth in the course of 1999-2000, while such revisions have been more scattered and timid as regards the euro area. This may have led to a weaker perceived euro equilibrium exchange rate.

22. An alternative capital flow story pertains to the issuance of euro-denominated bonds, which took off very vigorously in 1999, especially on the part of corporations. On this story, portfolio diversification into the euro would have been initiated more on the liability than on the asset side, thereby softening the

euro. The share of euro denominated bond issues world-wide rose from 35 per cent in 1998 (for the legacy currencies) to 45 per cent in 1999, although it fell back in 2000 to 39 per cent (according to preliminary figures from Capital Data). However, an overwhelming share of the euro-denominated issues stemmed from the euro area itself and a significant portion thereof substitutes for traditional bank lending, with no exchange rate implications. Easier bond finance for European companies may nonetheless have facilitated the aforementioned acquisitions of firms overseas, *i.e.* outflows of capital (but some acquisitions were partly financed with shares or by borrowing dollars, not by selling euros).

23. In sum, none of the various types of capital flows on its own seems to consistently drive exchange rate developments. However, lumping together net FDI and portfolio flows, a very tight correlation emerges between cumulative net long-term capital outflows since January 1999 and the effective exchange rate (Figure 11). Given that the current account remained relatively close to balance over the period, a similarly striking relationship emerges between the cumulative basic balance (long-term capital flows plus current account) and the exchange rate. Changes in the pattern of international capital flows — driven *e.g.* by shifts in investors' profitability expectations or by further European financial market integration — could thus be among the forces driving the exchange rate over the medium run.

24. Less prominent in commentaries thus far but no less striking a parallel can been drawn between the evolution of the euro's effective exchange rate and the price of oil (Figure 10). The US dollar price of oil nearly tripled between January 1999 and the summer of 2000. While GDP is nowadays far less oil-intensive than in the early 1970s, large oil price swings still have first-order impacts on inflation, output and current accounts, and can therefore be expected to affect exchange rates as well. Another line of reasoning in this context is based on foreign exchange and portfolio transactions. The rising oil price led to increased €/$ conversions by euro area-based buyers, which put additional downward pressure on the euro. On the other side of the oil trade, oil producers most likely re-exchanged only relatively small portions of the dollar proceeds into euros, therefore doing little to support it. The dollar proceeds most likely were used, apart from general expenditures, for redeeming (dollar-denominated) debt, to increase foreign exchange reserves (which are held mainly in dollars), or for portfolio investments, where, according to most global asset allocation models, the share of the euro is modest, at around one third. Other factors, such as "safe haven" effects, can play a role as well.

25. More recently, another intriguing argument has surfaced, namely that both in the euro area and outside, notably in Eastern Europe, legacy currency cash holdings are being converted into US dollars, thus temporarily at least weakening the euro (Sinn, 2001). Sizeable amounts of legacy currency cash are indeed known to be circulating more or less illegally and it is plausible that part thereof is being converted into US dollars prior to the introduction of euro banknotes. But the timing and scale of these conversions are not precisely established, and this factor may be at play in 2001 more than in the first two years of the euro.

26. A completely different line of explanation revolves around the notion of communication failures. Insufficiently co-ordinated statements on the euro on the part of Eurosystem, NCB and government officials at times created some cacophony.[14] The problem was publicly recognised by some parties to the Eurosystem itself[15] as well as by the Eurogroup. In fact, euro area finance ministers agreed in 1999 to exercise restraint in their comments about the exchange rate, and now generally base their pronouncements

14. In April 2000 for instance, the French Minister of Finance expressed concern that the euro was weakening more than warranted by the fundamentals while the French Secretary of State in charge of Industry stated that the euro's level had been helpful. Another potential source of confusion were the statements made on occasion by some German Landeszentralbank presidents.

15. See for example, the December 1999 issue of the *Quarterly Bulletin* of the Nederlandsche Bank, which notes that "In the recent past, casual remarks about the euro exchange rate have been known to cause some confusion on financial markets".

on language agreed in common, in co-operation with the ECB. In any event, while dissonant official messages may add to exchange rate volatility in the very short run, they are unlikely to drive exchange rate trends over longer time spans.

27. A last set of analysts — including some European central bankers (Welteke, 2000) — consider that the euro's depreciation can simply not be fully explained by any combination of fundamentals, but in part at least reflects market participants' herd-like behaviour. To the extent that it is less risky for their reputation to fail conventionally than to succeed unconventionally, investors may be tempted to follow the herd of other investors and to focus somewhat exclusively on the same selected set of fundamentals. It has even been suggested that any given sustained movement of the exchange rate in one or the other direction would set in motion a search of fundamental variables, including unobservable ones, that will rationalise it.[16] The dollar's appreciation would then be viewed as evidence of the strength of the US economy, and the focus of market analysts would concentrate on growth, new economy tales, flexibility and FDI inflows, whereas news about the widening current account deficit and unsustainable debt accumulation would be under-weighed. The focus as regards Europe instead would be on rigidities. The beliefs so formed about the strong US performance and the weak euro area economy would then reinforce the euro's depreciation. And the latter in turn would consolidate those beliefs. The process could last for a while, as it did in the first half of the 1980s ("reaganomics" *versus* "eurosclerosis"), until the credibility of the beliefs starts to be eroded by the widening discrepancy between facts and perceptions. A small trigger could then reverse the process, as the Plaza Agreement seems to have done in 1985. In such a case, it is critical to try and ensure an orderly reversal of the previous misalignment, so as to avoid overshooting in the opposite direction.

28. That the euro is bound to appreciate over the longer run has been asserted repeatedly and consistently by the euro area's monetary authorities. Underpinning this prediction is the alleged unsustainability of the current configuration of current account balances, against the background of the large international debtor position of the United States and the correspondingly sizeable creditor position of Japan, with the euro area in between (Figure 12).[17]

Econometric analyses

29. Given the regime switch associated with the launch of the euro, it is still early days to carry out econometric exchange rate analysis. A number of studies have nonetheless attempted to do so, based on a variety of modelling approaches (Box 1). Partly depending on the latter, but also reflecting the use of rather different data sources, the set of explanatory variables deemed relevant varies quite a bit (Table 2). Across studies, the most prominent fundamentals include net foreign assets, productivity differentials and interest rate differentials. However, no single variable shows up consistently and robustly in all studies.

