

Stirböck, Claudia; Buscher, Herbert S.

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Claudia Stirböck and Herbert S. Buscher*

Exchange Rate Volatility Effects on Labour Markets

With the transition to the euro, exchange rate volatility between the countries participating in European Monetary Union has been eliminated, reducing uncertainty and transaction costs. The other side of the coin is the loss of the exchange rate as a potential mechanism of adjustment to external shocks. The present article uses the case of Germany to study the implications of EMU for labour markets.

The transition to the euro, the single European currency, has been accompanied by the final fixing of bilateral nominal exchange rates between the countries participating in EMU. While the long-term flexibility of exchange rates might be useful in order to achieve stabilisation at the macroeconomic level in the case of an exogenous shock, exchange rate volatility theoretically exerts a negative impact on a nation's economy. Exchange rate volatility, strong fluctuations of the nominal exchange rate especially in the short run, is thereby assumed to have negative effects on the microeconomic level. Such fluctuations cause costs as well as uncertainties. Both of these effects, uncertainty and transaction costs, may influence economic agents in their decisions. As far as international economic activities are adversely affected by this, the elimination of exchange rate volatility can lead to positive impacts on exports, production and employment. As long as these expected positive effects of the euro are more important than the loss of the nominal exchange rate as a potential adjustment mechanism,¹ the introduction of the euro will exert a positive labour market effect. The present paper gives an overview of the implications for labour markets that might be expected in EMU.

First, short-term exchange rate variability and the pattern of foreign trade are described. Country-specific developments as well as time-period differences are stressed. In the empirical regressions presented later, these specificities are taken into account. A comparison of the volatility of the Deutschmark against the currencies of the EU countries to that against extra-EU currencies such as the yen and the dollar shows that volatility is quite small in relation to the European countries, which at the same time are Germany's most important trading partners.

This is followed by a brief overview of empirical studies which try to prove negative impacts of exchange rate volatility. We refer especially to studies focusing on the impact of volatility on labour markets by Gros,² Belke and Gros,³ and Jung.⁴ Our empirical estimations are partly based on the results found by Gros, Belke and Jung as, in the first estimations, we also use autoregressive (AR) models without making

* Centre for European Economic Research (ZEW), Mannheim, Germany. This research was undertaken with support from the Deutsche Post-Stiftung (German Mail Foundation) in the project 'Arbeitsmarkteffekte der Europäischen Währungsunion' (Labour Market Effects of European Monetary Union). Helpful comments from our colleagues Thiess Büttner and Friedrich Heinemann are gratefully acknowledged. We are also indebted to Ingo Sängler for excellent research assistance. All remaining errors are our own.

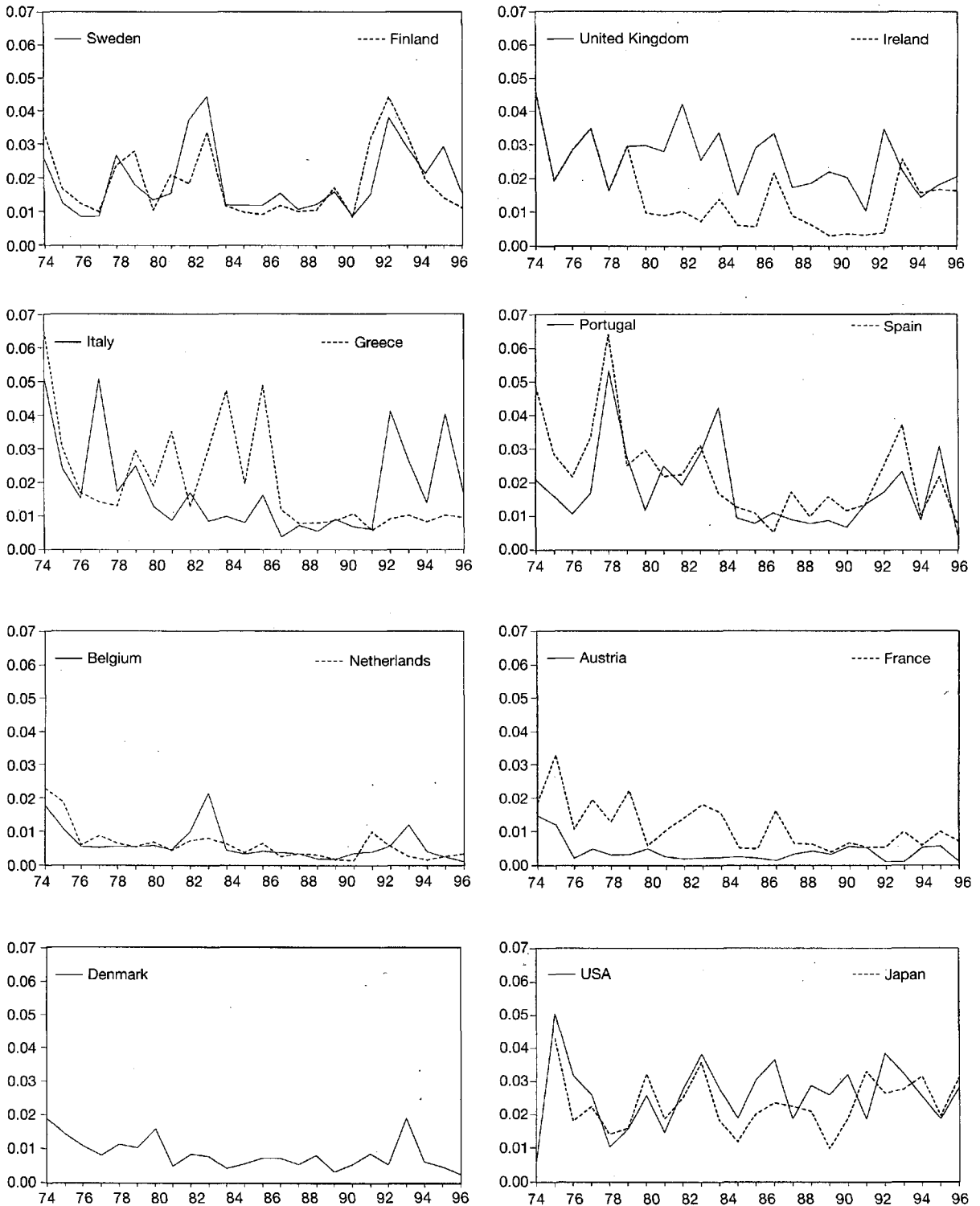
¹ For a discussion and an analysis of the adjustment effects of monetary instruments before EMU see Claudia Müller, Herbert S. Buscher: The Impact of Monetary Instruments on Shock Absorption in EU-Countries, Discussion Paper No. 99-15, ZEW Mannheim 1999.

² Daniel Gros: Germany's Stake in Exchange Rate Stability, in: INTERECONOMICS, No. 5, 1996, pp. 236-240.

³ Ansgar Belke, Daniel Gros: Evidence on the Costs of Intra-European Exchange Rate Variability, Diskussionsbeiträge No. 13, Institut für Europäische Wirtschaft, Bochum 1997.

⁴ Alexander Jung: Is There a Causal Relationship between Exchange Rate Volatility and Unemployment?, in: INTERECONOMICS, No. 6, 1996, pp. 281-282.

Figure 1
Yearly Standard Deviation of the Percentage Change of the Bilateral Nominal Exchange Rate of the DM
against the 13 other EU Currencies as well as the Dollar and the Yen
 (end-of-month values)



Sources: OECD; own calculations.

use of a structural model. With only the use of endogenous lag variables in order to approximate a structural model, it is possible to test the empirical influence of further variables, i.e. exchange rate volatility, on unemployment. Three different volatility measures for four different country groups were used to test the robustness of the reported effects. Finally, on the basis of monthly data, we analyse five subperiods defined according to differences in exchange rate stability. In addition to that, we make use of a reduced form model, a dynamic version of Okun's law, in order to try to confirm the direct influence of volatility on the labour markets analysed in the AR models.

