Project funded under the Socio-economic Sciences and Humanities

European Commission

Working Paper D.1.1a

How does the European Integration affect the European Stock Markets?

Burcu Erdogan

January 2009

Draft

How does the European Integration affect the European Stock Markets?

Burcu Erdogan[a]

Abstract: This paper examines the integration of stock markets in Germany, France, Netherlands, Ireland and UK over the January 1973- August 2008 period at the aggregate market and industry level considering the following industries: basic materials, consumer goods, industrials, consumer services, health care and financials. The analysis is practised by using correlation analysis, β-convergence and σ-convergence methods. β-convergence serves to measure the speed of convergence and σ-convergence serves to measure the degree of financial integration. We might expect priori that European stock markets have been more integrated during the process of monetary, economic and financial integration in Europe.

We find evidence for an increasing degree of integration both at the aggregate level and also at the industry level, although some differences in the speed and degree of convergence exist among stock markets. To our surprise, there is a downward trend in convergence for certain industries in certain countries in 2000s; especially for those industries, which are more prone to regional shocks, such as health care, financials and consumer services. Moreover, the cross sectional dispersion in health care industry has not shown a regular descending trend. Additionally, EU wide factors can better explain the changes in returns than those of US.

Keywords: Financial integration, EU, stock markets, β-convergence, σ-convergence, correlation analysis

JEL Classification: C22, G15, G12, F36

[a] German Institute for Economic Research (DIW Berlin), Mohrenstr. 58, D-10117 Berlin, berdogan@diw.de.
The research leading to these results has received funding from the European Community's Seventh Framework Program (FP7/2007-2013) under grant agreement number 217266.

Table of Contents

List of Figures

List of Tables

1. Introduction

In the last two decades, European financial markets have faced crucial structural and institutional adjustments with the aim of accelerating the financial integration in money, credit, bond, and equity markets. The integration of the financial markets adds to the effective transmission of the common monetary policy and to economic growth by removing frictions and barriers to exchange and by allocating the capital more effectively. It is important to monitor the state of integration in various segments of the market in order to identify areas where further initiatives are needed.

Integrated stock markets generate better opportunities for international investors by eliminating country specific risks and let them diversify their portfolios across countries. A larger pool of funds other than the limited local financing will be available for the corporations. The integration of European stock markets promotes to decreasing the cost of equity capital. Hence, the number of productive investments increases, which flourishes the economic growth. Moreover, in an economic environment where better risk-sharing opportunities exist, households will be able to smooth their consumption in a better way; in other words wealth effects on consumption will be more relevant. Evaluating the dynamics of the equity market integration is, therefore, important for monetary policy makers.

The main objective of this paper is to investigate the existence and the degree of integration among stock markets in the five member states of the European Union (EU) (Germany, France, Netherlands, Ireland, United Kingdom (UK)) at the country as well as at the industry level. The following industries are under consideration: basic materials, consumer goods, industrials, consumer services, health care and financials.

To address our questions, the paper utilizes methods to measure the degree and speed of financial market integration. Baele et al. (2004) (5) propose three major dimensions to quantify the state and the evolution of financial integration: price-

based, news-based and quantity-based. In this paper, the price-based and news-based dimensions, which measure discrepancies in returns on assets, will be used. They are direct controls of the law of one price that holds if the financial integration is complete. Assets in perfectly integrated stock markets are priced identically, which have the same risk factor and yield ([1].). Yet, it is a hard exercise to identify such assets. However, Babetskii et al. (2007) (3) point to an alternative argument based on the Walras' law of markets for expecting equalization of stock market returns. To be more precise, the Walras' law applied to the financial system implies, if (n-1) (financial) markets are in equilibrium (i.e. the exchange rate, money and bond markets), then the last (stock exchange) market cannot be in disequilibrium.

Our empirical study is based on correlation analysis, β-convergence and σ-convergence approaches. The correlation analysis gives us a general idea about the level and development of the integration process. The speed of integration is determined via beta convergence. Dispersion of financial returns across countries or industries shows how far various markets or industries deviate from integration, namely degree of convergence.

We analyse the time period from January 1973 to August 2008. This period has witnessed several critical economic events in the EU. In January 1973, UK, Ireland and Denmark were brought into the European Economic Community (EEC). The European Monetary System (EMS) was established in March 1979 including an exchange rate mechanism to create stable exchange rates in order to improve trade between EU member states and thus help the development of the single market. This was a forerunner of the progressive realization of Economic and Monetary Union (EMU). EMU has been achieved in three discrete steps. Stage one of the EMU began in July 1990 with the removal of all restrictions on capital movements. In January 1994, stage two of the EMU commenced with the establishment of the European Monetary Institute. Monetary policy was then conducted corresponding to a set of non-binding guidelines. The third and the final stage of EMU began in January 1999 with the introduction of the euro and the irrevocable fixing of exchange rates. The conduct of a single monetary policy under the responsibility of the European Central Bank (ECB) was also initiated at this stage.

How is the integration of stock markets in the EU member countries affected during

[1]See Adjouté and Danthine (2003)(15), Baele et al. (2004) (5) and Bekaert and Harvey (1997) (10) and Adam et al. (2002)(1)

these harmonization efforts? We might expect priori that European stock markets have been more integrated during the process of monetary, economic and financial integration in Europe. As the real economies converge due to increased monetary coordination and as the countries become more interdependent through trade, the expected cash flows and volatilities may converge giving rise to co-movement of profits and dividends of European companies, and consequently the valuation of equities may turn out to be more homogeneous. Additionally, as inflation rates and interest rates converge to a certain level across Europe, dividends and profits of companies are discounted at a similar rate, which may lead to converge of stock returns across countries. Another driving force under the expectation of stock market integration in Europe is the elimination of exchange rate risk with the introduction of the euro. Exchange rate fluctuations are an important source of risk that is priced on capital markets; a more volatility in exchange rate of a country increases the risk premium in that country since investors require a higher return to compensate for the higher uncertainty. Elimination of currency risk result in homogeneous reward to risk ratios across European stock markets. Finally, stock markets have become more synchronized due to improvements in computer and communication technology; and therefore a faster information transmission and processing.

This paper is organized into five sections. After the introduction, section 2 provides a review of the existing literature on the integration of stock markets in Europe. Section 3 summarizes the methods to measure convergence. The first subsection considers correlation analysis, the second subsection considers β-convergence and the third subsection includes σ-convergence method. Section 4 then considers the data and the empirical analysis of stock market integration in Europe. The final section is the conclusion.

2. Literature

Different studies and approaches have been undertaken to analyze and measure the progress of stock market integration in Europe. ECB publishes regular annual reports on "Financial Integration in Europe" [1] with the purpose of contributing towards the advancement of European financial integration and raising public awareness of the Eurosystem's role in supporting the financial integration process. Hartmann, Maddaloni and Manganelli (2003) (20) provide an overview of the structure and integration of the euro area financial systems, and a comparison of the US and Japan financial structures with that of the euro area at the national level.

A part of the literature tends to assess how far global factors affect expected returns in national markets using specific asset pricing models[2]. Hardouvelis, Malliaropulos and Priestley (1999, 2006) (18) (19) estimate a conditional asset pricing model to determine the importance of EU-wide risk relative to country-specific risk, and they report a tendency toward higher market integration. Hardouvelis et al. (2004) (17) provide evidence for diminishing country effects and amplifying sector effects as stock market integration increases. The disadvantage of this part of the literature is that the results depend on the specification of the asset pricing model. Ayuso and Blanco (1999) (2) show that there has been an increase of the degree of market integration between stock markets during the nineties using a refinement of the approach suggested by Chen and Knez (1995) (14), whose advantage is being dependent on the condition of absence of arbitrage opportunities. On the other side, the disadvantage of this method is that it fails to control for the dynamics of the integration process.

Fratzscher (2002) (16) proposes a multivariate GARCH model to analyze the integration process of European equity markets since the 1980s. This approach allows him to evaluate the relative importance of regional shocks originating in the euro

[1] The first report was published on 28 March 2007 (7) and the second one was published on 29 April 2008 (8).

[2] See Bekaert and Harvey (1995)(9) and Stulz and Karolyi (2001) (22)

area with respect to global shocks coming from the rest of the world (US). He concludes that European equity markets have become more integrated with each other and have gained importance in world financial markets since 1996, and the exchange rate variability reduced in the mean time. The driving force behind these outcomes is suggested to be the convergence of interest rates.

There is another branch of papers that investigate the relative importance of country versus industry effects in explaining equity returns. Heston and Rouwenhorst (1995) (21) find that industrial structure explains very little of the cross-sectional difference in country return volatility from 1978 to 1992 and state that diversification across countries within an industry is a much more effective tool for risk reduction than industry diversification within a country. On the other hand, there are more recent studies, which show that the industry effects are becoming more important. Baca et al. (2000) (4), Cavaglia et al. (2000) (13), Brooks and Del Negro (2004) (11) are among those studies.

Adjouté and Danthine (2003)(15), provide a comprehensive review of the recent developments in European equity returns. They calculate the cross sectional dispersion in country and sector returns to measure their relative importance using a multifactor model that allows for equity returns to be affected not only by the global market portfolio, but also by country and sector factors. As the cross sectional dispersion increases, the diversification potential also increases. They find that between 1980 and 1990, country diversification has been better, whereas, the potential of diversifying across sectors rose afterwards

Adam et al. (2002) (1) apply a quantity-based approach and report data on international portfolio diversification for investment funds, pension funds and insurance companies in Europe. Their results suggest that there is an increased financial integration of the euro area equity markets, although considerable differences within euro area countries persist.

Baele et al. (2004) (5) present a set of specific measures to quantify the state and evolution of financial integration in the euro area in different markets based on the law of one price. They develop two types of indicators, namely price-based and news-based measures. Related to the evolution of the home bias, they build up a number of quantity-based indicators. Their results point out that the unsecured money market is fully integrated, while integration is reasonably high in the government and corporate bond market, as well as in the equity markets. The credit market is among

the least integrated, especially in the short-term segment.

There are some studies that evaluate financial integration for some new EU member states within themselves and the with the euro zone, such as Cappiello et al. (2006) (12), Babetskii, Komarek and Komarkova (2007) (3) and Baltzer et al. (2008) (6). Cappiello et al. (2006) (12) use a factor model for market returns to show that the integration of the new EU member states with the euro area increased during the process of EU accession. The Czech Republic, Hungary and Poland are found to exhibit return co-movements both between themselves and with the euro area. Babetskii et al. (2007) (3) provide evidence for β- and σ-convergence of stock market returns in the Czech Republic, Hungary, Poland and Slovakia using country as well as sectoral indices. They do not find strong indications on the effect of the EU accession of all four countries. Baltzer et al. (2008) (6) use price-based, new-based and quantitiy-based measures to find that financial markets in the new EU Member States (plus Cyprus, Malta and Slovenia) are significantly less integrated than those of the euro area, whereas, there is strong evidence that the process of integration is well under way and has accelerated since accession to the EU.

This paper differs from the previous studies for two reasons. First, to the best of our knowledge, it is the first application of β- and σ- convergence of equity returns in Germany, France, Netherlands, Ireland and UK. Second, we apply these approaches not only to the national, but also to the industry level.

3. Methods to Measure Convergence

3.1. Correlations

In order to get a first stance about the degree of stock market integration, we will exercise a standard correlation analysis of stock market returns. The intuition of this approach is that the more integrated the markets are, the higher is the co-movement between their prices. It is worth noting that higher correlation alone is not a necessary or sufficient condition for greater market integration. The data should be examined further to be able to derive conclusions about stock market integration.

3.2. β-Convergence

β-convergence is an indicator borrowed from the growth literature, where it has been used to assess regional or cross-country per capita income and productivity convergence. Adam et al. (2002) (1) has proposed the exercise of this concept to refer to the speed at which financial markets integrate. We run the following time series regression for the respective national market or industry to be studied:

$$\Delta R_{i,t} = \alpha_i + \beta R_{i,t-1} + \sum_{l=1}^{L} \gamma_l \Delta R_{i,t-l} + \epsilon_{i,t} \tag{3.1}$$

where $R_{i,t}$ represents the return spread between respective national or industry asset in country i and the benchmark return at time t. Δ is the difference operator, α is the country specific constant and $\epsilon_{i,t}$ is the white-noise disturbance. The lag length L is based on the Schwarz information criterion. To allow betas to vary over time, we introduce four dummy variables that distinguish between different periods, relative to basis period 1973m1-1979m2. The following periods are considered

specifically: Establishment of EMS (1979m3-1990m6), stage one of EMU (1990m7-1993m12), stage two of EMU (1994m1-1998m12) and finally stage three of EMU after the introduction of euro (1999m1-2008m8). The construction of β is as follows: $\beta R_{i,t-1} = \beta_0 R_{i,t-1} + \beta_1 D_1 R_{i,t-1} + \beta_2 D_2 R_{i,t-1} + \beta_3 D_3 R_{i,t-1} + \beta_4 D_4 R_{i,t-1}$.

A negative β coefficient means that convergence takes place and the size of β is a direct measure of the speed of convergence. This allows us to compare integration across different industries, countries and sample periods. The larger is the beta in absolute value, the faster is the convergence. The intuition behind this reasoning is that returns in countries or industries, where returns are relatively high, tends to decrease more rapidly than those in countries or industries with low returns.

The fact that market capitalisations differ tremendously across countries and industries in the sample necessitates the construction of separate benchmarks for each country-industry pair excluding the industry in the country under consideration. The local markets in UK, Germany and France can have a larger influence on a single European benchmark yield, which would bias the estimates of convergence. This is true not only at the aggregate level but also at the industry level. Therefore, we construct separate benchmark indices for each country-industry combination. As an illustration, assume that we calculate the benchmark index for industry j in country i. First of all, we determine all the weight series for each country-industry combination by means of the corresponding market capitalisations for our whole sample period. Then, we normalise the weights of all other country-industry pairs excluding the weight of industry j in country i. Using these normalised weights, we recalculate the benchmark index industr j in country i, where we omit the index of itself. In the end, we have 35 benchmark indices for our analysis.

