MARKET RISK DYNAMICS AND COMPETITIVENESS AFTER THE EURO:

Evidence from EMU Members

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Abstract

In this paper we propose an empirical model that considers theoretical facts on the relationship between real exchange rates and the net exports of the economy to supplement the interaction of a number of financial and economic factors with the stock market. We discuss the impact of exchange rate fluctuations on market risk in terms of Value at Risk (VaR). Our empirical findings show that common currency introduction produced increments in VaR whereas European stock returns are more sensitive to changes in competitiveness regarding the EMU rather than national exports. Finally, we show that the synchronisation of variation in competitiveness through the introduction of a single currency has made these changes more decisive in explaining financial market fluctuations.

KEYWORDS: Euro, Competitiveness, Market Risk, Net Export, Value-at-Risk, Volatility

JEL Codes: F33, G24, G28, O24

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1. Introduction

Over the past decade the world economy faced significant changes in financial markets and international competitiveness. More recently, the growth of trading activity in financial markets coupled with numerous instances of financial instability and a number of widely publicised losses in financial institutions have resulted in a re-analysis of the risks. The most widely advocated approach to have emerged to measure market risk is that of Value-at-Risk (VaR).

Parallel with this development, turbulence in the foreign exchange markets has also undergone significant changes compared with the pre-euro period. This effect was foreseen by various economists (Ghironi and Giavazzi, 1997; Martin, 1997; Benassy et al., 1997; Gros and Thygessen, 1992; Kenen, 1995; Aglietta and Thygessen, 1995; Cohen, 1997). But were these two developments really correlated? And, if so, how exactly could monetary reform be held responsible for higher stock market risk?

One can consider several potential links between exchange rates and stock market. For example, exchange rates may affect a firm’s value by means of its impact on the liquidity of a firm’s shares. There is a growing literature on the effect of liquidity on firm value. The pioneer work by Amihud and Mendleson (1986) present the first evidence to support the hypothesis that asset liquidity is priced in equilibrium. Among more recent papers, Datar et al. (1998), Brennan et al. (1998) and Easley et al. (1999) all suggest that asset liquidity affects a firm’s value through its impact on the firm’s expected return. If the asset liquidity, influenced by exchange rates, determines the firm’s value and expected returns, then it is pertinent to study the link between the exchange rate and the market risk, which is the scope of this study.

However, the phenomenon of higher risk is not easily explained in such a straightforward context, as there is no obvious modification in this mechanism ascribable to the introduction of a currency. We consider stock prices and real exchange rates to be intermediated by changes in corporations competitiveness reflected in variations in trade flows directions. In turn, the changes in competitiveness are reflected in company’s stock prices and related market risk.

In a multicountry world, movements in one exchange rate can be offset by other factors, such as movements in other exchange rates or interest rates. There are many studies that examine the relationship between exchange rate volatility and international trade.

Asseery and Peel (1991) examine the influence of volatility on multilateral export volumes finding that volatility of exchange rates has significant positive effects on exports. At the same time, Bini-

Smaghi (1991) finds strong support for the conventional assumption about volatility effects on trade. Cushman (1983), Kenen and Rodrick (1986), Giovannini (1988), Franke (1991), Pozo (1992), Sercu (1992), Sercu and Vanhulle (1992), Chowdhury (1993) and Kroner and Lastrapes (1993) among others, provide evidence that the level of exchange rate volatility impacts the volume of trade flows. On the contrary, Koray and Lastrapes (1989), Lastrapes and Koray (1990), Gagnon (1993) in their studies on the effect of exchange rate volatility on trade conclude that the relationship between the volatility and trade is weak.

Moreover, it is accepted that if the volume of trade flow is impacted by exchange rate volatility so will the value of firms. But the conclusions of relevant empirical studies are quite different. Amihud (1994) examines a sample of 32 top US exporters and concludes that their stock returns are not affected by changes in the value of the dollar. Bartov and Bodnar (1994) find that the abnormal returns of 208 firms are uncorrelated with changes in the value of the dollar. Griffin and Stulz (2001) noted that changes of weekly exchange rates had negligible impacts on industry stock indices in developed countries. In contrast, Bartov et al. (1996) finds that the return variability of US multinational corporations increases with an increase in exchange rate volatility. Bodnar and Gentry (1993), studying industry portfolios in the US, Japan and Canada, find that only 30% of them are significantly affected by exchange rate changes. He et al. (1996) examine a large sample of Japanese firms and find that of the 422 exporting companies, 25% are significantly affected by exchange rates fluctuations. Nevertheless, the discussions and arguments indicate that there is a relationship, which seems stronger or weaker in the light of different samples and studies. In our opinion this interrelation between the exchange rate and corporation value is the one most likely to be the link between higher stock market risk and a common currency in the context of structural changes accounted after the euro.

We have constructed a monthly series of market risk as monthly averages of daily VaR (Jorion, 1997) estimated by means of GARCH model (Bollerslev, 1986). GARCH(1,1) was used since it is found to be adequate for many financial time series (Bollerslev, Chou and Kroner, 1992). McNeil and Frey (2000) use GARCH in yet another way to get value at risk. They use GARCH to estimate the volatility, and extreme value theory to get tail probabilities. Ahlstedt (1998) argues that the GARCH models represent a methodological and empirical improvement over other estimates. Therefore, the estimated impact of changes in Euro/USD exchange rates on net exports of EMU countries to the USA is the key regressor of our interest explaining the dynamics of the level of market risk in our empirical model.

