DISCUSSION PAPER SERIES

IZA DP No. 37

# Exchange Rate Volatility Effects on the German Labour Market: A Survey of Recent Results and Extensions

Herbert S. Buscher
Claudia Mueller

March 1999

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-0
Fax: +49-228-3894-210
Email: iza@iza.org

IZA Discussion Paper No. 37
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# ABSTRACT

# Exchange Rate Volatility Effects on the German Labour Market:
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In this paper, a survey on theoretically expected and empirically proved impacts of exchange rate volatility is given. With regard to the West German unemployment, the effects of volatility are empirically analysed using three different volatility measures and four country groups. In autoregressive models, a significant disturbing impact of volatility can be found with annual data as well as with monthly data for the whole period. While this impact does not differ for the three volatility measures, it is, however, less strong when using the monthly data. Differentiating for different subperiods by use of the monthly data, the reported impact is stronger for relatively stable periods and country groups. When isolating the cyclical component of the unemployment rate, it can be demonstrated that the whole reported impact solely affects this component. In a dynamic Okun-type relation, an additional significant impact of volatility, however, cannot be proved for all subperiods.

JEL Classification: E32, F16, F31

Keywords: European Monetary Union, exchange rate volatility, Okun's law, West German labour market

Herbert S. Buscher
ZEW
P.O. Box 10 34 43
D-68034 Mannheim
Tel.: +49 621 1235 135
Fax: +49 621 1235 223
Email: buscher@zew.de

* This research was undertaken with support from the Deutsche Post AG under 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 Sänger for excellent research assistance. All remaining errors are our own.

## Non-technical summary

Theoretically, exchange rate volatility is supposed to have a short-term negative impact on the economic development and therefore on labour markets. This influence might be exerted via disturbances in the export and growth performance of a country as well as via the investment channel. Empirical studies rarely find significant empirical results. More disaggregated studies are hereby more successful in catching an impact of volatility statistically.

Some recent studies concentrate on the direct influence of exchange rate fluctuations on labour markets. Going into more detail in the present study, we tried to systematise this empirical influence being observable in autoregressive regressions of German unemployment on the basis of annual data. Paying attention to the historical development of exchange rates and their fluctuations, we can clearly identify volatile and stable country groups as well as subperiods.

We therefore differentiate between three methods of volatility approximation, specific country group effects and relevant subperiods. Using monthly data, we actually find an influence of volatility in autoregressive models that is stronger for relatively stable time periods and for relatively less volatile country groups than for more volatile periods and countries. With respect to the volatility measures, strong or systematic differences cannot be identified.

In the analysis, due to the short-term nature of volatility effects, we further isolate the cyclical component in the development of unemployment. The AR-model estimates explaining the cyclical unemployment show that the whole impact of volatility solely affects this component of unemployment. By the use of a more complex model, which also focuses on the explanation of this cyclical component, we cannot confirm the same impact. Adding the volatility as an additional explanatory variable in a dynamic specification of an Okun-type relation, we only find a statistically convincing impact for the beginning of the 1980s and in the 1990s. In contrast to the results above, the volatile period seems to be affected stronger than the stable period.

Although the exchange rate volatility' s influence is not systematic, it is still present and clearly has a disturbing, however, rather small, impact. This seems to result in some better conditions for the labour markets in EMU.

# 1 Introduction

The transition to the Euro, the single European currencies, has been accompanied by the final fixing of bilateral nominal exchange rates between the countries participating in EMU. While long term flexibility of exchange rates might be useful in order to achieve a stabilisation at the macroeconomic level in 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 supposed to have negative effects on the microeconomic level. Such fluctuations cause costs as well as uncertainties. Both of these effects, uncertainty and transaction costs, might 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 the labour markets that might be expected in EMU.

In the following section, we give a description of short term exchange rate variability and of the structure of foreign trade. Country-specific developments as well as time period differences are stressed. In our empirical regressions presented in a later section, we take these specifities into account. A comparison of the volatility of the German Mark against the currencies of the EU-countries to the one against extra-EU currencies, such as the Yen and the Dollar, shows that volatility is quite smaller in relation to the European countries which simultaneously are the most important trade partners of Germany.

Section 3 gives a general overview of theoretically supposed and some empirically proved negative impacts of exchange rate volatility. We especially refer to studies focusing on the impact of volatility on the labour markets by Gros (1996), Belke and Gros (1997) as well as Jung (1996). Our empirical estimations are presented in Section 4. They partly base on the results found by Gros, Belke and Jung as, in the first estimations, we also refer to autoregressive models without making 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. For the same reason, we present estimations on the basis of annual and monthly data. Finally, on the basis of the monthly data, we analyse five subperiods defined according to differences in exchange rate stability. In addition to that, we make use of a

[1] See Müller and Buscher (1999) for a discussion and an analysis of the adjusting impacts of the monetary instruments before EMU.

reduced form model, a dynamic version of Okun' s law. By this, the direct influence of volatility on the labour markets analysed in the AR-models before shall be confirmed.

## 2 What did flexible exchange rates cost in the past?

In a strongly export-oriented economy such as Germany, competitiveness in international trade also influences its 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 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, such a volatility may also adversely affect foreign trade.

Figure 1 shows the extent of the percentage changes[2] of the bilateral nominal exchange rate[3] and gives an impression of the different European currencies' variability in relation to the D-Mark. In the illustration as well as in the calculation of the annual volatility, we use end-of-the month exchange rate data by the OECD. Instead of referring to average values, these data relate to specific points of time. Advantageously this dataset catches short-term fluctuations which have to be consciously considered for the purpose of measuring volatility. The presentation starts in 1973, the time when the Bretton Woods System broke down and when the transition to free floating currencies took place. In 1972, Germany, Belgium, Luxembourg, France, Italy, Denmark, the Netherlands, Great Britain and Ireland joined an informal joint float system against the Dollar; some of them, however, did so only temporarily. In that year, this system was set up in order to avoid currency turbulences in Europe. Joining this system, the European currencies 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 hereby meant to be stabilised towards each other. But in relation to the Dollar the snake should 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 by the implementation of the European Monetary System (EMS) formed 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

[2] The following depicted percentage changes are calculated by taking the first difference of the logarithm of the external values of the D-Mark.

[3] 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.

between 1992 and 1996, and Great Britain was only a participating member state between 1990 and 1992. Thus, only Great Britain and Sweden are not represented in the EMS today.

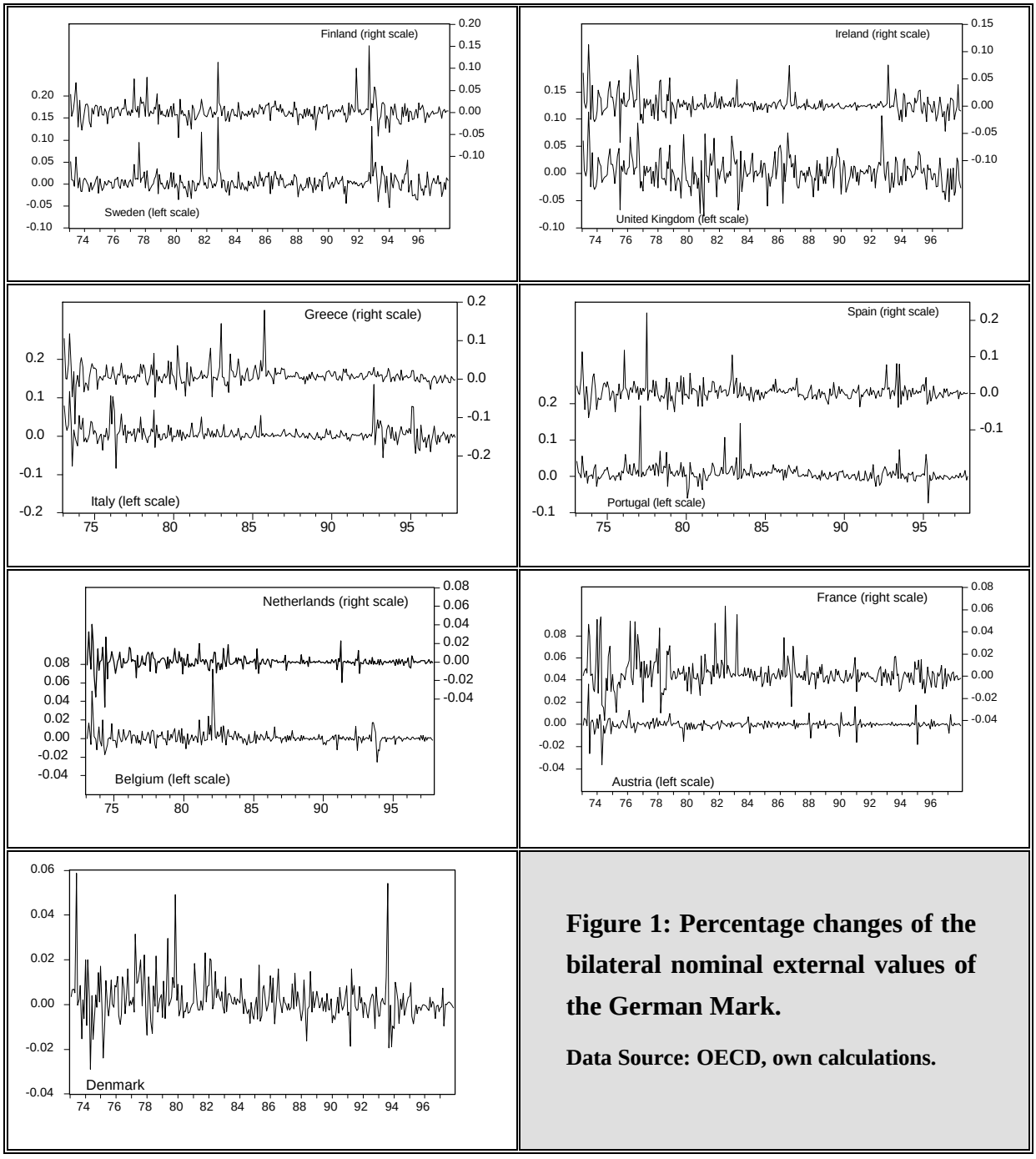



**Figure 1: Percentage changes of the bilateral nominal external values of the German Mark.**

**Data Source: OECD, own calculations.**

The analysis of all EU currencies' exchange rate fluctuations shows that they clearly differ in their levels of variability, but also that the fluctuations occur with different frequencies. The percentage changes of the German Mark (DM) in relation to the Belgian/Luxembourg Franc, the Danish Crown, the French Franc, the Dutch Guilder and the Austrian Shilling have moved within a relatively narrow band of 4 to 8 % (except for a unique deviation of the Belgian/Luxembourg Franc). All of these countries except for Austria were among the

founder-countries of the EMS in 1979.

The strongest fluctuations can be observed for the Greek Drachma, the Portuguese Escudo and the Spanish Peseta. They all participated later in the EMS. In most instances, however, such extremely strong exchange rate fluctuations meant unique peaks which occurred particularly during the 1970s or at the beginning of the 1980s. A look at the frequency of such fluctuations obviously proves that the currencies of Belgium & Luxembourg, the Netherlands and Austria fluctuated to a considerably lesser extent than for example those of Italy, Finland, Portugal, Sweden, Spain, Ireland and Great Britain. Overall, exchange rates were much less volatile at the end of the 1980s than in the 1970s. In the 1990s, however, several disturbances, sometimes relatively strong ones, took again place. Even nominal exchange rates such as the Dutch Guilder or the Austrian Shilling, which had previously become very stable in relation to the DM, experienced major volatility. Due to a series of crises which began in 1992, the margin of tolerated exchange rate fluctuations in the EMS was extended in 1993 from $\pm 2.25$ % to $\pm 15$ %. Despite strong nominal exchange rate stability between 1987 and 1992, differences in e.g. national inflation rates which have led to turbulence since 1992 were still existent.

In spite of the general currency stabilisation in Europe, some countries have been subject to strong volatility over a long period of time. Especially Great Britain has been exposed to permanent and heavy upward as well as downward currency corrections from 1973 until today. Other countries, by contrast, such as Italy and Portugal also experienced constant fluctuations, but they were subject to an ongoing nominal depreciation. The mainly positive changes of the exchange rates reflect that fact. Additionally, the Italian and Portuguese currencies always fluctuated to different extents anyway. Greece, in contrast, was also subject to a permanent nominal depreciation against the DM, but particularly since 1986 this has happened with continuity. Thus, after this point of time, the Greek Drachma does not seem to fluctuate extremely. While in the long-term the nominal value of both the Greek Drachma and the Italian Lira in relation to the DM changed a lot, their short-term fluctuations against the DM that both currencies experience differ in severity. Their changes are therefore differently well predictable.

