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BY

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Contents

ABSTRACT

Central banks react to movements in exchange rates probably in order to limit their effects on inflation and on exports. The impact of import prices on inflation is small, however, according to the analysis of the P-Star models for the United States and for Germany. Furthermore, there is no clear-cut evidence that exchange rate volatility dampens exports. In an ECM-framework, it is shown that only in one of the five major European economies exports to the United States are negatively influenced by a higher volatility. Therefore, it is difficult to argue that the future European Central Bank should follow a policy which is oriented at the exchange rate.

JEL Classification: E58, F17

I. The Purpose of the Paper*

According to the Maastricht Treaty, the target of the European Central Bank (ECB) is to achieve price level stability. In an open economy, changes in import prices may affect the overall price level. It seems natural, therefore, for a central bank to be concerned with import prices and exchange rates. Along this reasoning, a depreciation of the home currency would cause the central bank to tighten its policy if it believes that otherwise inflationary expectations would increase which might be difficult to check. This argument would lead to reactions of the central bank even if exchange rates tend to return to their original level — or for that matter: if purchasing power parity (PPP) holds — or even if increases in import prices have no permanent effect on the price level. Another factor that may lead to a leaning against the wind strategy of the central bank is the intention to limit the variability of exchange rates. Viewing this as a measure of uncertainty many observers argue that "excessive" fluctuations tend to reduce the level of international trade.

The purpose of this paper is to analyze whether the empirical basis for these arguments is strong enough to recommend that the ECB should be concerned with and react to exchange rate changes. In Section II, we report reaction functions for the central banks of the G7-countries to check whether exchange rates have indeed mattered for monetary policy in the past. The next section includes models for the inflationary process; here, it is intended to estimate the short-term effects of import prices on inflation. The P-star model is used for the United States, i.e. for a very large economy with a small international sector — the characteristics of EMU as a whole — and second for Germany, i.e. the largest European economy which is very open and where therefore a substantial impact of import prices on the overall price level may be expected. In Section III, we test a standard single-equation model for the determination of bilateral exports between the five largest European economies on the one hand and the United States on the other. The variable of exchange rate volatility is included in the equations to test the hypothesis that it affects exports negatively. Policy conclusions are summarized in the final section.

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* Prepared for the CEPR Workshop "Options for the Future Exchange Rate Policy of the EMU" (Paris, April 4/5, 1997).

II. The Exchange Rate in the Reaction Function of Central Banks

In order to demonstrate the importance of exchange rates for the behavior of central banks in the G7-countries, we make use of the reaction functions estimated by Solveen (1996). While they are derived there from a theoretical model à la Barro and Gordon (1983) in order to analyze the importance of the independence of central banks, the purpose here is to analyze the reaction of central banks to exchange rate changes. The characteristics of the functions can be summarized as follows:

1. The endogenous policy variable is the day-to-day money market rate (r). While it may be argued that central banks use other indicators such as the money stock for their actions[1], the reasoning here is that all central banks more or less focus on determining the short-term interest rate when deciding upon the course of their policy.

2. The factors determining monetary policy are those commonly stated by the central banks themselves. Apart from the exchange rate we use indicators related to the business cycle and inflation: Cyclical movements are measured in terms of capacity utilization cu (actual real GDP relative to potential output); inflation π is defined as the annual rate of increase in the deflator for private consumption.[2]

The choice of the exchange rate measure needs explaining. For the European countries — except for Germany — the appropriate measure seems to be the nominal effective exchange rate; these countries can be assumed to be concerned with the exchange rates vis-à-vis the currencies of their main trading partner countries. For Germany, the most relevant foreign

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1 The most obvious candidate would be the Deutsche Bundesbank. But also the German central bank manipulates the repo rate and does not pursue a policy of directly controlling the monetary base (Deutsche Bundesbank 1995). Furthermore, the target variable M3 is not significant in the reaction function for the money market rate (Solveen 1996: 53ff.).

2 We use the OECD-estimates for potential output. The deflator is used instead of the CPI because of the peculiarity of the index in the United Kingdom.

currency is the US dollar according to the statements of the Deutsche Bundesbank.[3] The dollar is also the obvious choice for Canada and for Japan because of their large share of exports to the US. For the US we try two measures, i.e. the yen and the nominal effective exchange rate.

The reaction functions[4] are estimated in the common error-correction framework. For all seven countries, the equation to begin with is of the following type[5]:

$$
\begin{aligned}
\Delta r_t = {} & c - \alpha \cdot r_{t-1} + \alpha_1 \cdot \pi_{t-1} + \alpha_2 \cdot cu_{t-1} + \alpha_3 \cdot e_{t-1} \\
& + \sum_{i=1}^{4} \beta_i \cdot \Delta r_{t-i} + \sum_{i=0}^{4} \gamma_i \cdot \Delta \pi_{t-i} \\
& + \sum_{i=0}^{4} \delta_i \cdot \Delta cu_{t-i} + \sum_{i=0}^{4} \lambda_i \cdot \Delta e_{t-i} + u_t
\end{aligned} \qquad [1]
$$

After estimating all lagged coefficients in the first model, we follow the method ("general to specific") described by Gilbert (1986) and eliminate the coefficient with the lowest t-value until the final prediction error (FPE) of the equations reaches the minimum, i.e. until the "best" model in terms of the FPE is found. Tests for cointegration are based on Kremers et al. (1992). In equation [1], the null-hypothesis of no cointegration is equivalent to stating that $H_0\colon \alpha = 0$. The results for the final model are reported in the appendix (Table A1).

The importance of the variables under consideration can be demonstrated with the help of shock simulations. Here, we concentrate on the reaction of the central banks to the exchange rate: How does the path of the short-term interest rate change in response to a permanent one-percent devaluation of the respective currency? Figure 1 shows the dynamics of the adjustment. Note that the United States is left out here because the exchange rate was not significant in the reaction function (Table A1), a fact that supports the notion of "benign neglect" on the side of the Fed.

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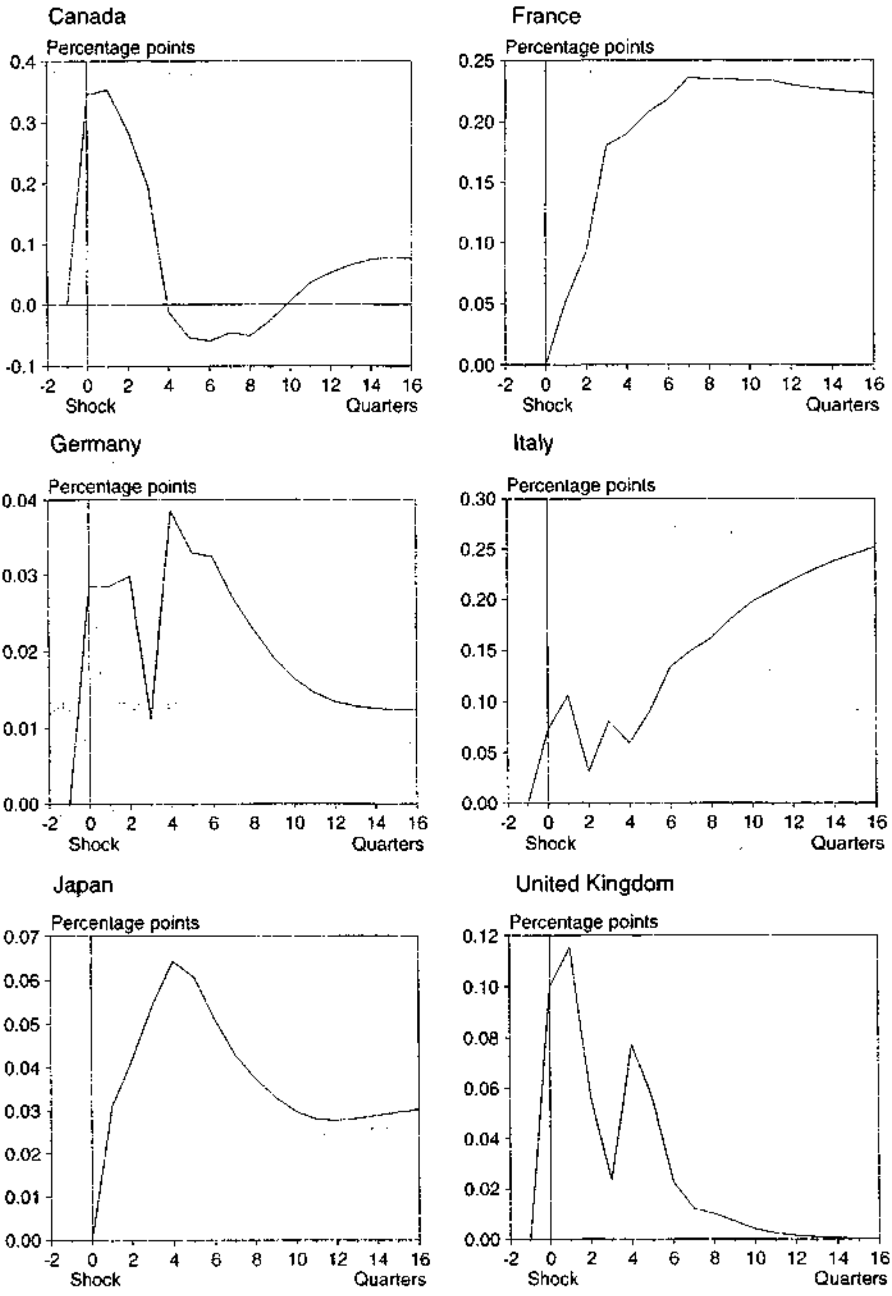
3 Movements of the price of European currencies should not matter for the Bundesbank because of the anchor function of the D-mark in the EMS. Instead, the other countries would probably react to stabilize the exchange rate.

