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International coordination of monetary policy

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SUMMARY

Part 1. – International coordination of monetary policies – concepts and consequences

1. The assumed negative impact of exchange rate volatility on foreign trade and employment is frequently used as justification for international monetary coordination efforts. Our analysis indeed identifies such a negative impact for the labour markets in both the US and – due to largely more rigid structures – in the euro area.
2. However, we consider this finding insufficient to warrant international monetary policy coordination in an environment of "excessive" volatility. To the extent that a rule-based monetary policy delivers higher growth and employment than a discretionary policy, the gains to be derived from coordination would decline substantially.
3. Increased global financial integration diminishes the gains from policy coordination. As economic conditions overseas become increasingly important in setting domestic policies, the incentive to enact a "beggar-thy-neighbour" policy declines, even in the case of no coordination.
4. It should be noted that the relation between monetary policy and exchange rate volatility is complex and non-linear in nature. As a result, it is difficult to determine the monetary policy necessary to reduce exchange rate volatility to a predetermined level. That said, the ECB should not assign a role to the EUR/USD exchange rate other than that of a variable in the second strategy pillar.

Part 2. – Does the ECB follow the US Fed?

1. There is a widely held believe that the ECB has followed the US Fed in setting interest rates. Our empirical analysis, however, paints a different picture: there is no systematic evidence supporting the hypothesis of the ECB tracking the Fed. Other than making parallel moves in times of crises, the ECB has pursued an independent policy.
2. The differences in the central banks' objectives can be seen to support this finding: whereas it is the Fed's aim to deliver maximum employment and stable prices, the ECB's primary objective is maintaining price stability.
3. Furthermore, there are marked differences in monetary policy: whereas the Fed pursues a business cycle-oriented approach, the ECB tends to pursue a more trend-oriented policy.
4. It should be noted that periods of parallel changes in short-term rates cannot *per se* be interpreted as evidence for policy coordination; both central banks appear to have reacted in a similar way to shocks hitting the financial markets.

Part 3. – Stock prices – a challenge for central banks

1. Our analysis suggests that increases in stock market returns exert a slightly, albeit temporary, positive impact on output, whereas an increase in stock market volatility has a slightly, again temporary, negative impact.
2. However, these findings do not lead us to recommend that the ECB should react to changes in stock market valuations, for at least three reasons: central banks (i) cannot influence stock prices according to pre-determined policy goals; (ii) lack knowledge on the correct valuation level; and (iii) may provoke the "moral hazard" problem simply by pledging to support stock markets through monetary policy actions.
3. In view of insufficient data on the price level of the economies' total stock of wealth and weighing the costs and benefits of taking stock markets into account when setting monetary policy, a credible, price stability-oriented monetary policy appears to be the dominant strategy.

Part 4. – ECB monetary policy – review and outlook

1. In the euro area, the velocity of money has declined markedly so that the money overhang has not yet spilled over into output and price increases. Given a trend-stable money demand function, however, price effects have to be taken into account. Our P-star model forecasts inflation to rise towards 2.5% by the end of 2003.
2. In view of the weakness in the euro area's growth rates, calls for an easier monetary policy can be expected to continue. However, further rate cuts, and thus increases in credit and money supply, should be incompatible with keeping future price level rises in line with the ECB's envisaged inflation paths.
3. Excessive easing is unlikely to be in the interest of a stability-oriented monetary policy: it could well remove economic incentives to encourage badly needed reforms, potentially adding to the costs of reversing the structural growth decline. Ultimately, this could be expected to provoke even louder calls for lower interest rates.

ZUSAMMENFASSUNG

Teil 1. – Internationale Koordinierung der Geldpolitik – Konzepte und Konsequenzen

1. Ein Argument, mit dem immer wieder die Notwendigkeit internationaler währungspolitischer Koordination begründet wird, ist der dämpfende Einfluss von Wechselkursunsicherheit auf Außenhandel und Beschäftigung. Wir weisen diesen zwar empirisch für die Arbeitsmärkte in den USA und – wegen des höheren Offenheitsgrades und rigider Arbeitsmärkte stärker noch – in Euroland nach.
2. Dieser Befund reicht jedoch für sich genommen nicht aus, bei „übermäßiger" Wechselkursvolatilität koordinierte währungspolitische Aktionen zu begründen. Denn in dem Maße, wie eine Selbstverpflichtung der Geldpolitik auf regelgebundene Strategien für mittelfristig höheres Wirtschaftswachstum und damit mehr Beschäftigung sorgt als eine diskretionäre Politik, sinken auch die Erträge eines koordinierten Ansatzes erheblich.
3. Darüber hinaus verringert die zunehmende Finanzmarktintegration die Erträge der Politikkoordination erheblich. Die wirtschaftliche Lage im Ausland wird so für Regierungen immer wichtiger. Dies verringert automatisch ihre Anreize, auf Kosten anderer Volkswirtschaften „beggar-thy-neighbor policies" durchzuführen, selbst wenn keine Koordinierung vorgesehen ist.
4. Die Beziehung zwischen der Ausrichtung der Geldpolitik und der Volatilität des Wechselkurses ist komplexer und nichtlinearer Natur. Deshalb ist die für eine Verringerung der Volatilität erforderliche fallweise Intervention der Geldpolitik nur schwer zu bemessen. Eine Ausrichtung der EZB-Geldpolitik am Euro-Dollar-Wechselkurs über dessen Rolle im Rahmen der zweite Strategie-Säule hinaus empfehlen wir deshalb nicht.

Teil 2. – Folgt die EZB der Fed?

1. Die Auffassung, die EZB folge mit in ihrem Zinssetzungsverhalten der US Federal Reserve (Fed), ist verbreitet. Eine empirische Analyse der Zinspolitiken legt jedoch einen gegenteiligen Schluß nahe: Es ist nicht systematisch zu erkennen, dass die EZB mit ihrer Zinspolitik der Fed „hinterhergelaufen" ist. Abgesehen von parallelen Politikmaßnahmen in „Krisenphasen", verfolgte die EZB eine von der Fed unabhängige Geldpolitik.
2. Dieses Ergebnis ist zum einen auf die unterschiedlichen geldpolitischen Zielfunktionen der beiden Zentralbanken zurückzuführen: Während die US-Notenbank für maximale Beschäftigung und stabile Preise zu sorgen hat, ist es primäre Aufgabe der EZB, für Preisstabilität zu sorgen. Zum anderen dürften die unterschiedlichen geldpolitischen Philosophien für dieses Ergebnis eine wichtige Rolle spielen: Während die Fed ihre Geldpolitik stark konjunkturell ausrichtet, verfolgte die EZB bisher eine eher
3. Dass sich in den letzten Jahren ein markanter Gleichlauf der Änderungen der Kurzfristzinsen in den USA und dem Euroraum zeigte, deutet nicht per se auf eine bewusste Koordinierung: Die Zentralbanken dürften vielmehr ähnlich schnell auf Schocks, die die globalen Finanzmärkte betrafen, reagiert haben.

Teil 3. – Aktienmärkte – eine Herausforderung für die Geldpolitik

1. Im Euroraum zeigt sich, dass ein Kursanstieg auf den Aktienmärkten temporär einen geringen positiven Impuls auf den Output ausübt, während steigende Kursvolatilität temporär leicht negativ wirkt.
2. Doch der Schlussfolgerung, die EZB solle sich an Aktienkursbewegungen ausrichten, folgen wir nicht: (i) Zentralbanken können Aktienkurse nicht zielgerecht beeinflussen, (ii) sie haben nicht das Wissen über das „richtige Kursniveau" und (iii) könnten durch Intervention(-sankündigung) ein ernstes „Moral Hazard"-Problem provozieren.
3. Angesichts der verfügbaren Datenbasis und nach Abwägung der Kosten und Nutzen empfiehlt sich eine glaubwürdige, auf Preisstabilität ausgerichtete Geldpolitik.

Teil 4. – EZB-Geldpolitik – Rück- und Ausblick

1. Im Euroraum ist die Umlaufgeschwindigkeit des Geldes stark gefallen, so dass sich der Geldüberhang noch nicht in Output- und Preissteigerungen entladen hat. Die Trendstabilität der Geldnachfrage legt aber nahe, dass der Geldüberhang noch preiswirksam wird: Unser „Preislücken"-Modell deutet an, dass die Inflation bis zum vierten Quartal 2003 auf etwa 2,5 Prozent steigen wird.
2. Die Rufe nach billigem Geld dürften anhalten. Wenn aber Inflations-Zielverfehlungen vermieden werden sollen, ist von weiteren Zinssenkungen – also einer weiteren Ausweitung des Geld- und Kreditangebots – abzuraten.
3. Nicht zuletzt dürfte es auch nicht im Interesse einer langfristig stabilitätsorientierten Geldpolitik liegen, die Zinsen übergebührlich niedrig zu halten: Die Geldpolitik liefe Gefahr, die Anreize für Strukturänderungen zu verwässern und damit den Reformprozess aufzuhalten, was langfristig wiederum um so lautere Rufe nach expansiver Geldpolitik provoziert.

Part 1: Impact of exchange rate volatility on labour markets – a case for transatlantic monetary policy coordination?

CONTENT*: 1. Introduction. – 2. Exchange rate uncertainty and employment. – 3. How to measure exchange rate variability? – 4. An empirical analysis. – 5. Some remarks on the necessity of international policy coordination.*

SUMMARY: *In this paper, we analyse the effects of exchange rate volatility on labour market performance, both theoretically and empirically. We consider a simple Dixit/Pindyck-style model to show that there is a negative relationship between exchange rate variability and job creation. The underlying idea is that uncertainty of future earnings raises the "option value of waiting" to create a job. We also find that a higher reservation wage, a better bargaining position of workers and higher costs of job creation strengthen the adverse impact of uncertainty on employment. Thus, the link between exchange rate variability and employment should be stronger in most European countries than in the US. Our regression analysis confirms this conclusion. However, these results do not support the concept of transatlantic monetary policy coordination: it can be shown that a commitment by central banks to rule-based rather than discretionary monetary policy significantly contributes to solid economic performance. Implementing a coordinated approach leads to smaller marginal gains.*

1. Introduction

In the past four years, the euro/dollar exchange rate, much as the DM/dollar rate before, has undergone large and ex ante unpredictable movements, which are at times difficult to understand and which are often perceived to be politically costly. Mundell (2000, 2000a), for example, argued that movements of the euro/dollar rate comparable to those of the DM/dollar rate since 1971 would break Euroland apart. There are different reasons why politicians and economists are concerned with exchange rate variability. Firstly, it is typically argued that exchange rate variability discourages trade. However, a substantial amount of empirical literature on this issue fails to confirm that exchange rate variability has any significant impact on the volume of trade. Furthermore, there is no compelling reason why the volume of trade should be a politically important variable in itself. Instead other variables such as (un)employment appear to be much more important from a normative point of view. The purpose of this section is to show, both theoretically and empirically, that exchange rate variability may indeed have an important effect on labour markets. If this is the case, some analysts typically conclude that it should be possible to agree on a common line that makes it possible to contemplate joint monetary policy action (coordination) to reduce excessive exchange rate variability. This is especially so in light of the fact that the unemployment rate is a highly relevant political variable.

Many analysts support the view that exchange rate variability is not usually connected with variability in the fundamentals and thus undesirable. However, it is usually accepted that concrete action to reduce exchange rate variability, at least among the G-3, is either impossible or *politically unacceptable* (and, hence, labour market deregulation in the eurozone is the only way to eradicate negative impacts of euro volatility on labour markets). However, the Nobel-Prize winner of 1999, Robert Mundell (2000, 2000a), for example, argues that this should not be the case. The huge size

of private foreign exchange markets does not imply that policy cannot influence exchange rates, all that is required is for intervention not to be sterilised by automatically matching a sale of foreign exchange with a purchase of government assets.[1] In other words, monetary policy must be geared to the exchange rate if it wants to influence it. Mundell argues that given the large degree of inflation convergence achieved, the long-term thrust of monetary policy is actually very similar throughout the G-3, so that it should be possible to agree on a common line that makes it possible to contemplate joint action to reduce excessive exchange rate variability.

This quite typical and revealing argument can be developed more fully as follows. If the results of this section can be confirmed by future research, and if similar results can be found for other key currencies, eg, dollar/yen, euro/yen, they would in principle warrant a new look at the costs from the system of globally floating exchange rates. In particular, one should concentrate on the implications for the debate on the design of EU/US monetary relations and especially on the role one believes the exchange rate should play in monetary policy, ie, the *desirability* of influencing the exchange rate. By this, topics of current interest, such as formulating "general orientations for exchange rate policy" beyond the ECB strategy's second pillar and "reasons for managing the exchange rate of the euro against the US dollar", are addressed directly.

Do the US and the Euroland constitute closed economies for which the exchange rate should be irrelevant? Mundell (2000) suggests that it would be a great mistake to believe that the closed nature of the three big blocs of the G-3 lessens the importance of exchange rates, or that the dollar/euro rate can be treated with "benign neglect". To gain more insight in the potential exposure of the US and of Euroland to exchange rate volatility, Belke and Gros (2002) looked at the share of trade in national income. These raw data suggest that Euroland may be substantially more open than the United States. This seems to imply that the European Central Bank may need to give the exchange rate a larger role in determining its policy for Euroland, especially in its second pillar ("all relevant variables"), at least compared to the US Federal Reserve Board. In principle, therefore, Euroland is open enough for the exchange rate to matter for monetary policy.

However, in our view (1) further work is needed to corroborate the first preliminary results of this section so that they can be used as a basis for concrete policy recommendations; and (2) there is no clear case for policy coordination even if a significant impact of exchange rate volatility on a core macro variable such as the unemployment rate can be found in the data. We elaborate on the main reasons for this in part 5 of this paper.

The concept of closer international coordination of (macro) economic policies, especially monetary policy, tends to be popular among politicians. Mostly it is taken for granted that a greater international integration of finance, goods, and factor markets *per se* requires more international policy cooperation and synchronisation, at least within the G-3. It is expected that in doing this, important benefits for the participating countries will result: since the resolution of economic problems like unemployment, inflation and insufficient growth is expected to be enhanced, an increase in wealth is anticipated. It is argued that because of the high and still growing international integration of markets, the economic policy of a country will not only influence the domestic economy but to a significant extent also the economic conditions abroad.

[1] Moreover, intervention should take place in both the spot and the forward markets in order to avoid outward interest arbitrage and a higher interest rate than justified by the liquidity tightening alone. Lastly, interventions should be concerted with monetary partners for credibility reasons.

Recessions and inflations can therefore be exported and imported just like goods and services. The economic policy of a foreign country could affect the goals of the domestic economy in a negative way (negative spillovers) and by this, limit the room for its economic actions. As such, government targets can no longer be reached by economic policy alone. This can only be attained through international coordination.

In discussing the arguments in favour of international coordination of economic policy, we will first take a look at the question of whether international monetary policy coordination is necessary, ie, whether there is a manifest interest in it in view of the negative impacts of exchange rate volatility on the labour market (sections 2 to 4). We then investigate briefly the international economic interdependencies and thus the possible spillovers, ie, the effects that the economic development and the economic policy of one country has on the rest of the world. After that, we examine the justification for an international policy (section 5). Let us now turn to the first of our questions dealing with a necessary but not sufficient condition for coordination.

How can exchange rate variability have a significant impact on labour markets, given the weak empirical link between exchange rate variability and the volume of trade mentioned above? Our answer to this question is that an increase in exchange rate variability may well have an immediate (short-run) impact on job creation decisions of firms and therefore be reflected in the employment data, whereas there need not be a short-run impact on the volume of trade. A decision of a firm whether or not to invest (and to create jobs) in export-oriented activities incurs sunk costs, such as creating a new production line or building up a distribution system in foreign markets. Therefore, an increase in exchange rate volatility may well deter firms from creating employment, but firms who are already active in foreign trade will not cut their exports just because of an increase in exchange rate volatility. Another reason why exchange rate variability might not have an immediate impact on the volume of trade comes from the "pricing to market" idea, ie, firms keep local prices fixed even in the face of large exchange rate changes. This implies that foreign sales should react little to exchange rates. Firms keep producing but their domestic currency earnings become variable whereas their domestic costs remain stable. Exchange rate variability can thus certainly influence the variability of profits, even if trade changes only marginally. Therefore, firms might react to an increase in exchange rate (and hence profit) variability in the first instance by reducing investment and employment in trade-related activities. This might depress future trade volumes but firms will not necessarily export less in the short run just because exchange rate variability has increased. The long-run response, on the other hand, is more difficult to isolate in empirical work because there are other long-run trends that influence trade volumes (eg, reduction in transport costs, shifts in tastes, etc) and because variability changes so much over time.

The goal of this section is twofold. First, we develop a simple model to illustrate a mechanism that explains a negative relationship between exchange rate uncertainty and job creation. The model is based on the idea that uncertainty of future earnings raises the "option value of waiting" (see Dixit (1989)). When firms create a job, they have to incur sunk costs, such as hiring costs and costs of the provision of job-specific capital. Moreover, wage payments are typically also sunk, since firing restrictions and employment contracts prevent firms from laying off workers too rapidly. If the exchange rate is uncertain, firms fear an unfavourable appreciation of the (domestic) currency, in which case they incur heavy losses. With high uncertainty and with binding employment contracts, firms may prefer to delay job creation, and this is even so if they are risk-neutral. On the other hand, even when non-binding contracts can be signed and work relationships can be closed down easily, higher volatility still has an

adverse impact on employment via job destruction. Moreover, the better the bargaining position of workers, the higher the option value of waiting and the stronger the impact of uncertainty on employment. Since generous unemployment compensation systems, union power and firing restrictions generally improve the bargaining position of workers, we would expect that the link between exchange rate uncertainty and employment should be stronger in most European countries than in the US.

The second goal of this section is to provide some casual empirical evidence on the negative relation between exchange rate uncertainty and labour markets. We consider the influence of two measures of external exchange rate variability of the euro area and of the US on two key labour market indicators: (changes in) unemployment rates and employment growth.[2] We find that exchange rate variability has a statistically significant negative impact on unemployment and employment in the euro area, even when adding various control variables. For the US, the evidence points only to an impact on unemployment, and the coefficients are typically smaller (though significant) than in the euro area. These results confirm the theoretical presumption that there is a negative impact of exchange rate variability on (un)employment which is more pronounced in the euro area where labour markets are perceived to be more rigid than in the US.

The literature provides other mechanisms through which uncertainty may have an adverse impact on employment. First, in unionised labour markets in which contract wages are set in advance, uncertainty in labour demand (coming from uncertainty in productivity or in the exchange rate) may cause rational unions to set a higher wage than would otherwise be the case. Uncertainty results in a ´risk premium` in the wage, and thus in higher unemployment (Andersen and Sorensen (1988) and Sorensen (1992)). Another channel by which uncertainty might affect employment is via its impact on investment. Our theoretical arguments are equally valid for firms deciding on a certain investment project, and, by the same reasoning, high uncertainty might induce firms to postpone investment projects (see Belke and Gros (2001)). Unemployment can be expected to rise if investment falls because investment is an important component of demand. Moreover, technological complementarities between labour and capital imply that a capital slowdown entails a fall in employment (see eg, Rowthorn (1999)).

The outline of this section 2.1 is as follows. In section 2, we develop our model of job creation and uncertainty to illustrate the negative relationship between uncertainty and employment. Section 3 defines our measure of exchange rate variability. Section 4 presents and comments on the regression results. Section 5 concludes.

2. Exchange rate uncertainty and employment

In the following, we present a simple model of job creation and exchange rate uncertainty to illustrate the basic idea underlying the "option value of waiting" *à la* Dixit (1989). The model does not pretend to be close to reality. It is designed to convey the basic idea in a simple way. Moreover, our intention is to present a model that allows us to ask whether even a *temporary*, *short-run* increase in uncertainty can have a strong impact on employment, and how this impact depends on labour market parameters.

[2] These are the two politically most important variables of the indicators linked to popular explanations of the impact of financial volatility on the real sector (Dixit (1989), Aizenman and Marion (1999), Ramey and Ramey (1995)). On the other hand, the lack of comparable data for European countries prevents us from testing the effects on job creation and job destruction flows directly.

Consider a set-up in which there are three periods and in which a single firm active in an export-oriented industry decides on its job creation policy. During the first two periods (called zero and one), the firm can create a job, hire a worker and produce output that is sold in a foreign market during the subsequent periods. If the job is created during period zero, the worker is hired for two periods (zero and one) to produce output to be sold in periods one and two. If the job is created in period one, the worker is hired only for period one and output is sold in period two.