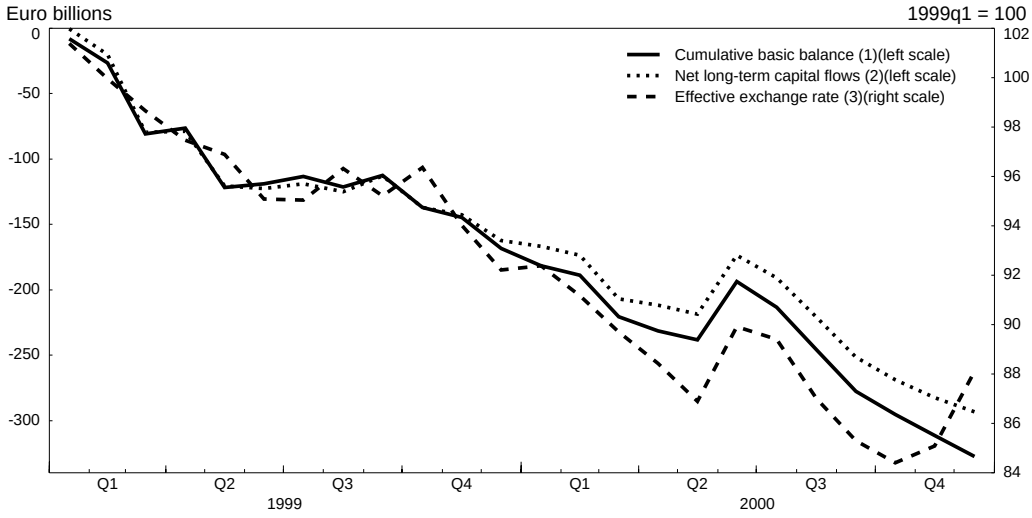
30. While the determinants differ from one study to the next, the research conducted thus far tends to corroborate the view that the euro experienced some overshooting, especially in its second year, thus implying that towards the end of 2000 there remained significant scope for appreciation. There is less of a consensus, however, on the magnitude of this misalignment, and therefore on how much appreciation can

16. See De Grauwe (2000) and, for a more theoretical analysis of how such beliefs can be formed and sustained, Kurz and Motolese (2000).

17. Obstfeld and Rogoff (2000), among others, make the case that a turnaround in the US current account, while not necessarily an immediate prospect, is inevitable over the medium run and will be accompanied by substantial dollar depreciation. The framework they use, however, may lead them to overstate the magnitude of the latter (Visco, 2000). Demographic trends, and notably the fact that Japan is ahead of Europe and Europe of the United States in the ageing process, also ought to be borne in mind when assessing current account sustainability (see Turner *et al.*, 1998).

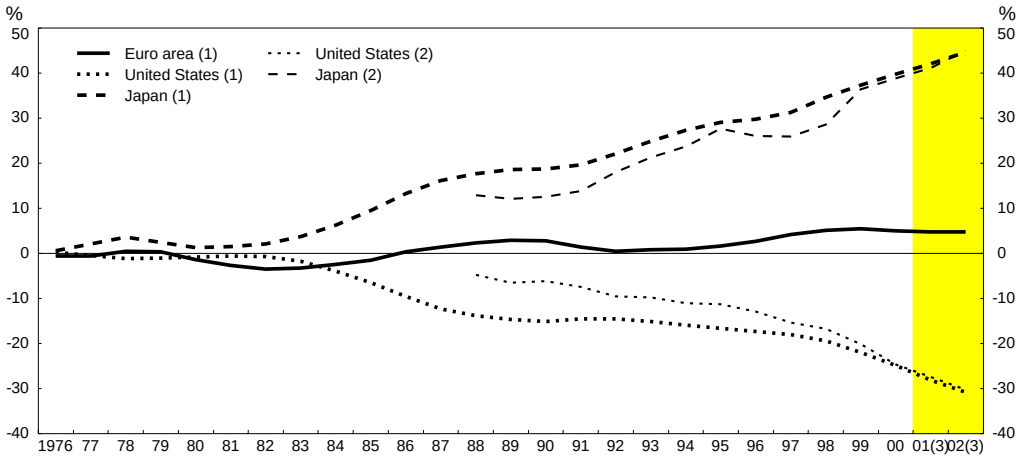
be expected or is desirable, nor over which horizon (Table 3). Also, the derived point estimates of the "equilibrium" exchange rate are highly uncertain,[18] and often cannot be directly compared across studies.

Figure 11. Exchange rate, capital flows and basic balance



1. Cumulation of current account plus net FDI plus net portfolio flows since January 1999.
2. Net cumulative FDI plus portfolio flows since January 1999.
3. Broad effective exchange rate.
Source: European Central Bank.

Figure 12. Net foreign asset positions
In per cent of GDP



1. Calculated as the cumulated current account balances, starting in 1976.
2. Actual net foreign assets.
3. OECD projections.
Source: OECD.

18. For example, Clostermann and Schnatz (2000) see the medium-run bilateral equilibrium rate at around $/€1.13, but the 95 per cent confidence interval around this estimate spans a rather wide range of $/€1.00 to 1.26.

Box 1. **Modelling the equilibrium exchange rate**

Exchange rate models based on the principle of purchasing power parity (PPP) — essentially monetary models with either flexible or sticky prices, or portfolio balance models — assume that the real exchange rate is stationary, *i.e.* that it exhibits a tendency to return to a constant mean following a perturbation. Hence, according to PPP, the nominal exchange rate adjusts to compensate for inflation differentials, keeping the equilibrium real rate constant in the long run. Yet, the PPP hypothesis has been routinely rejected empirically both in its absolute and relative form, at least on the basis of aggregate price data and over post-World War II samples. Although this might be partly due to the lack of power of statistical tests, as the recent success of panel data analysis suggests,[1] there can also be some macroeconomic reasons (shifts in the fundamental relationships between countries, currency-market imperfections). The failure of the monetary approaches to provide macroeconomic reasons for persistent real exchange rate fluctuations has prompted researchers to look for alternative models or explanations that accommodate a time-varying equilibrium rate.