4 Tests for unit roots are not reported because the main purpose here is to demonstrate the importance of a particular variable. See Solveen (1996) for detailed test statistics.

5 Except for the interest rate, all variables are in logs. Quarterly data are used.

Figure 1: Response of the Short-term Interest Rate to a One Percent Devaluation of the Home Currency



The response is quite different for the six countries with respect to the size and the pattern. The strongest tightening after a devaluation takes place in Canada and in France (more than 30 and 20 basis points, respectively), while the smallest increase in the short-term interest rate is calculated for Germany and for Japan (less than 10 basis points). It has to be noted that these responses are only partial, i.e. they do not reflect the whole system at work since only one equation was estimated for each country.[6] Therefore, not too much emphasis should be put on the pattern in the medium term. Nevertheless, it can be said that there is a significant impact of exchange rate movements on monetary policy in six of the G7-countries.

III. Import Prices and Inflation

Inflation rates may be affected by changes in import prices, whether these come about by changes in raw material prices and other goods or primarily by movements in the exchange rate. How much import prices matter for current inflation can only be tested in a complete model. The framework chosen here is the P-star approach developed by Hallman, Porter and Small (1991) which was later applied to Germany by the Deutsche Bundesbank.[7] The P-star model is derived from the quantity theory of money. It states that the equilibrium price level (P*) is determined solely by the money stock. The model allows for a dynamic adjustment of the actual price level (P) to the equilibrium path; the difference between P* and P is called the price gap which drives the adjustment of inflation: If this gap is positive, inflation will increase and vice versa. The price gap can be derived in various ways.[8] Here, we follow Tödter and Reimers (1994) who estimate the price gap directly in the money demand function.

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6 Vector autoregressions would be more appropriate if the response of the whole system were to be analyzed. For example, an increase in the interest rate might lead to a higher output gap which would lead to a reduction in the interest rate and so on.

7 For an extensive version cf. Tödter and Reimers (1994). In this paper, we largely follow Krämer and Scheide (1994).

8 By definition, the price gap is equal to the sum of the output gap and the velocity gap. Several researchers choose to estimate the equilibrium values of output and velocity to calculate the gaps by, for example, detrending or using the Hodrick-Prescott filter.

The quantity equation (all variables in logs) can be written as

[2] $m - p = y - v$ or

[2'] $m - p^* = y^* - v^*$

where the variables are the money stock m, the price level p, output y and velocity v; the asterisks refer to the respective equilibrium values. The equation of the demand for real balances

[3] $m - p = \beta_1 + \beta_2 y + u$

is combined with [2]:

[4] $v = -\beta_1 + (1 - \beta_2)y - u$

Since equilibrium velocity is

[4'] $v^* = -\beta_1 + (1 - \beta_2)y^*$

we can derive the equilibrium price level p* by combining [2'] with [4']:

[5] $p^* = m - \beta_1 - \beta_2 y^*$

Subtracting p from both sides and solving for the real money stock, we get (now using an index for time)

[6] $m_t - p_t = \beta_1 + \beta_2 y_t^* + e_t$ with $e_t = p_t^* - p_t$

This long-run money demand function is estimated for the United States and for Germany.[9] The residuals of these regressions form the price gap which enters the equation for inflation:

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9 To account for instabilities in the respective money demand functions, dummies were added: For the United States, a dummy for the intercept and the slope was used for the period after 1990 because, obviously, the parameters of the demand function changed in the early 1990s; for Germany, a dummy was used for the intercept only to account for the effects of German unification (from 1990:3 onwards).

$$[7] \qquad \pi_t = c + \sum_{i=1}^{5} \alpha_i \cdot \pi_{t-i} + \sum_{i=0}^{5} \gamma_i \cdot \Delta ip_{t-i} + \sum_{i=0}^{5} \delta_i \cdot \Delta ulc_{t-i} + \mu \cdot pgap_{t-1} + u_t \; .$$

In this regression, we do not only use monetary factors (i.e. the price gap) as in Hallman, Porter and Small, but also cost factors which affect the short-run dynamics, i.e. import prices and unit labor costs.[10] The estimation period is 1975–1996. The unit root tests for all variables under consideration are reported in Table A2. Since all the series are I(1) — except for, of course, the price gap which is I(0) —, fourth differences are used in the estimation.[11] The results are summarized in Table 1 and Table 2. The test-statistics show that there are no misspecifications in the equations.[12] The coefficients show the expected positive signs. The quality of the regression can be demonstrated in a dynamic simulation (Figure 2).

As we are interested in the effect of import prices on inflation, we run shock simulations: Each of the right hand side variables is raised by one percent for one year. Figure 3 shows that a one percent increase in import prices raises the inflation rate by one or two tenths of a percentage point in both countries. This effect naturally dissipates after a few quarters just as the effect stemming from higher unit labor costs. In contrast, the effect of one percent increase in the money stock builds up slowly and is more persistent.

The results show that the impact of import prices on inflation is significantly positive in the short run; however, it is not very large. Also, the openness of the two economies does not play a role because the effect is more or less the same. In general, import price inflation was not very important in the past 15 years in both countries in spite of substantial changes in exchange rates[13]: It was roughly stationary around zero, and the rates of change rarely exceeded

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[10] See Tödter and Reimers (1994) and Krämer and Scheide (1994) for a discussion.

[11] Quarterly data are used. For pragmatic reasons, i.e. to smooth the series of inflation, we use year-over-year changes rather than quarter-over-quarter changes of the variables.

[12] In the regressions, a few dummies have to be used for outliers; some of the sudden changes in inflation are, for example, due to tax increases so that they cannot be explained by this model.

[13] Of course, import prices increased a lot faster in the wake of the oil price shocks in the 1970s.

