UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

# INTEGRATION OF EUROPEAN EQUITY MARKETS

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Bachelor thesis in Financial Economics (15 hp)

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## Abstract

This thesis analyses the integration levels of European equity markets towards a regional market and the world market. In addition, we test for seasonality and unit root presence in the equity market indices. We use the returns of national equity indices of five euro-countries. We compare these to the STOXX Europe 50, representing our regional market, and MSCI World, representing the world market. First, in the results of the seasonality test, we find little evidence of consistent seasonal patterns, other than the first years after the introduction of the euro, which may be due to external political factors. Secondly, using an Augmented Dickey-Fuller test, we find no evidence of unit root present in the returns of the indices. However, we can't reject the unit root when the levels of the indices are used. Thirdly, by using a modified Jorion-Schwartz regression model, we find significant evidence that the European equity markets are highly integrated towards the European regional market, meanwhile, in some cases exhibiting segmentation towards the world market.

**Keywords:** Integration, equity markets, euro, indices, AEX, BEL20, CAC40, DAX30, LuxX, STOXX EUROPE, MSCI, risk premium seasonality, financial crisis.

# 1. Introduction

The European Union is one of the largest projects to promote integration and cooperation between the European nations. The goal is to create a functioning single market for free movement of goods, capital, services and people, also called the "Four Freedoms". This essay focuses on the capital market, mainly the European equity markets. The promotion of freedom of movement has been a longstanding project in the EU, but the financial crisis of late 2007-early 2008 became one of the largest obstacles the project had faced, resulting in a euro crisis in the wake of the financial meltdown. The focus of many European economies has since been favoring domestic stability instead of increasing integration of markets.

One of the biggest advancements in the promotion of equity market integration is the introduction of the common European currency. On January 1, 1999 the European Monetary Union was formed and since then the ECB (European Central Bank) controls a common monetary policy. The process of creating the EMU lead to a convergence towards the larger European economies, in terms of interest rates and inflation levels, as well as a general business synchronization between member states. In order to join the EMU, a member state had to fulfill the Maastricht criteria. This process was one of the key factors responsible for the convergence of European member states.

The introduction of a common currency removes many inefficiencies of international equity market trading in Europe. Despite the fact that the euro does not encompass every member of the EU, it entails higher integrated European equity markets. It also helps the integration process since it improves several other aspects, an example is the reduced information and transaction costs. Another example is that several legal restrictions were diminished, leading to greater investment and savings opportunities for citizens within the so-called Eurozone. One of the more basic implications introducing the euro is the fact that it removes currency risk. Leading to a reduction in exchange rate exposure for stocks traded within the Eurozone. This increases the incentive for investors to view the EMU as a single market of opportunity. However, given the importance of diversification, it also raises questions regarding the scale of success for the integration process.

Because of the development of the common currency and the increased effort of European integration, we expect to see greater levels of integration and co-movements between the European economies after the financial crisis and during the European sovereign debt crisis. This study tests the levels of integration of the European equity markets towards a regional and

a world market index, STOXX EUROPE 50 and MSCI World respectively, to see if there is any significant evidence of further integration with the rest of Europe and the world. Are the larger European national markets more integrated with the MSCI than the smaller ones or are there similar patterns? Since we focus on the levels of integration, we measure for external and domestic effects by isolating larger events into smaller sub-periods. The aim is to measure integration in a more accurate way.

We also perform tests to check for the validity of the estimates by using an Augmented Dickey-Fuller test and test for seasonal effects using seasonality dummies.