To create a job, the firm pays a start-up cost c, which reflects the cost of hiring, training and the provision of job-specific capital. After a job is created, a worker is hired and is paid a wage w above the worker's fallback (or reservation) wage $\underline{w}$ during every period the worker is employed. The fallback wage measures (besides disutility of work) all opportunity income that the worker has to give up by accepting the job. In particular, it includes unemployment benefits, but it might also be positively related to a collective wage set by a trade union or to a minimum wage, both of which should raise the worker's fallback position. In general, we would argue that the fallback wage should be higher in countries that are characterised by generous unemployment benefit systems, by strong trade unions or by minimum wage legislation.

In every period in which the worker is employed, he produces output to be sold in the following period in a foreign market at domestic price p, which has a certain component p^* (the foreign price) plus a stochastic component e (the exchange rate). We assume that the foreign price is fixed ("pricing to market"), and that the exchange rate follows a random walk. In period one, the exchange rate e_1 is uniformly distributed between $-\sigma_1$ and $+\sigma_1$. The exchange rate in period two, e_2, is uniformly distributed between $e_1-\sigma_2$ and $e_1+\sigma_2$. An increase in σ_i means an increase in uncertainty, or an increase in the mean preserving spread in period i=1,2 (σ_i is proportional to the standard deviation of e_i). Uncertainty can be temporary (eg, if $\sigma_1>0$ and $\sigma_2=0$) or persistent (if also $\sigma_2>0$). As will become apparent soon, however, the variability of the exchange rate during the second period has no influence on the result.

The wage rate w for the job is determined by the (generalised) Nash bargaining solution that maximises a weighted product of the worker's and the firm's expected net return from the job. We assume that both the firm and the worker are risk-neutral. This assumption implies that risk-sharing issues are of no importance for our analysis. Thus we may assume realistically (but without loss of generality) that the worker and the firm negotiate a fixed wage rate w (which is independent of realisations of the exchange rate) when the worker is hired, so that the firm bears all the exchange rate risk. A wage contract which shifts some exchange rate risk to the worker would leave the (unconditional) expected net returns unaffected, and has therefore no effect on the job creation decision. Of course, if the firm was risk-averse, the assumption that the firm bears all exchange rate risk would make a postponement of job creation in the presence of uncertainty even more likely.

Consider first the wage bargaining problem for a job created in period zero, in which case the worker is hired for two periods. After the job is created (and the job creation cost is sunk), the (unconditional) expected net return of this job is equal to $E_0(S_0) = 2p^*-2\underline{w} = 2\pi$, where $\pi=p^*-\underline{w}$ denotes the expected return of a filled job per period (we abstract from discounting). Denoting the bargaining power of the worker by $0<\beta<1$, the firm's net return from the job created in period zero is[3]

[3] Formally, the wage bargain leads to a wage rate maximising the Nash product $(2w-2\underline{w})^{\beta}(2p^*-2w)^{1-\beta}$ whose solution is $w=(1-\beta)\underline{w}+\beta p^*$, and hence the expected net return for the firm is $2p^*-2w-c=(1-\beta)(2p^*-2\underline{w})-c$.

(1) $E_0(\Pi_0) = (1-\beta)E_0(S_0) - c = 2(1-\beta)\pi - c$.

In order to make the problem non-trivial, the expected return from job creation in period zero must be positive, ie, we assume that $2(1-\beta)\pi - c > 0$.

Implicit in our model is the assumption that the firm and the worker sign a binding employment contract for two periods (zero and one). Hence they cannot sign a contract that allows for the possibility of job termination in the first period whenever the exchange rate turns out to be unfavourable. In period one (after realisation of the exchange rate) the conditional expected surplus from job continuation is $E_1(S_1)=\pi+e_1$ which may be negative if the exchange rate falls in period one below $-\pi<0$. In such circumstances, both the worker and the firm would benefit from termination. If a contract allowing for termination in period one could be signed, the unconditional expected surplus in period zero would be larger (consequently both the worker and the firm would prefer to sign such a contract).[4] However, bearing in mind the interpretation of a rather short period length (a month, to be compatible with our empirical analysis), the assumption of a binding contract for two periods seems to be more appropriate. Of course, once a binding contract for two periods is signed, the worker always prefers continuation (since the contract wage exceeds the fallback wage), and the firm would incur losses if the exchange rate turns out to be unfavourable. We consider in Appendix 1 an alternative set-up, which allows for the possibility of job destruction. It turns out that in this case, uncertainty does not delay job creation, but job destruction becomes more likely if uncertainty increases. Hence, the negative relationship between exchange rate variability and employment is robust to this variation.

If the firm waits until period one, it keeps the option of whether or not to create a job. It will create a job only if the exchange rate realised during period one (and so expected for period two) is above a certain threshold level, or barrier, denoted by b. Given that an employment relationship in period one yields a return only during period two, this barrier to make the creation of the job just worthwhile is given by the condition that the (conditional) expected net return to the firm is zero:

(2) $(1-\beta)(p^* + b - \underline{w}) - c = 0$ or $b = c/(1-\beta) + \underline{w} - p^* = c/(1-\beta) - \pi$.

Whenever $e_1 \geq b$, the firm creates a job in period 1, and the conditional expected net return to the firm is $E_1(\Pi_1) = (1-\beta)(\pi+e_1)-c \geq 0$. Whenever $e_1 < b$, the firm does not create a job in period one, and its return is zero. Hence, whenever both events occur with positive probabilities (ie, whenever $\sigma_1 > b > -\sigma_1$)[5], the unconditional expected return of waiting in period zero is given by:

(3) $E_0(\Pi_1) = [(\sigma_1 + b)/(2\sigma_1)]0 + [(\sigma_1 - b)/(2\sigma_1)][(1-\beta)(\pi + (\sigma_1+b)/2) - c]$,

where the first element is the probability that it will not be worthwhile to create a job (in this case the return is zero). The second term represents the product of the

[4] Of course, such a flexible contract implies that some exchange rate risk is shared between the worker and the firm. However, the reason why they both benefit is not the risk-sharing aspect, but the fact that the flexible contract excludes continuation of unprofitable work relationships.

[5] We do not a priori restrict the sign of the barrier b. Hence one of these conditions is automatically satisfied, whereas the other is satisfied only if uncertainty is large enough.

probability that it will be worthwhile to create the job (because the exchange rate is above the barrier) and the average expected value of the net return to the firm under this outcome. Given condition (2) this can be rewritten as:

$$(4)\quad E_0(\Pi_1) = (1-\beta)\,(\sigma_1-b)^2 / (4\sigma_1)\,.$$

This is the key result since it implies that an increase in uncertainty *increases* the value of the waiting strategy, since equation (4) is an increasing function of σ_1.[6] As σ_1 increases it becomes more likely that it is worthwhile to wait until more information is available about the expected return during period two. At that point the firm can avoid the losses that arise if the exchange rate is unfavourable by not creating a job. This option not to create the job becomes *more valuable* with *more uncertainty*. The intuitive explanation is that waiting implies that the firm foregoes the expected return during period one, but it keeps the option not to create the job which is valuable if the exchange rate turns out to be unfavourable. The higher the variance the higher the potential losses the firm can avoid and the higher the potential for a very favourable realisation of the exchange rate, with consequently very high profits.
It is now clear from (1) and (4) that a firm prefers to wait if and only if

$$(5)\quad (1-\beta)(\sigma_1-b)^2 / (4\sigma_1) > 2(1-\beta)\pi - c\,.$$

As the left hand side is increasing in σ_1, the firm delays job creation if exchange rate uncertainty is large enough. The critical value at which (5) is satisfied with equality can be solved as[7]

$$(6)\quad \sigma_1^{*} = 3\pi - c/(1-\beta) + 2\sqrt{p(2p - c/(1-ß))}\,.$$

Whenever $\sigma_1 > \sigma_1^{*}$, firms decide to postpone job creation in period zero. Since σ_1^{*} is increasing in π (and thereby decreasing in the fallback wage $\underline{w}$), decreasing in the cost of job creation c and decreasing in the worker's bargaining power β, we conclude that a strong position of workers in the wage bargain (reflected in a high fallback wage or in the bargaining power parameter) and higher costs of hiring raise the option value of waiting and make a postponement of job creation more likely. Thus, the adverse impact of exchange rate uncertainty on job creation and employment should be stronger if the labour market is characterised by generous unemployment benefit systems, powerful trade unions, minimum wage restrictions or large hiring costs. That such features of the labour market are detrimental to employment is of course not surprising. The adverse impact of these features on employment has been confirmed empirically in various studies, (see, eg, Nickell (1997)). What our simple model shows is that these features also reinforce the negative employment effects of exchange rate uncertainty.

Another important implication of the model is that *only the current*, short-term uncertainty σ_1 has an impact on the decision to wait. Future uncertainty, represented here by σ_2, does not enter in the decision under risk neutrality. If one takes a fixed pe-

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[6] Formally, this results from the fact that equation (4) is only valid whenever σ_1 exceeds b (otherwise the exchange rate could never exceed the barrier and the firm never creates a job in period 1) and whenever $-\sigma_1$ is lower than b (otherwise the exchange rate could never fall below the barrier and the firm always creates a job in period one).

[7] The other (smaller) solution to this equation is less than |b| and is therefore not feasible.

riod, eg, one month, the likelihood that job creation will be postponed to the end of that period depends only on the uncertainty during that period and not on future uncertainty. This implies that *even short spikes* in uncertainty as, eg, grasped by a contemporaneous uncertainty proxy in empirical investigations of the real option effect detected above, can have a *strong impact* on employment.

Our crude model has abstracted from risk aversion. However, we would argue that the basic conclusion that even a temporary increase in uncertainty can make a postponement of job creation optimal is robust because a prolonged period of high uncertainty means that expected returns beyond the next period would be discounted more heavily. Moreover, the additional impact of risk aversion on job creation should be stronger under the realistic assumption that firms bear all the exchange rate risk.

In sum, we retain two conclusions from the model. First, even a *temporary* "spike" in exchange rate variability can induce firms to postpone the creation of jobs (of course and for exactly this reason, the level of the exchange rate at the same time loses explanatory power). Second, the relationship between exchange rate variability and (un)employment should be particularly strong if the labour market is characterised by rigidities that improve the bargaining position of workers. A stronger fallback position of workers raises the contract wage, lowers the net returns to firms and induces firms to delay job creation in the face of uncertainty.

Our argument rests on the assumption that workers cannot be fired immediately if the exchange rate turns out to be unfavourable. Hence, sunk wage payments are associated with the decision to hire a worker. These sunk costs and, consequently, the impact of uncertainty on job creation become more important if there are high firing costs. However, as we argued in Belke and Kaas (2002), even if there are no firing costs and if workers can be laid off at any point in time, exchange rate uncertainty should have a direct impact on job destruction. Under the scenario of a labour market in which the firm and the worker can sign a contract only for one period and keep the option to terminate the work relationship whenever it becomes unprofitable, we show that the probability of job destruction is increasing in uncertainty. Hence, there is also a negative impact of exchange rate uncertainty on employment in this case. Moreover, this amount is more pronounced if the worker's fallback wage is higher. Therefore, the basic conclusions of the model presented here remain valid.

3. How to measure exchange rate variability?

We now proceed to the practical issue of how one should measure exchange rate variability. We used a very simple measure: for each year of our sample 1973 to 2001, we calculated a standard deviation of the basis of 12 monthly observations of the first difference of the exchange rate. What kind of exchange rate did we take as the basis for our calculations? We used both the nominal effective rate of the US and the euro area (reconstituted for the past) and the bilateral euro/dollar rate. In order to attain percentage changes, we directly used the first difference of the raw numbers for the effective exchange rates as they are indices, with a base around 100. In the case of the bilateral euro/dollar rate we used the first difference of the natural logarithm. The historical series of the external exchange rate of Euroland was taken directly from the official sources, which calculate the average of bilateral exchange rates of the original 11 euro countries, with weights given by the non-euro trading partners.

We use monthly exchange rates to calculate volatility instead of daily (or other higher frequency) volatility because the required data were easier to obtain on a consistent basis for the entire sample period. Another reason to prefer this measure over more short-term alternatives (eg, daily variability) was that we are convinced that

while the latter might be important for financial investors it is less relevant for decisions on whether to export or to invest, which have a longer time horizon. The drawback of this decision was that we had to use annual data in order to have a meaningful measure of variability. We thus had only about 28 observations for each country, but this turned out to be sufficient.

In principle one could have used option prices to extract implicit forward-looking volatilities, but options prices are generally available only for the US dollar and sometimes against the DM, and even then only for limited periods. Hence it would not have been possible to construct a measure of euro volatility on a consistent basis using option prices. We used actual exchange rate changes instead of only unanticipated ones, but at the monthly horizon the anticipated change is usually close to zero. Hence actual and unanticipated changes should give the same results.

An advantage of using monthly data is that price indices are available on a monthly basis so that one could use real exchange rates. We have preferred to use nominal rates in this first test since over a short-term horizon nominal and real exchange rates are usually highly correlated. The average variability (standard deviations) of the nominal effective exchange rate of the euro area was 1.13% for the post-1973 period, while that of the US was much higher at 1.96%. Lastly, the average volatility of the nominal dollar/euro exchange rate amounts to 2.35%.

4. Empirical analysis

In this section, we present and comment on the results of the first tests on the importance of two measures of exchange rate variability (effective and bilateral), and two measures of labour market performance (changes in unemployment and employment growth) on both sides of the Atlantic. We start with the following statement: exchange rate variability enters all equations with the expected sign, and is statistically significant in nearly all cases.

Methodology

In cases of doubt we always preferred *taking differences* since the disadvantages of differencing when it is not needed appear to us much less severe than those of failing to difference when it is appropriate. In the first case, the worst outcome would be that the disturbances are a moving average, but the estimators would still be consistent, whereas in the second case the usual properties of the OLS test statistics would be invalidated. All macroeconomic series were taken from the Ameco data set of the EC Commission. All exchange rate data were taken from the IMF (see annex).

As a first step, we present the results of some simple tests. We explain the first difference of the unemployment rate and the first difference of the index of employment by their own past and lags of our measure of exchange rate variability. The results that are summarised below in the first row of tables 3 and 4 are thus standard causality tests on the annual data used throughout this section.

Tables 3 and 4 summarise the regression results from bivariate VARs on annual data (1973-2001, sometimes shorter periods had to be used subject to data availability).[8] The

[8] The individual regression results are available on request.

hypothesis tested is, as usual, that exchange rate variability does not have an influence on the two variables investigated here.[9]

All the results presented here are implicitly based on a comparison of two regression equations (notations chosen for consistency reasons, for a similar procedure see Belke and Gros 2001, pp. 238 ff., and with an application to export shocks Belke and Gros 1999):

$$(8) \qquad DUE_t = \alpha_0 + \sum_{i=1}^{N} \alpha_i \cdot DUE_{t-i} + u_t, \text{ and}$$

$$(9) \qquad DUE_t = \alpha_0 + \sum_{i=1}^{N} \alpha_i \cdot DUE_{t-i} + \sum_{i=0}^{N} b_i \cdot EXV_{t-i} + u_t,$$

where DUE_t stands for the change in the unemployment rate (between period t and t-1), EXV_{t-i} specifies the level of intra-European exchange rate variability (between period t-i and period t-i-1), u_t represents the usual i.i.d. error term and N is the maximum number of considered lags (according to Belke and Gros (2001), two lags). Exchange rate variability (measured by an indicator as explained above in section 3) can then be said to "cause" unemployment if at least one ß, ie, one of the coefficients on the past and contemporaneous (change in) exchange rate variability, is significantly different from zero. In other words, these tests measure the impact of the stationary level of exchange rate variability on changes in national unemployment rates once the autonomous movements in unemployment have been taken into account by including lagged unemployment rates among the explanatory variables. Thus, a significant effect (of whatever sign) implies that one can reject the hypothesis that exchange rate variability does not influence unemployment at the usual confidence levels. In order to be allowed to use the standard t-distribution for the purpose of model selection, one has to use *changes* of the unemployment rate as the level of this variable (as opposed to our measure of exchange rate variability) is clearly *non-stationary*. Substituting the change in employment (DEMPMAN) in the above setting describes our proceedings in the case of employment and investment instead of unemployment.

[9] We thus use VARs in first differences of the respective real variables. Since we classify all real variables as integrated of order one, we feel justified to deviate from the usual specification of an Augmented Dickey-Fuller test (including a drift term) only by neglecting the (insignificant) lagged endogenous level variable. The significance of the coefficient estimates of the lags of the changes in the real variables and of the indicator of exchange rate variability can then be judged on the basis of the usual standard normal respectively the asymptotic values of the student-t-distribution. Cf. Belke and Gros (2001) and Haldrup (1990), pp. 31 f.

Table 3. – Regression results based on the variability of the nominal effective exchange rate

	Euroland		***US***	
	Unemployment	**Employment**	**Unemployment**	**Employment**
Basic, best specification	0.61** 0.82***(-2)	-0.63* -1.21*** (-2)	0.50**	-0.28
Robustness: additional variables				
First differential of exchange rate	0.57** 0.81*** (-2)	-0.56* -0.51* -1.22***	0.46**	-0.34
Spread (long - short term)	1.06***	-1.55***	0.31**	-0.55**
Real short-term interest rate	1.01***	-1.52***	0.33*	-0.29
Change in real short-term interest rate	1.00***	-1.50***	0.36**	-0.46*

Note: Point estimates for the impact of exchange rate volatility are displayed together with their significance levels (***: 1 %; **: 5 %; *: 10 %). Numbers in brackets refer to the lags of the implemented volatility variable.

Table 3 shows the results using the level of effective nominal exchange rate variability, and Table 4 the ones for the variability in the bilateral euro/dollar rate.
For each of the two variables mentioned, we first used as explanatory variables only their own past and lags of exchange rate variability. The results reported in the first row imply that exchange rate variability, whether measured by the standard deviation of the nominal effective rate or by that of the bilateral euro/dollar rate, has a significant impact.

Table 4. – Regression results based on the variability of the nominal bilateral euro/dollar exchange rate

	Euroland		***US***	
	Unemployment	**Employment**	**Unemployment**	**Employment**
Basic, best specification	0.41**	-0.57* (-1)	0.41**	-0.69** (-1)
Robustness: additional variables:				
First differential of exchange rate	0.40**	-0.54* (-1) -0.73** (-2)	0.45**	-0.59** (-1)
Spread (long - short term)	0.45***	-1.01** (-1)	0.34**	-0.94*** (-1)
Real short-term interest rate	0.38**	-1.18* (-1)	0.37**	-0.69** (-1)
Change in real short-term interest rate	0.55***	-1.48** (-1)	0.47***	-0.83** (-1)

Note: Point estimates for the impact of exchange rate volatility are displayed together with their significance levels (***: 1 %; **: 5 %; *: 10 %). Numbers in brackets refer to the lags of the implemented volatility variable.

As exchange rate variability could be either caused by or stand for some other macroeconomic variables, we also performed a series of robustness tests by adding

- the level of the exchange rate,
- the spread between long- and short-term interest rates, and,
- the (first difference of) real short-term interest rates.

Only the coefficient estimate, its significance level and the lag order of exchange rate variability are displayed in the summary tables. The numbers in parentheses correspond to the lag order of exchange rate variability. For example, if the impact effect is estimated to be lagged by two years, this might indicate inflexibilities in the respective national labour market. The expected sign of the (change in) exchange rate variability is positive for (the changes in) the unemployment rate and negative for (the changes in) employment.

The specification of the underlying equations is based on the usual diagnostics combined with the *Schwarz Bayesian Information Criterion (SCH)*. The latter is chosen as our primary model selection criterion since it asymptotically leads to the correct model choice if the true model is among those under investigation. The regression that reveals the lowest SCH-value and at the same time fulfills the usual diagnostic residual criteria is chosen. As already stated above, the sample chosen is from 1973 to 2001 in order to exclude the Bretton Woods period of fixed exchange rates, which would have introduced structural breaks in the relationships. The procedure is exactly the same for each country. We never intervene to exercise a discretionary judgment. As usual, we add country specific dummies from time to time in order to account for possible breaks in the VAR relations. These dummies are added only if they improve the SCH statistics even if a penalty for the extra dummy is taken into account) and do

not lead to a rejection of the normality assumption of the residuals. At the same time, they should contribute to fulfill the criteria on the residuals, especially those on normality. However, none of our results is due to the implementation of these dummies. Most of the dummies were also economically meaningful (relating to the two oil crises, or the onset of EMU for Euroland) and most disappeared when policy variables were introduced in the robustness tests below.

Summary of results

The results have to be read from tables 3 and 4 in a particular way. In these tables, point estimates for the impact of exchange rate volatility are displayed together with their significance levels. For Euroland, the point estimate obtained from the first specification implies that a decrease of one percentage point in the variability (standard deviation) of the nominal effective exchange rate of the euro is associated during the same year with a decrease in the Euroland unemployment rate of nearly two thirds of a percentage point; and this is followed two years later by another reduction in the unemployment rate of 0.82 percentage points. We will comment only briefly on the impact coefficients because the longer-run effects depend on the dynamic behavior of the variables (Belke and Gros 2001).