Table 1 — Test Results for the Final Models[a] — P-Star

	United States	Germany
R^2	0.99	0.98
Adjusted R^2	0.99	0.97
Tests for autocorrelation		
LM-test 1st order (χ^2 - distributed)	1.63 (0.20)	0.06 (0.80)
LM-test 4th order (χ^2 - distributed)	3.04 (0.55)	3.08 (0.54)
Tests for heteroskedasticity		
ARCH-test (χ^2 - distributed)	1.13 (0.29)	0.93 (0.34)
LR-test (χ^2 - distributed)	–5.72 (1.00)	3.60 (0.06)
Test for structural breaks		
Chow-test (mid-of-sample, F-distributed)	0.56 (0.91)	1.18 (0.32)
Test for the normality of residuals		
Jarque-Bera-test (χ^2 - distributed)	1.63 (0.44)	1.18 (0.55)
FPE ($x10^5$)	1.24	0.96

[a]Significance levels in brackets.

Table 2 — Estimated Coefficients of the P-Star-Models[a]

	United States	Germany
Period	1975:1–1996:4	1975:1–1996:4
constant	0.01 (1.50)	0.01 (5.24)
$pgap_{t-1}$	0.04 (3.84)	0.07 (3.87)
π_{t-1}	1.05 (22.91)	0.60 (8.65)
π_{t-2}	—	—
π_{t-3}	—	–0.12 (–1.78)
π_{t-4}	–0.36 (–4.09)	—
π_{t-5}	0.22 (2.97)	0.14 (3.32)
Δip_t	0.16 (9.16)	0.10 (7.38)
Δip_{t-1}	–0.15 (–7.50)	–0.03 (–1.92)
Δip_{t-2}	—	—
Δip_{t-3}	—	0.03 (2.63)
Δip_{t-4}	0.07 (3.14)	—
Δip_{t-5}	–0.04 (–2.50)	—
Δulc_t	—	0.07 (1.87)
Δulc_{t-1}	–0.08 (–2.28)	–0.11 (–2.01)
Δulc_{t-2}	0.22 (4.55)	0.13 (3.09)
Δulc_{t-3}	–0.10 (–2.70)	—
Δulc_{t-4}	—	0.04 (1.85)
Δulc_{t-5}	—	—
# dummies	6	3

[a] t-statistics in brackets.

Figure 2: Dynamic Simulation of the Inflation Rate in the United States and in Germany on the Basis of the Estimated P-Star Models

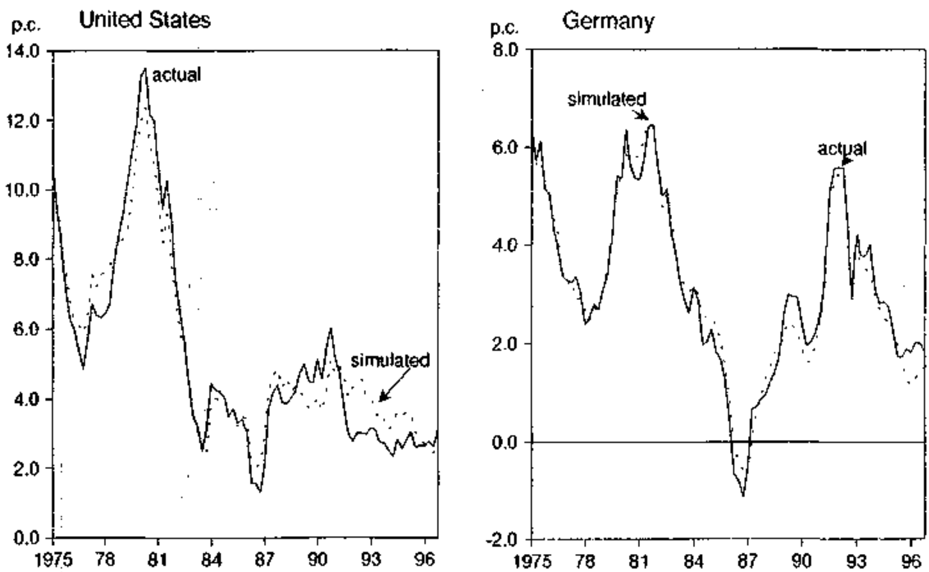
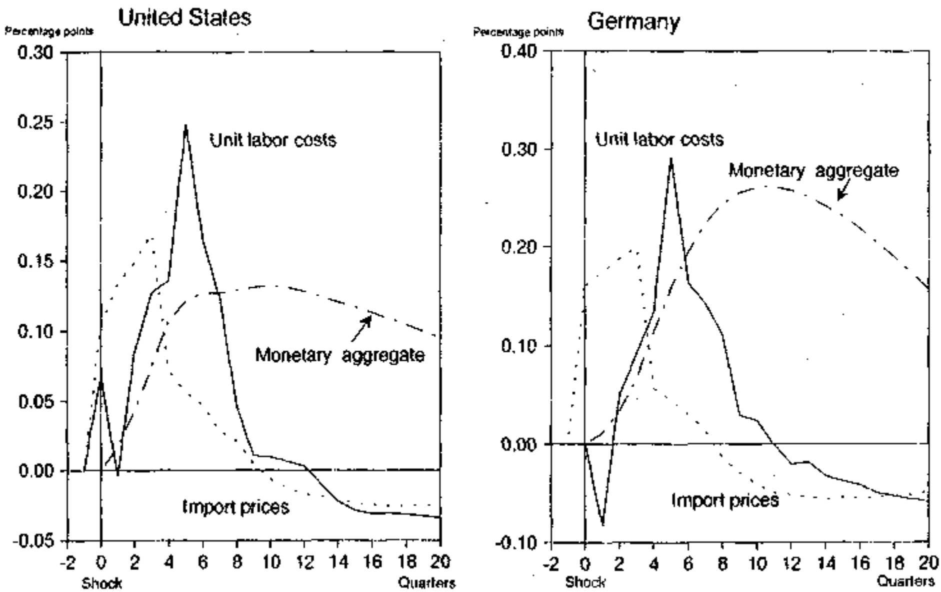


Figure 3: Response of the Inflation Rate in the United States and in Germany to a One Percent Rise in the Monetary Aggregate, the Import Prices and the Unit Labor Costs



5 percent. In addition, only part of such increases was due to depreciations of the home currency. Consequently, it is difficult to argue that a depreciation should lead the central bank to tighten its policy. One can be skeptical with regard to such a policy advice for two reasons: First, we do not know whether monetary policy can indeed manipulate the exchange rate in the desired way, and second, a monetary tightening would have a dampening effect on inflation only with a lag; as our results show, the effects of changes in the money stock become substantial only after the effect of import prices on inflation has peaked.

IV. Exports and the Volatility of the Exchange Rate

According to practically all economic theories, the real exchange rate has an impact on the volume of trade. If a currency devalues, it may be that foreign exporters accept some reduction of their profit margins in order to limit the loss of market shares; nevertheless, exports to the respective country will be reduced. The effect of central bank actions on the real exchange rate is limited to the short run. In the long run, the real exchange rate is solely determined by real factors. This means that a central bank can influence the real rate and thus the competitiveness of exporters only — if at all — in the short run.

Apart from the impact of the level of the exchange rate, it may be that its volatility matters for trade. A common argument is that the central bank should react to movements in exchange rate in order to reduce the volatility which has, according to a number of theories, a negative effect on exports. We test this proposition by looking at the determinants of exports of the five major EU-countries.[14] The United States is the country which has the biggest share in total EU-exports.[15] Therefore, we analyze the behavior of exports to the US.

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[14] France, Germany, Italy, Spain and the United Kingdom.

[15] In 1994, the last year for which data are available, exports to the United States amounted to around 20 percent of total EU-exports (OECD 1997a). Looking at the United States does also make sense because deviations from PPP have been much larger for the dollar than for European exchange rates.

