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**Article — Digitized Version**

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Intereconomics

*Suggested Citation:* Jung, Alexander (1996) : Is there a causal relationship between exchange rate volatility and unemployment?, Intereconomics, ISSN 0020-5346, Nomos Verlagsgesellschaft, Baden-Baden, Vol. 31, Iss. 6, pp. 281-282, <https://doi.org/10.1007/BF02928608>

This Version is available at:

<https://hdl.handle.net/10419/140567>

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main concern on the way to EMU. Given the need for a sufficient degree of convergence it is clear that not all EU Member States can participate in EMU. Some countries are unlikely to meet the 1999 deadline. Therefore the framework of the EMU has to support the efforts of the "pre-ins" to join the Euro area, especially in time before the Euro banknotes and coins are introduced. A close policy coordination between the Euro area and the other members of the EU is a matter of common interest and an integral part of the completion of the EMU process. Everything has to be done to avoid real exchange-rate misalignments between the Euro and the other EU currencies, and to avoid excessive nominal exchange-rate fluctuations because trade between Member States would be

negatively affected. The lessons have been learnt from past experience.

Given the linkage between exchange-rate stability and convergence there will be a role for reinforced convergence programmes in the management of the new ERM. A favourable performance relative to convergence objectives would be expected to strengthen the case for support for a currency outside the Euro area in the case of speculative attacks. Convergence and exchange-rate discipline among the "pre-ins" will improve and monetary solidarity within the Union will become stronger in order to protect the Single Market and make it work. The new ERM in Stage III will be decisive to provide the prospect of full participation in the Euro area and to protect the Single Market.

Alexander Jung\*

## Is There a Causal Relationship between Exchange Rate Volatility and Unemployment?

*In his article on "Germany's Stake in Exchange Rate Stability" (INTERECONOMICS, September/October 1996), Daniel Gros recently wrote that, as he sees it, the exchange rate volatility of the D-Mark against the other European currencies has a causal impact on the German unemployment rate. In the following it is examined whether Granger causality tests support this view and whether it is possible to infer from this that the establishment of a monetary union in Europe will contribute to a significant easing of unemployment problems.*

A closer look at the trends in the exchange rate volatility and in the unemployment rate (Figure 1) makes this seem doubtful. It shows that the structural increase in unemployment in Germany in the past few years is obviously not attributable to a corresponding increase in the exchange rate volatility. At most, it can be assumed that there is a correlation between the change in the unemployment rate and the exchange rate volatility. In fact, it is precisely this relationship which was tested by Daniel Gros in the above-mentioned article by means of a simple regression analysis on the basis of annual data for the period 1971-95.

However, it seems noteworthy that, if monthly data and Granger causality tests are used instead of the simple regression analysis, the existence of the impact asserted by Daniel Gros cannot be proved

even for changes in the unemployment rate. Instead, Granger causality between changes in the unemployment rate and the exchange rate volatility points in the opposite direction.

For the purpose of the analysis, the monthly standard deviation of the weighted external value of the D-Mark vis-à-vis the currencies of the other EU countries serves as a simple measure of volatility.<sup>1</sup> The standard deviations were calculated on the basis of daily data, which were only available from September 1977 onward, however. In order to eliminate potential structural breaks caused by German reunification, unemployment in Germany was examined on the basis of the west German unemployment rate expressed as a percentage of the labour force, and the causality tests were based on the change in the unemployment rate, both relative to the previous

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<sup>1</sup> Further volatility measures were used in: Deutsche Bundesbank: Financial market volatility and its implications for monetary policy, Monthly Report, April 1996, pp. 51-67.

### Granger Causality Tests

The Granger causality concept tests whether, by adding another variable, it is possible to make a significant overall improvement in a forecast of variables which had been made on the basis of their lags.