Cost of Flexible Exchange Rates

In a strongly export-oriented economy such as Germany, competitiveness in international trade also influences the domestic economic situation, since production in the export sector has an influence on growth and thus on employment. Exchange rate changes can adjust the price competitiveness of an economy, thus avoiding or at least diminishing the risk of long-term misalignments of the domestic currency. If, however, major exchange rate fluctuations bring about frequent changes in the domestic competitive situation, this volatility may also adversely affect foreign trade.

Figure 1 shows the extent of volatility, measured by the annual standard deviation of the percentage changes⁵ of the bilateral nominal exchange rates,⁶ and gives an impression of the different European currencies' variability in relation to the Deutschmark. In the illustration as well as in the calculation of the annual volatility, we use end-of-month exchange rate data from the OECD. Instead of representing average values, these data relate to specific points in time. This dataset has the advantage that it catches short-term fluctuations, which have to be taken into consideration for the purpose of measuring volatility. The presentation starts in 1973, the time when the Bretton Woods System broke down and the transition to free-floating currencies took place. In 1972, Germany, Belgium, Luxembourg, France, Italy, Denmark, the Netherlands, the UK and Ireland joined an informal

joint float system against the dollar; some of them, however, did so only temporarily. The system was set up in order to avoid currency turbulences in Europe. The European currencies joining this system had to remain within a so-called currency snake with a $\pm 2.25\%$ margin of tolerated exchange rate flexibility. The currencies inside this snake were intended to be stabilised towards each other in this way, but in relation to the dollar the snake was to be a floating group of currencies. However, the heavy exchange rate fluctuations could not be eliminated; and eventually only five countries remained in the system. In 1979, a new attempt to influence exchange rates was started with the implementation of the European Monetary System (EMS) by Belgium and Luxembourg, Denmark, France, Germany, Ireland, Italy and the Netherlands. In 1989 Spain entered the EMS, followed by Portugal in 1992, Austria in 1995, Finland in 1996 and finally Greece in March 1998. Italy did not participate between 1992 and 1996, and the UK was a member only between 1990 and 1992. Thus, only the UK and Sweden are not represented in the EMS today.

Figure 1 shows that volatility in the southern, peripheral countries of Spain, Italy, Portugal and Greece was significantly higher than in other countries over the whole time period. But Finland, Sweden and the UK were also subject to high volatility. In contrast, Belgium/Luxembourg, Denmark, France, Austria and the Netherlands showed a far lower degree of volatility. Their exchange rates against the Deutschmark fluctuated mainly up to the 1980s and then stabilised to a large extent. Between 1992 and 1994, volatility increased again especially in the countries with formerly high volatility. Since 1995, a general decrease in exchange rate volatility within the EU can be observed.

The exchange rate volatility of the Deutschmark in relation to the US dollar and the Japanese yen is as high over the whole period as that in relation to the most volatile European currencies. In contrast to the European currencies, however, there were no instances of stronger exchange rate stability.

Looking at the changes in the nominal exchange rates and their standard deviations, we can observe that six of the fourteen other EU member states have stabilised their exchange rate in relation to the Deutschmark. This is the case for Belgium/Luxembourg, Denmark, France, the Netherlands and Austria. Since the end of the 1980s, these core countries have developed into a hard currency bloc, the so-called 'DM-bloc'.

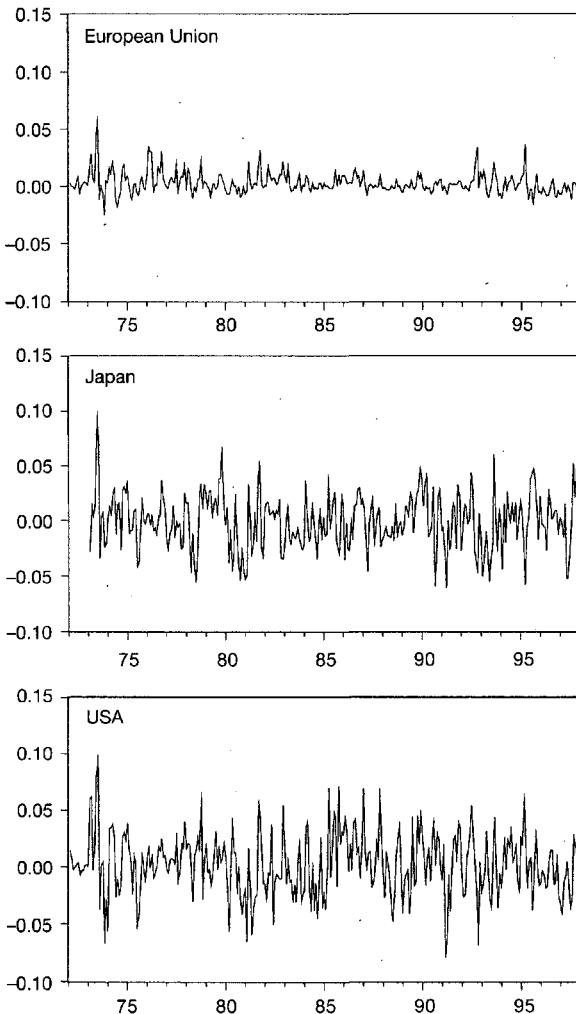
⁵ The percentage changes are calculated by taking the first difference of the logarithm of the external values of the D-Mark.

⁶ When examining short-term changes, in general the development of nominal exchange rates is analysed. As inflation rates are not subject to major swings in the short run, the trend of nominal exchange rates corresponds roughly to the development of real exchange rates beyond this (short-term) time horizon.

The course of the percentage changes of the Deutschmark in relation to the currencies of the other EU countries, as well as to the yen and the dollar, can be seen in Figure 2: Significantly higher and more frequent changes than against the EU currencies or even against the EMS currencies can be noted for the relation to the dollar and the yen. This means that intra-European trade is subject to far smaller exchange rate uncertainties than extra-European trade.

The common objective of the European countries is the reduction of the existing exchange rate volatility

Figure 2
Percentage Changes of the Nominal External Values of the DM against the Currencies of the EU Countries, Japan and the USA



Sources: Deutsche Bundesbank; own calculations.

between the EU currencies. By way of a common currency, the theoretically assumed negative effects of exchange rate fluctuations on foreign trade and thus on domestic productivity and employment, which are discussed below, should be eliminated. After all, intra-European exports form the bulk of the total exports of most European states.

Figure 3 shows that in 1996, Germany exported 57% of its total exports to its European partner countries. A further 9.2% of German exports went to Central and Eastern Europe, approximately 7.6% to the USA, and 8.7% to South-East Asian newly industrialised countries (NICs). Comparing Germany's export pattern in 1991 and 1996, it is obvious that exports to the USA have risen both in percentages and in absolute figures. Apart from the USA, the Central and East European countries as well as the South-East Asian NICs increasingly imported from Germany not only in absolute but also in relative terms. German exports to the EU have gone up not in relative, but in absolute terms, although to a far lesser extent than e.g. exports to the USA.

The percentage of German exports to the EU – as can be seen in Figure 4 – rose continuously between 1981 and 1989 and reached its peak in 1989, when exchange rate stability in Europe was at its highest. But in 1993 it fell from 63.4% to 58.4% and has not crossed the 60% line since. However, those of Germany's export markets that have grown fastest since 1993 lie outside central Europe. The (relative) fall in exports to the EU should also at least partially be attributable to cyclical causes. Even if the percentage of exports to EU countries has increasingly stagnated, the EU member states still remain Germany's most important trading partners. After a boom phase, the trade share has returned to its natural level of almost 60%.