The first upper right entry in Table 3 comes from a standard causality type regression, and we have reproduced the results in detail below in Table 3a in order to give a concrete example. This entry refers to the impact of the variability of nominal effective exchange rates on Euroland labour markets. The dependent variable in this case is represented by the change in the unemployment rate (DUREU). The depicted specification of the regression equation leads to the "best" result in terms of the (lowest realisation of) Schwarz criterion.

Table 3a – Example regression for Euroland: unemployment rate on the variability of nominal effective exchange rates

Dependent Variable: DUREU
Method: Least Squares
Sample: 1973 2001
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.547368	0.450076	-3.438017	0.0022
DUREU(-1)	0.738169	0.129756	5.688894	0.0000
EXVNEEREU	0.614833	0.255707	2.404448	0.0246
EXVNEEREU(-2)	0.821263	0.269925	3.042559	0.0058
D83	-1.362151	0.520793	-2.615531	0.0155
D92	1.194570	0.453450	2.634402	0.0148

R-squared	0.677388	Mean dependent var	0.189655
Adjusted R-squared	0.607255	S.D. dependent var	0.703230
S.E. of regression	0.440709	Akaike info criterion	1.381129
Sum squared resid	4.467169	Schwarz criterion	1.664018
Log likelihood	-14.02637	F-statistic	9.658632
Durbin-Watson stat	2.018440	Prob(F-statistic)	0.000045

A similar story emerges when one carries out the same test on the rate of employment growth defined as the first difference in the index of employment, ie, roughly speaking the percentage change in the number of employed persons. Exchange rate variability had a significant impact on the European labour market from this angle as well. The regression result for the impact of the variability of nominal effective exchange rates for Euroland on the dependent variable employment (DEMPEU) is dis-

played in Table 3b (again we chose the "best" fit in terms of lowest realisation of the Schwarz criterion). Reverse causation does not appear plausible as mirrored by additional pairwise Granger-causality tests applied to exchange rate variability and the labour market variables used in the regressions. In addition, we rate the possibility that exchange rate variability at our high frequency was caused by slow-moving variables such as labour market rigidities or moderate unemployment. Lastly, there is evidence that exchange rates mainly react to financial rather than to real fundamentals like labour market variables (Canzoneri et al. 1996). If exchange rate volatility is largely noise (Rose 1996, Flood and Rose 1995), it does not make sense to treat this variable as endogenous and to regress it on labour market variables. Let us now turn to some robustness tests of the empirical results gained so far.

Table 3b – Example regression for Euroland: employment growth on the variability of nominal effective exchange rates

Dependent Variable: DEMPEU
Method: Least Squares
Sample: 1973 2001
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.912109	0.733383	3.970791	0.0006
DEMPEU(-1)	0.617423	0.120250	5.134506	0.0000
EXVNEEREU	-0.635770	0.343156	-1.852712	0.0774
EXVNEEREU(-1)	-0.548227	0.337184	-1.625899	0.1182
EXVNEEREU(-2)	-1.212938	0.325619	-3.725026	0.0012
D91	7.938697	0.637798	12.44705	0.0000
D92	-6.862967	1.183268	-5.800010	0.0000
R-squared	0.924131	Mean dependent var		0.757825
Adjusted R-squared	0.903439	S.D. dependent var		1.849384
S.E. of regression	0.574681	Akaike info criterion		1.936503
Sum squared resid	7.265691	Schwarz criterion		2.266540
Log likelihood	-21.07930	F-statistic		44.66221
Durbin-Watson stat	1.727141	Prob(F-statistic)		0.000000

Robustness: The Impact of Potential Shock Absorbers

The purpose of the following is to report the results of some tests for the robustness of the relationships found so far. We try to take into account the three most plausible ways in which exchange rate variability could stand for some other variable. For each hypothesis, we then implement the same procedure based on the SCH criterion explained above.

The three hypotheses we consider are:

i) Exchange rate variability is just a sign of a misalignment (ie, a wrong level of the exchange rate).
ii) Exchange rate variability just reflects the stress caused by a tight monetary policy, the tightness of monetary policy being measured by the spread, the difference between long- and short-term interest rates.
iii) Exchange rate variability just reflects the stress caused by a tight monetary policy, but tight monetary policy is defined as high real short-term interest rates.

Re (i): A first possible reason for the significant negative (positive) correlation of exchange rate variability with (un-) employment might be that this volatility just

stands for misalignments of the real exchange rate. The basic argument is simple: the dollar (or the euro, or its main component, the DM) was very strong when it was also variable. This argument could also be turned on its head because one suspects that the dollar was variable when it was very weak. But it needs to be addressed because it represents a popular explanation for the results we obtain.

In order to take this hypothesis into account, we added the first difference (the level is not stationary) of the (nominal) effective exchange rate (NEER) in the regressions displayed in the second rows of Tables 3 and 4. Note again that point estimates *for the impact of exchange rate volatility* are displayed together with their significance levels. The results suggest that this hypothesis does not hold a lot of explanatory power as the addition of the level of the exchange rate does in no case change the magnitude or significance level of the coefficient of exchange rate variability. Except for the case of the US (employment), the latter remains highly significant.

Re (ii): Transatlantic exchange rate variability could also just be the result of tight monetary policy pursued on either side. The hypothesis is that a restrictive monetary policy leads to employment losses in the short term, and this is exclusively assigned to exchange rate variability in Tables 1 and 2. However, this problem of identification can be reduced by explicitly adding a variable that indicates the tightness of the national monetary policy to the equation. We use the *spread* (long- minus short-term interest rates) as a first indicator. This control variable actually improves the performance of the equation overall, and has the additional advantage of eliminating the two lagged effects that appear for Euroland in some cases.

Re (iii) Adding only the real short-term interest rate to the equation also does not change the results in the sense that the coefficient on exchange rate variability remains significant. We used both the level and the first difference of this control variable because it was not clear whether it is stationary or not. However, as the last two rows of tables 3 and 4 show, the results are virtually identical whether one uses the level or the first difference (at least if one uses nominal effective exchange rates).

For Euroland we thus find that in all equations exchange rate variability is significant and enters with the expected sign. For the US there are, however, more entries in the unemployment column. It is interesting to note that, by contrast, for Euroland the impact on employment seems to be stronger. Taking the strong evidence in favour of *eurosclerosis* in some larger eurozone countries, such as Germany, into account, this strong result is in line with the labour market model developed in chapter 2.[10]

5. Some remarks on the necessity of international economic policy coordination

Our main policy conclusion is that reducing exchange rate variability in the two dominant G3 economies might deliver substantial *benefits*. The data from the past suggest that exchange rate variability had a statistically significant negative impact on unemployment and employment in Euroland. For the US, the evidence points only to an impact on unemployment. This weaker result is on the one hand probably due to higher flexibility in the labour markets and, hence, to a minor importance of hiring and firing costs in the US. However, volatility in the bilateral rate *and* in the nominal effective rates seems to matter. On the other hand, the potential exposure of the US economy to exchange rate variability compared with Euroland is significantly weaker. If one looks at the share of trade in national income, it becomes obvious that while

[10] We enacted our regression analysis for measures of real exchange rate variability (see annex) as well. These measures are highly correlated with our measures of nominal exchange rate variability and led to nearly the same results.

Euroland as a whole is less open than its constituent members, it is substantially more open than the US.

Hence, some commentators, such as Robert Mundell (2000), argue that it would be a great mistake to believe that the closed nature of the three big blocs of the G-3 would make exchange rates less important, or that the dollar/euro rate can be treated with "benign neglect". In addition, total bilateral trade between Euroland and the US is the most important bilateral trade relationship in the world, indicating the relative importance of the US dollar/euro exchange rate. He argues that given the large degree of inflation convergence achieved, the long-term thrust of monetary policy is actually very similar throughout the G-3. Therefore, it should be possible to agree on a common line that makes it possible to contemplate *joint action* to reduce excessive exchange rate variability.

We would argue that volatility matters because employment decisions (as investment decisions) have some degree of irreversibility. Job creation is discouraged by higher exchange rate variability, and the effect should be more pronounced when labour markets are "rigid". The estimated effect of volatility on (un)employment might appear to be economically small. In fact, a decrease of one percentage point in the standard deviation of Euroland's nominal effective exchange rate (which amounts to abandoning all volatility) reduces unemployment by only half a percentage point. However, we should point out that this is only the impact effect in the first year, whereas there are also substantial lag effects in some regressions.

A common argument against reducing exchange rate variability is the position that volatility must have a valve somewhere else. In other words, could the gains from suppressing exchange rate variability that are suggested by our results be lost if the volatility reappears elsewhere, for example in higher interest rate variability? We would argue that recent research suggests this is true. Seen on the whole, the existing literature is sceptical about the "squeeze the balloon" theory, ie, a trade-off between exchange rate volatility and the volatility of other variables. Rose (1996), for example, shows that official action can reduce exchange rate variability, even holding constant the variability of fundamentals such as interest rates and money. Coordination between the Fed and the ECB could thus, at least theoretically, keep the dollar/euro volatility under control. This view is supported by results of Flood and Rose (1995) who show that there is no clear trade-off between exchange rate volatility and macroeconomic stability. Furthermore, Jeanne and Rose (1999) develop a model of a foreign exchange market with an endogenous number of noise traders and multiple equilibria of high and low exchange rate volatility. In their model, monetary policy can be used to lower exchange rate volatility without affecting macroeconomic fundamentals. In the same vein, Canzoneri et al (1996) show that exchange rates do not generally move in the direction one would expect if they were to offset shocks. Hence, we would argue that the "squeeze the balloon" theory argument is probably not the decisive one to reject transatlantic monetary policy coordination. Instead, we claim there are other more important reasons, discussed below, that strongly and more significantly run against the latter.

The main focus of this section is to give models of the exchange rate volatility/labour market channel a stronger theoretical background and to illustrate the main findings by first simple regressions. However, much further work is needed to corroborate our first preliminary empirical results so that they can be used as a basis for concrete policy recommendations. In particular, one should concentrate on the implications for the debate on the design of EU/US monetary relations and especially on the role one believes the exchange rate should play in monetary policy, ie, the *desirability* of influencing the exchange rate. We realise that our results are preliminary,

not least because the questions posed in this section *have not been posed* in this way in the literature so far. We have a limited number of observations owing to the annual data we use, which is a further reason to be cautious.

Monetary policy coordination?

Many readers might sympathise with the point of view that exchange rate variability is usually not connected with variability in the fundamentals and thus undesirable. However, and unfortunately for some, *concrete action to reduce exchange rate variability* at least among the G-3 seemed to be either impossible or politically unacceptable until the events of 11 September 2001 (Mundell 2000, 2000a). The same is valid with respect to *labour market deregulation* in the eurozone. However, both measures would (according to our model and at least theoretically) be complementary and get rid of the negative impacts of euro/dollar volatility on labour markets.

In the introduction to this section, we emphasised that demands for a closer international coordination of (macro) economic policies, especially of monetary policy, are popular with politicians. Hence, we might ask whether the empirical results presented in this section justify a claim that gearing monetary policy to the dollar/euro exchange rate via coordination will lead to substantial benefits?

In discussing the arguments in favour of an international coordination of economic policy, we will first take a look at the international economic interdependencies and thus on possible spillovers, ie, on the effects the economic development and the economic policy of one country has on the rest of the world. After that, the justification for an international policy coordination is examined.

Over the years, international linkages have grown in importance. Since the early 1950s, the volume of world trade has grown faster than the GDP of the industrialised countries. Their degree of openness has thus increased distinctly. The international flows of capital have grown even faster than world trade. This resulted in highly integrated international financial markets. Since portfolios can be restructured quickly, exchange rates became more volatile. All this had the effect that international linkages and the international transmission of economic developments and economic policy became much more important than in the past. This has been enforced in recent years by some new factors making economic interdependencies, especially between Europe and the US, even stronger. Since ICT goods and services are characterised by a high value-to-weight ratio, an advanced degree of vertical specialisation, and a highly internationalised production, their emergence adds a new dimension to the international linkages that is not fully reflected in the trade figures. This makes international transmission more important than in the past (Begg et al 2002). Therefore, potential for the international transmission of business cycles is high.

In contrast to this, all empirical studies show that international spillovers are of only a modest magnitude. In addition, there seems to be an asymmetry between the US and the rest of the OECD: whereas the economic goals of the US are hardly affected by economic policy measures in the rest of the OECD, the economic policy of the US has a significant impact on the other highly industrialised countries (Bryant et al., 1988). Although international linkages and international transmission are certainly undeniable facts, they do not show up in empirical estimates of spillovers. A reason could be that the interdependencies have been accelerating so that an estimation with past data will lead to an underestimation of their present importance. But on the other hand, it could well be that the low values of spillovers have to be taken seriously and the international co-movement of central economic indicators has to be explained differently, namely by common shocks. In case they would have hit most of the highly

industrialised countries simultaneously, one would not have to rely on international linkages and spillovers.

This and the low estimated values for the spillovers suggest more cautious expectations with respect to possible effects of international coordination on welfare. But there are reasons for even more caution since the demands for more international coordination cannot be justified economically by the existence of significant spillovers alone. This is only one necessary condition to which a further one has to be added: the foreign economic policy has to exert interdependent effects and the home country does not have enough instruments to reach all its goals. So international coordination cannot be justified if

- there are no spillovers;
- the domestic goals are affected by the foreign policy in the same way as by domestic measures (in that case all spillovers from abroad could be neutralised by combinations of domestic instruments);
- a country can reach all its goals by itself (ie, it has as many independent instruments as goals).

Those who demand more international policy coordination first of all have to prove that none of these cases is relevant. In addition, they have to show that policy coordination is in the interest of the countries that are envisaged to participate. This point can be discussed within a game theory approach that Hamada (1985) has introduced into the debate. It is used to solve the strategic decision problem that can arise in a flexible exchange rate system if an internationally uncoordinated policy to fight inflation unintentionally leads to a recession. This is the case if every country by means of a restrictive monetary policy tried to create an appreciation of its currency, and by that an increase of unemployment to bring the inflation rate down. Although an appreciation of all currencies is of course not possible, this would lead to an unintended recession. Hamada and others (eg, Cooper 1985) show that a cooperative solution and even a Stackelberg solution (where one country takes the lead and the others follow) are in terms of welfare superior to a non-cooperative outcome like a Cournot-Nash-solution. A country can reach all its goals by itself (ie, it has as many independent instruments as goals).

All empirical studies done on the basis of this theoretical approach show very low effects on welfare from the international coordination of economic policy. Even these results have to be interpreted cautiously since they are only valid under restricted assumptions: eg, international coordination is costless, the true macroeconomic model is known to all, there are no incentives for cheating, politicians always act in the interest of their voters etc. Since it cannot be assumed that they all hold, the empirical results could be insignificant.

More recently, new aspects relevant to the international policy coordination issue have been brought forward by models of the new open economy macroeconomics (Corsetti and Pesenti 2001, Betts and Devereux 2000, Obstfeld and Rogoff 2001). Among others, the models analyse the impact of exchange rate uncertainty on the volume of trade and, through this channel, also on the labour market performance, risk premia in setting export prices and the impact of deeper financial market integration. Contrary to intuition and to the approaches discussed, those new models show that a *deeper integration of international financial markets will lower the welfare gains from policy coordination*. If international portfolio diversification creates interdependencies between the consumption growth rates of different countries, it is in the interest of all countries to take into consideration the economic situation abroad when formulating their policies. It would be to their own detriment if they did not do this.

Another important result is the superiority of monetary rules to which central banks are firmly committed over discretionary monetary policy. On the basis of this argument and the many others we have put forward in this respect in our past reports, we favour an international coordination of monetary policies on the basis of rules. The US, Japan and the EMU should choose a monetary strategy to guarantee price level stability. The concrete form of that strategy does not have to be the same, but it is important that it produces the expectation of stable prices. It is important is that smaller countries could then set an exchange rate goal vis-à-vis these stability oriented countries and could by this import price stability. If their strategy is credible, a lot of benefits will result: fixed exchange rates, low actual and expected inflation. Bilateral exchange rates would only then have to adjust to real shocks but no longer to monetary ones. They thus would be stabilised (See Meltzer 1996).

In our recent work (Belke and Gros 2002a), we find a high degree of correlation between domestic monetary policy volatility, interest rate volatility, and exchange rate volatility. However, the results seem to indicate that this correlation cannot be interpreted as a causal relationship, again emphasising our confidence that both volatilities are driven by international financial markets.

Hence, the questions of what is driving the volatilities of exchange rates and interest rates (eg, monetary policy) cannot be answered within this section. However, our model is valid independent of what exactly drives the random walk in exchange rates: relative domestic monetary policies or international common monetary shocks. We might be able to draw further policy conclusions based on an additional report that could try to identify the causing variable. The most important but by now largely unresolved research question is how much volatility is entailed in alternative monetary policy regimes.

We base our policy conclusions on the present state of analysis as we see it. However, the academic understanding of international economic interdependencies in trade as well as in financial markets and especially their dynamics is far from perfect. The New Open Macroeconomics is a rapidly growing area of research, so new theoretical and empirical results will improve our knowledge. The case study presented at the beginning of this section was made along these lines and produced some new arguments that could deliver some support for the international coordination case. At present, one should, however, be cautious not to draw simple and premature conclusions like that. Instead, one has to examine these and other new theoretical arguments and empirical evidence very carefully before basing policy advice on them. Therefore, we will first engage ourselves in further research and watch the work of others in this area, and then will try a fair and deliberate assessment of what could responsibly be recommended for policy action.

Part 2: Does the ECB follow the FED?

CONTENT*: 1. Introduction. – 2. ECB and Fed interest rate setting – first prima facie evidence. – 3. An extended empirical analysis. – 4. Conclusions.*

SUMMARY: *The belief that the ECB follows the Fed is so entrenched with market participants and commentators that the search for empirical support would seem to be both a waste of energy and a trivial task. However, as this task is much less straightforward than conventional wisdom would have one believe, this section aims to give an answer to the question whether the ECB has followed the Fed. According to our analyses there is little support for the proposition that the ECB systematically reacted in response to the Fed (or its converse). Apart from concerted actions in times of crises (11 September 2001), our findings suggest that monetary policy coordination efforts between the ECB and the Fed – even if there were any – do not play a statistically convincing role in explaining the ECB's actual interest rate setting policy since its inception.*

1. Introduction

In this section we will address the question of whether the ECB has systematically followed the US Federal Reserve in setting interest rates. Such a behaviour of a young institution like the ECB would not come as a surprise to some given the need to build up credibility and competence in a relatively short-period of time: Following the monetary policy actions of the Fed might be regarded as a rational strategy on the part of the ECB, offering the chance to import the Fed's reputation. However, the ECB might well have had a rationale for refusing to engage in such co-operation since it might otherwise lose its independent status and neglect its focus on domestic price stability. It fact, in following the Fed the ECB would not gain any credibility in the initial phase of EMU if a policy of a "follower" does not lead to the desired results. Whether the ECB has in fact followed the Fed since its inception or not is an empirical question. The empirical issues will be addressed in the following paragraphs.[11]

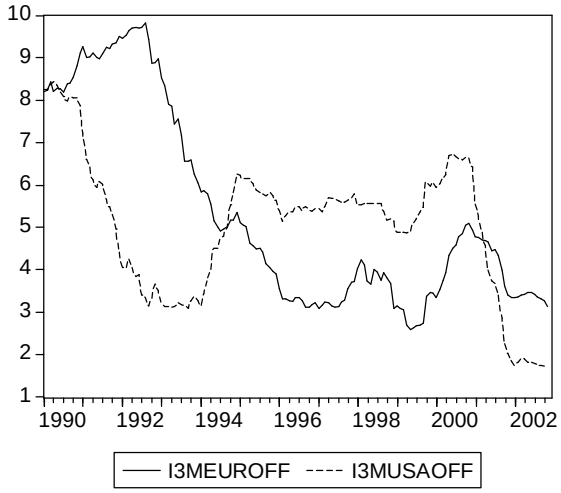
2. ECB and Fed interest rate setting – first prima facie evidence

A simple way to answer this question might be to look at the behaviour of the official rates set by the ECB and the Fed. However, these rates do not move frequently enough to allow the use of standard statistical methods. Hence one has to find indicators from financial markets, for example short term interest rates. Although central banks do not directly set the most widely watched indicator of short monetary conditions, namely the 3-month interest rate, they can nevertheless determine pretty much its evolution. If the ECB had systematically followed the evolution in the US (moves by the Fed as well as changes in US financial markets), one would expect to find that

[11] The question whether the ECB follows the Fed is intertwined with the question of whether the US business cycle leads and determines the European cycle. However, there is still a lack of convincing evidence in the data supporting this hypothesis. A simple fact suggests that if there is a determining influence of the US cycle on Europe it cannot has not been transmitted through traditional channels: Net exports did not contribute to the 2001 slowdown in the euro area (the contribution of net exports to demand growth was approximately the same in 2000 and 2001). Thus, it seem reasonable to assume the contagion must have come through the financial markets.

changes in US interest rates tend to lead changes in euro area short-term rates. At first sight this seems to have been the case if one looks at the short life span of the euro (see figure 1). Figure 1 plots the two series in question since the start of EMU.[12] This figure suggests at first sight that the US was leading the euro area by around one month both when interest rates were going up, from the trough in early 1999 and when they started falling in early 2000. Many observers concluded from this apparent relationship that the ECB mimicked the Fed in its monetary decisions. However, this popular belief cannot be corroborated by statistical analysis.[13]

Fig. 1. – Three-month interest rates in the EU and the US



Data source: Datastream Primark.