We also use an alternative measure of integration, which is "news-based". Integration of stock markets implies that the asset prices react only to common news; local shocks do not constitute a systematic risk. In other words, purely local shocks can be diversified away with a portfolio of assets from different regions. Therefore, the proportion of asset price changes that is explained by common factors represents a news-based measure for the integration of equity markets. In this paper, we take the benchmark indices, of which calculation is explained above, as a proxy for common EU news; and US total market and industry indices as a proxy for global news -with the aim of a comparison of integration of stock markets EU wide and world wide. We implicitly assume that the degree of systematic risk is identical across compared

assets. If the markets are integrated, then the assets across countries should all react to common news the same way as the benchmark index does. We run the following regression for the respective national or industry index to separate common influences from local:

$$\Delta R_{i,t} = \alpha_{i,t} + \beta^*_{i,t} \Delta R_{b,t} + \epsilon_{i,t} \tag{3.2}$$

where $\Delta R_{i,t}$ is defined as the change in return of an asset from time $t-1$ to time t in country/industry i. Similarly, $\Delta R_{b,t}$ represents the return change from time $t-1$ to time t in the benchmark index. $\alpha_{i,t}$ is a time varying intercept, $\beta^*_{i,t}$ is the time dependent beta with respect to the benchmark index and $\epsilon_{i,t}$ country/industry specific white-noise error. As the integration increases, the intercept $\alpha_{i,t}$ converges to zero, the beta converges to one and the proportion of the variance in explained $\Delta R_{i,t}$ by the common factor $\Delta R_{b,t}$ increases towards 1. The first argument arises from the fact that in fully integrated markets, changes in return should not be systematically larger or smaller than those in the benchmark market. The second argument stems from the definition of the beta:

$$\beta^*_{i,t} = \frac{Cov_{t-1}\left(\Delta R_{i,t}, \Delta R_{b,t}\right)}{Var_{t-1}\left(\Delta R_{b,t}\right)} = \rho_{i,b,t} \frac{\sigma_{i,t}}{\sigma_{b,t}} \tag{3.3}$$

where Cov_{t-1} and Var_{t-1} are respectively the conditional covariance and variance operators, $\rho_{i,b,t}$ is the conditional correlation between return changes of the local and the benchmark assets, and $\sigma_{i,t}$ and $\sigma_{b,t}$ are the conditional standard deviations of these return changes respectively. The higher is the market integration; the closer is the correlation between return changes of the relevant assets. The local country/industry volatility should converge towards that of the benchmark index, since the common factors should drive the changes in returns. Accordingly, $\beta^*_{i,t}$ should converge to one. The size of the betas should be an indicator of the degree of integration. As we mentioned above, the country/industry specific error $\epsilon_{i,t}$ shrinks as integration increases, and therefore, the third argument follows. This fact enables us to use another alternative measure for the integration of markets: the proportion of local/industrial variance explained by the common or global factor. More specifically, the variance ratio should converge to one, as the markets get more and more integrated.

Finally, as we are interested in the dynamics of conversion over time, we use a simple moving regression technique. We repeatedly move the data window of three years one month ahead and re-estimate until the last observation is reached, so that we derive a time series for $\beta^*_{i,t}$.

3.3. σ-Convergence

β convergence measures the speed of convergence, however, it does not indicate to what extent markets are already integrated. Adam et al. (2002) (1) proposed an indicator to measure the degree of integration, namely σ-convergence, which they also borrowed from the growth literature. It is the cross-sectional dispersion in stock returns, which can be calculated at each point in time by taking the standard deviation of industry or aggregate market returns across countries. Convergence takes place if the cross-sectional dispersion of a variable decreases over time. In case the cross-sectional dispersion converges to zero, full integration is reached.

4. Empirical Analysis

4.1. Data

In our paper, stock market integration is analysed using Datastream [1] stock market indices with a monthly frequency. Datastream indices cover a wide range of national stock markets and typically at least 80% of the total market capitalisation for each country, which makes it a more accurate representation of the whole market available. A number of sector indices are also included in Datastream. Since Datastream indices are consistent, homogeneous and thereby comparable across countries, they are widely preferred in empirical research. One of the most attracting features of this databank is that the stock market indices are available starting from January 1973 for the most developed economies. This makes it possible to investigate the whole period after the Bretton Woods System of fixed exchange rates.

The selection of the data is driven by the availability of data for a longer time series and for a larger sample of countries and industries. Datastream country and industry indices are transformed into returns by taking percentage changes for our study. The data cover monthly stock returns in Euro[2] from January 1973 to August 2008 for five EU countries: Germany, France, Netherlands, Ireland and United Kingdom (UK). The benchmark indices are calculated as explained in section 3.2. US aggregate market and industry indices are extracted from Datastream. The national market returns together with returns for the following industries for each country are investigated: basic materials, consumer goods, industrials, consumer services, health care and financials. Only for health care industry in Ireland, the time series starts later on July 1981.

[1] I would like to thank the Financial and Economic Data Center (FEDC) of the SFB 649 at Humbold University of Berlin for providing me a guest account for Datastream.

[2] The stock indices for UK and US were in the respective local currency. Exchange rates covering to whole sample period are extracted from World Market Monitor of Global Insight and the indices are transformed into Euro using those exchange rates.

Figure A.1 shows smoothed return series series of aggregate markets for the whole sample period for all the countries under consideration. The vertical lines indicate the time intervals that we tend to analyse, sequentially: before EMS, introduction of EMS, stage one of EMU, stage two of EMU, stage three of EMU (introduction of euro). The return series are smoothed using Hodrick-Prescott (HP) filter with a λ of 14400 for the monthly data. The returns move closer starting from 1990s, which might point out that common euro area factors became more important for the stock markets across Europe afterwards. In the early 2000s, this co-movement becomes more striking. Yet, in the last two years, returns start to diverge again.

4.2. Correlations

Table B.1 serves for a preliminary analysis of correlations between aggregate market/industrial stock returns and the relevant EU benchmark returns. The first column reports the correlations in the basis period (1973m1-1979m2), and the succeeding columns show the change in correlation with respect to previous period. Only for health care industry in Ireland, the second column includes the basis correlation value.

We examine the change in correlation structure by performing a specific test following Taylor and Tonks (1989) (23). If $\hat{\rho}$ is the sample correlation coefficient between two markets, a statistic ξ can be constructed as follows (Kendall and Stuart, 1967):

$$\xi = \frac{1}{2}\ln\left(\frac{1+\hat{\rho}}{1-\hat{\rho}}\right) \sim N\left[\frac{1}{2}\ln\left(\frac{1+\rho}{1-\rho}\right), \frac{1}{T-3}\right] \tag{4.1}$$

where ρ is the population correlation coefficient and T is the sample size. The test statistic for the equality of the correlation coefficients between period 1 and period 2 can be constructed as:

$$\zeta = \frac{\xi_1 - \xi_2}{var(\xi_1) - var(\xi_2)} \sim N(0,1) \tag{4.2}$$

The null hypothesis for the test is $H_0 : \rho_1 = \rho_2$. If the test statistic rejects H_0, we can conclude that there is a significant difference in correlation coefficients between two periods.

Table B.1 reports the test results. The correlation changes with " $*$ " indicate an increase and with " $**$" indicate a decrease in correlation coefficients with respect to the previous period at a significance level of 10%. When we look at *Table B.1*, we see a certain pattern in the change of correlation coefficients. The stock markets in Germany and France became significantly more correlated with the EU benchmarks for all industries at the first stage of EMU, when all the capital restrictions were removed. Netherlands's stock markets started to be more correlated with EU already before stage one, during the period of EMS. The significant increase in correlations of British stock markets started during EMS and continued at the first stage of EMU. Strikingly, the third period of EMU; after the introduction of euro; is the period when we observe most of the significant decreases in the correlation coefficients, especially in the health care industry. This might suggest that, at this stage of EMU, health care industries at almost all countries were affected by local factors rather than EU wide factors. The stock market returns in Ireland are less correlated with EU than the returns in other countries for all sectors. Ireland stock market seems to be isolated from other EU stock markets in that sense.

4.3. β-Convergence

We run the regression in (3.1) to see the speed of convergence for the aggregate market and industries in stock markets. The results are reported in *Table C.1*. Note that we only present the significant betas. The p-values other than 0 are given in brackets. "$*$" corresponds 5%, "$**$" to 10% and "$***$" to 15% significance level. For the health care industry in Ireland base time interval is 1979m2-1990m6, for all the other country and industries it is 1973m1-1979m1. All the betas given in the succeeding periods are the significant changes in betas in the relevant time period.

First of all, all constants in all regressions are not significantly different from 0, which denotes unconditional convergence of stock returns. All the β coefficients in the base periods for all industries in all countries are negative in the base time period, meaning that in fact convergence takes place for all and in fact at a high speed. We can distinguish the speeds of convergence looking at the size of the betas. Note that a significant negative change in beta refers to an accelerated convergence, whereas a significant positive change refers to a slow down in convergence. *Table C.1* offers that the convergence takes place for the stock markets of all countries for every industry,

however, the speed of convergence changes across countries and industries. The industries converge at a different speed than the market, which justifies an analysis at an industry level.

The estimation of β coefficients could also be performed in a seemingly unrelated regressions (SUR) framework where a dependency between the equations is allowed. For instance, the residuals from equations within an industry might be interdependent. To be more precise, there might be such a shock that hits only a specific industry accross Europe. First of all, we test statistically whether a SUR model - which takes a certain industry as a system- is necessary at all. If ρ_{ij} is the correlation coefficient between the residuals of independent equations for country $i \in \{1, 2, ...N\}$ and country $j \in \{1, 2, ...N\}$, where the set $\{1, 2, ...N\}$ represents all the sample countries, the test statistic is as follows:

$$T \sum_{i,\forall i} \sum_{j,j>i} \rho_{ij}^2 \sim \chi^2_{\frac{N(N-1)}{2};1-\alpha} \tag{4.3}$$

The null hypothesis H_0 : *the correlation coefficients are the same* $\forall i, j$. We run the test for each industry, reject H_0 for all at a significance level of 5% and find out that for all the industries a SUR model would bring more efficiency to the system. *Table C.2* reports the β estimates from SUR model. The betas change slightly, but they are still negative and offer a high speed of convergence for the stock markets of all countries for all industries. The standard errors of the coefficients from SUR model are less than those of the independent equation estimations.[3]

For a robustness check, we also run a Quandt-Andrews break point test for all estimations of equation (3.1) but without the introduction of time dummies. Quandt-Andrews break point test checks whether there is a structural change in the original equation parameters. The null hypothesis for this test is that there are no breakpoints within trimmed data. Maximum LR F-statistics suggest that there exists a break point in betas from the industries health care and consumer services in Ireland; and from consumer services in France at a significance level of 5%.[4] In other words, the speed of convergence changes at certain times for the named industries and countries. It is interesting that, the significant break points exist for service

[3]The estimation outputs are not reported here for briefness, however they are available from the author on request.

[4]Results of Quandt-Andrews break point test for each estimation are available from the author on request.

industries, which are more prone to regional shocks; and for Ireland, of which stock market could be more affected by local shocks rather than EU wide shocks.

Another robustness check we perform is adding a business cycle component to our regression (3.1) in order to see whether the stock market integration depends on the stance of the business cycle. In order to control for it, we include German industry production index, which is available at a monthly frequency, as a proxy for business cycle indicator. The betas do not change significantly when we add the industry production index as an explanatory variable to our regressions. For the sake of brevity, we do not present all results here, but they are available on request.

Moreover, we run the regression (3.2) in order to compare the convergence to EU and convergence to US. We obtain a time series for β^* estimations using a moving regression method. The convergence of β^*s to one denote convergence to benchmark, and the size of the β^* is an indicator of degree of integration. The variance ratio is also an indicator of convergence; it should converge to one, as the markets get more and more integrated. We report our results for βs and variance ratios of all national and industry returns of all countries in Appendix. When we look at the β^* estimations, we see a general trend of increasing convergence to EU benchmark, as well as to US benchmark; β^*s move to and around one. Broadly speaking for all industries, returns converge to EU benchmarks to a greater extent than those of US. This points that EU wide factors can better explain the changes in returns. A closer look at the graphs indicate that there is a decrease in convergence at certain countries and certain industries after the introduction of the euro; that is basic materials in France; consumer goods in UK and Ireland; health care in UK; consumer services in Germany and France; financials in UK and Ireland. The graphs for variance ratios also reveal that there is an increasing trend of convergence; and convergence to EU is actually better than convergence to US. Interesting enough, we also see a downward trend in convergence in the 2000s in the following industries: basic materials in France, UK, Ireland and Netherlands; consumer goods in UK and Ireland; health care in UK, Ireland, France and Netherland; financials in UK,Ireland, France and Netherland; and industrials in Germany.

The evidence of decreasing convergence after the introduction of euro is just the opposite of what we expected. There are several arguments, which could have produced this outcome. First, the origins of the random shocks may be regional. When we consider the industries, where we observe decrease in convergence in the recent years,

we see that they are generally the ones which may be susceptible to regional shocks; such as health care, consumer services and financials. Alternatively, diminishing convergence might be a result of country-specific economic effect of global shocks. Heterogeneous industrial structures of countries, differences in the structure of the banking system and in the credit channel affect the transmission of global shocks to asset values in different ways. Even if a common monetary policy is fulfilled, the transmission of monetary policy to economic activity may divert across countries. Finally, if a country becomes more specialized in an industry, the contents of country indices become different leading to less synchronized returns. This is in fact a consistent with market integration: different industries may be outstanding in each country. Therefore, economic shocks may selectively affect specific industries; hence effects on countries may differ.

4.4. σ-Convergence

Figure D.1 plots the HP filtered country and industry dispersions. Country dispersion was higher than that of industry up to the introduction of euro, hence country diversification used to be better than industry diversification. Together with the introduction of euro, industry dispersion exceeded country dispersion. Therefore, industry diversification became superior to country diversification in the last stage of EMU.

When we look at the cross section dispersions for each industry (*Figure D.2*), we observe that there is a decrease in volatility in all industries other than health care industry. In other words, we observe σ-convergence for all but not for health care industry. This industry should be affected by different local shocks in each country. Finally, the σ-convergence is continuous for consumer goods industry, but in other industries volatility increases in the mid 2000s. The arguments explaining the fall in degree of convergence are presented in the previous subsection.