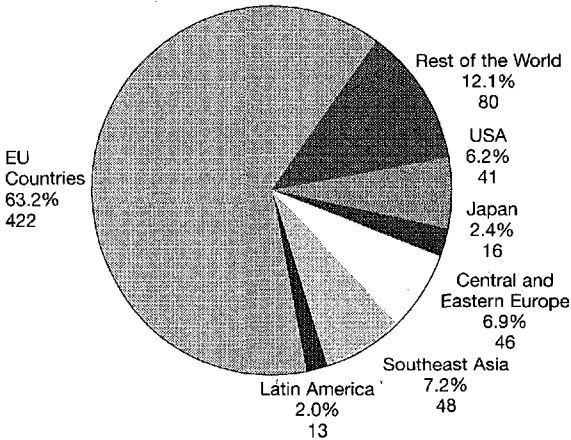
A similarly strong intra-European trade orientation is to be found in France, whose exports to EU member states in 1996 accounted for 63% of the total volume.⁷ Within the entire EU, the bulk of foreign trade is intra-European trade. Even if the existence of one currency in the EU does not contribute to the stabilisation of the external value of the euro in relation to the US dollar or to other non-European currencies, the elimination of exchange rate fluctuations within the EU alone could thus eliminate negative effects to currently approx. 57% of German and 63% of French foreign trade. Consequently, dynamic profits and thus

⁷ Source: I.N.S.E.E.

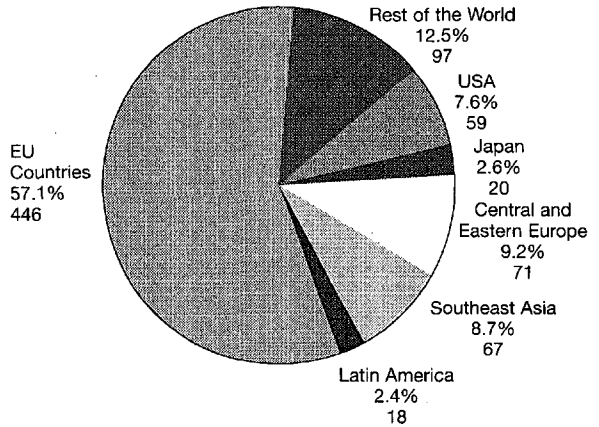
Figure 3
Exports from Germany to Various Countries

(absolute figures in D-Mark billion)

Trade quota 1991
in % and absolute (in DM bn)



Trade quota 1996
in % and absolute (in DM bn)



Sources: Deutsche Bundesbank; own calculations.

an increase in trade can be expected. The relatively low proportion of German exports to the USA therefore does not mean that the stabilisation of the future European currency in relation to the dollar would only have a positive impact on the contemporary approx. 8% of German exports going to the USA. On the one hand, the international ranking of the US dollar as an invoicing currency suggests that a large percentage of extra-European German foreign

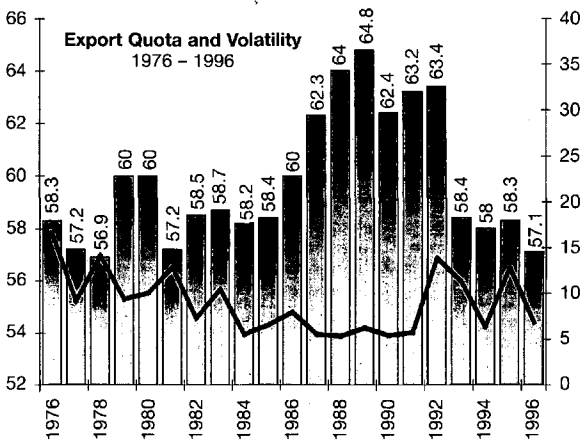
trade would be affected by dollar fluctuations. On the other hand, dynamic effects have to be considered again, for a higher euro-dollar exchange rate stability would also lead to an increase in the percentage of exports to those non-European countries invoicing in US dollars.

Examining German exports to the individual EU member states as shown in Figure 5, we can observe that at the beginning of 1997, 55.8% of Germany's intra-European exports went to the DM bloc. This means that in the 1990s only minor exchange rate volatility affected 32% of total German exports. 44.2% of Germany's intra-European exports, i.e. 25.3% of total German exports, were subject to slightly higher exchange rate fluctuations, but with no significantly higher exchange rate risk than the exports to non-EU countries. Thus, exchange rate stability and high percentages of German exports can be found simultaneously in the EU countries.

Figure 4

Development of Exports Percentages from West Germany to EU Countries

(in per cent)



Bar chart shows intra-EU trade share. Curve shows volatility (*1000) (right-hand scale).

Sources: Deutsche Bundesbank; own calculations.

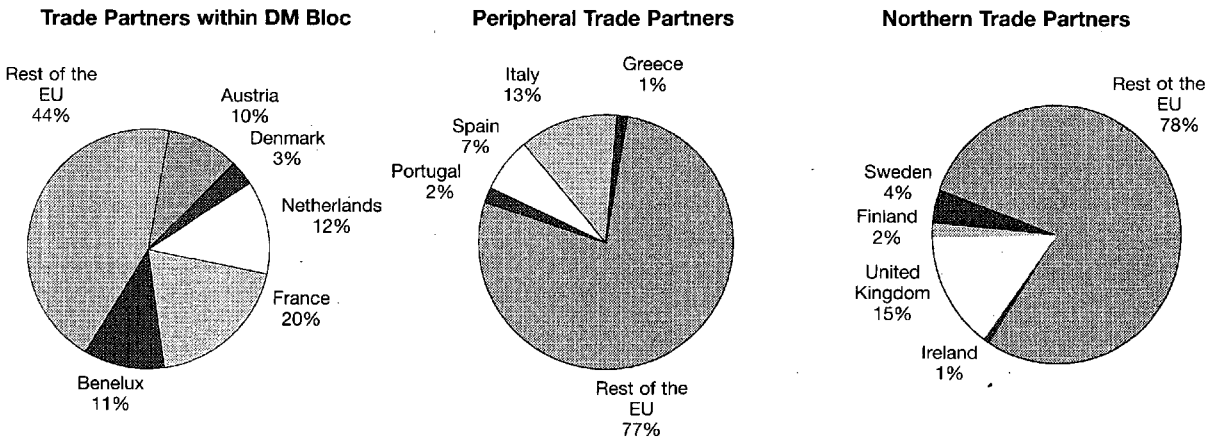
Empirical Evidence To Date

Traditionally, only little empirical evidence of the influence of exchange rate volatility on trade or exports has been found.⁸ Since the end of the 1980s

⁸ In a survey from 1984, the International Monetary Fund (IMF) presents a variety of studies dating from the 1970s and 1980s that do not focus on exports but on investments or output, which detect significant adverse effects of volatility. The studies quoted by the IMF find no significant empirical impact of exchange rate volatility on exports and thus fail to detect a direct link between exchange rate movements and international trade.

Figure 5

Shares of German Exports to Countries of the D-Mark Bloc, to 'Peripheral Countries' and to Northern Member States of the EU per 1st Quarter 1997



Source: Deutsche Bundesbank.

there have been a variety of studies which demonstrate significant negative interrelations between volatility and, besides e.g. investment, trading activity. These analyses differ from the previous ones. Traditionally, exchange rates and short-term fluctuations in these rates should be suitable to represent exchange rate risk. Capturing by means of a survey the individual impression exporters have of the effect of exchange rate variability, Duerr⁹ finds that the major US manufacturing firms are more concerned about long-term swings in exchange rates than about volatility in the short run. It seems that the construction of long-term uncertainty measures, which can depict more than just the current exchange rate fluctuations or exchange rate variabilities, has led in more recent approaches to better, more significant results. Such results are found by De Grauwe,¹⁰ Perée and Steinherr,¹¹ and Aizenman and Marion,¹² who come to similar conclusions with respect to international trade and investment respectively.