The procedure used here to ascertain the existence of a follower-leader relationship was a Granger-causality test procedure. These tests can show whether past values of a certain variable (e.g. US interest rates) influence another variable (e.g. euro interest rates) after one has taken into account the patterns that might link the second variable (euro rates) to its own past. A battery of statistical tests was run covering the entire euro period (1999-early 2002)[14]. This gave the result that US interest rates influence euro interest rates during the same month. However, the US interest rate of the previous month did not have a statistically significant influence on the current month euro interest rate when all these other factors were taken into account.[15] This suggests that the visual impression of a US leadership over the entire euro period might be misleading.

In view of the above considerations the conclusion to be drawn is that there is no statistical evidence proving that the ECB follows the Fed. However, the absence of evidence also works the other way round: It is impossible to prove that the two are in-

[12] The data we use comprise the sample 1994:01 to 2002:10, and are taken from the homepage of the European Central Bank (http://ecb.eu.int). *U.S.*: US3m LIBOR, *Eurozone*: until 1997:12: DM3m FIBOR Bundesbank, from 1998:01: EURO3m EURIBOR.

[13] Begg et al. (2002, p. 42) and Breuss (2002, p. 13) see a time lag between Fed and ECB interest rate decisions. They attribute the reason for the Fed's moving first to the US cycle leading the euro zone's.

[14] We used first differences, i.e. changes in interest rates, since the level series seemed to contain a unit root.

[15] Incidentally by looking at the behaviour of US interest rates over time we found that euro interest rates also influence US interest rates, again during the same month.

dependent of each other because the moves on both sides of the Atlantic so often seemed to be contemporaneous. This is actually what one would expect if the most important shocks have come from global financial markets and both have been equally quick to respond to them. Our conclusion is supported by Peiró (2002, p.149), who finds "a preponderance of synchronic over dynamic relationships [which] can be regarded as evidence in favour of those theories that attribute the origin of world cycles to common shocks". Table 1 below gives a sample of the type of results we obtained.

Tab. 2. – Regression of the 3-month interest rate in the euro area on the 3-month interest rate in the US (in first differences)

Dependent Variable: DI3MEUR (first difference in euro 3-month interest rates)
Method: Least Squares
Sample (adjusted): 1999:01 2002:10
Included observations: 46 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.032744	0.016000	2.046515	0.0472
DI3MEUR(-1)	0.185143	0.079483	2.329339	0.0248
DI3MUSA	0.373523	0.068981	5.414891	0.0000
D9904	-0.371603	0.099611	-3.730547	0.0006
D9910	0.383853	0.110030	3.488602	0.0012

R-squared	0.726428	Mean dependent var	0.003913
Adjusted R-squared	0.699738	S.D. dependent var	0.179313
S.E. of regression	0.098257	Akaike info criterion	-1.700141
Sum squared resid	0.395831	Schwarz criterion	-1.501376
Log likelihood	44.10325	F-statistic	27.21722
Durbin-Watson stat	1.333784	Prob (F-statistic)	0.000000

3. Further steps of empirical analysis

This section will outline our statistical approach in more detail. As explained in the main text, the 3-month short-term interest rates of the US and the euro area were used as they are widely watched indicators of the monetary policy stance. In order to cope with the relatively short sample available for the EMU period we also include up to 9 years before the start of EMU in our analysis, implicitly testing the validity of the leader-follower hypothesis for the ECB's predecessor, the Bundesbank, as well. However, the behaviour of the latter might have also been influenced by the anticipation of EMU.

Preliminaries

The first step in the empirical work concerned the choice of the statistical procedure. The simplest available procedure was chosen to ascertain the existence of a follower-leader relationship; i.e. the so-called Granger-causality tests (and related approaches). These tests can show whether past values of a certain variable (e.g. US interest rates) influence another variable (e.g. euro interest rates) after the patterns that might link the second variable (euro rates) to its own past have been taken into consideration. In order to make sure that our results do not depend on the particular test period chosen, we ran a battery of statistical tests for a number of periods, e.g. covering the entire euro period (1999 until October 2002) and different periods from 1995 onwards.

Before the regressions were run, however, an important empirical caveat had to be taken into account. Since the level series seems to contain a unit root[16] and Granger causality tests tend to give misleading results if the variables considered in the VAR contain unit roots, it was first tested whether the interest rates were actually stationary during the time period considered. The results of the unit root tests are summarised in the following two tables separately for euro and US dollar interest rates. It appears that the series have to be differenced once (to get the change in interest rates between two periods) in order to make them stationary. The null hypothesis in each case is that the variable under consideration is non-stationary. The conclusion to be drawn from the above standard unit root tests is that both the euro (I3MEUR) and the US interest rate (I3MUSA) cannot be rejected to be integrated of order 1 (i.e. a time series of the changes is stationary). This implies that the following Granger causality tests must be run in first differences, i.e. changes in interest rate. It is also a first indication that Figure 2.13 in the main text, which suggests a leader-follower relationship in levels, might be misleading.

Tab. 3. – Unit root tests, Augmented Dickey-Fuller unit root test for the euro interest rate (I3MEUR)

Levels			**Differences**		
Sample	*ADF Test Statistic*	*Lag order*	*Sample*	*ADF Test Statistic*	*Lag order*
1990:06 2002:11	-1.30	4	1990:07 2002:11	-3.30**	4
1995:01 2002:11	-2.59	2	1995:01 2002:11	-4.41***	2
1995:01 2000:12	-2.13	2	1995:01 2000:12	-3.91***	2
1999:01 2002:11	-1.40	2	1999:01 2002:11	-5.11***	2

*** (**, *) indicates significance of the ADF test statistics at the 1% (5%, 10%) critical value. MacKinnon one-sided critical values for rejection of hypothesis of a unit root. The ADF-test equation includes a constant. The lag length was chosen according to the Schwarz information criterion.

Tab. 4. – Unit root tests, Augmented Dickey-Fuller unit root test for the US interest rate (I3USA)

Levels			**Differences**		
Sample	*ADF Test Statistic*	*Lag order*	*Sample*	*ADF Test Statistic*	*Lag order*
1990:06 2002:10	-2.14	4	1990:07 2002:04	-3.33***	4
1995:01 2002:04	-0.52	2	1995:01 2002:10	-4.27***	2
1995:01 2000:12	-1.61	2	1995:01 2000:12	-5.38***	2
1999:01 2002:10	-0.35	2	1999:01 2002:10	-3.43**	2

*** (**, *) indicates significance of the ADF test statistics at the 1% (5%, 10%) critical value. MacKinnon one-sided critical values for rejection of hypothesis of a unit root. The ADF-test equation includes a constant. The lag length was chosen according to the Schwarz information criterion.

Granger causality

The next step was to use a standard statistical package to establish whether there is a follower-leader relationship between the changes in these two interest rates. The results are tabulated below. One should be well aware that the results often depend greatly on the lag structure. For robustness reasons and with an eye to our hypothesis of a possible break in the relation around the turn of the year 2000-01, a variety of dif-

[16] The level series does not fluctuate around a constant mean and its variance is not constant and finite.

ferent sample periods was also used. This enabled us to take into account that the periodicity of the lag is not a priori fixed by theory. Thus a range of results is summarized below.

Table 5: Results of Granger causality test by sample period and lag length

a) Lag length: two months

Sample period	Null hypothesis	Observations	F-statistic	Probability
1990:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	151	0.23860	0.78804
	DI3MEUR does not Granger Cause DI3MUSA	151	1.44150	0.23992
1995:01 2000:12	DI3MUSA does not Granger Cause DI3MEUR	72	1.97119	0.14729
	DI3MEUR does not Granger Cause DI3MUSA	72	0.91405	0.40584
1995:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	94	1.78149	0.17434
	DI3MEUR does not Granger Cause DI3MUSA	94	0.52539	0.59315
2000:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	34	0.05316	0.94832
	DI3MEUR does not Granger Cause DI3MUSA	34	0.95536	0.39645
1999:01 2000:12	DI3MUSA does not Granger Cause DI3MEUR	24	0.11296	0.89378
	DI3MEUR does not Granger Cause DI3MUSA	24	0.17906	0.83745
1999:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	46	1.45418	0.24539
	DI3MEUR does not Granger Cause DI3MUSA	46	0.42727	0.65516

b) Lag length: four months

Sample period	**Null hypothesis**	**Observations**	**F-statistic**	**Probability**
1990:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	149	0.71131	0.58551
	DI3MEUR does not Granger Cause DI3MUSA	149	1.31177	0.26858
1995:01 2000:12	DI3MUSA does not Granger Cause DI3MEUR	72	1.34197	0.26431
	DI3MEUR does not Granger Cause DI3MUSA	72	0.63530	0.63920
1995:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	94	0.97784	0.42408
	DI3MEUR does not Granger Cause DI3MUSA	94	0.98030	0.42275
2000:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	34	0.68688	0.60779
	DI3MEUR does not Granger Cause DI3MUSA	34	1.21298	0.33020
1999:01 2000:12	DI3MUSA does not Granger Cause DI3MEUR	24	0.17675	0.94691
	DI3MEUR does not Granger Cause DI3MUSA	24	0.46167	0.76279
1999:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	46	0.87300	0.48934
	DI3MEUR does not Granger Cause DI3MUSA	46	1.08915	0.37610

c) Lag length: twelve months

Sample period	Null hypothesis	Observations	F-statistic	Probability
1990:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	141	0.61660	0.82452
	DI3MEUR does not Granger Cause DI3MUSA	141	1.01232	0.44231
1995:01 2000:12	DI3MUSA does not Granger Cause DI3MEUR	72	0.80182	0.64669
	DI3MEUR does not Granger Cause DI3MUSA	72	0.84615	0.60427
1995:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	94	0.86555	0.58465
	DI3MEUR does not Granger Cause DI3MUSA	94	1.08233	0.38848
2000:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	34	1.81845	0.18756
	DI3MEUR does not Granger Cause DI3MUSA	34	3.73129	0.02798
1999:01 2000:12	DI3MUSA does not Granger Cause DI3MEUR	N.A.	N.A.	N.A.
	DI3MEUR does not Granger Cause DI3MUSA	N.A.	N.A.	N.A.
1999:01 2002:10	DI3MUSA does not Granger Cause DI3MEUR	46	2.16922	0.05801
	DI3MEUR does not Granger Cause DI3MUSA	46	1.48812	0.20521

Source: Own calculations. N.A. means 'not available' due to limited sample.

In no case does one have to reject the null hypothesis that the US interest rate does not 'Granger cause' the euro interest rate and vice versa. This is the result applying the usual 5% significance level. There is only one exception, using 12 lags and the sample period 1999:01 to 2002:10. Only in this one case is the US interest rate significant at the 10% level, in the equation for the euro interest rate. But using the specification (with the sample 2000:01 to 2002:10) for the US interest rate, it is also found that it is determined by the euro interest rate.

Bivariate VARs

One objection to the standard tests performed so far is that the 'normal Granger causality tests' might be unduly influenced by particular episodes. That is why the bivariate relationships were looked at in more detail. Vector autoregressions (VAR) identify the lag structure that seems to give the best econometric fit, as compared to other specifications. For the same reason as above, regressions based on first differences are stressed here. Thus the euro interest rate change is taken as the dependent variable and we analysed whether its variation could be explained by past changes of the euro interest rate as well as by contemporaneous and past changes of the US interest rate.

The US interest rate can be said to 'cause' the euro interest rate if at least one of the coefficients on past US interest rate changes is significantly different from zero. Thus, a positive sign implies that one can reject the hypothesis that the change in the US interest rate does not influence the current change of the euro interest rate at the usual confidence levels. Of course, our special interest is on the significance of the coefficient of the lagged change in the US interest rate.

Although regressions were also run over the whole sample available, i.e. from 1990 onwards (and these regressions essentially gave the same results), only the results from the regressions over the sample 1995:01 to 2002:10 (Tables 6.A) and over a

sample limited to the EMU period 1999:01 to 2002:10 (Tables 6.B) are displayed here. The best specifications (according to model selection criteria such as the Schwarz criterion) of three types of regression are presented. The first is the best specification possible without using dummies. In the second, dummies were used to capture the euro changeover and a surprise interest rate cut by the ECB. Although the lagged change in US interest rates was not found to be significant, a third specification was chosen to test whether a structural break in the coefficient on the lagged change of the US interest rate could nonetheless be identified. From the usual test statistics, the specifications look quite well identified. Note that the regression equations also satisfactorily cope with the events in the wake of the 11th September.

Table 6: Bivariate regression results
A. Estimations for the sample period 1995:01 to 2002:10

Panel a)

Method: Least Squares, Dependent Variable: DI3MEUR
Sample (adjusted): 1995:01 2002:10
Included observations: 94 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000666	0.016452	0.040474	0.9678
DI3MEUR(-1)	0.203689	0.093520	2.178030	0.0320
DI3MUSA	0.391138	0.088119	4.438743	0.0000

R-squared	0.270175	Mean dependent var	-0.022234
Adjusted R-squared	0.254134	S.D. dependent var	0.178922
S.E. of regression	0.154524	Akaike info criterion	-0.865544
Sum squared resid	2.172859	Schwarz criterion	-0.784375
Log likelihood	43.68058	F-statistic	16.84368
Durbin-Watson stat	1.845717	Prob(F-statistic)	0.000001

Panel b)

Method: Least Squares, Dependent Variable: DI3MEUR
Sample: 1995:01 2002:10
Included observations: 94 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003057	0.015006	-0.203727	0.8390
DI3MEUR(-1)	0.209853	0.083767	2.505187	0.0141
DI3MUSA	0.293767	0.084393	3.480948	0.0008
D9812	-0.548259	0.138570	-3.956545	0.0002
D9910	0.467564	0.148850	3.141164	0.0023

R-squared	0.434070	Mean dependent var	-0.022234
Adjusted R-squared	0.408635	S.D. dependent var	0.178922
S.E. of regression	0.137592	Akaike info criterion	-1.077326
Sum squared resid	1.684905	Schwarz criterion	-0.942044
Log likelihood	55.63431	F-statistic	17.06581
Durbin-Watson stat	1.679483	Prob(F-statistic)	0.000000

Table 6: Bivariate regression results *(cont'd)*
A. Estimations for the sample period 1995:01 to 2002:10

Panel c)

Method: Least Squares, Dependent Variable: DI3MEUR
Sample (adjusted): 1995:01 2002:10
Included observations: 94 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003952	0.015095	-0.261824	0.7941
DI3MEUR(-1)	0.237313	0.091983	2.579952	0.0115
DI3MUSA	0.323952	0.094126	3.441665	0.0009
DI3MUSA(-1)	-0.067712	0.092501	-0.732020	0.4661
D9812	-0.538946	0.139514	-3.863013	0.0002
D9910	0.457348	0.149891	3.051199	0.0030

R-squared	0.437495	Mean dependent var	-0.022234
Adjusted R-squared	0.405535	S.D. dependent var	0.178922
S.E. of regression	0.137952	Akaike info criterion	-1.062120
Sum squared resid	1.674707	Schwarz criterion	-0.899782
Log likelihood	55.91964	F-statistic	13.68861
Durbin-Watson stat	1.737534	Prob(F-statistic)	0.000000

B. Estimations for the entire EMU period (sample 1999:01 to 2002:10)
B.1 Without contemporaneous US interest rate

Panel a)

Method: Least Squares, Dependent Variable: DI3MEUR
Sample (adjusted): 1999:01 2002:11
Included observations: 47 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.017082	0.018452	0.925741	0.3600
DI3MEUR(-1)	0.196075	0.112313	1.745790	0.0883
DI3MUSA(-1)	0.170481	0.089557	1.903597	0.0640
D9904	-0.362649	0.116356	-3.116708	0.0033
D9910	0.606578	0.116799	5.193353	0.0000
D0109	-0.331162	0.116201	-2.849914	0.0068

R-squared	0.633718	Mean dependent var	0.000851
Adjusted R-squared	0.589049	S.D. dependent var	0.178591
S.E. of regression	0.114487	Akaike info criterion	-1.377969
Sum squared resid	0.537397	Schwarz criterion	-1.141780
Log likelihood	38.38228	F-statistic	14.18710
Durbin-Watson stat	1.622936	Prob(F-statistic)	0.000000

B. Estimations for the entire EMU period (sample 1999:01 to 2002:10) *(cont'd)*
B.1 Without contemporaneous US interest rate

Panel b)

Method: Least Squares, Dependent Variable: DI3MEUR
Sample (adjusted): 1999:01 2002:11
Included observations: 47 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010196	0.019784	0.515351	0.6090
DI3MEUR(-1)	0.213267	0.121288	1.758354	0.0860
DI3MUSA(-1)	0.174409	0.096842	1.800971	0.0789
D9904	-0.355153	0.125803	-2.823080	0.0072
D9910	0.612477	0.126294	4.849601	0.0000

R-squared	0.561158	Mean dependent var	0.000851
Adjusted R-squared	0.519363	S.D. dependent var	0.178591
S.E. of regression	0.123814	Akaike info criterion	-1.239787
Sum squared resid	0.643854	Schwarz criterion	-1.042963
Log likelihood	34.13501	F-statistic	13.42660
Durbin-Watson stat	1.369955	Prob(F-statistic)	0.000000

Panel c)

Method: Least Squares, Dependent Variable: DI3MEUR
Sample (adjusted): 1999:01 2002:11
Included observations: 47 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.018114	0.024937	0.726383	0.4715
DI3MEUR(-1)	0.204898	0.156968	1.305353	0.1986
DI3MUSA(-1)	0.208420	0.124358	1.675970	0.1008

R-squared	0.222247	Mean dependent var	0.000851
Adjusted R-squared	0.186894	S.D. dependent var	0.178591
S.E. of regression	0.161040	Akaike info criterion	-0.752624
Sum squared resid	1.141093	Schwarz criterion	-0.634530
Log likelihood	20.68666	F-statistic	6.286599
Durbin-Watson stat	1.828220	Prob(F-statistic)	0.003968

B. 2: Including contemporaneous US interest rate

Panel a)

Method: Least Squares, Dependent Variable: DI3MEUR
Date: 12/06/02 Time: 19:31
Sample (adjusted): 1999:01 2002:10
Included observations: 46 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.033306	0.016220	2.053351	0.0468
DI3MEUR(-1)	0.188224	0.095795	1.964873	0.0566
DI3MUSA	0.329063	0.083815	3.926075	0.0003
DI3MUSA(-1)	0.007263	0.088018	0.082519	0.9347
D9904	-0.372632	0.099034	-3.762682	0.0006
D9910	0.409447	0.110834	3.694224	0.0007
D0109	-0.175320	0.106890	-1.640192	0.1090

R-squared	0.744358	Mean dependent var	0.003913
Adjusted R-squared	0.705029	S.D. dependent var	0.179313
S.E. of regression	0.097387	Akaike info criterion	-1.680974
Sum squared resid	0.369887	Schwarz criterion	-1.402702
Log likelihood	45.66240	F-statistic	18.92619
Durbin-Watson stat	1.505598	Prob(F-statistic)	0.000000

B.2: Including contemporaneous US interest rate *(cont'd)*

Panel b)

Method: Least Squares, Dependent Variable: DI3MEUR
Sample (adjusted): 1999:01 2002:10
Included observations: 46 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.032038	0.016541	1.936927	0.0598
DI3MEUR(-1)	0.196679	0.097656	2.013992	0.0508
DI3MUSA	0.381295	0.079150	4.817348	0.0000
DI3MUSA(-1)	-0.018415	0.088426	-0.208258	0.8361
D9904	-0.369990	0.101091	-3.659970	0.0007
D9910	0.381681	0.111824	3.413224	0.0015

R-squared	0.726724	Mean dependent var	0.003913
Adjusted R-squared	0.692564	S.D. dependent var	0.179313
S.E. of regression	0.099424	Akaike info criterion	-1.657747
Sum squared resid	0.395402	Schwarz criterion	-1.419228
Log likelihood	44.12818	F-statistic	21.27442
Durbin-Watson stat	1.359629	Prob(F-statistic)	0.000000

Panel c)

Method: Least Squares, Dependent Variable: DI3MEUR
Sample (adjusted): 1999:01 2002:10
Included observations: 46 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.036492	0.019746	1.848128	0.0716
DI3MEUR(-1)	0.204762	0.121859	1.680328	0.1003
DI3MUSA	0.493384	0.090089	5.476650	0.0000
DI3MUSA(-1)	-0.073588	0.110080	-0.668495	0.5075

R-squared	0.548469	Mean dependent var	0.003913
Adjusted R-squared	0.516217	S.D. dependent var	0.179313
S.E. of regression	0.124720	Akaike info criterion	-1.242543
Sum squared resid	0.653318	Schwarz criterion	-1.083531
Log likelihood	32.57849	F-statistic	17.00564
Durbin-Watson stat	1.480339	Prob(F-statistic)	0.000000

Whereas the analysis of regressions for the sample 1995:01 to 2002:10 (Table 6.A) is straightforward and leaves no room for a significant impact of the US interest rate in the euro-interest rate regression equations, the regression results for the EMU period deserve a special comment here. As might be suspected, the lagged US interest rate might have had a significant impact on the euro interest rate especially in the initial phase of EMU. As far as the information criterion is concerned, the results clearly show that the specifications including the contemporaneous US interest rate (see Table 6.B.2) always beat those regressions including only the lagged US interest rate (see Table 6.B.1). Hence, also if we strictly limit our analysis to the de facto euro period, the hypothesis of a contemporaneous relationship between the euro and the US interest rate dominates that of the U.S. being the leader and the euro zone being the follower. This view is supported by asymptotically consistent cross correlations between changes in the euro and the US interest rates which we also conducted.[17]

[17] Moreover, the specifications including only the lagged U.S. interest rate did not pass the CUSUM's Q stability tests conducted later on in this section (like their counterparts calculated for a longer sample).