While PPP may hold for tradeable goods, the real exchange rate is also influenced by the relative price of non-tradeable goods and services, which represent a large portion of a country's total output. According to one popular theory, a country will see its real exchange rate appreciate if the productivity growth differential between the tradeable and non-tradeable sectors is larger than in other countries (Balassa, 1964, Samuelson, 1964). The approach was further refined to take into account the potential impact of public spending for which the allocation between tradeables and non-tradeables might be different from the private sector (Rogoff, 1992). However, many have questioned the assumption that PPP holds even for tradeables, arguing that the underlying conditions of perfect competition and a high degree of substitution between traded goods are not met for a significant portion of a country's output. Imperfect competition allows for "pricing-to-market" behaviour even in the case of relatively homogeneous goods. Imperfect substitutability allows for a relatively fast-growing country to improve its terms of trade by switching to the production of higher value-added, differentiated products.

More generally, the relaxation of the assumption of perfect substitutability implies that countries are no longer "pricetakers" on world markets, so that the real exchange rate can play a role in restoring product market equilibrium. This underpins the Fundamental Equilibrium Exchange Rate model (FEER) developed by Williamson (1994), in which the equilibrium exchange rate jointly ensures internal (saving/investment balance) and external (current account) equilibrium. An alternative though related empirical approach, referred to as the Behavioural Equilibrium Exchange Rate (BEER), also acknowledges the influence of macro imbalances in the determination of the real exchange rate in the long run (see for instance, MacDonald, 1997, Clark and MacDonald, 1998). However, it takes a more agnostic view of the specific value that is needed to simultaneously ensure internal and external equilibrium. In addition, the BEER approach is more encompassing and allows for the inclusion of other variables, which may impact on a country's terms of trade, such as oil and/or other commodity prices.[2]

1. Recent examples include Bayoumi and MacDonald (1999), Anker (1999) or Higgins and Zakrajsek (2000).
2. The Natural Real Exchange Rate (NATREX) approach, developed by Stein (1994), explicitly builds the dynamics of a country's external position and capital stock into a FEER framework.

Table 2. **Key explanatory variables across econometric investigations**

Study	Sample period	Data frequency	Key determinants	Comments
Alberola *et al.* (1999)	1980-98	Quarterly	cppi, nfa	
Alberola *et al.* (2001)	1980-99	Quarterly	labour productivity, nfa	Similar to Alberola *et al.* (1999) except for the use of labour productivity instead of cppi
Björksten and Kim (2000)	1990-99	Monthly	cpi, interest rates	Synthetic euro is computed using HICP weights
Hansen and Roeger (2000)	1980-99	Quarterly	cppi, nfa	Close to Alberola *et al.* (1999) approach
van Aarle *et al.* (2000)	1980m1-1999m2	Monthly	M1, industrial output, nominal 3-month and 10-year interest rates	
Clostermann and Schnatz (2000)	1975-98	Quarterly	irlreal, cppi, oil, gov	
Chinn and Alquist (2001)	1991m1-2000m6	Monthly	M1, GDP, 3-month interest rates, cpi, cppi	
Lorenzen and Thygesen (2000)	1960-99	Annual	nfa, dem, cppi, R&D spend in % of GDP	Author's long-run model
Goldman Sachs (2000)	1970Q1- …	Quarterly	productivity, irlreal, nfa	
Gern *et al.* (2000)	1973Q2-2000Q1	Quarterly	short-term real interest rate	
Teïletche (2000)	1980-99	Monthly	productivity, gov, irlreal, M1, industrial production	
Duval (2001)	1970-99	Quarterly	tradeable/non-tradeable deflator, propensity to consume, multi-factor productivity, irlreal	Euro area proxied by Germany, France plus Italy

M1 = narrow money stock.
Source : OECD.

Table 3. **Selected estimates of the euro's "equilibrium" exchange rate**

Study / basis	**Methodology**	**Reference currency(ies)**	**Reference period**	**"Equilibrium" rate ($/€) or under(-)/over(+) valuation (%) for the reference period**
EC (1999*a*)	PPP	Main trading partners	Early Sep. 1999	-8 to -13 %
Alberola *et al.* (1999)	Internal/external balance model	US$	End-1998	$/€ 1.26
Alberola *et al.* (2001)	Internal/external balance model	Main trading partners	End-1999	-12.4%
Hansen and Roeger (2000)	Internal/external balance model	Main trading partners	1999 Q3	around -15%
Wren-Lewis and Driver (1998)	FEER model	US$	2000	$/€ 1.19 - 1.45
Borowski and Couharde (2000)	FEER model	US$	1999 first half	$/€ 1.23 - 1.31
Clostermann and Schnatz (2000)	Eclectic combination	US$	Winter 1999/2000	short-run: $€ 1.20 medium-run: $/€ 1.13
Chinn and Alquist (2001)	Monetary model	US$	June 2000	medium-run: $/€ 1.17 - 1.24
Lorenzen and Thygesen (2000)	Internal/external balance model	US$	1999	long-run: $/€1.28
		US$	End-1999	medium-run: $/€1.19
		US$	Mid-2000	short-run: $/€ 1.09
IMF (2000*b*)	Saving-investment approach	US$	Summer 2000	around -30%
		Main trading partners	Summer 2000	-10 to -20%
Goldman Sachs (2000)	DEER model	US$	End-May 2000	$/€ 1.21
Gern *et al.* (2000)	Interest rate differential based model	US$	2000 Q1	short-run: around $/€1.03
Schulmeister (2000)	PPP for tradeables	US$	Mid-2000	$/€ 0.87
Teïletche (2000)	Eclectic combination	US$	June 2000	$/€ 1.09
Duval (2001)	NATREX model with interest rate differential and Balassa-Samuelson effects	US$	2000 Q3	$/€ 1.15
OECD PPP estimates	GDP PPP	US$	2000	$/€ 1.09

PPP: Puchasing Power Parity; FEER: Fundamental Equilibrium Exchange Rate; DEER: Dynamic Equilibrium Exchange Rate; NATREX: Natural Real Exchange Rate.
Source : OECD.

Furthermore, the equilibrium rate is often found to vary substantially over time. It may even be path-dependent, *i.e.* be influenced by the trajectory of the actual exchange rate.

An eclectic approach

31. In the spirit of the BEER approach, and taking into account the results obtained in the aforementioned studies, a range of potentially relevant fundamentals is first considered. The analysis is then progressively narrowed down. It is conducted for the real effective exchange rate and, given its prominence in real life as well as in research on this topic, for the bilateral real exchange rate of the euro *vis-à-vis* the US dollar.