In addition to these more recent empirical analyses often focusing on long-term uncertainty, studies con-

centrating on export price elasticities, i.e. the degree of pass-through of price changes, were in some cases able to identify disturbing effects of exchange rate volatility on these export variables. Examples of such studies are Sapir and Sekkat,¹³ Döhrn¹⁴ and Clark and Faruqee.¹⁵ The latter, however, find only a small impact. In contrast to these authors, Arcangelis and Pensa¹⁶ for example do not detect a generally significant impact of exchange rate volatility on export prices. However, besides the importance of long-term uncertainty, we take pricing-to-market behaviour into account in our construction of different volatility measures.

The direct influence of exchange rate volatility on unemployment and employment growth is tested by Gros, Belke and Gros, and Jung. In negatively influencing those real variables that have empirically been taken into account so far, exchange rate volatility can – indirectly – exert a negative impact on the labour market. In a simple causality analysis Belke

⁹ Michael G. Duerr: Protecting Corporate Assets under Floating Currencies, New York, Conference Board, 1997.

¹⁰ Paul De Grauwe: International Trade and Economic Growth in the European Monetary System, in: European Economic Review 31, 1987, pp.389-398.

¹¹ Eric Perée, Alfred Steinherr: Exchange Rate Uncertainty and Foreign Trade, in: European Economic Review 33, 1989, pp. 1241-1264.

¹² Joshua Aizenman, Nancy P. Marion: Volatility and the Investment Response, NBER, Working Paper 5841, 1996.

¹³ André Sapir, Khalid Sekkat: Exchange rate volatility and international trade: the effect of the European Monetary System, in: Paul De Grauwe, Lucas Papademos: The European Monetary System in the 1990's, pp. 182-198.

¹⁴ Roland Döhrn: Zur Wechselkursempfindlichkeit bedeutender Exportsektoren der deutschen Wirtschaft, in: RWI-Mitteilungen 44, 1993, pp. 103-116.

¹⁵ Peter B. Clark, Hamid Faruqee: Exchange Rate Volatility, Pricing-to-Market and Trade Smoothing, IMF Working Paper 126, Washington 1997.

¹⁶ Giuseppe De Arcangelis, Cristina Pensa: Exchange Rate Volatility, Exchange-Rate Pass-Through and International Trade: Some New Evidence from Italian Export Data, CIDEI Working Paper 43, Rome 1997.

and Gros detect significant positive (negative) links between exchange rate volatility and unemployment (employment growth) for a number of countries. Jung, using the same empirical method but a shorter time period and another measure of volatility, cannot confirm these links.

In their analyses, Belke and Gros define exchange rate volatility in the usual way as the short-term variability of exchange rates. Gros examines, for example, the German currency against the currencies of the original EMS countries – Belgium/Luxembourg, Denmark, France, Ireland, Italy and the Netherlands. In order to construct volatility measures, Belke and Gros do not take the generally used standard deviation of the aggregated external value which is generally supposed to capture short-term volatility,¹⁷ but instead make use of the annual standard deviation of the monthly changes in the log of each bilateral exchange rate and then aggregate these bilateral volatilities to one volatility measure for each European country.¹⁸ The reason given by Belke and Gros is the pricing-to-market behaviour of exporters. This implies that the development of each market including its exchange rate volatility matters individually. Exporters will probably wait to see if the exchange rate change is permanent, as otherwise the adaptation to the new exchange rate might not be worth the costs. As a consequence, each exporter is exposed to the exchange rate change in each foreign market separately. Volatility as measured by Belke and Gros could hereby show a higher level of volatility than the measures constructed in the traditional way. We took this problem into account by constructing different proxies of volatility.

Running regressions to observe the effects of exchange rate volatility on the German labour market over the period 1971 to 1995, Gros finds that a 1% increase in exchange rate variability raises unemployment by 0.6% while a decline in employment growth of 1.3 percentage points can be observed. The US dollar/Deutschmark exchange rate volatility seems to have no impact on German employment. But a negative impact of intra-European volatility on investment can be detected. Gros uses this transmission mechanism in order to explain the empirically found

phenomenon in theory. Each investment decision is a decision to wait or to invest now. The value of the option to wait rises with growing volatility, causing uncertainty about the possible return on investment.¹⁹ Gros argues that because of its inflexibility, decisions concerning the labour market are equivalent to investment decisions in Germany. Having a negative impact on investment, exchange rate volatility also influences employment in a negative way.

Belke and Gros include 11 EU countries in their estimations, examining the volatility of each national currency against the EMS currencies. The results for the EU countries do not differ much in general from the results for Germany found by Gros. Additionally, they test the robustness of the estimates by including further exogenous variables such as policy variables (e.g. interest rates) and cyclical variables (e.g. growth variables). The influence of the volatility variable remains significant and robust.

Jung also focuses on the volatility of the German currency against the EMS currencies, but he does not find any significant influence of this variable on German unemployment from 1977 to 1996. In contrast to Belke and Gros, Jung makes use of daily data and constructs monthly volatility measures. In addition to this difference, he uses the standard volatility measure, i.e. the standard deviation of the aggregated external value of a currency. Not only is Jung unable to confirm the results obtained by Belke and Gros using data at a monthly level, but he finds, on the contrary, that the change in the unemployment rate Granger causes the volatility of exchange rates. These differing results demand further research on the labour market effects of exchange rate volatility.

Volatility Measures

Having reviewed some recent results concerning the influence of exchange rate volatility on economic performance and especially on labour markets, we now present our own empirical analysis. We take into account the implications of the above-mentioned studies in the construction of volatility measures, which is why we make use of a long-term measure as well as of one catching pricing-to-market behaviour.

¹⁷ The IMF (Exchange Rate Volatility and World Trade, Occasional Paper 28, Washington 1984) underlines that there is no unique measure of volatility as the only proxy of uncertainty. However, the survey stresses that the use of standard deviations, the traditional measure of exchange rate variance, has some advantages, e.g. the well-defined properties, making them very useful for empirical analysis.

¹⁸ To aggregate these bilateral exchange rate volatilities, instead of weighting them traditionally according to trade shares, they use the countries' weights in the ECU (which also is a proxy for their weights in terms of GDP).

¹⁹ In this context, Gros uses the value of the option of waiting as modelled by Avinash Dixit: Entry and Exit Decisions under Uncertainty, in: *Journal of Political Economy*, Vol. 97, 1989, No.3, pp. 620-638.

First, we have to construct appropriate measures of volatility because of the lack of observable data on volatility. The definition of volatility may have an effect on the results. As a consequence, three different measures of volatility are constructed and tested, so that we can check the robustness of the volatility definitions:

□ The traditional measure of short-term volatility, i.e. the standard deviation of percentage changes in the aggregated nominal external value of the Deutschmark against the different country groups, as used for example by Jung.

□ The standard deviations of bilateral external values of the Deutschmark against the other countries aggregated to country-group volatilities by weighting the bilateral volatilities with trade shares. A similar measure using the ECU weights for aggregation was used by Gros as well as by Belke and Gros, as explained above.

□ A measure of volatility using an autoregressive or moving-average process of the past percentage changes of the external values. This procedure is intended to take account of long-term uncertainties as it catches the level of unanticipated fluctuations in the past. The construction of such a long-term uncertainty measure was motivated by the significant results of empirical studies presented above, where the focus was on the impact of long-term uncertainty on international trade.