Several potential factors of stock market risk are also included in the model in order to make it more specific. In particular, the remaining regressors in the model (referred to below as we further reference them) include proxies for business cycles, domestic market demand as well as bond yields, traded volume of stocks, and foreign reserves variables. Most of these factors are discussed in different contexts of interaction with financial market in financial and economic literature.

The impact of different interest rates on stock returns is studied by a number of researchers (e.g. Gallant and Tauchen, 1997; Peiro, 1996). A similar study by Rapach et al. (2004), among other factors, reveals that relative long-term government bond yields have negative impact on real return from holding stocks. Pavlova and Rigobon (2003) identify interconnections between stock, bond and foreign exchange markets and characterize their joint dynamics as a three-factor model.

Dumas et al. (2003) develop a ‘‘dynamic single-index’’ statistical model capturing the “world” business cycles as well as country-specific fluctuations. They consider current and past production as the information variable that investors use in their investment decision, as a way of predicting their decisions on which stage of the business cycle the economy is currently running. In our model we use unemployment as a mirror of the business cycle stage. Rapach et al. (2004) also consider change in the unemployment rate as a macroeconomic factor of stock returns.

Cuñado et al. (2004) show that growth in traded volume, the next factor in our empirical model, has a significant impact on stock market volatility in Spain. They, however, conclude that it was not just the acceleration in trading volume that brought about the increased volatility but most likely the intensification of the process of economic development and opening the borders. Thus, to reflect the process of economies development a proxy for domestic market demand (changes in retail trade) is considered as another explaining variable in the model.

An ample part of the foreign exchange reserves is usually invested in international financial markets (mainly in the liquid bond markets) and consistently the changes in the volumes of reserves will somehow be reflected in the financial market volatility. Thus, covering this variable which potentially may impact on general stability of the currency market (Masson and Turtleboom, 1997; Lehay, 1996; Hening, 1997) is also important in our study.

Our empirical research discusses how the set of above mentioned factors explain the market risk dynamics in a sample of EMU countries. The empirical results make it possible to obtain additional findings on how the competitiveness of companies and stock markets interact within the sample of the countries under consideration.

The outline of the remaining sections will be as follows. In Section 2, the changes in market risk before and after the introduction of the euro are discussed. Section 3 presents our empirical model describing the dynamics of stock market risk in competitiveness-exchange rates framework. Section 4 reports the empirical results and section 5 is the conclusion.

2. Market risk dynamics in pre- and post-euro periods

Financial risk is the prospect of financial loss (or gain) due to unforeseen changes in underlying factors. The changes that euro introduction in 1999 caused in stock markets is the target of particular study. To evaluate the market risk before and after the euro we used the Value at Risk indicator (see e.g. Jorion, P., 2000; Goorbergh and Vlaar, 1999). Value at Risk (VaR) is defined as the maximum potential change in value of a portfolio of financial instruments with a given probability over a certain time horizon, with the assumption that the composition of the theoretical portfolio remains the same[1]. VaR measures have many applications, such risk management and for regulatory requirements. In particular, the Basel Committee on Banking Supervision (1996) requires financial institutions such as banks and investment firms to meet capital requirements based on VaR estimates. The description of different possible techniques of VaR estimation is beyond the scope of our study. We simply apply just one to monitor the changes in stock market risk in the context of euro introduction.

Estimating volatility is the essence of evaluating of market risk. Among the variance methods of VaR estimation the static models do not take volatility clustering into account. By far the most popular model which captures this phenomenon is the Generalised Autoregressive Conditional Heteroskedasticity (GARCH), introduced by Bollerslev (1986) as an extension of the Autoregressive Conditional Heteroskedasticity (ARCH) model by Engle (1982). The GARCH model defines an innovation h_{t+1}, i.e.,

[1] Analytically, the VaR is defined by the top limit of integral of the probability density function (P) of expected returns (r) $a = \int_{-\infty}^{E(r)-VaR} P(r)dr.$

some random variable with mean zero conditional on time t information, I_t. This time t information is a set including not only the innovation at time t, $h_t \in I_t$, and all previous innovations, but also any other variable available at time t as well. In finance theory, h_{t+1} might be the innovation in a portfolio return. In order to capture serial correlation of volatility, or volatility clustering, the GARCH model assumes that the conditional variance of the innovations depends on the latest past squared innovations as is the assumption in the less general ARCH model, possibly augmented by the previous conditional variances. In its most general form, GARCH(p,q), can be written as:

$$s_t^2 = w + \sum_{j=1}^{p} b_j s_{t-j}^2 + \sum_{i=1}^{q} a_i h_{t-i+1}^2 \qquad (1)$$

p lags are included in the conditional variance, and q lags are included in the squared innovations. In our study we regard these innovations as deviations from some constant mean portfolio return:

$$r_{t+1} = m + h_{t+1} \qquad (2)$$

expressed h_{t+1} as $s_t e_{t+1}$, where e_{t+1} is assumed to follow some probability distribution with zero mean and unit variance, such as the standard normal distribution. The parameters are conditioned as $w > 0$, $b \geq 0$ and $a \geq 0$ to ensure positive variances. If the market was volatile in the current period, the next period's variance will be high, and is intensified or offset in accordance with the magnitude of the return deviation this period. Naturally, the impact of these effects hinges on the parameter values. Note that for $a + b < 1$, the conditional variance exhibits mean reversion, i.e., after a shock it will eventually return to its unconditional mean $w/(1 - a - b)$. In this way, if $a + b = 1$, this is not the case, we would have persistence.

In order to estimate these parameters by means of likelihood maximisation, one has to make assumptions about the probability distribution of the portfolio return innovations h_{t+1}.