Does the relationship change over time?

Both our pair-wise Granger causality tests and, above all, our simple bivariate VARs gave the result that, if at all, US interest rates influence euro interest rates during the same month. However, the US interest rate of the previous month did not have a statistically significant influence on the current month's euro interest rate when all the other factors were taken into account.[18] This suggests that the visual impression of a US leadership over the entire euro period might be misleading.

One might still argue that interest rates in Europe tended to be influenced by what had happened on the other side of the Atlantic but that this had changed during 2001. In that year the Fed cut interest rates at an unprecedented speed (and by an unprecedented magnitude) because it feared an unravelling of the financial equilibrium in the US. The ECB took a more relaxed stance on this point as the euro area economy did not show any of the (potential) disequilibria of the US economy (current account, consumer financial position, over-investment). Hence, one might be tempted to conclude that over the whole sample the lagged US interest rate change was insignificant in the regression equation for the euro interest rate change, while it would become significant if only a large sub-sample (namely until December 2000) had been considered. In order to test whether this kind of reasoning is correct, some efforts were taken to search for breaks in the relation between US and euro interest rates around the turn of year 2000:1.

From the previous analysis the following specification (1) of our regression equation looked best suited to us as a standard reference to test for breaks:

(1) DI3MEUR = C(1) + C(2)*DI3MEUR(-1) + C(3)*DI3MUSA + C(4)*DI3MUSA(-1).

As stressed above, the coefficient C(4) of the lagged US interest rate is the coefficient of interest here. To start with, a Wald test of the coefficient restriction C(4)=0 was conducted, a test which measures how different the unconstrained regression is against the regression with the above restriction. Both tests clearly fail to reject the null hypothesis of C(4) = 0, i.e. the (first difference of the) lagged US interest rate having no impact on the current difference of the euro interest rate.

Table 6: Wald-test of significance of lagged U.S. interest rate

Panel a) Full sample 1995:1 - 2002:10

Wald Test:			
Null Hypothesis:	C(4)=0		
F-statistic (1, 90)	1.529230	Probability	0.2194
Chi-square (1)	1.529230	Probability	0.2162

Values in brackets denote degrees of freedom.

[18] Incidentally, by looking at the behaviour of US interest rates over time we found that euro interest rates also influence US interest rates, again during the same month.

Panel b) Limited sample 1995:1 - 2000:12

Wald Test:			
Null Hypothesis:	C(4)=0		
F-statistic (1, 68)	0.230547	Probability	0.6327
Chi-square (1)	0.230547	Probability	0.6311

Values in brackets denote degrees of freedom.

Stability over time

We then examined: (a) whether all the coefficients in the above regression equation are stable around our guess of the structural break, that is 2000:12, (b) whether the parameter C(4), i.e. the coefficient of the lagged difference of the US interest rate, is stable across the sample without prior fixation of a breakpoint, and (c) whether the coefficients are stable in general without prior fixation of a breakpoint. The underlying regression equation was estimated for the whole sample 1995:01 to 2002:10.

Re (a): At first, a Chow breakpoint test was conducted, i.e. the reference equation is fitted separately for each sub-sample to see whether there are significant differences in the estimated equations, the latter indicating a structural change in the relationship. The new Chow forecast test estimates the model for the sub-sample 'until 2000:12' and then – based on this estimated model – predicting the values of the difference of the euro interest rate, i.e. the dependent variable, in the remaining data points from 2001: 1 onwards. Large forecast errors would cast doubt on the stability of the estimated relation between euro and US interest rates. Both tests indicate no structural break in the relationship, at least none which is located between 2000:12 and 2001:1. However, one has to be careful because breaks might be indicated for neighboured points in time. A sequential plot of the F-statistics over all data points in the sample would seemed useful to us here, choosing the highest significant point as the 'true breakpoint'. However, no empirical realisation of the F-statistics derived sequentially for all possible breakpoints from 2000: 1 to 2000:12 proved to be significant.

Table 7: Chow tests for a breakpoint at the turn of year 2000:1

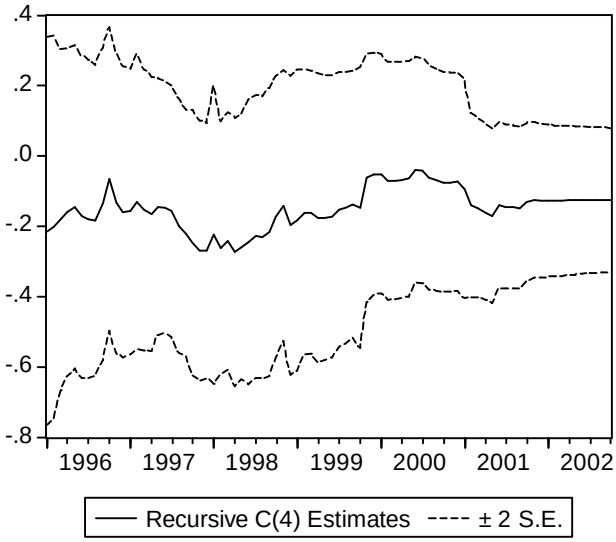
Chow Breakpoint Test: 2001: 1			
F-statistic	0.684760	Probability	0.604425
Log likelihood ratio	2.947156	Probability	0.566707

Chow Forecast Test: Forecast from 2001: 1 to 2002:10			
F-statistic	0.298539	Probability	0.998782
Log likelihood ratio	8.666977	Probability	0.994898

Re (b): A simple approach is that of recursive estimates (of the coefficient of the lagged difference of the US interest rate) starting with the start of the sample period and adding observations over time. With this approach one can trace the evolution of this coefficient as more and more data are used in the estimation. From the graph it can be seen that coefficient C(4) displays variation when more data is added, i.e. a sudden increase in mid-1999 and a fall at the end of 2000, there is a strong indication of instability and a structural break at the end of 2000. However, it has to be noted

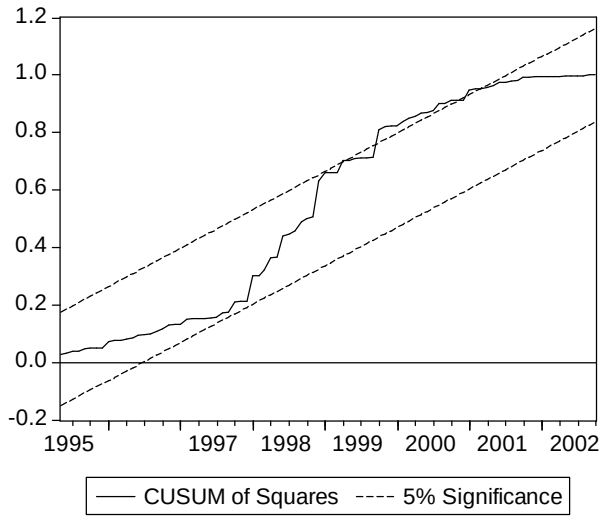
that the significance bands throughout embrace the null, meaning that coefficient C(4) is never significantly different from zero (as mirrored by the regression results).

Fig. 2. – Recursive coefficients of lagged U.S. interest rate



Re (c): A CUSUM of Squares test was also conducted, which is essentially a combination of recursive estimation and a Chow test. Movements outside the critical 5%-lines would be suggestive of parameter instability. By crossing the lines, our test statistic in fact indicates some instability in the equation during the year 2000, since the test statistic slightly exceeds the critical line at that point in time. Since structural breaks are not indicated at all if there is no lagged US interest rate included in our specifications, we regard this piece of evidence as additional support of our view that it makes sense to leave out the lagged U.S. interest rate from our estimations of the euro interest rate.

Fig. 3. – CUSUM test of euro area interest rate equation



4. Conclusions

It appears that there is no statistical evidence that would lend credibility to the widely purported hypothesis that interest-rate setting by the ECB follows the Fed. The differences of the central banks' objective functions can be held responsible for this finding: whereas it is upon the Fed to deliver maximum employment and stable prices, the ECB's primary objective is maintaining price stability. In addition, there are marked differences in the conduct of monetary policy: whereas the Fed pursues a business cycle oriented approach, the ECB tends to pursue a more trend oriented policy. However, it should be noted that this absence of evidence also works the other way round: It is impossible to prove that the two are independent of each other because the moves on both sides of the Atlantic quite often seemed to be contemporaneous. This is actually what one would expect if the most important shocks have come from global financial markets and both have been equally quick to respond to them ('common shock hypothesis'). The results are not surprising in view of the fact that internationally coordinated monetary policy under extreme circumstances on 11 September 2001 is one of the rare examples where it really makes sense (and that this has clearly been understood by the European central bankers). So apart from concerted actions in times of crises (11 September 2001), our findings suggest that monetary policy coordination efforts between the ECB and the Fed – even if there were any – do not play a statistically convincing role in explaining the ECB's actual interest rate setting policy since its inception.

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Part 3: Stock prices – a challenge for central banks

CONTENT: *1. Synchronisation of international asset price movements. – 2. Benefits and costs of asset price movements. – 3. The role of stock prices for monetary policy. – 4. Conclusion.*

SUMMARY: *The growing co-movement of international stocks prices poses new challenges for monetary policy. Empirical findings suggest that stock price increases exert a slightly positive impact on real output, whereas rising stock price volatility exerts a slightly negative influence on production. In spite of these results we do not support the idea that central banks should base their policy on stock price changes, given the lack of knowledge on the part of central banks to identify "unjustified" pricing actions. In general, it seems advisable for monetary policy to pursue a credible policy oriented towards maintaining price stability rather than target and/or react to stock price changes. Most importantly, by focusing on price stability rather than on output, monetary policy should be able to prevent "moral hazard" from emerging, which might be a source of its own inflating stock prices and potentially destabilizing the economy.*

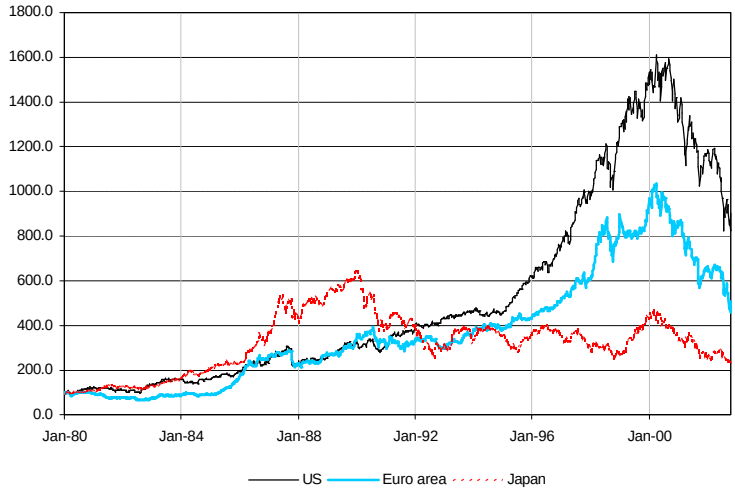
1. Synchronisation of international financial asset price movements

One of the most significant aspects of financial globalization has been the extremely rapid expansion of international financial markets. The enormous increase in liquid assets available to international market participants is widely believed to be worrisome for several reasons: it could erode central banks' ability to exercise monetary control; it could trigger potential inflationary pressures; and it might facilitate the opening of speculative positions and may cause the quality of credit to decline with detrimental effects for output and employment. For instance, the financial market turbulences in 1998, as other crises previously, produced strong price movements in the securities markets worldwide. Cross-market return correlations temporarily underwent dramatic changes, challenging portfolio allocation and risk management strategies which rely on constant historical co-movements of asset prices.[19] More recently, the marked decline in international stock market valuations affected virtually all economies of the western world at the same time, raising concerns about the consequences this might have for the prospects of economic welfare.

In view of the series of international financial market turbulences in the recent past, it comes as no surprise that there has been increased interest in the causes and consequences of international asset-price linkages for output and employment. In the following, a brief overview on the international synchronisation of bond and stock prices movements in the last decades, measured by simple gliding correlation coefficients, is provided.

[19] Asset price linkages can be analysed along three dimensions, namely (1) synchronicity, (2) causality and (3) convergence (see Kremer, M. (1999)). Synchronicity refers to the direction and intensity with which international asset prices move together and can be measured with simple correlation coefficients. The concept of causality outlines the relation between two variables one of which is a cause of the other and can be analysed by way of Granger Causality Tests (Granger (1969)). The term convergence refers to international bond and stock prices' tendency to move toward an equilibrium valuation, e.g. the same level, and can be measured with cointegration techniques.

Fig. 1. – US, euro area and Japanese stock market performance indices

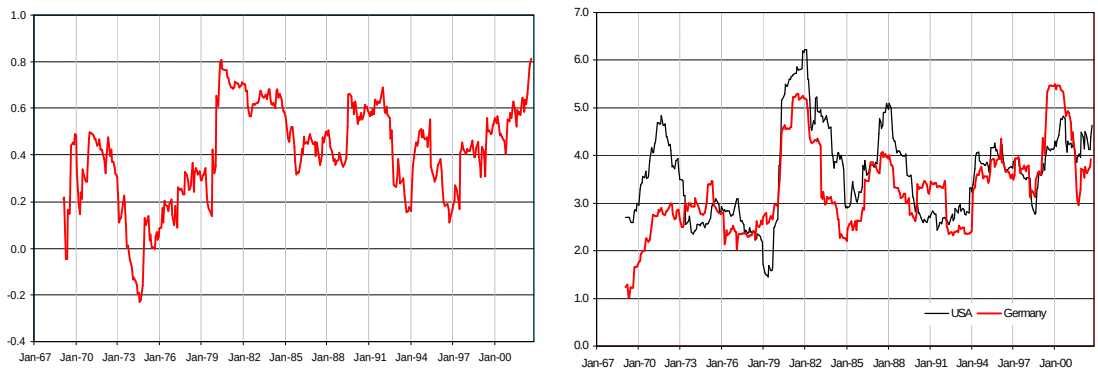


Data source: Datastream Primark; own calculations. – January 1980 = 100, weekly data. – The indices represent broadly defined stock market performance indices.

Fig. 1 gives a first impression that the European stock market development has been much more aligned to the developments in the US stock market performance than that in Japan. (The same is true for the German stock market performance (not shown here)). Fig. 2 and Fig. 3 show the synchronicity and volatility of the German and US bond and stock market, respectively. Fig. 2 (a) shows the co-movement of 10-year US and German government bond yield changes for the period February 1969 to October 2002. On average, the correlation coefficient has been 0.40 but, at the same time, has fluctuated widely. Most notably, the yield change co-movement has strongly since the end of 2000, having reached the highest level in the period under review. This finding can largely be explained by the ramifications of the international cyclical downswing which kicked in around the beginning of 2000, accompanied by the stock market crash. – Fig. 2 (b) presents the volatilities of the 10-year US and German government bond yields changes in percent which, on average, have tended to move in parallel with the volatility level in the US. Most notably, volatility measures in both currency areas have tended to drift upwards since the middle of the 1990s, exceeding the long-term average of 3.6 and 3.3, respectively, in October 2002.

Fig. 2. – 10-year US and German bond yields – correlation and volatility

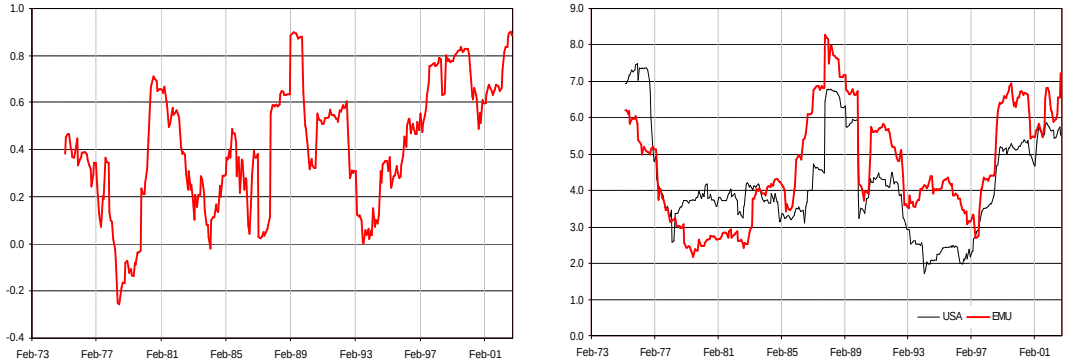
(a) Correlation coefficients (b) Volatility



Data source: Datastream Primark; own calculations. – Period February 1969 to October 2002. – Correlation coefficients calculated on the basis of absolute monthly yield changes over a 24-month gliding window. – Standard deviation of monthly yield changes in percent over a 24-month window.

Fig. 3. –US and German stock market performance – correlation and volatility

(a) Correlation coefficients (b) Volatility



Data source: Datastream Primark; own calculations. – Period February 1974 to October 2002. – Correlation coefficients calculated on the basis of absolute monthly index changes over a 24-month gliding window. – Standard deviation of monthly index changes in percent over a 24-month window.

Fig. 3 (a) shows the correlation coefficients between the US and euro area stock market performance indices. In general, the co-movements between stock markets has been quite similar to that of the long-term government bond yield changes but, at the same time, fluctuated much more strongly. Since early 1993, the co-movements between the two markets has increased drastically, presumably reflecting the internationalisation, i.e. globalisation, paradigm which characterises the workings in the financial markets in the latter half of the 1990s. – Fig 3 (b) shows the volatility measures of the US and euro area stock markets. Again, both US and euro area stock market volatility tended to move in parallel with the latter having tended to exceed the former by quite a margin on average. Interestingly, since the middle of the 1980s stock market volatility in the euro area has been well above that in the US.

The finding that the synchronisation of international financial asset prices has increased in recent years might be attributable to a variety of factors. To start with, monetary policies in the major industrial countries have adopted a course seeking low and stable inflation, exerting similar effects on asset pricing in both currency areas. Second, the growing internationalisation of portfolio management techniques should

have translated into an increased co-movement of asset prices as effects of trading and sales activities in one market segment quickly and increasingly spill over into others ("relative price mechanism"). Third, the emergence and spreading of financial market crises across major financial markets of the industrial countries has also contributed the synchronicity of asset prices.

2. Benefits and costs of asset price movements

According to the Efficient Market Hypothesis (EMH), asset price movements are a direct response to the emergence of "news": With new information coming available and changing market agents' hitherto established expectations, asset prices will change. That said, asset price volatility is to be considered as a natural phenomenon in the functioning of financial markets. In an efficient market, asset prices incorporate all available information at a given point in time. As a result, individuals do not have competitive advantages over their competitors in the acquisition and interpretation of information. If asset prices are formed in line with the EMH, financial markets can be expected to allocate scarce resources to the most efficient use. Hence properly functioning, efficient financial markets can be expected to improve the allocation of scarce resources and be thus beneficial to an economy's level of investment spending, employment and growth.