## 1.1 Purpose of the thesis

The purpose of this thesis is to answer the question, how much integration have the Benelux, German, and French equity market indices experienced since the introduction of the common European currency. If the markets show higher levels of integration over time, the national equity market movement should be similar and proportional to both the regional index as well as the world index. A second purpose of the thesis is to go on a deeper level and look for periods where we expect to find a difference of the market movements or an increase of co-movements of the markets. The results will make it possible for us to reach a conclusion about the equity market integration for the five countries studied during the period 1999-2014. By dividing the research period into four sub periods, one between 1999-2002, a period with high optimism for the euro, despite varying financial states of the European economies, one for the period 2003-2006, a period right before the global financial crisis, and a period for 2007-2010, to try to capture the effects of the financial crisis, and one last sub period for 2011-2014, the period after the global financial crisis and the emergence of the European sovereign debt crisis. We expect to find evidence of increased levels of integration over time, between the European national equity indices and the regional market index and a similar result towards the world market index, albeit at lower levels.

The purpose is clarified as follows:

- *Since the introduction of the euro, has the European equity markets been further integrated with the European regional index or the World market index? Has this process been affected by the major financial developments?*

By looking at changes over time for each of the markets during the period 2000-2014, and segmenting the period into four smaller sub periods, we evaluate if the market changes are economically and statistically significant to deduce the levels of equity market integration.

Since we are investigating the time-period in which the European debt crisis erupted, we have chosen to include risk premium as a variable in our model. This is also something that is not commonly used among previous studies in this field, hopefully it will help us to capture eventual effects which it could have on the European markets.

Since Kim et al (2002) criticized several older studies for not including seasonality tests. We have, in order to build upon previous works, decided to include tests for seasonality of the European equity markets in our study. This will help us to investigate the effects of seasonal fluctuations and determine if there are seasonal trends, which are commonly shared between the European markets. Depending on the nature of the significant results, we find in this test, they will either strengthen or weaken the integration process. This test uses the same sub periods as the other test in order to specify periodical changes. Clarified as:

- *Is there any sign of significant seasonality on the European equity markets during the period 1999-2014, either during the whole period or only during specific times in the series?*

## 1.2 Data description

The data used for this thesis is from the period January 1999 to December 2014. It consists of market indices from the selected countries as well as global indices, in total there are 192 observations per index (January 1999 is missing from the LuxX data). All the data are extracted from DataStream and European Central Bank and utilized in Stata.

## 1.3 Main findings

Our results for European equity integration show that since the introduction of the euro there has been a high degree of market integration towards the regional European market index during the whole period with varying degree of fluctuation. The financial crisis influenced the integration levels with a significant effect and the markets has yet to return to the same levels of market integration as pre-2007. The results of testing integration of the European national indices towards the world market are more inconclusive, as there is evidence of market segmentation during several periods, not concentrated to a specific time-period. While looking at the whole period 1999-2014 the European equity indices show no clear integration with the world market, instead it demonstrates signs of segmentation towards the world market as in the case of CAC40, which implies a possibility of diversification of assets by using the CAC40.

When testing for seasonality we find evidence of seasonal effects during several periods in our sub periods but no recurring seasonal pattern, and no significant evidence of seasonal effects during the whole time-period. During the first time-period (1999-2002) we find seasonality during October for all the equity markets, and evidence of a possible significant January effect during the period 2007-2010.

## 1.4 Outline of the Thesis

This thesis is constructed as following, first we present the theory section, which contains previous findings relevant to our research area, and thereafter the Method section will follow, explaining the statistical models and the data that has been used in this thesis. The third part is the result section, in which we present our result from the tests. Finally, we interpret and analyze the results of our thesis in order to draw some conclusion about the integration of European equity markets in an analysis and discussion part.

# 2. Theory

The study of market integration versus segmentation in Europe is well established and thoroughly examined. The groundwork for defining if a market is well integrated or segmented towards another market is presented in Jorion & Schwartz paper *Integration vs. Segmentation in the Canadian Stock Market*, 1986. Jorion & Schwartz defines integration as a situation where investors can earn the same risk-adjusted expected returns on similar financial instruments on different national markets, implying that a world index is mean-variance efficient and as a result, the only priced risk should be systematic risk relative to the world market. Moreover, segmentation is defined as a situation opposite to integration, where only national factors (e.g. domestic systematic risk) should enter the pricing of assets (Jorion & Schwartz, 1986 pp.603-604). Jorion & Schwartz further defines what hinders market integration, or as they call it *barriers*, and classifies them into two categories: *Indirect barriers* and *Legal barriers*. Examples for these kinds of barriers could be; differences in financial functioning, restrictions and different judicial status between foreign and domestic assets for indirect and legal barriers respectively (Jorion & Schwartz, 1986 pp.604).

