International portfolio diversification: did industry and country effects change after the formation of the Euro?

Bachelor Thesis in Economics and Business Economics

ABSTRACT

For investors, it is highly relevant to know whether it is more important to diversify over countries or over industries. In this paper, 10 Eurozone countries, which adopted the Euro in 1999, have been studied. Before the formation of the Euro in 1999, country effects were dominant over industry effects within the Eurozone. Since 1999 a decrease in country effects can be observed. Not only the Eurozone countries, but also the European countries which did not adopt the Euro, experienced a structural decline in country effects. This implies an increased financial integration within the EMU. Comparing the country effects of Eurozone versus non-Eurozone countries shows that adoption of the Euro does not contribute to more integration. The study also explicitly looks at the effect of the financial crisis, starting in 2007. Contrary to my expectations, the country effects have only increased temporarily within the Eurozone since the financial crisis and rapidly retuned to its pre-crisis level. Moreover, the country effects did not exceed the industry effects after the financial crisis.

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1. Introduction

When investors want to diversify their international portfolios it is the question whether it is more important to focus on diversifying over countries or rather over industries. Managers who believe that international returns are mostly driven by industry factors, often use a two-stage strategy. These managers first allocate the portfolios to separate industries followed by a selection of the most attractive stocks from each sector. Managers who believe that geographical factors are dominant over industry factors decide on a country allocation first and subsequently select the best stocks from each country.

Heston and Rouwenhorst (1995) show that by selecting international stocks, the managers can reduce risk by diversifying across both countries and industries. However, they prove that it is more important to be geographically diversified than to be diversified over industries within the twelve studied European countries.

Since the formation of the economic and monetary union (EMU) in 1992, the European equity markets have become highly integrated. With the formation of the EMU, a common monetary policy was introduced, but the main aim was to introduce a single European currency, the Euro. From 1999 onwards, the prices of stocks and bonds on the stock exchange were expressed in Euros and in 2002 the coins and banknotes were introduced.

Rouwenhorst (1999) investigated the importance of country effects within the EMU countries' equity returns after 1992. He concluded that over the period 1993 – 1998 country effects were still dominant. Thereafter, Cavaglia *et al.* (2000) and Phylaktis and Xia (2006) presented evidence for emerging industry factors in determining equity returns. Cavaglia *et al.* suggests that industry effects may now dominate country effects. One of the financial developments that contributed to this dominance of sector effects is the rise of the internet sector followed by the burst of this dot-com bubble in spring 2000. This internet bubble was the result of an internet hype since 1997. In spring 2000 the bubble burst and the stock market collapsed. This event is an example of sector effects becoming more important.

This paper will focus on the developments of country effects in the period after the Euro was formed in 1999. Within the period 1990 until 2019, a distinction will be made between four sub-periods. One period before the Treaty of Maastricht, one period after the Treaty of Maastricht, one period after the formation of the Euro and one period after the global financial crisis of 2007 – 2008. The dataset contains 10 European developed countries in which

the Euro was introduced in 1999 (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal and Spain). The countries that adopted the Euro at a later stage have not been included in the research to be able to measure the effect around the introduction of the Euro. Per country the data is divided into 10 industries.

The main question in this paper is whether country effects decreased since the formation of the Euro. More importantly the research will study if country effects have re-emerged since the global financial crisis and the European debt crisis of 2010. First it will be investigated whether the relative increase in the importance of industry effects in the Eurozone have continued. Thereafter, it will be investigated whether the country effects have decreased since the formation of the Euro using Welch's t-tests. To compare differences between samples, a comparison will be made between 5 developed European non-Eurozone countries vs the 10 Eurozone countries. The hypothesis is that there are decreasing country effects since the Euro was formed in 1999 until the financial crisis because of the integration. Herein, a stronger decline within the Eurozone countries is expected than within the non-Eurozone countries. Moreover it is expected to see increasing country effects after the global financial crisis due to destabilization within the Eurozone.

This study adds to the previous literature in the way that it helps understanding the effect of the introduction of the Euro on industry and country effects. More importantly it helps to get a clear picture of the role of the global financial crisis and the Euro debt crisis on these covariations of stock returns across countries and industries. Especially interesting is the post-crises period. It will be investigated whether the destabilization within the Eurozone has led to a returning importance of country effects.

The results have shown that there are changing roles of country and industry effects over time. The upcoming industry effects have continued and there are decreasing country effects since the formation of the Euro in 1999. Industry effects are dominant within the Eurozone since the beginning of 1999, which implies that investors should diversify more across industries rather than across countries. Furthermore, both the Eurozone countries as well as the non-Eurozone countries experience a significant structural decline in country effects. The financial integration within the EMU, due to a joint economic policy and trading agreements, seems more important than having a single currency, the Euro. Moreover, I was expecting to see a stronger increase in country effects since the financial crisis than is observed. The effects have only increased temporarily and have not exceeded the industry effects.

The paper is structured as follows. Section 2 describes the findings of country and industry effects as found in existing academic papers and elaborates on integration after the introduction of the Euro. Section 3 covers the data as used in my analysis whereby in Section 4 the method is explained. Section 5 describes the results of the tests followed by the conclusions in Section 6.

2. Theoretical framework

2.1 The importance of Country and Industry effects

Already in the late 60's it was discovered that international diversification results in higher gains than diversification within a single country. Amongst others, Grubel (1968) and Levy and Sarnat (1970) demonstrated low correlations between different national markets and the efficiency of international diversified portfolios in order to establish these gains. After these tests it was Lessard (1973) who first relied on industry factors as an important factor for country index returns (Lessard, 1974).

Heston and Rouwenhorst (1995) compared country and industry effects and did research on the degree of these effects. In their paper they document that there are three reasons for investors to pay more attention to geographical diversification within Europe than to industrial diversification. First, when shifting an international portfolio geographically, it leads to larger and more variable tracking errors on average than shifting the industrial composition of the same portfolio. Also, stocks from one country spread across different industries are closer substitutes than stocks from the same industry in diverse countries. Finally, most of the benefits of international diversification arise from geographical diversification, more so than from industrial diversification.

Griffin and Karolyi (1998) re-examined whether gains from international diversification are due to different industrial structures across countries. They used the Dow Jones World Stock Index with coverage in 25 countries and over 66 industries. Instead of individual stock returns, they used country-industry index returns and decomposed thereby both country and industrial sources of variation. Griffin and Karolyi documented that a limited part of the fluctuation of the country index returns can be explained by their industrial composition, which confirms the earlier findings of Heston and Rouwenhorst.

As announced in the introduction, Rouwenhorst (1999) investigated whether there was a diminishing role of country effects on equity returns due to the formation of the EMU. He concluded that the country effects in 1993 – 1998 were still larger than industry effects in the economically integrated countries of Western Europe.

Cavaglia, Brightman and Aked (2000) provide evidence for the emergence of industry effects within equity markets. They investigated 21 developed equity markets over the period 1986 until 1999. Cavaglia *et al.* suggest that, with the growth of relative importance of the industry factors, the industry factors are now more important than the country factors. This growth relative importance of industry factors means that diversifying across industries ensures higher risk reduction than diversifying across countries.

Thereafter, Phylaktis and Xia (2006) examined the changing roles of industry and country effects in the global equity markets over the period 1992 until 2001. They found a considerable increase in industry effects since 1999. Looking at the effects within Europe, the industry effects have surpassed the country effects since 1999. This reversal in dominance of effects is more pronounced than within other regions. This implies that with the start of the EMU, and subsequently with the introduction of a single currency, the financial integration within Europe has increased.

I will investigate whether the relative increase in the importance of industry effects have continued. Due to the findings of Cavaglia et al. (2000) and Phylaktis and Xia (2006) the hypothesis is that the industry effects have become more important and now dominate country effects. This question has become more relevant since the financial crisis in 2007-2008, which subsequently led to destabilization within the Euro area from 2010 onwards. This research amongst others focusses on the question whether this destabilization in the Eurozone has led to a returning importance of country effects.

2.2 Integration and the formation of the Euro

Until a few years after the World War II it was uncommon to trade internationally in shares. There were closed-borders for trade in financial assets and strict capital controls (Stulz, 1999). The Maastricht Treaty of 1992 caused a shift of the relationships between the countries within Europe. With the implementation of this treaty, the economic and monetary union (EMU) was formed and gave thereby legislative power to the European parliament and in time the common currency, the Euro, was introduced. The EMU was formed to establish a joint

economic policy, to promote price stability and to improve the functioning of the internal market[1]. According to Hardouvelis, Malliaropulos and Priestley (2006), the stock market converged in the period running up to the EMU. The expected returns now became more determined by the market risk of Europe than by the country specific risk.