1. How Does the Volatility of the Exchange Rate Affect Trade between Two Countries?

For a long time, there was unanimity between economists that an increasing volatility of the exchange rates results in reduced international trade.[16] The explanation rests on the assumption that firms are risk averse: An increasing in volatility raises the uncertainty concerning profits, and firms will concentrate more on the domestic market where the margins are not influenced by changes in the exchange rate, at least not to the same extent as on the foreign market. In contrast to this reasoning, de Grauwe (1988) shows that more restrictive assumptions with respect to the utility function of the firms than simply risk aversion are necessary to come to such a clear-cut conclusion. Using a simple model, he demonstrates that the direction of the influence of exchange rate volatility on the volume of exports depends on the convexity properties of the utility function. If the respective firm is very risk averse, a rise in the volatility of exchange rates still results in a decrease of expected total utility; however, it is possible that the expected marginal utility of selling abroad increases so that the firm will expand its export activities. In general, therefore, the correlation between the volatility of exchange rates and exports may be either positive or negative. This explains why empirical tests have come up with conflicting results.[17] Another reason for this may be that the possibilities for firms to insure themselves against losses related to exchange rate changes have improved significantly in recent years, thus reducing the risk of export activity.

2. Measuring Exchange Rate Volatility

In our tests, we calculate the standard deviation of the monthly changes in the nominal exchange rate of the dollar vis-à-vis the respective currencies over the past twelve months. This is the measure of exchange rate volatility which is also the basis in many empirical studies on this topic. The resulting series for the five largest EU-countries are shown in Figure 4. The use

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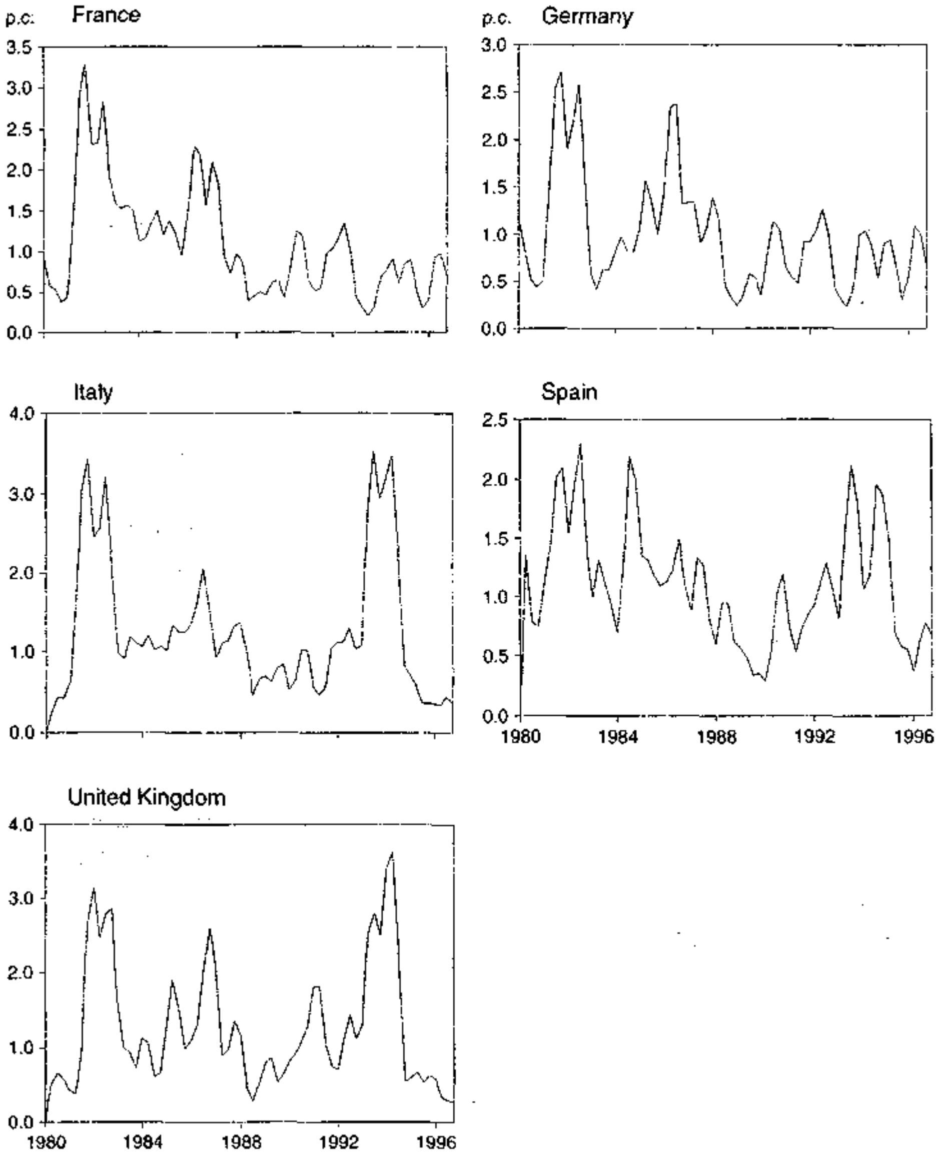
[16] See, for example, the paper by Hooper and Kohlhagen (1978).

[17] Cf. the survey by Coté (1994). She also discusses other reasons why uncertainty about exchange rates may result in an increase of exports. Furthermore, the effects on export prices depend crucially on the assumptions of the underlying model.

Figure 4: Variability of the $-Exchange Rate[1]



[1] Standard deviation of the monthly change of the $-exchange rate over the past twelve months.

of the nominal instead of the real exchange rate can be justified because costs of production are given in the short run. Nevertheless, there are only minor differences between the volatility of the nominal and the real exchange rate if the standard deviation is used.

Recently, ARCH-, GARCH- and related models were often used to calculate a measure for uncertainty of exchange rates (for example, Holly 1995). In such models, uncertainty increases with the forecast error of individuals. There are several reasons why we do not use this approach. The most important one is that the purpose of this paper is to give advice to policy-makers. For practical purposes, therefore, it is preferable to use a measure which can be easily observed. Otherwise, monetary policy would have to be based on the results of an econometric model which very much depend on its specification.

3. The Empirical Model

We estimate a model with the standard assumptions concerning the determinants of exports.[18] The explanatory variables are the real exchange rate e between the US dollar and the home currency of the respective European country and an indicator of economic activity in the United States which is approximated by the index of industrial production y.

Possible constraints on the supply side in the exporting country [19] are captured by the rate of capacity utilization cu. This is defined as the ratio between actual industrial production and its trend, which is calculated with a Hodrick-Prescott filter. Finally, exchange rate volatility σ is added to the equation.

For all series, logarithms of quarterly data are used. The estimation period is 1980 to 1996. For France, data for exports to the United States are available only from 1982 onwards so that, in this case, we start with the first quarter of 1984. The results of the unit root tests are

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[18] A problem with bilateral trade is that the respective price indices are not available. We therefore use the price index for total exports of the respective country for deflating the nominal values of exports to the US.

[19] Compare the discussion in Döpke, Fischer (1994).

reported in Table A2 in the appendix.[20] The degree of integration of the various series is usually as expected. As an exception, French real exports appear to be I(0). However, we handle this series as if it was integrated in order to be able to compare the results. With respect to exchange rate volatility, the results are mixed. In two cases, the series seem to be integrated of order one, in three cases they seem to be stationary. According to the hypothesis to be tested, exchange rate volatility has a long lasting influence on the level of trade and not only a temporary one on its growth rate. Therefore, we follow the reasoning by Hansen (1993: 150) and include this variable in the ECM-framework.[21]

The following equation is estimated:

[8]
$$\Delta x_t = c + \alpha \cdot x_{t-1} + \beta \cdot e_{t-1} + \gamma \cdot y_{t-1} + \delta \cdot \sigma_{t-1} + \sum_{i=1}^{4} \alpha_i \cdot \Delta x_{t-i} + \sum_{i=0}^{4} \beta_i \cdot \Delta e_{t-i} + \sum_{i=0}^{4} \gamma_i \cdot \Delta y_{t-i} + \sum_{i=0}^{4} \delta_i \cdot \Delta \sigma_{t-i} + \sum_{i=0}^{4} \mu_i \cdot cu_{t-i} + u_t$$

4. The Results

We again apply the general-to-specific method and eliminate step by step the coefficients with the lowest t-statistic until the FPE of the equation reaches its minimum. After each elimination, we test whether the assumptions of the OLS-method (normality of residuals, homoskedasticity, structural stability of the model and no autocorrelation) are fulfilled. The test results for the final models are shown in Table 3.