If we calculate, as a measure of bilateral volatility, annual standard deviations of the percentage changes of the nominal exchange rates depicted in Figure 1, we get a similar picture to the one described above. Figure 2 shows that the volatility in the southern, peripheral countries, Spain, Italy, Portugal and Greece, was significantly higher than in other countries over the whole time period. But Finland, Sweden and Great Britain were also subject to high volatility. On the contrary, however, Belgium/Luxembourg, Denmark, France, Austria and the Netherlands show a far less volatility. Their exchange rates against the German Mark also fluctuated mainly up to the 1980s and then they stabilised to a large extent. Between 1992 and 1994, volatility increased again with the former, but not that strong with the latter. Since 1995, a general decrease in the exchange rate volatility within the EU can be observed.

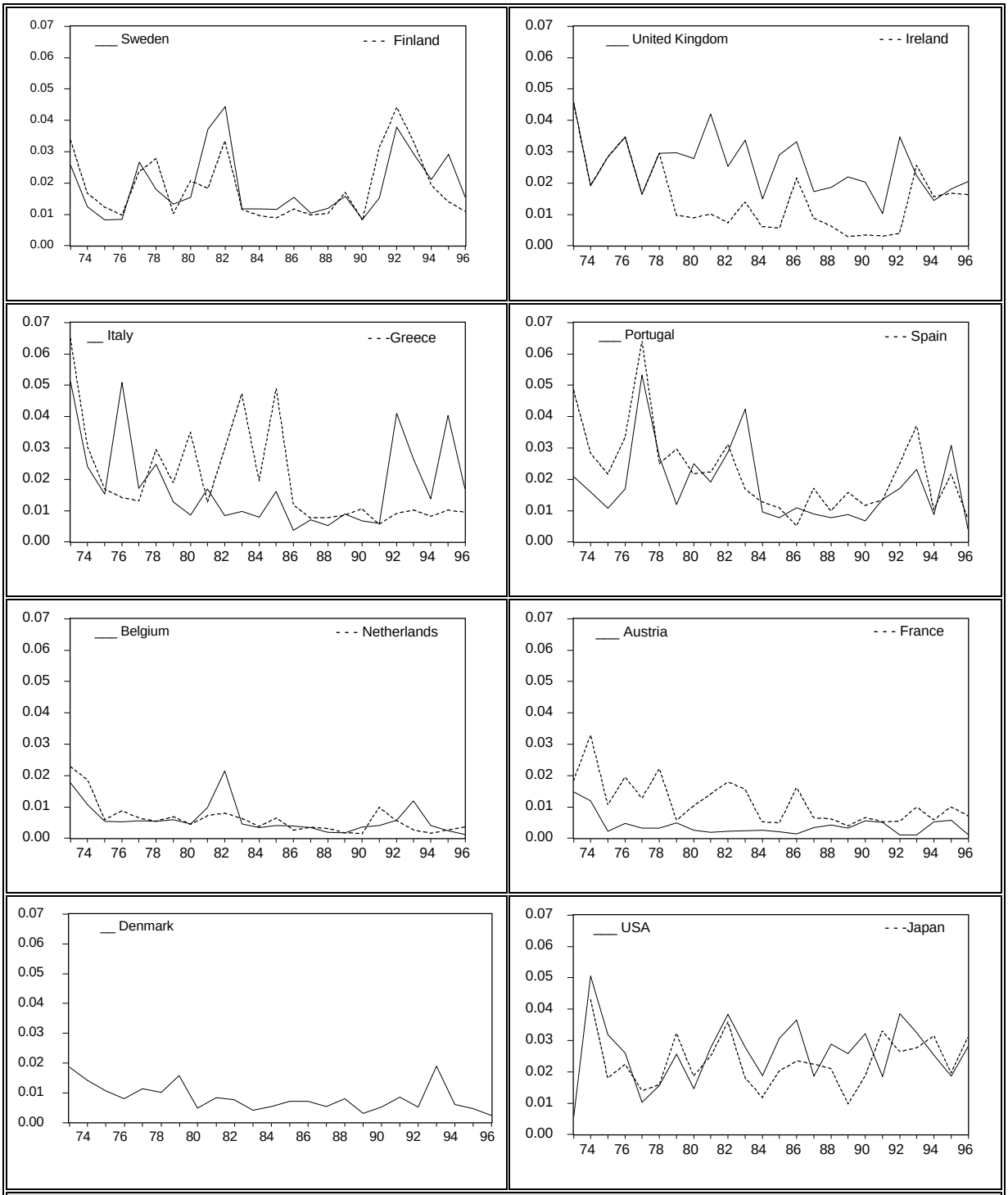


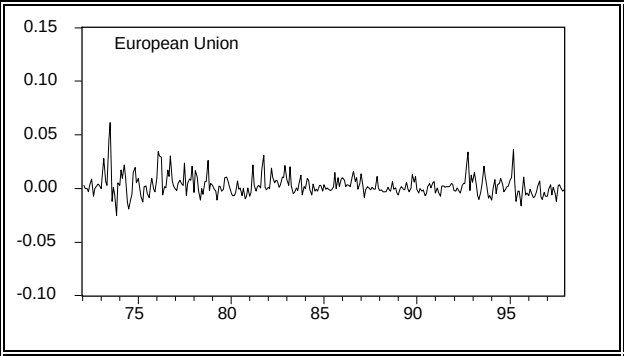

**Figure 2: Standard deviation of the percentage change of the bilateral nominal exchange rate of the DM against the 13 other EU currencies as well as the Dollar and the Yen. End-of-month values.**
**Source: OECD, own calculations.**

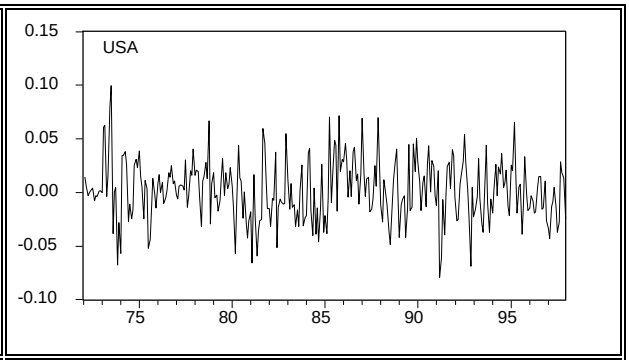
The exchange rate volatility of the DM in relation to the US-Dollar and the Japanese Yen is over the whole period as high as that in relation to the most volatile European currencies. In contrast to the European currencies, however, there were no instances of stronger exchange rate stability.

Looking at the changes of the nominal exchange rates and their standard deviations, we can

observe that six of the 14 other EU member states have mostly stabilised their exchange rate in relation to the DM. This is the case of Belgium/Luxembourg, Denmark, France, the Netherlands and Austria. Since the end of the 1980s, these core countries have developed into a hard currency block, the so-called "DM-block".

The course of the percentage changes of the DM in relation to the currencies of the other EU-countries, as well as to the Yen and the Dollar can be seen in Figure 3. 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.



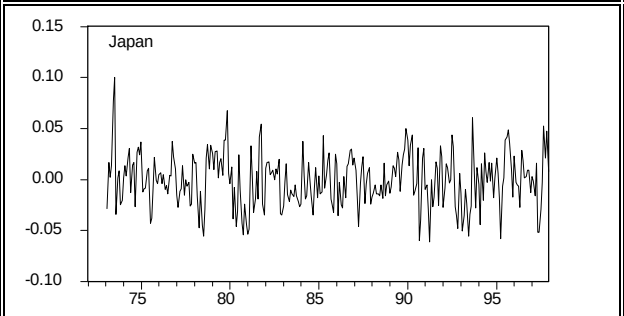



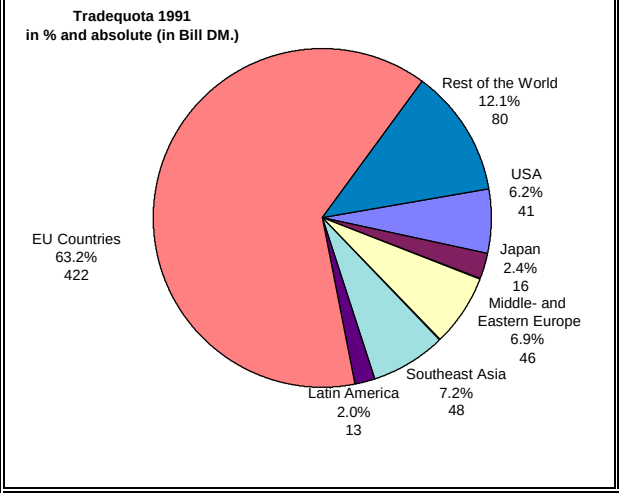

**Figure 3: Percentage changes of the nominal external values of the DM in against the currencies of the EU-countries, Japan and the USA.**
**Sources: German Bundesbank; own calculations.**

The common objective of the European countries is the reduction of the existing exchange rate volatility between the EU-currencies. By way of a common currency, the theoretically assumed negative effects of the exchange rate fluctuations on foreign trade and thus on domestic productivity and employment, which are discussed in Section 3, should be eliminated. After all, the intra-European exports form the bulk of total exports of most European states.

Figure 4 shows that in 1996, Germany exported 57 % of its total exports to its European partner countries; that is the majority of its total exports. A further 9.2 % of German exports went to Central and Eastern Europe, approximately 7.6 % to the USA, and 8.7 % of the German exports went to South-East-Asian threshold countries.

In a comparison of export structure of Germany in the years 1991 and 1996, it is obvious that the exports to the USA have risen both in their percentage and in absolute figures. Apart from the USA, the Central and East European as well as the emerging South-East-Asian countries increasingly imported from Germany not only in absolute, but also in relative terms. The

German exports to the EU have gone up not in relative, but in absolute terms as well, but, however, to a far lesser extent than e.g. exports to the USA.



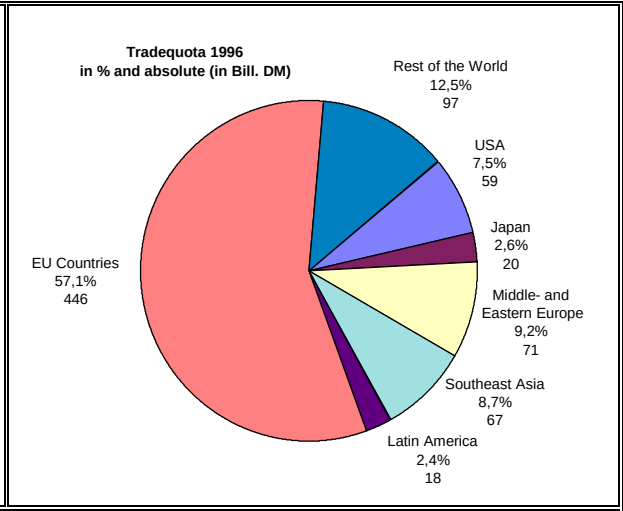




**Figure 4: Exports of Germany to different countries; absolute figures in billion D-Mark. Sources: German Bundesbank; own calculations.**

This export percentage - as it can be seen in Figure 5 - has risen continuously between 1981 and 1989 and reached its relative peak in 1989, the time 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, Germany' s export markets that have grown fastest lie outside central Europe since 1993, but this slump should at least partially be attributable to cyclical reasons. Even if the percentage of exports to EU-countries stagnated increasingly, 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 affects France, whose exports to EU member states in 1996 accounted for 63 %[4] of the total volume. Within the entire EU, the bulk of foreign trade is intra-European trade.

[4] Source: I.N.S.E.E.