Since the 1980s, the European financial market has undergone a huge transformation in both size and importance for investors worldwide, from small markets, compared to the markets in the UK and the US (Baele et al. 2004 pp. 525). According to Marcel Fratzscher there is significant amount of integration since 1996, and much of it is strengthened by the drive towards the EMU (Fratzscher, 2002 pp.165). By including several European countries, both those with

and without adoption of the euro, he finds that the EU projects for a unified internal market has created more integrated equity markets with less diversification opportunities, as well as more efficient equity markets in Europe (Fratzscher, 2002 pp. 190). The evidence presented by Colm Kearny and Brian M. Lucey in their paper International equity market integration also supports this notion*: Theory, evidence and implications* (2004).

Many, for example Kim, Suuk Joong, Moshirian Fariborz, & Wu, Eliza (2003), question the earlier results about European equity market integration. They discuss some shortcomings of previous European equity market integration studies and question the importance of the EMU and the integration process of European equity markets. They highlight the limited time-periods, often only including up to right after the introduction of the euro, disparities about the importance of elimination of exchange rate risk as well as the lack of seasonality tests (Kim et al., 2003 pp.2477). This is where our thesis comes in; in contrast to previous studies, we will implement a test for seasonality on the European markets just as Kim et al. If there is any seasonality present at the same period, it might be an indicator of well-integrated markets.

Kim et al (2003) find that the macroeconomic convergence process associated with the euro is a larger driving factor for integration of the European equity markets than the elimination of exchange rate risk. This result is contradicted by the results from Baele et al. 2004, because they find in their study that there is not only a higher degree of integration in the euro-area, but also globally among major equity markets (Baele et al. 2004 pp. 527).

Hardouvelis, Gikas A., Malliaropulos, Dimitrios & Priestly, Richard (2006), further support the conclusion of Kim et al. where they take a closer look at the time-period between 1992 and 1998. They find similar evidence of a link between the increased integration of European stock markets and the prospects of formation of the EMU, they also underline that the integration process picked up its speed during the second half of the 1990s. This means that the expected returns on the markets involved, became more determined by EU-wide market risk rather than being determined by local risk. Furthermore, Hardouvelis et al (2006) also manages to specify that the integration was indeed a euro specific phenomenon, which according to them means that it is independent of possible simultaneous world market integration. This assumption is further backed up by the fact that they also study the integration of the UK markets. There they find that the UK did not experience a similar development as the EMU countries experienced.

Other work points towards a broader European integration trend as in David Büttners and Bernd Hayos work from 2010, where they find that there is a significant trend towards integration in

Europe as a whole, not only limited to the Eurozone. In their test, they also observe that Foreign exchange rate risk and interest rate spreads depress the integration process among old EU member states and for participants in the Eurozone. This means that if a country implement the Euro, one can expect an increase in stock market integration towards the Eurozone markets. Further Büttner and Hayos fail to find significant evidence of seasonality effects.

Geert Bekaert, Campbell R. Harvey, Christian T. Lundblad and Stephan Siegel (2013) studies the European equity integration some years later than Fratzscher and in their study find in contrast to previous studies including Fratzscher and several others that the adoption of the common currency, the Euro, does not significantly contribute to integration of the European equity markets (Bekaert et al., 2013 pp.584).