5. Conclusion

This paper's main objective is to investigate the existence and the degree of convergence among stock markets in Germany, France, Netherlands, Ireland and UK at the country and industry level considering six different industries: basic materials, consumer goods, industrials, consumer services, health care and financials. We used correlation analysis, β-convergence and σ-convergence methods to deal with our questions. β-convergence serves to measure the speed of convergence and σ-convergence serves to measure the degree of financial integration.

To summarize our results, stock markets that we studied show an increasing degree of integration both at the aggregate market level and also at the industry level, although some differences in the speed and degree of convergence exist among stock markets. There is a downward trend in convergence for certain industries in certain countries in 2000s; especially for those industries, which are more prone to regional shocks, such as health care, financials and consumer services. The countries might have been specialized in different industries resulting in less synchronized returns. In addition, EU wide factors can better explain the changes in returns than those of US. In the mid 2000s, the degree of stock market integration falls considerably for all industries. The cross sectional dispersion in health care industry has not shown a regular descending trend; regional shocks could have affected this industry differently in each country.

The finding in this paper should be investigated further. The scope of this paper is not that extensive to capture the impacts of regional and global shocks on European stock markets. Future research may explore different sources of shocks on stock markets and their affects.

Bibliography

[1] Klaus Adam, Tullio Jappelli, Annamaria Menichini, Mario Padula, and Pagano Marco.
Analyse, compare, and apply alternative indicators and monitoring methodologies to measure the evolution of capital market integration in the european union?
Report to the European Commission, pages 1–95, 2002.

[2] Juan Ayuso and Roberto Blanco.
Has financial integration increased during the nineties?
Banco de España, Servicio de Estudios Documento de Trabajo no. 9923, 1999.

[3] Ian Babetskii, Luboš Komárek, and Zlatuše Komárková.
Financial integration of stock markets among new eu member states and the euro area.
Czech Journal of Economics and Finance (Finance a uver), 57(7-8):341–362, 2007.

[4] Sean P. Baca, Brian L. Garbe, and Richard A. Weiss.
The Rise of Sector Effects in Major Equity Markets.
Financial Analysts Journal, 56(5):34–40, 2000.

[5] Lieven Baele, Annalisa Ferrando, Peter Hördahl, Elizaveta Krylova, and Cyril Monnet.
Measuring financial integration in the euro area.
Occasional Papaer Series No. 14, European Central Bank, pages 1–93, 2004.

[6] Markus Baltzer, Lorenzo Cappiello, Roberto A. De Santis, and Simone Manganelli.

Measuring financial integration in new EU member states.
Occasional Papaer Series No. 81, European Central Bank, 2008.

[7] European Central Bank.
Financial Integration in Europe.
April, 2007.

[8] European Central Bank.
Financial Integration in Europe.
April, 2008.

[9] Geert Bekaert and Campbell R. Harvey.
Time-Varying World Market Integration.
Journal of Finance, 50(2), 1995.

[10] Geert Bekaert and Campbell R. Harvey.
Emerging equity market volatility.
Journal of Financial Economics, 2004.

[11] Robin Brooks and Marco Del Negro.
The rise in comovement across national stock markets: market integration or IT bubble?
Journal of Empirical Finance, 11(5):659–680, 2004.

[12] Lorenzo Cappiello, Bruno Gérard, Arjan Kadareja, and Simone Manganelli.
Financial integration of new eu member states.
Working Paper Series, European Central Bank, no. 683, 2006.

[13] Stefano Cavaglia, Christopher Brightman, and Michael Aked.
The Increasing Importance of Industry Factors.
Financial Analysts Journal, 56(5):41–54, 2000.

[14] Zhiwu Chen and Peter J. Knez.
Measurement of Market Integration and Arbitrage.
Review of Financial Studies, 8(2):287–325, 1995.

[15] Jean-Pierre Danthine and Kpate Adjaouté.
European Financial Integration and Equity Returns: A Theory Based Assessment, pages 185–246.
European Central Bank, Frankfurt, 2003.

[16] Marcel Fratzscher.
Financial market integration in europe: On the effects of emu on stock markets.
International Journal of Finance & Economics, 7(3):165–93, 2002.

[17] Gikas A. Hardouvelis, Richard Priestley, and Dimitrios Malliaropulos.
The Impact of Globalization on the Equity Cost of Capital.
Discussion Paper Series, No. 4346, Centre for Economic Policy Research, 2004.

[18] Gikas A. Hardouvelis, Richard Priestley, and Dimitrios Malliaropulos.
Emu and european stock market integration.
Discussion Paper No. 2124, Centre for Economic Policy Research, 79(1), 2006.

[19] Gikas A. Hardouvelis, Richard Priestley, and Dimitrios Malliaropulos.
Emu and european stock market integration.
Journal of Business, 79(1), 2006.

[20] Philipp Hartmann, Angela Maddaloni, and Simone Manganelli.
The Euro-area Financial System: Structure, Integration and Policy Initiatives.
Oxford Review of Economic Policy, 19(1):180–213, 2003.

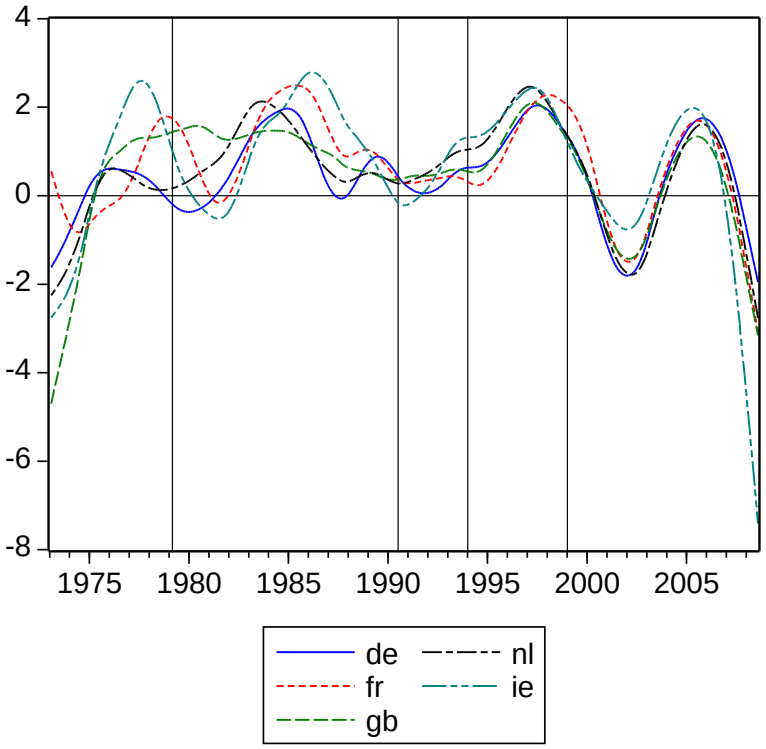
[21] Steven L. Heston, K. Geert Rouvenhorst, and Roberto E. Wessels.
The structure of international stock returns and the integration of capital markets.
Journal of Empirical Finance, 8(2):173–197, 1995.

[22] René Stulz and G. Andrew M. Karolyi.
Are financial assets priced locally or globally?
Paper No. 2001-11, Dice Center, 2001.

[23] Mark P Taylor and Ian Tonks.
The internationalisation of stock markets and the abolition of u.k. exchange control.
The Review of Economics and Statistics, 711(2):332–36, 1989.

A. Data

Figure A.1.: Returns of the Aggregate Stock Markets



B. Correlations

Table B.1.: Correlations of Stock returns with EU benchmark returns

	'73m1-'79m2	'79m3-'90m6	"90m7-'93m12	'94m1-'98m12	'99m1-'08m8
	Correlation	Change in correlation w.r.t. previous period			
GERMANY					
Market	0,535	0,006	0,278*	0,037	0,036
B. Mater.	0,460	0,042	0,275*	-0,012	-0,066
Indust.	0,556	-0,131	0,396*	-0,113**	0,156*
Cons. Gds	0,312	0,088	0,334*	0,087	-0,020
Hlth Care	0,389	0,095	0,184*	0,088	-0,141**
Cons. Svs	0,376	0,065	0,210*	-0,146	0,267*
Finan.	0,294	0,222*	0,240*	-0,008	0,068
FRANCE					
Market	0,525	0,049	0,272*	0,038	0,046*
B. Mater.	0,392	0,115	0,326*	0,035	-0,150**
Indust.	0,445	-0,025	0,409*	-0,044	0,063
Cons. Gds	0,216	0,264*	0,256*	0,068	0,020
Hlth Care	0,342	0,158*	0,127	0,174*	-0,229**
Cons. Svs	0,418	0,126	0,107	0,107	0,114*
Finan.	0,362	0,068	0,413*	-0,025	0,057*
NETHERLANDS					
Market	0,663	0,151*	-0,058	0,049*	-0,034
B. Mater.	0,632	-0,032	0,122	0,130*	-0,066
Indust.	0,562	-0,016	0,096	0,069	0,146*
Cons. Gds	0,220	0,204*	0,149	0,046	-0,133
Hlth Care	0,382	0,268*	0,011	0,019	-0,109
Cons. Svs	0,374	0,152*	0,253*	-0,027	0,115*
Finan.	0,688	0,086*	0,046	0,009	0,060*
IRELAND					
Market	0,398	0,235*	0,084	0,077	-0,163**
B. Mater.	0,355	0,254*	0,032	0,094	-0,082
Indust.	0,155	0,107	0,316*	-0,326**	-0,019
Cons. Gds	0,197	0,146	0,075	0,165	-0,001
Hlth Care	NA	0,471	0,032	-0,082	-0,254**
Cons. Svs	0,170	0,407*	0,009	-0,003	0,031
Finan.	0,594	-0,190**	0,220*	0,124	-0,050
UNITED KINGDOM					
Market	0,431	0,160*	0,175*	0,100*	-0,048
B. Mater.	0,408	0,175*	0,168*	-0,060	0,023
Indust.	0,408	-0,017	0,303*	-0,049	0,147*
Cons. Gds	0,346	0,065	0,206*	-0,121	0,118
Hlth Care	0,136	0,486*	0,027	0,049	-0,099
Cons. Svs	0,291	0,216*	0,094	0,126	0,070
Finan.	0,429	0,137*	0,105	0,122*	0,073*

C. β-Convergence

Table C.1.: Beta Estimates

	'73m1-'79m2	'79m3-'90m6	"90m7-'93m12	'94m1-'98m12	'99m1-'08m8
MARKET					
DE	-1.192*	0.160**(0.099)			
FR	-1.020*				
NL	-1.103*				0.246*(0.033)
IE	-1.066*				0.237**(0.055)
UK	-1.103*	0.167***(0.104)			
BASIC MATERIALS					
DE	-1.0172*				0.268*(0.014)
FR	-1.149*				
NL	-0.975*				
IE	-1.077*				
UK	-0.918*			-0.272**(0.086)	
INDUSTRIALS					
DE	-1.072*	0.272*(0.005)			
FR	-0.932*				-0.227***(0.117)
NL	-0.986*	0.205*(0.045)			
IE	-1.106*			0.236***(0.110)	
UK	-1.089*				
CONSUMER GOODS					
DE	-1.169*				
FR	-1.181*				
NL	-0.941*				
IE	-1.539*	0.407* (0.002)	0.330* (0.043)	0.437** (0.053)	0.620* (0.000)
UK	-1.074*				
HEALTH CARE					
DE	-0.979*				-0.241** (0.056)
FR	-0.988*				
NL	-0.981*	-0.158*** (0.144)		-0.274** (0.096)	
IE	NA	-1.035*		-0.345*** (0.137)	
UK	-0.942*				
CONSUMER SERVICES					
DE	-1.006*	0.224* (0.022)			
FR	-0.827*	-0.194** (0.056)		-0.435* (0.032)	
NL	-1.070*				
IE	-0.591*	-0.367* (0.006)	-0.508* (0.005)	-0.517* (0.002)	-0.615* (0.000)
UK	-0.975*				
FINANCIALS					
DE	-1.013*				
FR	-1.026*		0.454* (0.035)		
NL	-0.999*				-0.206* (0.057)
IE	-1.117*				0.342* (0.005)
UK	-1.110*				

Table C.2.: Beta Estimates from SUR Model

	Market	Basic Mat.	Indust.	Cons. Goods	Health Care	Cons. Services	Financ.
DE	-0.966*	-0.936*	-0.934*	-1.123*	-0.985*	-0.917*	-0.993*
FR	-1.016*	-1.071*	-0.976*	-1.262*	-0.989*	-0.919*	-1.014*
NL	-1.036*	-0.968*	-0.895*	-0.926*	-1.066*	-1.123*	-1.024*
IE	-1.019*	-1.059*	-1.070*	-1.147*	-1.064*	-0.854*	-1.056*
UK	-0.950*	-0.968*	-0.940*	-1.044*	-0.955*	-0.973*	-0.983*

