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## Euroland's trade with the rest of the world: An SNA-based estimation

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# Kiel Working Papers

Kiel Working Paper No. 888

**Euroland's Trade with the Rest of the World:  
An SNA-based Estimation**

by  
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## Contents

<b>I. Introduction .....</b>	<b>1</b>
<b>II. The Share of Intra-Euroland Trade for the EMU and its Members .....</b>	<b>3</b>
<b>III. Euroland's Exports, Imports and Degree of Openness .....</b>	<b>10</b>
<b>IV. The Determinants of Euroland's Exports.....</b>	<b>13</b>
<b>V. Estimation Results and Export Forecast for 1998 and 1999 .....</b>	<b>15</b>
<b>VI. Conclusions .....</b>	<b>20</b>
<b>Appendix I: Data Sources and Methods of Calculation.....</b>	<b>20</b>
<b>Appendix II: Testing for the Order of Integration.....</b>	<b>23</b>
<b>References .....</b>	<b>25</b>

## **Abstract**

The paper presents an estimation of Euroland's foreign trade with the rest of the world based on the exports and imports of the eleven member states of the European Monetary Union according to their Systems of National Accounts (SNA). In order to isolate the trade with the rest of the world from intra-European trade flows, the share of intra-trade is derived from customs statistics. Once the time series are constructed, real exports are regressed on indexes of industrial production abroad and the real external value of the ecu — both calculated with respect to the 20 most important trading partners — using an error correction model. The estimation results are used to forecast Euroland's exports in 1998 and 1999.

JEL Classification: E32; F41.

Keywords: Ecu; Euro; error correction model; export forecast; intra-European trade; real external value.

## I. Introduction

With the beginning of the European Monetary Union on January 1st 1999, the European Central Bank (ECB) takes over the responsibility for monetary policy from the eleven member countries. This creates the need for business cycle reports and forecasts for Euroland as a whole, which requires the solution to some serious data aggregation problems. Especially for the analysis of foreign trade, the creation of a new supra-national economic entity implies that one has to focus on trade with non-EMU-member countries, international trade flows within Euroland becoming internal transactions. So far, the necessary distinction between intra- and extra-trade exists only for goods (system of special trade) but not for services which amount to about one fifth of external trade. The official System of National Account (SNA) data provided by Eurostat for Euroland are simply the sum of exports ( $X_i$ ) and imports ( $M_i$ ) of the respective individual countries (Eurostat 1998a: 63). As opposed to the SNA data published by Eurostat, "exports" and "imports" in this paper refer to trade between Euroland as a whole and the rest of the world; consequently, the trade among EMU-countries is defined as intra-trade.

In order to determine the level of Euroland's SNA-exports and imports one would have to deduct the intra-trade figures from the official trade data included in the SNA.<sup>1</sup> However, this is not possible because of the lacking differentiation between intra- and extra-Euroland trade in Euroland's SNA. Therefore, the share of intra-trade in exports and imports of Euroland is approximated by the national intra-trade shares until 1994, weighted by the size of the respective

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<sup>1</sup> One could renounce to that by restraining the analysis to *net* exports as it is done in Döpke et al. (1998a: 17). Assuming that member  $i$ 's reported exports to member  $j$  just equal  $j$ 's reported imports from country  $i$ , Euroland's intra exports just equal its intra imports, so net intra-exports are zero; then one can see that :

$$(X-M)_{EMU,extra} = \sum X_{i,extra} - \sum M_{i,extra} = \sum (X_{i,extra} + X_{i,intra}) - \sum (M_{i,extra} + M_{i,intra}) = \sum (X_{i,total} - M_{i,total}).$$

However, in practice there are considerable differences between exports and imports because they are reported by different persons. The difference amounted to 60 bn ecu in 1997 (5.5 percent of intra-trade). Although imports are cif and exports fob, reported intra-imports regularly are lower than reported intra-exports (Eurostat 1998b). Furthermore, it is of economic interest to analyze exports and imports separately.

country. From 1995 on, special trade figures for Euroland distinguishing external trade from intra-trade are available, so the need for aggregation of national data does not exist any more. Yet both techniques have to be used in order to construct a long time series of intra-trade shares. The common strategy of determining Euroland's exports ( $X$ ) and imports ( $M$ ) is summarized by equations [1a] and [1b].

$$[1a] \quad X = (1 - w) \sum_{i=1}^{11} X_i, \quad [1b] \quad M = (1 - m) \sum_{i=1}^{11} M_i .$$

where  $X_i$  and  $M_i$  are the seasonally adjusted export and import levels in ecu (prices of 1990) of country  $i$  according to its SNA,  $w$  represents the share of exports to Euroland in the sum of the eleven member states' total goods exports and  $m$  the corresponding share of intra-imports.<sup>2</sup>

Once exports of Euroland have been determined, they are regressed on their determinants within an error correction model. Finally, the econometric results are used to forecast Euroland's exports in 1998 and 1999. Along this line of objectives, the paper is organized as follows: in chapter two, the shares of intra-Euroland exports and imports are calculated and its insights for the understanding of regional trade patterns are briefly discussed. Chapter three presents the time series of Euroland's exports, imports and its degree of openness. Chapter four lays down the model to explain Euroland's exports and the construction of regressors. Chapter five presents and discusses the estimation and forecasting results using an error-correction framework. The appendices explain the data sources as well as the methods of calculation and show the results of the augmented Dickey-Fuller tests referred to in chapter four.

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<sup>2</sup> For the remainder of the paper,  $X$  and  $M$  are reserved for SNA figures whereas goods exports and imports (e.g. according to special trade) are symbolized by  $X_S$  and  $M_S$  respectively. For simplicity the time index  $t$  is introduced in equation [6] only. The formulae from equation [1a] through [5] hold in each period of time.

## **II. The Share of Intra-Euroland Trade for the EMU and its Members**

The use of SNA data rather than customs' statistics makes sense for business cycle purposes because the SNA trade balance (exports less imports) is one of the expenditure elements that together sum up to GDP. Moreover, despite their growing importance volumes of trade in services are only available within the SNA, balance-of-payments statistics showing only series in current prices. As one must take invisible trade into account in order to give a correct idea of the total trade volume, I choose exports and imports based on the SNA as the series to be constructed and explained. About 20 percent of Euroland's total exports were services in 1995, ranging from 10.1 (Ireland) to 36.7 percent (Austria). The contribution of invisible trade to overall imports of the eleven EMU members was 21 percent, ranging from 14.3 (Portugal) to 26.8 percent (Ireland). For Germany, these shares amounted to 13.5 and 21.7 percent respectively (cf. IMF 1998).