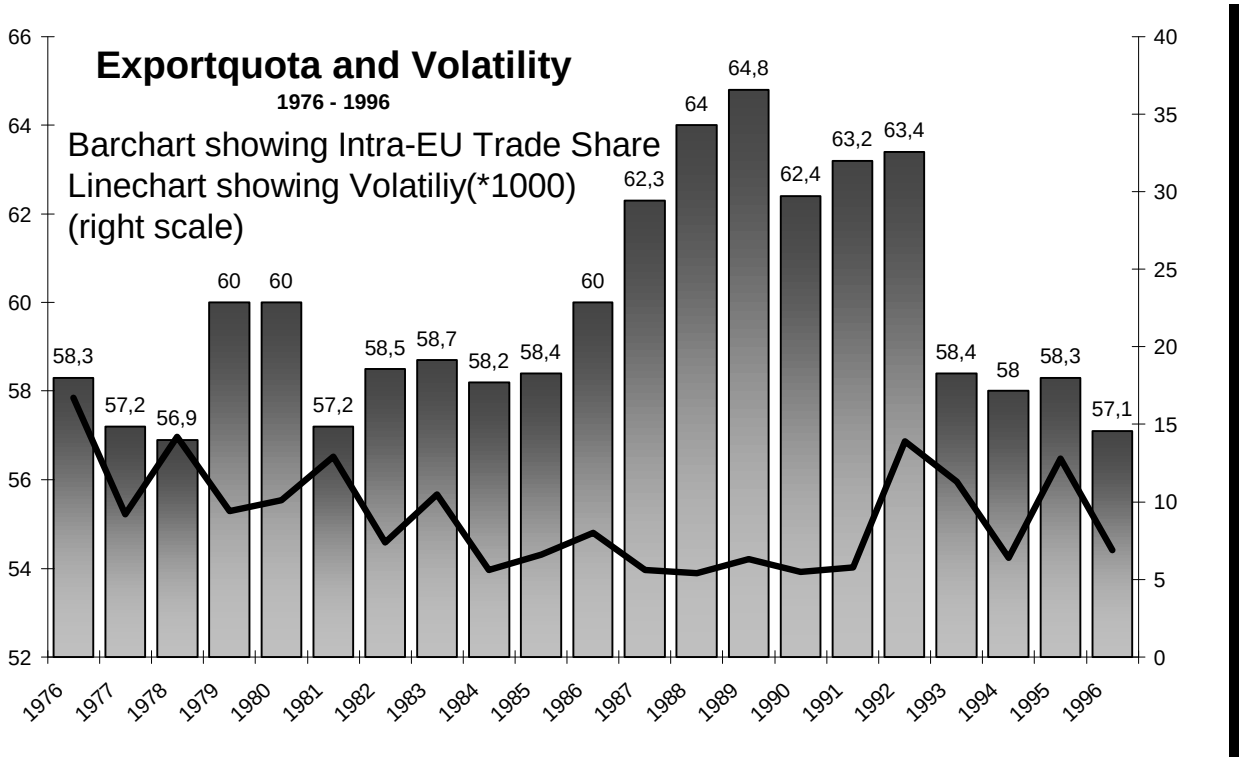



**Figure 5: Development of export percentages of West Germany to EU-countries; data in percent. Data source: German Bundesbank, own calculations.**

Even if the existence of one currency in EU should not contribute to a 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 eliminate negative effects to currently approx. 57 % of the German and 63 % of the French foreign trade. Consequently, dynamic profits and thus an increase in trade could be expected. The relatively low proportion of German exports to the USA does therefore not mean that a stabilisation of the future European currency in relation to the Dollar would only have a positive impact on the contemporary approx. 8 % of all German exports. On the one hand, the international ranking of the US-Dollar as invoicing currency suggests that a large percentage of the extra-European German foreign trade would be affected by fluctuations of the Dollar. 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-Dollar.

Examining the German exports to the single EU member states in Figure 6, we can observe that at the beginning of 1997, 55.8 % of Germany' s intra-European exports went to the D-Mark block. This means that in the 1990s, only minor exchange rate volatility has affected 32 % of German exports.

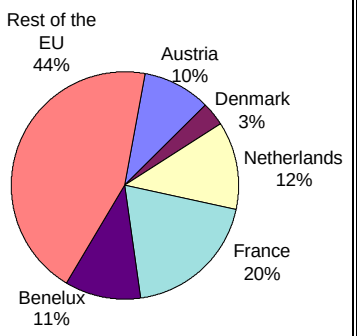
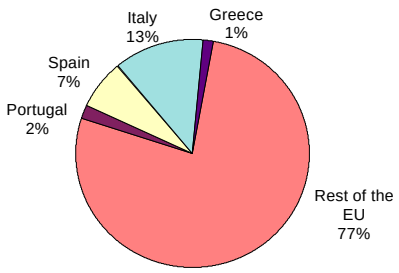
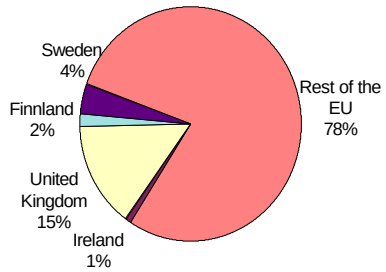
| Trade partners within DM-block | Peripheral trade partners | Northern trade partners |
|---|---|---|
|  |  |  |



**Figure 6: Shares of German exports to countries of the D-Mark-Block, to "peripheral countries" and to northern member states of the EU per 1st Quarter 1997.**

**Data source: German Bundesbank.**

44.2 % of the intra-European exports, that is 25.3 % of total German exports, have been 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. In the next section we will explain to what extent a single currency within EMU can have a positive real-economic influence.

# 3 Costs of currency diversity

## *3.1 Transaction costs of currency diversity*

On the one hand, the transition to a single currency within EMU eliminates the volatility of bilateral nominal exchange rates and thus transaction costs in form of hedging and information costs, on the other hand, it avoids transaction costs caused by financial intermediaries, as they even occur with bilaterally fixed, but heterogenous currencies. [5]

The latter are mainly costs associated with exchanging money, that is fees raised by banks and exchange offices. Hedging costs accrue by the use of, e.g. hedging instruments. Lastly, information costs, companies have to pay for analysing and updating information on the developments in the international financial markets in order to obtain background knowledge which they need for foreign investment and for staff training. Further costs arise in accounting. Balances of domestic and foreign subsidiaries have to be comparable and clearly arranged, and accounts receivable in foreign currencies have to be stated, usually in the domestic currency.

[5] For further information see Traud (1996), pp. 116-117.

By the elimination of the aforementioned transaction costs, EMU leads to a positive static effect. The EU Commission[6] estimates the cost of financial intermediation to be at least 0.5 % of the European GDP, which annually corresponds to 13 to 19 billion ECU for the EU. A more intense intra-European trading activity characterised the period between 1986 to 1995. For this phase, Dumke, Juchems, and Sherman (1997) even calculated transaction costs amounting to 0.8 % of the GDP of the European Union.

Thygesen (1990) amounts the transaction costs of companies to 0.1 % for large enterprises and even up to 0.5 % for smaller ones. Information costs in particular are disproportionally high for smaller firms. Apart from that, hedging is more widespread in large companies, and they also practise it more easily. Reasons for these smaller costs are unique fixed costs which accrue independently from the size of the company as well as the usually wider diversification (and hence reduced risk) of large companies. Due to the importance of small and medium-sized companies in some industries and countries, Thygesen estimates the total transaction costs for producers and consumers at 0.25 to 0.5 % of the EU-GDP. Here the consumers have to pay, above all, the costs of exchange (amounting to 2 to 5 % of the amount exchanged) when travelling abroad as tourists.

The Cecchini report from 1988 amounts the growth potential of the EU-economy upon elimination of all existing restrictions of the total EU-trade to 4.5 - 6.5 % of the EU-GDP. According to Thygesen, this is, however, unrealistically high. Certainly, not all transaction costs of foreign trade can be fully ruled out within EMU. Nevertheless, while transaction costs are expenses for producers and consumers, they represent a part of the financial sector's profits. In this respect, a decline of hedging measures and currency diversity means also a decrease of commissions as well as fees and, consequently, the reduction of a part of banking profits and potentially of jobs in the banking sector.

Although these profits are lost, a single currency in Europe will be an important contribution to minimise intra-European transaction costs and to promote the further integration of the European internal market.

### *3.2 Costs of exchange rate volatility*

Apart from these negative static effects of exchange rate volatility, the theory of international economics also assumes negative dynamic effects of exchange rate uncertainty on growth and employment.

Already in 1990, the European Commission (1990) in its annual report "One Market, one Money" mentions an increase in economic efficiency and an improved resource allocation as

[6] Cf. European Commission (1990). p. 21.

consequences of the elimination of exchange rate risks. As long as there is still uncertainty with respect to the future development of exchange rates, a certain risk mark-up on the interest rates will prevail. A further convergence of the interest rates could bring about additional growth effects. The Commission estimates that the reduction of the aforementioned risk mark-ups by 0.5 % could lead to an increase in the long-term growth rate of 5 % of the EU-GDP.

Sapir and Sekkat (1990) differentiate between an old and a new approach in the theoretical explanation of exchange rate variability and its influence on trade. In the so-called „old" approach it was generally argued that higher exchange rate volatility imposes a risk mark-up on economic activities such as foreign direct investment and international trade. This reduces the yield of international corporate activities and thus the trading volume.

In addition to levying such a mark-up, volatile exchange rates also affect the profit calculation of an enterprise. Exports invoiced in foreign currency lead to variable revenues, since the profit margin at given export prices fluctuates. If a company has a strong market position, it may be able to pass changes in the exchange rate through to the price[7] and thus, to some extent, it makes the consumer pay the costs of exchange rate volatility. Therefore, Sapir and Sekkat (1990) focus on market structure and on the degree of pass-through in international trade in the so-called „new" approach. However, in a theoretical model, the authors show that such a pass-through decreases with rising exchange rate volatility.

Constructing a function of price determination under imperfect competition, they suppose that the import price (PM) depends on the marginal costs of production (C), a mark-up (g) on these costs, and the nominal exchange rate (E):

$$d \ln(PM) = d \ln(C) + d \ln(g) - d \ln(E).$$

In a world of imperfect competition, exporters make use of price discrimination. This means that the highest possible import prices are set for each import market and that their adjustment is rigid, at least in the short-term. Such a pricing-to-market strategy therefore causes them to adjust their mark-ups g if the exchange rate E changes, i.e. in cases of depreciation the profit margin decreases. In this new approach, it is assumed that this adjustment of g is influenced in its extent by the degree of exchange rate fluctuation. The change in g can therefore be defined as $c(I)*d \ln(E)$ with I being an index of exchange rate instability and c being the extent of adjustment which is proportional to I. If variability I is very strong, the extent of adjustment c rises and a change in the exchange rate induces a large adjustment of the mark-up g.

The following transformation shows that with increasing volatility the responsiveness of import prices, i.e. the pass-through, goes down:

$$d \ln(PM) = d \ln(C) + c(I)*d \ln(E) - d \ln(E)$$

[7] See Falk and Falk (1998) for a discussion of the pricing-to-market behaviour and its evidence for German

$\Leftrightarrow$ $d \ln(PM) = d \ln(C) - [1 - c(I)]*d \ln(E)$.

The change of the import prices is influenced by $1 - c(I)$, i.e. the change is the smaller, the higher the instability. This induces that the more volatile the exchange rate, the higher the extent of adjustment of the mark-ups. Exporters lower their degree of pass-through. By this, exchange rate changes cause profit margin changes. The more volatile the exchange rate, the higher the incentive not to adjust prices, hence to accept a cut in profits. A sales price formation which follows the market structure keeps producers from adjusting prices. High adjustment costs, for example for printing new price lists, make a pass-through strategy more difficult. Instead, they accept fluctuations in their revenues that might prevent them from exporting. Only in phases of low volatility, the degree of adjustment rises again. The approach of Sapir and Sekkat shows that with increasing stability of exchange rates in a monetary union, a greater responsiveness of trade prices to exchange rate changes can be expected.

All in all, it is assumed that the foreign trade risks mentioned above will restrict producers in their international activity. This means that risk averse companies either reduce their exports and thus their output, or they concentrate international activities on less risky countries instead of being able to react to undistorted price signals. Another possible consequence is the relocation of production facilities to foreign countries. Foreign direct investment is in many cases, although not generally, accompanied by a reduction of the investment activity at home. Domestic investment is also affected if export chances are not realised due to the aforementioned exchange rate volatility. If this restriction on exports diminished due to a perfect exchange rate stability under a single European currency, this could effect a rise of employment and a fall of the unemployment rate.

In a survey from 1984, the International Monetary Fund (IMF) summarises existing studies and approaches trying to establish an empirical link between exchange rate variability and important economic variables such as trade, investment and output. The IMF survey presents a variety of studies dating from the 1970s and 1980s that do not focus on exports but on investments or output detecting significant adverse effects of volatility. In finding no significant empirical impact of this volatility on exports, the studies quoted by the IMF fail to detect a direct link between exchange rate movements and international trade.

Differentiating between an aggregated and a disaggregated approach, the survey analyses effects of variability on total world trade as well as on bilateral trade. On the aggregated level, Bergsten and Cline (1983) show that changes in output and hence real income growth explain the largest part of variability in trade. This factor, however, does not explain all of the variation in trade and it cannot be excluded that changes in output are not caused by the variability of

exporters.

exchange rates. Nevertheless, neither the authors themselves nor the IMF replicating Bergsten and Cline's test[8] could prove a significant effect of exchange rate volatility.