Figure C.1.: Convergence in Market Returns, EU-US Comparison

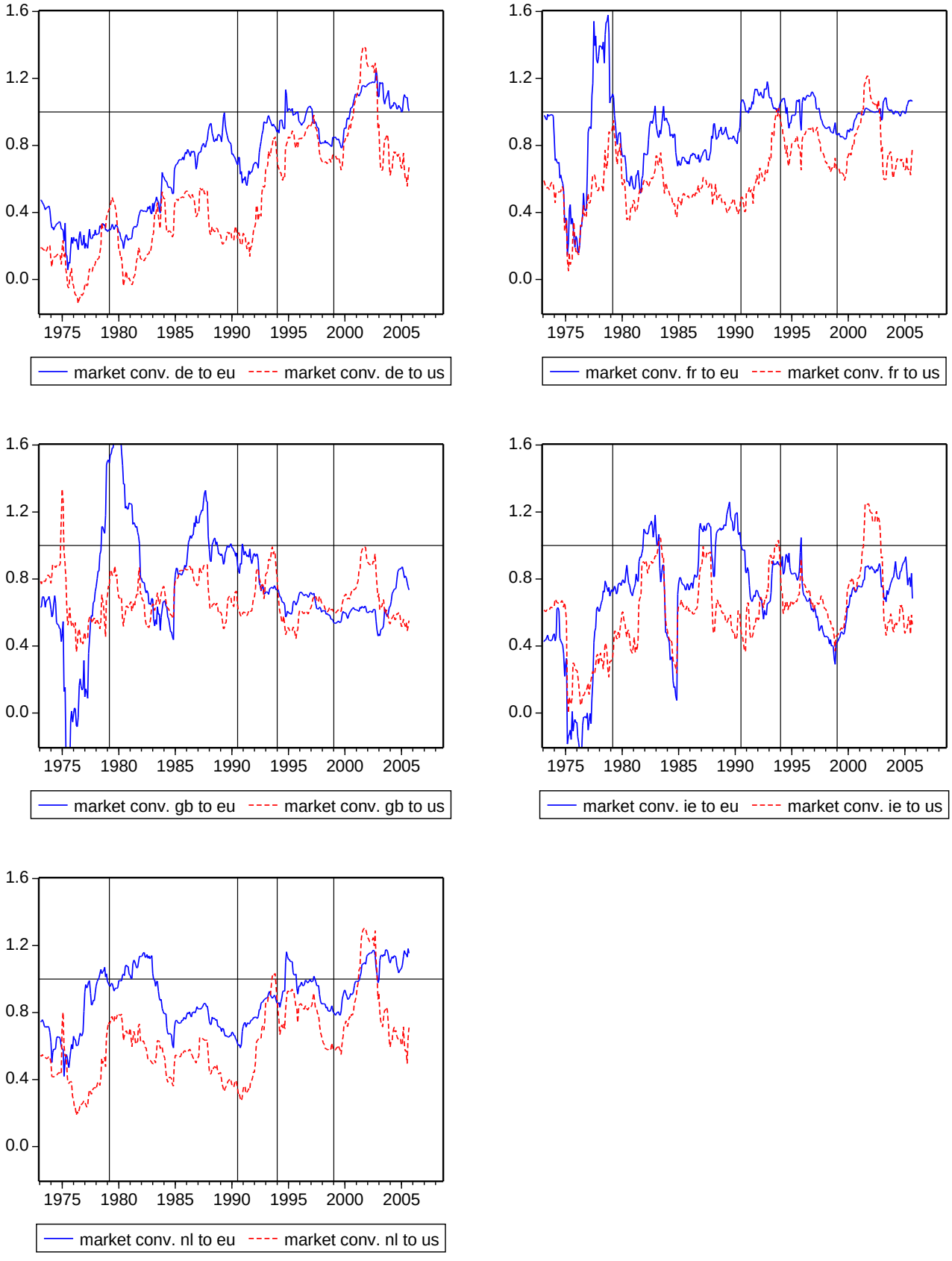


Figure C.2.: Convergence in Basic Materials, EU-US Comparison

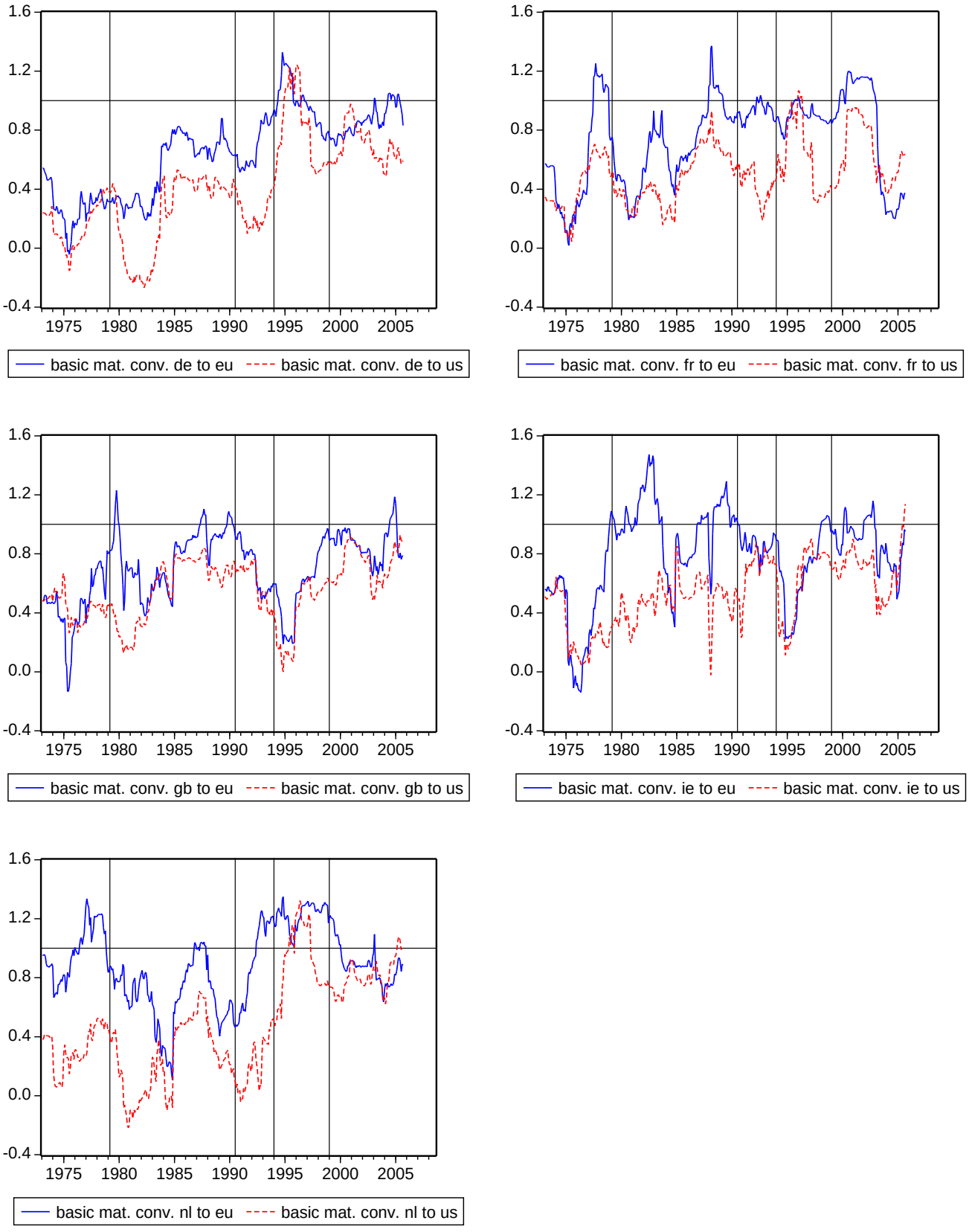


Figure C.3.: Convergence in Industrials, EU-US Comparison

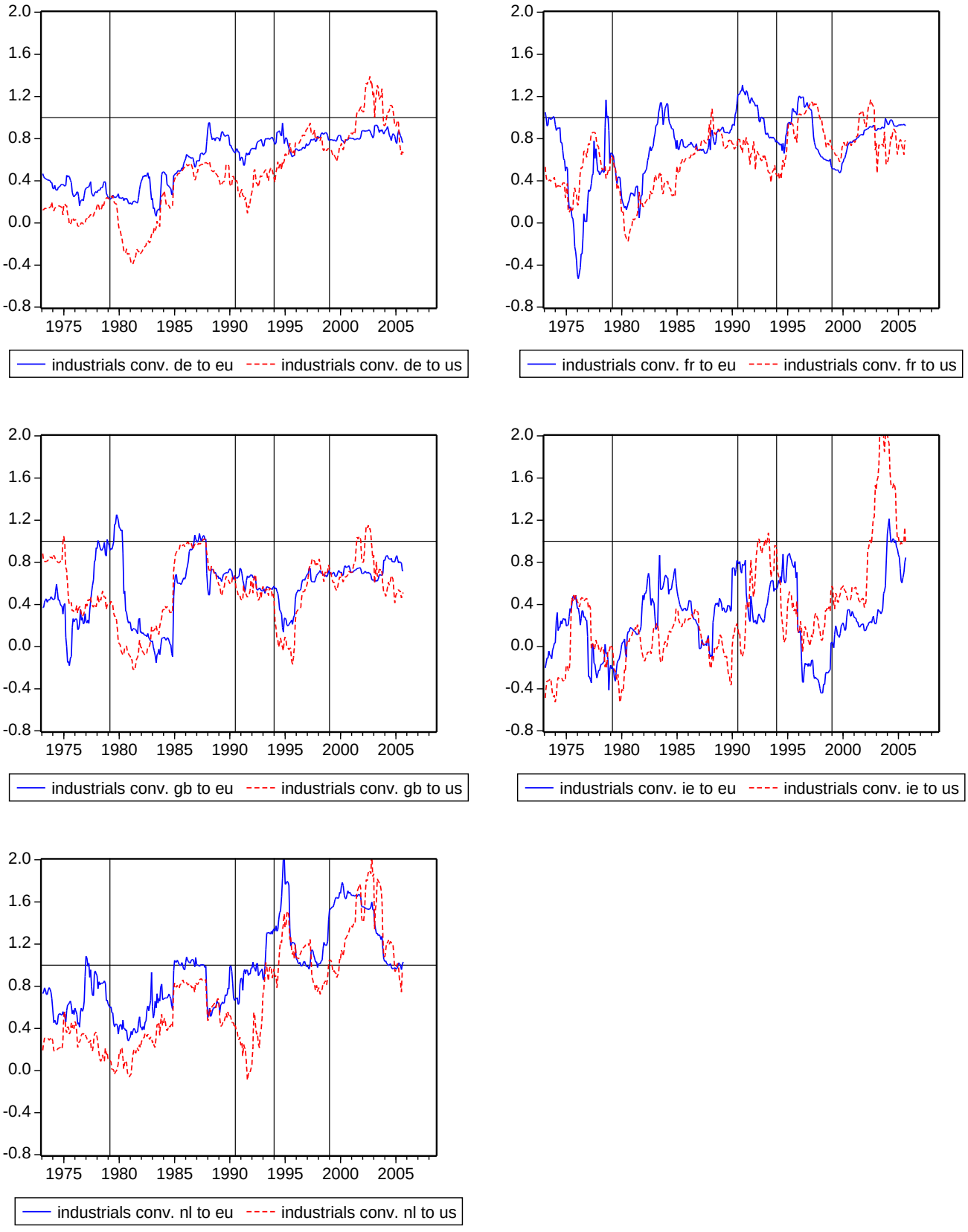
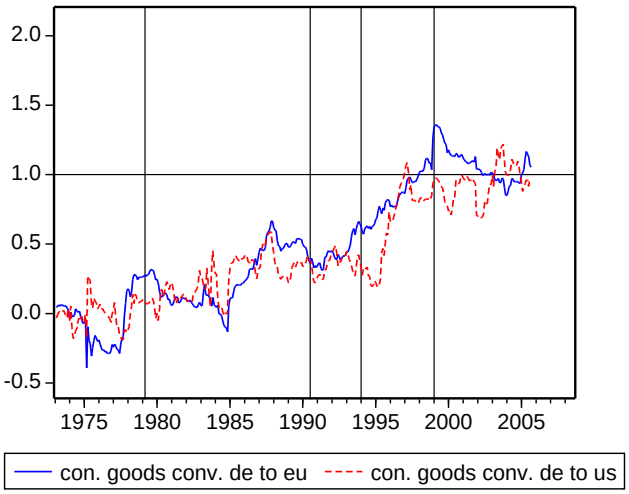
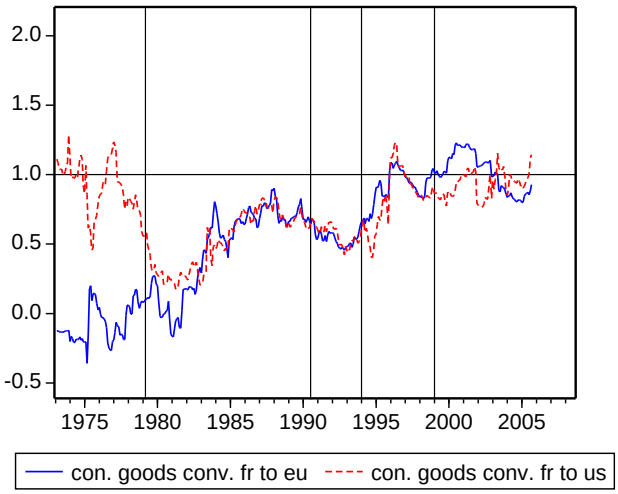
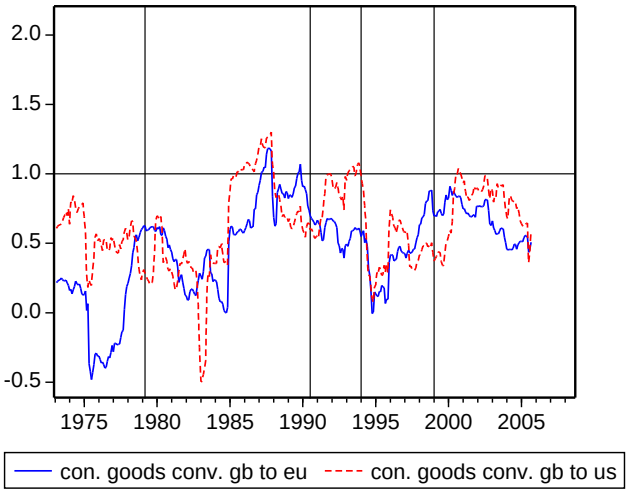
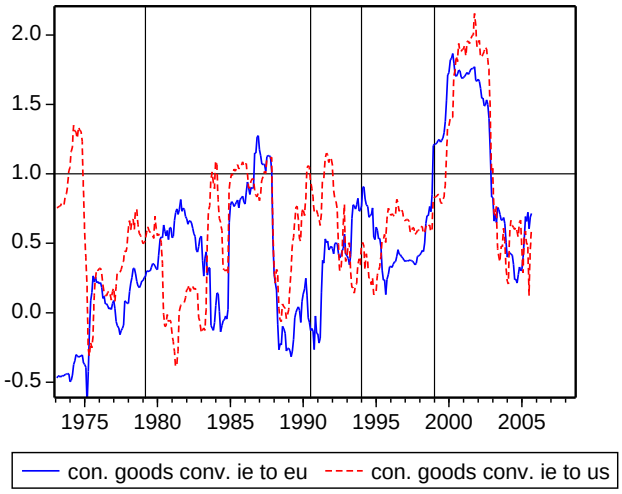