# 3. Methodology

The methodology used for this thesis is based on quantitative data, sorted as a time series, and analyzed by utilizing econometric tests, explained further down in this chapter. The first step in this study is to illustrate the tendencies and patterns noticeable by using simple descriptive statistics. Afterwards, since we are using time-series, we need to test for trending variables and the presence of unit root in our series before we can perform our regression test, this is performed by doing seasonality test with a variable for growing trend over time and doing a Augmented Dickey-Fuller test for unit root. Finally, a regression by using a Jorion-Schwartz test for segmentation, to test for how well integrated the equity markets of the core of the European Union has become during the first decade of 2000's and early 2010's.

## 3.1 Seasonality

We will conducts a test for seasonality and time trend for our indices during our time-period to account for possible tendencies of growth over time. If we were to ignore testing for seasonality, it could lead to false conclusions regarding one variables effect on the other. When using a time series at a monthly rate, it may exhibit seasonality. In other words, the changes over time may be a seasonal trend pattern. So when using non-seasonally adjusted data it might be viable to test the time series for seasonality in a regression with seasonal dummy variables to account for possible seasonal effects (Wooldridge, 2014).

In our sample we can for example expect to find a small seasonal effect in January of every year, often called the "January effect", referring to a general increase of equity prices in January, often credited to be the effect of investors selling off equities for tax reasons, allowing capital gains, facilitating reinvestments in the next calendar year (Investopedia, 2015).

To test for seasonality, the model is as presented by Wooldridge (2014):

$$y_1 = \beta_0 + \delta_1 jan_t + \delta_2 feb_t + \delta_3 mar_t + \delta_4 apr_t + \delta_5 may_t + \cdots + \delta_{11} nov_t + trend$$

For our thesis, the base month is December, to measure the possibility of some January effect, $\beta_0$ is therefore the coefficient for December. The variables January through to November are denoted as dummy variables to test for the difference in returns from December, whether the time period *t* corresponds to the appropriate month in our time series. The variable trend tests for trends in the time series. The reason to include a variable for trends is to take in consideration the possibility of trends for unobserved factors. We will be performing seasonality testing of the national indices for both prices and returns to observe the possibility of time trending variables present in the indices. The reason being that prices of the indices are not de-trended and the returns are de-trended. If there were to be no seasonality in our sample, then $\delta_1$ through $\delta_{11}$ would all be zero (0).

## 3.2 Unit Root – Augmented Dickey-Fuller test

To further optimize and strengthen the validity of our estimates in our regression we need to test for unit root. To test if the time series exhibit a unit root or stationarity we conduct an Augmented Dickey-Fuller test with a null-hypothesis of unit root process present in the time series to check if the test procedure will be correctly estimated by OLS or if further measures need to be taken to get non-faulty estimates. If the variables in the regression are not stationary (i.e. unit root present), then it can be proved that the standard assumptions for asymptotic analysis will not be valid. This implies that the standard t-values will not follow a t-distribution, so we cannot validly undertake hypothesis tests about the regression parameters. The test itself is an extension of a Dickey-Fuller test, but it removes the possible effects of autocorrelation in the time series, by using lags, to then test using the same procedure. If there is evidence of unit root in the time series, it will cause difficulties for the validity of the regressions, or even produce invalid estimates. The Augmented Dickey-Fuller test statistic is a negative number, where the more negative the stronger rejection of the null-hypothesis (Wooldridge, 2014).

The model provided to test for unit root is the Augmented Dickey-Fuller test provided by Wooldridge (2014):

$$\Delta y_t = \alpha + \theta y_{t-1} + \gamma_1 \Delta y_{t-1} + \cdots + e_t$$

$H_0: \theta = 0$ against $H_1: \theta < 0$

Where $\Delta y_t$ is the first difference operator. If we fail to reject the null-hypothesis the sample is said to exhibit unit root, which is explained to have the properties to permanently change the outcome of the time series, which would not decay as it would if the process is stationary. The $H_1$is therefore the hypothesis of a stationary process, which is preferable for the validity of the estimations of the results. We will conduct two DF-tests, one for the whole sample using indices prices, with and expected result of failure to reject the null-hypothesis in favor of stationarity. And a second test for the whole sample using the returns of the indices where we expect to reject the null-hypothesis in favor of $H_1$, that the time series is a stationary process, following a random walk, and thus giving us a more valid estimation of results of the Jorion-Schwartz model regression.