Since the formation of the EMU, Europe has been strongly integrated due to common legislation on European level, the abolition of border controls and a common currency. On January 1, 1999 the Euro area was formed with initially 11 member countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) and has expanded over the years. The Eurozone started in 1999 with the registration of the value of the Euro. From 1999 on, the prices of stocks and bonds on the stock exchange were expressed in Euros. Only three years later, on January 1, 2002, the coins and banknotes were introduced. The EMU currently consists of 28 countries of which 19 countries have adopted the Euro as their currency.

Fratzscher (2002) analysed the financial market integration within Europe. His main focus was the role of the EMU on the process of financial integration and showed three important findings. The first result was that European equity markets have become integrated to a large extend since 1996. Moreover the Eurozone market has become much more important in world financial markets. Finally, the financial integration of European equity markets is mainly due to the drive towards EMU. Important factors in the drive towards the formation of the EMU were the elimination of exchange rate volatility and the uncertainty in the process of a monetary merger.

Thereafter Baele *et al.* (2004) did specific research into financial integration in the Eurozone on behalf of the European Central Bank. This paper confirmed the findings of Fratzscher about the rising degree of integration due to higher correlation between equity returns in Euro area countries. Moreover they found that equity returns in the numerous Eurozone equity markets increasingly come from common news and less from country specific factors.

But up to what level is this integration possible? Stulz (2005) claims that there is a limit to the financial globalization because of the twin agency problem. This problem arises from differences of interest between rulers of sovereign states and inside managers of the company at the expense of outside investors. When there is a significant twin agency problem, there

[1] https://www.europa-nu.nl/id/vh7dosu15tzr/economische_en_monetaire_unie_emu

will be a diffuse of ownership what results in limitations of economic growth, financial development and financial globalization for its country.

Even more impactful on the financial integration was the financial crisis of 2007 – 2008. This global financial crisis started in 2007 in the United States with a crisis in the market for subprime mortgages and led in the end to the European debt crisis. This Euro debt crisis started in the Eurozone countries at the end of 2009 and was due to the fact that doubts arose in the government bond market whether some countries were still able to repay their debt.

Ireland, Portugal and Spain were affected worse than other countries in the sample. These countries were unable to finance its debts independently, or to relieve over-indebted banks without help from other Euro counties or the European Central Bank (ECB).

This crisis had an enormous impact on the European Union and also on the European equity markets. From this point onwards, there was increasing distrust and destabilization in Europe.

The hypothesis in this study regarding country effects is that there are decreasing country effects since the Euro was formed in 1999 until the global financial crisis. After the global financial crisis, which led in the end to the European debt crisis, the hypothesis is to see increasing country effects again due to the destabilization within the Euro area.

3. Data

The total returns used in this research are derived from the Financial Datastream database. The returns are not presented in the same way as Heston and Rouwenhorst (1995) did in their paper. They used single stock returns of European countries derived from the MSCI index. In this paper market-weighted country-industry indices are used instead of individual stock returns. These indices already contain all the individual stocks from one industry in a country, weighted by its market-value. Therefore performing the analysis on these country-industry indices will give exactly the same outcome as when the regressions are performed on individual stocks. Using the market-weighted indices is a more convenient method with exactly the same results.

The first sample includes 10 countries from the Eurozone that adopted the Euro right after its introduction in 1999. The eleventh country that introduced the Euro in 1999, Luxembourg, was left out of the sample because of the lack of sufficient data. A second sample consists of 5 developed European countries which did not adopt the Euro. All countries in both samples contain 10 industry sectors (*Table 1*).

***Table 1**: Studied countries and industries*

Eurozone countries	Non-Eurozone countries	Industries
Austria (OE)	Denmark (DK)	Oil & Gas (OILGS)
Belgium (BG)	Norway (NW)	Basic Mats (BMATR)
Finland (FN)	Sweden (SD)	Industrials (INDUS)
France (FR)	Switzerland (SW)	Consumer Goods (CNSMG)
Germany (BD)	United Kingdom (UK)	Health Care (HLTHC)
Ireland (IR)		Consumer Services (CNSMS)
Italy (IT)		Telecom (TELCM)
Netherlands (NL)		Utilities (UTILS)
Portugal (PT)		Financials (FINAN)
Spain (ES)		Technology (TECNO)

Documented in this table are the two samples used in this research. The studied industries are the same for both samples.

The data derived from Datastream are total return indices. These indices contain the total returns of all individual stocks within its index, including dividends. This data first have to be transformed into monthly total returns in percentages. These returns in percentages show us the increase or decrease in the index relative to the previous month. These returns can be calculated using the following formula:

$$R = \frac{RI_n}{RI_{n-1}} - 1 \qquad (1)$$

In addition to the total returns indices, the market values from the country-industry indices have been retrieved from the Financial Datastream database. These market values will be used to perform market-weighted regressions as well to determine market weighted country and sector effects.

Table 2 shows the descriptive variables of the investigated countries and industries. It summarizes the market-weighted performances of the countries and industries over the period from February 1990 until May 2019. The returns are expressed as percentages per year to create a clear view of the returns earned in the period.

Table 2: *Summary statistics, annualised returns and standard deviations, Feb 1990 – May 2019*

	Annualised	
Country/Industry	Mean	St dev
Country		
Austria	8,94	19,35
Belgium	11,44	16,54
Finland	20,05	28,77
France	12,67	17,92
Germany	10,68	18,2
Ireland	14,65	20,63
Italy	9,82	21,43
Netherlands	13,34	17,61
Portugal	7,17	16,23
Spain	13,89	20,20
Denmark	14,99	16,38
Norway	14,77	21,35
Sweden	17,35	21,77
Switzerland	11,63	15,13
United Kingdom	11,57	14,62
Europe	14,15	
Industry		
Oil & Gas	13,78	19,12
Basic Mats	13,19	20,15
Industrials	13,53	19,59
Consumer Goods	14,35	18,68
Health Care	14,01	12,54
Consumer Services	11,96	16,11
Telecom	14,69	19,81
Utilities	12,78	13,48
Financials	11,73	19,30
Technology	20,64	33,60

This table presents the average performance of European countries and industries and its standard deviation in percentages per year.

In my analysis I used monthly data from February 1990 until May 2019. Within this period the data is divided into four sub-periods. The first period from 1990 until 1991 is the period leading up to the Maastricht Treaty. Within this period there was not much known and a lot of uncertainty about the formation of the Euro and therefore can be used to measure the effect of the introduction of the Euro. The second sub-period ranges from 1992 until 1998. This period starts from the Maastricht Treaty and contains the run-up to the Euro. From January 1999 the EMU was actually realized. The third sub-period runs from 1999 until 2007. This breakpoint is the start of the financial crisis which is followed by the Euro debt crisis. This third

sub-period also includes the burst of the internet bubble in spring 2000. The last sub-period runs from 2008 until now and includes the global financial crisis and Euro debt crisis.
One issue is that not all country-industry indices are available from 1990. This is not a problem as long as every country has returns from at least one industry. Missing data is eliminated from the cross-sectional regression.

4. Methodology

The method used in this paper is a modified version of the method used in Heston & Rouwenhorst (1995). My research is based on index returns instead of individual stock returns. This model based on index returns, is also used in the paper of Griffin and Karolyi (1998), who apply the dummy variable regression analysis on market-weighted index returns instead of individual security returns. Both methods lead to the same results in terms of country and industry effects.
In cross-sectional regressions the returns of the indices will be explained by country and industry effects, plus an error-term. This error-term can be defined as a variable which contains all other sources uncorrelated with the country and industry-specific influences, also called the index-specific variation. For every country and industry a dummy variable is created. This dummy variable equals 1 if the index contains stocks from that industry and 0 otherwise. The same concept is used for the country dummies.
On a monthly basis the following cross-sectional regression is being estimated:

$$R_{ic} = \alpha + \beta_1 I_{i1} + \beta_2 I_{i2} + \cdots + \beta_{10} I_{i10} + \gamma_1 C_{i1} + \gamma_2 C_{i2} + \cdots + \gamma_{11} C_{i11} + e_i \quad (2)$$

R_{ic} in this equation is the return on the market-weighted index I in country C. I_{in} are the sector dummies for the different industries. C_{in} are the country dummies for the different countries. By running a cross-sectional regression for every month, all β_i's and γ_i's, representing the sector and country effects, can be estimated. From these estimations, a time series of the estimated industry and country effects can be created, which gives the possibility to analyse the country and industry effects over time[2].