Figure C.4.: Convergence in Consumer Goods, EU-US Comparison









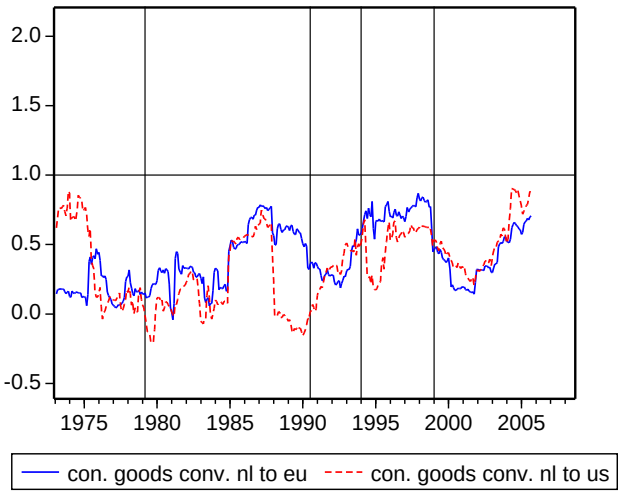
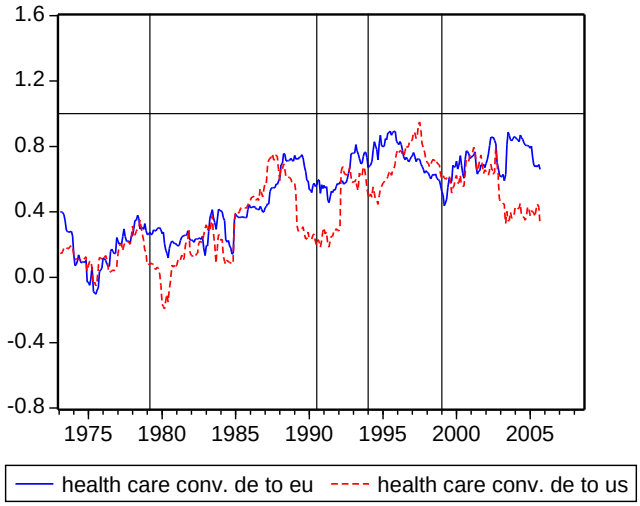
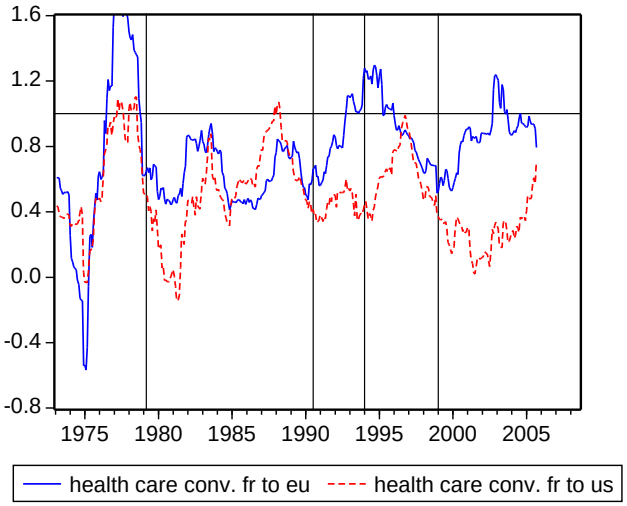
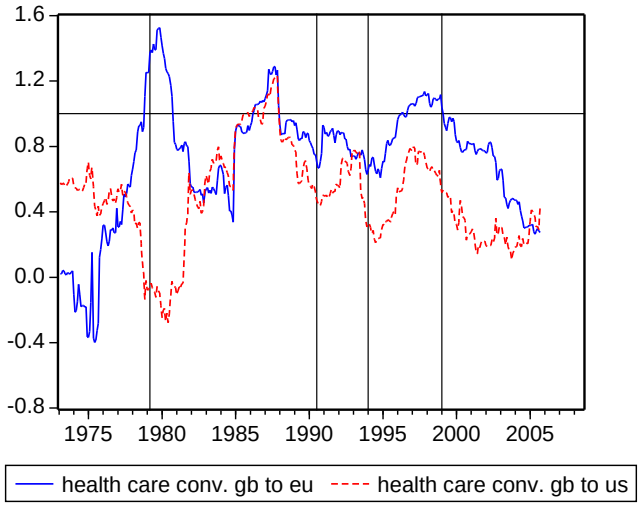
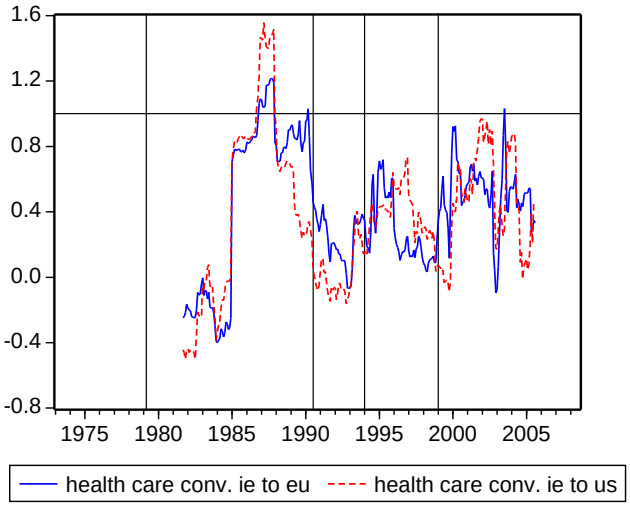


Figure C.5.: Convergence in Health Care, EU-US Comparison









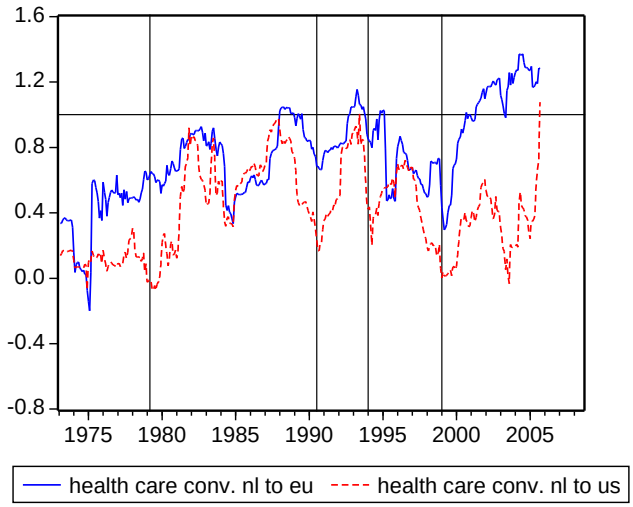
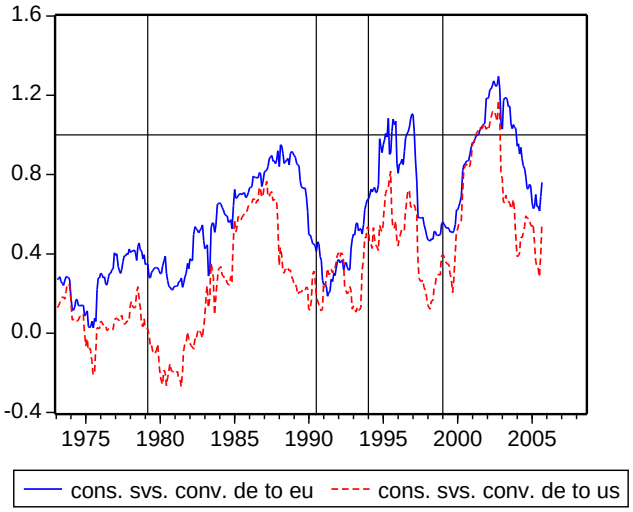
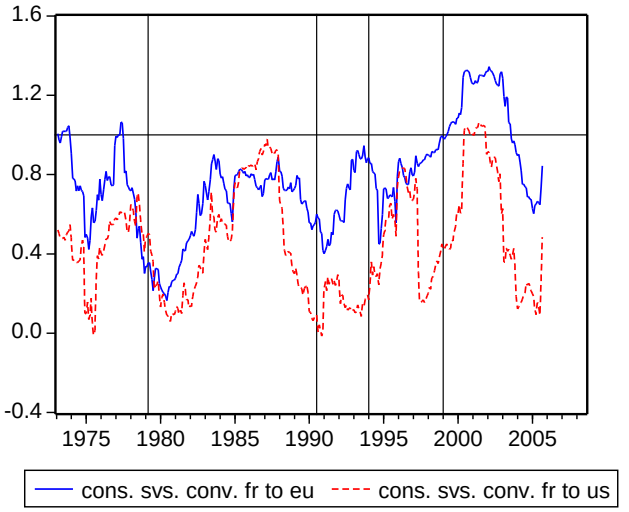
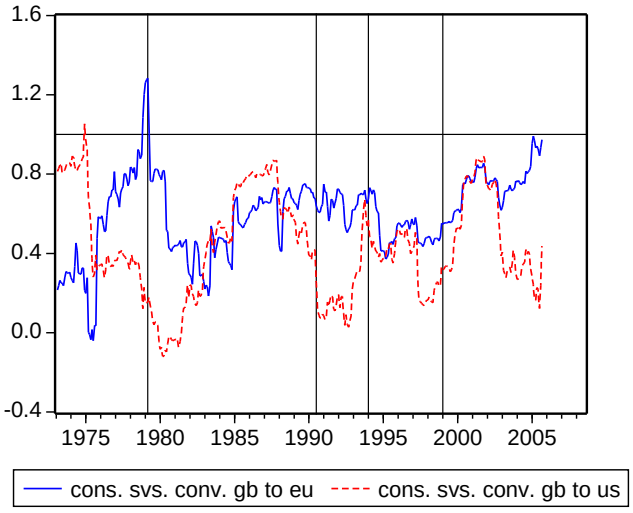
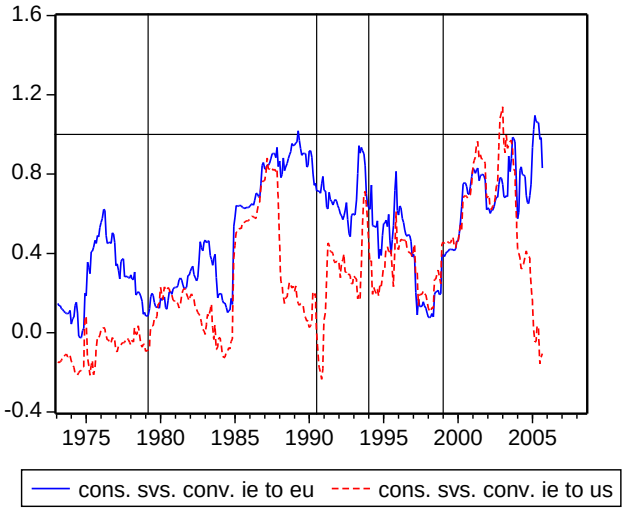


Figure C.6.: Convergence in Consumer Services, EU-US Comparison









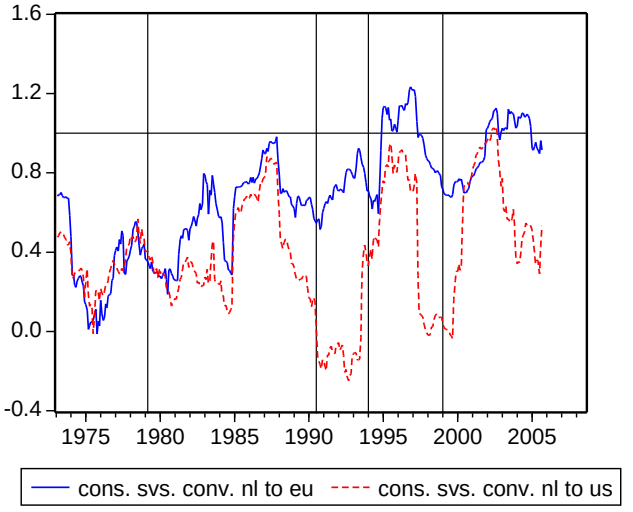
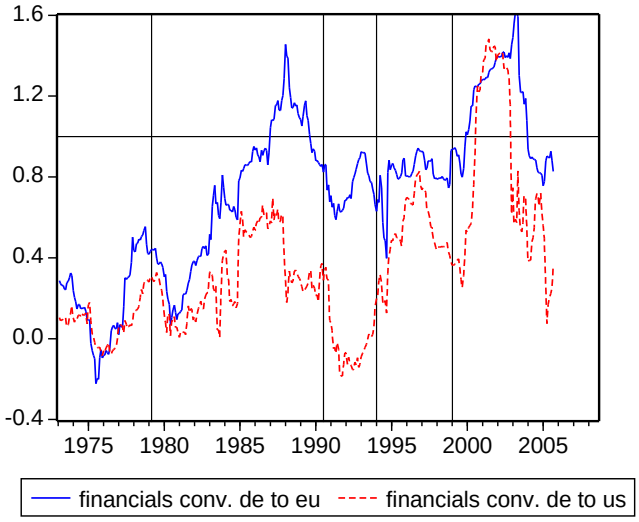
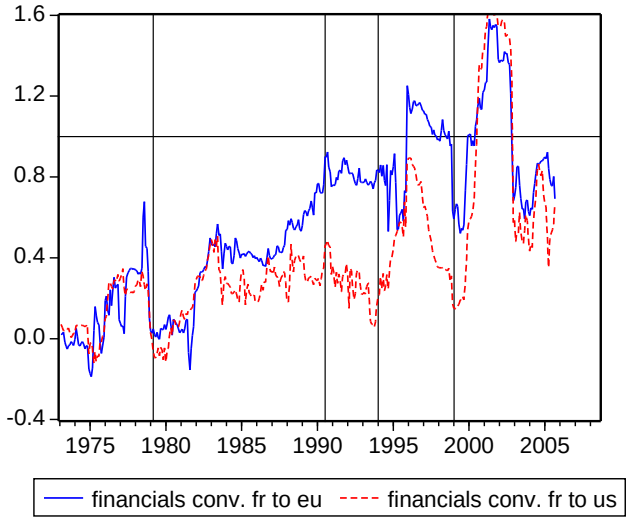
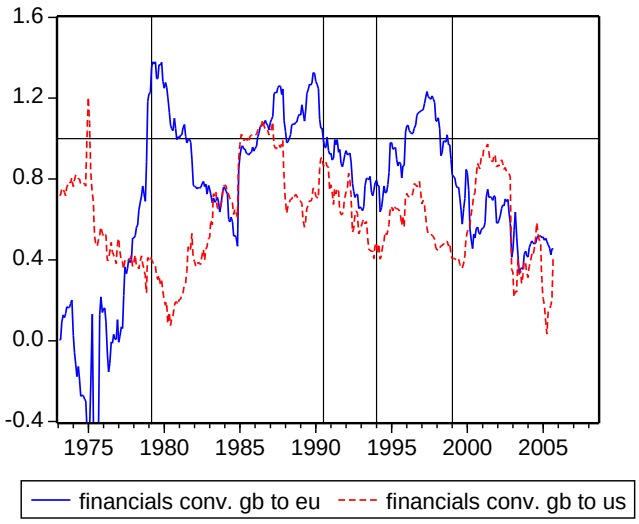
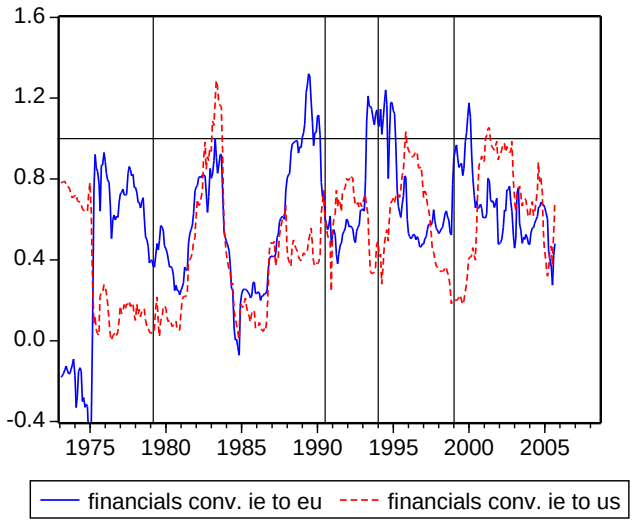