## 3.3 Jorion-Schwartz segmentation model

The model that will be used to test the market integration versus market segmentation is based on the model presented by Jorion & Schwartz in their previously mentioned paper *Integration vs. Segmentation in the Canadian Stock Market* (1986). Jorion & Schwartz use their model to test the integration/segmentation of the Canadian equity market towards a global North American market. By focusing on restrictions imposed by the model on the pricing of the assets, they were able to measure the levels of segmentation on the Canadian equity market (Jorion & Schwartz, 1986 pp 603-604). The Jorion & Schwartz model test is further simplified by Wang & Di Iorio in their work; *Are China-related stock markets segmented with both world and regional stock markets?* (2007) for an easier use of model for our test.

In our thesis, we test for equity market integration between a selection of European stock indices and a regional, as well as a world market, similar to the basis of the Jorion & Schwarz paper where they test the integration towards a global market. In our case, the STOXX Europe 50 represents the regional market, and MSCI World Index represents the world market. The dependent variables for our model are the stock indices representing the countries respective equity markets, and the STOXX Europe 50 and MSCI World index are our independent variables representing a regional and world index respectively, with the addition of including the risk premium of European bonds as an estimation of risk. The model as presented by Wang & Di Iorio for our test is:

$$R_{it} = \hat{\alpha} + \beta_i^D\left(R_{Dt} - Rf(R_{Dt})\right) + \beta_i^G\left(R_{Gt} - Rf(R_{Gt})\right) + \beta_i^y(Risk\ Premium) + \varepsilon_{it}$$

Where $R_{it}$ is the monthly return on the country indices, or a portfolio *i* representative of the market, the $R_{Dt}$ is the European index representing the regional equity market. $R_{Gt}$, is the return

of the global market index minus the$R_{Dt}$. $(R_i)$ and $(R_{Dt})$ are the values of the portfolio $i$, and the European regional index, respectively. $\beta_i^D$ and $\beta_i^G$, are the factor sensitivities, also called factor loading by Wang and Iorio (2007). As previously mentioned, risk premium is also included in the regression. The risk premium is calculated as the value of the national 3-month Treasury bill rate of the countries used in the thesis, subtracted the rate US 3-month Treasury bill, representing the risk-free asset.

Furthermore, we have also decided to split up the time-period into four sub periods to test for time sensitivity, if the rate of market integration performed differently during different time-periods.

# 4. Data

The data for this thesis is retrieved from Thomson Reuters DataStream, a database of financial and macroeconomic data, covering among other things, equities, and stock market indices. The data have been collected on a monthly basis for the period January 1999 to December 2014, resulting in 190-191 observations for each variable studied during the period, with only one missing value in our sample, the latter for the Luxembourger index for January 1999. Following the acquisition of the data, we split the period into sub periods, since we expect the results to be different when controlling for time specific events, such as the period around the 2008 financial crisis. The first sub-period is the period January 1999 to December 2002, the second sub-period is between January 2003 to December 2006, and the third sub-period is between January 2007 to December 2010, and the last sub-period is between January 2011 and December 2014.

All included indices used in the thesis are calculated in euro, including the MSCI World Index, which for proper use, is recalculated into euro. The indices used for this thesis are the AEX; Netherlands, BEL20; Belgium, CAC40; France, DAX; Germany; LuxX; Luxembourg, MSCI World Index and STOXX Europe 50.

## 4.1 Sub-periods

By dividing the whole sample period into smaller sub-periods we expect to define/isolate time varying financial events that affected the market in one way or another. The market effects could be such as the introduction of the euro, January 1999, or other major macroeconomic effects such as the 2008 financial crisis. From this, we expect to be able to isolate time-period specific statistical and economically significant effects.