The following Granger causality test is based on two stationary variables. Two equations, i.e. for the unemployment rate (UEMR) and the exchange rate volatility (VOLA), are estimated; the same procedure is repeated using changes in the unemployment rate (DUEMR) where X may equal UEMR or DUEMR:

$$(a) \Delta \ln X = \sum_{j=1}^2 a_j \Delta \ln X_{t-j} + \sum_{j=1}^2 b_j \Delta \ln \text{VOLA}_{t-j} + u_t$$

$$(b) \Delta \ln \text{VOLA} = \sum_{j=1}^2 c_j \Delta \ln \text{VOLA}_{t-j} + \sum_{j=1}^2 d_j \Delta \ln X_{t-j} + v_t$$

The first null hypothesis, that exchange rate volatility does not Granger cause the change in the unemployment rate ( $H_0: b_j = 0$ ), and the second null hypothesis, that the change in the unemployment rate does not Granger cause the exchange rate volatility ( $H_0: d_j = 0$ ), are tested by means of F-tests. The null hypothesis is rejected if its probability is smaller than 5%. The endogenous variable then Granger causes the exogenous variable.

Figure 1

#### Unemployment and Exchange Rate Volatility in (western) Germany

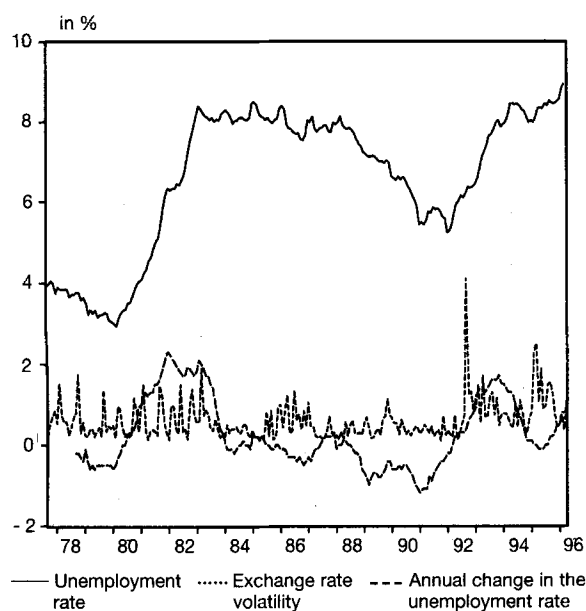


Table 1

#### Results of the Tests for Granger Causality<sup>1</sup>

Endogenous variable	Exogenous variable	F-tests for exogenous variable	Probability
(1) Unemployment rate	Volatility	0.54	59%
(2) Unemployment rate (change from previous month)	Volatility	0.88	42%
(3) Unemployment rate (change from previous year)	Volatility	0.88	42%
(4) Volatility	Unemployment rate	1,28	28%
(5) Volatility	Unemployment rate (change from previous month)	4.99	1%
(6) Volatility	Unemployment rate (change from previous year)	4.96	3%

<sup>1</sup>Applying the above tests does not allow for the determination of the optimal lag of each variable according to the criterion of the final prediction error. This procedure, however, would not reverse the result.

month and relative to the previous year. Unit root tests were carried out separately showing that the exchange rate volatility and the change in the (unadjusted) unemployment rate are stationary; hence it can be tested for Granger causality between these two variables.

The test statistics indicate a rejection of the null hypothesis that there is Granger causality between exchange rate volatility and the unemployment rate (and a change in that rate) with a high level of significance for the whole period under consideration (see Table 1, lines (1) to (3); probability greater than 5%). Conversely, the level of the unemployment rate does not explain exchange rate volatility significantly either (see Table 1, line (4); probability greater than 5%). However, the tests suggest that the change in the unemployment rate has a significant impact on the exchange rate volatility (see Table 1, lines (5) and (6); probability smaller than 5%). To that extent, changes in the unemployment rate Granger cause exchange rate volatility.

However, this result, too, has to be interpreted with caution. Ultimately, it probably reflects the fact that observed exchange rate volatility cannot be seen in isolation as an "exogenous" variable in the above macroeconomic relationship; instead, it is the result of complex interactions in which the underlying market fundamentals also play an important role. To conclude, the evidence provided here obviously conflicts with the results submitted by Daniel Gros on the basis of simple regressions using annual data.