The coefficients of the final models are presented in Table 4. The t-statistic of the coefficient α indicates whether there is a cointegrating relationship between the time series of real exports, the real exchange rate, industrial production abroad and exchange rate variability.

[20] For US industrial production, real exports and the real exchange rate a constant and a time trend is included for the tests of stationarity of the levels of these time series. In all other cases, only a constant is included.

[21] A similar approach is used by Arize (1995).

Table 3 — Test Results for the Final Models[a] — Export Functions

	France	Germany	Italy	Spain	United Kingdom
R^2	0.83	0.82	0.75	0.84	0.85
Adjusted R^2	0.76	0.77	0.69	0.78	0.80
Tests for autocorrelation					
LM-test 1st order (χ^2 - distributed)	0.49 (0.48)	0.91 (0.34)	2.03 (0.15)	0.90 (0.34)	1.33 (0.25)
LM-test 4th order (χ^2 - distributed)	9.47 (0.06)	2.37 (0.67)	1.84 (0.76)	7.03 (0.13)	8.11 (0.09)
Tests for heteroskedasticity					
ARCH-test (χ^2 - distributed)	0.02 (0.90)	0.36 (0.55)	0.26 (0.61)	3.45 (0.06)	0.08 (0.78)
LR-test (χ^2 - distributed)	−13.92 (1.00)	−2.73 (1.00)	3.07 (0.08)	−2.40 (1.00)	−5.84 (1.00)
Test for structural breaks					
Chow-test (mid-of-sample, F-distributed)	0.45 (0.94)	0.86 (0.61)	0.99 (0.49)	0.90 (0.58)	0.74 (0.74)
Test for the normality of residuals					
Jarque-Bera-test (χ^2 - distributed)	0.16 (0.92)	0.57 (0.75)	0.01 (0.99)	2.00 (0.37)	1.77 (0.41)
FPE ($x10^{-3}$)	1.71	2.01	2.67	5.43	1.85

[a]Significance levels in brackets.

Table 4 — Estimated Coefficients of the Export Functions[a]

	France	Germany	Italy	Spain	United Kingdom
Period	1984:1– 1996:4	1980:1– 1996:4	1980:1– 1996:4	1980:1– 1996:4	1980:1– 1996:4
constant	0.10	–1.97	–0.01	–3.30	–0.89
	(0.28)	(–4.14)	(–1.27)	(–3.17)	(–2.43)
x_{t-1} [b]	–0.25	–0.34	—	–0.32	–0.38
	(–3,05*)	(–5.07***)		(–3.55*)	(–4.58***)
e_{t-1}	—	–0.42	—	–0.35	–0.25
		(–5.41)		(–3.51)	(–3.08)
y_{t-1}	0.15	0.66	—	0.80	0.49
	(1.34)	(4.63)		(3.47)	(3.51)
σ_{t-1}	—	0.02	—	–0.02	0.01
		(1.56)		(–0.64)	(1.52)
Δx_{t-1}	–0.38	–0.20	–0.23	–0.33	–0.19
	(–3.87)	(–2.98)	(–2.53)	(–4.34)	(–2.61)
Δx_{t-2}	0.23	—	—	—	–0.10
	(2.51)				(–1.55)
Δx_{t-3}	0.24	–0.16	—	—	—
	(2.73)	(–2.55)			
Δx_{t-4}	—	—	—	—	–0.27
					(–4.28)
Δe_t	–0.49	–0.45	–0.18	–0.43	–0.49
	(–3.85)	(–4.02)	(–1.57)	(–2.13)	(–4.65)
Δe_{t-1}	–0.46	—	–0.21	0.67	—
	(–3.13)		(–1.67)	(3.21)	
Δe_{t-2}	—	0.20	–0.63	–0.39	—
		(1.64)	(–4.81)	(–1.86)	
Δe_{t-3}	–0.32	—	—	—	—
	(–2.36)				
Δe_{t-4}	0.39	0.25	—	—	–0.14
	(3.00)	(2.07)			(–1.59)
Δy_t	—	1.43	2.65	—	—
		(3.30)	(4.80)		
Δy_{t-1}	—	—	—	5.56	0.95
				(6.72)	(2.37)

Table 4 — continued

	France	Germany	Italy	Spain	United Kingdom
Δy_{t-2}	—	1.05 (2.50)	2.83 (5.55)	−3.12 (−3.03)	—
Δy_{t-3}	−1.29 (−2.02)	—	—	2.75 (3.22)	−0.87 (−1.89)
Δy_{t-4}	—	0.98 (2.24)	0.73 (−1.45)	−3.18 (−3.98)	0.78 (1.56)
cu_t	—	—	−1.17 (−3.28)	—	—
cu_{t-1}	—	—	0.87 (2.28)	—	—
cu_{t-2}	−0.67 (−2.00)	—	—	−1.57 (−3.06)	−0.41 (−1.69)
cu_{t-3}	—	—	—	—	—
cu_{t-4}	—	—	0.58 (2.09)	1.39 (2.74)	—
$\Delta\sigma_t$	—	0.02 (1.53)	—	—	—
$\Delta\sigma_{t-1}$	−0.03 (−1.94)	—	−0.06 (−3.01)	—	—
$\Delta\sigma_{t-2}$	0.04 (3.00)	—	0.07 (4.10)	—	—
$\Delta\sigma_{t-3}$	−0.02 (−1.33)	—	—	—	—
$\Delta\sigma_{t-4}$	—	—	—	—	—
# dummies	1	1	2	3	4

[a]t-statistics in brackets. — [b]The t-value for this coefficient is the basis for the test of cointegration. The null-hypothesis of no cointegration is rejected at the 1 %, 5 % and 10 % level (***, ** and *), respectively. For the critical values, cf. Banerjee et al. (1992).

Only for Italy, the hypothesis of no cointegration cannot be rejected. For France, there seems to be a long-run relationship only between real exports and US industrial production. This means that in the long run the real exchange rate and the exchange rate volatility do not matter for the level of real exports. Figure 5 shows the results of the dynamic simulation of exports using the estimated models.

In general, the coefficients have the expected sign. With respect to exchange rate volatility, the results are mixed. For three countries, this series is included in the long-run relationship. For Spain, the coefficient has a negative sign, whereas the effect is positive for Germany and for the United Kingdom. But the values of the coefficients are rather small: An increase in the volatility by 10 percentage points changes the volume of exports by at most 0.6 percent. In order to demonstrate the short-run dynamics, we run shock simulations in which the volatility of exchange rates is increased permanently by one percentage point. Figure 6 shows that there is a small impact of the volatility on exports in France and in Italy which lasts only about one year. For the other three countries, the changes in exports have roughly the same magnitude but, as mentioned before, the effect works in different directions.

These results are in line with other findings which show no clear-cut evidence concerning the direction of the influence of exchange rate volatility on the volume of exports. Furthermore, the coefficients in the long-run relationship are rather small. Consequently, it seems very questionable whether monetary policy should try to smooth movements of the dollar exchange rate.