32. The following set of "classic" variables were considered as determinants of the real exchange rate over longer-run horizons:

- The income level, as measured by GDP per capita (*gdppop*), which may capture catch-up effects.
- The ratio between the consumer and producer price index (*cppi*), as a proxy for productivity differentials between the treadable and non-tradeable sectors.
- The external balance sheet, measured directly, as a ratio to GDP, by net foreign assets (*nfa*) or proxied by cumulating current account flows (*cumca*).
- The internal balance, as reflected by government net lending (*nlg*) or government consumption as a ratio to GDP (*gov*).
- The demographic balance, captured by a dependency ratio (*dem*), as a determinant of saving.
- The terms of trade, computed as the ratio of export to import prices for goods and services (*tot*), or captured more narrowly but with less of a possible simultaneity bias by the real price of oil (*wpoil*).

In addition to these variables, and unlike earlier studies, forward-looking old-age dependency ratios 10, 20, 30 and 40 years hence (*dep10*, *dep20*, *dep30*, *dep40*) were also tried out. Furthermore, a measure of the dependence of activity on oil (net oil imports over GDP, *noi*) was included to control for the fact that over time, activity has become less oil-intensive.[19] The data are of a half-yearly frequency and span two decades (1981:1 to 2000:2) for the effective exchange rate equation and 25 years (1976:1 to 2000:2) for the bilateral equation. The sources used are described in more detail in Annex I. All variables except *nfa* and *wpoil* are expressed as differentials between the euro area and its partner(s), and most are in natural logs. The real exchange rates are expressed in logs, with an increase corresponding to a depreciation of the euro, and *wpoil* is defined as the OECD crude oil import price, cif, in euros per barrel, deflated by the euro area-wide CPI.[20] It is important to note that a number of the candidate explanatory variables are highly correlated, although in some cases the correlation is clearly spurious (Tables 4 and 5).

19. In contrast with the straight use of *wpoil* in Annex VII of OECD (2001).

20. The fact that changes in the exchange rate are largely passed through into the euro price of oil is not a major drawback as regards exogeneity, as shown in Annex II.

Table 4. **Cross-correlations for the real effective exchange rate**

	q	cppi	cpig	dem	dep10	dep20	dep30	dep40	gdppop	gdpg	gov	irlreal	nlg	noi	tot	wpoil	nfa
q	1	0.38	0.26	-0.45	0.12	0.23	-0.31	0.13	0.20	-0.17	0.36	-0.33	-0.27	0.22	-0.54	0.27	-0.61
cppi	0.38	1	-0.26	-0.61	0.65	0.08	-0.67	0.60	0.71	-0.02	0.83	0.32	-0.25	-0.19	0.24	-0.39	-0.32
cpig	0.26	-0.26	1	0.38	-0.53	-0.09	0.38	-0.47	-0.47	-0.20	-0.49	-0.91	0.45	0.41	-0.68	0.66	-0.57
dem	-0.45	-0.61	0.38	1	-0.62	-0.47	0.94	-0.50	-0.80	-0.03	-0.79	-0.48	0.51	0.31	-0.33	0.54	0.28
dep10	0.12	0.65	-0.53	-0.62	1	-0.32	-0.61	0.98	0.92	0.04	0.89	0.51	-0.15	-0.71	0.70	-0.81	0.11
dep20	0.23	0.08	-0.09	-0.47	-0.32	1	-0.46	-0.46	-0.04	0.10	0.02	0.21	-0.61	0.36	-0.20	0.08	-0.20
dep30	-0.31	-0.67	0.38	0.94	-0.61	-0.46	1	-0.48	-0.80	-0.09	-0.77	-0.56	0.50	0.38	-0.40	0.59	0.28
dep40	0.13	0.60	-0.47	-0.50	0.98	-0.46	-0.48	1	0.87	0.02	0.83	0.41	-0.06	-0.70	0.65	-0.75	0.14
gdppop	0.20	0.71	-0.47	-0.80	0.92	-0.04	-0.80	0.87	1	0.12	0.89	0.55	-0.26	-0.64	0.64	-0.80	-0.04
gdpg	-0.17	-0.02	-0.20	-0.03	0.04	0.10	-0.09	0.02	0.12	1	-0.09	0.23	-0.37	-0.06	0.17	-0.14	0.25
gov	0.36	0.83	-0.49	-0.79	0.89	0.02	-0.77	0.83	0.89	-0.09	1	0.47	-0.30	-0.46	0.51	-0.69	-0.12
irlreal	-0.33	0.32	-0.91	-0.48	0.51	0.21	-0.56	0.41	0.55	0.23	0.47	1	-0.42	-0.49	0.71	-0.69	0.42
nlg	-0.27	-0.25	0.45	0.51	-0.15	-0.61	0.50	-0.06	-0.26	-0.37	-0.30	-0.42	1	0.00	-0.11	0.24	-0.21
noi	0.22	-0.19	0.41	0.31	-0.71	0.36	0.38	-0.70	-0.64	-0.06	-0.46	-0.49	0.00	1	-0.71	0.75	-0.34
tot	-0.54	0.24	-0.68	-0.33	0.70	-0.20	-0.40	0.65	0.64	0.17	0.51	0.71	-0.11	-0.71	1	-0.92	0.57
wpoil	0.27	-0.39	0.66	0.54	-0.81	0.08	0.59	-0.75	-0.80	-0.14	-0.69	-0.69	0.24	0.75	-0.92	1	-0.43
nfa	-0.61	-0.32	-0.57	0.28	0.11	-0.20	0.28	0.14	-0.04	0.25	-0.12	0.42	-0.21	-0.34	0.57	-0.43	1