Considering Gaussian innovations

$$e_t \overset{iid}{\sim} N(0,1), \qquad h_{t+1}|I_t \sim N(0, s_t^2) \qquad (3)$$

leading to a conditional log likelihood of h_{t+1} equal to:

$$\mathbf{l}_t(h_{t+1}) = -\log\sqrt{2p} - \frac{1}{2}\log s_t^{\,2} - \frac{h_{t+1}^2}{2s_t^{\,2}} \qquad (4)$$

The log-likelihood for all series is $\sum_{t=1}^{T}\mathbf{l}_t(h_{t+1})$.

The GARCH (1.1) is used to predict the volatility dynamics during VaR estimation period for a sample of 10 EMU member states. The daily VaR estimates, for left tail probability of 1% according to Basel Accord (1996) are reflected in figure 1 in appendix 1 while the average VaR for the pre- and post-euro periods and the corresponding growth in absolute terms is reported in the table 1. The increase in average daily VaR is obvious in EMU major stock markets. Among the countries with significant growth in market risk are the two largest economies of the EMU – Germany and France, only Italy and Austria produced a slight reduction in VaR.

The volatility of exchange rates is of high importance because it affects decisions of market participants. The consequences of exchange rate volatility on trade have long been at the centre of the debate on the optimality of alternative exchange rate regimes.

In fact, the volatility of exchange rates has also grown. For the first four years of the post-euro period the variance of percentage changes in monthly real exchange rates was 1.191 against 0.745 points of a similar pre-euro period[2]. By the 08/2004 the figure had already reached up to 1.235.

INSERT TABLE 1 HERE

Further, we construct and apply an empirical model to explain how the introduction of euro could impact stock market risk.

3. Empirical Model

The starting point is the relationship between financial market risk (f), estimated on stock price volatility, and a sample of explaining variables – changes in exchange rates (e), changes in domestic market demand (l), traded volume of stocks (n), bond yields (t), foreign official reserves (v) and the business cycles (r).

[2] Our own calculations based on monthly series of real exchange rates by ERS, United States Department of Agriculture.

$$f = f\left(\Delta e, \Delta l, n, t, v, r\right) \quad (5)$$

We assume that the main link between the stock market risk and exchange rates, which maybe affected by the common currency introduction, is the change in general competitiveness of the economy, reflected in terms of changes in net exports.

The relationship between real exchange rates and net exports is widely discussed in the financial literature. A number of comparatively older studies (e.g. Ethier, 1973; Cushman, 1986; Peree and Steinherr, 1989) have shown that an increase in exchange rate volatility will have adverse effects on the volume of international trade. More recent studies have demonstrated that increased volatility can have ambiguous or positive effects on trade volume (Viaene and de Vries, 1992; Franke, 1991; Sercu and Vanhulle, 1992). Barkoulas et al. (2002) concludes that under risk aversion, the benefits of international trade are reduced, resulting in a decrease in the volume of international trade. The trade surplus or deficit is reduced as well. However, they note that analysis which considers only the (often indeterminate) effects of exchange rate uncertainty on the volume of trade will not be capable of generating predictions of optimal behaviour.

Our interest in this relationship is limited to the most general ideas on the relationship of net exports with the exchange rates and its volatility by estimating the impact of changes on net export, without any requirement of model modifications or prediction making.

Relating the macroeconomic dependence of import (t) and export (i) with the exchange rates, GDP (y) and GDP of the counterpart (y') we have:

$$x = \left(t - i\right) = t\left(\overset{-}{e}, \overset{+}{y}'\right) - i\left(\overset{+}{e}, \overset{+}{y}\right) = x\left(\overset{-}{e}, \overset{-}{y}, \overset{+}{y}'\right) \quad (6)$$

Hence, the net export (x) changes caused by the exchange rate fluctuations from Eq.6 could be expressed as $\left(\Delta e \left({}^{\partial x}\!/_{\partial e}\right)\right)$:

Thus, our model describing the dependence of market risk from factors including changes in competitiveness for a single country is:

$$f = a_0 + a_1\left(\frac{\partial x}{\partial e}\right)\Delta e + a_2\Delta l + a_3 n + a_4 t + a_5 v + a_6 r \quad (7)$$

These particular changes in net exports reflect the changes in competitiveness of the output of the country vs. the output of the trade party. Hence, the proxy for the general competitiveness of EMU countries is the change in the EMU net exports ($\hat{x}$) equal to:

$$\Delta\hat{x} = \sum_{i=1}^{n}\left(\Delta e_i \frac{\partial x_i}{\partial e_i}\right) \tag{8}$$

The main assumption is that after introducing the euro the changes in net exports of all the member states reflect the fluctuations of the single currency $(\hat{e})$.

$$\Delta\hat{x} = \Delta\hat{e}\sum_{i=1}^{n}\frac{\partial x_i}{\partial \hat{e}} \tag{9}$$

Thus, the changes in net exports of separate countries caused by the exchange rate changes are of the same sign. A single currency has a synchronising effect on general competitiveness changes, so that EMU has a larger $\Delta\hat{x}$ in the case of the euro.

By replacing this term in the equation (7) for the $i-th$ from the n countries we obtain:

$$f_i = a_0 + a_1\left(\Delta\hat{e}\sum_{i=1}^{n}\frac{\partial x_i}{\partial \hat{e}}\right) + a_2\Delta l_i + a_3 n_i + a_4 t_i + a_5 v_i + a_6 r_i \tag{10}$$

From that our proposition is that the exchange rate driven changes of general competitiveness determine the level of financial market risk, which explains the phenomenon of higher value-at-risk in case of a vulnerable euro. These ideas are summarized following two propositions.