When separating Euroland's intra-trade from trade with the rest of the world, I offer a computation of Euroland's share in each country's exports and imports for the time before 1994. The shares are extracted from the annual figures of the OECD International Trade by Commodities Statistics (ITCS) database (figures are values in current US dollars). It is assumed that Euroland's geographic pattern of trade in services corresponds to the one of trade in goods. Such an assumption is necessary because SNA exports comprise services whereas the ITCS does not. The assumption is not fulfilled exactly in practice. Germany, for example, sent 43.5 percent of its total goods exports to Euroland in 1995, but only 38.0 percent of its services exports (cf. Deutsche Bundesbank 1998: 42–45). This incorrectness in the German case leads to an underestimation of 3 bn ecu in Euroland's real exports (0.6 percent) and to a corresponding overestimation of the intra-trade volume in 1995. There is some hope for this mistake to cancel out with an underestimation of the huge intra-European services exports by France, Italy, Spain, Portugal and Austria which are favorite



destinations for holiday trips.<sup>3</sup> German imports from outside Euroland are underestimated by 1.6 bn ecu (0.3 percent) in 1995.

Formally, for each country ( $i$ ) in Euroland, the weight of intra exports,  $w_i$ , is given by:

$$[2] \quad w_i = XS_i^{EMU} / XS_i,$$

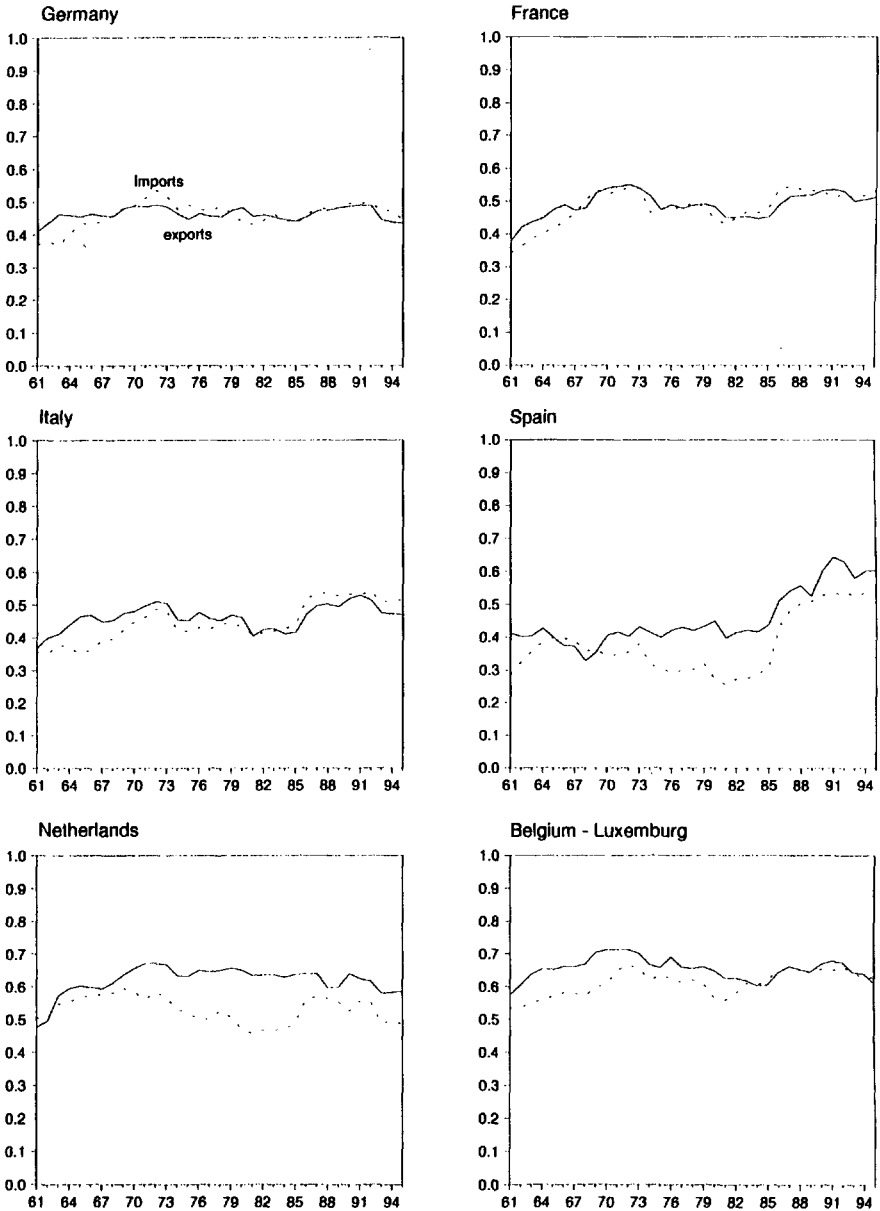
with  $X S_i^{EMU}$  being  $i$ 's merchandise exports to Euroland and  $X S_i$  being its overall merchandise exports. An analogous calculus is carried out for imports to determine  $m_i$ . Figure 1 shows the results of these calculations for each EMU member country. Being available, the data has been extracted beginning in 1961 in order to draw some interesting insights for the history of European integration.

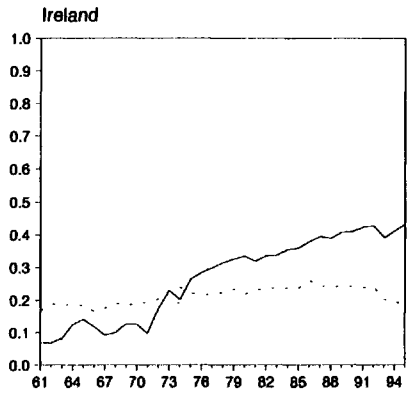
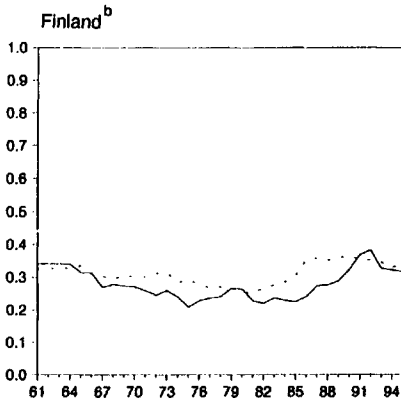
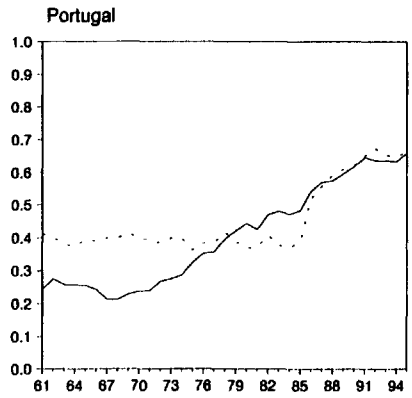
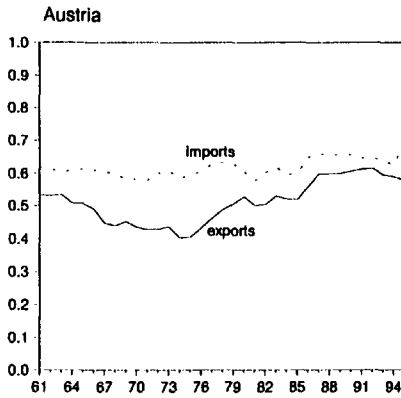
The share of intra-trade in the exports and imports of EMU member states as it is calculated in equation (3) below, dissimulates very heterogenous national developments one can observe in Figure 1. Differences can be found with respect to the level of the intra-trade share and to its change over time. As to the latter, one may distinguish between the group of the founders of the European Community („core Europe“) and later entrants geographically situated in the periphery of Euroland. The share of intra-trade of the former rose during the period of regional trade integration in the sixties but has been fluctuating since then without any new upward trend, whereas the peripheral countries have in common a substantial increase of the intra-trade share until the early nineties. In these countries, the increasing trend of the share dominates the ups and downs due to international business cycle asynchronities. However, it is within this periphery that the share shows the strongest cross-section variance: whereas Portugal completes about two thirds of its foreign transactions with Euroland, it is only one third for Finland and Ireland. The reason is the proximity of important trading partners such as the United Kingdom (for Ireland), Sweden,