[2] For running these regressions MATLAB is being used, because this program has the convenience that it is suitable for handling larger matrices containing all data.

By estimating *Equation 2* it is important to include the market weights of the indices. One index can be twice as large as the other index and therefore also has to count twice as heavy as the other index. These weights have been taken into account by making use of Weighted Least Squares (WLS) instead of Ordinary Least Squares (OLS). By the use of WLS, the return of each index is weighted by its market value at the beginning of the month.

There is one issue that appears by estimating *Equation 2*. All returns belong to both one country and one industry, what leads to an identification problem if dummy variables are defined for every country and industry. This problem, called perfect multicollinearity, means there are two or more explanatory variables that are strongly correlated in the regression, which influences the estimation of the coefficients. One solution to avoid this dummy trap is to drop one country dummy and one industry dummy from the regression. When you drop this last country and industry dummy, restrictions as presented in the following formulas can be used to estimate the country and industry effect of these omitted dummies:

$$\sum_{j=1}^{10} w_j \beta_j = 0 \tag{3a}$$

$$\sum_{k=1}^{10} v_k \gamma_k = 0 \tag{3b}$$

The sum of all weighted β's and γ's has to be zero. W_j and v_k in these equations stands for the weights of its industry *j* and its country *k* in the world market portfolio. From formula (*3a*) and (*3b*) the sensitivities can be calculated for the last two dummy variables, which are omitted from the regression. This relationship is described in formulas (*4a*) and (*4b*) by dividing the dummies by the weight of the omitted dummy. This is described as follows:

$$-\frac{w_1\beta_1 + w_2\beta_2 + \cdots + w_{j-1}\beta_{j-1}}{w_j} = \beta_j \tag{4a}$$

$$-\frac{v_1\gamma_1 + v_2\gamma_2 + \cdots + v_{j-1}\gamma_{j-1}}{v_j} = \gamma_j \tag{4b}$$

Formulas (*4a*) and (*4b*) are used in the dummy matrix used in the regression for indices belonging to the omitted country or sectors. Moreover these formulas are being used to calculate the last country and sector effect of these omitted dummies to complete the set of estimated β's and γ's.

Based on the estimated β's and γ's from the cross sectional regressions, the country and sector effects can be measured. To judge the relevance of the estimated effects, the market-weighted average absolute country and industry effects are being calculated from the estimated β's and γ's. This method, also called mean absolute deviation (MAD), is a method also used by Rouwenhorst (1999), Cavaglia *et al.* (2000) and Phylaktis and Xia (2006) when conducting research on country and industry effects. MAD is constructed by the absolute value of the estimated country or industry effect on time t times the corresponding market value. The industry MAD (*5a*) and country MAD (*5b*) can be defined as follows:

$$MAD_{It} = \sum_{j=1}^{10} w_{jt} \left|\beta_{jt}\right| \tag{5a}$$

$$MAD_{Ct} = \sum_{k=1}^{10} v_{kt} \left|\gamma_{kt}\right| \tag{5b}$$

To judge the difference between Eurozone countries and non-Eurozone countries, we first estimate the coefficients over the 10 industries and 10 Eurozone countries to see the country effects and industry effects within the countries who joined the Eurozone in 1999. Thereafter the equation will be estimated again, now for the 5 developed non-Eurozone European countries, which all have different currencies. In this way, the Eurozone countries can be compared to the non-Eurozone European developed countries to see if the introduction of a single currency, the Euro, has led to a stronger decrease in country effects.

For both sets of countries, the β's and γ's are estimated over the full sample, 1990 until 2019, as well as over the four sub-periods. From analysing these average country and industry effects and standard deviations preliminary conclusions can be drawn. Are country effects or industry effects more volatile? Are country effects of Eurozone countries smaller than from non-Eurozone countries?

To test significance of increases or decreases in country effects, I will use a two-sample t-test for equal means assuming unequal variance. This test is called the Welch's t-test and is created by Welch (1938) as a transformation of the already existing Student's t-test. The Welch's t-test is more reliable in this research because the two samples used in the test have unequal sample sizes (Zimmerman, 2004).

In this Welch t-test, the means of two sample periods will be compared to each other. The hypotheses are defined as follows:

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

where μ_1 and μ_2 denote the sample means. The t-statistic of the Welch's test (t_w) is determined in the following way:

$$t_w = \frac{\mu_1 - \mu_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_1}}} \tag{6}$$

where μ denotes the sample mean, s denotes the sample variance and the N denotes the sample size. In addition to the t-statistics, the degrees of freedom (f_w) have to be determined by the following formula:

$$f_w = \frac{(\frac{1}{N_1} + \frac{u}{N_2})^2}{\frac{1}{N_1^2(N_1 - 1)} + \frac{u^2}{N_2^2(N_2 - 1)}} \tag{7}$$

The u in formula (*7*) denotes the ratio of the two sample variances. U is calculated as follows:

$$u = \frac{s_2^2}{s_1^2} \tag{8}$$

After performing this test for the period before and after the formation of the Euro, the four sub-periods are also compared. This is, the first period with the second, the second with the third and finally the third with the fourth sub-period will be compared to assess if any changes in country effects over time are present.

After executing these tests for the Eurozone, the tests will be executed again, now for the non-Eurozone. Finally, they will be executed to analyse if there are any significant differences between the country effects of the Eurozone and the non-Eurozone over time[3].

The null hypothesis assumes that the means of both tested sample periods have equal means. When the null hypothesis is rejected, this means that there is a significant difference in the country effects between the sub-periods. Hence, the country effects did change over time when the null hypothesis is rejected.

[3] The Welch's t-tests have been executed using STATA.

5. Results

Running the regression in *Equation 2* gives us β's for the country dummies and γ's for the industry dummies over the period February 1990 until May 2019 as presented in *Table 3* and *Table 4*. Analysing these average β's and γ's and standard deviations gives us insight in the sensitivity of each country and industry to the total return of the portfolio. The average absolute country and industry effects can tell us if the country effects or industry effect were higher over the given time and if the effects have increased or decreased over time. In the following chapters we will subsequently analyse the results for the studied Eurozone countries (Section 5.1 and 5.2) and non-Eurozone countries (Section 5.3 and 5.4). In Section 5.5 and 5.6 we will compare the results of the two sub-samples. The combined results of all studied European countries can be found in *Appendix A*.

5.1 Country and Industry effects in Eurozone countries

Table 3 presents the country and industry effects estimated on the 10 Eurozone countries. Analysing the full sample, country effects were about as volatile as industry effects. When looking at the sub-periods there are two remarkable values. The standard deviations of the telecom industry and the financial industry in the sub-period 1999 until 2007 were extremely high compared to the other industries in the period, 6.10% and 7.06% respectively. These high volatile sectors can be explained by the internet bubble which collapsed in spring 2000.

Table 3: *Industry and Country Effects in Eurozone Stock Returns, Feb 1990 – May 2019*

	Full sample		**1990-1991**		**1992-1998**		**1999-2007**		**2008-2019**	
Country/Industry	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev
Constant	0.76	4.91	-0.33	4.69	1.53	4.71	0.79	4.95	0.43	4.96
Country effect, $\boldsymbol{\gamma}$										
Austria	-0.20	3.67	-0.46	6.34	-1.20	3.19	0.44	3.86	-0.05	3.00
Belgium	-0.01	2.69	-0.42	2.22	0.24	2.45	-0.15	2.56	0.01	2.97
Finland	0.33	5.25	-2.17	6.53	1.20	6.44	0.70	6.17	-0.10	2.58
France	0.09	1.48	0.34	2.49	-0.11	2.07	0.17	1.21	0.11	0.88
Germany	-0.07	1.65	-0.03	2.11	-0.17	1.92	-0.13	1.38	0.01	1.57
Ireland	0.12	4.10	-0.39	5.19	0.67	4.32	0.13	3.94	-0.14	3.83
Italy	-0.09	1.89	-0.32	3.57	-0.06	5.22	-0.09	2.28	-0.07	1.87
Netherlands	0.04	3.84	0.24	2.03	0.33	1.93	-0.18	1.59	-0.01	2.03
Portugal	-0.22	3.01	-1.25	4.24	0.09	4.48	-0.08	3.88	-0.36	3.24
Spain	0.18	3.21	0.25	4.71	0.44	3.63	0.19	2.63	0.01	2.45
Average absolute country effect	1.68		2.30		2.18		1.59		1.34	