Proposition I.

In case of a single currency the $\sum_{i=1}^{n}\left(\Delta e_i \frac{\partial x_i}{\partial e_i}\right)$ is replaced with $\Delta\hat{e}\sum_{i=1}^{n}\frac{\partial x_i}{\partial \hat{e}}$, where $\left|\Delta\hat{e}\sum_{i=1}^{n}\frac{\partial x_i}{\partial \hat{e}}\right| \geq \left|\sum_{i=1}^{n}\left(\Delta e_i \frac{\partial x_i}{\partial e_i}\right)\right|$ because of the synchronised impact on foreign trade. The currency fluctuations cause greater fluctuation in general competitiveness of EMU production and result in higher volatility and risk in stock markets.

Proposition II.

The more significant variable $\sum_{i=1}^{n}\left(\Delta e_i \frac{\partial x_i}{\partial e_i}\right)$ (compared with $\Delta e_{it} \left(\partial x_i \big/ \partial e_i\right)$ national alternative) in $f_i = a_0 + a_1\left(\sum_{i=1}^{n}\left(\Delta e_i \frac{\partial x_i}{\partial e_i}\right)\right) + a_2 \Delta l_i + a_3 n_i + a_4 t_i + a_5 v_i + a_6 r_i$ equation, the deeper are particular economies integrated, and euro fluctuations are more decisive for particular stock markets.

To test proposition I empirically, it is sufficient to prove the significance of the e in the eq.6. Therefore, when the empirical results support proposition II, together with higher volatility of real exchange rates in the post-euro period, we can fully explain the indicated growth in VaR after the euro.

4. Empirical findings

4.1. Changes in competitiveness vs. exchange rates

Before proceeding to the empirical testing of the stated hypothesis explaining the dynamics in the level of market risk we need to obtain estimated changes in net export. We used balanced monthly panel data 1995/01-2004/06 (see table 4 in appendix 2) for 11 EMU member countries (excluding Greece) to build an empirical model where the counterpart of the EMU is the USA. In context of our study the appropriate panel regression model has fixed individual effects (b_{i0}) and different slopes (Cornwell and Schmidt, 1984) for log-exchange rates.

$$x_{it} = b_{i0} + b_{i1} \ln e_{i(t-l)} + b_2 \left(\frac{y'}{y_i}\right)_{t-l} \qquad (11)$$

Heteroskedasticity adjusted estimates of the model are reported in Table 2.

Based on the b_{i1} vector and the log-returns of the exchange rates with the five month lag, the impact of the exchange rate fluctuations on the net export of the particular countries (the $\Delta e_{it} \left(\partial x_i \big/ \partial e_i\right)$ series) is estimated. We interpret these estimates as changes of competitiveness of domestic production in the international market (considering US market). Finland and Ireland are removed from the sample of the countries during further analyses because of insufficient observation during the period of study. At the same time because of non robust b_{i1} coefficient, the Luxembourg is also excluded from the group.

It is normal to assume that the larger the $\Delta\hat{x}_t$ caused by FX changes, the stronger is the position of European companies' shares at the stock markets. Therefore investors can expect the related market risk (VaR) to fall.

INSERT TABLE 2 HERE

4.2. Explaining higher stock market risk

4.2.1. The choice between two parallel models

Certain proxies are used for the variables in eq. 10 along with estimated proxy of changes of general $\left(\Delta\hat{e}_{(t-5-l)}\sum_{i=1}^{n}b_{i1}\right)$ and alternatively country individual $\left(\Delta e_{i(t-5-l)}b_{i1}\right)$ competitiveness because of real exchange rate fluctuations. The changes in retail trade volumes are used to proxy the dynamics of domestic market demand (Δl). We also use the long-term government bond yields, the importance of which already has been discussed (t). Unemployment rate is included to reflect the particular stage of business cycle (r). The higher the unemployment, the deeper is the crisis and the higher is market risk.

$$f_i = a_0 + a_1\left(\Delta\hat{e}_{(t-5-l)}b_{i1}\right) + a_2\Delta l_{i(t-l)} + a_3\ln(n_{i(t-l)}) + a_4 t_{i(t-l)} + \\ + a_5\ln(v_{i(t-l)}) + a_6 r_{i(t-l)} \qquad (12)$$

$$f_i = a_0 + a_1\left(\Delta\hat{e}_{(t-5-l)}\sum_{i=1}^{n}b_{i1}\right) + a_2\Delta l_{i(t-l)} + a_3\ln(n_{i(t-l)}) + a_4 t_{i(t-l)} + \\ + a_5\ln(v_{i(t-l)}) + a_6 r_{i(t-l)} \qquad (13)$$

We consider two identical models by taking the country individual competitiveness variable in one (1) and the general competitiveness in the other (2) case (see Table 3). Balanced monthly panel data for post euro period (1999/01-2003/12) has been used[3] (see table 5 in appendix 2). The results suggest that replacing the $\Delta\hat{e}_{(t-5-l)}b_{i1}$ in the first model (1) with the $\Delta\hat{e}_{(t-5-l)}\sum_{i=1}^{n}b_{i1}$ in the second (2) improves the model. If the first variable is significant at a 5% confidence level, the variable of general

[3] Last six months were dropped due to the balanced data use.

competitiveness is significant at a level of 1%. The empirical results show that the growth in exchange rates reduces the international competitiveness of particular economies exports, and vice versa, as we know from macroeconomic theory.

We show that the changes in competitiveness in turn cause fluctuations in the level of stock market risk by increasing the risk when the national production loses position on the international markets, and by calming down the stock market when competitiveness grows.