Figure C.7.: Convergence in Financials, EU-US Comparison









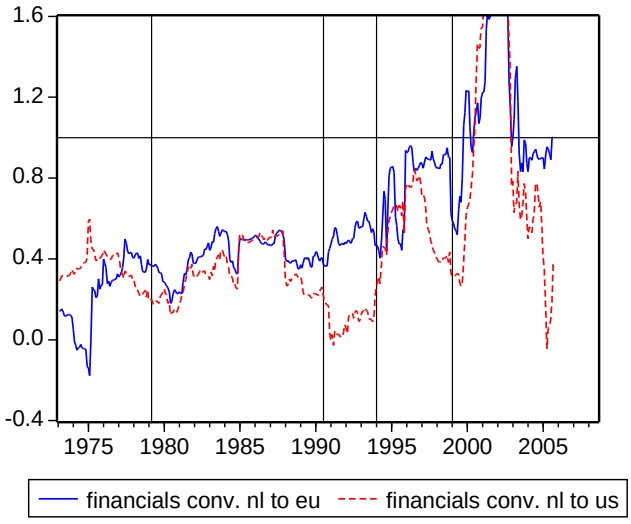
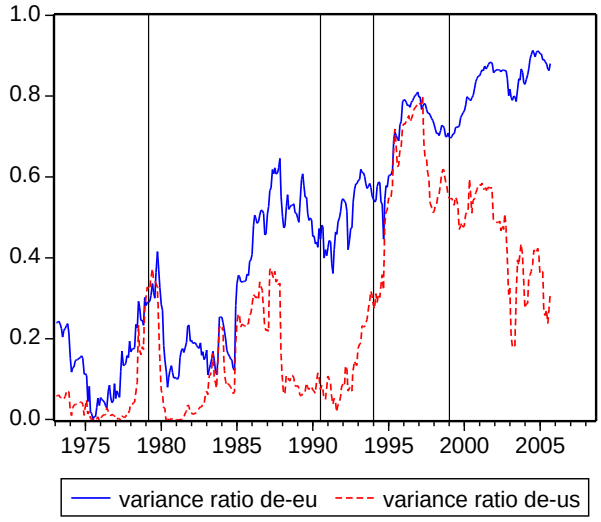
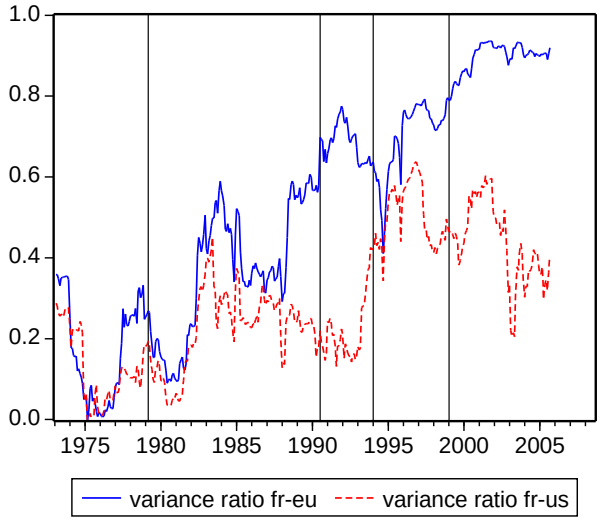
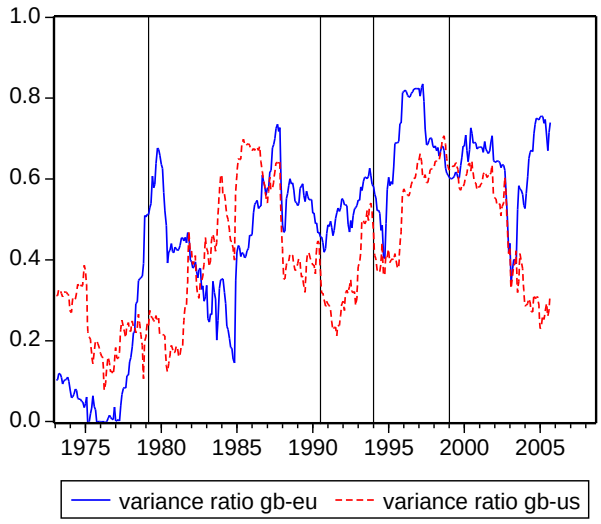
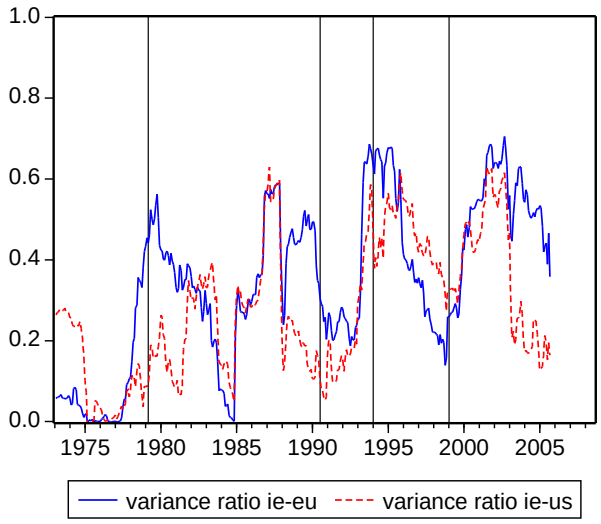


Figure C.8.: Variance Ratio, Market Returns, EU-US Comparison









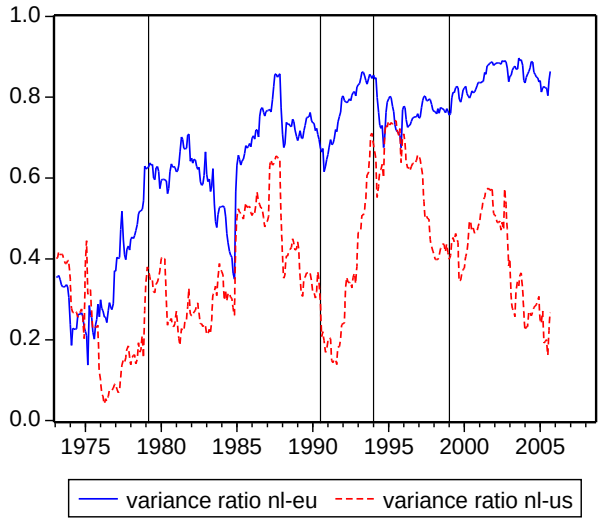
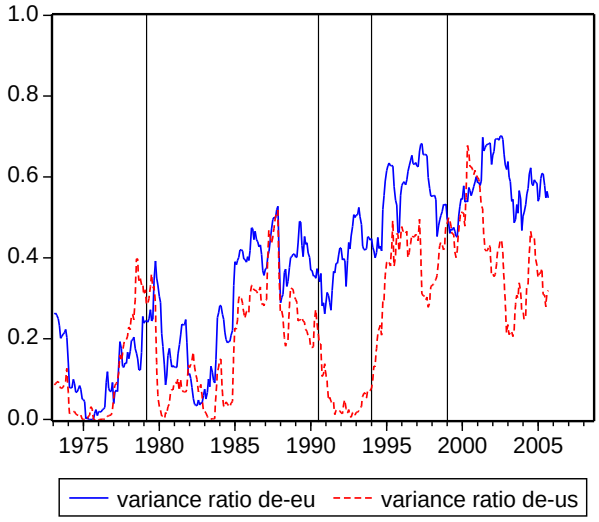
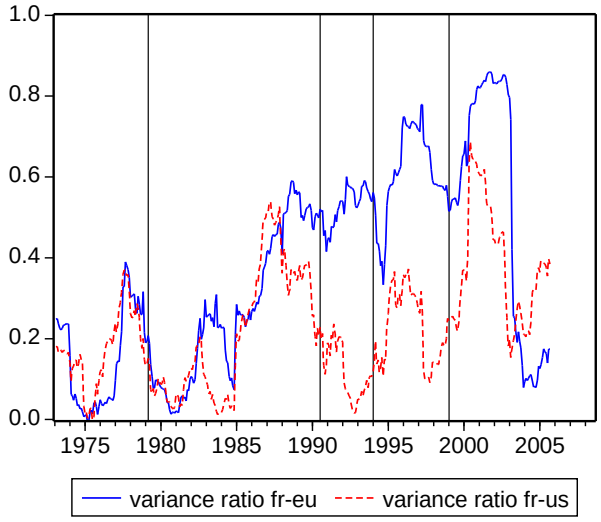
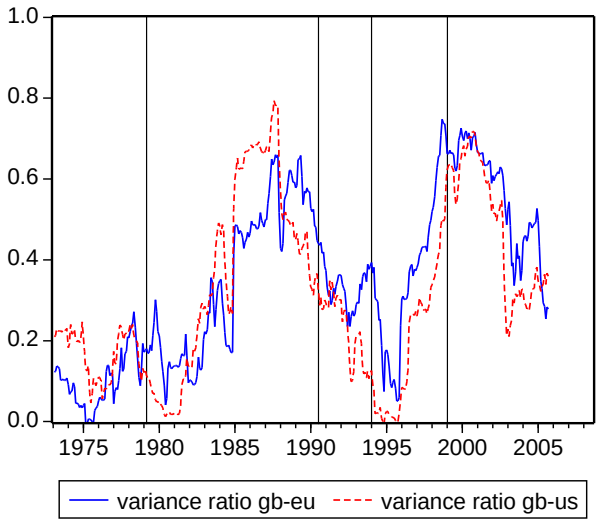
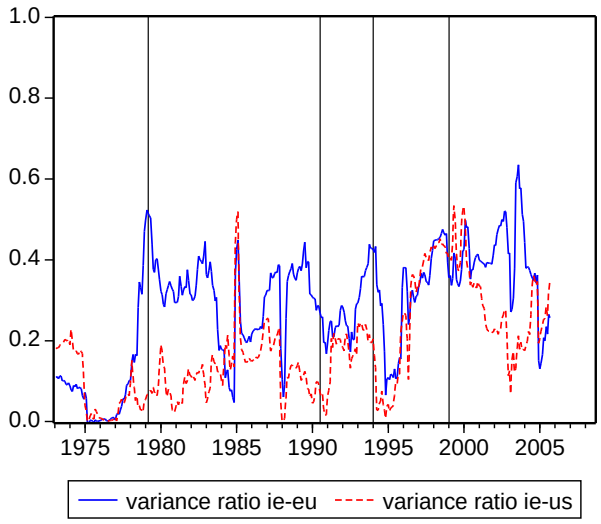