In contrast to the estimations by Belke and Gros, we examine the volatility of the Deutschmark against different country groups separately, because we expect to find specific influences with respect to these different subsamples, such as core countries whose currencies are less volatile or peripheral countries whose currencies usually show a higher degree of volatility against Germany's (DM) currency.²⁰ The currency groups analysed are as follows:

□ *EU-countries* are all 14 other EU members, i.e. Austria (AT), Belgium and Luxembourg (BG), Denmark (DK), Greece (GK), Finland (FN), France (FR), Ireland (IR), Italy (IT), the Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SD) and the United Kingdom (UK). As the currencies of three countries were unavailable on a daily basis from 1973 (GK from 1976, IR from April 1979 and FN from 1983), we used a group of:

□ *Representative countries* (ES, FR, IT, NL, AT, SD and UK) instead of the EU countries in the estimations using monthly data since their external value as well

as their volatility turns out to show nearly the same movements.

□ *EMS countries* are the countries that participated immediately in the exchange rate system when it was founded in 1979, i.e. all EC countries at that time except for the UK: BG, DK, FR, IR, IT and NL.

□ *Peripheral countries*: GK, IT, ES and PT.

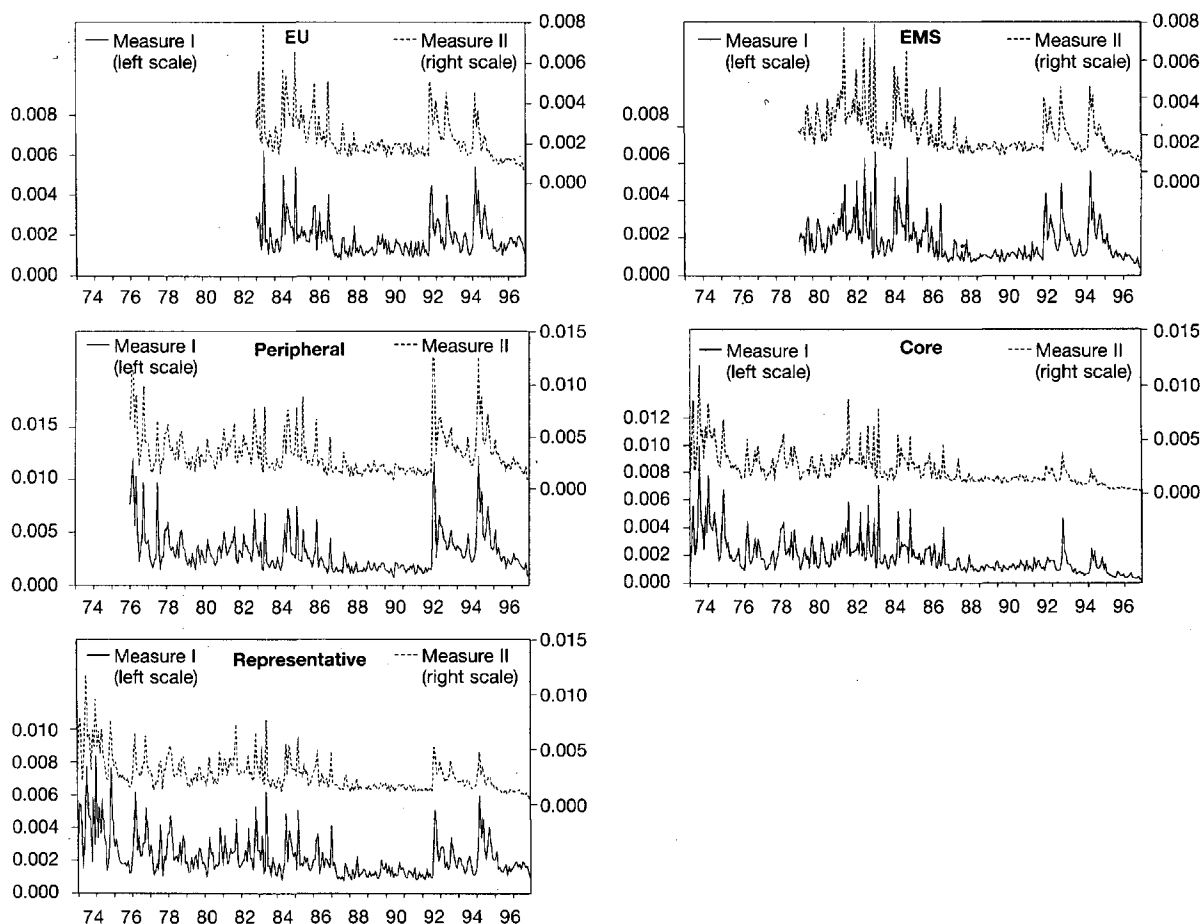
□ *Core countries* (the countries of the DM bloc): NL, BG, DK, FR and AT.

Monthly volatility measures are constructed on the basis of daily exchange rates from WM Reuters described above. Figure 6 presents measures I and II for monthly volatility based on daily exchange rates. Both monthly measures turn out to be extremely similar in their development in each country group. The fluctuations of the Deutschmark against the peripheral countries is the highest and, in addition, there are two strong peaks in the 1990s. In contrast to this, exchange rate volatility vis-à-vis the core countries has been virtually non-existent since the mid-1980s. It seems surprising that volatility vis-à-vis the EU countries – except for the 1990s – is not much higher than volatility vis-à-vis the core countries alone. This is influenced by the fact that the individual core countries – corresponding to their greater importance in German trade – are accorded high weights in the aggregation of external values. Additionally, the development of EMS country volatility is more or less identical to that of the EU countries. The latter – only calculable from 1983 – is approximated by the volatility of the representative country group, which is about the same as the original EU volatility.

Obviously, there are stable and volatile periods which will be examined separately in the estimations using monthly data. While from 1973 to 1978 and from 1984 to 1986 there are periods of, in general, strong volatility, a relatively low degree of volatility marks the periods from 1979 to 1983 and especially 1987 to 1991. From 1992 to 1997, the degree of volatility varies between individual country groups: vis-à-vis the core countries, the Deutschmark proved to be very stable, while it was very volatile vis-à-vis the peripheral countries. These divergences between

²⁰ In order to calculate the external values of the Deutschmark against these groups of countries, we use the geometric average weighted with the countries' shares in German exports as published by the German Bundesbank. See Deutsche Bundesbank: Aktualisierung der Außenwertberechnungen für die D-Mark und fremde Währungen, in: Monatsberichte der Deutschen Bundesbank 1989 (4), pp. 44-49, here p. 46.

Figure 6
Volatility Measures I and II



Note: EMS and EU country volatility cannot be indicated from 1973 on as data for three countries were not available for the whole period (GK from 1976 on, IR from 4/1979 and FN from 1983 on).

Sources: WM Reuters; own calculations.