INSERT TABLE 3 HERE

Hence, the growth in exchange rates results in higher stock market risk. A set of other factors of stock market risk and volatility, already discussed, are also incorporated in the particular model.

While explaining the growth in market risk we made another, a more significant finding, in the context of European integration. Nowadays the situation (risk, volatility, etc.) in particular EMU stock markets is more affected by the general competitiveness of the sample of European economies. So the contemporary level of European integration already acknowledges the concept of "General Competitiveness of European Economy". In fact, the introduction of a single currency in EMU was another major step in this direction.

4.2.2. Robustness checks

This section investigates the robustness of the empirical findings to a number of experiments with the estimated models (see appendix 3 tables 6-7). First, we tried the robustness of model one by one excluding the regressors. Signs and statistical significance are as expected, so that robustness with respect to EMU8 is not lacking. The other regressors are robust as well.

Next, a number of different lag structures were tried. We experiment with different lags for the regressors in the model (0, 3, 6, 9 and 12 month lags were tried one by one), to see how the EMU8 behaves. EMU8 is again robust. Coefficients and statistical significance for the other regressors in most cases also behave in an appropriate manner. However, in the case of change in domestic demand (TRADE), the coefficient keeps the positive sign for 3 and 6 month lag options, while the maximal significance is obtained for 3 month lag. Statistical significance of unemployment (UNEMPLOYMENT) lacks since 3 month lag and registers change in sign in the 6 month lag option. These cases can be interpreted as specific time limitations of the impact of these two factors and, in general, do not affect the robustness of the empirical model.

5. Conclusion

The stock markets of most EMU member states registered higher market risk after euro introduction. First of all, higher volatility of exchange rates affects the stock markets through consequent changes in the stock market value of firms. We show that exchange rates fluctuations affect the stock market risk by causing fluctuations in trade flows of the countries – our proxy for international competitiveness of the national economies.

Moreover, an even more interesting fact regarding this is that common currency strengthens the "net volatility" of changes in competitiveness for the entire sample of countries by synchronising the changes of relative prices. Hence, the growth or reduction of Euro/USD exchange rates has a similar (positive or negative) effect on international competitiveness of all the economies of the Monetary Union (at least for the observed 8 member states).

The empirical study also shows that due to the deep economic integration of particular European economies at both governmental and corporate levels, the changes in "General competitiveness" are more significant in explaining the stock market risk in separate countries than the changes in competitiveness on national levels. This phenomenon indicates a new stage of European economic integration where a European corporations and brands are represented on the international market of goods and services.

Summarising, the stock markets of most EMU member states registered higher market risk after euro introduction. Our analyses show that the Euro introduction had a triple effect on market risk, as it (1) resulted in higher volatility of exchange rates, (2) increased market risk on the stock markets because of higher synchronised fluctuations in general competitiveness, taking into account that (3) for the sample of countries it becomes more significant in explaining the dynamics of stock prices than the competitiveness changes at the national level.

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Appendix 1. Market risk dynamics