Table 3: *continued.*

	Full sample		1990-1991		1992-1998		1999-2007		2008-2019	
Country/Industry	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev
Industry effect, $\boldsymbol{\beta}$										
Oil & Gas	0.10	4.11	1.00	3.34	-0.24	4.04	0.39	4.96	-0.07	3.43
Basic Mats	0.11	2.52	-0.33	1.60	-0.34	1.86	0.53	2.97	0.13	2.56
Industrials	0.09	1.74	-0.28	1.70	-0.25	1.45	0.31	2.27	0.18	1.36
Consumer Goods	0.11	2.78	-0.95	2.39	0.00	2.69	0.06	3.42	0.39	2.23
Health Care	0.07	3.51	1.02	1.26	-0.02	1.87	-0.24	4.70	0.22	3.38
Consumer Services	-0.06	1.94	0.01	1.47	-0.19	1.95	-0.19	2.10	0.10	1.85
Telecom	0.10	4.51	0.63	3.49	0.81	2.71	-0.12	6.10	-0.24	3.97
Utilities	0.08	3.30	1.01	2.75	0.15	3.20	0.33	3.64	-0.31	3.09
Financials	0.34	4.72	0.22	2.22	1.10	4.07	-0.12	7.06	0.25	2.53
Technology	-0.10	2.55	-0.19	1.21	0.09	1.95	-0.07	2.46	-0.22	3.05
Average absolute industry effect	2.37		1.67		2.04		3.35		1.92	

This table presents the country and industry effects of the countries that introduced the Euro in 1999, expressed as percentages per month.

As reported in *Table 3*, the average absolute country and industry effects are calculated over time as described in *Equation 5a* and *5b*. Analysing the full sample, it is remarkable that the average absolute country effect of 1.68% is substantially lower than the average absolute industry effect of 2.37%. This average dominance of industry effects over the full sample is probably caused by the high average industry effects of 3.35% in the period 1999 until 2007 due to the burst of the dot-com bubble. During the first two sub-periods, the country effects were larger than the industry effects, but during the last two sub-periods this was the other way around. Analysing *Figure 2* and *Figure 3*, the same pattern is visible. In the first period, until 1999, the county effects were dominant, after which it reversed and the industry effects became dominant. This already confirms the idea that over time country effects became less relevant as European stock markets became further integrated as a result of the European integration.

Looking at the country effects, a decrease over time can be seen. Where the average country effect was initially 2.30% in the period leading up to the Maastricht Treaty, it shrunk to 2.18% in the runup to the Euro (*Table 3*). In the following period, after the formation of the Euro, a strong decline in average country effects can be observed. In the sub-period from 1999 until 2007, country effects in the Eurozone decreased further to 1.59% and it declined even more to an average absolute country effect of 1.34% after 2007.

Figure 1 and *Figure 2* both show the 36-months rolling average of the relative country and industry effects as a percentage of the overall variance in the market. In both graphs we display the results in a different way. *Figure 1* is a cumulative graph, showing all the effects that explain the equity index returns being market, county and industry effects in one cumulative graph. The effects that cannot be explained are captured in the error-term and therefore belong to the index-specific variation. *Figure 2* presents the 36-months moving average of the relative country and industry effects as a percentage of the total variance to be explained on a non-cumulative scale.

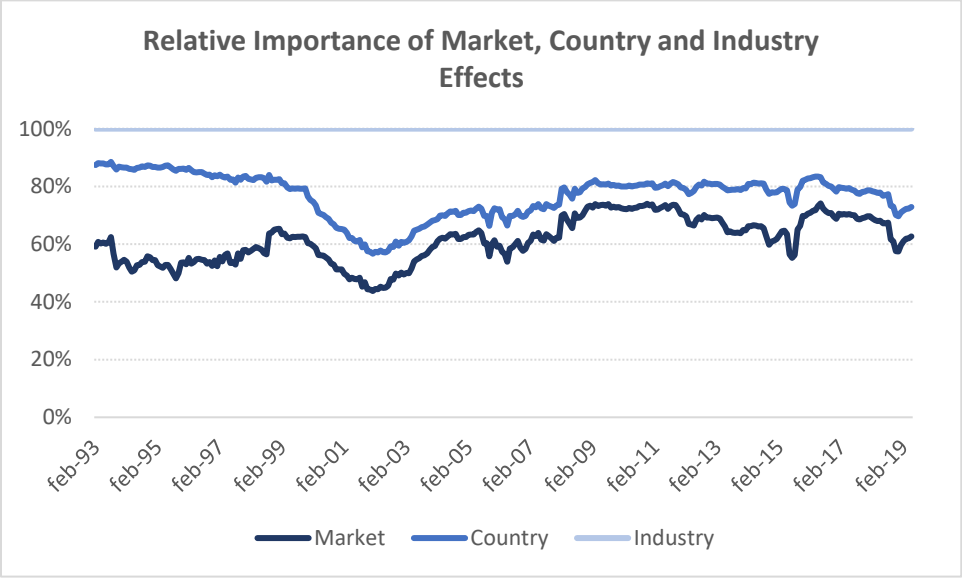

Figure 1: *36-months moving average of the variance of the country, industry and market effects of the countries that introduced the Euro in 1999.*

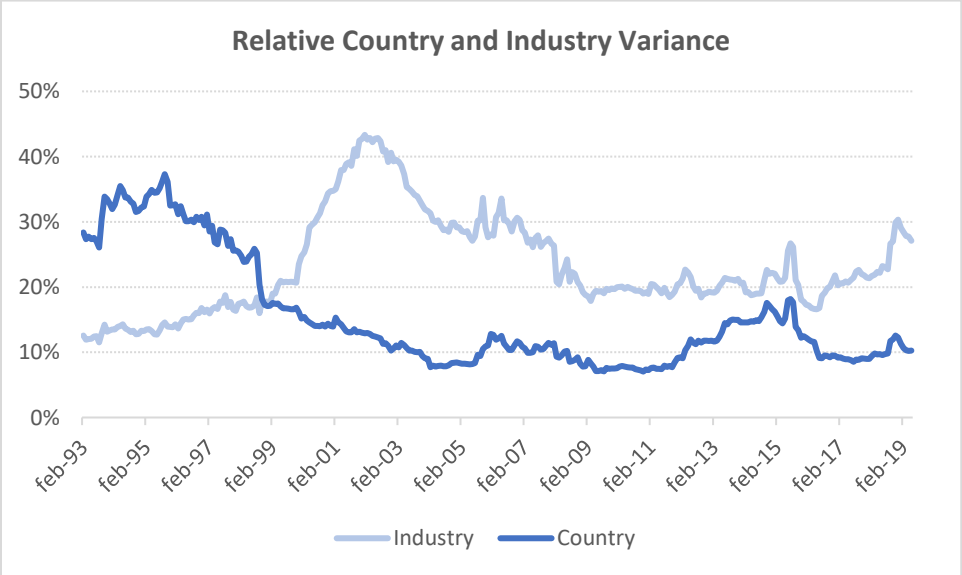

Figure 2: *36-months moving average of the country and industry variance of the countries that introduced the Euro in 1999, expressed as a percentage of the overall variance.*

In *Figure 1* we see that from the market, country and sector effects, the first one is dominant explaining around 60% of the overall variance that can be explained. It also shows that overall sector effects seem to dominate country effects.

This is better visualized in the *Figure 2*. This figure shows the upcoming importance of the industry effects with its peak at the end of 2001. After the burst of the internet bubble we see sector effects slowly declining again. However, the industry effects remained dominant over country effects.

The country effects as displayed in *Figure 2* slowly decrease from around 30% of the overall variance that can be explained to just below 10% at the start of the financial crisis in 2007. After the financial crisis we see country effects slowly creeping up again. In the graph it can be seen that since 2011 (which represents the 36-months rolling average over 2008-2011) country effects go up to a level of close to 20% of the overall variance that is explained. This increase can be explained by the global financial crisis and the Euro debt crisis of 2010, followed by more destabilization within the Eurozone and thus increasing country effects. However, this level of around 20%, explained from country effects, is still below the percentage explained by sector effects. From 2017 onwards, we see the country effects returning to its pre-crisis level of around 10% of variances being explained by country effects. It was expected to see a strong increase in country effects. The effects however have only increased temporarily and to a limited extend. Moreover, the country effects were already at a pre-crisis level at the end of 2016 and did not surpass the industry effects.