Since uncertainty might lead to a shift in trade patterns, more disaggregated approaches have been conducted instead of merely regarding total world trade volumes or growth. However, none of these studies could detect a significant impact of exchange rate variability on (bilateral) trade flows. Two of the most relevant cross-section analyses are the following: Kenen (1979) who cannot find a significant link between the growth rate of 16 industrial countries' exports and real as well as nominal variability of exchange rates between 1973 and 1976. Additionally, Thursby and Thursby (1985) do not detect a significant difference in the change of exports or GNP depending on the extent of nominal or real exchange rates.

Since the end of the 1980s there has been a variety of studies which demonstrate significant negative interrelations of volatility and, besides e.g. investment, trading activity. These analyses differ from the previous ones. Traditionally, change rates and short-term fluctuations in these rates should be suitable to represent exchange rate risk. Capturing by a survey the individual impression exporters have of the effect of exchange rate variability, Duerr (1977) already finds that the major U.S. manufacturing firms are more concerned about long-term swings in exchange rates than about volatility in the short run. It seems as if the construction of long-term uncertainty measures, which can depict more than just the actual exchange rate fluctuations or exchange rate variabilities, have in more recent approaches led to better, more significant results. Such results are found by De Grauwe (1987), Perée and Steinherr (1989) as well as Aizenman and Marion (1996) who come to similar conclusions with respect to international trade and investment, respectively.

De Grauwe (1987) finds a positive correlation between exchange rate stability and trade. At the beginning, de Grauwe is confronted with a puzzle: „On the one hand we observe a significant success of the EMS-countries in avoiding the highly volatile exchange rate movements observed for other currencies. On the other hand, some key macroeconomic indicators were significantly less favourable within the system than outside it.„[9] According to the indicated growth rates for investment and for GDP during 1973-78 and 1979-85, a deceleration of both growth rates can be found inside EMS-countries. In the major industrialised non-EMS-countries, this is not present to the same extent.

Concerning trade growth, de Grauwe detects a similar puzzling effect. Although there is a greater exchange rate stability, the growth of intra-EMS trade has decreased much more than the one of EMS-non-EMS trade. Running a Seemingly Unrelated Regression Estimation on

[8] See IMF (1984), Appendix II.
[9] De Grauwe (1987), p.390.

bilateral trade flows[10], de Grauwe tries to control the impacts of the declining GDP growth and intra-EMS trade integration as well as the effects of real exchange rate changes on intra-EMS trade growth. Hereby, de Grauwe makes use of a long-term measure of volatility being defined as the variance of the annual percentage changes of the bilateral real exchange rate between currency i and currency j around the mean observed during period t. He finds that the growing stability of the EMS-countries' exchange rates has had a positive impact on the growth of intra-EMS trade by 0.1 % during 1979-85 compared to 1973-78, while the slowdown in trade integration has had a negative impact of 2.1 % and the decline in GDP growth of 0.8 % on it.

Supposing that the EMS member countries without EMS would have been subject to an exchange rate variability of about the same extent as the non-EMS-countries during 1979-85, de Grauwe calculates the additional source of trade growth of the stability in EMS which amounts to 1.2 %. Since this obviously positive impact of greater exchange rate stability on trade has been compensated by other, negative factors, the growth of intra-EMS trade has been declining. De Grauwe also states that it is not the exchange rate arrangement of the EMS that has caused minor growth rates of GDP and investment inside EMS member countries. Decelerating growth rates in EMS are explained by the fact that the EMS member countries had accumulated higher levels of budget deficits and, therefore, conducted more restrictive fiscal policies than non-EMS-countries.

Perée and Steinherr (1989) differentiate between short-term exchange rate risk and medium- or long-term exchange rate uncertainty. While the former can be hedged, although provoking some transaction costs, the latter cannot. Since most researchers have concentrated on short-term exchange rate risk neglecting the effects of long-term uncertainty, they might not have been able to detect a significant link between exchange rate volatility and trade.

As variances of exchange rate changes in the past do not give the uncertainty expected for the future, Perée and Steinherr try to develop other measures of exchange rate uncertainty than the simple volatility. In order to concentrate on the impacts of medium-term volatility, they make use of accumulated or historical experience as a proxy for the economic agents' confidence in future exchange rate stability. By the use of the largest spread of minimum and maximum values of the nominal exchange rate over a certain time period as well as the current deviation of nominal and equilibrium exchange rate[11] at time t, they construct a first measure of exchange rate uncertainty and current misalignment. As this measure does not take into account how long the periods of past and present misalignments from equilibrium exchange rates have been,

[10] For his comparison of EMS-countries and non-EMS-countries, he takes Belgium, France, Germany, Italy and the Netherlands as representative countries for EMS-countries and Canada, Japan, Switzerland, the United Kingdom, and the United States as major industrialised countries not being member of EMS.

[11] The basis for the equilibrium exchange rates is given by the purchasing power paritiy during periods of fixed exchange rates; while equilibrium exchange rates are approximated by a trend passing through the 1970 value of the previous trend and the equilibrium rates in 1984 as they were computed by Williamson (1985, p. 82) in periods of flexible exchange rates.

its duration and its amplitude are taken into account in a second measure in which more weight is given to the preceding five years.

On the basis of these measures, Perée and Steinherr run their estimations for the period from 1960 to 1985. The regressions test whether real exports are a function of world demand, the real exchange rate, the terms of trade and of the uncertainty measures. Such equations are estimated for the US, Japan and the UK having flexible exchange rates as well as Germany and Belgium being members of the EMS. Arguing that the analysis focuses on long-term uncertainty of exchange rates, periods of fixed but adjustable parities can be included. They find no significant negative impact of uncertainty on U.S. exports. As the latter are generally invoiced in U.S.-$, U.S. producers do not bear the uncertainty of international trade. In the case of the U.K., Germany, Belgium and Japan, however, the uncertainty variables are mostly significant. In these countries, long run exchange rate variability seems to have a negative impact on real exports.

A recent study by Aizenman and Marion (1996) finds a significant negative impact of several volatility measures, including exchange rate volatility, on private investment. In their research, the authors analyse the influence of volatility on private, public and total investment in 47 developing countries from 1970 to 1992. Besides an exchange rate volatility measure, Aizenman and Marion use measures of the volatility of government consumption and of nominal money growth as well as a weighted index of volatility of these three variables. In contrast to other studies, volatility is assessed by the average standard deviation of the residuals from first-order autoregressive processes. Constructing the measure of exchange rate uncertainty by such an autoregressive process includes long-term experience about the development of exchange rate risk in the measure. That is the reason why we constructed a similar measure for use in our estimations.

The simple correlation has already given a highly significant negative correlation between private investment and the three volatility measures, whereas the correlation between the volatility of the change in the real exchange rate and the average share of private investment in GDP is as high as −0.34 and has a t-value of −3.80. Running a cross-country regression with several control variables, Aizenman and Marion uncover a significant negative impact of all three volatility measures - separately tested - on private investment. But this negative effect cannot be found on public or on aggregated investment.

Although using the standard measure of short-term volatility, i.e. the standard deviation of exchange rate changes, Müller and Heinemann (1999) can detect a weak negative influence of volatility on international mobility of private capital. Their regressions base on investment-savings correlations introduced by Feldstein and Horioka (1980), one of the standard procedures to assess capital mobility. Differentiating the effect in different time periods, Müller and Heinemann find a sharp increase in the mobility of private capital from the 1960s on. The

existence of volatility in the 1980s and the 1990s has, however, significantly disturbed this private capital mobility.

In addition to these more recent empirical analyses often focusing on long-term uncertainty, studies concentrating on export price elasticities in analogy to the pass-through mentioned by Sapir and Sekkat (1990) were in some cases able to identify disturbing effects of exchange rate volatility on these export variables. Examples for such studies are, besides Sapir and Sekkat, Döhrn (1993) as well as Clark and Faruqee (1997). The latter, however, only find a small impact. In contrast to these authors, Arcangelis and Pensa (1997) do, for example, 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 as it is described in Section 4.

On the basis of their theoretical model of pass-through presented above, Sapir and Sekkat test the influence of exchange rate stability on import price elasticity. This responsiveness of import prices in five countries to changes in foreign costs and in exchange rates was estimated for seven industries and eight exporting countries including the largest industrial countries as well as countries inside and outside the EMS from 1966 to 1987. As a measure of volatility, Sapir and Sekkat use annual standard deviations of the 12 monthly percentage changes in the bilateral end-of-period exchange rates.

In the sectors of chemical production, metal production, motor vehicles and textiles & clothes, the authors could detect a high degree of pass-through of production costs of at least 70 %. Exporters in these industries seem to have a relatively strong market power. On the contrary, the other three sectors being agricultural and industrial machinery, office machines and electrical goods only show little or no significant market power. They have a low degree of at most 40 % of cost pass-through.

Concerning the influence of exchange rate volatility on import prices, Sapir and Sekkat test in the first place whether volatility lowers the influence of exchange rate pass-through and after that they examine whether volatility imposes the traditionally supposed risk premium. While the influence of the current exchange rate change is mostly significant, in thirty out of thirty-five cases neither the impact of the lagged one nor the sum of both turns out to be significantly different from zero. A negative effect of an added risk premium can therefore not be proved. Moreover, volatility has a significant influence on exchange rate pass-through in only four out of thirty-five cases.

The behaviour of the German markets is hereby atypical compared to the other countries. Most of the rare significant cases of an influence of volatility on import prices via the two mentioned effects can be found for the German sectors. In the other importing countries, volatility has no significant direct impact on import prices.

Additionally, Sapir and Sekkat analyse the import price elasticity depending on whether exporters are EMS- or non-EMS-countries. Concerning intra-EMS trade, the degree of exchange rate pass-through seems to be slightly higher, but the results are generally not significant.

Döhrn (1993) is another sector-specific study focusing on the elasticity of prices, more precisely on the exchange rate elasticity of export prices in German industries. Building sector-specific real effective exchange rates for motor vehicles, mechanical engineering, electrical engineering and chemical industry, Döhrn finds that these real exchange rates show less variability than the German real exchange rate weighted according to the aggregated export structure and not deflated by sector-specific price variables. He therefore tests if this higher stability in the real exchange rate development stands for greater responsiveness of export prices to nominal exchange rate changes in these four sectors between 1978 and 1991.

Döhrn observes significant impacts of exchange rate changes on export prices. On average, export prices respond by about 50 % to exchange rate changes; this is how half of the variation in nominal exchange rates is compensated. Further tests state that there is also a negative responsiveness of the export volume of about 0.54 to 0.85 % of remaining changes in real exchange rates. In contrast to other studies, a strong and significant impact of exchange rate variability can be found on this sectoral level on export prices as well as on export volumes.

The direct influence of exchange rate volatility on unemployment and employment growth is tested by Gros (1996), Belke and Gros (1997) as well as Jung (1996). In negatively influencing those real variables that empirically have been regarded so far, exchange rate volatility can – indirectly - exert a negative impact on labour market. In a simple causality analysis Belke and Gros detect significant positive (negative) links between exchange rate volatility and unemployment (employment growth) for a number of countries. Jung (1996) 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 as it is usual as the short-term variability of exchange rates. In Gros (1996) e.g. it is the German currency against the currencies of the original EMS-countries - Belgium/Luxembourg, Denmark, France, Ireland, Italy, and the Netherlands - that is regarded. In order to construct volatility measures, they do not take the generally used standard deviation of the aggregated external value which generally

is supposed to catch short-term volatility.[12] Instead, the authors 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.[13] The reason Belke and Gros refer to is the pricing-to-market behaviour of exporters. This induces that the development of each market matters individually. Exporters probably will wait to see if the exchange rate change is permanent, otherwise the adaptation to the new exchange rate might not be worth their costs. As a consequence, each exporter is exposed to the exchange rate change in each foreign market separately. Their measured volatility could hereby show a higher level of volatility than the measures constructed in the traditional way. By constructing proxies of volatility which are presented in Section 4, we paid attention to this problem.

Running regressions to observe the effects of exchange rate volatility on the German labour market over the period 1971 to 1995, Gros (1996) finds that a 1 % increase in exchange rate variability rises unemployment by 0.6 % while a decline in employment growth of 1.3 % can be observed. The US-$/German Mark exchange rate volatility seems to have no impact on German employment. But a negative impact of the 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. Hereby the value of the option to wait rises with growing volatility, causing uncertainty about the possible return on investment.[14] 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.