Table 5. **Cross-correlations for the real bilateral exchange rate**

	q	cpig	cppi	dem	dep10	dep20	dep30	dep40	gdppop	gdpg	gov	irlreal	nlg	noi	tot	wpoil	nfa
q	1	-0.19	0.19	0.57	0.51	-0.67	-0.14	0.60	-0.77	-0.28	0.58	-0.69	-0.58	-0.63	-0.78	-0.26	0.78
cpig	-0.19	1	0.13	-0.18	-0.13	0.08	-0.15	-0.20	0.34	-0.05	-0.18	-0.31	0.48	0.20	0.16	-0.12	-0.41
cppi	0.19	0.13	1	0.07	0.82	-0.58	-0.91	0.76	-0.55	-0.56	0.78	-0.26	-0.47	-0.77	0.36	-0.46	0.37
dem	0.57	-0.18	0.07	1	0.32	-0.52	0.01	0.41	-0.49	-0.16	0.32	-0.33	-0.31	-0.39	-0.49	-0.25	0.63
dep10	0.51	-0.13	0.82	0.32	1	-0.80	-0.86	0.99	-0.83	-0.46	0.93	-0.45	-0.77	-0.91	-0.09	-0.52	0.75
dep20	-0.67	0.08	-0.58	-0.52	-0.80	1	0.47	-0.86	0.75	0.35	-0.73	0.56	0.56	0.72	0.38	0.43	-0.89
dep30	-0.14	-0.15	-0.91	0.01	-0.86	0.47	1	-0.77	0.53	0.46	-0.78	0.26	0.54	0.76	-0.31	0.53	-0.31
dep40	0.60	-0.20	0.76	0.41	0.99	-0.86	-0.77	1	-0.88	-0.46	0.93	-0.50	-0.80	-0.91	-0.20	-0.52	0.84
gdppop	-0.77	0.34	-0.55	-0.49	-0.83	0.75	0.53	-0.88	1	0.57	-0.93	0.63	0.88	0.81	0.40	0.50	-0.82
gdpg	-0.28	-0.05	-0.56	-0.16	-0.46	0.35	0.46	-0.46	0.57	1	-0.64	0.32	0.29	0.42	-0.06	0.39	-0.26
gov	0.58	-0.18	0.78	0.32	0.93	-0.73	-0.78	0.93	-0.93	-0.64	1	-0.57	-0.85	-0.86	-0.12	-0.59	0.70
irlreal	-0.69	-0.31	-0.26	-0.33	-0.45	0.56	0.26	-0.50	0.63	0.32	-0.57	1	0.42	0.36	0.56	0.43	-0.47
nlg	-0.58	0.48	-0.47	-0.31	-0.77	0.56	0.54	-0.80	0.88	0.29	-0.85	0.42	1	0.75	0.23	0.47	-0.70
noi	-0.63	0.20	-0.77	-0.39	-0.91	0.72	0.76	-0.91	0.81	0.42	-0.86	0.36	0.75	1	0.14	0.43	-0.74
tot	-0.78	0.16	0.36	-0.49	-0.09	0.38	-0.31	-0.20	0.40	-0.06	-0.12	0.56	0.23	0.14	1	-0.01	-0.56
wpoil	-0.26	-0.12	-0.46	-0.25	-0.52	0.43	0.53	-0.52	0.50	0.39	-0.59	0.43	0.47	0.43	-0.01	1	-0.29
nfa	0.78	-0.41	0.37	0.63	0.75	-0.89	-0.31	0.84	-0.82	-0.26	0.70	-0.47	-0.70	-0.74	-0.56	-0.29	1

33. At higher frequencies, the exchange rate might deviate from its long-run path, due to fluctuations in real long-term interest rate (*irlreal*) or GDP growth (*gdpg*) differentials for example. Hence, after deriving an estimate of the equilibrium exchange rate, a dynamic equation including these variables is estimated to explain short-run movements.

34. A long-run expression was first tested, using cointegration techniques. Defining the real exchange rate as *q*, the long-run equation is:

$q_t = constant + \beta^i * X_{it} + \eta * noi_t * wpoil_t$, where the X_is are the other long-run determinants.

35. Different sub-sets of determinants were tested in turn (to avoid multicollinearity problems), and where applicable alternative measures of the determinants were tested, until a significant and economically meaningful cointegrating vector was identified. The Stock and Watson (1993) methodology was used to identify significant variables as it allows a standard interpretation of the t-statistics. The long-run relationship was then tested for cointegration directly with the Johansen test. As the latter has low power in small samples, the residuals of the cointegrating vector were also tested for stationarity using the augmented Dickey-Fuller and Phillips-Perron tests (Annex III). Then a dynamic equation was derived where the cointegrating, or long-run equilibrium, vector provides an error-correction mechanism, and temporary fluctuations may be explained by the change in the long-run determinants as well as interest rate and per capita income differentials, when significant:[21]

$$\Delta q_t = \alpha * (q_{t-1} - constant - \beta^i * X_{i,t-1} - \eta * noi_{t-1} * wpoil_{t-1}) + \delta_1 * \Delta q_{t-1} + \delta_{2i}(L) * \Delta X_{it} + \mu(L) * irlreal_t + \gamma(L) * gdppop_t$$

36. The estimation period extends through 1999:2, as the oil dependency measure was not available for 2000, and some of the data beyond end-1999 are early estimates subject to first-order revisions.

Equilibrium real effective exchange rate

37. The final equation for the real effective exchange rate, together with standard diagnostic tests, is presented in Table 6, where α is the error-correction coefficient, the β^is are the long-run coefficients of the associated X_i variables, and η is the coefficient on the oil variable. The coefficients for the terms-of-trade and the saving/investment variables display the expected sign, at conventional significance levels: a rise in the oil price leads to a depreciation of the real effective exchange rate, since the negative terms-of-trade shock for the euro area is large (the United States and United Kingdom instead being major oil producers); a rising dependency ratio ten years hence in the euro area relative to its partner countries translates into an exchange rate depreciation, reflecting the need for higher savings to be generated in the years to come.