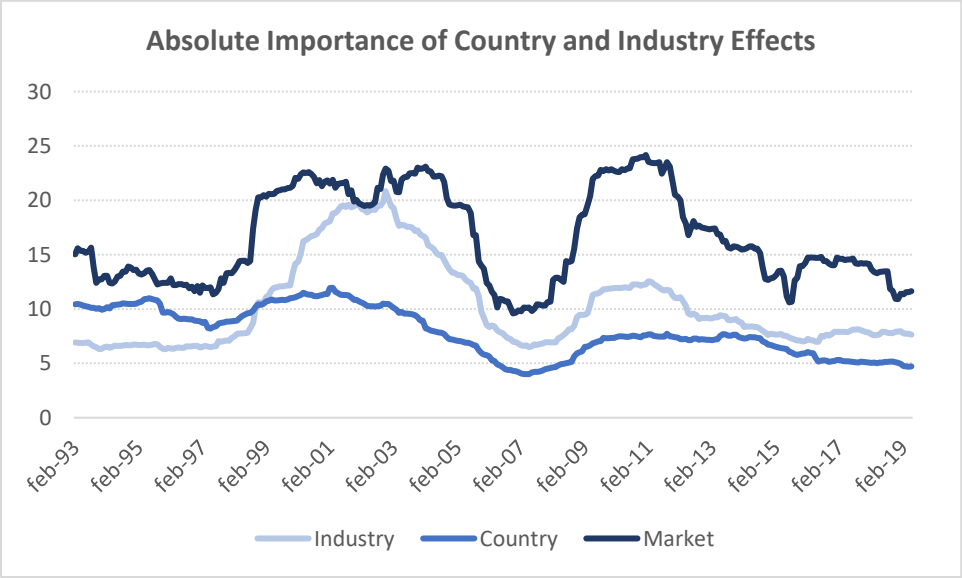

Figure 3: *36-months moving average of the market, country and industry volatility within the Eurozone stock market, expressed as percentage volatility per year.*

In *Figure 3* the absolute importance of the country and industry effects are displayed (so not as percentage of overall variance) In this graph, the same pattern of dominant industry effects since 1999 is visible. Also shown in *Figure 3* is the decline in absolute country effects after the formation of the Euro until the Financial crisis of 2007 – 2008, after which the country effects increased again. Only mid-2016 the country effects were at a pre-crisis level again.

5.2 Welch's t-tests Eurozone

To judge the significance of the increases or decreases of the country effects between the sub-periods in the Eurozone, the Welch's t-test for equal means has been applied. The results can be seen in *Table 4*.

Table 4: *Welch's t-test for equal means in the Eurozone – unequal sample sizes*

Variable	**Obs**	**Mean**	**St Dev**	**Degrees of Freedom**	**Welch's t-statistic**	**H_a: $\mu_1 < \mu_2$**	**H_a: $\mu_1 \neq \mu_2$**	**H_a: $\mu_1 > \mu_2$**
Before Euro	106	2.20	0.92	157.84	7.58	1.000	0.000***	0.000***
After Euro	245	1.45	0.68					
1990-1991	22	2.30	0.69	47.17	0.65	0.742	0.516	0.258
1992-1998	84	2.18	0.97					
1992-1998	84	2.18	0.97	159.80	4.53	1.000	0.000***	0.000***
1999-2007	108	1.59	0.79					
1999-2007	108	1.59	0.79	186.32	2.70	0.996	0.008***	0.004***
2008-2019	137	1.34	0.56					

This table presents the results of the Welch's t-test of the period before and after the formation of the Euro and the four sub-periods within the Eurozone, compared to each other. The mean and standard deviations are expressed as percentages per month.
** = Significant at a 10% level*
*** = Significant at a 5% level*
**** = Significant at a 1% level*

Analysing *Table 4*, all the significant differences found, point towards a decrease in country effects over time. Remarkable are the results of the t-test of the first sub-period, 1990-1991, and the second sub-period, 1992-1998. None of the alternative hypotheses are significant at a level of 10% and therefore the null hypothesis cannot be rejected. This means that the absolute country effects of the first sub-period and the second sub-period are not significantly different. A possible explanation for this outcome is the short time-period of the first sub-sample.

Based on the significant differences of the sub-periods before and after the formation of the Euro and the sub-periods 1992-1998 and 1999-2007, it can be concluded that the country effects have significantly decreased on average.

Comparing the sub-periods 1999-2007 and 2007-2019 we see again a significant decline in the importance of the country effects. So contrary to the expectation of a rise in country effects we saw this effect is only temporary and did not alter the longer term trend of declining country effects.

5.3 Country and Industry effects in developed European non-Eurozone countries

Table 5 reports the estimated country and industry effects of the 5 non-Eurozone countries.

Table 5: *Industry and Country Effects in European Stock Returns, Feb 1990 – May 2019*

	Full sample		**1990-1991**		**1992-1998**		**1999-2007**		**2008-2019**	
Country/Industry	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev	Mean	St dev
Constant	0.92	5.10	-0.03	5.10	1.67	4.55	0.86	4.74	0.65	4.31
Country effect, γ										
Denmark	-0.07	3.43	0.17	3.43	-0.75	3.07	0.38	2.79	-0.05	2.47
Norway	0.04	5.70	-1.33	5.70	-0.22	3.70	0.39	2.99	0.13	2.20
Sweden	0.21	4.61	-0.08	4.61	0.36	3.44	0.18	1.62	0.18	1.45
Switzerland	-0.20	2.11	-0.35	2.11	0.29	2.89	-0.30	1.65	-0.38	2.21
United Kingdom	-0.15	2.21	0.54	2.21	-0.27	2.31	-0.31	1.84	-0.05	1.64
Average absolute country effect	1.68		2.65		2.11		1.51		1.39	
Industry effect, β										
Oil & Gas	0.06	4.08	0.00	4.08	-0.13	3.47	0.60	4.46	-0.25	3.80
Basic Mats	-0.06	1.64	-0.35	1.64	-0.75	2.21	0.55	3.73	-0.06	4.54
Industrials	0.01	2.22	-0.77	2.22	-0.47	2.56	0.39	2.94	0.14	2.34
Consumer Goods	0.19	4.85	-0.03	4.85	-0.08	4.55	0.28	5.01	0.32	1.98
Health Care	0.22	1.66	1.34	1.66	-0.07	2.21	-0.10	3.73	047	3.25
Consumer Services	-0.04	1.74	0.04	1.74	0.17	2.21	0.01	2.40	-0.22	3.06
Telecom	-0.02	3.54	0.52	3.54	0.46	4.14	-0.27	5.17	-0.21	3.62
Utilities	0.16	3.54	0.72	3.54	-0.17	3.93	0.38	4.52	0.09	3.74
Financials	0.05	1.04	-0.49	1.04	0.33	2.66	0.06	2.43	-0.04	2.81
Technology	0.29	9.06	-1.34	9.06	1.99	7.99	-0.36	12.17	0.02	5.51
Average absolute industry effect	2.50		1.89		2.40		2.99		2.27	

This table presents the country and industry effects of developed European countries with all different currencies, expressed as percentages per month.

Looking over the full period, the industry effects are, just as in the Eurozone countries, larger than the country effects. The average absolute industry effect of 2.50% in the non-Eurozone countries, as measured over the full period, is larger than that of the Eurozone countries,

which only reached 2.37%. Analysing the four sub-periods, from the sub-period starting in 1992 onwards, there has been a change in dominance from country effects to industry effects. Where this reversal occurred in 1999 within the Eurozone countries, this was already the case by the end of 1995 within the non-Eurozone countries, as can be seen in the 36-month moving average model of the country and industry volatility in *Figure 6*.

Figure 4 and *Figure 5* again show the 36-months rolling average of the relative country and industry effects as a percentage of the overall variance in the market, but now for the non-Eurozone countries. *Figure 4* is the cumulative graph, while in *Figure 5* the results are displayed on a non-cumulative scale. As presented in *Figure 4* and *Figure 5,* the industry effects are also relatively more important than the country effects for these 5 non-Eurozone countries. Especially in the third sub-period, from 1999 until 2007, the relative industry effects were substantially higher than the relative country effects. This affirms what can be seen in *Table 5,* where is shown that the average absolute industry effects were almost twice as high as the average absolute country effects in this period.