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<sup>3</sup> For the other 10 EMU members, geographically disaggregated services export data were not available as a long time series.

Figure 1  
 Share of Euroland in EMU Members' Trade in Goods  
 Share of exports (imports) destined to (coming from) other EMU  
 member countries<sup>a</sup>





<sup>a</sup> All figures are values in current US dollars. - <sup>b</sup> No data available from 1961 to 1963.  
Source: OECD ITCS database, own calculations.

Denmark and Norway (for Finland) which are not members of the EMU. As opposed to them, Spain and Portugal are not surrounded by a powerful purchaser or seller other than Euroland. For the countries in the geographic center of Euroland, country size matters most for the explanation of the intra-trade share: smaller countries such as the Netherlands, Belgium-Luxembourg and Austria have their share closer to 0.6 whereas for big ones (Germany, France and Italy) it falls slightly short of 0.5.

The overall share of intra-trade in exports,  $w$ , can be obtained by weighing the national intra shares from [2] together. Thereby  $\theta_i$ , the size of the country in terms of exports, serves as a weight.

$$[3] \quad w = \frac{\sum_{i=1}^{11} X_i^{EMU}}{\sum_{i=1}^{11} X_i} = \frac{\sum_{i=1}^{11} w_i X_i}{\sum_{i=1}^{11} X_i} = w_1 \theta_1 + w_2 \theta_2 + \dots + w_{11} \theta_{11} = \sum_{i=1}^{11} w_i \theta_i .$$

$$\text{where } \theta_i = \frac{X_i}{\sum_{i=1}^{11} X_i} .$$

An analogous computation is done for imports. Using weights like  $\theta$  rather than absolute export levels by area of destination enables us to take each country's SNA exports ( $X_i$ ) which include services and thus represent a more comprehensive measure for the country size. Moreover, unlike special trade figures before 1995, export series based on SNA are available on a quarterly basis (see appendix I for source details). As noted above, the intra trade shares  $w_i$  and  $m_i$  represent annual averages.<sup>4</sup>

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<sup>4</sup> A transformation of annual figures into quarterly ones (thereby smoothing the abrupt changes in  $w$  at the beginning of each year) is possible but has not been performed here because this would unrealistically reduce the variance of Euroland's exports and imports. Using annual weights the variance is already quite small compared with the one of the sum of the members' quarterly exports. Smaller-than-realistic variances are not desirable in view of the econometric analysis that follows in section IV.

The method of calculating  $w$  changes with the beginning of 1995 because official quarterly special trade data for Euroland are available then, separated in trade with the rest of the world ( $XS$  and  $MS$  respectively) and intra-trade ( $TS$ ). Thus a country-by-country analysis is not necessary any more. As the SNA data used here are seasonally adjusted, an adjustment becomes necessary for the special trade figures as well. In order to minimize distortions due to these operations, the series  $XS$ ,  $MS$  as well as  $(XS+TS)$  and  $(MS+TS)$  rather than the intra-trade flows are adjusted. The multiplicative census-X-11 method is applied.<sup>5</sup> The share of all third countries in the sum of exports of the eleven EMU member states then is given by (analogously for imports):

$$[4] \quad 1 - w_{95} = \frac{XS_{sa}}{(XS + TS)_{sa}},$$

where “*sa*” indicates seasonally adjusted series. The final step now consists in rebasing the series  $(1-w)$  — derived from (3) — to  $(1-w_{95})$  given in (4) with the average value of  $(1-w_{95})$  in 1995 as the new basis.<sup>6</sup> Figure 2 shows the weight of the rest of the world, i.e. the factor by which Eurostat’s SNA trade figures have to be multiplied to obtain Euroland’s real exports and imports.

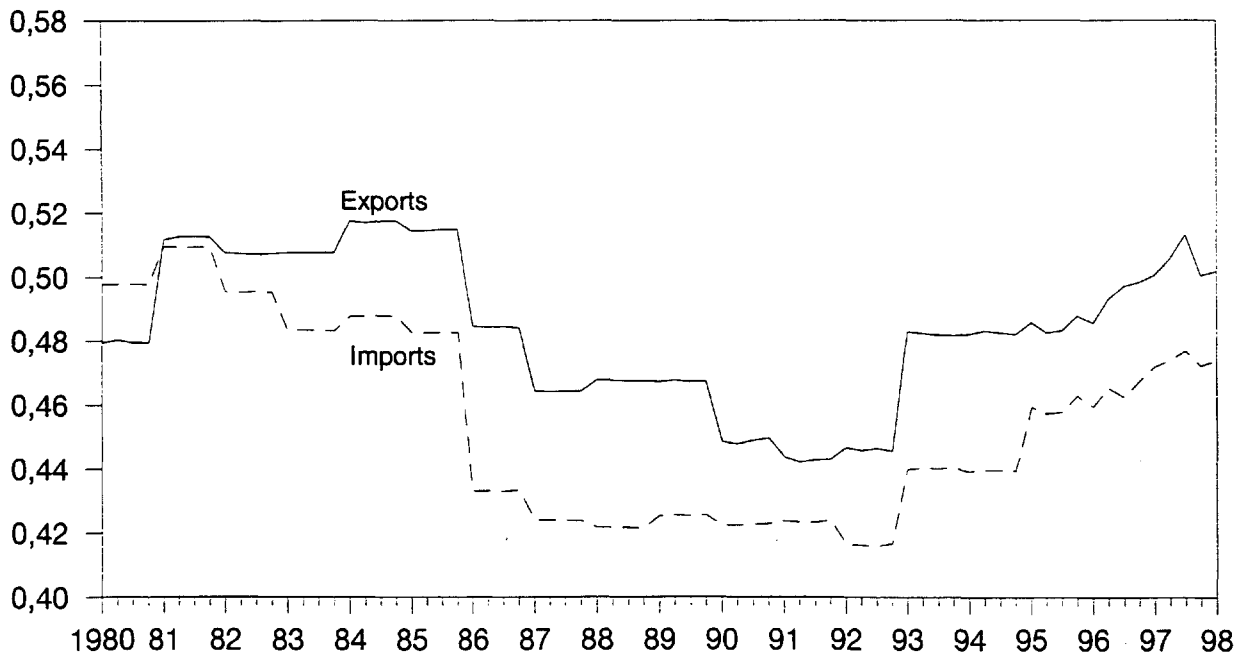
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<sup>5</sup> As this procedure requires a sample size of at least four years, we filled the missing observations (1998 II to 1998 IV) by forecast values consistent with Döpke et al. (1998b).