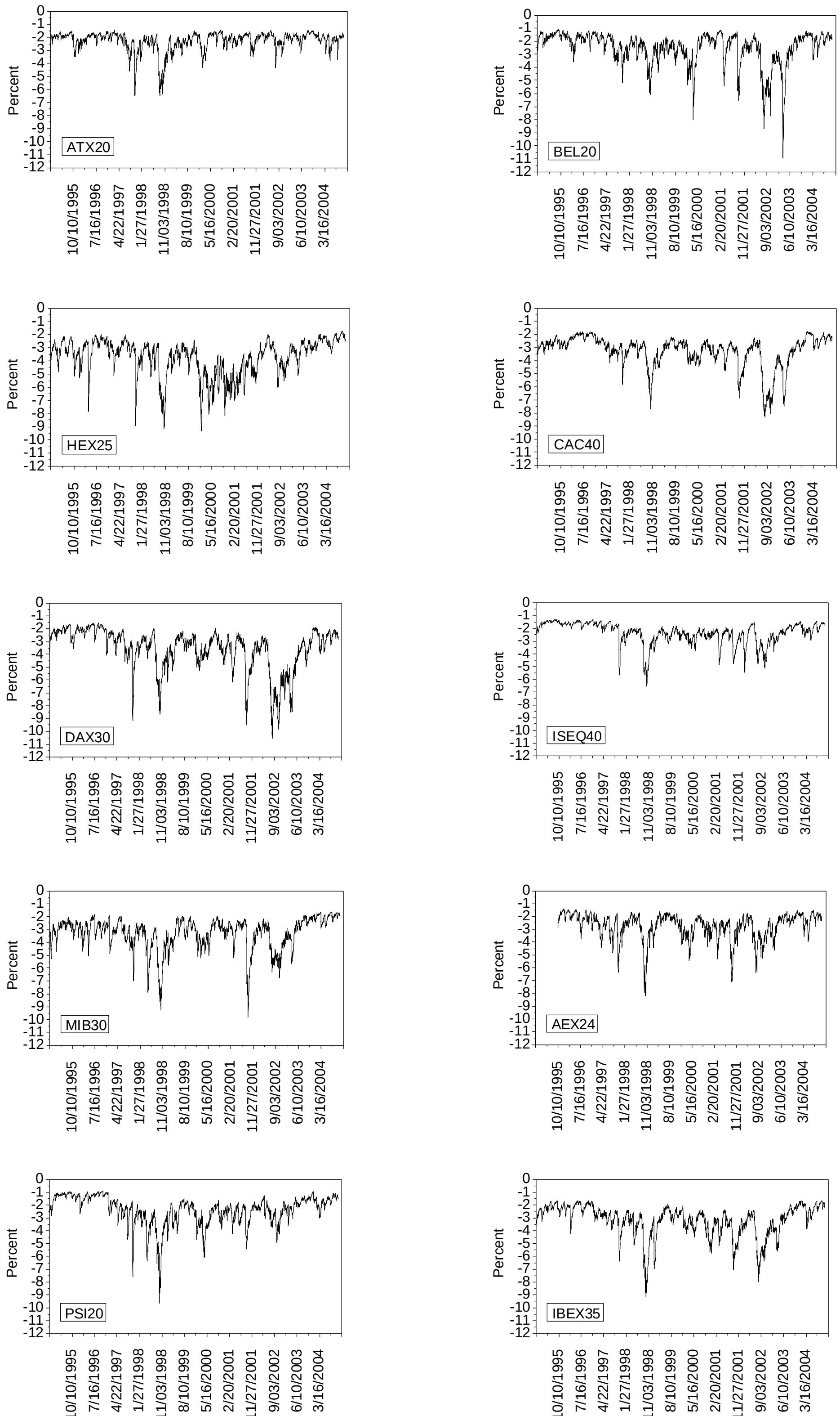

Figure 1. Value-at-Risk dynamics in EMU major stock markets: $VaR = -V\left(e^{m+sf^{-1}(a)} - 1\right)$, where V represents the initial value of some theoretical portfolio and $f(\cdot)$ is the cumulative distribution function of the standard normal probability distribution. GARCH (1.1) model is used for volatility forecasting.

Appendix 2. Data description

Table 4
Descriptive statistics for monthly data for the panel with 11 cross sections: 1995/01-2004/06

NET EXPORT

	Austria	Belgium	Finland	France	Germany	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain
Mean	83.4	-390.1	104.0	628.2	2270.5	669.0	1036.3	-20.8	-890.0	40.1	-42.9
Median	55.1	-380.3	103.7	576.5	2241.3	454.2	1057.7	-2.5	-899.7	33.5	-54.5
Maximum	379.0	-22.9	270.4	1437.2	4269.5	2163.0	1759.4	16.1	-465.0	159.5	238.9
Minimum	-150.1	-693.1	-194.6	-32.4	753.0	-126.5	329.1	-226.5	-1213.9	-167.7	-325.8
Std. Dev.	103.7	142.6	70.8	336.6	861.4	629.1	287.3	54.4	179.3	45.5	111.9

GDP RATIO

	Austria	Belgium	Finland	France	Germany	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain
Mean	44.8	37.6	73.0	6.5	4.5	94.9	8.0	479.8	23.2	82.8	15.2
Median	44.9	38.0	74.8	6.7	4.5	96.3	8.0	473.3	23.8	82.9	15.4
Maximum	55.3	46.1	85.9	8.0	5.8	109.0	9.6	792.7	28.0	141.9	18.5
Minimum	30.4	25.5	55.0	4.6	2.9	78.0	6.2	412.4	17.0	66.6	12.2
Std. Dev.	8.0	6.5	9.7	1.1	0.9	7.7	1.1	62.4	3.1	13.0	1.7

REAL EXCHANGE RATE (EURO/USD)

Mean	111.7
Median	112.1
Maximum	141.3
Minimum	84.8
Std. Dev.	16.4

Note:

NET EXPORT	Net exports to USA (ml. USD) (x). Our own evaluations based on U.S. Census Bureau data
GDP RATIO	USA GDP/GDP $\left(y' / y\right)$ of the EMU member state ratio. Our own calculations based on Eurostat's quarterly data
REAL EXCHANGE RATE	Real exchange rates (e) index (2000 average=100%). Source: ERS, United States Department of Agriculture.

Appendix 2. Data description (continued)

Table 5
Descriptive statistics for monthly data for the panel with 8 cross sections: 1998/10-2003/12

MARKET RISK

	Austria	Belgium	France	Germany	Italy	Netherlands	Portugal	Spain
Mean	2.248506	3.011755	3.820158	4.304242	3.745171	3.027104	3.00624	3.760452
Median	2.086519	2.617973	3.435668	3.812825	3.5486	2.837025	2.818665	3.482125
Maximum	4.973214	7.139443	7.469823	8.607236	7.730505	6.4128	7.326068	7.698977
Minimum	1.560709	1.24687	2.394064	2.330409	2.318071	1.889673	1.530123	2.163114
Std. Dev.	0.578273	1.312033	1.257402	1.603473	1.229161	0.932797	0.995916	1.177494

EMU8

Mean	-1.938133
Median	18.95272
Maximum	253.2226
Minimum	-380.4286
Std. Dev.	157.9432

MEMBER

	Austria	Belgium	France	Germany	Italy	Netherlands	Portugal	Spain
Mean	-0.054746	-0.134036	-0.386433	-0.925374	-0.284699	-0.070635	-0.024737	-0.057472
Median	0.535356	1.310721	3.778868	9.049102	2.784034	0.690725	0.241902	0.562013
Maximum	7.152762	17.51223	50.48853	120.9028	37.19679	9.228603	3.231992	7.50892
Minimum	-10.74594	-26.30946	-75.85134	-181.6381	-55.88252	-13.86457	-4.855576	-11.28101
Std. Dev.	4.461411	10.92295	31.49134	75.41103	23.20085	5.75618	2.015898	4.683558