V. Policy Conclusions

The question whether the European Central Bank should react to exchange rate movements is twofold: Is it desirable and is it feasible? If exchange rate changes are drastic and if they lead to substantial fluctuations of import prices, the target for the inflation rate may not be achieved in the short run. However, empirical estimates such as presented in this paper show that these effects are not large. The issue of exchange rate volatility has been discussed in the literature for a long time. The results presented in Section IV are another example of the ambiguity with

Figure 5: Dynamic Simulation of the Exports to the United States on the Basis of the Estimated Models

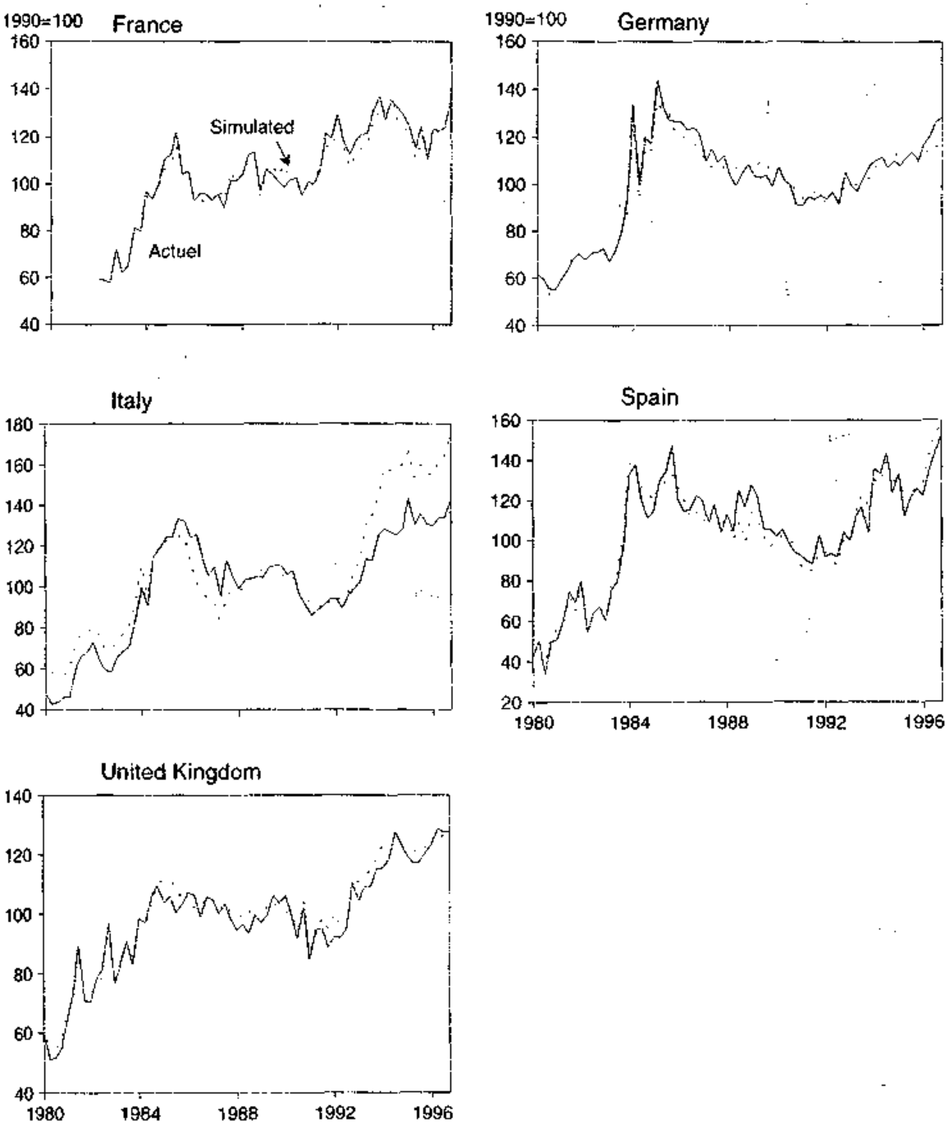
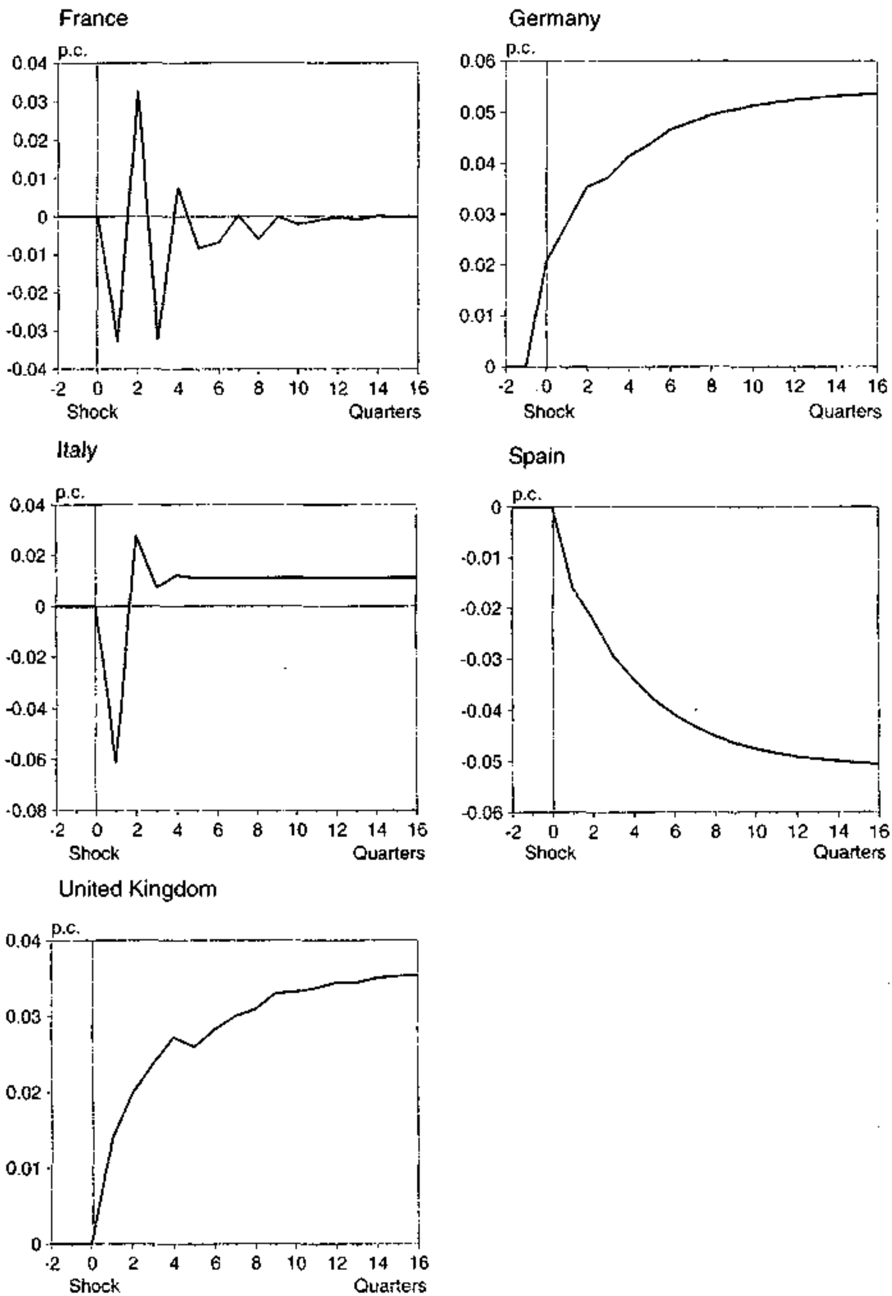


Figure 6: Response of the Exports to the United States to a One Percent Rise in Exchange Rate Variability



respect to the hypothesis of a negative impact on international trade. In general, they do not lend support to a policy of exchange rate orientation.

Even if exchange rate movements raise uncertainty for exporters and investors, it must still be asked whether the reaction of central banks would reduce it. The causes of exchange rate fluctuations are often just not known, so a change in the domestic interest rate may not have the desired effect. There are numerous examples when interest rate changes did not have the predicted effect on the exchange rate in the past. If the trend of the real exchange rate turns into another direction because of real changes in the respective economies at work, can the central bank really know how to prevent this? As an example: At which level of the short-term interest rate in Germany would the appreciation of the US dollar in the early 1980s have stopped at a rate of DM 2.00 instead of going up to DM 3.40?