## 4.2 Stock Indices

### *MSCI World Index*

The MSCI World Index captures large- and mid-cap representation across 23 developed market countries with 1642 constituents. The index covers approximately 85% of all free float-adjusted market capitalization in each of the included countries. The index is reviewed quarterly with an objective to reflect the changes in the underlying equity markets in a timely manner, the index is reviewed semi-annually (MSCI, 2015).

### *STOXX Europe 50*

The STOXX Europe 50 is a blue-chip index for a representation for super-sector leaders in Europe. The index covers the 50 largest and most liquid stocks from 18 European countries, not limited to countries with euro as their current currency. The index is weighted quarterly according to free float-market capitalization, and reviewed annually in September (STOXX, 2015).

### *AEX*

The AEX index reflects the performance of the 25 largest and most traded shares listed on the Amsterdam Stock Exchange, and a widely used indicator for the Dutch stock market. The index is a free float-market capitalization index with a weight cap of 15%, and reviewed annually in each march (Euronext, 2015).

### *BEL 20*

The BEL 20 index reflects the performance of the 20 largest and most trades shares on the Euronext Brussels, and a widely used indicator for the Belgian stock market. It is a free float-market capitalization, subjected to a 12% weighting cap. BEL 20 is reviewed annually in each march (Euronext, 2015)

### *CAC 40*

The CAC 40 reflects the performance of the 40 largest and most traded shares on the Euronext Paris; it is also used as a widely accepted indicator for the Paris stock market. The index is weighted according to free float-market capitalization subject to a 15% weighting cap (Euronext 2015).

*DAX*

The DAX is an index that consists of the 30 most actively traded blue-chip shares and represents approximately 75% of the aggregate capital stock of listed German stock corporations. It is further used an indicator for the Frankfurt stock exchange. The index is weighted according to free float-market capitalization with a weighted cap of 10%. The DAX is updated on a quarterly basis (STOXX, 2015).

*LuxX*

The LuxX is an index that consists of the 9 highest valued and most traded shares on the Luxembourg stock exchange. The index is weighted according to free float-market capitalization, with a weight limit of 20%, when a weight of a share exceeds 20% the weight is readjusted and the excess is distributed proportionally between the rest of other index constituent companies (Société de la Bourse de Luxembourg S.A. 2014).

# 5. Results

The results consist of four parts; the first part introduces the descriptive statistics, basic statistical values for our indices during the whole period and the subsequent sub-periods. Thereafter in the second part, we conduct our seasonality test on the whole period and the four sub periods. In the third part, we present the results of the Dickey-Fuller test for unit root on our time series based indices. In the fourth and final section, we present the results of our Jorion-Schwartz test for market integration.

Table 1: Descriptive statistics, all periods.

| Time Period | Jan1999- Dec2014 | | | Jan1999- Dec2002 | | | Jan2003- Dec2006 | | | Jan2007- Dec2010 | | | Jan2011-Dec2014 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Obs | Mean | Std. Dev | Obs | Mean | Std. Dev | Obs | Mean | Std. Dev | Obs | Mean | Std. Dev | Obs | Mean | Std. Dev |
| AEX | 191 | .0006 | .0596 | 47 | -.0060 | .0695 | 48 | .0069 | .0504 | 48 | -.0044 | .0725 | 48 | .0057 | .0450 |
| BEL20 | 191 | .0010 | .0518 | 47 | -.0099 | .0499 | 48 | .0151 | .0396 | 48 | -.0072 | .0704 | 48 | .0058 | .0385 |
| CAC40 | 191 | .0029 | .0550 | 47 | -.0015 | .0675 | 48 | .0106 | .0384 | 48 | -.0054 | .0643 | 48 | .0047 | .0445 |
| DAX30 | 191 | .0057 | .0638 | 47 | -.0052 | .0784 | 48 | .0143 | .0545 | 48 | .0044 | .0694 | 48 | .0090 | .0493 |
| LuxX | 190 | .0046 | .0649 | 46 | -.0001 | .0856 | 48 | .0207 | .0471 | 48 | -.0048 | .0725 | 48 | .0023 | .0455 |
| STOXX EUROPE 50 | 191 | .0007 | .0475 | 47 | -.0029 | .0593 | 48 | .0066 | .0329 | 48 | -.0054 | .0585 | 48 | .0045 | .0328 |
| MSCI World (Euro) | 191 | .0028 | .0435 | 47 | -.0018 | .0557 | 48 | .0060 | .0325 | 48 | -.0019 | .0519 | 48 | .0087 | .0279 |