<sup>6</sup> The chaining factors are 0.985 for exports and 0.901 for imports. The latter clearly deviates from 1 because from 1995 on, intra-imports and intra-exports are set equal by definition, called „intra-trade“, and are derived from the *export* statistics because they are considered to be more reliable than import reports by the statistical authority (Eurostat 1998b). In practice there are considerable differences (see footnote 1). As before 1995 our calculations for the intra-import share are based on import statistics, the change of methods affects imports more heavily than exports.

Figure 2

### Share of the Rest of the World in EMU Members' Exports and Imports



### III. Euroland's Exports, Imports and Degree of Openness

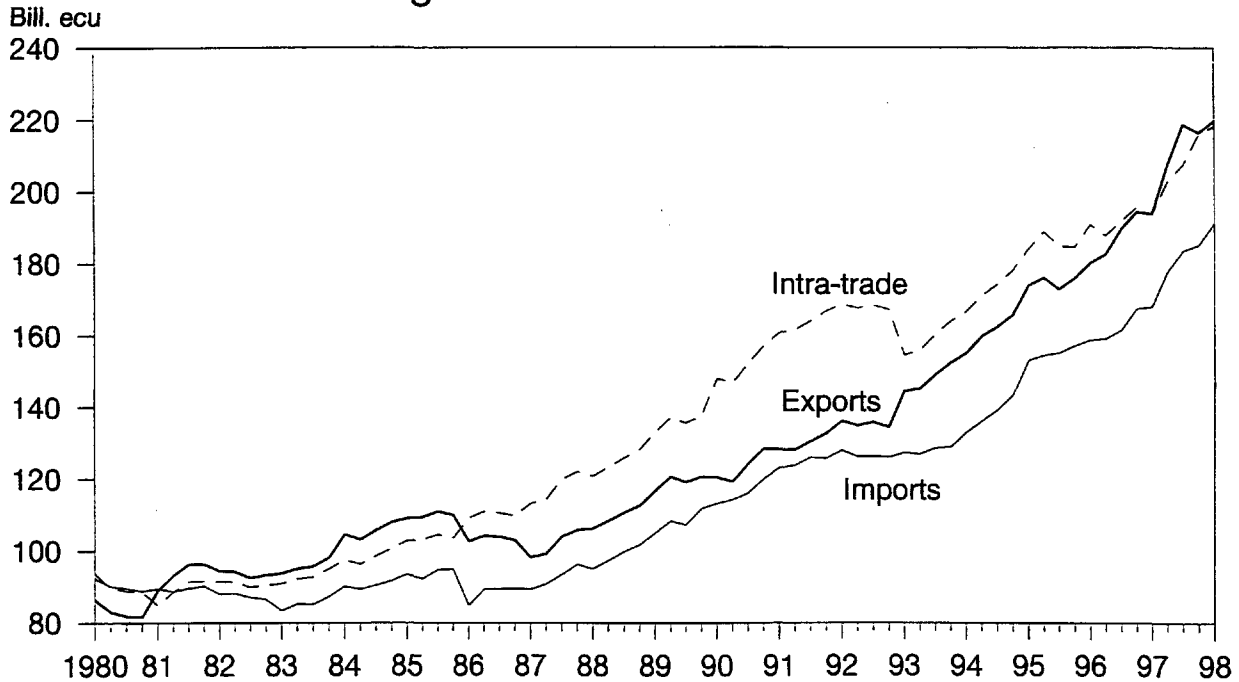
Euroland's exports and imports can easily be calculated now according to equations [1a] and [1b]. Euroland's intra-trade ( $T$ ) based on exports is derived as a residual from the total exports of the eleven states and Euroland's exports:

$$[5] \quad T = \left( \sum_{i=1}^{11} X_i \right) - X .$$

The results are illustrated in Figure 3.

Euroland's exports had long been lower and less dynamic than intra-trade that grew by an average 5.3 percent per year in the eighties and by an annual 4.5 percent from 1990 to 1997. So far in the nineties, exports rose by an average 7.9 percent per year, at twice the pace shown in the previous decade, and are as important as intra-trade again. Imports also increased faster from 1991 to 1997 than before (6.4 percent per year after 2.5) but at a more moderate pace compared to exports. Thus the trade surplus has widened. As both exports and imports have been growing faster than total production, they have become more important for the economy as the evolution of the export-(import-) to-GDP ratio underlines in Figure 4. As a consequence the degree of openness — defined as the sum of ex- and imports relative to GDP — has soared substantially. Surpassing its level of 1980 by more than 50 percent, it was at one third in 1997, compared to 28.6 percent for the United States and 25.2 percent for Japan. Growth of external trade has played a major role for economic growth in the nineties but has also made Euroland more vulnerable to external shocks. The analysis of the "cycle-making behavior" of exports confirms the finding for the degree of openness: Euroland looks more like a closed economy compared to each of its member states, e.g. Germany, but its business cycle is more affected by export variations than those of Japan and the United States (cf. Döpke et al. 1998b: 7–9).