TRADE

	Austria	Belgium	France	Germany	Italy	Netherlands	Portugal	Spain
Mean	2.247619	2.88254	4.265079	0.679365	2.261905	3.634921	4.260317	6.031746
Median	1.5	2.3	4	0.4	2.4	3.9	4.3	6
Maximum	13.6	9.8	10.3	6.2	5.4	10.8	16.6	10.5
Minimum	-3.6	-3.7	-0.7	-3.4	-1.1	-7.4	-7.9	1.9
Std. Dev.	3.633751	3.386717	2.150181	2.198985	1.253952	4.089529	4.63808	1.981106

LOG (TRADED)

	Austria	Belgium	France	Germany	Italy	Netherlands	Portugal	Spain
Mean	13.86582	15.04216	17.78988	17.82006	19.8233	15.20609	16.62162	18.40176
Median	13.8928	15.09747	17.93917	17.84267	19.8233	15.25649	16.86611	18.39836
Maximum	14.69503	15.88282	18.71098	18.61468	20.26482	16.03867	17.57519	19.18314
Minimum	13.12981	13.85015	16.58183	16.80993	19.12076	13.98976	14.98853	17.46229
Std. Dev.	0.350807	0.433255	0.68846	0.501226	0.23386	0.370557	0.679087	0.50653

BOND

	Austria	Belgium	France	Germany	Italy	Netherlands	Portugal	Spain
Mean	4.854603	4.894921	4.753016	4.649206	4.923492	4.766667	4.913651	4.862381
Median	5.06	5.08	4.93	4.78	5.13	4.92	5.09	5.05
Maximum	5.77	5.79	5.66	5.54	5.75	5.67	5.81	5.76
Minimum	3.74	3.74	3.69	3.62	3.82	3.72	3.77	3.69
Std. Dev.	0.578142	0.577514	0.538863	0.517096	0.556536	0.544311	0.581598	0.572867

Appendix 2. Data description (continued)

Table 5 (continued)

LOG (RESERVES)

	Austria	Belgium	France	Germany	Italy	Netherlands	Portugal	Spain
Mean	9.701383	9.526381	11.06698	11.40466	10.82213	9.852599	9.603671	10.55496
Median	9.768681	9.51392	11.05991	11.42412	10.86735	9.846864	9.634954	10.57457
Maximum	9.982128	9.907743	11.23022	11.51983	10.96809	10.19668	9.850219	11.06093
Minimum	9.21114	9.345133	10.89176	11.2474	10.59122	9.736133	9.224835	9.963123
Std. Dev.	0.211148	0.109276	0.097267	0.070559	0.10271	0.089106	0.157217	0.187303

UNEMPL

	Austria	Belgium	France	Germany	Italy	Netherlands	Portugal	Spain
Mean	3.933	7.573	9.360	8.454	9.844	3.048	4.776	11.617
Median	3.900	7.600	9.100	8.300	9.400	3.000	4.500	11.300
Maximum	5.100	9.600	11.400	10.300	11.800	4.400	6.500	15.000
Minimum	2.900	6.100	7.800	7.200	8.200	2.200	3.800	10.200
Std. Dev.	0.624	0.881	0.909	0.775	1.089	0.513	0.876	1.074

Note:

VaR	Stock market risk (%). VaR indicator is estimated for the indexes of particular EMU stock markets (f). GARCH (1.1) model is used for the parameters estimation.
EMU8	Summed changes in net exports to USA for a sample of 8 EMU member states (Austria, Belgium, France, Germany, Italy, Netherlands, Portugal and Spain) caused by the changes of real exchange rates (ml. USD). Source: Our own evaluations based on U.S. Census Bureau data $\left(\sum_{i=1}^{8} \Delta e_{i(t-5-l)} b_{i1}\right)$.
MEMBER	Changes in net exports to USA of particular EMU member state caused by the changes of real exchange rates (ml. USD). Source: Our own evaluations based on U.S. Census Bureau data $\left(\Delta e_{i(t-5-l)} b_{i1}\right)$.
TRADE	Monthly growth rates of retail trade (Δl) compared to the same period of the previous year (%). Source: Eurostat.
TRADED	Traded volume of stocks. Source Reuters. (n).
BOND	Long-term government bond yields (t) (monthly average, not seasonally adjusted). Source: Eurostat.
RESERVES	Foreign official reserves, including gold in million euros (end of period). Source: Eurostat.
UNEMPL	Harmonised unemployment rates (r).Unemployment according to ILO definition (%). Source: Eurostat.

Appendix 3. Robustness checks

Table 6
Excluding regressors

Number of regressors excluded from equation	(0)	(1)	(2)	(3)	(4)	(5)
EMU8	-0.0003 (-2.6466)	-0.0003 (-2.5418)	-0.0002 (-2.2362)	-0.0002 (-1.6357)	-0.0002 (-1.7715)	-0.0002 (-1.7811)
TRADE	0.0162 (2.7311)	0.0157 (2.5552)	0.0149 (2.4561)	0.0088 (1.3984)	0.0118 (1.8539)	
LOG(TRADED)	0.1278 (1.8941)	0.2029 (3.2333)	0.2799 (5.1262)	0.2999 (5.1754)		
BOND	-0.4018 (-4.6234)	-0.4389 (-4.8851)	-0.3765 (-4.3043)			
LOG(RESERVES)	0.3748 (1.6841)	0.5289 (2.3873)				
UNEMPLOYMENT	0.1429 (2.7170)					
Adj. R2	0.6044	0.6056	0.6077	0.5989	0.5866	0.5876

Note: t-stats. are given in parentheses.