However, asset price volatility might be associated with considerable costs, an impression which has certainly gained ground in view of the many financial crises seen, especially in the second half of the 1990s. For instance, the Asian financial crisis, which started in the fourth quarter of 1997 as a currency crisis, spilled over into a fully-blown financial market crisis, causing sharp and erratic asset price movements in the world financial markets. In addition, the Russian debt crisis, kicking in in 1998, brought the crisis to a new height. Not only did the crises threaten the stability and health of the financial systems but they were also accompanied by a substantial growth slowdown across the economies of the industrialized world. More recently, the marked increase in stock market valuations in the second half of the 1990s was followed by a dramatic fall in stock prices setting in at the end of 2000, affecting all major stock markets at virtually the same time. Here again, the crisis was widely seen as threatening the economic well-being of the industrialized world.

Concerns about the emergence and consequences of a high level of market volatility, e.g. financial market crisis, do not come as a surprise given the assumed impact on domestic growth, employment and inflation. In fact, stable economic expansion, a high level of employment and stable and low inflation have become generally accepted macro-economic policy goals. That said, the analyses of the causes and consequences of financial market volatility have become an issue of heightened interest among policy makers, including central banks. So far, there is a wide consensus in the economic literature that the "adequate", or "optimal", level of market volatility is hard, if not impossible, to identify. Given the costs related to the build up, unfolding and overcoming the effects of a financial market crisis, however, it is widely believed that prevention measures in particular should play a prominent role in the objective function of monetary policy makers.

Stock markets in particular play an important role for an economy's financial and economic well-being. The stock market is the crucial mechanism for allocating scarce resources in a market economy and thereby property rights. For instance, effi-

cient stock markets determine the cost of capital, create incentives to identify poorly managed firms, and facilitate takeover of such companies, replace their management and make the firms profitable. Moreover, stock markets have very often been subjected to major price swings, thereby raising the question whether the observed level of price volatility is compatible with changes in the economic fundamentals widely assumed to determine stock prices.

To conclude, stock market movements caused by expectations which are linked to the real economic developments are to be considered essential in a market-based economy. However, asset price movements that are unrelated to the performance of the real economy – so-called "price bubbles" – are widely considered detrimental to economic welfare. Having said that, one may be inclined to include the stabilization of stock market prices in the central bank's objective function. However, the justification for such a recommendation has to meet at least three requirements: (a) the central bank – or a coordinated monetary policy between central banks – must be able to influence stock prices according to pre-set policy objectives; (b) stock price movements should exert an impact on the real economy; (c) central banks must be able to distinguish between stock price movements that are linked to the real economy and those unjustified by real economic developments. The remainder of this chapter will discuss these issues in more detail.

3. The role of stock prices for monetary policy

3.1. Central banks' impact on stock prices

When discussing the potential impact monetary policy might exert on stock prices, a theoretical stock pricing model is required. The Discount Present Value (DPV) model is the traditional theoretical concept for explaining the "fair price" of stocks. According to the DPV model, the stock price, P_t, in period *t* is the sum of the discounted value of expected future cash flows:

$$(1) \qquad P_t = E_t \sum_{i=1}^{\infty} \delta^i D_{t+i},$$

where E(.) represents the expectation operator, δ_{t+i} the discount factor $[1/(1 + r_{t+i})]$, *r* the interest rate and *D* represents cash flows. Assuming time-varying discount factors, (1) can be easily restated as:

$$(2) \qquad P_t = E_t \left[\sum_{j=1}^{\infty} \left[\prod_{i=1}^{\infty} \delta_{t+i} \right] D_{t+j} \right].$$

The DPV model suggests that monetary policy influences stock prices in two ways. First, the price of long-term assets like stocks reflects market expectations of central banks' short-term interest rate decisions. The market uses these short-term rates (plus a risk premium) to discount the future income of assets, and may guarantee a kind of arbitrage(-free) relationship between expected stock returns and the expected short-term rate. Second, the long-term returns that investors require to hold an asset should contain an inflation premium. Thus, the long-term view on future inflation influences

today's prices of long-term assets. As monetary policy controls inflation in the long-term, it has a strong impact on market expectations of inflation, and thus today's stock prices.

Box. 1. – Stock prices and short-term interest rates

In an arbitrage-free capital market, a theoretical link between stock returns and a central bank's short-term interest rate can be established (for a detailed approach see Cassola and Morana (2002), pp. 45). The expectation theory of the term structure of interest rates can be written in logarithmic form as:

$$(1)\quad l_t = \frac{1}{n}\sum_{j=0}^{n-1} E_t\left[i_{t+j}\right] + \phi_l ,$$

where l_t is expressed as an average of expected one-period yields, $E_t\left[i_{t+j}\right]$, ϕ_l is a term premium and n is the maturity of the bond.

The simple present value model for the stock market is:

$$(2)\quad F_t = E_t\left[\sum_{j=1}^{\infty}(1+\upsilon)^{-j} D_{t+j}\right],$$

where F_t is the real stock market capitalization, υ is the real risk-adjusted discount rate and D_t is the real dividend paid at time t. Assuming a constant rate of growth for dividends (g), the Gordon (1962) growth model is:

$$(3)\quad F_t = \frac{1+g}{\upsilon - g} D_t .$$

If dividends are constant the formula simplifies to:

$$(4)\quad \frac{D_t}{F_t} = \upsilon ,$$

where the dividend yield D_t / F_t equals the real risk-adjusted rate of return on capital.

According to (2) the long-term interest rate is the weighted sum of the expected further short-term interest rate plus a risk premium. In an arbitrage-free market, the return on a risky asset should equal the riskless rate plus a premium compensating the investor for holding a risky asset: the investor should earn a real risk-adjusted rate of return on capital. So if the premium for holding risky assets fluctuates around a more or less predictable level (that is the risk premium qualifies as a stationary variable), a more or less predictable relation between the short-term interest rate, set by the central bank, and stock market returns, e.g. the stock market valuation, should exist.

In a world with transaction costs, however, the existence of time-lags is a common phenomenon. This suggests that stock prices may only be systematically influenced in the long- rather than short-run. Moreover, there is great uncertainty about the intensity with which monetary policy affects stock prices. In fact, empirical findings support the hypothesis that interest rates effect stock prices in an expected manner only after four quarters rather than in the short-run.

Given that asset prices are based on expectations, from a central bank's point of view it is essential that the markets perceive its reaction function correctly. If, for instance, financial markets are sure that a central bank is pursuing a policy of price stability, any deterioration in inflation perspectives should be accompanied by expectations of an increase in short-term rates. In turn, this should exert a dampening effect on asset prices if central bank short-term rates serve as the benchmark rates for discounting future income streams. If stock price action complies with the Efficient Market Hypothesis and Rational Expectations (EMH-RE) and central bank short-term rates determine the benchmark for short-term asset returns, asset prices should be linked to the expected path of official rates (see box 1).

Given the role of expectations in determining stock prices, a loosening of a hitherto stable relationship between expected stock returns and expected short-term rates might occur, at least temporarily. To start with, the level of risk premiums demanded by markets to compensate for holding risky assets might decline, leading to (one-off) higher stock returns, e.g. valuations. Moreover, expectations of a higher rate of economic growth – which was one of the basic characteristics of the "New Economy" paradigm in the second half of the 1990s – may induce investors to expect higher future profits and capital returns. That said, a systematically higher economic growth path might be associated with a higher real short-term central bank and therefore stock returns.

The ad hoc considerations above seem to suggest that if market expectations perceive the central bank's reaction function properly, a kind of arbitrage relation can be expected to link stock prices to the short-term interest rate which, in turn, is set by the central bank. However, as the experience gained in the second half of the 1990s has shown, such an arbitrage relation may become rather loose if "exuberant expectations" gain ground among investors. Given the detrimental economic consequences associated with sharp falls of stock prices, this finding raises the question of the role stock prices should have for monetary policy.

3.2. Stock price movements and the real economy

The synchronicity of international asset price movements can be expected to have real economic consequences. Therefore, we outline the channels through which stock prices might influence the real economy. The stock market may influence the real economy through five main channels: cost of capital, wealth, confidence, balance sheet effects, and the stability of the financial sector.

1. The *first channel* operates through the impact that stock prices may have on firms' cost of equity capital, and thus on their investment spending. An increase in stock prices may signal good opportunities for investment, as this investment can be financed at lower cost by new issues of stock. When stock prices rise, the market value of the firm relative to the replacement cost of its stock of capital (the so-called "Tobin's q") tends to increase. As a result, it would be profitable for the firm to increase investment spending. As the capital stock adjusts, gradually, to its higher long-term value, q will revert to a normal level.
2. The *second channel* operates through the impact of wealth on consumption. A permanent increase in stock prices implies an increase in financial wealth. Assuming that economic agents try to smooth their consumption over time, the increase in financial wealth leads to higher current and future consumption, stimulating aggregate demand and output. It should be noted that, for most households in the euro

area, changes in stock prices seem to have modest direct wealth effects, since direct and indirect holdings of quoted shares are still relatively small. Thus there are reasons to believe that this transmission channel is currently not very important in the euro area, although its role may have increased somewhat over recent years.

3. As a *third channel*, stock prices may affect investment and consumption via confidence effects. For example, a decline in stock prices may signal increased downward risks to future economic activity and employment, which may hurt consumer confidence and actual consumption spending – even of households that do not own stocks. Likewise, a general fall in stock prices may even lead firms that have not issued quoted shares to revise their profit expectations and investment plans downwards.

4. The *fourth channel* is the possibility that stock prices affect consumption and investment through a balance sheet effect. Because of asymmetric information in credit markets, the ability of firms and households to borrow depends on the value of the collateral they can offer. As the value of the collateral increases, the ability to borrow and invest increases. This process, known as the financial accelerator, suggests that initial financial conditions (i.e. the risk attached to and the value of collateral) are essential to determining the magnitude and duration of the effects of equity price changes on investment and consumption.

5. The *fifth channel* refers to financial stability. A well-functioning financial sector is a prerequisite for sustained real growth. The financial sector is connected to every other sector of the economy through its role of collecting savings and channelling them to investors. A financial crisis may lead to a contraction in the credit and money supply and, as a result, a decline in economic activity. (A well-known example of this is the Great Depression in the United States of America in the 1930s. A high overinvestment caused a severe decline in the stock prices followed by a banking collapse and a credit crunch.) More general, financial instabilities tend to make recessions much deeper and longer, even increasing the risk that a recession turns into a depression. In addition, a financial sector stability crisis and its consequences may destroy public confidence in a market-oriented economic system which, in turn, could pose a threat to political stability.

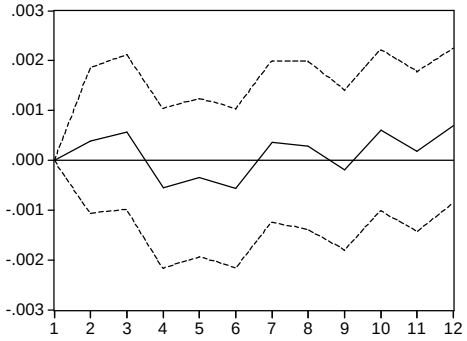
Box 2. – Stock price changes and GDP growth in the euro area

A small-scale vector autoregressive (VAR) model of the type pioneered by Sims (1980) is used as the basic framework for studying the impact stock price changes exert on output. The key advantages of the VAR approach are that all variables are assumed to be endogenously determined and only weak restrictions are placed on the dynamic behavior of the variables of interest. The sample period is 1980-Q1 to 2002-Q3.

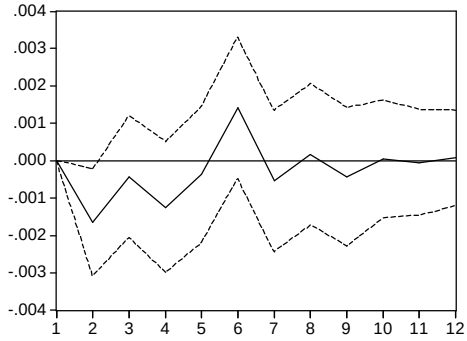
The endogenous variables are (i) real euro area GDP, (ii) the euro area real 3-month money market rate, (iii) real euro area stock market performance, (iv) and the Euro stock market volatility. As an exogenous variable we control for real US area stock market performance. All data are available as quarterly data. To guarantee stationary series we calculated quarterly changes of annual growth rates. In other words: all data are quarter-to-quarter-differences of fourth log-differences (d4d …); the only exception is the Euro stock market volatility (measured as standard deviation of monthly index changes in percent).

The impulse-response function (a) shows that an increase in euro stock market return has a slightly positive impact on GDP growth rate only in the very short term; the positive impact peters out after 3 quarters. The impulse-response function (b) shows that an increase in the euro stock market performance volatility exerts a negative impact on the development of the GDP growth rate. Again, this effect is transitory and dies out after 5 quarters.

(a)



(b)



Data source: ECB, Datastream Primark; own calculations.

Our simple empirical analysis (see box 2) suggests that an increase (decrease) in the euro stock market performance has a slightly positive (negative) temporary impact on output growth; the effect peters out after 3 quarters. Moreover, an increase (decrease) in the euro stock market performance volatility exerts a negative (positive) impact on output growth. This effect vanishes after 5 quarters. In view of the five theoretical transmission channels mentioned above, the empirical findings may encourage claims for monetary policy interference in the stock market to keep stock prices on a steady performance path. However, such a policy would face at least three major problems:

1. *Time lag problem*: Milton Friedman's hypothesis that it would take more than a year before a monetary policy action fully affects the economy's price level might be applied to stock prices, too. This reduces hopes that monetary policy actions might be in a position to influence stock markets in the short-term.
2. *Knowledge problem*: The foremost difficulty lies in establishing whether an asset price development should be attributed to real or inflationary pressures. So it is doubtful whether any agent, e.g. a central bank, would have the knowledge to judge whether or not movements of asset prices rely on fundamentals or must be

regarded as the beginning of an inflationary process, i.e. the emergence of a bubble. So the fair answer to the question "is it possible to identify asset price misalignments and bubbles?" should be "no" for most circumstances.

3. *Moral hazard problem*: The moral hazard problem is well-known and a key aspect of considerations concerning incentive compatibility. The moral hazard problem may arise, for instance, when private investigators expect that sharp declines of stock prices would trigger interest rate cuts by central banks. In such an environment, investors would reduce their degree of risk aversion due to the expected support mechanism provided by monetary policy, thereby causing distortions in the allocation of capital (and even provoke excessive increases in stock prices) which, in turn, should be detrimental to overall economic welfare.

3.3. Stock prices: a useful indicator for monetary policy?

Various empirical analyses show that financial prices such as stock prices, yields and term structure spread yield curves contain useful information about future real economic and inflation developments, at least over medium-term periods. At a first glance, this seems to support an outstanding role for financial market prices as indicators for monetary policy. However, although the regression fit is in most cases impressive according to standard metrics, the forecast errors are generally rather high from an operational point of view. Thus, policy makers face a lot of uncertainty if they try to evaluate whether any change in the indicator variable reflects shifts in agents' expectations or, instead, the influence of other factors omitted from the forecasting equation.

Moreover, from a strategic perspective, it is crucial that monetary policy still relies on an "external" anchor and not on market expectations themselves. The anchoring of expectations about monetary policy can probably best be achieved by a strong and credible commitment to long-term price stability. The respective long-term inflation goal is then given a heavy weight in any reaction function which economic agents use in forming their expectations about the future course of short-term interest rates. By linking monetary policy decisions to market expectations instead, the form of expectations about inflation and hence the future path of short-term interest rates becomes self-fulfilling; and this could lead to policy instability and also inflation instability. This exposes financial markets to speculative attacks and jeopardizes the credibility of the central bank.

Independently of the danger of sliding into a vicious circle, putting more weight on market expectations could be interpreted by market participants as a shift in the monetary policy regime. This makes it difficult for the central bank to assess the stance of monetary policy because market indicators become less reliable (which should show up in coefficient changes in the forecasting equations) and other indicators (as, for example, the money stock) may lose their indicator properties owing to changes in the behavior of market participants. Finally, the central bank could end up in a situation in which it is impossible, or at least much more difficult, to stabilize expectations merely because monetary policy has been geared to market expectations. All this suggests, as Woodford convincingly argued, that modeling structural relationships, including the monetary policy reaction function, is unavoidable in order to make more reliable inferences about the indicator quality of a financial market variable and to assess its usefulness for monetary policy purposes.

Another line of argumentation refers to the problem of measuring inflation correctly. Alchian and Klein (1973) and Goodhart (1995) alluded to this shortcoming by

arguing that a correct measure of inflation should also take asset price developments into account in so far as these determine future consumer prices. Monetary policy should give asset prices an explicit role in the policy making process in order to smooth the business cycle and consumer price inflation. However, this viewpoint may create more difficulties than it resolves. If the objective function for monetary policy were to be broadened beyond consumer prices by focusing on some amalgamated index that also included stock prices, this would, in practice, create new problems of its own:

1. Given a much higher volatility of asset prices than consumer prices, targeting the stability of this index could be expected to lead to greater and more frequent adjustments in monetary policy, which would have adverse consequences for the stability of consumer prices and output. Viewed from this perspective, it is questionable whether asset prices should play a substantive role in the determination of monetary policy.
2. Developments in asset prices may be driven by changes in many more or less "fundamental" factors – such as expected rates of return, time preferences, fiscal treatment, or risk premia – that in principle need not prompt an adjustment to the monetary policy stance. A difficulty lies in establishing whether an asset price development should be attributed to real or inflationary pressures. There is a further complication to the extent that policy may need to react differently to a stock change towards, rather than away from, equilibrium. If a stock market price level increases, but the level is brought closer to equilibrium, a policy reaction would be destabilizing. The identification problem is thus twofold: first, in finding out to what degree a stock price change reflects real factors and, second, in identifying how the new stock price relates to the equilibrium price on the relevant asset market.
3. Moreover, at a technical level, the construction of a relevant asset price index is problematic. As the asset market consists of numerous sub-markets with generally heterogeneous products, changes in expenditure patterns are relatively pronounced and differences in product quality have a relatively strong impact on price developments. As a consequence, it is hardly possible to construct a representative asset price index. Although these measurement problems also apply to the consumer price index, they are significantly smaller: consumer products are more homogeneous, the pertinent expenditure patterns are less variable, and the time horizon determining the value of these products is much shorter.

The arguments suggest that no matter whether a central bank's objective is keeping price stability (as it is in the case of the (ECB)) or whether it pursues the objective of maximum employment and stable prices (as it is in the case of the Fed) the use of stock prices as a valid indicator of monetary policy poses a number of problems which are by no means easy to solve. So indeed, the inclusion of stock prices in the central bank objective function seems to create more difficulties than it might resolve.

4. Conclusion

The growing co-movement of international asset prices stocks poses new challenges for monetary policy. Empirical findings suggest that an increase in the stock market performance exerts a slightly positive impact on real GDP, whereas an increase in stock market performance volatility has a negative influence on real GDP. In spite of these results, however, we do not support the idea that central banks should base their policy on stock price movements as central banks do not have the ability to attribute stock price changes to fundamentally justified or "irrational" processes ("knowledge problem"). Moreover, a *moral hazard* problem might be provoked if private investors can rely on the central bank's monetary policy (on a stand-alone basis or in an internationally coordinated effort) responding to declines in stock market valuations with an easier monetary policy. In particular, a monetary policy responding to the business cycle (e.g. output gap) could also increase the risk of causing moral hazard, thereby fostering the emergence of economically unfavorable stock price movements. As a result, it appears rational for the ECB to pursue a credible policy oriented towards maintaining price stability.

Finally, it should be noted that there is still considerable uncertainty about the adequate money and credit supply bringing about price stability in the prices level of current production and the stock of wealth (stocks, real estate, housing, etc.). This is largely due to a lack of comprehensive data on the economy's total stock of wealth. However, focusing on stabilizing the price level of current production (which is actually a sub-set of the price level) can be interpreted as a strategy of stabilizing an economy's overall price level if the mechanism of relative prices works effectively and efficiently. Having said that, in a well-functioning market economy a monetary policy focus on the stabilizing the consumer price level might be conducive to ultimately stabilizing the economy's total price level.