If the aim of the central bank is to smooth the movement of the exchange rate, there is the additional problem of time lags between the observation and the policy action ("recognition lag") and between the policy action and the response of the exchange rate ("transition lag"). These lags are certainly much shorter than, for example, those of the effect of monetary policy on the inflation rate; but if exchange rate volatility is to be reduced, they would have to disappear completely. Otherwise, the policy actions may raise volatility. Furthermore, even if such a policy is successful, it has to be taken into account that the consequence must be a greater volatility in interest rates. This would have a negative impact on investment which may be larger than the total effect of exchange rate volatility on exports and on investment.[22]

Another — and perhaps a more important — problem in this context is, how the central bank can discriminate between a movement of the exchange rate around a known trend and the beginning of a new trend. Only in the first case monetary policy might try to do something to react to reduce the volatility; but it can still be asked why a reaction is necessary at all if the trend is known. In the second case, however, there is no reason for monetary policy to react because the change is caused by a shift in the fundamentals.

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22 For an analysis of the effects of uncertainty on investment cf. Seppelfricke (1996).

These arguments are not new in the discussion on exchange rate regimes. Maybe the European Central Bank fares better in its policy if influential people get rid of the illusion that a weak currency creates jobs whereas a strong currency is bad for the economy. The present discussion on EMU shows that this philosophy is still alive.

Appendix A:

Table A1 — Estimates of Reaction Function [1][a]

	United States	Japan	Canada	Germany	France	United Kingdom	Italy
Period	1983–95	1980–95	1982–95	1980–95	1980–95	1980–95	1980–95
constant	–0.01 (–0.24)	–3.63 (–2.82)	1.27 (2.57)	1.06 (4.91)	25.83 (5.32)	2.58 (4.94)	28.61 (4.52)
r_{t-1} [b]	—	–0.32 (–5.32***)	–0.32 (–5.02***)	–0.22 (–5.89***)	–0.24 (–6.20***)	–0.42 (–6.18***)	–0.30 (–5.12***)
π_{t-1}	—	0.10 (1.52)	0.35 (4.52)	0.09 (1.91)	0.12 (3.84)	0.23 (3.42)	0.39 (8.91)
cu_{t-1}	—	0.10 (2.80)	0.21 (5.41)	0.17 (5.94)	0.12 (3.52)	0.37 (6.65)	0.38 (5.88)
e_{t-1}	—	0.01 (3.43)	0.02 (1.33)	0.01 (1.30)	–0.05 (–5.01)	—	–0.06 (–4.07)
Δr_{t-1}	0.48 (5.20)	0.34 (5.15)	0.28 (4.21)	0.13 (1.57)	—	0.12 (1.54)	–0.11 (–1.35)
Δr_{t-2}	—	—	0.07 (1.42)	0.17 (2.24)	—	–0.13 (–1.84)	–0.27 (–3.51)
Δr_{t-3}	—	—	—	—	—	—	—
Δr_{t-4}	0.10 (1.59)	0.12 (1.78)	0.20 (3.88)	—	0.20 (3.67)	—	—
$\Delta\pi_t$	0.39 (3.88)	0.13 (1.52)	—	0.17 (1.98)	0.51 (4.74)	–0.32 (–1.62)	0.56 (3.62)
$\Delta\pi_{t-1}$	–0.16 (–1.41)	—	—	—	—	–0.26 (–1.98)	–0.41 (–2.71)
$\Delta\pi_{t-2}$	—	—	–0.30 (–2.49)	—	—	—	—
$\Delta\pi_{t-3}$	—	—	—	–0.26 (–3.12)	—	0.19 (1.62)	–0.55 (–3.97)

Table A1 — continued

	United States	Japan	Canada	Germany	France	United Kingdom	Italy
$\Delta\pi_{t-4}$	—	–0.22	—	—	—	–0.34	—
		(–2.47)				(–2.25)	
Δcu_t	0.16	0.31	0.30	0.10	—	0.26	0.46
	(2.04)	(4.32)	(2.66)	(2.70)		(1.26)	(3.51)
Δcu_{t-1}	0.43	—	0.52	—	—	–0.83	—
	(4.68)		(4.69)			(3.25)	
Δcu_{t-2}	–0.19	0.18	–0.60	—	—	—	—
	(–1.96)	(2.47)	(–4.87)				
Δcu_{t-3}	—	0.13	0.28	—	—	—	—
		(1.71)	(2.43)				
Δcu_{t-4}	0.10	–0.10	—	—	—	—	—
	(1.38)	(–1.37)					
Δe_t	—	—	0.35	0.03	—	–0.10	–0.07
			(7.24)	(3.64)		(–3.21)	(–1.97)
Δe_{t-1}	—	0.02	—	—	—	–0.05	—
		(2.13)				(–1.30)	
Δe_{t-2}	—	—	—	—	—	—	0.09
							(2.26)
Δe_{t-3}	—	0.01	—	–0.02	–0.06	—	—
		(1.24)		(–1.87)	(–1.59)		
Δe_{t-4}	—	0.01	–0.20	0.03	—	–0.06	0.07
		(1.51)	(3.70)	(3.55)		(–2.00)	(1.94)
# dummies	1	3	7	3	5	5	4

[a]t-statistics in brackets. — [b]The t-value for this coefficient is the basis for the test of cointegration. The null-hypothesis of no cointegration is rejected at the 1 %, 5 % and 10 % level (***, ** and *), respectively. For the critical values, cf. Banerjee et al. (1992).

Table A2 — Unit Root Tests[a] for the Time Series Used in the P-Star Models

Variable[b]	DF	ADF1	ADF2	ADF3	ADF4	Result
			United States			
p	–0.08	–1.54	–1.04	–0.96	–0.68	
$\pi = \Delta p$	–1.99	–2.47	–2.49	–2.95**	–2.06	I(1)
ip	–0.04	–0.68	–1.20	–1.25	–1.29	
Δip	–4.60***	–5.42***	–5.14***	–4.87***	–3.53***	I(1)
ulc	0.09	0.91	–0.80	–0.71	–0.64	
Δulc	–2.51	–2.84*	–3.13**	–3.13**	–2.16	I(1)
$pgap$[c]	–0.84	–4.30***	–3.00***	–2.94***	–2.73***	I(0)
			Germany			
p	–0.32	–2.12	–1.67	–1.55	–1.45	
$\pi = \Delta p$	–2.13	–2.44	–2.57*	–2.68*	–2.41	I(1)
ip	0.94	–0.79	–0.60	–0.56	–0.55	
Δip	–3.80***	–4.65***	–4.84***	–4.47***	–3.12**	I(1)
ulc	0.91	–1.74	–1.92	–2.00	–1.52	
Δulc	–2.93**	–4.09***	–3.42**	–3.85***	–3.47**	I(1)
$pgap$[c]	–1.79	–4.67***	–3.02***	–2.55**	–2.14**	I(0)

[a]Dickey-Fuller test and augmented Dickey-Fuller t-test. Regressions include a constant and for levels a linear time trend. ***, ** and * indicate rejection of the unit root hypothesis at the 1 %, 5 % and 10 % significance level, respectively, based on the critical values of McKinnon (1990). — [b]Logs of the respective variables: Δ = first difference. — [c]In the test specifications for *pgap* neither a constant nor a time trend is included.