Figure 3  
Euroland's Foreign Trade<sup>a</sup>

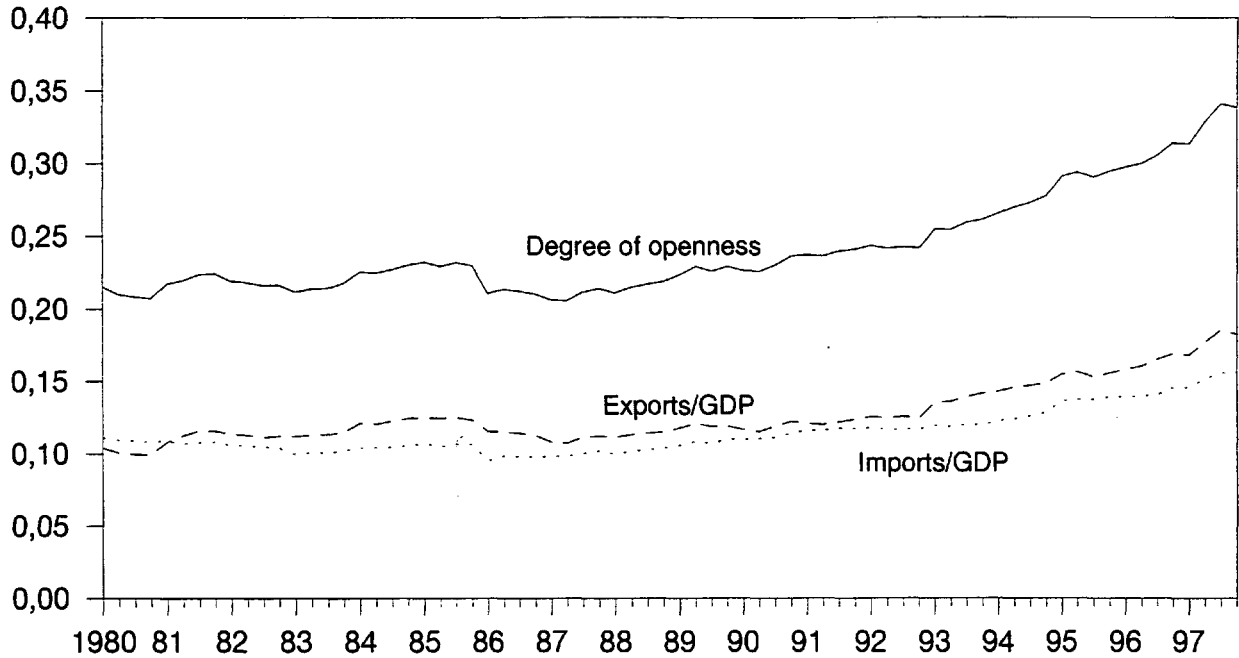


<sup>a</sup> Exports, imports and intra-trade (based on exports) at constant prices of 1990, seasonally adjusted.





Figure 4  
Euroland's Degree of Openness<sup>a</sup>



<sup>a</sup> Sum of ex- and imports relative to GDP.

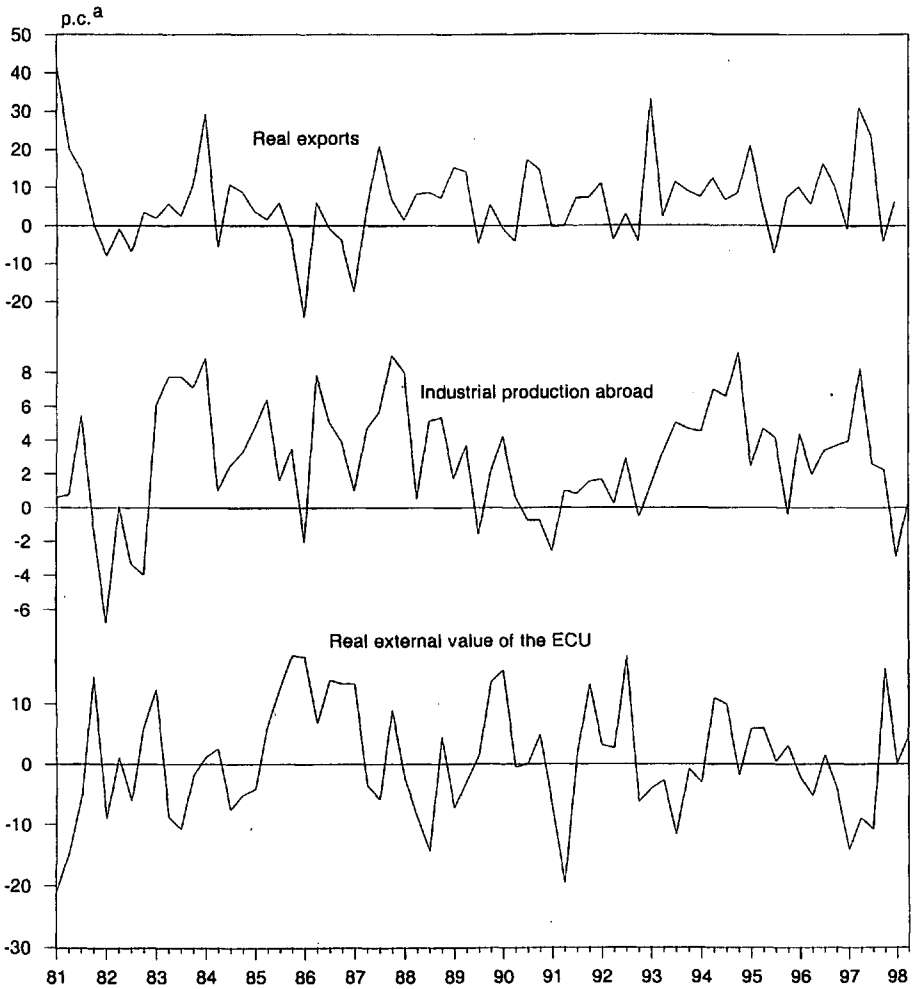


#### IV. The Determinants of Euroland's Exports

If Euroland by its increasing openness becomes more vulnerable to external shocks such as economic crises in emerging economies, one would like to know what sorts of changes in macroeconomic variables particularly affect the exports of Euroland. Therefore an econometric analysis is undertaken which is to quantify the importance of the main determinants for exports mentioned in the literature. These are economic activity abroad, price competitiveness and the ongoing globalization of production processes. If income in the rest of the world rises, the demand for consumption and investment goods is up as well and will partly be met by higher imports thus pushing Euroland's exports (cf. Rose 1989: 153 f.). The price competitiveness of a country improves if for given price levels the national currency devalues or if for given exchange rates, price and unit labor cost inflation abroad is higher than in Euroland. The prices in "dollar" for European products fall and foreign demand for them increases (cf. Siebert 1994: 227 ff.). Finally, in the recent past exports are boosted by an intensification of the international division of labor. Firms in industrialized countries delocalize their production to low-cost countries or they follow a strategy of "global sourcing" which consists of buying components from the best international supplier rather than producing them themselves. As a consequence goods change their location several times during their production process thereby increasing the volume of international trade.