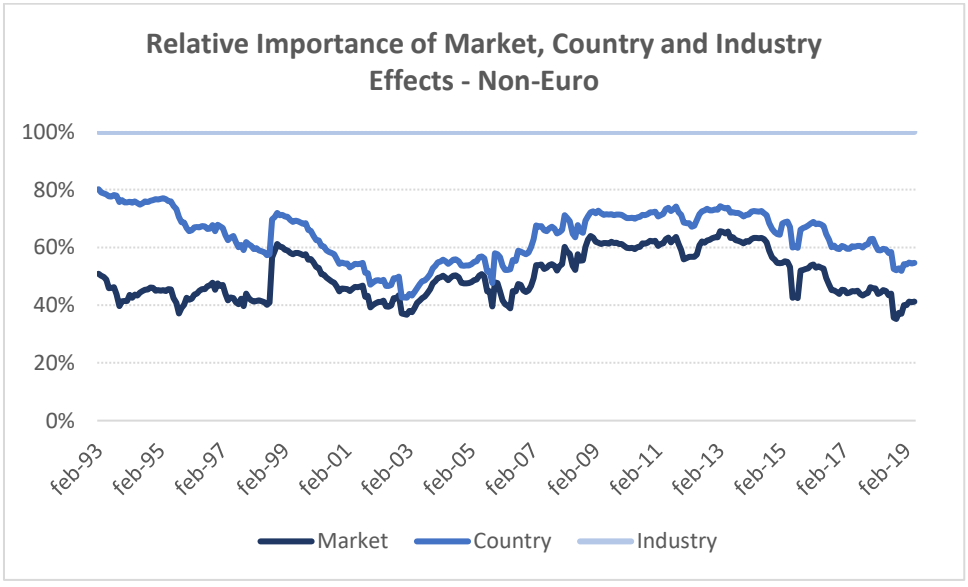

Figure 4: *36-months moving average of the variance of the country, industry and market effects of European developed countries with different currencies.*

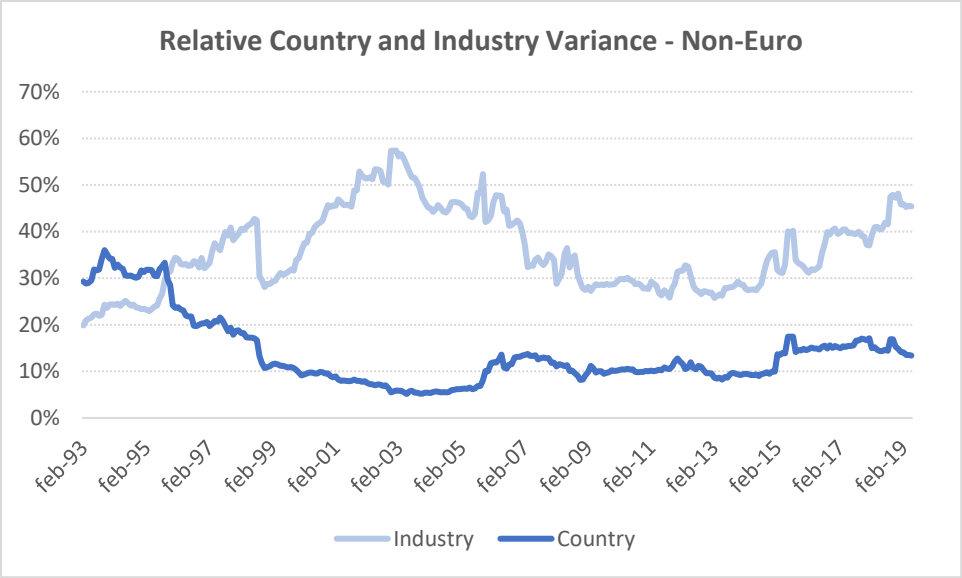

Figure 5: *36-months moving average model of the industry and country variance of European developed countries with different currencies, expressed as a percentage of the overall variance.*

Overall *Figure 5* shows the same patterns than the similar graph we had for the Eurozone countries. Country effects declined from roughly 30% of the overall explained variance to a level below 10% pre financial crisis. Also for this sample we see country effects growing slightly in importance since 2007. As a percentage of overall market variance the country effects remain slightly higher than for the Eurozone countries. Developments like Brexit might play a role in this as the UK is part of this sample.

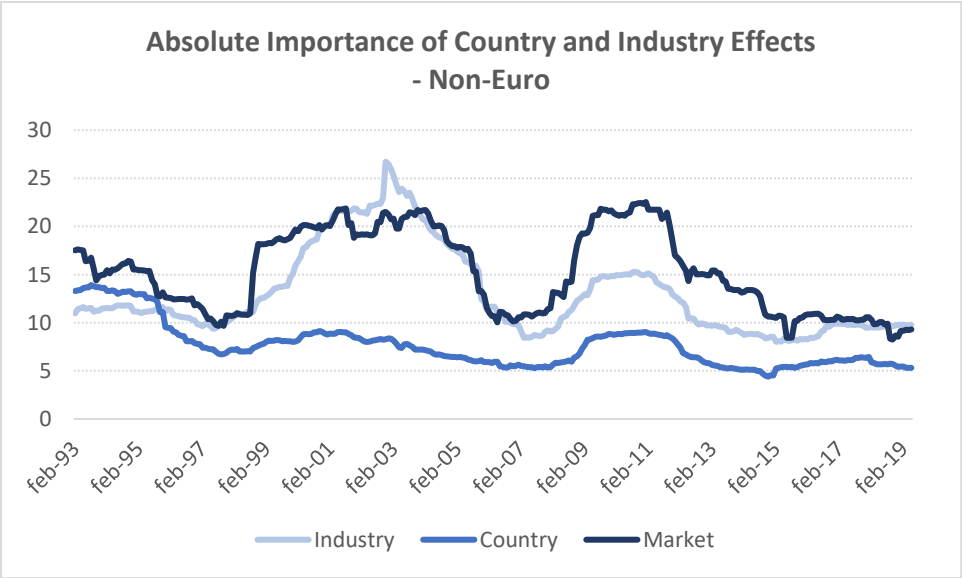

Figure 6: *36-months moving average of the market, country and industry volatility within the European non-Eurozone stock market, expressed as percentage volatility per year.*

Looking at the absolute importance of the effects in *Figure 6*, the country effects are relatively stable over the period from 1997 until now. Notable is the increase in country and industry effects from mid-2008 until mid-2012 which might be explained by the financial crisis of 2007 – 2008. This increase in effects within the developed non-Eurozone declines shortly after the increase to its earlier level again.

5.4 Welch's t-tests non-Eurozone

The observations within the non-Eurozone, given in the previous section, cannot directly be assumed. To judge the significance of the increases or decreases of the country effects between the sub-periods within the non-Eurozone, the Welch's t-test for equal means has been applied. These results are presented in *Table 6*.

Table 6: *Welch's t-test for equal means in the non-Eurozone – unequal sample sizes*

Variable	**Obs**	**Mean**	**St Dev**	**Degrees of Freedom**	**Welch's t-statistic**	**H_a: $\mu_1 < \mu_2$**	**H_a: $\mu_1 \neq \mu_2$**	**H_a: $\mu_1 > \mu_2$**
1990-1991	22	2.58	0.84	45.214	2.28	0.986	0.028**	0.014**
1992-1998	84	2.09	1.13					
1992-1998	84	2.09	1.13	126.71	4.32	1.000	0.000***	0.000***
1999-2007	108	1.49	0.66					
1999-2007	108	1.49	0.66	242.52	0.57	0.714	0.572	0.286
2008-2019	137	1.44	0.75					

This table presents the results of the Welch's t-tests of the four sub-periods within the non-Eurozone, compared to each other. The mean and standard deviations are expressed as percentages per month.
** = Significant at a 10% level*
*** = Significant at a 5% level*
**** = Significant at a 1% level*

The four studied sub-periods have been compared to each other. Reported in *Table 6* are the alternative hypothesis on the Welch's t-tests for equal means. When these hypotheses are significant, they imply significant differences in country effects between the sub-periods. The country effects of the first sub-period (1990-1991) and the second sub-period (1992-1998) are significantly different from each other at a significance level of 5%. Moreover, the second sub-period (1992-1998) and the third sub-period (1999-2007) are significantly different from each other at a 1% significance level.

None of the alternative hypothesis are significant when comparing the third sup-period (1999-2007) and the last sub-period (2008-2019). This implies that the null hypothesis, which

assumes equal means, cannot be rejected. There is no significant difference between the country effects of the sub-period before the global financial crisis and the last sub-period with the global financial crisis and the Euro debt crisis included.

5.5 Comparing country effects of Eurozone countries with non-Eurozone countries

To examine the effect of the introduction of the Euro on the country effects, the absolute country effects of the Eurozone are compared to those of the non-Eurozone countries.
As analysed in the previous section, the country effects have decreased since the formation of the Euro. To assess if this trend is actually different from the European non-Eurozone countries, which all have different currencies, the development of country effects for both samples are plotted in *Figure 7*.