Appendix 3. Robustness checks (continued)

Table 7
Changing the lags for the regressors

Lags	(0)	(3)	(6)	(9)	(12)
	-0.0003	-0.0002	-0.0003	-0.0002	-0.0002
EMU8*	(-2.3723)	(-1.5580)	(-2.0738)	(-1.4863)	(-1.5865)
	-0.0082	0.0125	0.0092	-0.0005	0.0145
TRADE	(-1.3247)	(1.8725)	(1.3306)	(-0.0620)	(2.0475)
	0.1470	0.1514	0.2088	0.1481	0.1745
LOG(TRADED)	(2.0918)	(2.1711)	(2.9526)	(2.1064)	(2.4948)
	-0.3335	-0.3274	-0.1923	-0.1796	-0.0392
BOND	(-3.4699)	(-3.3469)	(-1.8420)	(-1.6741)	(-0.3626)
	0.3628	0.4799	0.6282	0.7376	0.8915
LOG(RESERVES)	(1.5528)	(1.8887)	(2.3427)	(2.8009)	(3.2278)
	0.1372	0.0649	-0.0013	0.0365	0.0173
UNEMPLOYMENT	(2.5370)	(1.1745)	(-0.0231)	(0.6747)	(0.3135)
Adj. R2	0.6056	0.6049	0.6047	0.6034	0.6033

Note: * lag is kept invariant as it appears in the original model.
t-stats. are given in the parentheses.

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Table 1
VaR before and after euro and the growth in absolute terms

Country	**Index**	**Exante (%)** (1995/01-1998/12)	**Expost (%)** (1999/01-2004/08)	**Growth** (% points)
Germany	DAX30	-2.97	-3.97	1.00
Belgium	BEL20	-2.16	-2.76	0.60
France	CAC40	-2.94	-3.50	0.56
Ireland	ISEQ40	-2.09	-2.55	0.46
Spain	IBEX35	-2.96	-3.36	0.40
Finland	HEX25	-3.53	-3.88	0.35
Portugal	PSI20	-2.31	-2.45	0.14
Netherlands	AEX24	-2.66	-2.78	0.12
Italy	MIB30	-3.43	-3.19	-0.24
Austria	ATX20	-2.42	-2.18	-0.24

Note: For normal distribution assumption of returns VaR is computed as: $VaR = -V\left(e^{m+s f^{-1}(a)} - 1\right)$, where V represents the initial value of some theoretical portfolio and $f(\cdot)$ is the cumulative distribution function of the standard normal probability distribution. m and s with GARCH(1.1) are the estimates of the parameters of normal probability distribution function.
Source: Our own estimates based on Reuters data.

Table 2
FGLS estimates of the model (eq.11)

Dependent Variable: x_{it}

Country (i)	b_{i0}	b_{i1}	b_2
Common			0.274* (2.334)
Country Specific			
Austria	883.791	-172.721** (-2.860)	
Belgium	1594.762	-422.875** (-5.282)	
Finland	1391.424	-278.212** (-7.341)	
France	6368.738	-1219.168** (-7.106)	
Germany	16010.822	-2919.492** (-6.719)	
Ireland	11648.354	-2339.249** (-7.451)	
Italy	5265.262	-898.207** (-6.374)	
Luxembourg	-421.855	56.980 (1.140)	
Netherlands	147.510	-222.84* (-1.976)	
Portugal	384.072	-78.044** (-2.727)	
Spain	808.284	-181.321** (-2.675)	
l (lag)		5	6

Unweighted Statistics			
Adj. R-sq.	0.881	S.E. of regression	285.020
Significance of Group Effects Test			
F-stat	34.605 [a]	F-crit. (1%)	2.336
White General Test			
Chi-sq. stat	22.834 [b]	Chi-sq. crit (1%)	15.086
Included Observations			
Total panel obs.	1188	Obs. in cross sections	108

Note:
a) $H_0 : b_{11} = ... = b_{n1}$ of common constant term is rejected. We use the regression model with fixed individual effects as all the results are to be applied only on a sample of EMU countries.
b) H_0 of homoskedasticity is rejected.
t-stats. are given in the parentheses.
** significant at 1%, * significant at 5% confidence level.

Table 3.
FGLS Estimates of alternative models (eq.12 and eq.13)

Dependent Variable: f_i

Model	(1)	(2)	l (lag)
Constant term	-1.601 (-0.837)	-1.841 (-0.968)	
Competativeness change	-1.91E-03* (-2.311)	-2.65E-04** (-2.647)	0
Change in domestic demand	0.016** (2.732)	0.016** (2.731)	3
Traded stock volume [c]	0.132* (1.953)	0.128 (1.894)	1
Bond yields	-0.396** (-4.564)	-0.402** (-4.623)	0
Foreign reserves [c]	0.342 (1.532)	0.375 (1.684)	1
Unemployement	0.144** (2.753)	0.143** (2.717)	0
AR(1)	0.746** (24.399)	0.749** (24.621)	
Unweighted Statistics			
Adj. R-sq.	0.603	0.604	
S.E. of Regression	0.842	0.841	
Significance of Group Effects Test			
F-stat	1.1424[a]	1.1276[a]	
F-crit. (1%)	2.6772	2.6772	
White General Test			
Chi-sq. stat	29.6992[b]	28.1000[b]	
Chi-sq. crit (1%)	27.6882	27.6882	
Included Observations			
Total panel obs.	480	480	
Obs. in cross sections	61	61	

Note:
a) $H_0 : b_{11} = ... = b_{n1}$ of common constant term is accepted.
b) H_0 of homoskedasticity is rejected.
c) Variables are expressed in logs.
t-stats. are given in the parentheses.
** significant at 1%, * significant at 5% confidence level.