Figure C.9.: Variance Ratio, Basic Materials, EU-US Comparison









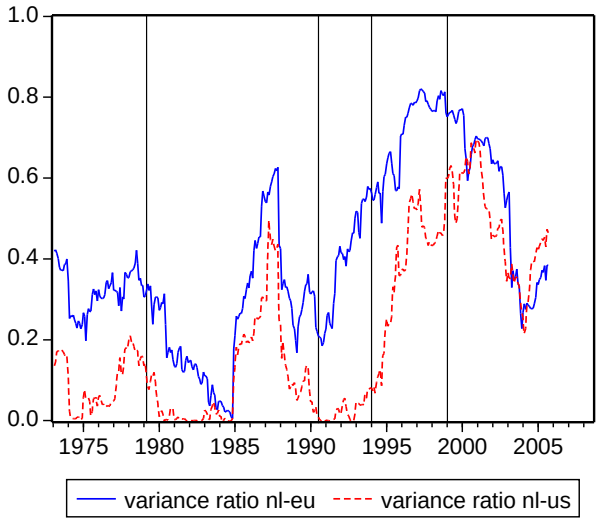
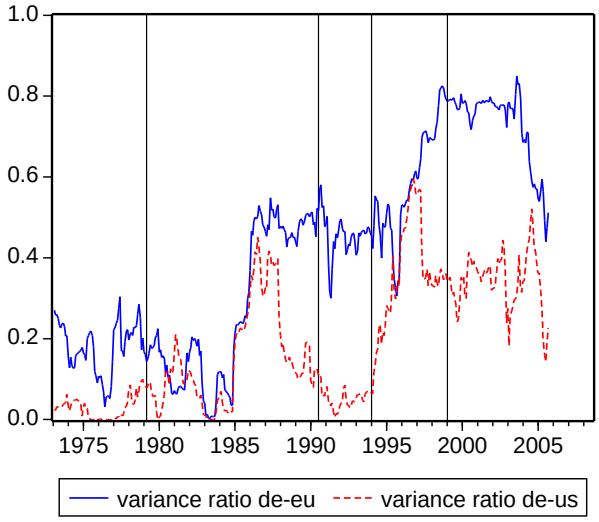
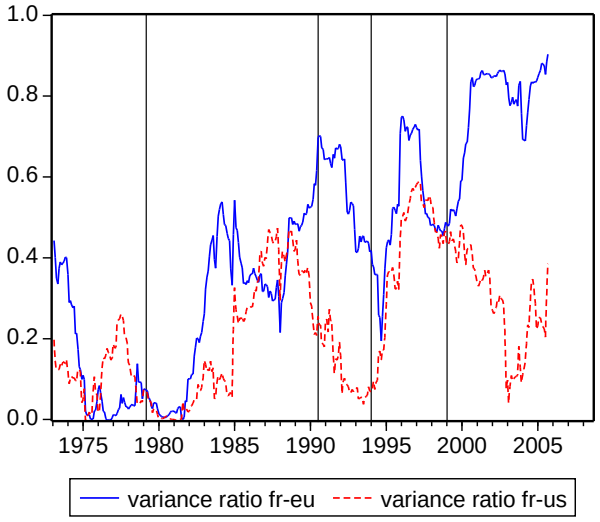
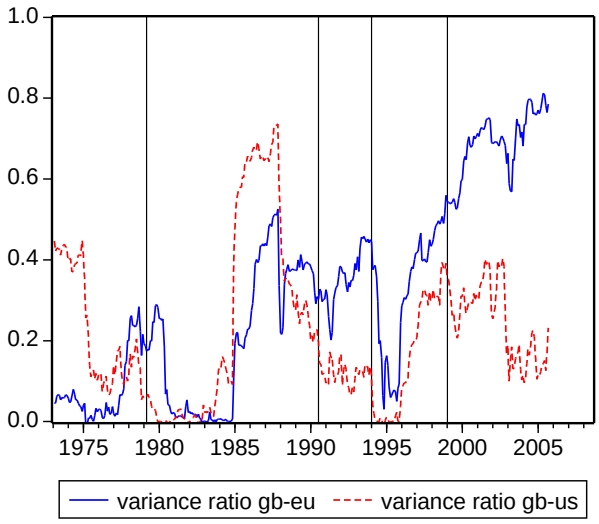
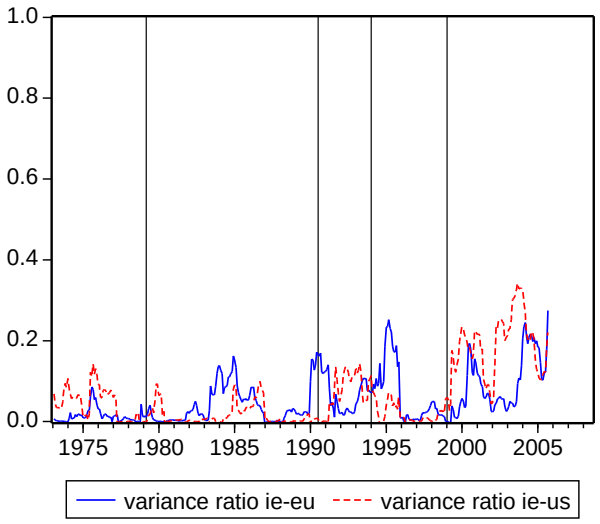


Figure C.10.: Variance Ratio, Industrials, EU-US Comparison









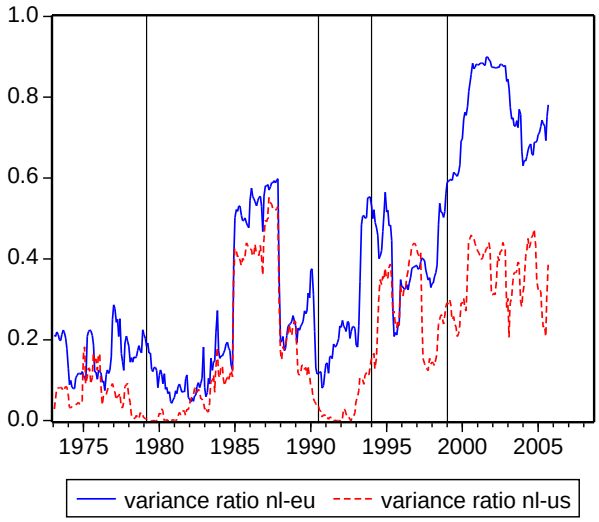
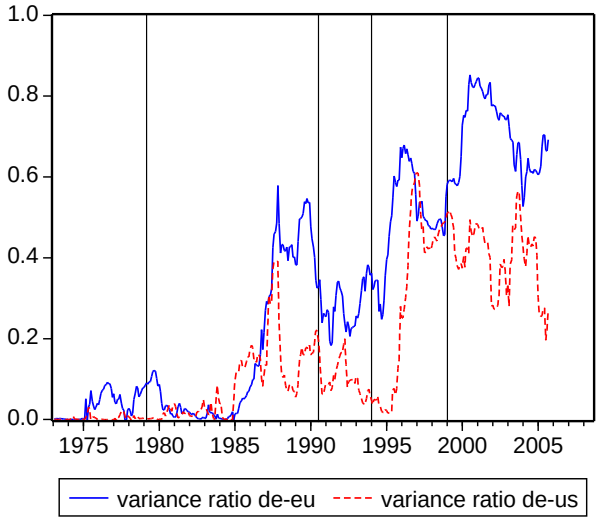
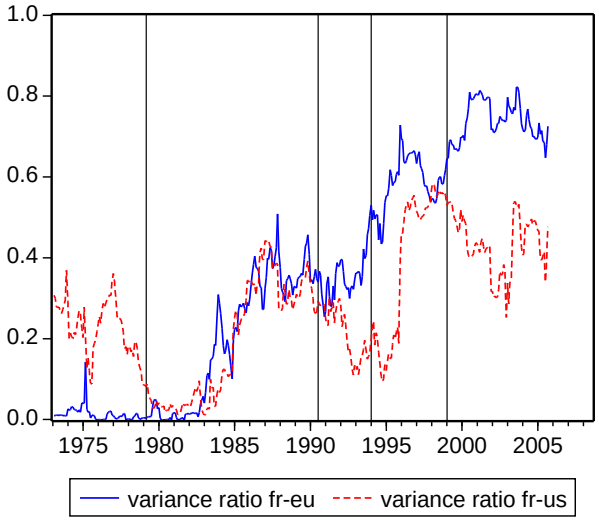
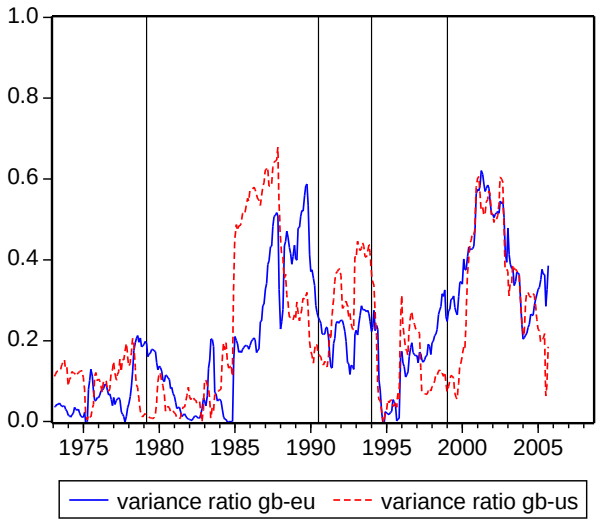
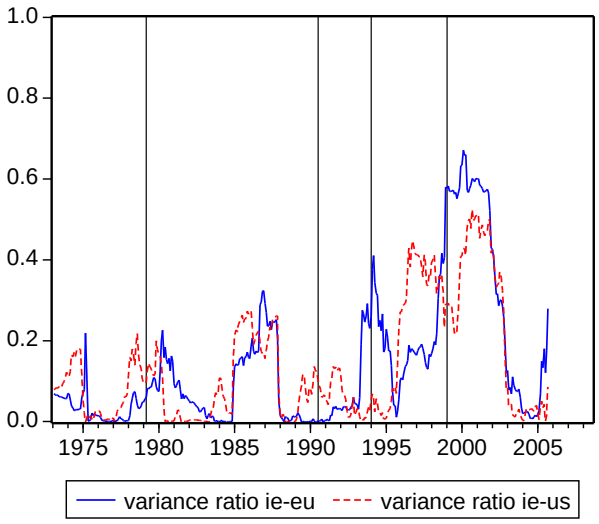


Figure C.11.: Variance Ratio, Consumer Goods, EU-US Comparison









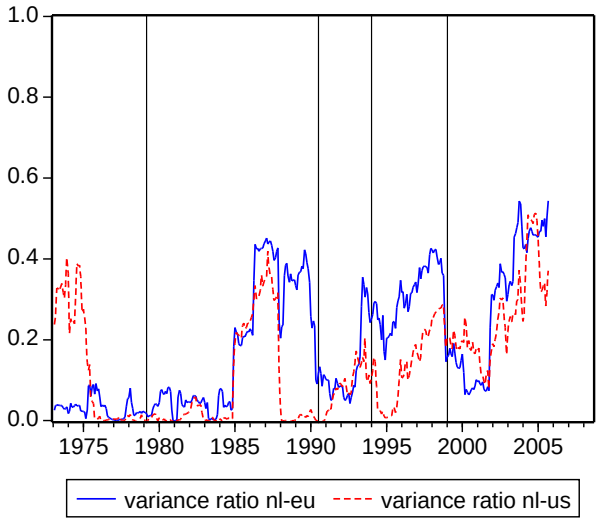
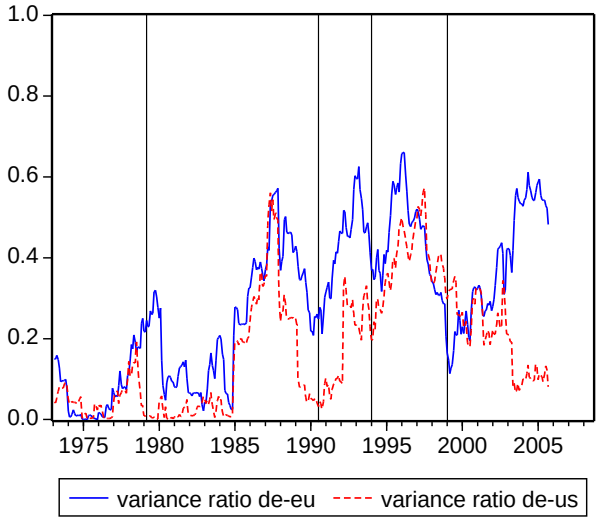
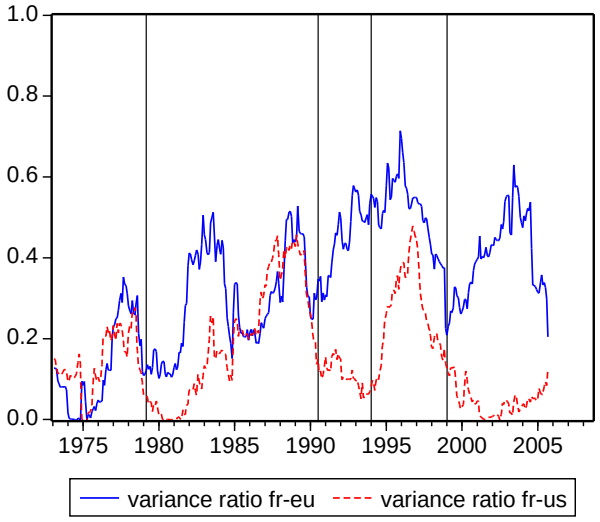
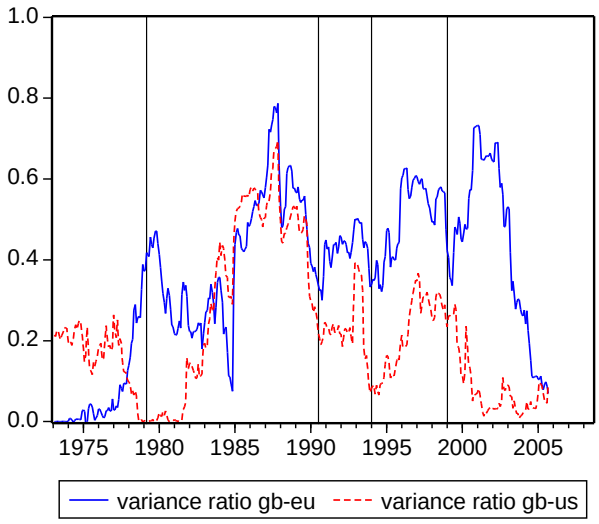
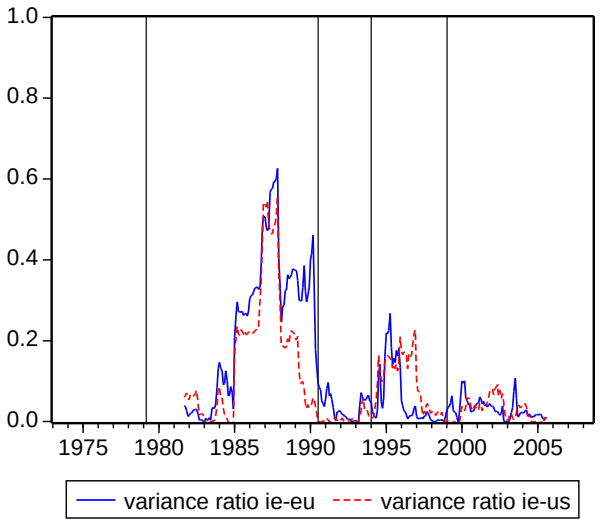