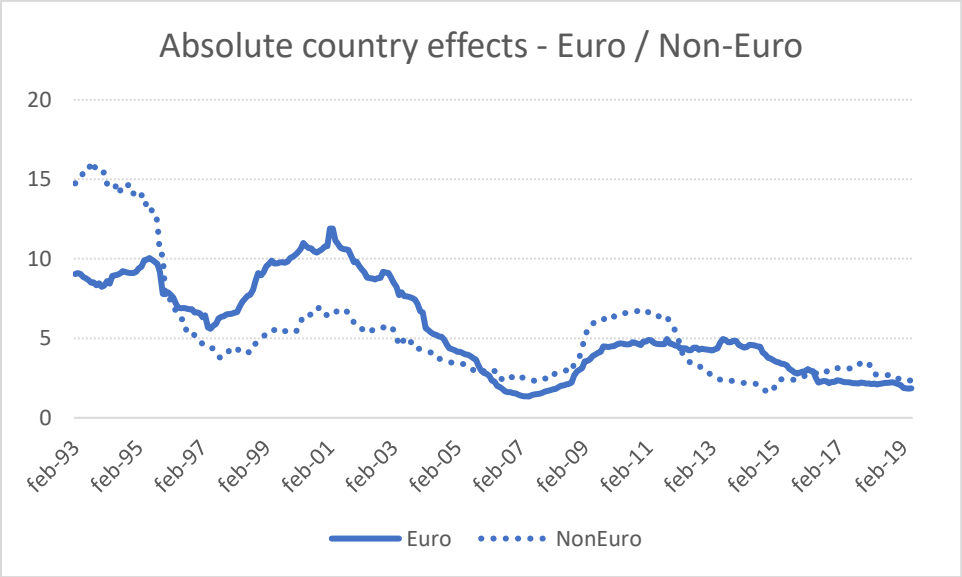

Figure 7: *Comparing 36-months moving average model of the Eurozone and non-Eurozone countries, expressed as percentages volatility per year*

Towards the formation of the Euro, an increase in country effects can be observed within the Eurozone countries. The increase within the Eurozone is considerably higher than in the non-Eurozone, which could possibly be explained by the uncertainty surrounding the formation of the Euro. After the Euro was implemented, the effects decreased again, now to a lower level than before. The decrease in country effects within the Eurozone is stronger than the decrease that can be observed within the non-Eurozone. This might be explained by the integration of the Eurozone countries, where a single currency could provide more stability than different currencies. After the fluctuations of the financial crisis and the Euro debt crisis, the country effects of both samples have reached roughly the same level.

In general, a structural decline in country effects can be observed for both samples and we do not observe a major difference in these trends. This leads to the conclusion that the financial integration within the EMU has been more important than having a single currency, the Euro. This implies in practice that for European equity portfolios sector diversification is more important that country diversification, irrespective whether these portfolios contain stocks from the 10 Eurozone countries or from developed European non-Eurozone countries.

5.6 Welch's t-tests comparing Eurozone countries with non-Eurozone countries

Analysing *Figure 7* in the previous section, it is expected to see no significant differences between the country effects of the two samples within Europe. To examine whether the country effects within the Eurozone countries are substantially different from the country effects within the non-Eurozone countries, the Welch's t-test for equal means has been applied. This two-sample t-test assumes unequal variances and is therefore more reliable than the Student's t-test. The results are presented in *Table 7*.

Table 7: *Welch's t-test for equal means between Euro and non-Eurozone – unequal sample variance*

	Euro / non-Euro	**Obs**	**Mean**	**St Dev**	**Degrees of Freedom**	**Welch's t-statistic**	**Ha: $\mu_1 < \mu_2$**	**Ha: $\mu_1 \neq \mu_2$**	**Ha: $\mu_1 > \mu_2$**
1990-1991	*Euro*	22	2.30	0.69	42.443	-1.228	0.113	0.226	0.887
	Non-Euro	22	2.58	0.84					
1992-1998	*Euro*	84	1.18	0.97	164.238	0.559	0.712	0.577	0.289
	Non-Euro	84	2.09	1.13					
1999-2007	*Euro*	108	1.59	0.79	208.941	0.989	0.838	0.324	0.162
	Non-Euro	108	1.49	0.66					
2008-2019	*Euro*	137	1.34	0.56	252.302	-1.163	0.123	0.246	0.877
	Non-Euro	137	1.44	0.75					

This table presents the results of the Welch's t-test comparing the mean of the Eurozone with the non-Eurozone for every sub-period. The mean and standard deviations are expressed as percentages per month.
** = Significant at a 10% level*
*** = Significant at a 5% level*
**** = Significant at a 1% level*

None of the alternative hypotheses are significant at a level of 10% and therefore the null hypothesis cannot be rejected. This means that the absolute country effects of the Eurozone countries are not significantly different from the absolute average country effects of the non-Eurozone countries. These results confirm the observations of *Figure 7* in the previous section.

When diversifying portfolios across countries it makes insufficient difference whether the portfolios contain stocks from the studied Eurozone countries or from the studied non-Eurozone countries.

6. Summary and conclusion

This paper examines whether it is superior for investors to diversify across countries or across industries when composing their portfolios. The study is based on the methodology as first introduced by Heston and Rouwenhorst (1995). My research studies whether the country effects have decreased since the formation of the Euro and have re-emerged again since the financial crisis. Moreover, we analysed the differences between the country effects of the Eurozone countries and the European non-Euro countries.

Country-industry indices of 10 European countries which introduced the Euro in 1999 are examined and compared to that of 5 European non-Eurozone countries. By performing this research, a dummy variable regression is used. From this monthly cross-sectional regression, a time series of the estimated industry and country effects is created. All β_i's and γ_i's are representing the sector and country effects.

Based on the results, the following can be concluded. First of all, I examined whether the upcoming industry effects have continued. The results indicate that there are changing roles of country and industry effects within the Eurozone over time. Both the decrease in country effects and the increase in industry effects played a role in the relative importance of the industry effects. Country effects are no longer dominant since the beginning of 1999, what confirms the previous findings of Cavaglia *et al.* (2000) and Phylaktis and Xia (2006).

The outcomes have also shown that there are significant decreasing country effects after the Euro was formed in 1999. Both the Eurozone countries as well as the non-Eurozone countries experience a structural decline in country effects which implies an increase in the financial integration within the EMU. This financial integration within European equity markets confirms the previous findings of Fratzscher (2002) and Beale *et al.* (2004).

Furthermore, the country effects of the Eurozone countries are not significantly different from the non-Eurozone countries. This implies that it is insufficient whether to diversify across the 10 studied Eurozone countries or across the 5 studied non-Eurozone countries. The financial integration within the EMU, due to a joint economic policy and trading agreements, is apparently more important than having a common currency, the Euro.

Moreover, I studied the impact of the financial crisis on the country effects. I expected to see a stronger increase in country effects within the Eurozone as the financial crisis resulted in the European debt crisis. However, the analysis shows that these country effects have only increased temporarily and rapidly retuned to its pre-crisis levels. Furthermore, the country effects have not exceeded the industry effects.

These results have the following implication for investors within the Eurozone equity markets. It is more favourable to diversify over industries than over countries within the Eurozone. When diversifying portfolios across countries it makes insufficient difference whether you diversify across Eurozone or non-Eurozone countries.

One area of further research could be to analyse country effects of global developed markets (e.g. G7 countries) and compare these with the European markets. When comparing these two samples, it can be studied whether diminishing country effects are stronger in Europe or are just a result of globalisation.