In accordance to other empirical studies (cf. Döpke and Fischer 1994) we use industrial production abroad rather than foreign GDP as a proxy for foreign economic activity, first because the higher variance of industrial production gives this index a higher explanatory power for changes in exports, second because the index has a smaller time lag in publication than GDP. For this purpose an index of seasonally adjusted industrial production is constructed for 22 countries. The choice of countries was dominated by the criteria of importance as an export market for Euroland and online-availability (see appendix I). The price competitiveness is measured by the real external value of the ecu relative to the currencies of 19 out of the 22 countries mentioned. The index is a geometric average of the bilateral real external values on the basis of consumer prices

# Determinants of Euroland's Exports



<sup>a</sup> Percent change over previous quarter, annualized.



(see appendix I). Both independent variables are integrated of order one (see appendix II). Their percentage changes on a quarter-on-quarter basis are plotted against those of real exports in Figure 5.

Finally, the intercept and the trend variable reflect the growing integration of international trade. The estimation uses an error correction model in order to illustrate both long-run and short-run effects of changes in the explanatory variables. All variables are logarithms, the dependent variable is the difference in logarithms of the current and the previous volume of exports, thus the model is specified in rates of change over the previous quarter. This specification is chosen because the adjustment to the long-term level of exports can well be interpreted quarter by quarter. The choice of year-on-year rates of change would imply a more complex reparametrization of the long-term relationship, even if the dependence of exports on foreign production and the external value of the ecu is better visualized by the latter specification. To see this, one has to compare Figure 5 below with Figure 3 of Döpke et al. (1998b: 7). Cointegration is looked for between the levels of exports, industrial production and the real external value of the ecu to explain the equilibrium in the long-run, with the time trend being taken into account. The short-run adjustment path in the basic model is described by taking the current rate of change in the independent variables as well as four lags of the rate of change in all three variables into account. Step by step, insignificant lags are eliminated using standard F-tests and t-tests respectively, until all coefficients are significant at a 10 percent level at least.

## **V. Estimation Results and Export Forecast for 1998 and 1999**

The estimation described in section IV using the methods of least squares yields the following results (*t*-values in brackets):

$$\begin{aligned}
[6] \quad \Delta \ln X_t = & 3.42 - 0.80 \left[ \ln X_{t-1} - 0.63 \ln I_{t-1} + 0.55 \ln e_{t-1} - 0.0136t \right] \\
& - 0.35 \Delta \ln X_{t-2} + 0.98 \Delta \ln I_t + 1.15 \Delta \ln I_{t-1} - 0.31 \Delta \ln e_t \\
& + 0.38 \Delta \ln e_{t-4} - 0.05 D^{92/IV} + \hat{u}_t
\end{aligned}$$

With the critical value calculated by Banerjee et al. (1992: 42) amounting to  $-4.48$  at a significance level of 1 percent, the null hypothesis of “no cointegration” can be rejected because  $|-7.23| > |-4.48|$ . Thus, a necessary condition for the expression in square brackets to be interpreted as the temporary deviation from a stable long-term equilibrium is fulfilled (Hansen 1993: 141). All the other coefficients are also significant at a 1 percent level.<sup>7</sup> The dummy variable needed for technical reasons is 1 in 1992 IV, 0 else. The specification of equation [6] allows the long-run coefficients to be interpreted as elasticities: a 1 percent rise in foreign industrial production causes a 0.63 percent increase in exports whereas a 1 percent decline in the real external value of the ecu boosts them by 0.55 percent. The  $t$ -values of the coefficients within square brackets are obtained by the Bewley transformation of equation [6] (Hansen 1993: 143–144). Table 1 summarizes other important quality features of the estimation.

Table 1 — Properties of the Estimation Equation

Measure	Realization <sup>a</sup>
Adjusted R <sup>2</sup>	0.67
Standard error of regression [pc]	1.30
Durbin-Watson test statistic	1.78
LM-Test for first-order autocorrelation	0.44 [0.51]
LM-Test for forth-order autocorrelation	1.77 [0.16]
Jarque-Bera normality test	1.15 [0.56]
White test for heteroscedasticity	1.05 [0.45]
Test for structural change (middle of sample interval)	0.47
Critical value at a 10 pc significance level	2.10

<sup>a</sup>Probabilities in brackets.

Source: Own calculations.

<sup>7</sup> The third and the fourth lag of the change in exports were both significant at the 10 percent level. They have been eliminated because they cannot be used for forecasting purposes. This elimination leaves nearly unchanged all the properties shown in Table 1.

The 0.63 long-run elasticity with respect to industrial production abroad is lower than those found for single states which usually are more than unity (cf. Lapp et al. (1995: 11) for the G7-countries, Döpke and Fischer (1994: 59 f.), Boss et al. (1997: 277), and Strauß (1998: 164 f.) for Germany). However, trend and intercept show bigger coefficients. This discrepancy, among other reasons, stems from the higher weight of emerging markets in Euroland's exports compared to single EMU member states; because of deepening market penetration by European firms exports to newly industrialized countries continued to rise sharply even in times of temporary stagnation in industrial production. The globalization of production processes also makes exports grow at a stronger pace than industrial production by pushing trade in intermediate products. As the sample period in the studies mentioned generally starts in 1980 or earlier, these more recent phenomena have a stronger impact on the estimation presented here. Furthermore, sufficiently long time series are not available for Central and Eastern Europe; this is why the rapid evolution of sales to this region can only be reflected by the trend variable. A more technical explanation for the huge importance of the time trend could be that the use of annual rather than the (non available) quarterly intra-trade shares before 1995 smoothes the export series too much such that the trend explains more than it would do in the presence of the more volatile quarterly figures (see footnote 4). Unlike the constant terms and the long-run production elasticity, the long-run exchange-rate elasticity as well as the short-term adjustment rather confirm the results of single-country studies. According to equation [6], a 1 percent change in economic activity abroad is of greater importance for export fluctuations than the same change in the real exchange rate. But as during the sample period the standard deviation of quarterly changes in the real external value (2.2 points) is much higher than the one of industrial production abroad (0.7 points), a great deal of the volatility of real exports hinges on changes in price competitiveness (see Table 2).