In addition to Gros (1996), Belke and Gros (1997) include 11 EU-countries in their estimations, each time regarding the volatility of the national currency against the EMS currencies. The results for the EU-countries do in general not differ much from the results for Germany found by Gros (1996). Additionally, they test the robustness of the estimates by including further exogenous variables such as policy variables (e.g. interest rates) as well as cyclical variables (e.g. growth variables). The influence of the volatility variable remains significant and robust.

Nevertheless, Jung (1996) focuses on the volatility of the German currency against the EMS currencies as well, but he does not find a significant influence of this variable on the German unemployment from 1977 to 1996. In contrast to Belke and Gros, Jung makes use of daily data

[12] The IMF (1984) underlines that there is no unique measure of volatility being the only proxy of uncertainty. Although, the survey stresses that the use of standard deviations, being the traditional measures of exchange rate variance, has some advantage, e.g. the well-defined properties, making it very useful for empirical analysis.
[13] To aggregate these bilateral exchange rate volatilities, they use, instead of weighting them as traditional according to trade shares, the countries' weights in the ECU (which also is a proxy for their weights in terms of GDP).
[14] In this context, Gros refers to the value of the option of waiting as it was modelled by Dixit (1989).

and he 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. Besides the fact that Jung cannot confirm the results of Belke and Gros using data at a monthly level, he finds that, on the contrary, the change of the unemployment rate Granger causes the volatility of exchange rates.

These differing results demand further research in the context of labour market effects of exchange rate volatility. The regression in Section 4 presents a further step in the analysis of labour market effects of exchange rate volatility.

# 4 Empirical evidence

Having reviewed some recent results concerning the influence of exchange rate volatility on economic performance and especially on labour markets, we present our own empirical analyses in the following. Important implications of Section 3 we take into account concern the construction of volatility measures. This is why we make use of a long-term measure as well as of one catching pricing-to-market behaviour.

First, before testing the influence of volatility on cyclical unemployment and its impact in a small reduced form model, an Okun-type relationship, we refer to an AR-model of unemployment. This means that lags of the endogenous variable and a volatility measure explain the change in the unemployment rate. We continue to estimate the influence of exchange rate fluctuations on unemployment as proposed by Belke and Gros (1997) as well as Jung (1996). This is due to the conflicting results of the authors which are described in Section 3.

On the basis of the results obtained by Belke and Gros (1997) as well as by Jung (1996), estimations are therefore run on a more differentiated basis using annual as well as monthly data. To investigate volatility using data at a monthly level in order to construct annual measures has a strong disadvantage insofar as exchange rate fluctuation always occurs at a short-term level. As a consequence, the volatility describing process might be systematically disturbed if it only includes one observation a month. This might be one reason why Jung (1996) using daily data in order to construct a monthly volatility measure could not confirm the effects found by Gros (1996). In addition to that, the use of monthly data and volatility measures from 1973 to 1997 allows to differentiate more stable from more volatile periods and to run individual estimations for each period.

We have to construct appropriate measures of volatiliy because of the lack of observable data on volatility. Here, the way of defining volatility may also have an effect on the results as

discussed in detail in Section 3. As a consequence, three different measures of volatility are constructed and tested, so that we can check the robustness of the volatility definitions:

I. The traditional measure of short-term volatility, i.e. the standard deviation of percentage changes in the aggregated nominal external value of the DM against the different country groups as used for example by Jung (1996).

II. The standard deviations of bilateral external values of the DM 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 (1996) as well as by Belke and Gros (1997) as explained earlier on.

III. A measure of volatility using an autoregressive or moving-average process of the past percentage changes of the external values. This procedure is supposed 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 is motivated by the significant results of empirical studies presented in Section 3, which focused on the impact of long-term uncertainty on international trade.

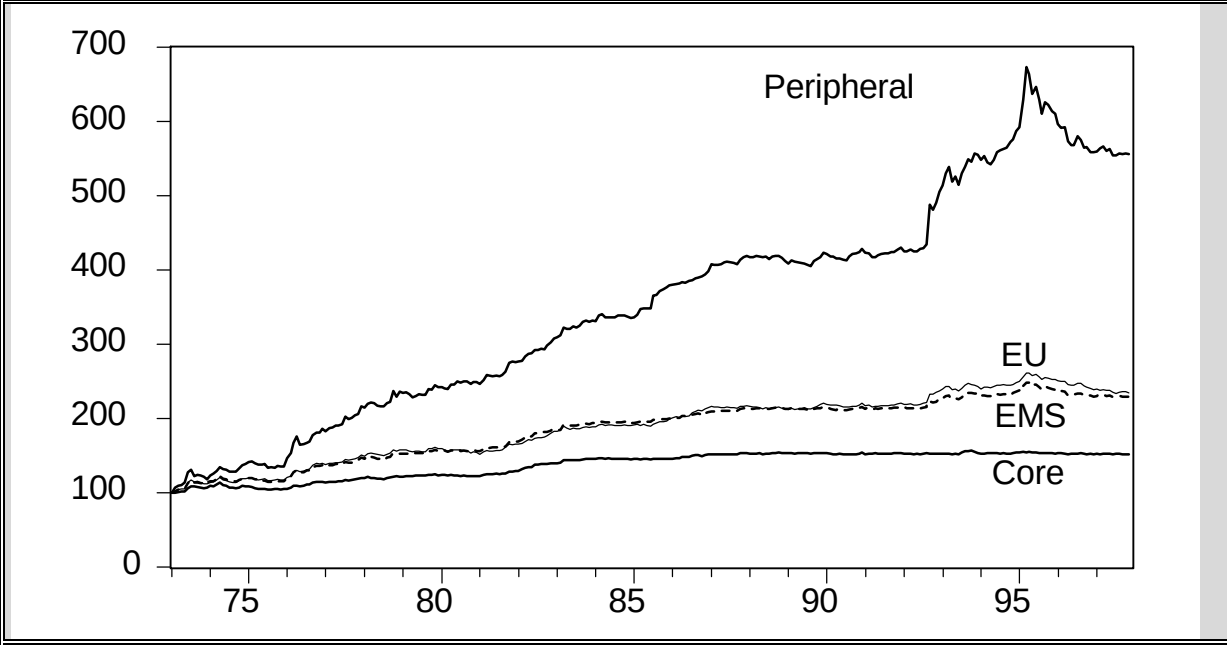
Annual volatility measures are calculated on the basis of monthly data using OECD exchange rates as presented in Section 2. In addition to the annual volatility measures, we construct monthly volatility measures on the basis of daily exchange rates from Datastream.

Besides the estimations of Belke and Gros, we regard in each case the volatility of the DM against different country groups. We consider them as 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 the currency of Germany (BD). The analysed currency groups 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 have not been available on a daily basis from 1973 (GK from 1976, IR from April 1979 and FN from 1983), it is referred to a group of:
- ***Representative countries*** (being 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 EMS was founded in 1979, i.e. all contemporary EC-countries except for the UK: BG, DK, FR, IR, IT and NL.
- ***Peripheral countries***: GK, IT, ES and PT.
- ***Core countries*** (being the countries of the DM-block): NL, BG, DK, FR as well as AT.

In order to calculate the external values of the DM against these groups of countries, we use the geometric average weighted with the countries' shares in German exports as indicated by the German Bundesbank.[15] Figure 7 shows these external nominal values.

**Figure 7: Nominal external value indices of the German Mark against different country groups:**




**Note: Aggregated nominal external value indices, weighted by trade shares. Base year of indices is 1973. Data source: OECD, German Bundesbank, own calculations.**

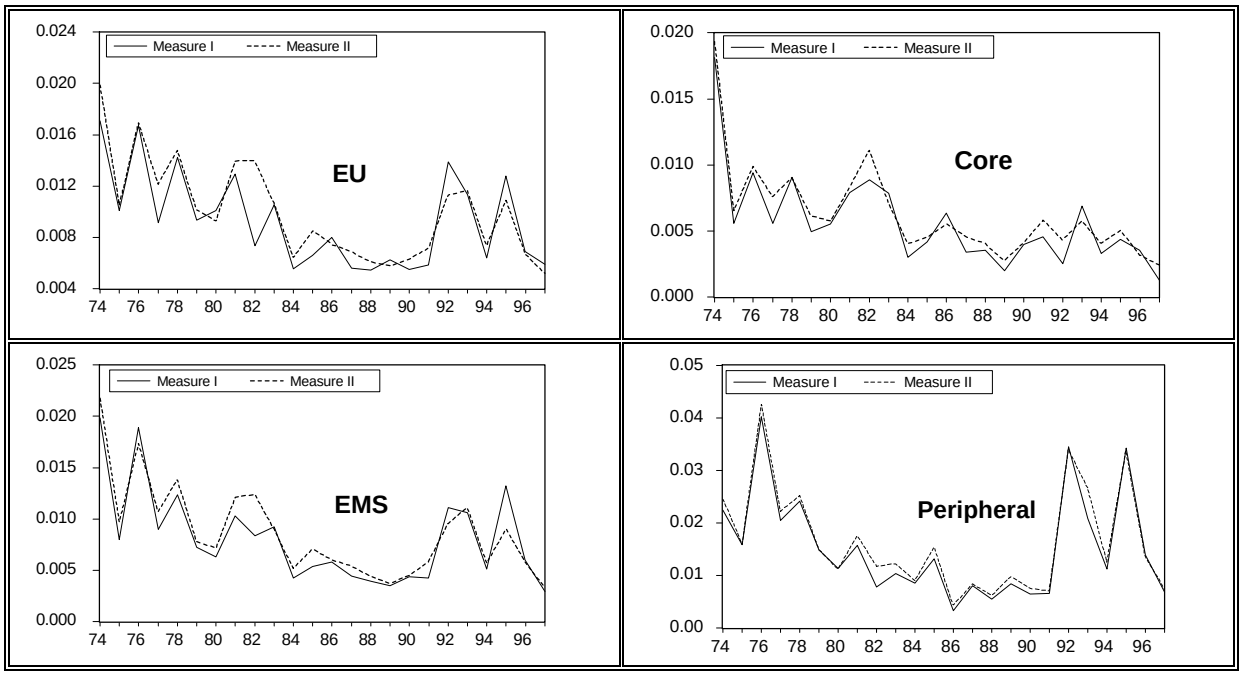
### *4.1 Estimations with annual data*

#### *4.1.1 Annual volatility measures*

According to the descriptions given above, we construct the volatility measures I and II. The comparison of these measures, given in Figure 8, shows that both variables do not develop in exactly the same way. Some peaks of measure II are overstated, while others are understated in comparison to measure I. All in all, we cannot find any systematic difference in comparing both measures. On the basis of this descriptive comparison, the aggregation of bilateral volatilities to a multilateral one – with the purpose of making each market matter separately – does not seem to lead to a higher level of volatility.

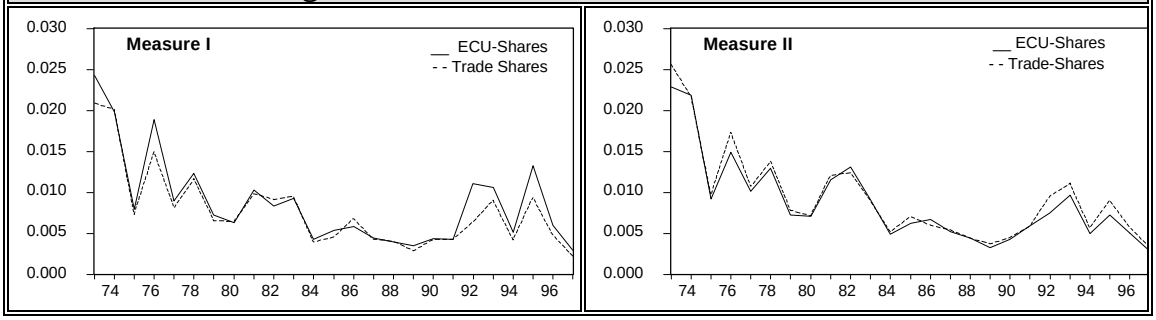
**Figure 8: Volatility measures I and II**

[15] Deutsche Bundesbank (1989), p.46.




In addition to the way of aggregating, the degree of volatility might be influenced if ECU-weights instead of trade weights are used in order to aggregate external values or multilateral volatility - as Belke and Gros (1997) used them. Figure 9 shows measure I and II of the core country volatility comparing trade and ECU-shares.[16] The use of either trade or ECU shares does not seem to matter as there is neither a strong difference in the development nor in the level of both measures.