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Appendix A

Table 8: *Industry and country effects of studied European countries in European Stock Returns, Feb 1990 – May 2019*

	Full sample		**1990-1991**		**1992-1998**		**1999-2007**		**2008-2019**	
	Gem	St dev	Gem	St dev	Gem	St dev	Gem	St dev	Gem	St dev
Country effect, γ										
Constant	0.85	4,59	-0,17	4,71	1,61	4,46	0,28	5,21	1,06	3,87
Austria	-0.29	3.59	-0.46	6.81	-1.22	3.35	0.14	3.68	-0.06	2.59
Belgium	-0.09	2.69	-0.48	3.16	0.23	2.73	-0.37	2.63	0.03	2.60
Finland	0.29	5.54	-2.15	6.47	1.12	5.96	0.55	6.90	-0.08	2.74
France	-0.01	1.94	0.33	2.98	-0.23	2.57	0.10	1.52	-0.03	1.52
Germany	-0.15	2.06	-0.11	2.90	-0.22	2.37	-0.12	1.65	-0.15	2.01
Ireland	0.04	3.87	-0.46	5.17	0.58	4.01	-0.20	3.72	0.01	3.61
Italy	-0.19	3.70	-0.40	3.75	-0.14	5.80	-0.18	2.39	-0.21	2.82
Netherlands	-0.05	1.91	0.28	1.84	0.21	1.89	-0.30	1.90	-0.03	1.90
Portugal	-0.39	3.72	-1.32	4.27	-0.09	4.30	-0.24	3.58	-0.59	3.26
Spain	0.10	3.20	0.25	4.46	0.43	3.60	0.14	2.60	-0.19	3.14
Denmark	0.02	2.87	0.25	3.05	-0.60	3.17	0.33	2.90	0.10	2.52
Norway	0.09	3.36	-1.48	5.87	-0.10	4.04	0.21	3.32	0.37	1.87
Sweden	0.27	2.68	-0.07	5.05	0.45	3.74	0.23	1.79	0.24	1.76
Switzerland	-0.10	2.15	-0.23	2.10	0.37	2.66	-0.13	1.65	-0.38	2.15
United Kingdom	-0.08	1.99	0.59	2.32	-0.17	2.44	-0.13	1.86	-0.08	1.65
Average absolute country effect	1.79		2.62		2.25		1.59		1.54	
Industry effect, β										
Oil & Gas	0.07	3.83	0.45	3.48	-0.19	3.45	0.67	4.49	-0.39	3.33
Basic Mats	-0.01	2.97	-0.36	1.37	-0.57	1.75	0.37	3.63	0.08	3.05
Industrials	0.03	1.99	-0.53	1.64	-0.42	1.83	0.22	2.23	0.26	1.83
Consumer Goods	0.11	2.87	-0.56	3.08	-0.11	3.09	0.19	3.59	0.30	1.59
Health Care	0.18	3.07	1.27	1.35	-0.07	1.95	0.11	3.94	0.22	2.91
Consumer Services	-0.05	2.00	0.06	1.35	0.06	1.79	-0.04	2.01	-0.15	2.20
Telecom	-0.01	3.88	0.54	2.61	0.37	2.69	-0.10	5.20	-0.27	3.16
Utilities	0.06	3.23	0.83	2.71	-0.07	3.27	0.39	3.55	-0.31	2.91
Financials	0.00	2.37	-0.34	0.98	0.23	2.03	-0.13	2.52	0.02	2.58
Technology	0.24	6.77	-0.86	6.62	1.60	6.06	-0.27	9.19	0.01	3.70
Average absolute industry effect	2.14		1.55		1.86		2.69		1.97	

This table presents the country and industry effects of the studied developed European countries, expressed as percentages per month.

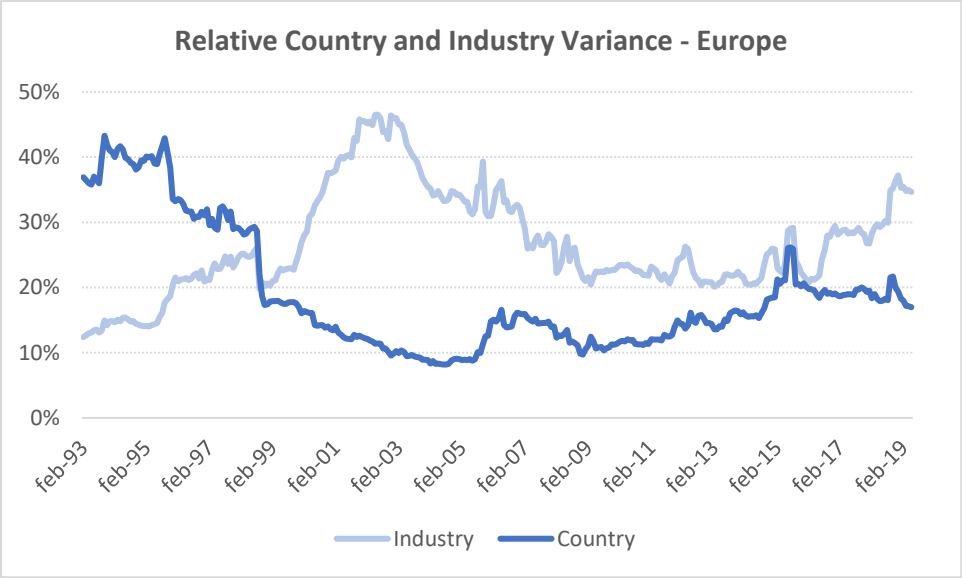

Figure 8: *36-months moving average model of the industry and country variance of the European countries studied in this paper, expressed as a percentage of the total variance.*

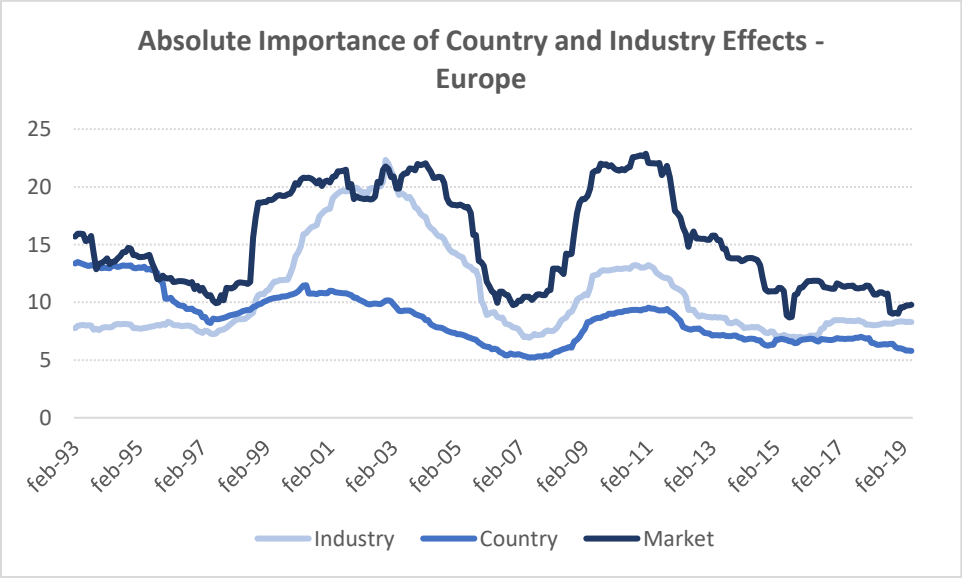

Figure 9: *36-months moving average of the market, country and industry volatility within the European stock market, expressed as percentage volatility per year.*

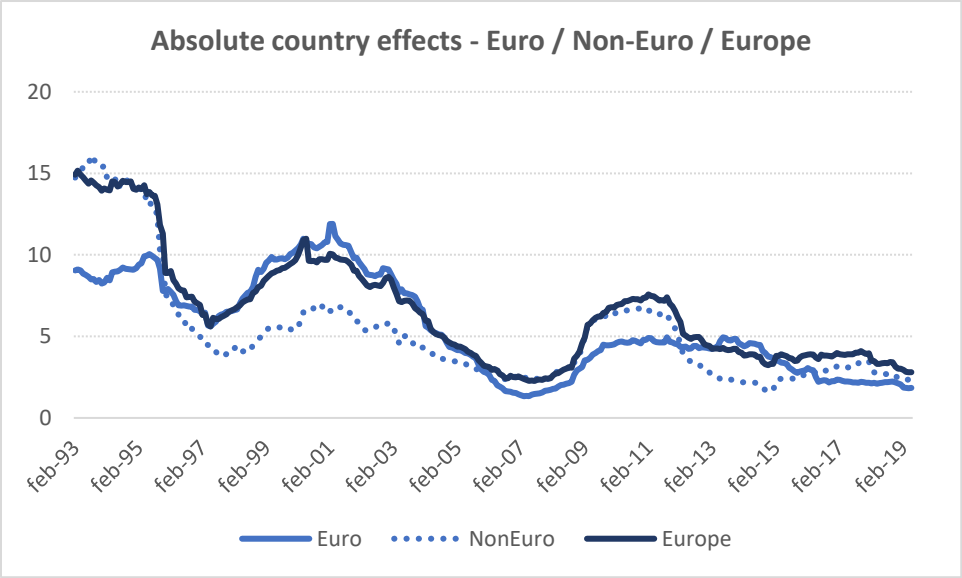

Figure 10: *Comparing 36-months moving average model of the Eurozone, non-Eurozone and European countries, expressed as percentages volatility per year*