Figure C.12.: Variance Ratio, Health Care, EU-US Comparison









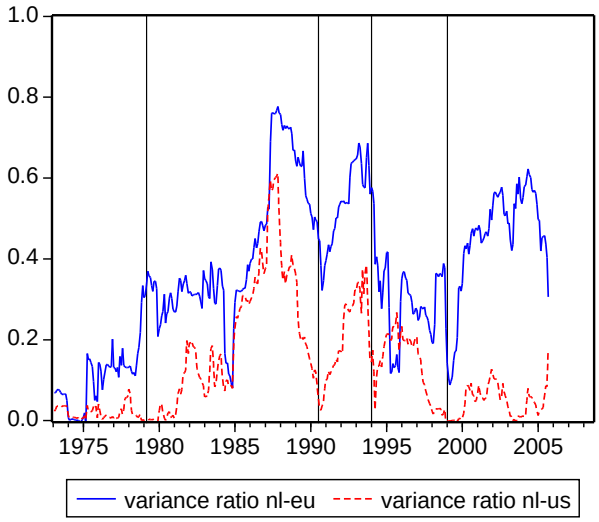
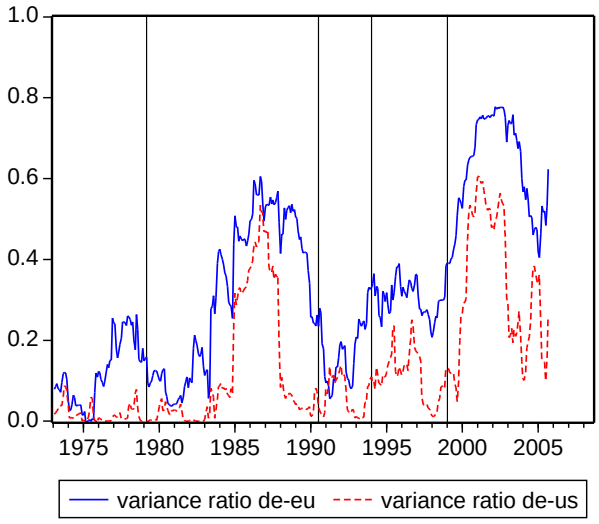
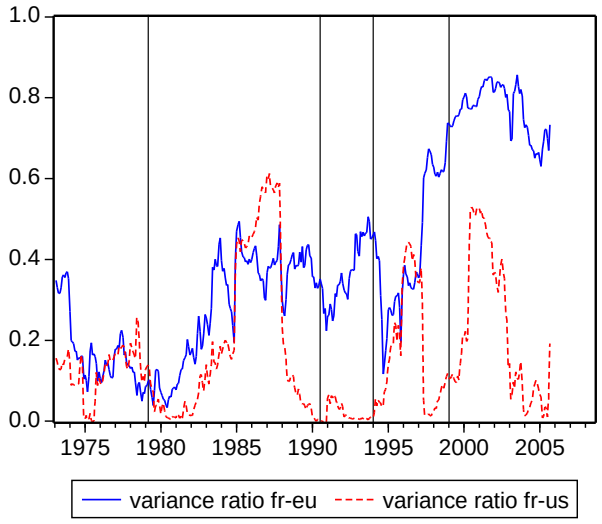
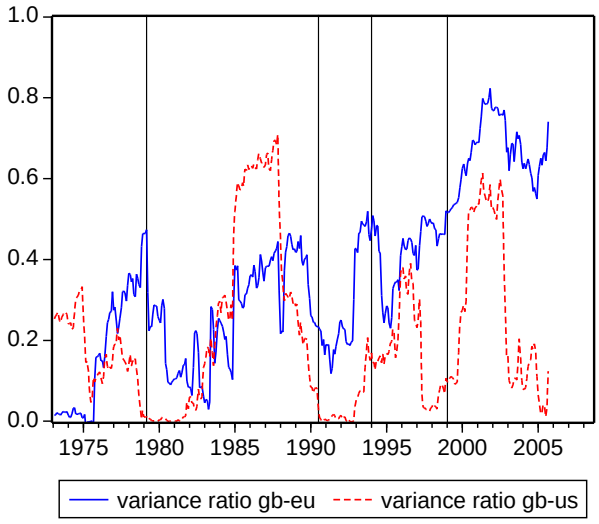
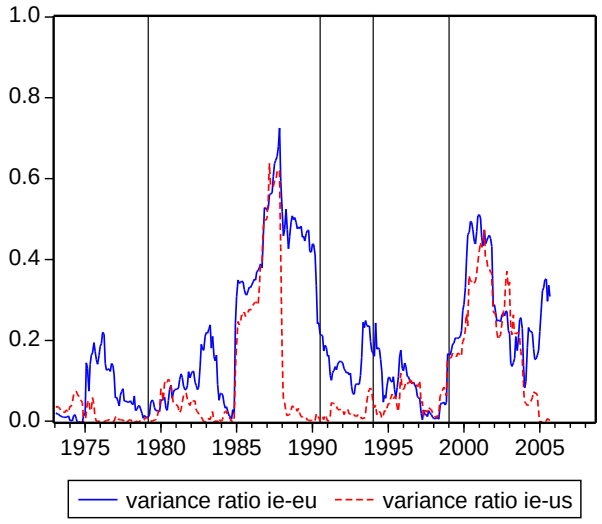


Figure C.13.: Variance Ratio, Consumer Services, EU-US Comparison









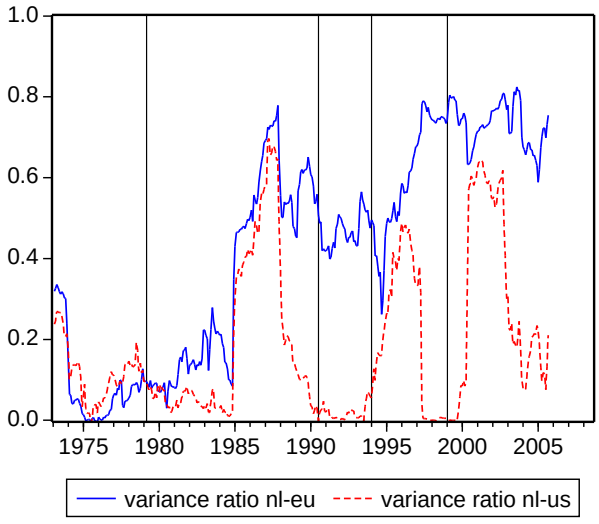
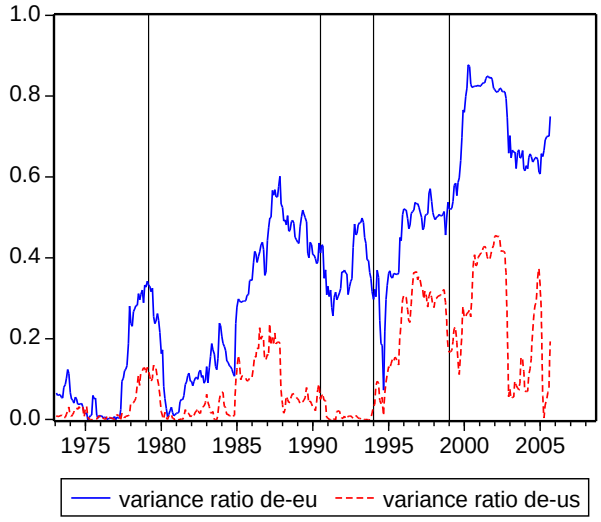
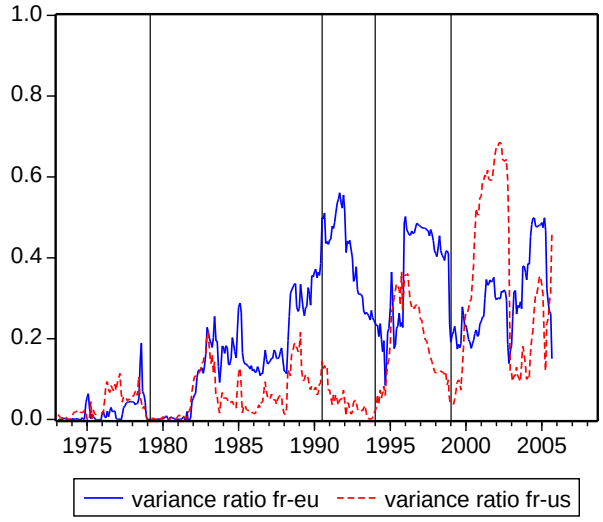
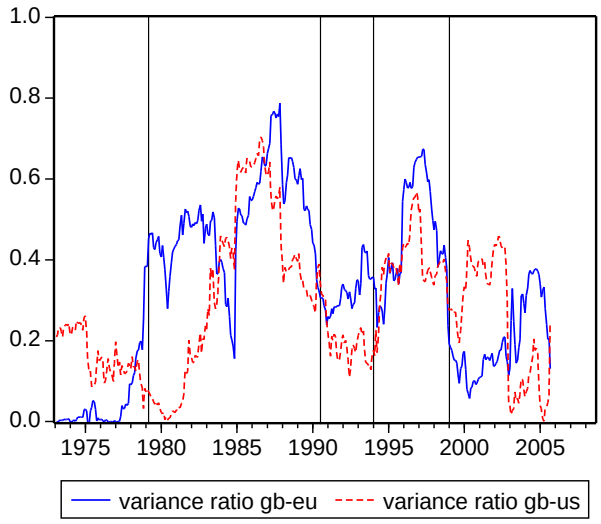
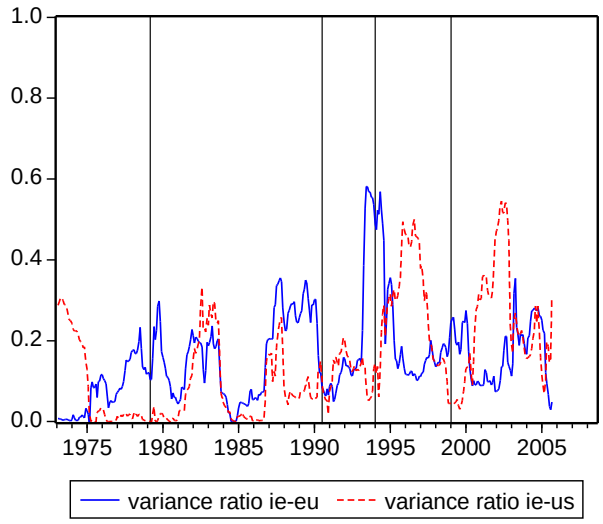


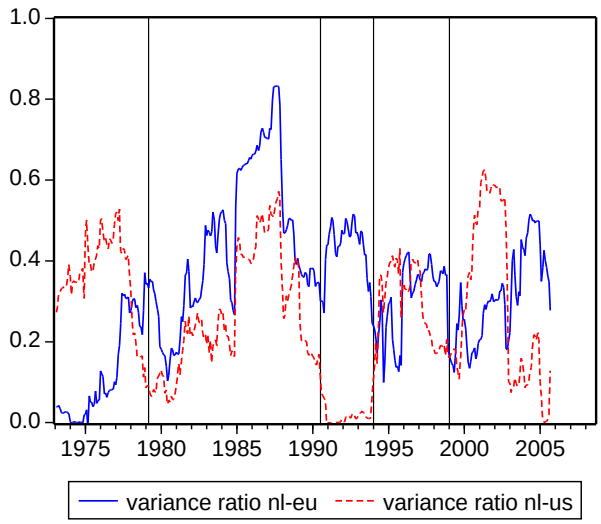
Figure C.14.: Variance Ratio, Financials, EU-US Comparison











D. σ-Convergence

Figure D.1.: Cross section dispersions, Country-Industry Comparison

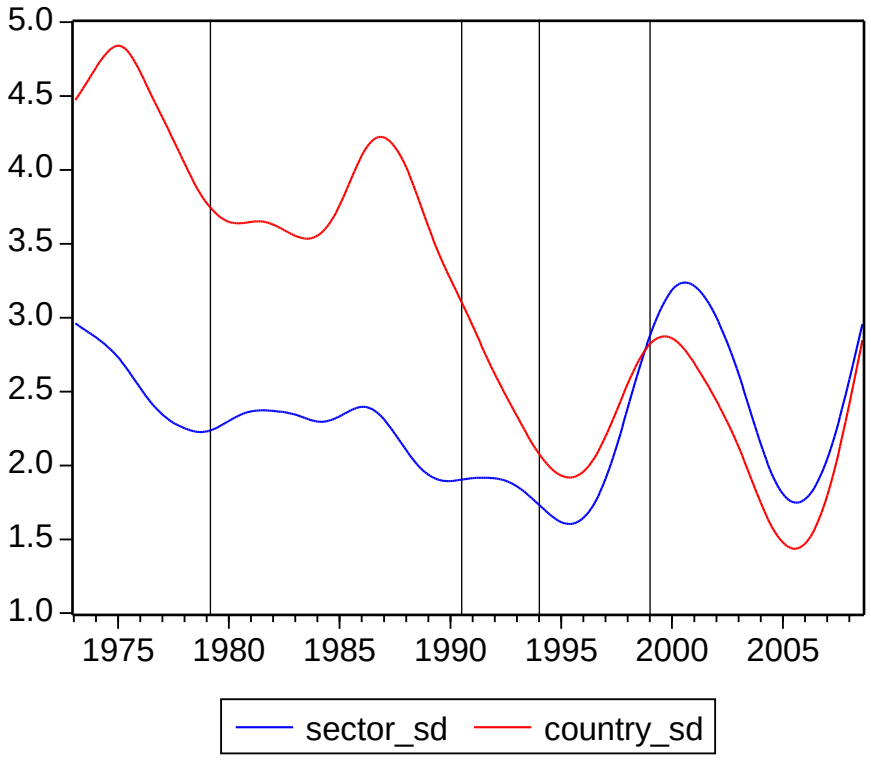


Figure D.2.: Cross section dispersion, Industries