Table A3 — Unit Root Tests[a] for the Time Series Used in the Export Models

Variable[b]	DF	ADF1	ADF2	ADF3	ADF4	Result
			France			
e	–1.49	–2.16	–2.13	–2.52	–2.38	
Δ*e*	–5.22***	–4.41**	–3.45**	–3.35**	–3.53**	I(1)
x	–3.85**	–3.02	–3.51**	–4.11**	–3.59**	I(0)
cu	–2.19	–2.01	–2.62*	–2.79*	–2.65*	I(0)
σ	–2.76*	–3.58***	–2.48	–2.50	–2.35	
Δσ	–5.84***	–6.95***	–4.99***	–4.41***	–4.66***	I(1)
			Germany			
e	–1.31	–1.78	–1.76	–2.13	–2.24	
Δ*e*	–6.56***	–5.34***	–3.81***	–3.37**	–3.46**	I(1)
x	–2.20	–1.75	–1.89	–1.85	–1.79	
Δ*x*	–12.57***	–6.28***	–5.18***	–4.56***	–3.13**	I(1)
cu	–2.70*	–2.95**	–3.09**	–3.66***	–3.49**	I(0)
σ	–3.73***	–5.91***	–3.71***	–3.20**	–3.39**	I(0)
			Italy			
e	–1.50	–2.11	–1.93	–2.38	–2.48	
Δ*e*	–6.44***	–5.75***	–4.00***	–3.61***	–3.65***	I(1)
x	–1.92	–1.95	–2.36	–2.79	–2.60	
Δ*x*	–8.84***	–5.22***	–3.91***	–3.95***	–4.51***	I(1)
cu	–3.31**	–3.74***	–3.38**	–3.12**	–3.59***	I(0)
σ	–2.33	–3.21**	–2.48	–3.48**	–4.00***	I(0)

Table A3 — continued

Variable[b]	DF	ADF1	ADF2	ADF3	ADF4	Result
			Spain			
e	–1.22	–1.73	–1.94	–2.17	–2.02	
Δe	–6.31***	–4.65***	–3.72***	–3.73***	–3.26**	I(1)
x	–2.73	–1.89	–2.38	–2.45	–2.01	
Δx	–13.00***	–5.91***	–4.87***	–5.25***	–4.29***	I(1)
cu	–3.63***	–2.68*	–3.26**	–4.31***	–3.86***	I(0)
σ	–2.77*	–3.42**	–2.10	–2.30	–2.36	
$\Delta\sigma$	–7.59***	–9.20***	–6.30***	–5.49***	–4.87***	I(1)
			United Kingdom			
e	–2.00	–2.36	–2.30	–2.36	–2.46	
Δe	–7.36***	–5.90***	–4.90***	–4.22***	–4.55***	I(1)
x	–2.82	–2.11	–1.80	–1.80	–1.36	
Δx	–12.14***	–8.48***	–6.14***	–6.97***	–4.79***	I(1)
cu	–2.47	–3.38**	–3.24**	–3.20**	–3.02**	I(0)
σ	–2.84*	–4.42***	–2.50	–2.71*	–2.95**	I(0)
			Industrial Production in the United States			
y	–1.72	–2.91	–2.83	–3.37*	–2.96	
Δy	–5.43***	–4.96***	–3.84***	–4.22***	–4.06***	I(1)

[a]Dickey-Fuller test and augmented Dickey-Fuller t-test. Regressions include a constant and (for levels of e, x and y) a linear time trend. ***, ** and * indicate rejection of the unit root hypothesis at the 1 %, 5 % and 10 % significance level, respectively, based on the critical values of McKinnon (1990). — [b]Logs of the respective variables: Δ = first difference.

Appendix B:

Data Sources and Methods of Calculation

1. Time Series for the P-Star-Models

Prices (p):	Germany: Deflator of private consumption (Statistisches Bundesamt). United States: CPI (OECD).
Real monetary aggregates (m):	Germany: M3. Deutsche Bundesbank. United States: M2 (OECD). Deflated by the deflator of private consumption (Germany) and the CPI (United States), respectively.
Import prices (ip):	Germany: Deflator of imports (Statistisches Bundesamt). United States: Import prices (Department of Commerce).
Unit labor costs (ulc):	Germany: Total economy (Statistisches Bundesamt). United States: Business sector (Department of Labor).

2. Time Series for the Export Models

Real exports (x):	Nominal exports to the United States. France (INSEE), Germany (Deutsche Bundesbank), Italy (Istituto Nazionale di Statistica), Spain (OECD) and United Kingdom (Office of National Statistics). Deflated by export prices (same sources).
US industrial production (y):	OECD.

Real exchange rate (e): Nominal exchange rates vis-à-vis the US-dollar (IMF). Real exchange rates calculated by using the consumer price index in the United States and in the respective country:

$$e\left[\frac{nat.\ curr.}{\$}\right]=ne\left[\frac{nat.\ curr.}{\$}\right]\cdot\frac{CPI\ US}{CPI\ European\ Country}$$

with ne = nominal exchange rate.

Domestic capacity utilization (cu): Normal capacity utilization in manufacturing is calculated by using a Hodrick-Prescott filter $(\lambda = 1600)$. Industrial production (OECD).

Exchange rate volatility (σ): Standard deviation of monthly changes in the nominal exchange rate vis-à-vis the US dollar over the past twelve months. Nominal exchange rates (IMF).

Bibliography

Arize, A.C. (1995). Trade Flows and Real Exchange-Rate Volatility: An Application of Cointegration and Error-Correction Modeling. *The North American Journal of Economics and Finance*, 6 (1): 37–51.

Banerjee, A., J.J. Dolado and R. Mestre (1992). On Some Simple Tests for Cointegration: The Cost of Simplicity. *Discussion Paper of the Institute of Economics at Aarhus University*.

Barro, R.J., and D.B. Gordon (1983). Rules, Discretion and Reputation in a Model of Monetary Policy. *Journal of Monetary Economics* 12: 101–121.

Côté, A. (1994). *Exchange Rate Volatility and Trade — A Survey*. Working Paper 94-5. Bank of Canada. Ottawa.

Döpke, J., and M. Fischer (1994). Was bestimmt die westdeutschen Exporte? *Die Weltwirtschaft*: 54–66.

Deutsche Bundesbank (1995). *Die Geldpolitik der Bundesbank*. Frankfurt am Main.

Gilbert, C.L. (1986). Professor Hendry's Econometric Methodology. *Oxford Bulletin of Economics and Statistics*, 48: 283– 307.

Hallman, J.J., R.D. Porter and D.H. Small (1991). Is the Price Level Tied to the M2 Monetary Aggregate in the Long Run? *The American Economic Review*, 81: 841– 858.

Holly, S. (1995). Exchange Rate Uncertainty and Export Performance: Supply and Demand Effects. *Scottish Journal of Political Economy* 24: 381–391.

Hooper, P., and S.W. Kohlhagen (1978). The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade. *Journal of International Economics*, 8: 483–511.

IMF (1997). *International Financial Statistics*. Washington, D.C.

Krämer, J., and J. Scheide (1994). Geldpolitik: Zurück zur Potentialorientierung. Kiel Discussion Papers 235. Institut für Weltwirtschaft, Kiel.

Kremers, J.J.M., N.R. Ericsson and J.J. Dolado (1992). The Power of Cointegration Tests. *Oxford Bulletin of Economics and Statistics*, 54: 325–348.

Lapp, S., J. Scheide and R. Solveen (1995). Determinants of Exports in the G7-Countries. Kieler Working Papers 707. Institut für Weltwirtschaft, Kiel.

McKinnon, J.G. (1990). Critical Values for Cointegration Tests. *UCSD Economics Discussion Paper*: 90–94.

OECD (1997a). *Foreign Trade Statistics*. Paris.

— (1997b). *Main Economic Indicators*. Paris.

Seppelfricke, P. (1996). *Investitionen unter Unsicherheit*. Schriften zur angewandten Ökonometrie 31. Frankfurt am Main.

Solveen, R. (1996). Verhindert die Unabhängigkeit der Zentralbank politische Konjunkturzyklen? Kiel Working Papers 747. Institut für Weltwirtschaft, Kiel.

Tödter, K.-H., and H.-E. Reimers (1994). P-Star as a Link Between Money and Prices in Germany. *Weltwirtschaftliches Archiv*, 130: 273–289.