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Part 4: ECB monetary policy – review and outlook

CONTENT: *1. ECB monetary policy issues in the last 6 months. – 2. Inflation forecast on the basis of the P-star model. – 3. ECB rate outlook. – 4. Excursion: bank credit expansion in Germany.*

SUMMARY: *The ECB interest rate cut on 5 December 2002 seems to have been motivated by actual concerns about the business cycle, e.g. "overriding objectives", rather than based on the signals provided by forward looking inflation indicators. The monetary stimulus should add to the already generous money supply, pushing the inflation of the HICP towards 2.5 percent until the end of 2003. Needless to say, in view of the inflation path implied by the already existing monetary overhang a further policy easing appears to be incompatible with the ECB's objective of keeping inflation below the 2.0 percent ceiling in the medium-term. At this juncture it should be noted that the lack of governments' commitment to bringing about sustainable public finances clearly poses a growing risk to the credibility of the ECB's price stability promise going forward.*

1. ECB monetary policy issues in the last 6 months

Since June 2002, the annual expansion of the stock of M3 has remained well above the 4.5% reference value, growing at an average monthly rate of 7.4%. Even though inflation of the Harmonised Index of Consumer Prices (HICP) has accelerated in the last six months, the strong nominal M3 expansion has translated into a strong real M3 expansion (see figure 1 (a)), thereby having increased the "price gap" markedly (for a more detailed analyses see the following paragraph). It should be noted that some of the strong M3 expansion seems largely due to portfolio shifts which have increased market agents' preference for holding relatively liquid assets included in M3 relative to alternative assets. However, the strong expansion of M3 over recent months has also been driven by the low level of central bank interest rates. That said, the hypothesis that an excess of liquidity has been built up in the euro area, posing potential risks towards future price stability, cannot be dismissed lightly.

The strong M3 expansion can largely be explained by the pronounced increase in the growth of the stock of M1. Since June 2002, the annual expansion of M1 has increased from 6.8% to 8.2% in October, whereas the annual growth rates of the stock of M2 has remained broadly stable at around 6.5%. Even though the slight acceleration in annual HICP inflation, the real expansion of M1 and M2 has increased strongly (see figure 1 (b) and (c)). As regards the asset side of the euro area banking sector, the growth of bank loans to non-banks (excluding government agencies) has remained broadly stable since June 2002, standing at 5.0% (2.7% in real terms) in October (see figure 2). In view of the current trend in bank lending for the euro area as a whole, bank credit – the actual source of "money production" – seems to have remained relatively robust, especially so when taking into account the marked decline in overall economic activity in the euro area (see ECB, Monthly Bulletin November 2002, pp. 12; for further details on the actual situation of bank lending in Germany, see paragraph 4).

So far, the excess M3 holdings have been accompanied by a decline in the actual velocity of M3 below its long-term trend. This finding actually reflects the de-

cline in overall economic activity in the euro area and may explain why the monetary overhang has not yet influenced prices and/or real output. Assuming a trend stable velocity of money, however, a monetary overhang can be expected to sooner or later feed through into an increase in the overall price level ("real balance effect"). Such a scenario is all too plausible given the long-term trend stability of the velocity of M3: the latter implying that, on average, market agents prefer to hold an equilibrium level of real money holdings relative to their real income. At the current juncture, however, market agents hold real M3 balances well in excess of the long-term equilibrium holdings.

In line with the money and credit data, debt securities issuance activity in the euro area appears to have remained, by and large, stable in recent months, not indicating any debt capital market inefficiencies in the euro area.[20] Fig. 3 (b) and 3 (c) show the annual growth rates of various debt stocks outstanding, deflated by the current inflation of the euro area consumer price index, respectively. As can be seen, total issue growth has declined markedly from the high rates seen in 1999-2000, having stabilized around 4.5 percent in the last 6 months. Debt issued by banks and central governments has remained fairly stable at rates around 2.8 and 2.1 percent, respectively. In contrast, debt issued by non-financial corporations has declined strongly since the levels seen in late 2001. However, the last real growth rates of around 6.7 percent suggests that the market has remained receptive for absorbing additional corporate bond supply.

Until December 2002, the ECB withstood calls for an easier monetary policy and kept the main refinancing rate unchanged at 3.25%. The bank's reasoning for keeping rates stable seems to have been largely based on unfavourable monetary developments and, most importantly, current HICP inflation and core inflation running stubbornly above the ECB's 2.0 percent ceiling. In fact, the ECB policy stance conveyed, in line with the signal provided by its policy strategy, that a monetary policy easing would be incompatible with bringing euro area inflation to the envisaged level of no more than 2.0 percent. However, the growing concern about the ramifications of the tensions in national and international financial markets, especially the decline in the stock markets, for the economic conditions in the euro area, have gradually led the ECB to change its policy stance. Moreover, ongoing uncertainties surrounding geopolitical events have certainly played an increasingly important role in the ECB's policy reasoning.

The ECB cut its main refinancing rate by 50bp to 2.75% on 5 December 2002. Even though widely expected and widely hailed by the financial market agents, the decision to cut rates may nevertheless encourage a number of critical questions. For instance, the monetary easing can be expected to stimulate the expansion of money supply even further, thereby negatively affecting the inflation outlook in the euro area; this issue will be addressed in more detail in the following paragraph. (It should be noted that an increasing money supply may translate not only into price rises of the current production but also into higher asset prices (stocks, real estate, etc.).) In addition, due to the unknown workings of the transmission mechanism, the monetary pol-

[20] Fig. 3 (a) shows total euro denominated euro debt issues outstanding issued by euro area residents and non-residents in EUR billion in percent of total issues in the period December 1990 to September 2002. At the end of September 2002, bank issues accounted for 36.3 percent of total issues outstanding, non-monetary financial coporations for 5.7 percent, non-financial corporations for 6.2 percent and central and other governments for 49.6 and 2.2 percent, respectively (see figure 3 (b) and (c)).

icy easing, aimed at supporting the business cycle, runs the risk of inducing unfavourable swings in the cyclical behaviour of the euro area economies.

There is a widely held consensus that the lacklustre economic performance in the euro area can be attributed to a large extent to structural problems such as high taxation, high degree of government intervention, etc. As a result, it seems interesting to ask whether monetary policy easing might have an impact on the incentives for bringing about desired reforms. Whereas lower rates might be beneficial for output and employment in the stort-term it is fair to say that at the same time an easier monetary policy might artificially reduce the economic incentive for speeding up product and process innovations which are to be considered as essential for improving the growth outlook. This is because a (successful) counter-cyclical monetary policy tends to prevent the market mechanism from sorting out inefficient producers and honouring efficient suppliers. Moreover, an easier monetary policy reduces the incentive for politicians to seek structural reforms because lower interest rates to be paid on government debt allow badly needed reform measures to be put off even longer, thereby potentially raising the costs of bringing about reforms.

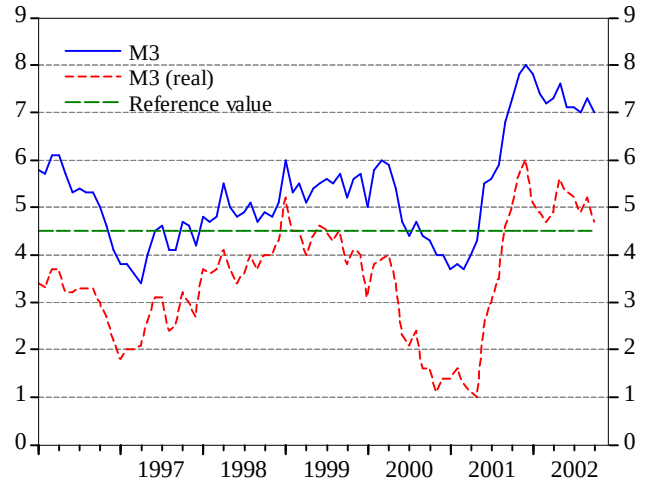
Moreover, the growing public deficits in a number of countries, associated with *de facto* attempts to change the European Stability and Growth Pact ("Pact"), are very worrying. In fact, there is a strong rationale for having Pact in place, as it aims to prevent "negative externalities" in terms of building up unsustainable government debt levels and supports the credibility of the ECB's price stability promise. Governments should, even under the current economic slowdown, continue to adhere strictly to the Pact's requirements. In view of forthcoming demographic changes, even balanced budgets may well prove insufficient to establish sustainable fiscal positions in a number of euro area countries. Most countries will even have to start generating substantial surpluses and paying down debt. Thus, a lack of commitment to bring about sustainable government finances clearly threatens the credibility of the ECB's price stability promise going forward.

On 5 December 2002, the ECB Governing Council also decided to keep the M3 reference value for 2003 unchanged at 4 ½ percent. This decision was taken on the grounds that the evidence continues to support the assumptions which have formed the basis of the derivation of the reference value since 1999, namely those relating to trend potential output growth of 2-2½% per annum and to a trend decline in M3 income velocity of ½-1% per annum in the euro area.[21] In view of the strong excess liquidity built up in the past, however, the decision to keep the reference value at 4 ½ percent for 2003 might cause the reference value concept to provide the central bank with misleading signals. As the excess liquidity can be expected to translate into higher prices (with an uncertain time-lag), the envisaged money expansion rate for 2003 should have made explicit allowance for the price level effects resulting from excess liquidity, that is the reference value for 2003 should have been set at a rate less that 4 ½ percent. Having said that, the possibility has increased that even if annual M3 growth rates decline towards the reference value, thereby indicating declining inflationary pressure, inflation will actually increase. However, neglecting the excess liquidity built up in the past when determining the reference value might well compromise the signal function of M3.

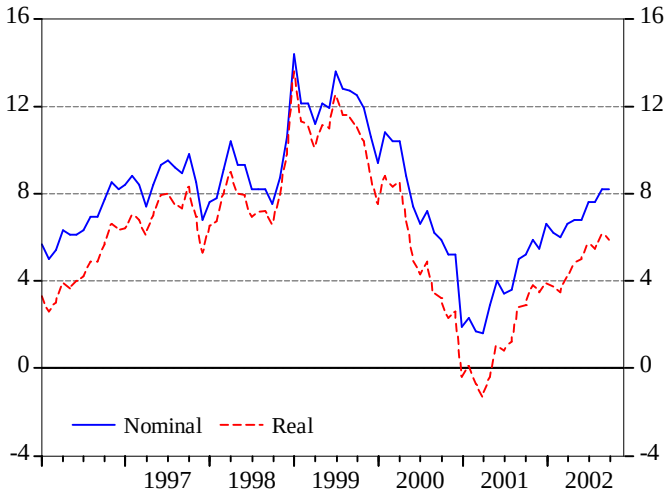
[21] See ECB, "Review of the quantitative reference value for monetary growth", 5 December 2002. The ECB writes that "there are at present no signs of structural breaks or changes in the long-run fundamental relationship between money and prices in the euro area which underlies the derivation of the reference value".

Fig. 1. –Annual growth rates of monetary aggregates in percent

(a) M3, nominal and real, and reference value



(b) M1, nominal and real



(c) M2, nominal and real

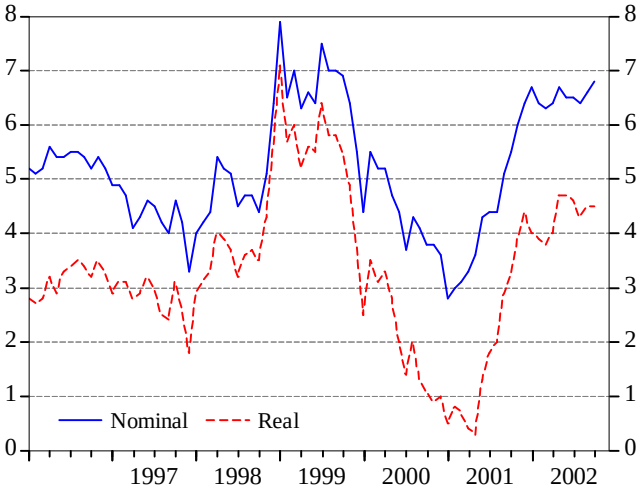


Fig. 2. – Annual growth rates of bank lending, nominal and real, in percent

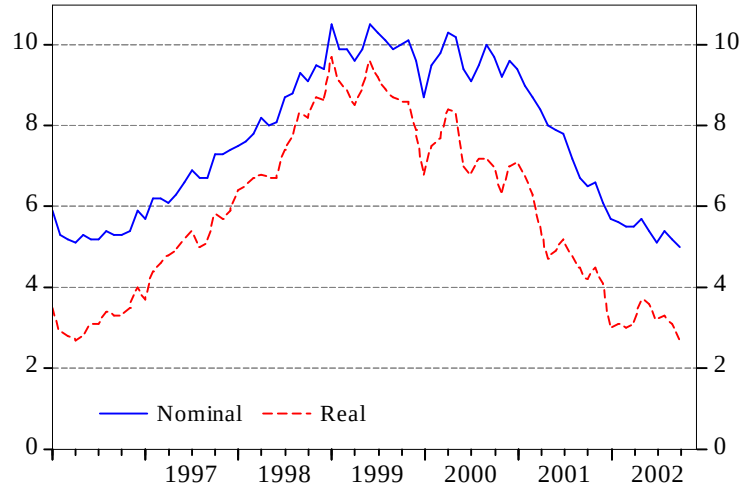
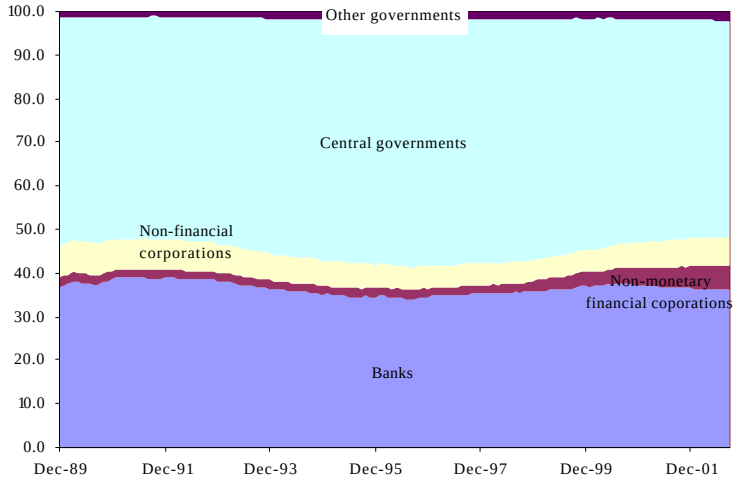


Fig. 3. – Euro area debt markets

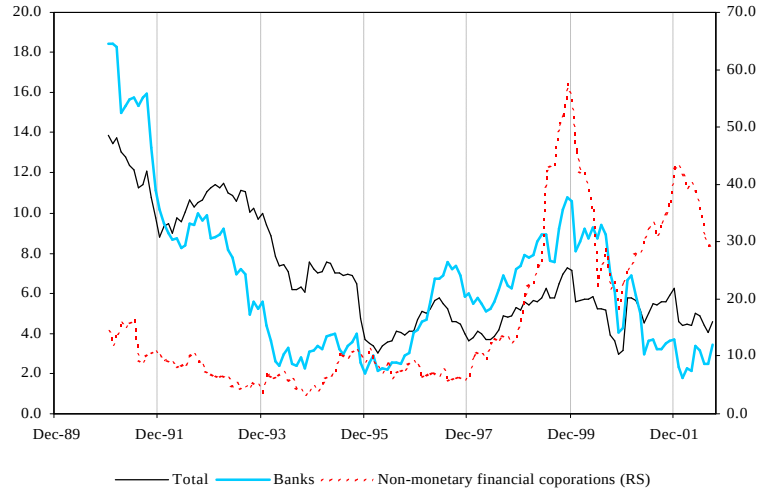
*(a) Total debt issues outstanding by euro area residents in EUR billion**



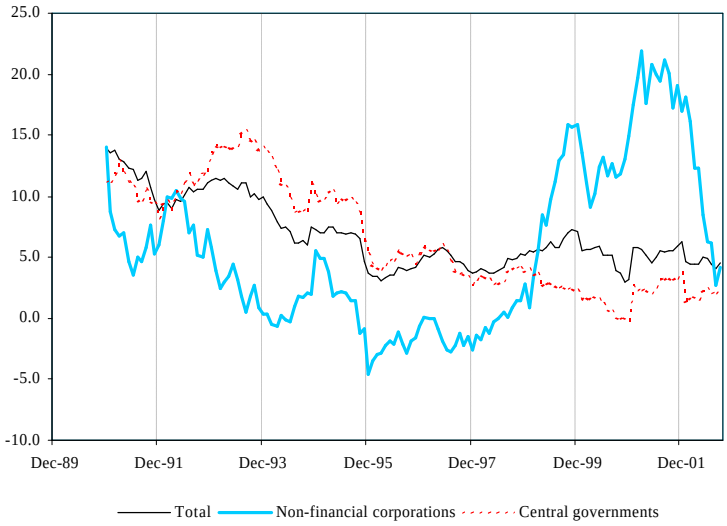
*Total issuance outstanding, issued by euro area residents and non-residents, euro denominated.

Fig. 3. – Euro area debt markets *(cont'd)*

(b) Annual growth rates of total debt (real), MFI and central government in percent



(c) Annual growth rates of total debt, non-monetary financial corporations and non-financial corporations in percent



ECB Press Conference, Introductory statement, 5 December 2002

"We continued our in-depth assessment of **monetary, financial and economic developments** and the discussions we had in early November on the appropriate stance of monetary policy, taking account of the new information. Overall, since our last meeting, the arguments in favour of a cut in the key ECB interest rates have strengthened. The evidence that inflationary pressures are easing has increased, owing in particular to the sluggish economic expansion. Furthermore, downside risks to economic growth have not vanished.

As a result, the Governing Council has decided to lower the key ECB interest rates by 50 basis points.

At today's meeting, we also reviewed the reference value for monetary growth, which has an important role under the **first pillar** of the ECB's monetary policy strategy. The Governing Council has decided to leave the current value unchanged at an annual growth rate of 4½% for the broad aggregate M3. This decision was taken on the grounds that the evidence continues to support the assumptions which have formed the basis of the derivation of the reference value since 1999, namely those relating to trend potential output growth of 2-2½% per annum and to a trend decline in M3 income velocity of ½-1% per annum in the euro area. We will issue a separate press release this afternoon explaining in greater detail the background to this decision.

When comparing current developments with the reference value, it is important to remember that the reference value is a medium-term concept. Short-term movements of M3 do not necessarily have implications for future price developments. Moreover, deviations of M3 from the reference value must be analysed in conjunction with other real and financial indicators in order to understand their implications for price stability.

Turning to the most recent data, in the period from August to October 2002 the three-month average of the annual growth rate of M3 was 7.1%, unchanged from the previous three-month average. M3 growth has been influenced considerably by portfolio re-allocations in an environment of general uncertainty and particularly by stress in financial markets. At the same time, it also reflects the low level of interest rates in the euro area which makes the holding of liquid assets relatively attractive.

There is ample liquidity in the euro area. However, in the light of the sluggish economic growth, it is unlikely that this excess liquidity will translate into inflationary pressures in the near future. The recent moderation of the growth in loans to the private sector, particularly to non-financial corporations, supports this assessment.

Turning to the **second pillar**, recent information has strengthened the evidence of a decline in inflationary pressure. The sluggishness of real GDP growth in the euro area was confirmed yesterday by Eurostat's first estimate, which indicates that quarter-on-quarter growth was 0.3% in the third quarter. This was towards the lower end of expectations. Recent euro area-wide survey data suggest that overall sentiment in the economy remains lacklustre, with business confidence improving somewhat but consumer confidence falling further. It is expected, therefore, that economic growth will also remain subdued in the coming months.

This disappointing picture mainly reflects the persistently high degree of uncertainty. Geopolitical tensions with potential consequences for oil prices, developments in financial markets, the sluggish growth of the world economy and the persistence of global imbalances are all factors that weigh adversely on confidence. These factors also have negative effects on euro area consumption, investment and the labour markets. As it is hard to predict when this uncertainty will start to abate, it must be taken into account in the more medium-term outlook for growth.

The subdued economic activity should limit potential upward risks to price stability and help to ease inflationary pressure. Let me elaborate on this.

First, when looking back, we recognise that inflation has been rather persistent despite the economic slowdown. This persistence has partly reflected a series of transitory developments, such as the indirect effect of previous oil and food price increases and a limited changeover effect. However, structural factors in the labour and product markets have also played a role, as mirrored, in particular, in the upward trend in wage developments observed until recently. This trend has only just shown signs of stabilisation. Services price inflation has also remained stubbornly high. Indeed, structural rigidities have impeded an appropriate adjustment of wages and prices. As a result, annual inflation rates have remained above 2% during most of 2002, including November, as has been confirmed by Eurostat's flash estimate, which indicates an annual HICP inflation rate of 2.2%.