38. Neither the net financial position of the euro area nor the sectoral productivity differential measure come out significantly as long-run determinants.[22] In fact, the coefficient obtained for *nfa* does not even carry the expected sign. A closer look at the results presented in the studies claiming to find a significant role for the net financial position suggests, however, that the relationship is not very robust. At the same time, one of the most careful studies, by Clostermann and Schnatz (2000), omits this variable for

21. Each explanatory variable was introduced with two lags and non-significant variables were eliminated sequentially.

22. Both variables were tested in various cointegrating vectors, taking into account potential multicollinearity problems, but without success.

lack of reliable data and notes that cumulated current account flows do not come out significantly. One reason may simply be that the net financial position is measured poorly and in rather different, *ad hoc*, ways across studies.[23] Another technical reason might be that although the relationship holds in the long run, this might not be the case over shorter time spans. Finally, it might be that expected rather than contemporaneous *nfa* is the relevant explanatory variable. On the other hand, to the extent that a country's current account position is a reflection of its fiscal behaviour, for example, when an expansionary fiscal policy fosters the country's borrowing abroad, a variable that reflects government action ought to show a notable degree of collinearity with the net external asset position. Hence, variables such as government expenditures, or demographic or old-age dependency, might well proxy the net financial assets, while at the same time being more accurately measured. The failure to establish a significant role for sectoral productivity in the determination of the equilibrium real rate might stem from measurement difficulties, as empirical results vary greatly with the variable proxying productivity differentials (relative prices, labour productivity or total factor productivity).

Table 6. **Dynamic equation for the real effective exchange rate**

Variable	Parameter value	t statistic
α	-0.211	-3.2
constant	-0.246	-2.9
β^{dep10}	0.059	3.9
η	1.003	4.2
Δ(cppi)	-1.416	-2.4
Δ(wpoil)	0.030	1.1
gdppop	-1.640	-3.1
Δ(irlreal)	-1.046	-2.9
Δ(irlreal)(-1)	-1.160	-3.1
R^2 adjusted = 0.58	JB normality = 0.49	Arch = 0.28
S.E. = 0.03	LM serial corr. = 0.30	
S.S.R. = 0.02	Chow breakpoint (1990:1) = 0.25	

Notes:
1. Long term coefficients are reported with the appropriate sign of the long-run equation.
2. p-values are reported for the diagnostic tests.

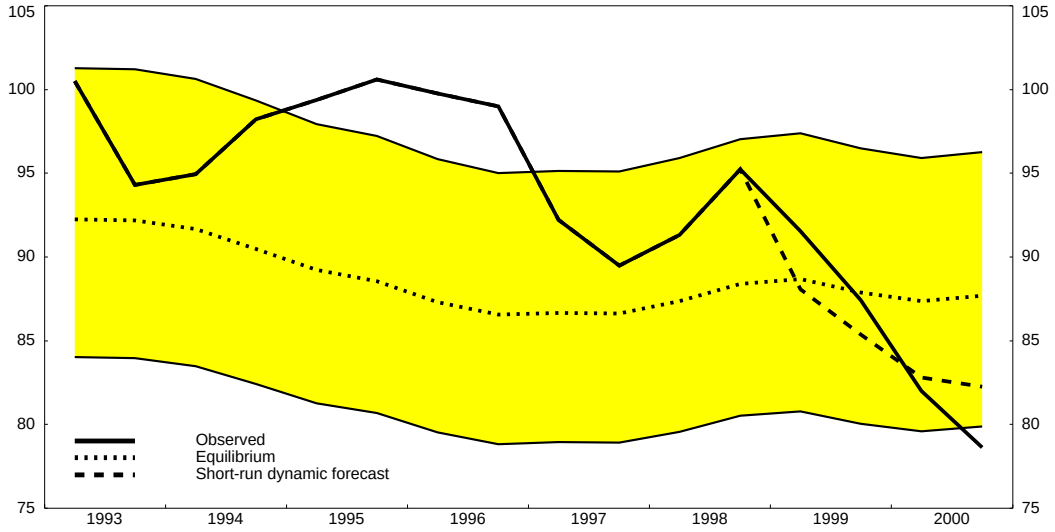
39. In the short run, an improvement in the sectoral productivity differential triggers an appreciation of the exchange rate. So does an increase in the per capita income differential. The real interest rate differential could enter in level terms (stationarity tests are not conclusive, in line with the empirical literature), but the change in the differential appears to be more robust, and a relative rise of the euro area's interest rate does, as expected, yield an appreciation of the euro. Overall the right-hand-side variables explain well over half of the variation of the real exchange rate. Finally, the persistence of the deviation is not out of line with the typical results reported in the literature, since the half-life approaches one and a half years (ln(0.5)/ln(1-0.21), *i.e.* 3 semesters).

40. To assess the evolution of the euro, the long-run real equilibrium exchange rate can be derived based on the long-run coefficients. This does not provide a constant and "instrinsic" equilibrium value for the euro but a time-varying measure of the equilibrium rate of the euro conditional on the value of the underlying determinants. Misalignment is then computed as the difference between the observed and the

23. The more reliable annual ECB net international investment position series starts only in 1997.

equilibrium exchange rate (Figure 13).[24] Based on the above equation, the model suggests an undervaluation of the real effective exchange rate of the euro of 9 per cent in the second half of 2000.

Figure 13. Actual and estimated "equilibrium" real effective exchange rate
1995 = 100



Source: OECD.

41. A related question is the extent of the euro's overshooting *vis-à-vis* its short-run predicted rate. A dynamic forecast was computed for 1999:1 and subsequent semesters, based on the dynamic equation. The exchange rate path is thus somewhat different from the long-run equilibrium one, pointing to overshooting by only 5 per cent in the second half of 2000. Given the size of the standard errors associated with these estimates, it is fair to conclude that since the currency's launch, the short and long-run equilibrium values of the euro have moved closely together, without short-run factors driving much of a wedge between the two.

Equilibrium cross-Atlantic exchange rate

42. The same method was applied to the bilateral exchange rate *vis-à-vis* the US dollar (Table 7). Rising oil prices also lead to a slightly larger depreciation of the equilibrium exchange rate because the associated negative terms-of-trade shock for the euro area is larger when compared with the sole United States (a major oil producer). Rising government expenditure in the United States relative to the euro area translates into an appreciation of the euro, possibly reflecting the need, in the United States, for higher savings to be generated in the years to come. The old-age dependency ratio produces a similar effect, but the equation was somewhat less satisfactory. As both variables account for future movements in saving, it was decided to keep only government expenditures. Overall, this equation suggests that the euro overshot its equilibrium value *vis-à-vis* the dollar by nearly 15 per cent in the second half of 2000. Persistence in the

24. Figure 13 depicts the estimated long-run exchange rate as well as a shaded band corresponding to ± 2 standard errors. The short-run exchange rate line shows the dynamic forecast for 1999:1-2000:2, as described below.

deviation from the long-run equilibrium path is of about the same order as for the effective rate, the half-life being around one year (ln(0.5)/ln(1-0.28)).