**Figure 9: Core country volatility**
**Measure I and II weighted with trade and ECU-shares**



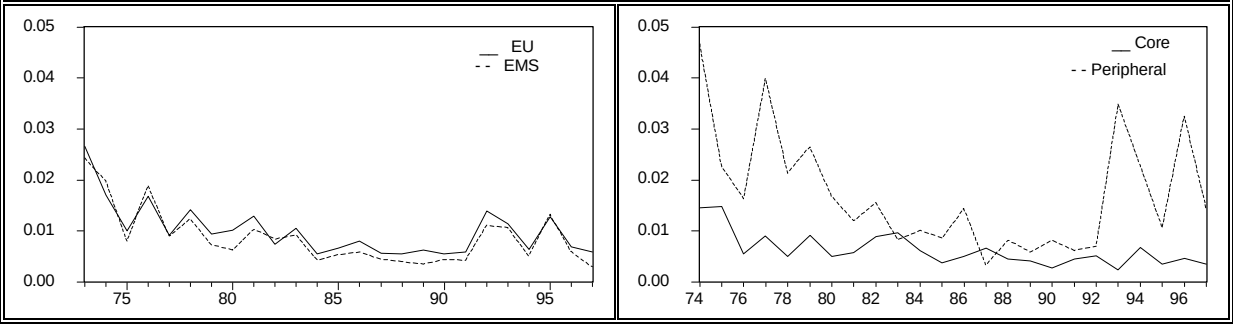

Since the standard deviation of actual percentage changes only catches the realised volatility of exchange rates in the past, we additionally build another measure of volatility with the purpose of catching long-term uncertainty in the fluctuation of the exchange rates. The survey in Section 3 has shown 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

[16] Here, the shares of the relevant currencies in the ECU in percent on 30.5.97 were used. To a large extent, the ECU-shares represent GDP-shares of the EU-countries.

and hence expected fluctuation. For this reason, the residuals of these processes reflect the unanticipated changes in exchange rates. The percentage exchange rate changes of the core countries can be represented by moving-averages of order 11, the peripheral countries' by moving-averages of order 3, the EU percentage exchange rate changes by an ARMA(1,10)-process and the EMS-countries' by a MA(10)-process.

Calculating the standard deviations of these processes' residuals gives measure III. This measure of unexpected exchange rate volatility is shown in Figure 10. Like the other measures before, volatility differs with regard to the country groups. Core country volatility is permanently low. The volatility of the German Mark against the EU- and EMS-currencies - like the volatility of the measures above - is very stable at the end of the 1980s and more volatile again in the 1990s although not as much volatile as in the 1970s. It seems to be surprising that again volatility against the EU-countries – except for the 1990s – is not much higher than volatility against the core countries alone. This is influenced by the fact that to the individual core countries – according to their actual higher importance in German trade – high weights are accorded in the aggregation of external values. The peripheral currencies – although more volatile - are only regarded to a lower extent in this aggregation and therefore do not influence the overall volatility of EU-currencies to a large extent.

**Figure 10: Annual standard deviation of the residuals of the ARMA-processes of the percentage changes of the external values**



### *4.1.2 Influence on the change of the unemployment rate*

The annual unemployment rate of West Germany[17] turns out to be integrated of order 1 in ADF-tests. The volatility measures though are all integrated of order O, 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 dependent variable. We can hereby find short-term influence and empirical causality. An explication of the first difference of the unemployment rate by its own lags, being an approximation of a structural model, is used in order to test the additional influence of volatility measures in a similar way as Belke and Gros (1997) did it.

Table A1 in the appendix shows the results. The explanation of the difference of the unemployment rate by its first and second lag already gives a strong empirical relation between the contemporary change in the unemployment rate and its past changes. As the residuals are already white noise, the specification proves to be of good quality. However, the first lag of the DM exchange rate volatility[18] against the different country groups as an additional explanatory variable turns out to have a significant influence as well - mostly at a 1%- or 5%-level of significance. All the coefficients prove to have the expected positive sign and therefore support the hypothesis that volatility increases the unemployment rate.[19]

Explaining the change in the unemployment rate additionally with the first lag of measure I of the DM volatility against the EMS-countries, we get a volatility coefficient of 0.7009 at a 5 %-level of significance. Against the hard currency block-countries, this coefficient is 0.8157 being significant at a 10 %-level. The coefficient of the volatility against the peripheral countries is 0.2725 and 0.7410 against the EU-countries. Both are significant at the 5 %-level.

Additionally, the first lag of measure II of volatility is significant for all country groups. These coefficients are always slightly lower – as well as less significant - except for the one standing for the volatility against the core countries. The volatility measure supposed to catch the pricing-to-market behaviour thus does statistically not show a higher impact than the traditional measure of short-term volatility – at least not in the estimations using data at an annual level. This means that this way of constructing a volatility measure does not lead to a stronger statistical influence, than the other measures.

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[17] We hereby use the West German unemployment rate from the German Bundesbank in all estimations.

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

[19] A statistical problem occurs as exchange rate volatility is not a priori independent of changes in the unemployment rate or of common trends. This problem of endogeneity can be ignored as long as the explanatory variable enters the equation with a sufficient number of lags. As the unemployment rate is regarded in its first difference, the volatility measures would have to be lagged by at least two periods. This is not the case for all significant volatility variables presented in Table A1. However, this problem of endogeneity is lessened by the results of Granger causality tests. Given the fact that pairwise Granger causality tests do not show a Granger causality of changes in the unemployment rate on exchange rate volatility, such a problem of endogeneity does not seem to be present in these estimations.

Using measure III which catches the volatility of unanticipated exchange rate changes, the influence of the volatility of the German Mark against all country groups is always significant without a delay. Fluctuations of the German Mark against the currencies of the peripheral and the core countries are only significant at the 10 % level, while against the EMS- and EU-countries they are even significant at a 1 %-level.

As the coefficients of all kinds of measures and of all country groups are significant, a negative impact of exchange rate volatility on labour markets seems to exist. The extent of the impact of the DM fluctuations against the currencies of the peripheral countries is less than especially the one against the core countries. It seems as if movements of the - in general more stable - currencies of the core countries do effect the change in the unemployment rate to a stronger extent. However, these fluctuations always have a lower degree, the overall extent of the negative impact will therefore still be smaller.

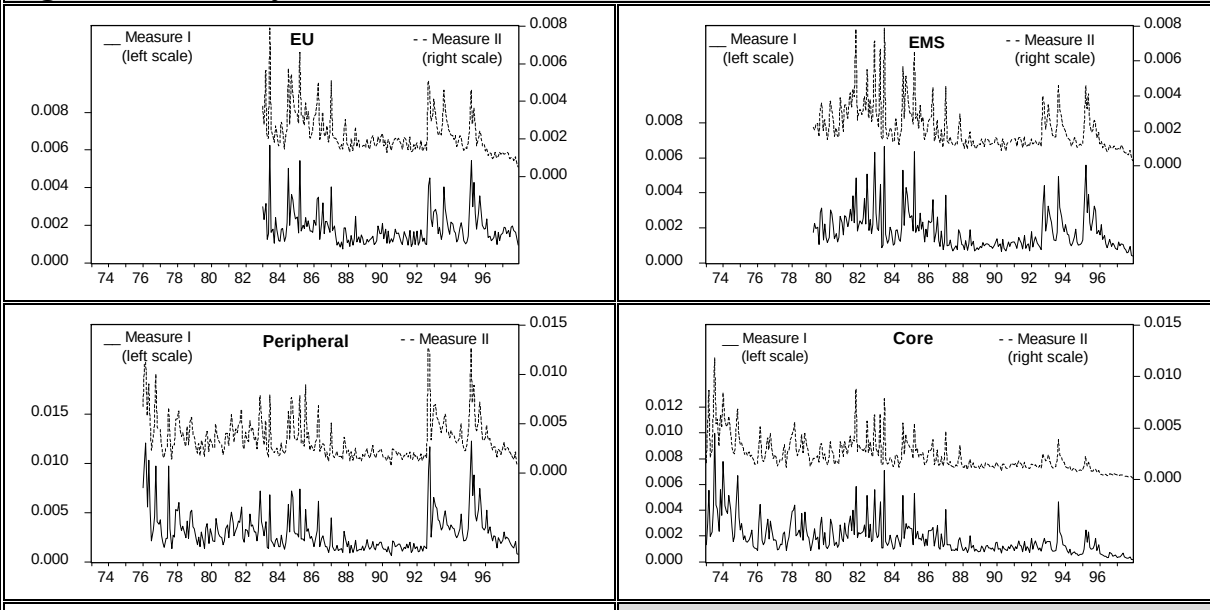
Table A2 in the appendix presents the additional influence of exchange rate volatility on the by its own lags unexplained part of the change in the unemployment rate using the residuals of the autoregressive basic specification. If there is an impact, the effects found in the regressions of Table 1 should be confirmed. This is the case: It turns out that the volatility explains between 11.6 % (core countries) and 21.4 % (EU-countries) of the so far unexplained part of the basic specification. The measures of variant II show a lower, but still significant influence – except for the core country volatility which again explains 15.4 %. By use of the same procedure with respect to the influence of the uncertainty measure, i.e. measure III, an additional 12 to 25 % of explanation are given. This result indicates that volatility, which is, however, not the most important determinant of unemployment, has a disturbing and non-negligible influence on the labour markets.

## *4.2 Estimations with monthly data*

### *4.2.1 Monthly volatility measures*

We construct monthly measures of exchange rate volatility in the same way as the annual measures. Figure 11 presents measures I and II for monthly volatility based on daily exchange rates. Both monthly measures turn out to be even more similar in each country group in their development than the annual measures. As before, the fluctuations of the DM against the peripheral countries is the highest. Additionally, two peaks mark it in the 1990s. In contrast to this, exchange rate volatility against the core countries has been nearly inexistent since the mid-1980s. Again, the development of EMS-country volatility is more or less identical to 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.

**Figure 11: Volatility measures I and II**

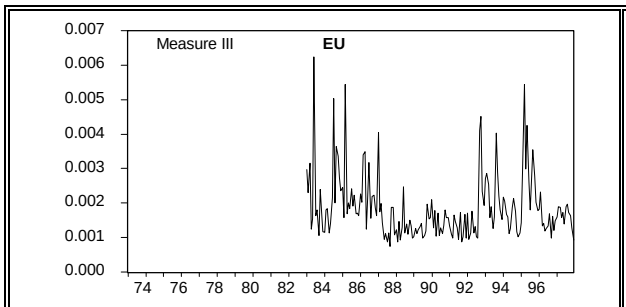


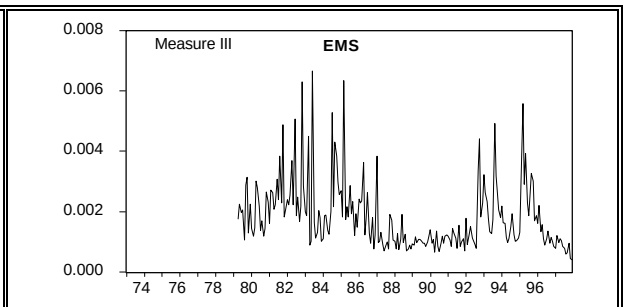

**Note: EMS- and EU-country volatility cannot be indicated from 1973 on as data for three countries has not been available for the whole period. (GK from 1976 on, IR from 4/1979 and FN from 1983 on)**
**Data Source: Datastream.**

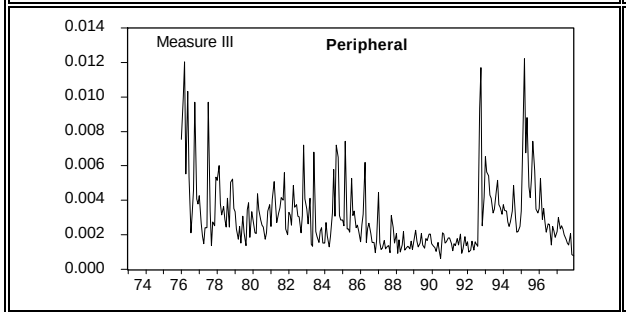
Obviously, there are stable and volatile periods which will separately be regarded in the estimations using monthly data. While from 1973 to 1978 and from 1984 to 1986, there are periods of, in general, strong volatility, a relatively low degree of volatility marks the periods from 1979 to 1983 and especially 1987 to 1991. From 1992 to 1997, this degree depends on the individual country groups. Against the core countries, the DM proves to be very stable while it has been very volatile against the peripheral countries in this period. These divergences in regard to the time period justify the splitting of the sample into these five subperiods after running regressions over the whole period.