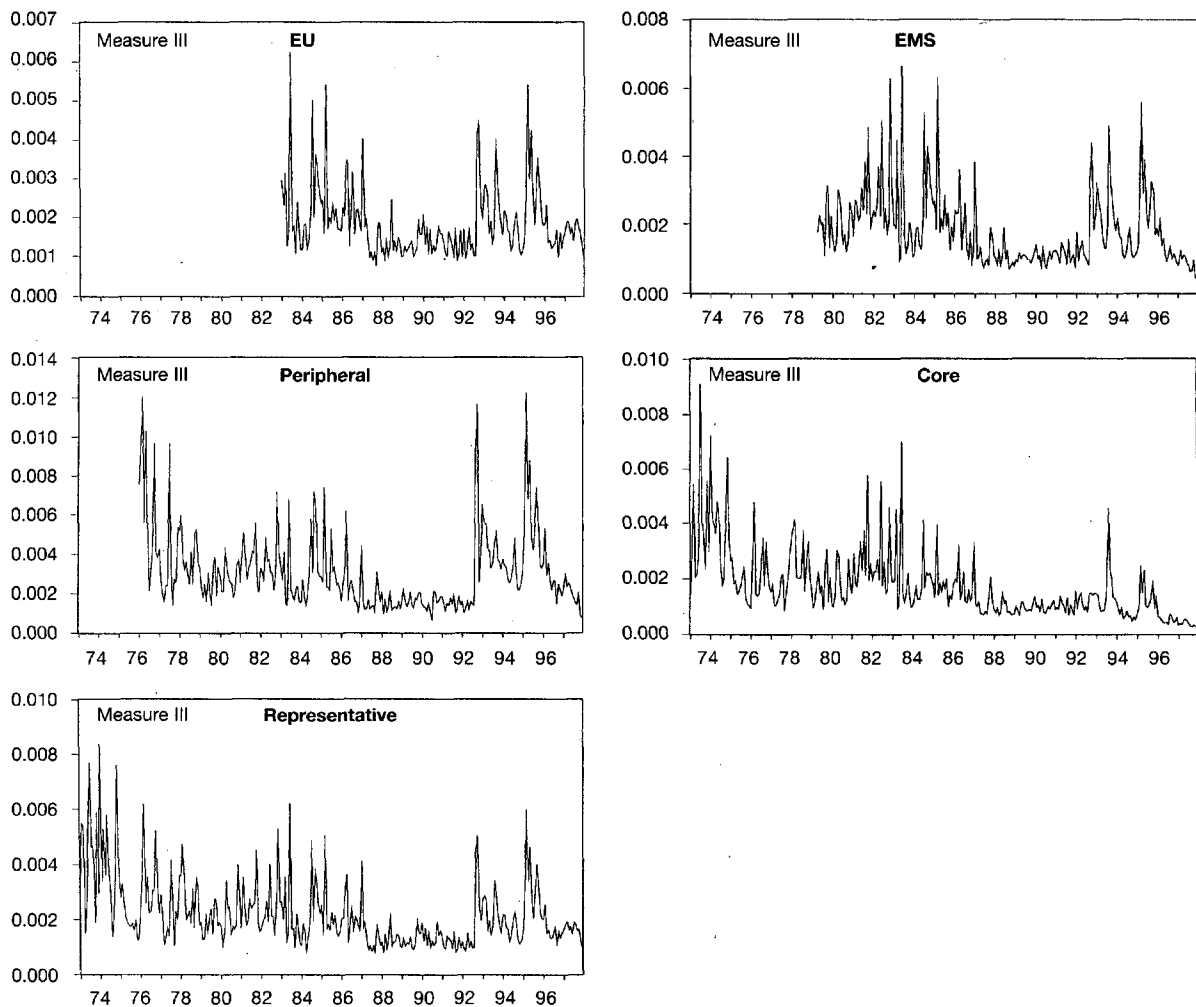
different time periods justify the splitting of the sample into five subperiods after running regressions over the whole period. Comparing volatility measures aggregated with trade shares to volatility measures aggregated with ECU shares did not show any major differences in the development or in the level of the two measures. The use of either therefore seemed to be justified.

Since the standard deviation of actual percentage changes only catches the realised volatility of exchange rates in the past, we additionally construct another measure of volatility with the purpose of catching long-term uncertainty in the fluctuation of exchange rates. We have shown above that such a procedure results in more significant estimations. In order to construct this third measure, the percentage changes of the exchange rates are explained by

autoregressive and moving-average processes. Consequently, the currencies' fluctuations are explained by their own past development. The statistical processes thus capture the explained, and hence expected, fluctuation. For this reason, the residuals of these processes reflect the unanticipated changes in exchange rates. Calculating the standard deviations of these processes' residuals gives a measure of unexpected exchange rate volatility.

The volatilities calculated according to measure III are presented in Figure 7. Their development is similar to that using measures I and II, but the fluctuation is somewhat stronger. The construction of the ARMA processes differs with respect to the time period. Concerning the core countries, there is for example an ARMA(1,32) process from 1973 to 1978, an AR(2) process from 1979 to 1983, an ARMA(1,2) process

Figure 7
Measure III of Exchange Rate Volatility



Note: See Figure 6.

from 1987 to 1991 and, finally, an MA(9) process from 1992 to 1997.

Change in the Unemployment Rate

Before testing the influence of volatility on cyclical unemployment using an Okun-type relationship in a small reduced form model, we examine an AR model of unemployment. In this model, lags in the endogenous variable and a volatility measure explain the change in the unemployment rate. We estimate the influence of exchange rate fluctuations on unemployment based on the results obtained by Belke and Gros on the one hand and on those obtained by Jung on the other hand. This is necessary due to their conflicting results. However, our estimations are run

on a more differentiated basis. Investigating volatility using data at a monthly level to construct annual measures has a considerable disadvantage, as exchange rate fluctuation always occurs in the short term. As a consequence, the process describing volatility might be systematically disturbed if it only includes one observation per month. This might be one reason why Jung, who used daily data to construct a monthly volatility measure, could not confirm the effects found by Gros. In addition, the use of monthly data and volatility measures from 1973 to 1997 allows us to differentiate between more stable and more volatile periods and to run individual estimations for each period. In order to obtain an impression of the divergences resulting from the use of monthly and daily data, we first replicated similar

estimations using all three volatility measures. The apparent inconsistency of the estimates using annual and monthly data indicates that the empirical relationship has to be examined in more detail.

As described above, the development of the Deutschmark volatility clearly indicates a structural break in time. Separating periods of higher and lower exchange rate stability, we can identify different subperiods. Regressions are therefore run for the following periods: 1973 - 1978, 1979 - 1983, 1984 - 1986, 1987 - 1991 and 1992 - 1997.

We use the West German unemployment rate as published by the Deutsche Bundesbank for all our estimations. This unemployment rate turns out to be integrated of order 1 in ADF tests. The volatility measures, however, are all integrated of order 0, i.e. they are stationary. A cointegrated relation therefore

cannot be expected. Instead, a simple, classic regression is estimated with the stationary difference in the unemployment rate as a dependent variable. This enables us to capture short-term influence and empirical causality. Therefore, changes in the West German unemployment rate are explained simply by its own lags. For each subperiod, we choose a white noise basic specification. We only include volatility²¹ as an additional explanatory variable if it improves the overall estimation of the subperiod examined. Up to 15 lags of the volatility measure have been included in the estimations in order to catch the volatility's short-term impact. The estimates are presented in Table 1.

In almost every subperiod we find that the same significant lag is statistically the best for each country group, independent of the measure of volatility. In the very stable time period from 1987 to 1991, volatility proves to have had an influence with the largest delay of eleven months. An exception is the volatility vis-à-vis the peripheral countries, which is significant at the fifth or the ninth lag. In the other periods, volatility is usually significant at the second or fourth lag. In general, the lag structure is indifferent of the way of calculating exchange rate volatility. Changes in the lag structure only occur in cases where the significance of the coefficients is weak. Problems of possible endogeneity only have to be taken into account in two cases where the first lag is significant, but according to the Granger causality tests we additionally conducted they do not seem to be present in this subperiod.²² Remarkably, the coefficients in the stable periods are much higher than the coefficients in more volatile periods and core country volatility usually seems to be stronger than the others.