Table 7. **Dynamic equation for the real bilateral exchange rate**

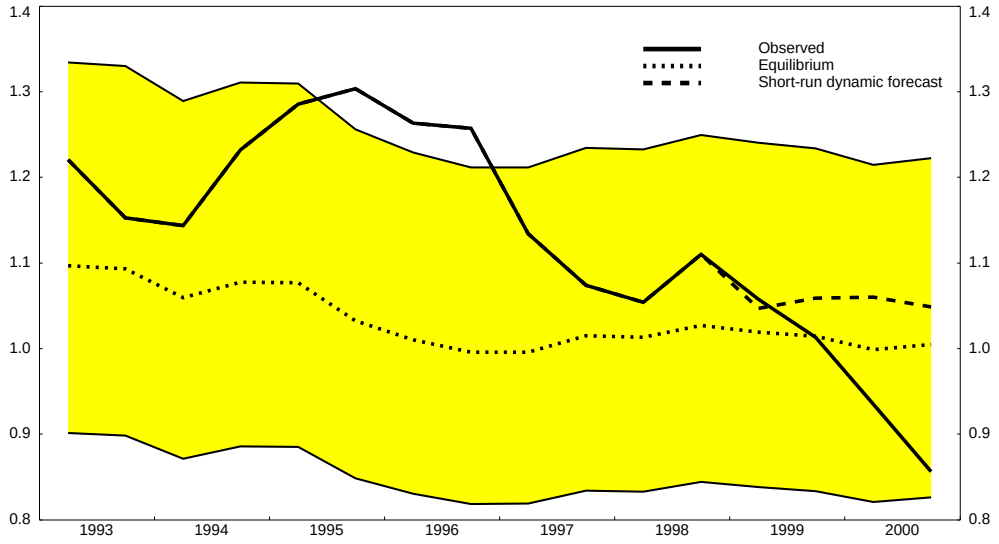
Variable	Parameter value	t statistic
α	-0.284	-4.1
constant	-0.703	-3.6
β^{gov}	9.800	-3.3
η	1.532	2.3
Δ(wpoil)	0.103	2.6
irlreal	-1.741	-4.1
Δ(gov)	3.763	1.3
R^2 adjusted = 0.53	JB normality = 0.29	Arch = 0.38
S.E. = 0.05	LM serial corr. = 0.54	
S.S.R. = 0.10	Chow breakpoint (1990:1) = 0.45	

Notes:
1. Long term coefficients are reported with the appropriate sign of the long-run equation.
2. p-values are reported for the diagnostic tests.

43. In the short run, rising euro interest rates will contribute to an appreciation of the exchange rate, as will a decline in relative government consumption. Overall, the equation tracks the evolution of the exchange rate somewhat less closely than for the effective rate, although it still explains over one half of its variance.

44. Like for the real effective exchange rate, a dynamic forecast was computed for 1999:1 and subsequent semesters, based on the dynamic equation. The exchange rate path thus generated lies significantly above the long-run equilibrium one, pointing to slightly greater overshooting (Figure 14).

Figure 14. Actual and estimated "equilibrium" nominal $/euro exchange rate



Source: OECD.

The euro's upside potential

45. The results presented in this paper should be interpreted with great care. They tend to support the view that the euro overshot in 2000, but they also highlight that the euro's "equilibrium" level cannot be pinned down with any precision. Indeed, the confidence bands in Figure 13 indicate that at conventional significance levels, the equilibrium real effective exchange rate index in the second half of 2000 was somewhere in between 80 and 96 (for 1995 = 100), with the actual value only slightly below the lower bound. In fact, the uncertainty surrounding the estimates is even more pronounced than suggested by confidence intervals. The euro's very short history not only makes the Lucas critique particularly relevant, given that historical data spanning different regimes across time and space are aggregated, but also implies serious data problems, given that for many variables no unique, reliable, homogeneous long-run series for the euro area is available. Furthermore, owing to the high degree of multicollinearity between plausible candidate explanatory variables, it is possible to identify more than one equilibrium vector and exchange rate, consistent with more than one underlying theoretical model. It is important to recall that more generally, exchange rate equations are rarely very robust, and that some of the key theoretically relevant determinants are typically unobservable or measured with error.

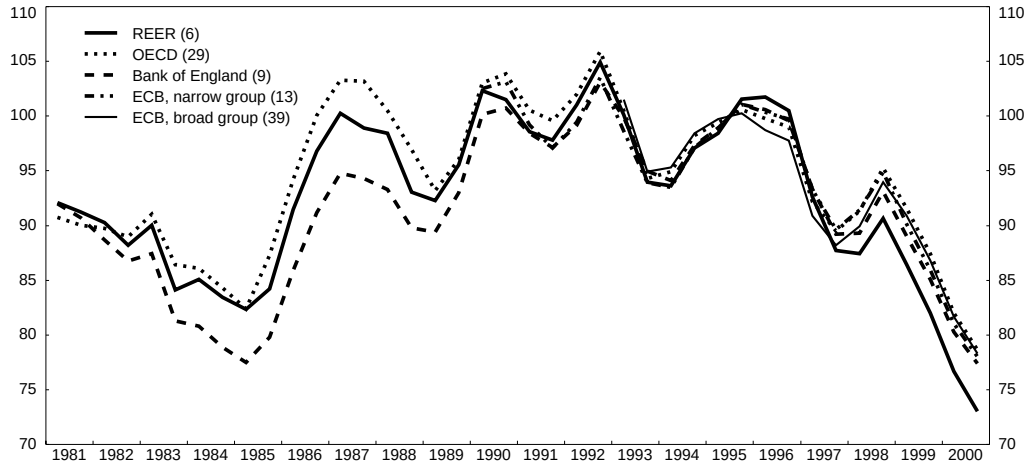
46. For all these reasons, it would be hazardous to draw overly clear-cut policy implications from the above estimates. Nonetheless, the results constitute evidence to back up the claim that over the medium run, and based on fundamentals, the euro had potential to appreciate in early 2001. Looking ahead, one factor which may impact on the euro exchange rate is the introduction of euro cash at the start of 2002, which might affect the perception of and demand for the euro.