To see how the model works, a shock simulation is done in Figures 6 and 7. First the model is solved with the historical data for industrial production abroad and the real external value of the ecu (see the ex-post simulation or

Table 2 — Descriptive Statistics of the Euroland Time Series from 87:1 to 97:4

Series	Mean of the rate of change <sup>a</sup>	Standard deviation of the rate of change <sup>a</sup>	Standard deviation of the trend adjusted series <sup>b</sup>
Euroland's real exports	1.69	2.25	3.29
Euroland's real imports	1.65	1.68	2.94
Euroland's real intra-trade <sup>c</sup>	1.54	2.35	2.95
Index of industrial production abroad (1990=100)	0.77	0.67	1.67
Index of the real external value of the ecu (1990=100)	-0.05	2.17	3.94

<sup>a</sup>Quarter on quarter. — <sup>b</sup>Defined as the deviation of the series from its Hodrick/Prescott (1600)-filter value in percent. — <sup>c</sup>Based on exports.

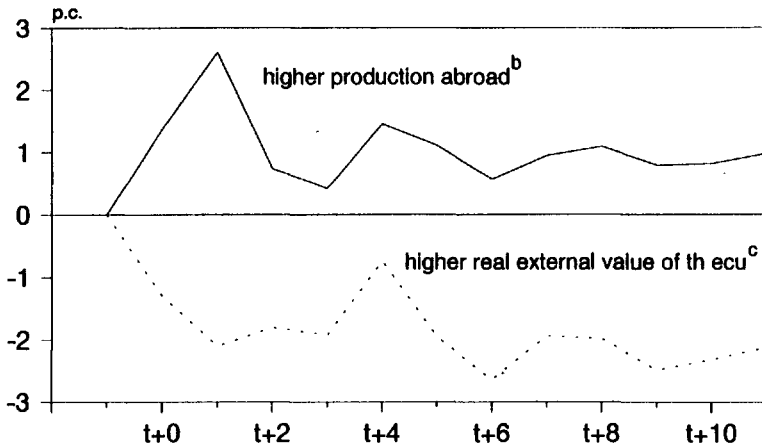
“historical simulation” in Figure 7). Then both regressors are risen alternatively by two respective standard deviations in period ( $t+0$ ).<sup>8</sup> This implies an increase by 1.4 percent in foreign production and one of 4.3 percent in the real external value of the ecu. Figure 6 shows the percentage change of exports relative to the values of the historical simulation, Figure 7 plots the levels for all three scenarios (historical, stronger foreign output and the real appreciation of the ecu). As the standard deviations are obtained from the sample period, one can understand that exchange rate changes caused more export volatility than did output fluctuations in the last eleven years.

The explanatory power of the model is illustrated by an ex-post forecast for 1996 and 1997, shown in Figure 8. For this aim the coefficients of equation [1] are reestimated for the sample 87.1 to 95.4. Then Euroland's real exports are simulated dynamically, i.e. using the historical values for industrial production abroad and the real external value of the ECU, but the estimated outcomes of  $\Delta \ln X_{t-2}$ .<sup>9</sup> Predicting annual rates of change in export levels of 6.1 and 10.8 percent respectively, the model comes close to the historical results (6.9

<sup>8</sup> In the example ( $t+0$ ) corresponds to 1991 I. But the relative deviation of “shocked” exports from their simulated historical values do no depend on the choice of the base year.

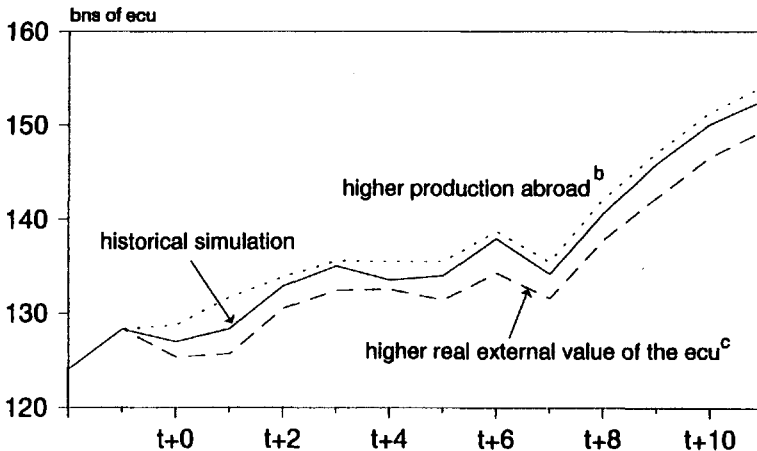
<sup>9</sup> That is, the endogenous variable is not reinitialized during the forecasting period (the terminology is taken from Pindyck and Rubinfeld (1981: 360)).

Figure 6 - Shock Simulation: Change in Exports following a permanent rise in industrial production abroad and in the real external value of the ecu<sup>a</sup>



<sup>a</sup>By two respective standard deviations. - <sup>b</sup>1.4 percent. - <sup>c</sup>4.3 percent.

Figure 7 - Shock Simulation: Export levels following a permanent rise in industrial production abroad and in the real external value of the ecu<sup>a</sup>



<sup>a</sup>By two respective standard deviations. - <sup>b</sup>1.4 percent. - <sup>c</sup>4.3 percent.



and 12.0 percent). Assuming that the long term relationship remains stable in the near future, the estimation results are used to carry out an ex-ante forecast of Euroland's exports in 1998 and 1999 as part of the Kiel Institute's business cycle forecast.<sup>10</sup> However, one should be careful when interpreting the results because the equation over- and underestimates the quarterly evolution of exports with errors being smoothed over several quarters. This is why only an interpretation of the annual rate of change is given here. Figure 8 shows an average increase in exports by some 4.5 percent in 1998 and by nearly 6 percent in 1999.