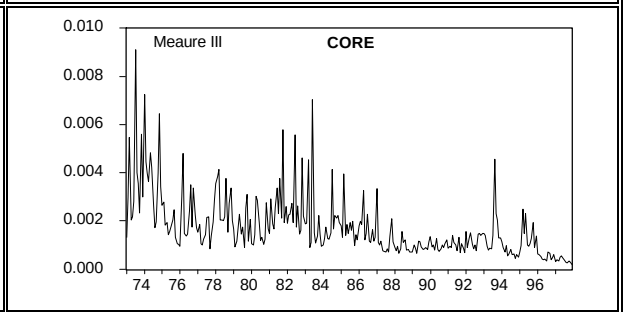
The same is true for the volatility measures calculated according to variant III. They are presented in Figure 12. Regarding their development, they are similar to the ones described above, however, they are a bit more fluctuating. The construction of the ARMA-processes now differs with respect to the time period. Concerning the core countries, there is for example an ARMA(1,32)-process from 1973 – 1978, an AR(2)-process from1979 – 1983, an ARMA(1,2)-process from 1987 – 1991 and, finally, a MA(9)-process from 1992 – 1997.

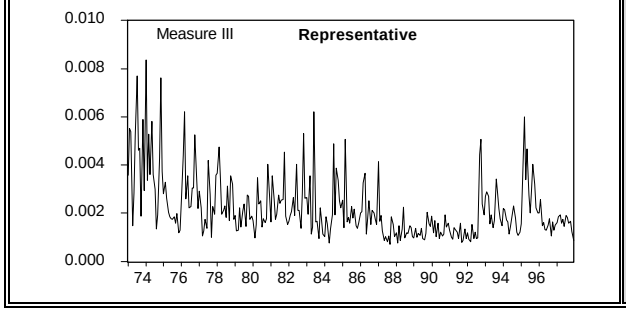
**Figure 12: Measure III of exchange rate volatility**




**Note: see Figure 11.**

### *4.2.2 Influence on the change of the unemployment rate*

Like in the estimations baring on the annual data, we run our regressions first over the whole sample period from 1973 to 1997. The explanation of the stationary change in the unemployment rate by its own past (using three lags) is already 41.7 % while it has explained about 32 % of the variation in the unemployment rate changes using the annual data. The residuals of this basic specification are white noise, additionally, no other statistical deficiencies are obvious.

In order to include the alternative measures of volatility, we choose its most significant lag according to the AIC- and SCHWARTZ-criteria (always giving the same lag). We hereby find only one lag where the estimation was superior to the basic specification, albeit to a very small extent. For each country group, this lag is the same for all measures. The volatility of the German Mark against the currencies of the EMS-countries is significant with a lag of two periods regardless of the measure. The volatility against the representative countries is significant with a lag of 4 months and the one against the core countries with a lag of 6. This is

different in case of the volatility of the DM against the peripheral countries. Only a statistical influence of volatility with a lag of 4 periods can be detected using measure II.[20]

**Table 1: Regression results using monthly data, whole period**

| | **Constant (t-statistic)** | **DWGRUE lag 1 (t-statistic)** | **DWGRUE Lag 2 (t-statistic)** | **DWGRUE lag 3 (t-statistic)** | **Volatility (t-statistic)** | **$R^2$ adj.** | **SER** | **DW** | **F (Prob F)** |
|---|---|---|---|---|---|---|---|---|---|
| 73 – 97 | 0.007 (1.333) | 0.237*** (4.248) | 0.252*** (4.535) | 0.296*** (5.296) | - | 0.417 | 0.085 | 2.061 | 71.309 (0.000) |
| **Measure I** | | | | | | | | | |
| EMS **lag 2,** 79 – 97 | -0.014 (-1.281) | 0.213*** (3.299) | 0.264*** (4.155) | 0.227*** (3.509) | 0.1342** [1] (2.448) | 0.395 | 0.085 | 2.043 | 37.306 (0.000) |
| Representative **lag 4,** 73 – 97 | -0.013 (-(1.351) | 0.219*** (3.941) | 0.238*** (4.299) | 0.292*** (5.278) | 0.096** (2.437) | 0.427 | 0.084 | 2.062 | 55.871 (0.000) |
| Core **lag 6,** 73 – 97 | -0.007 (-0.840) | 0.230*** (4.114) | 0.237*** (4.258) | 0.286*** (5.111) | 0.080** (2.075) | 0.424 | 0.085 | 2.034 | 54.941 (0.000) |
| **Measure II** | | | | | | | | | |
| EMS **lag 2**, 79 – 97 | -0.015 (-1.299) | 0.209*** (3.224) | 0.261*** (4.088) | 0.229*** (3.545) | 0.118** [1] (0.418) | 0.395 | 0.085 | 2.032 | 37.246 (0.000) |
| Repesentative **lag 4**, 73 – 97 | -0.011 (-1.089) | 0.223*** (3.984) | 0.238*** (4.283) | 0.291*** (5.234) | 0.069** (2.118) | 0.424 | 0.084 | 2.059 | 55.243 (0.000) |
| Peripheral **lag 4,** 76 – 97 | -0.006 (-0.636) | 0.201*** (3.375) | 0.247*** (4.199) | 0.288*** (4.867) | 0.039* (1.493) | 0.375 | 0.085 | 2.077 | 39.875 (0.000) |
| Core **lag 6,** 73 – 97 | -0.007 (-0.767) | 0.230*** (4.109) | 0.238*** (4.279) | 0.286*** (5.114) | 0.062* (1.938) | 0.423 | 0.085 | 2.036 | 54.703 |
| **Measure III** | | | | | | | | | |
| EMS **lag 2,** 79 – 97 | -0.015 (-1.332) | 0.209*** (3.227) | 0.263*** (4.135) | 0.224*** (3.457) | 0.148** (2.475) | 0.396 | 0. 085 | 2.050 | 37.361 (0.000) |
| Representative **lag 4,** 73 –97 | -0.012 (-1.189) | 0.222*** (3.949) | 0.238*** (4.279) | 0.291*** (5.246) | 0.092** (2.241) | 0.425 | 0.084 | 2.066 | 55.275 (0.000) |
| Core **lag 6**, 73 – 97 | -0.005 (-0.564) | 0.223*** (3.963) | 0.248*** (4.467) | 0.287*** (5.149) | 0.073** (1.784) | 0.421 | 0.085 | 2.059 | 54.678 (0.000) |

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

[1] Note: In these two cases: the volatility measure is significant, but the estimation is not improved according to the AIC and the SCHWARTZ-criteria.

Comparing these results with the results on the annual base, we find two important differences. First, in general, no difference in the lag structure occurs with respect to the different forms of calculating volatility. And second, the level of the coefficients is different. At the annual level, the coefficient of volatility against the core countries clearly has been three to four times higher than the one of the volatility against the peripheral countries. At the same time, the influence of volatility against the EMS- and the EU-countries has been slightly lower than against the core countries using the data at the annual level. Here, in the estimates with the data at the monthly level, the empirical impact of the volatility against the EMS- and the representative countries is

[20] This time, the problem of potential endogeneity can be ignored. All volatility measures are significant at always at least two lags. This is important this time as the Granger causality tests indicate to a strong extent that the change in the unemployment rate Granger causes the volatility while the volatility variables only Granger cause changes in the unemployment rate to a weak extent. Concerning the Granger causality of the

up to two times higher than against the core countries. As described above, the peripheral currencies' volatility is not generally significant. The most important difference in this context is the extent of the volatility' s impact. In addition to the fact that this time the volatility only contributes to a low degree to the explanation of the variation in the change of the unemployment rate, its impact is rather low. In the estimations using annual data, the coefficients are about 0.25 to 0.95. In the present case, they are much smaller ranging from 0.04 to 0.15.

This apparent inconsistency of the estimates with the annual and the monthly data indicates that the empirical relation has to be regarded in more detail. As described above, the development of the DM volatility clearly points to a structural break in time. Separating periods of higher and lower exchange rate stability, we can identify different subperiods as described above. Regressions are therefore run for the following time periods: 1973 - 1978, 1979 - 1983, 1984 - 1986, 1987 - 1991, 1992 - 1997.

First, the difference in the West German unemployment rate again is simply explained by its own lags. For each subperiod, we choose a white noise basic specification. Like in all estimations before, we only include the volatility as additional explanatory variable if it improves the overall estimation of the regarded subperiod. 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 2.

**Table 2: Regression results using monthly data, different sub-periods**

| | **DWGRUE Endogene lags** | **DWGRUE** | **Measure I (lag)** | **Measure II (lag)** | **Measure III (lag)** |
|---|---|---|---|---|---|
| **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) | --- | --- |

change in the unemployment rate, this result confirms the one of Jung (1996).

| 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) | --- |

***/**/***:** indicating that the coefficient is significant at the 10/5/1 percent 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 wrong sign of the coefficient. For this reason these results are not reported in the table.

In almost each subperiod we find again the same significant lag, which statistically is 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 month. An exception is again the volatility against 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 at the 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 of a weak significance of the coefficients. Problems of endogeneity only have to be regarded in two cases where the first lag is significant, but again, according to the Granger causality tests they do not seem to be present in this subperiod.[21]

Regarding the coefficients of the estimates, it is remarkable that the impact of the volatility is stronger in the subperiod estimations than in the estimations over the whole period. However, it is not as strong as in the estimates using the annual data. Again, the core country volatility usually seems to be stronger than the others. Remarkably, the coefficients in the stable periods are much higher than the coefficients in more volatile periods.

### *4.3 Exchange rate volatility and cyclical unemployment*

Since the causes for structural unemployment are generally expected to root in real economics, nominal variables or their fluctuation probably do not affect it. Exchange rate volatility thus should only have an impact on the cyclical component of unemployment which changes in the

[21] 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 interpreted carefully. Only the 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 of the unemployment rate.

more or less short term according to the business cycle. We therefore focus on cyclical unemployment[22] in the next step of our analysis. The first difference of this variable is presented in Figure A1 in the appendix.

As before, for each subperiod, we refer to a white noise basic specification being an AR-process of different orders. The results of the regressions explaining the cyclical component of unemployment by the volatility variables are given in Table 3. Remarkably, the coefficients do not only come close to the one of Table 2, but, moreover, they are quite similar. In general, their level is only slightly lower than the coefficients of the regressions using the non-cyclical unemployment data. Additionally, the same lag is significant in nearly each case.

**Table 3: Regression results of cyclical unemployment, sub-period estimations**

| | **CYCLICAL DWGRUE Endogene 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*** | --- | --- | --- |

***/**/***:** indicating that the coefficient is significant at the 10/5/1 percent level. The second column gives the endogenous lags included in the subperiod regression 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 wrong sign of the coefficient. For this reason these results are not reported in the table.

These results indicate that the regarded exchange rate volatility contributes solely to the explanation of the variation in short-term unemployment as expected. The whole impact of

[22] This cyclical component of unemployment is calculated using the Hodrick-Prescott-filter with a smoothing constant of 100.000.

volatility in Table 2 directly affects changes in cyclical unemployment. To the same extent to which the whole unemployment rate is affected, the cyclical component is influenced. However, again, most of the variation in the unemployment rate, independent of the regarded component, must have been caused by other factors. Estimations of the distinct impact of volatility on the residuals of the basic AR-model of rate changes unemployment further indicate an additional contribution of the volatility measures in the explanation of the unexplained part of 4 to 14% (mostly 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 chapter, we therefore refer to this model abandoning the AR-specification and thus concentrating on more complex specifications.

# 5 Okun' s law

Instead of only explaining the development of the unemployment rate by its own past, the influence of volatility should be tested in at least a reduced form model giving a mechanism of transmission. As mentioned above, we refer to the Okun' s law specification, a simple form model of labour market effects that gives an empirically proved relation 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.[23]

In addition to the Okun relation, a separate influence of volatility is tested. As the Okun relation is defined in this way:

$$(U - U^*) = ß\,(Yreal - Yreal^*),$$

the empirically analysed specification can be represented as follows:

$$(U - U^*) = ß_1\,(Yreal - Yreal^*) + ß_2\,Vola\ .$$

Here $ß_2$ catches the independent influence comparable to the one regarded in the estimations in Section 4.

In Table 4, we present the estimations that test if in addition to the cyclical growth of real GDP[24], volatility has a separate influence on the cyclical unemployment rate. Here, we use data on quarterly basis for the reason of data availability.[25] This has the disadvantage of fewer observation points when conducting subperiod estimations. Cyclical growth proves to be

[23] See Dornbusch and Fischer (1992), p.18.

[24] In order to get the cyclical component of real GDP, the smoothing constant was set to 10.000 applying the Hodrick-Prescott Filter.

[25] West German real GDP data are taken from the National Accounts of DIW.

stationary at the 5 % level of significance. However, estimates in subperiods have to be regarded carefully as the ADF-tests do not show the stationarity of the variable for the subperiods. Since we have regarded a short-term influence of up to 15 month ago in the estimations in the preceding sections, we now include up to five lags catching the volatility' s influence in the preceding five quarters.