Second, when looking forward from now until the early part of 2003, although recent developments in oil prices have lowered short-term price pressures, there are still some factors that could keep annual inflation rates above 2% for several months to come. Yet this short-term outlook is related both to

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base effects and to indirect taxes and administered prices, i.e. to temporary developments.
Third, when looking beyond the short term, we consider that both the overall economic environment and the euro exchange rate, which has strengthened since early this year, will contribute further towards reducing inflationary pressure. Moreover, we expect the indirect effects of previous increases in oil prices and other factors to further unwind. Although wage-related risks remain in place, they are judged less likely to materialise as long as the economic environment does not change substantially.
The assessment which guided today's monetary policy decision was that, overall, the prospect has strengthened for inflation to fall below 2% in the course of 2003 and to remain in line with price stability thereafter. Our decision should also help to improve the outlook for the euro area economy by providing a counterweight to some of the existing downside risks to economic growth, thereby supporting confidence. The most likely scenario is that economic growth will gradually recover in the course of 2003 towards rates more in line with potential. Falling inflation should support real disposable income and, together with a reduction in the gap between perceived and actual inflation rates, should underpin private consumption. Moreover, we expect an improvement in world demand. This, and the low level of interest rates, should benefit investment.
Let me point out that, with today's decision, the key ECB interest rates have reached a very low level by historical standards. The Governing Council will continue to monitor closely all factors that may affect the prospects for inflation in the euro area.
The outlook for the euro area economy will also very much depend on visible progress in other policy areas. Regarding **fiscal policies** in the euro area, I would like to reiterate that budgetary discipline strengthens the conditions for sustainable growth of GDP and employment. Therefore, sound fiscal positions, as enshrined in the Treaty and further developed in the Stability and Growth Pact, are in the interest of all the Member States. Given the disappointing fiscal developments in some countries and the challenges which have emerged to the EU fiscal framework, we welcome the moves to correct or prevent excessive deficits, i.e. the implementation of excessive deficit procedures in the case of Germany and Portugal and the early warning issued to France. Countries with remaining imbalances are urged to prepare sufficiently ambitious consolidation plans for their forthcoming stability programmes. Emphasis should be placed on a growth-oriented consolidation policy that strengthens the productive forces of the economy. The Governing Council considers the recent Commission communication to be a good starting point for rebuilding confidence in the budgetary framework. As already reflected in the Statement on the Stability and Growth Pact of 24 October 2002, we fully support the Commission's main objective, namely to improve the implementation of the Pact within the existing framework of rules.
Finally, I should like to stress again that there is still an urgent need to implement decisively the **structural reform agenda**. We note with some concern the slow progress in many euro area countries and call on governments to take determined action. The medium-term impact of these reforms on the economic growth potential of the euro area is likely to be substantial. A prompt implementation of structural reforms in the labour, product and financial markets is particularly important at this juncture since it would contribute to strengthening confidence in the euro area, thereby also supporting economic activity in the short term."

2. Inflation forecast on the basis of the P-star model

To estimate euro area inflation we took advantage of the "price gap" presented in ECB OBSERVER No 1, 17 April 2001. We regressed quarterly changes to the annual change in the euro zone consumer price index (DDLNCPI) onto (i) quarterly changes to the annual change in the price gap of M3 (DDLN4PLM3, gliding four quarter average), (ii) quarterly changes to the annual change in the output gap (DDLN4OG, gliding four quarter average), (iii) quarterly changes to the annual change in oil prices (DDLNOIL), (iv) quarterly changes to the annual change in the Euro-US dollar exchange rate (DDLN4EUROUSD, gliding four quarter average) and (v) lagged quarterly changes to the annual change in the price level (DDLNCPI). The results are

shown in tab. 1. All variables are expressed in logs. Figures in brackets show the number of lagged quarters. DUM represent dummy variables and the number in brackets show the respective year/quarter. All variables are statistically significant at conventional measures.[22]

Tab. 1. – Regression results for first differences of fourth differences of the log euro area deflator, 1982:Q2 to 2002:Q3

Dependent Variable: D4DLNP
Method: Least Squares
Date: 11/14/02 Time: 19:56
Sample (adjusted): 1982:2 2002:2
Included observations: 81 after adjusting endpoints

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C	-0.0009	0.0004	-2,280,202	0.0256
DUM801874	-0.0032	0.0007	-4,786,905	0.0000
DUM9234	-0.0054	0.0017	-3,150,638	0.0024
DUM012	0.0103	0.0024	4,234,645	0.0001
D4DLNOIL	0.0035	0.0011	3,113,283	0.0027
D4DLNEURO(-1)	-0.0178	0.0045	-3,971,911	0.0002
D4DLNAU4(-1)	0.3101	0.1123	2,760,710	0.0073
D4DlnPL4M3(-1)	0.3386	0.0947	3,574,151	0.0006
D4DLNP(-3)	0.1996	0.0844	2,364,283	0.0208
D4DLNP(-4)	-0.3666	0.0849	-4,319,397	0.0000
R-squared	0.6572	Mean dependent var		-0.0009
Adjusted R-squared	0.6137	S,D, dependent var		0.0036
S.E. of regression	0.0022	Akaike info criterion		-9.2522
Sum squared resid	0.0004	Schwarz criterion		-8.9566
Log likelihood	384.7158	F-statistic		15.1243
Durbin-Watson stat	1.9010	Prob(F-statistic)		0.0000
Breusch-Godfrey Serial Correlation LM Test (4 lagged Variables):				
F-statistic	1.9347	Probability		0.1148
Obs*R-squared	8.3871	Probability		0.0784
Jarque Bera	0.0068	Probability		0.9966
White Heteroskedasticity Test (no cross terms):				
F-statistic	0.814511	Probability		0.657958
Obs*R-squared	1,281,613.0000	Probability		0.616498
ARCH Test (4 lagged Variables):				
F-statistic	1,018,571.0000	Probability		0.403630
Obs*R-squared	4,123,861.0000	Probability		0.389503

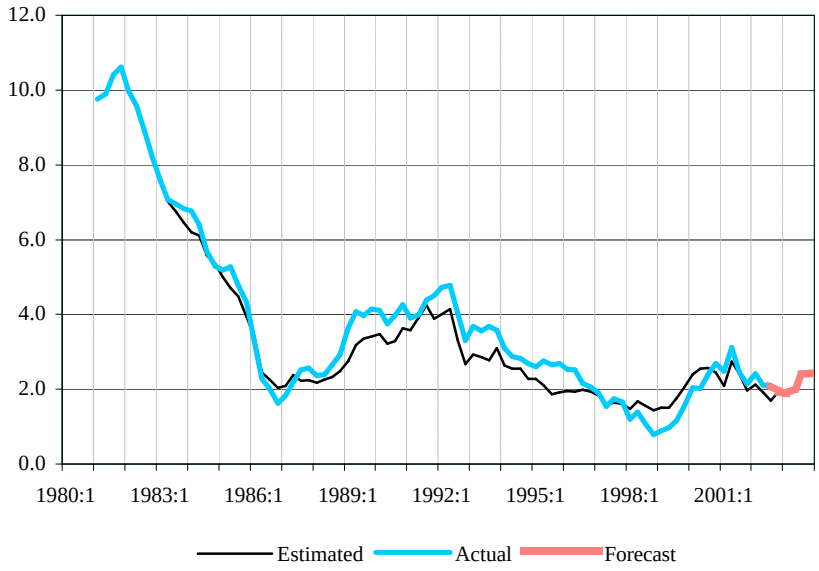
Figure 5 (a) shows actual and estimated annual inflation in the euro area for the period 1982:2 to the end of 2003. As can be seen, the model has explained the actual inflation path fairly well. Figure 5 (b) shows the forecast inflation until the end of 2003 in more detail. The model assumptions are as follows: (i) potential euro area output growth 2.0 percent; (ii) oil price US$25.0, (iii) EUR/USD 0.98 in 2002:3, 0.99 in 2002:4, 0.95 in 2003:1 and 0.9 thereafter, (iv) annual output growth in 2002:3 and 2002: 1.0 percent, and 1.8 percent in 2003; (v) annual M3 growth 7.0 percent in 2002:4, 6.5 percent in 2003:1 and 2003:2 and 6.0 percent in 2003:3 and 2003:4. On

[22] It should be noted at this juncture that the inclusion of stock prices in the P-star-based inflation forecast model (as outlined in section 4 of this report) does not improve the model's forecasting quality.

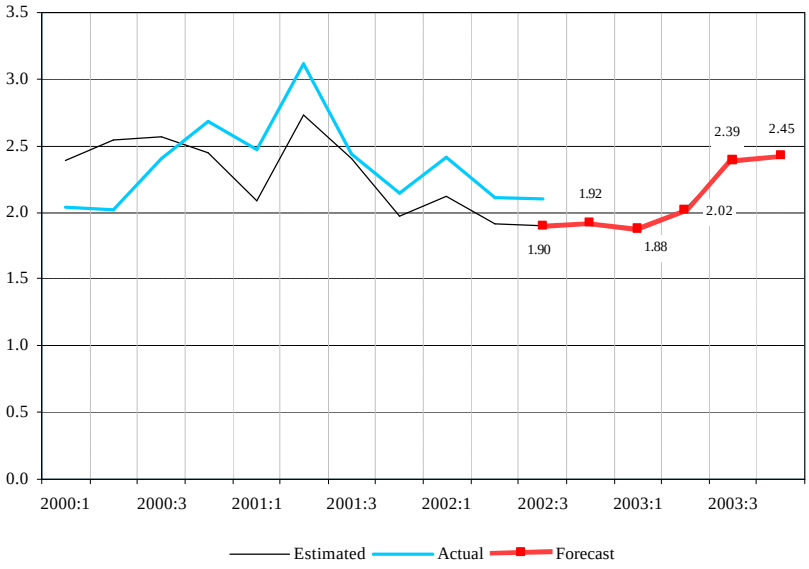
the basis of the data up to the end of 2002:2, the model predicts inflation to increase towards 2.5 percent around 2003:4, indicating an average inflation of 2.2 percent for the year 2003 as a whole, that is slightly above the ECB's upper 2.0 percent ceiling.

Fig. 5. – Euro area inflation, actual, estimated and forecast in percent

(a) 1983:1 to 2003:4



(b) 2001:1 to 2003:4



3. ECB rate outlook

Going forward, ECB monetary policy is likely to face a tough environment. Low economic expansion rates, unsatisfactory performance of the labour markets in numerous euro area countries and, most importantly, deteriorating public finances are most likely to provoke further calls for an easier ECB monetary policy. All the more so as current inflation is considered to have reached a low level and increasingly more at-

tention is being paid to the risk of deflation. Moreover, geopolitical uncertainties can be expected to prevail, keeping a lid on consumer and investor sentiment, thereby dampening hopes of a strong economic recovery in the euro area.

However, calls for a more cyclically-oriented monetary policy are not backed by sufficient theoretical or empirical evidence. In view of uncertainties in the form of unknown "time-lags" it is not advisable for the ECB to react to business cycle fluctuations. In fact, the driving forces of economic growth seem to be beyond the reach of monetary policy. The key for fostering growth in the euro area should be seen in a strengthening of market forces by way of structural reforms in the factor and product markets and reducing taxes and public spending.

In view of the stimulating monetary policy already in place, a further increase in the money supply, brought about by lower central bank interest rates, would clearly run the risk of rendering the inflation perspective in the euro area even less favourable: it is already unlikely that the 2003 target will be hit. A further interest rate reduction thus appears to be incompatible with the ECB's objective of keeping inflation below 2.0 percent in the medium-term.

4. *Digression*: bank credit expansion in Germany

Since 2000 German bank lending to domestic enterprises and resident individuals has shown a remarkably steep decline when compared with the developments to be observed in the last two decades (see figure 6). In May 2002, the annual growth rates of bank loans to non-banks (in domestic and foreign currencies) fell to the lowest level, both in nominal and real terms, seen in the period under review reaching –0.2 percent and –1.3 percent, respectively. These exceptionally low rates contrasted with average growth rates of 7.7 and 5.4 percent, respectively, for the period 1991 until September 2002. Lending to domestic enterprises and resident individuals has slowed most at the commercial banks, followed by the cooperative banks. Year on year, lending by commercial banks to the domestic private sector is currently even lower, and lending by the cooperative banks is only marginally higher. This is mainly due to the decline in short-term lending, which plays a more important role at commercial banks. Lending by Landesbanks and savings banks has risen by 2.0 percent year on year (see Bundesbank, October 2002, p. 34). Only recently, annual loan expansion rates have reversed their downward trend somewhat but have remained at a relatively low level.

Several demand-side factors spring to mind which might explain the downward trend in German bank lending such as, for instance, a substitution of bank loans through the issuance of money and capital market instruments and/or firms' substitution of external through internal funding. When taking a closer look, however, none of these factors provides an (empirically) convincing explanation. Turning to the demand-side factors, German banks may have become increasingly unwilling to grant loans to non-banks. This hypothesis can be subject to an empirical analysis by way of estimating a long-term credit demand function.[23] In October 2002, the Bundesbank wrote: *"As the result of the empirical analysis of loans granted by German banks to domestic private non-banks, it must be noted that the currently weak credit expansion is primarily cyclically induced and thus probably mainly due to credit demand ad-*

[23] Barclays Capital, "Deutschen Unternehmen geht der Bankkredit aus", 21. Mai 2002. See also Deutsche Bundesbank, The development of bank lending to the private sector, Monthly Bulletin October 2002, pp. 31.

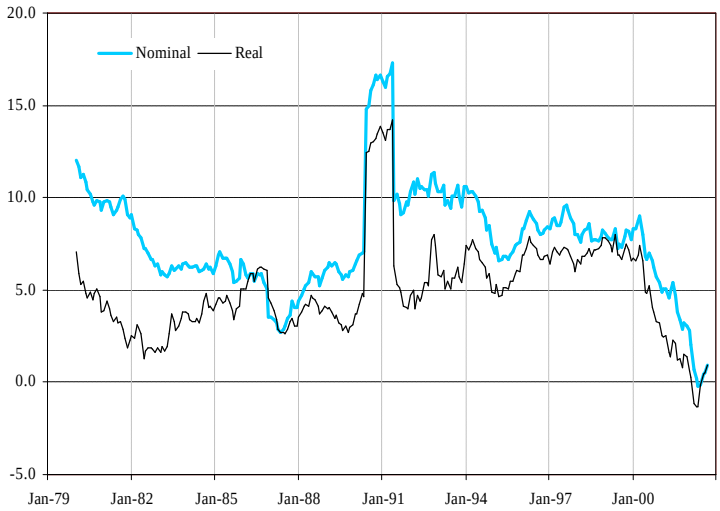
justments. A decline in stimulating special effects may also come into play. Nonetheless, additional factors relating to credit demand and credit supply may also be playing a role" (Bundesbank, 2002, p. 39).

In view of the empirical problems of identifying the factors responsible for the decline in bank lending in recent quarters, it might be premature to dismiss out of hand the hypothesis of "*credit rationing*" in the German bank sector. According to the theory of credit rationing, asymmetric information and risk-reward considerations on the part of banks may result in a situation in which banks are no longer willing to meet the full loan demand. In a period of credit rationing, the availability of credit is actually insufficient to fund all economically viable investment projects. The factors responsible for banks' lending restraint could be a heightened degree of risk aversion (as a direct result of loan losses, for example), shortage of equity capital and strategic reorganizations. Be that as it may, the currently still low bank loan expansion in Germany will deserve further observation and analysis for at least two reasons:

1 In general, the banking sector is the starting point of the monetary policy transmission mechanism. In fact, monetary impulses are channelled through the banking sector into the real economy. The banks' willingness and ability to grant loans to non-banks plays a crucial role in the successful conducting of monetary policy.

2 In Germany, bank loans represent the most important source of firms' external funding. Any unexpected bottleneck in the availability of bank loans can be expected to feed through into a decline in investment spending, thereby affecting negatively output and employment. With Germany accounting for a large share in the euro area output, unfavorable economic conditions bear certainly the potential to be spilled-over to other euro area countries.

Fig. 6. – Annual growth rates of German bank lending in percent



Data source: Deutsche Bundesbank, Datastream Primark; own calculations. – The real rate is the nominal rate minus the annual inflation of the euro area consumer price index.

Tab. 2. – Lending to enterprises and households in Germany, by category of bank, annual changes in percent

Period	All banks		Commercial banks		Savings and Landesbanks		Credit cooperatives and regional institutions of credit cooperatives	
	Total	of which medium- to long-term	Total	of which medium- to long-term	Total	of which medium- to long-term	Total	of which medium- to long-term
1989	7.6	6.9	12.4	12.4	5.9	5.2	7.8	7.2
1991	11.7	10.7	12.4	12.4	12.6	10.7	10.7	9.9
1993	8.2	10.6	7.2	13.5	11.2	13	8.0	10.1
1995	7.4	7.5	7.4	8.6	7.7	7.5	9.1	9
1997	5.9	7.0	4.8	6.7	6.1	7.0	5.8	6.7
1998	7.7	7.1	8.4	6.6	7.2	7.0	6.3	6.5
1999	6.4	7.5	5.5	5.9	8.9	10.7	4.6	6.5
2000	4.3	4.1	4.1	3.8	4.9	4.0	3.2	3.4
2001-Q1	4.1	3.7	3.9	3.7	4.6	3.6	2.3	2.5
2001-Q2	3.1	3	1.8	2.1	4.3	3.5	1.7	2.1
2001-Q3	2.4	2.5	0.4	1.1	4.0	3.2	0.4	1.4
2001-Q4	2.3	2.3	0.8	0.5	3.8	3.6	0.4	1.1
2002-Q1	1.2	2.2	1.6	0.4	3.1	3.4	0.4	1.6
2002-Q2	0.9	2.0	1.1	1.2	2.5	2.9	0.2	1.5
July	1.0	2.2	0.7	1.2	2.3	3.1	0.3	1.7
August	1.0	1.9	0.7	1.3	2.1	2.7	0.4	1.5

Data source: Deutsche Bundesbank.

APPENDIX

Schedules for the meetings of the Governing Council and General Council of the ECB and related press conferences 2002

Governing Council	General Council	Press Conferences
3 January		3 January
17 January		
7 February (Maastricht)		7 February
21 February		
7 March		7 March
21 March	21 March	
4 April		4 April
18 April		
2 May		2 May
16 May		
6 June		6 June
20 June	20 June	
4 July (Luxembourg)		4 July
18 July		
1 August		
29 August		
12 September		12 September
26 September	26 September	
10 October		10 October
24 October		
7 November		7 November
21 November		
5 December		5 December
19 December	19 December	

Schedules for the meetings of the Governing Council and General Council of the ECB and related press conferences 2003

Governing Council	General Council	Press Conferences
9 January		9 January
23 January		
6 February		6 February
20 February		
6 March		6 March
20 March	20 March	
3 April (Rome)		3 April
24 April		
8 May		8 May
22 May		
5 June		5 June
26 June	26 June	
10 July		10 July
31 July		
21 August		
4 September		4 September
18 September	18 September	
2 October (Lisbon)		2 October
23 October		
6 November		6 November
20 November		
4 December		4 December
18 December	18 December	

ECB OBSERVER – *recent publications*

Number	Title and content	Date of publication
No. 4	**International coordination of monetary policies – challenges, concepts and consequences** *Content: 1. International coordination of monetary policies. – 2. Does the ECB follow the Fed? – 3. Stock prices – a special challenge for monetary policy. – 4. ECB monetary policy review and outlook.*	19 December 2002
No. 3	**The Fed and the ECB – why and how policies differ** *Content: 1. The US Federal Reserve System and the European System of Central Banks – selected issues under review. – 2. The reaction functions of the US Fed and ECB. – 3. The influence of monetary policy on consumer prices. – 4. ECB rate policy and Euro zone inflation perspectives.*	24 June 2002
No. 2	**Can the ECB do more for growth?** Content: *1. Should the ECB assign a greater role to growth? – 2. Government finances and ECB policy – a discussion of the European Stability and Growth Pact. – 3. "Price gap" versus reference value concept. – 4. Assessment of current ECB policy and outlook.*	19 November 2001
No. 1	**Inflationsperspektiven im Euro-Raum** Content: *1. Warum die EZB-Geldpolitik glaubwürdig ist. – 2. EZB-Strategie – Stabilitätsgarant oder überkommenes Regelwerk? – 3. Stabilitätsrisiken der Osterweiterung. – 4. Zinspolitik der EZB in 2001 und 2002.*	17 April 2001

ECB OBSERVER – *objectives and approach*

The objective of ECB OBSERVER is to analyse and comment on the conceptual and operational monetary policy of the European System of Central Banks (ESCB). ECB OBSERVER analyses focus on the potential consequences of past and current monetary policy actions for the future real and monetary environment in the Euro zone. The analyses aim to take into account insights from monetary policy theory, institutional economics and capital market theory and are supplemented by quantitative methods. The results of the analyses are made public to a broad audience with the aim of strengthening and improving interest in and understanding of ECB monetary policy. ECB publishes its analyses in written form on a semi-annual basis.

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