## VI. Conclusions

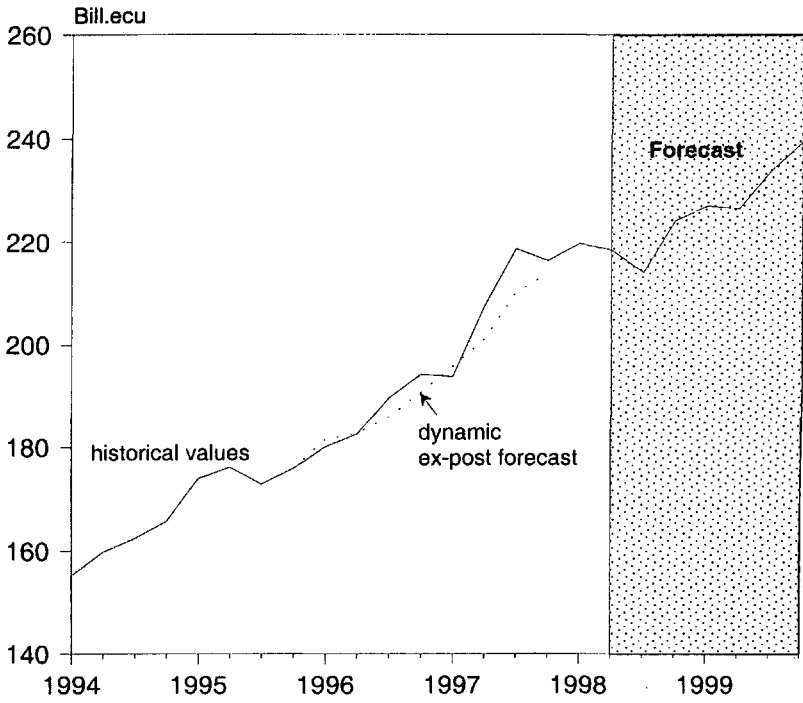
This paper provides an estimation of Euroland's exports to the rest of the world based on SNA data. The share of intra-trade in the sum of the eleven member countries' total trade in goods and services is approximated by OECD and Eurostat special trade figures. The computation shows that Euroland's exports and imports have been rising faster than intra-trade in the nineties thus widening substantially Euroland's degree of openness. An estimation on the basis of an error correction model exhibits a strong influence of the trend variable reflecting the internationalization of the production process and the growing importance of Central and Eastern Europe as an export market for Euroland. But also more "conventional" variables such as foreign industrial production and the real external value of the ecu have a significant impact on Euroland's exports with long-run elasticities of 0.63 and -0.55 respectively. With the help of the estimation equation a forecast of real exports is carried out and yields an increase of 4.5 percent in 1998 and one of 6 percent in 1999.

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<sup>10</sup> In the forecast for the 58th Kieler Konjunkturgespräch only the trade balance is shown explicitly but it contains the estimation of exports presented here (Döpke et al. 1998b: 22).

Figure 8

Dynamic Ex-post Forecast for 1996-97 and Ex-ante Forecast for 1998-99



## **Appendix I: Data Sources and Methods of Calculation**

Real SNA exports and imports are those published by Eurostat (1998a) for the period beginning 1991 and are chained together with the exports and imports series estimated for the eighties on the basis of the five biggest EMU members by Döpke et al. (1998a: 17). GDP data for Euroland prior to 1991 are also taken from Döpke et al. (1998a:17) and chained to the official figures by Eurostat.

The index of industrial production is a weighted arithmetic average of the national indexes of 22 countries: United Kingdom, Sweden, Denmark, Greece, Switzerland, Norway, United States, Canada, Japan, Australia, Turkey, Israel, Brazil, South Africa, Korea, Chinese Taipei, Hong Kong, Singapore, Indonesia, Thailand, Malaysia and India. These countries absorb more than 70 percent of Euroland's exports. Each country except for Indonesia buys at least 1 percent of them. For Central and Eastern European countries long time series are not available. The figures had to be seasonally adjusted (by the census-X-11 method) for Turkey, Brazil, Chinese Taipei, Hong Kong, Singapore, Indonesia, Thailand, Malaysia and India. They have been rebased to 1990 = 100 in some cases to make the overall index equal to 1990 = 100. Sources are the OECD (1998c), the IMF (1998) and national (for Australia, South Africa, Turkey, Malaysia, Chinese Taipei, Brazil, Indonesia, Hong Kong and Thailand). The weight of each country is its relative part in Euroland's merchandise exports in 1995 according to OECD (1998b).

The real external value of the ecu is computed with respect to the countries just listed except for Brazil, Hong Kong and Chinese Taipei. The weights are given by the sum of merchandise exports to and imports from the respective country relative to Euroland's total trade with these 19 states. Thus third market effects are not taken into account here. The nominal exchange rates are corrected by differences in consumer price inflation. For each country as well as for Euroland the index of consumer prices has been seasonally adjusted using the census-X-11 method. Foreign CPIs are derived from the CD-ROM corresponding to IMF (1998), Euroland's CPI is expressed by the harmonized consumer price index (HCPI) from 1995 onwards which has been prolonged back to 1980 by

the weighted arithmetic average of the eleven countries' rates of consumer price inflation with shares in Euroland's real GDP serving as weights according to Döpke et al. (1998a).

## Appendix II: Testing for the Order of Integration

Besides the stationarity of the residuals of the long-term relationship in equation [6], the levels of the time series used must be integrated of the same order to avoid spurious regression. All three variables are integrated of order one as the results of the (augmented) Dickey-Fuller tests show in Table 3.

Table 3 — Tests of Integration

Variable <sup>a</sup>	Specification <sup>b</sup>	ADF test statistics <sup>c</sup>	Breusch-Godfrey LM(1) test statistics <sup>d</sup>	Breusch-Godfrey LM(4) test statistics <sup>d</sup>
ln X	C, T, 0	-1.00	1.61 [0.21]	0.49 [0.75]
ln I	C, T, 1	-2.13	0.83 [0.37]	1.07 [0.38]
ln e	C, 1	-2.01	0.00 [0.96]	0.45 [0.77]
$\Delta$ ln X	C, 0	-7.34***	0.10 [0.75]	0.45 [0.77]
$\Delta$ ln I	C, 0	-5.99***	1.25 [0.27]	0.82 [0.51]
$\Delta$ ln e	C, 0	-5.35***	0.18 [0.67]	0.33 [0.86]

X = Euroland's real exports, seasonally adjusted.  
 I = Index of industrial production abroad.  
 e = Index of the real external value of the ecu.  
 $\Delta$  = First difference of variables.

<sup>a</sup> Sample period from 1980:1 to 1997:4. — <sup>b</sup> Test equation contains an intercept (C) or a linear time trend (T). The figure indicates the number of lagged endogenous variables. — <sup>c</sup> Significant at the 10 percent (\*), the 5 percent (\*\*) or the 1 percent (\*\*\*) level. Null: "Series under investigation is not stationary". — <sup>d</sup> Chi-square version, autoregressive process of first and fourth order, respectively. Probabilities in brackets.

At the example of Euroland's exports, equation [7] summarizes the idea of this test according to Dickey and Fuller (1981); the null hypothesis is  $\beta=0$ , i.e. "time series under investigation is not stationary".

$$[7] \quad \Delta X_t = c + \beta \cdot X_{t-1} + \gamma \cdot t + u_t.$$

In the case of the real external value of the ecu, the equation is specified without trend. The residuals  $u_t$  must be white noise, otherwise lags of the endogenous variable ( $\Delta X_{t-1}$ , then  $\Delta X_{t-1}$  and  $\Delta X_{t-2}$ , then  $\Delta X_{t-1}$ ,  $\Delta X_{t-2}$  and  $\Delta X_{t-3}$  etc.) are added until  $u_t$  is white noise and the testing procedure is run again. The null of non-stationarity cannot be rejected for any of the three variables (significance level of 10 percent), but their first differences are stationary (significance level of 1 percent). Consequently, their levels are integrated of order 1.

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