Table 1
Regression Results using Monthly Data

	DWGRUE ¹	DWGRUE ¹	Meas-	Meas-	Meas-
	Endoge-	F statistic	ure I	ure II	ure III
	nous		(lag)	(lag)	(lag)
	lags				
EMS					
79 - 83	1, 2	20.146***	0.233** (2)	0.201** (2)	0.233** (2)
84 - 86	2, 3, 5	5.238***	-	0.147* (4)	-
87 - 91	2, 3	4.255**	0.489*** (11)	0.388** (11)	0.440** (11)
92 - 97	1, 3	8.690***	0.157* (1)	0.207** (2)	0.151* (1)
Core					
73 - 78	1, 3	37.284***	0.185*** (5)	0.149*** (5)	0.197*** (5)
79 - 83	1, 2	20.146***	0.201* (2)	0.199** (2)	0.202* (2)
84 - 86	2, 3, 5	5.238***	0.188* (2)	0.180* (2)	-
87 - 91	2, 3	4.255**	0.558*** (11)	0.447*** (11)	0.528** (11)
92 - 97	1, 3	8.690***	0.320** (2)	0.349** (2)	0.331** (2)
Peripheral					
79 - 83	1, 2	20.146***	0.254** (2)	0.234** (2)	0.275** (2)
84 - 86	2, 3, 5	5.238***	-	0.125** (4)	0.169** (4)
87 - 91	2, 3	4.255**	0.387** (5)	0.395** (5)	0.264* (9)
92 - 97	1, 3	8.690***	0.065* (9)	-	-
Representative					
73 - 78	1, 3	37.284***	0.171*** (4)	0.139*** (4)	0.143** (4)
79 - 83	1, 2	20.146***	-	0.223** (2)	-
84 - 86	2, 3, 5	5.238***	-	0.155* (4)	-
87 - 91	2, 3	4.255**	0.453*** (11)	0.424*** (11)	0.453** (11)
92 - 97	1, 3	8.690***	-	0.165* (2)	-

¹ First difference in the West German rate of unemployment.

*/**/***: indicating that the coefficient is significant at the 10/5/1 per cent level. The second column gives the endogenous lags included in the subperiod regressions and the third column gives the F statistic of the basic specification.

Note: Several times lag fourteen of the volatility measures proved to be significant in the regression and contributed to the overall explanation in terms of the AIC and the SCHWARTZ criteria. Inserting the volatility measures lagged fourteen periods into the equations led to the coefficient's having the wrong sign. For this reason these results are not reported in the table.

Cyclical Unemployment

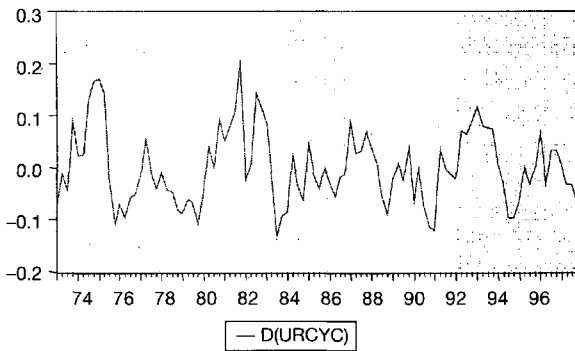
Since the causes of structural unemployment are generally expected to be rooted in the real economy, nominal variables or their fluctuation probably do not affect it. Exchange rate volatility should thus only have an impact on the cyclical component of unemploy-

²¹ For use in the estimations, all volatility measures have been multiplied by 100 each time.

²² This time the results of the Granger causality tests are rather mixed. Concerning the first two subperiods, they mostly indicate that each variable Granger causes the other one as well. Over the period from 1984 to 1986, only the change in the unemployment rate significantly Granger causes the exchange rate volatility. Due to the fact that this time period is very short, these results have to be interpreted carefully. Only volatility generally Granger causes changes in the unemployment rates from 1987 to 1991 and from 1992 to 1997. Besides the short period in the mid-1980s, the Granger tests usually confirm that volatility has an influence on the change in the unemployment rate.

Figure 8

First Difference of Cyclical Unemployment Rate



Sources: Deutsche Bundesbank; own calculations.

ment, which changes in the more or less short term according to the business cycle. We therefore focus on cyclical unemployment²³ in the next step of our analysis. The first difference of this variable is presented in Figure 8.

As before, for each subperiod we use a white noise basic specification, which is an AR process of different orders. The results of the regressions explaining the cyclical component of unemployment by the volatility variables are presented in Table 2. Remarkably, the coefficients are quite similar to those presented in Table 1. In general, their level is only slightly lower than the coefficients of the regressions using the non-cyclical unemployment data. Furthermore, the same lag is significant in nearly every case.

These results indicate that exchange rate volatility contributes solely to the explanation of the variation in short-term unemployment, as expected. The whole impact of volatility presented in Table 1 directly affects changes in cyclical unemployment. The cyclical component is influenced to the same extent to which the unemployment rate as a whole is affected. However, again, most of the variation in the unemployment rate, independent of the component examined, must have been caused by other factors. Estimations of the distinct impact of volatility on the residuals of the basic AR model of changes in the rate of unemployment further indicate an additional contribution by the volatility measures to the explanation of the unexplained part of 4 to 14% (mostly

²³ This cyclical component of unemployment is calculated using the Hodrick-Prescott filter with a smoothing constant of 100,000.

²⁴ See Rudiger Dornbusch, Stanley Fischer: Makroökonomik, Munich 1992, p. 18.

Table 2

Regression Results of Cyclical Unemployment

	CYCLICAL DWGRUE' Endogenous lags	CYCLICAL DWGRUE' F statistic	Measure I (lag)	Measure II (lag)	Measure III (lag)
EMS					
79 - 83	1, 2	11.245***	0.225** (2)	0.195** (2)	0.224** (2)
84 - 86	5	11.574***	0.192** (4)	0.195** (4)	0.244** (4)
87 - 91	2, 3	3.893**	0.506*** (11)	0.411** (11)	0.458** (11)
92 - 97	1, 3	10.759***	0.151* (1)	0.197* (2)	-
Core					
73 - 78	1, 3	22.815***	0.171*** (5)	0.135*** (5)	0.184*** (5)
79 - 83	1, 2	11.245***	0.197* (2)	0.198** (2)	0.197* (2)
84 - 86	5	11.574***	0.203* (2)	0.208** (4)	-
87 - 91	2, 3	3.893**	0.587*** (11)	0.479*** (11)	0.553*** (11)
92 - 97	1, 3	10.759***	0.329** (2)	0.376** (2)	0.332** (2)
Peripheral					
79 - 83	1, 2	11.245***	0.252** (2)	0.232** (2)	0.272** (2)
84 - 86	5	11.574***	0.165*** (4)	0.157*** (4)	0.206*** (4)
87 - 91	2, 3	3.893**	0.395** (5)	0.409** (5)	0.271* (9)
92 - 97	1, 3	10.759***	-	-	-
Representative					
73 - 78	1, 3	22.815***	0.159*** (4)	0.126*** (4)	0.163*** (4)
79 - 83	1, 2	11.245***	-	0.220** (2)	-
84 - 86	5	11.574***	0.223** (4)	0.229*** (4)	0.259** (4)
87 - 91	2, 3	3.893**	0.454*** (11)	0.440*** (11)	0.455** (11)
92 - 97	1, 3	10.759***	-	-	-

¹ First difference in the West German rate of unemployment.

*/**/***: see Table 1.

nearly 10%). Nevertheless, the estimates indicate that the AR specifications are extremely robust in the subperiods. Further, we can demonstrate that the whole effect of exchange rate volatility is on the component of unemployment which is influenced by the development of business cycles. A reduced form model also focusing on this aspect is Okun's law. In the following, we therefore use this model, abandoning the AR specification and concentrating on more complex specifications.

Okun's Law

Instead of explaining the development of the unemployment rate only by its own past, the influence of volatility should be tested in at least a reduced form model offering a mechanism of transmission. As mentioned above, we use the specification of Okun's law, a simple form model of labour market effects that gives an empirically proved relationship between real growth and the development of the unemployment rate. In the original estimations, it was demonstrated that each percentage deviation of real growth from its potential changes the unemployment rate by 0.4% in the opposite direction.²⁴

In addition to the Okun relationship, a separate influence of volatility is tested for. As the Okun relation is defined as follows:

$$(U - U^*) = \beta (Y_{real} - Y_{real}^*),$$

the empirically analysed specification can be represented as follows:

$$(U - U^*) = \beta_1 (Y_{real} - Y_{real}^*) + \beta_2 \text{Vola.}$$

Here β_2 catches the independent influence comparable to the one in the estimations above.