ANNEX I

The data

The sample consists of half-yearly data running from 1981:1 to 2000:2 for the effective exchange rate equation and from 1976:1 to 2000:2 for the bilateral exchange rate equation. They are mostly extracted from the OECD *Economic Outlook* No. 68. Hence, with the notable exception of the exchange rate, most data for the second half of 2000 are estimates or projections. The real effective exchange rate (REER) of the euro is computed using consumer price indices for deflation and against six of the main partner countries: United States, United Kingdom, Japan, Canada, Switzerland and Australia. Together, these countries account for half of the euro area's external trade. It was impossible to extend the list of partner countries without considerably shortening the time series for the explanatory variables. While this REER is narrowly based, it is highly correlated with broader REER measures, including the OECD's standard one (Figure A1). The dependency ratio is defined as the non working-age divided by the working-age population, and the old-age dependency ratio as the population aged 65 years and over divided by the population aged 20 to 64. One of the few variables not extracted from the *Economic Outlook* database is net foreign assets, which is constructed as the sum across euro area countries of cumulated current account flows adjusted for valuation and other factors affecting the stock, using the IMF Lane/Milesi-Ferretti database (extended beyond 1998 with OECD current account data). Net oil imports as a ratio to GDP, in constant 1990 US dollars, are extracted from the International Energy Agency's publication *Oil Information*. For the relevant euro area data, the aggregation procedure of the OECD's Analytical Data Base was followed. The non-euro area data entering the equation for the REER are either aggregates or trade- or GDP-weighted averages for the euro area's main trading partners.

Figure A1. Selected real effective exchange rates (1)
Semi-annual, 1995=100



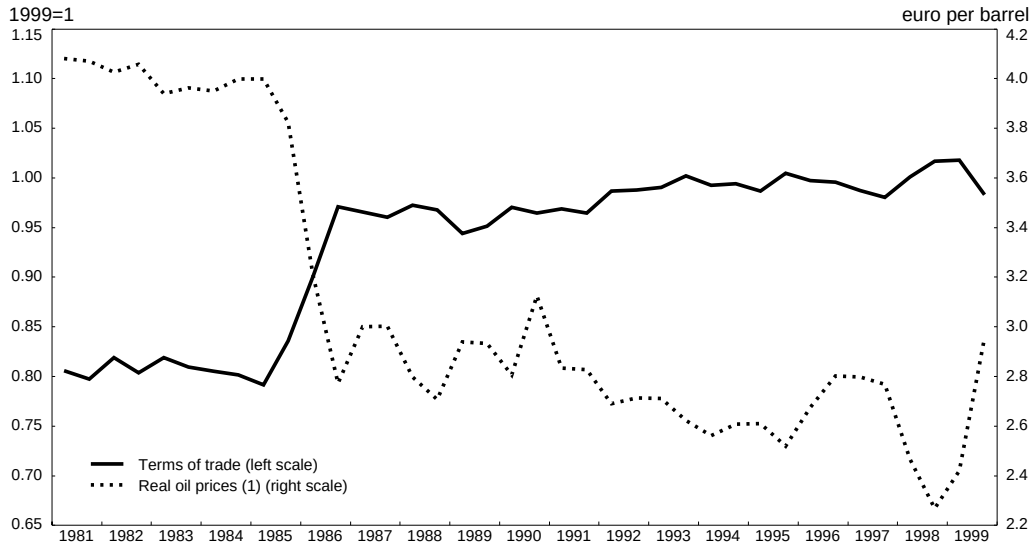
1. Deflated by the CPI. Figures in brackets are the numbers of trading partners. The ECB narrow group series begins in 1990 and the ECB broad group series in 1993.
Source: European Central Bank, Bank of England and OECD.

ANNEX II

Are oil prices exogenous?

Following Amano and van Norden (1995) and Closterman and Schnatz (2000), this paper has used the real price of oil as a proxy for exogenous changes in the terms of trade. Indeed, most large changes in the latter have been driven by exogenous supply shocks such as oil price shocks. Furthermore, comparing real oil prices in euro with the terms of trade for the euro area show that oil prices shocks do appear to account for most of the major movements in the terms of trade (Figure A2).

Figure A2. Terms of trade and oil prices



1. In logarithm, deflated by the CPI.
Source: OECD.

It could be argued that because oil prices are converted from US dollars into euros, the relationship merely captures a common trend between the exchange rate and oil prices in local currency. Standard Granger-causality testing and redundant variables testing on the long term cointegrating relationship allows

to assess the exogeneity of the oil price variable. As demonstrated in Sims *et al.* (1990), standard inference procedures are valid in this case under the maintained hypothesis of one cointegrating vector when one variable is analysed at a time. Table A2 displays the results.

Table A2. **Exogeneity tests**
p-values

Granger causality[1]		Redundancy test
Real effective exchange rate		
wpoil does not cause *q*	*q* does not cause *wpoil*	
0.18	0.77	0.00
Bilateral real exchange rate		
wpoil does not cause *q*	*q* does not cause *wpoil*	
0.23	0.35	0.00

1. For instance, there is an 18 per cent probability that the oil price does not Granger-cause the real effective exchange rate.

For the real effective exchange rate equation, the redundancy test provides strong evidence of the importance of the oil variable in the long-run relationship, while the Granger causality tests show that the price of oil Granger-causes the real exchange rate, while there is little evidence of the reverse. For the bilateral exchange rate equation, the evidence of oil price exogeneity is weaker, however.

ANNEX III

Cointegration tests

For each model, cointegration was tested using the Johansen test. However it has little power in small samples, and better evidence is provided by testing the stationarity of the residuals from the cointegrating equations estimated under the Stock and Watson (1993) methodology. For comparison purposes all test results are displayed below.

Table A1. **Cointegration tests**

Johansen[1]	Augmented Dickey-Fuller[2]	Phillips-Perron[2]
	Real effective exchange rate	
Null of no cointegrating vector is rejected at 5%	Null of presence of unit root is rejected at 1% level	Null of presence of unit root is rejected at 5% level
Null of at most one cointegrating vector is not rejected		
	Bilateral real exchange rate	
Null of no cointegrating vector not rejected	Null of presence of unit root is rejected at 1% level	Null of presence of unit root is rejected at 5% level
Null of at most one cointegrating vector is not rejected		

1. Test directly on the cointegrating vector.
2. Test on the residuals from the cointegrating vector.

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