The estimates actually show a separate influence of volatility that increases the level of the unemployment rate. Nevertheless, this influence is only observable in two time periods. From 1979 to 1983, there is a high influence of exchange rate volatility. 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. Additionally, from 1973 to 1978, we can find a significant influence of the first lag which is spurious. This is obvious when regarding its distinct influence in the robustness estimations, presented in Table A3 in the appendix.

**Table 4: Regression results of dynamic specification of Okun's law, independent influence of volatility, sub-periods**

| | **Cyclical Growth Lags** | **Cyclical WGRUE 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) |

***/**/***:** indicating that the coefficient is significant at the 10/5/1 percent level. Note: The coefficients crossed out have not proved to be independently significant in the distinct estimations shown in Table A3 in the appendix. The second and the third column show the basic specification for the subperiods.

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.[26] Only in the core countries, the undelayed influence is

[26] 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 additionally, it does Granger cause the unemployment variable while the latter,

significant in both periods. All in all, this is consistent with the monthly variables' influence that mostly seem to be two to six months delayed. Hence, it can be stated that the volatility of each country group having a positive sign has directly influenced cyclical unemployment in the 1990s as well as in the beginning of the 1980s when testing the additional influence of this variable in a properly specified Okun relation. 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 a quite large negative impact prior to further adjustment. Nevertheless, the level of the standard deviation of exchange rate changes in Figure 11 and 12 indicates that even the volatility of the DM against the peripheral countries, which is the strongest, rarely reaches this level of increase. Only in its most volatile time, i.e. referring to the two peaks in the 1990s, the peripheral volatility – even disregarding the smaller ones -increased so strongly. However, its immediate impact in this time is rather small, i.e. the unemployment rate only rises by about 0.3 to such an increase in volatility. Here, it is curious and contradictable 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.

## 6 Conclusion

The theoretically supposed 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 described in Section 3. Nevertheless, this study has tried to find systematic influences of the DM 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 of approximating exchange rate volatility. There is no difference in the estimates when including our three measures, i.e. the standard deviation of aggregated external values of the DM against different country groups, a pricing-to-market measure as well as a long-term measure.

On the basis of monthly data, we can – to some extent – confirm the results of Belke and Gros (1997). 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.

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this time, does not influence the first.

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

## References


AIZENMAN, Joshua and MARION, Nancy P. (1996): Volatility and the Investment Response, NBER, Working Paper 5841.

ARCANGELIS, G. and PENSA, De C., (1997): Exchange Rate Volatility, Exchange-Rate Pass-Through and International Trade: Some New Evidence from Italian Export Data, CIDEI Working Paper 43, Rome.

BELKE, Ansgar and GROS, Daniel (1997): Evidence on the Costs of Intra-European Exchange Rate Variability, Diskussionsbeiträge No. 13, Institut für Europäische Wirtschaft.

BERGSTEN, C. Fred and CLINE, William R. (1983): Trade Policy in the 1980s: An Overview, ed. by CLINE, William R.: Trade Policy in the 1980s, Washington Institute for International Economics, pp. 59-98..

CLARK, Peter B. and FARUQEE, Hamid (1997): Exchange Rate Volatility, Pricing-to-Market and Trade Smoothing, IMF Working Paper 97/126.

DE GRAUWE, Paul (1987): International Trade and Economic Growth in the European Monetary System, European Economic Review 31, p.389-398.

DEUTSCHE BUNDESBANK (1989): Aktualisierung der Außenwertberechnungen für die D-Mark und fremde Währungen, Monatsberichte der Deutschen Bundesbank 1989 (4), pp. 44 - 49.

DIXIT, Avinash (1989): Entry and Exit Decisions under Uncertainty in: Journal of Political Economy, 1989, Vol. 97, No.3, pp.620-638.

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

DORNBUSCH, Rudiger and FISCHER, Stanley (1992): Makroökonomik.

DUERR, Michael G. (1977): Protecting Corporate Assets under Floating Currencies, New York, Conference Board.

DUMKE, Rolf H., JUCHEMS, Alexander and SHERMAN, Heidemarie C. (1997), Kosten der Währungsvielfalt im Europäischen Binnenmarkt, in: Ifo-Schnelldienst 9/1997, pp. 3-18.

EUROPEAN COMMISSION (1990): One Money, one Market – An Evaluation of the Potential Benefits and Costs of Forming an Economic and Monetary Union, European Economy 44.

FALK, Martin and FALK, Rahel (1998): Pricing to Market of German Exporters: Evidence from Panal data, ZEW Discussion Paper No. 98-28.

FELDSTEIN, Martin and HORIOKA, Charles (1980): Domestic Saving and International Capital Flows, The Economic Journal, 90, 314-329.

GROS, Daniel (1996): Germany' s stake in Exchange Rate Stability,Intereconomics, 9/10 1996, pp. 236 - 240.

INTERNATIONAL MONETARY FUND (1984): Exchange Rate Volatility and World Trade, Occasional Paper 28.

JUNG, Alexander (1996): Is There a Causal relationship between Exchange Rate Volatility and Unemployment ?, Intereconomics, 11/12 1996, pp. 281-282.

KENEN, Peter B. (1979): Exchange Rate Variability: Measurement and Implications, Princeton University, mimeo.

MÜLLER, Claudia and BUSCHER, Herbert S. (1999): The Impact of Monetary Instruments on Shock Absorption in EU-Countries, ZEW Mannheim, mimeo.

MÜLLER, Claudia and HEINEMANN, Friedrich (1999): Capital Mobility within EMU, ZEW Mannheim, mimeo.

PERÉE, Eric and STEINHERR, Alfred (1989): Exchange Rate Uncertainty and Foreign Trade, in: European Economic Review 33, pp. 1241 – 1264.

SAPIR, André and SEKKAT, Khalid (1990): Exchange rate volatility and international trade: the effect of the European Monetary System, in: de GRAUWE, Paul and PAPADEMOS, Lucas (1990): The European Monetary System in the 1990' s, p.182-198.

THURSBY, Maric C. and THURSBY, Jerry G. (1985): The Uncertainty Effects of Floating Exchange Rates: Empirical Evidence on International Trade Flows, in: ARNDT, Sven W., SWEENEY, Richard J. and WILLET, Thomas D.: Exchange Rates, Trade, and the U.S. Economy.

THYGESEN, Niels (1990): Panel discussion: from the EMS to the EMU: Benefits and costs of an economic and monetary union relative to EMS, in: DE GRAUWE, Paul and PAPADEMOS, Lucas (1990): The European Monetary System in the 1990s, pp. 304-311.

TRAUD, Gertrud R. (1996): Optimale Währungsräume und die europäische Integration, DUV, Wiesbaden.

WILLIAMSON, J. (1985): The exchange rate system, 2nd edition, Institute for International Economics, Washington D.C.

# Appendix

### *Table A1: Regression results with annual data*

| | Constant (t-statistic) | DWGRUE lag 1 (t-statistic) | DWGRUE lag 2 (t-statistic) | **Voaltility (t-statistic)** | $R^2$ adj. | SER | DW | F | Prob F |
|---|---|---|---|---|---|---|---|---|---|
| | 0.267 (1.567) | 0.717*** (3.554) | -0.385* (-1.898) | - | 0.316 | 0.756 | 1.941 | 6.318 | 0.007 |
| **Measure I** | | | | **lag 1** | | | | | |
| EMS | -0.316 (-1.194) | 0.647*** (3.612) | -0.443** (-2.463) | **0.701** (2.674)** | 0.471 | 0.665 | 1.887 | 7.828 | 0.001 |
| EU | -0.457 (-1.455) | 0.643*** (3.567) | -0.390** (-2.172) | **0.741** (2.628)** | 0.466 | 0.668 | 2.080 | 7.700 | 0.001 |
| Peripheral | -0.179 (-0.701) | 0.716*** (3.863) | -0.425** (-2.270) | **0.272** (2.211)** | 0.423 | 0.694 | 2.088 | 6.622 | 0.003 |
| Core | -0.197 (-0.712) | 0.603*** (3.077) | -0.393* (-2.078) | **0.816* (2.049)** | 0.407 | 0.704 | 1.837 | 6.255 | 0.004 |
| **Measure II** | | | | **Lag 1** | | | | | |
| EMS | -0.304 (-1.059) | 0.602*** (3.182) | -0.405** (-2.201) | **0.647** (2.363)** | 0.439 | 0.685 | 1.833 | 6.994 | 0.002 |
| EU | -0.453 (-1.359) | 0.068** (3.253) | -0.398** (-2.177) | **0.701** (2.433)** | 0.518 | 0.680 | 1.942 | 7.172 | 0.002 |
| Peripheral | -0.189 (-0.711) | 0.7*** (3.749) | -0.430** (-2.274) | **0.264** (2.125)** | 0.414 | 0.699 | 2.058 | 6.423 | 0.003 |
| Core | -0.259 (-0.937) | 0.603*** (3.173) | -0.387** (-2.095) | **0.818** (2.305)** | 0.433 | 0.688 | 1.749 | 6.848 | 0.002 |
| **Measure III** | | | | **Lag 0** | | | | | |
| EMS | 0.411 (-1.485) | 0.655*** (3.748) | -0.458** (-2.594) | **0.792*** (2.889)** | 0.493 | 0.650 | 1.890 | 8.469 | 0.001 |
| EU | -0.606 (-1.789) | 0.668*** (3.824) | -0.424** (-2.413) | **0.872*** (2.865)** | 0.491 | 0.652 | 2.027 | 8.392 | 0.001 |
| Peripheral | -0.173 (-0.655) | 0.710** (3.789) | -0.414** (-2.188) | **0.263* (2.082)** | 0.410 | 0.702 | 2.072 | 6.325 | 0.003 |
| Core | -0.303 (-0.952) | 0.606*** (3.109) | -0.389* (-2.058) | **0.979* (2.068)** | 0.409 | 0.703 | 1.848 | 6.296 | 0.003 |

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

Note: The regression presented in the first line shows the autoregressive specification of the first difference of the unemployment rate (being white noise). All following regressions are an expansion of this basic model with the three different volatility measures at the given lags.

## Table A2: Distinct influence of volatility on residuals of the AR-basic specification of unemployment rate changes, annual data

| | Constant (t-statistic) | Volatility (t-statistic) | $R^2$ adj. | SER | DW | F | Prob F |
|---|---|---|---|---|---|---|---|
| **Measure I** | | **Lag 1** | | | | | |
| EMS | -0.587 (-2.256) | 0.653** (2.674) | 0.211 | 0.641 | 2.001 | 7.149 | 0.0139 |
| EU | -0.728 (-2.424) | 0.716** (2.693) | 0.248 | 0.640 | 2.213 | 7.251 | 0.013 |
| Peripheral | -0.455 (-1.898) | 0.269** (2.300) | 0.157 | 0.663 | 2.078 | 5.290 | 0.031 |
| Core | -0.452 (-1.706) | 0.723* (2.001) | 0.116 | 0.679 | 2.048 | 4.004 | 0.058 |
| **Measure II** | | **Lag 1** | | | | | |
| EMS | -0.557 (-2.296) | 0.580** (2.313) | 0.159 | 0.662 | 2.052 | 5.348 | 0.030 |
| EU | -0.701 (-2.189) | 0.641** (2.419) | 0.173 | 0.657 | 2.141 | 5.811 | 0.025 |
| Peripheral | -0.467 (-1.847) | 0.257** (2.195) | 0.142 | 0.669 | 2.074 | 4.817 | 0.039 |
| Core | 0.518 (-1.957) | 0.744** (2.279) | 0.154 | 0.664 | 1.980 | 5.192 | 0.033 |
| **Measure III** | | **Lag 0** | | | | | |
| EMS | -0.678 (-2.532) | 0.738*** (2.885) | 0.241 | 0.629 | 1.982 | 8.321 | 0.009 |
| EU | -0.877 (-2.703) | 0.846*** (2.941) | 0.250 | 0.626 | 2.106 | 9.647 | 0.008 |
| Peripheral | -0.449 (-1.810) | 0.261** (2.171) | 0.139 | 0.670 | 2.077 | 4.713 | 0.041 |
| Core | -0.550 (-1.811) | 0.879* (2.034) | 0.119 | 0.677 | 2.053 | 4.136 | 0.054 |

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

### *Table A3: Distinct influence of volatility measures on residuals of basic model, independent influence of volatility in dynamic specification of Okun's law monthly data*

| | **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 percent level. Note: These additional variable estimations have been conducted only for the significant cases given in Table 4.

### *Figure A1: First difference of cyclical unemployment rate*