In Table 3, we present the estimations that test whether, in addition to the cyclical growth of real GDP,²⁵ volatility has a separate influence on the cyclical unemployment rate. Here, we use data on a quarterly basis for reasons of data availability.²⁶ This has the disadvantage of fewer observation points for subperiod estimations. Cyclical growth proves to be stationary at the 5% level of significance. However, estimates in subperiods have to be examined carefully as the ADF tests do not show the stationarity of the variable for the subperiods. Since we have examined the short-term influence of a lag of up to 15

months in the estimations above, we now include up to five lags to capture the influence of volatility in the preceding five quarters.

The estimates actually show a separate influence of volatility, which increases the level of the unemployment rate. Nevertheless, this influence is only observable in two time periods. From 1979 to 1983, the influence of exchange rate volatility is high. With the exception of the EMS countries, it is significant at the 1% level. A slightly less significant influence is prevalent from 1992 to 1997. In addition, from 1973 to 1978 we find a significant influence of the first lag, which is spurious. This is apparent when examining its distinct influence in the estimations of robustness, presented in Table 4.

In the present estimates, it is therefore either lag 0 (from 1979 to 1983) or lag 3 (in general from 1992 to 1997) that is significant.²⁷ Only in the core countries is the undelayed influence significant in both periods. All in all, this is consistent with the monthly variables' influence, that mostly seems to be delayed by two to six months. Hence, it can be stated that the volatility of each country group which has a positive sign has directly influenced cyclical unemployment in the 1990s as well as at the beginning of the 1980s when testing the additional influence of this variable in a properly specified Okun relationship. With regard to all other subperiods, we cannot demonstrate such an influence of volatility on the development of unemployment.

Regarding the extent of the impact, the interpretation of the coefficients shows that a one percentage point increase in exchange rate volatility causes an immediate impact on cyclical unemployment by about 0.5 to 1.7 percentage points. This would result in quite a large negative impact prior to further adjustment. Nevertheless, the level of the standard deviation of exchange rate changes in Figures 6 and 7 indicates that even the volatility of the Deutschmark vis-à-vis the peripheral countries, which is the strongest, rarely reaches this level of increase. Only in its most volatile

Table 3

Regression Results of Dynamic Specification of Okun's Law, Independent Influence of Volatility

	Cyclical growth lags	Cyclical WGRUE ¹ lags	Measure I (lag)	Measure II (lag)	Measure III (lag)
EMS					
79 - 83	1	1,2	-	-	-
87 - 91	0	1	-	-	-
92 - 97	0,1	1,2	0.546** (3)	0.600** (3)	0.586** (3)
Core					
73 - 78	0	2	-	-	-
79 - 83	1	1,2	1.733*** (0)	1.760*** (0)	1.669*** (0)
87 - 91	0	1	-	-	-
92 - 97	0,1	1,2	0.703** (0)	0.775** (0)	0.711** (0)
Peripheral					
79 - 83	1	1,2	1.512*** (0)	1.330*** (0)	1.781*** (0)
87 - 91	0	1	-	-	-
92 - 97	0,1	1,2	0.308*** (3)	0.297** (3)	0.331** (3)
Representative					
73 - 78	0	2	-0.565* (1)	-0.501* (1)	-0.555* (1)
79 - 83	1	1,2	1.781*** (0)	1.823*** (0)	1.844*** (0)
87 - 91	0	1	-	-	-
92 - 97	0,1	1,2	0.643** (3)	0.677** (3)	0.644** (3)

¹ West German rate of unemployment.

*/**/***: indicating that the coefficient is significant at the 10/5/1 per cent level.

Note: The coefficients crossed out have not proved to be independently significant in the distinct estimations shown in Table 4. The second and the third columns show the basic specification for the subperiods.

²⁵ In order to get the cyclical component of real GDP, the smoothing constant was set to 10,000 applying the Hodrick- Prescott filter.

²⁶ West German real GDP data are taken from the national accounts as published by the Deutsches Institut für Wirtschaftsforschung, Berlin.

²⁷ This time, for the time period from 1979 to 1983, where mostly lag 0 is significant, Granger tests indicate a Granger causality of the cyclical unemployment rate for the volatility measure while the contemporary influence of volatility cannot be caught by Granger tests. From 1992 to 1997, the volatility measure mostly is again sufficiently lagged and in addition it does Granger cause the unemployment variable, while this time the latter does not influence the former.

Table 4

Distinct Influence of Volatility Measures on Residuals of Basic Model, Independent Influence of Volatility in Dynamic Specification of Okun's Law

	Measure I		Measure II		Measure III	
	Coefficient	Adj. R-squared	Coefficient	Adj. R-squared	Coefficient	Adj. R-squared
EMS						
79-83	-	-	-	-	-	-
87-91	-	-	-	-	-	-
92-97	0.422** (3)	0.128	0.496** (3)	0.167	0.440** (3)	0.147
Core						
73-78	-	-	-	-	-	-
79-83	1.205*** (0)	0.309	0.937*** (0)	0.312	1.127** (0)	0.275
87-91	-	-	-	-	-	-
92-97	0.586** (0)	0.142	0.442 (0)	0.08	0.620** (0)	0.152
Peripheral						
79-83	0.936** (0)	0.204	0.782** (0)	0.220	0.999** (0)	0.183
87-91	-	-	-	-	-	-
92-97	0.174* (3)	0.107	0.177** (3)	0.129	0.187** (3)	0.130
Representative						
73-78	-0.401 (1)	0.079	-0.285 (1)	0.053	-0.400 (1)	0.073
79-83	1.404*** (0)	0.313	1.048*** (0)	0.299	1.414*** (0)	0.297
87-91	1.076** (6)	0.224	-	-	1.146** (6)	0.254
92-97	0.408* (3)	0.121	0.524** (3)	0.201	0.408** (3)	0.125

*/**/***: indicating that the coefficient is significant at the 10/5/1 per cent level.

Note: These additional variable estimations have been conducted only for the significant cases presented in Table 3.

period, i.e. that of the two peaks in the 1990s, did peripheral volatility increase so strongly. However, its immediate impact in this period is rather small, i.e. the unemployment rate only rises by about 0.3 with such an increase in volatility. Here, it is curious and contradictory to the results above that this time the coefficients prove to be higher in the more volatile period and lower in the relatively stable period.

Conclusions

The theoretically assumed and convincingly demonstrated impact of exchange rate volatility is empirically rather difficult to prove. This has already been indicated by the results of former empirical studies. Nevertheless, this study has tried to find systematic influences by Deutschmark exchange rate volatility on a West German labour market variable.

One important result of our analysis is that we usually observe the same results regardless of the way in which exchange rate volatility is approximated. There is no difference in the estimates using our three measures, i.e. the standard deviation of aggregated external values of the Deutschmark against different country groups, the pricing-to-market measure and the long-term measure.

On the basis of monthly data, we can – to some extent – confirm the results obtained by Belke and

Gros. We also observe a negative, additional impact of volatility in an AR model. This disturbing influence is stronger for stable countries and for stable subperiods. However, economically, the extent of its negative impact is rather small. From these results, we can therefore expect positive impacts, though rather small, of EMU on the labour markets.

In the analysis, we further isolate the cyclical component in the development of unemployment. The estimates explaining this variable show that the whole impact of volatility solely affects this component. For this reason, we make use of a more complex model, a dynamic Okun-type specification, which also focuses on the explanation of the cyclical component of unemployment. Nevertheless, we cannot confirm the independent impact of the volatility variables that we find in the AR regressions for the whole period. Its impact can only be proved for the beginning of the 1980s and the 1990s.

Although we do not find a systematic influence of exchange rate volatility in the more complex model, its empirical impact is still present in the AR model. In each case, however, it is clearly disturbing. We therefore might expect better conditions for the labour markets within EMU. Probably, the extent is not very large as the level of the coefficients does not indicate a strong impact.