## 5.1 Descriptive statistics

Table 1 shows a complete summary of the descriptive statistics of the data that is being used in this paper. The stock indices, which are being used as independent variables, are STOXX EUROPE 50 (STXE) and Morgan Stanley Capital International World Index (MSCI).

The dependent variables are the following national indices, AEX (Netherlands), BEL20 (Belgium), CAC40 (France), DAX30 (Germany) and finally LuxX (Luxemburg).

The first variable in the table is the number of observations; here we can see that our data is complete for all the indices for all time-periods with one exception. The index of Luxemburg (LuxX) is missing one value, which is January 1999; therefore, it has 190 observations instead of the 191, which all the others have. This can also be seen in the first time-period (Jan1999-Dec2002) where LuxX has 46 instead of 47 observations.

The second variable is the mean, which shows the average return of the indices over the specified time-period. It indicates that the German index (DAX30) has had the highest return over the entire time-period from 1999 to 2014 with an average return of 0.57%. In contrast, the lowest notation of this measurement for the whole time is the STOXX Europe 50 with an average return of 0.07%. This is significantly lower than the world index MSCI in direct comparison with a difference of roughly 0.2%. This can also be concluded by looking at the different time-periods because they reveal that the MSCI did outperform the STXE index in 3 out of the 4 periods which is not surprising considering the overall result.

The third and final variable is the Standard deviation, which is a measurement of risk in this context. Here we can see that the LuxX index has been the riskiest from 1999 to 2014 with a standard deviation of 0.0649, narrowly followed by the DAX30 index with its 0.0637. On the bottom of the table, we find the two international indices (STXE and MSCI) which are, unsurprisingly, the least risky indices. This is likely due to international diversification of stocks, which generally reduces portfolio risk. The world index MSCI is more internationally varied than the STXE, which also show in the result since MSCI has a lower standard deviation than its European counterpart does, with 0.0435 compared to 0.0475.

Looking the entire time-period, we can conclude that the less risky national indices are also the ones with the lowest average returns, which is not a surprise. These are AEX, BEL20 and CAC40. LuxX and DAX30 have higher average returns but it also comes with the price of higher risk, of these two however, it is important to highlight that the German index has had higher average returns while still having lower risk than the LuxX index.

The first sub period stretches from January 1999 to December 2002; here all the variables have 47 observations except LuxX, which has been mentioned previously. First, one of the most noticeable things about this sub period is the fact that all of the indices have a negative average return. Combine this with the fact that all of the included indices except for BEL20 also have higher standard deviation; these are signs of a recession. There are several possible explanations for this and it is complicated to draw conclusions just by looking at these statistics. However, it is reasonable to think that the IT-crash could have played a part since it occurred during this time-period. Another contributing factor might be the World Trade Center terrorist attack in 2001.

The second sub period is Jan 2003-Dec 2006. In this period, all of the indices indicate positive average returns, which are the complete opposite of what they did in the previous time-period. The standard deviation is lower across the board compared to the 1999-2003 period.

The third sub period is Jan 2007-Dec2010; here, even the two international indices are negative despite them being far more diversified than the national indices, the MSCI return is -0.19% and the STXEs counterpart is -0.54%. The obvious explanation for this is the financial crisis, which struck the world economy during this time-period, this fact makes these results fairly predictable. It is safe to say that the euro currency crisis affected these results, which might be the reason that we can observe a noticeable difference between the two international indices. The result of the DAX30 index gives a glimpse of how resilient the German economy was towards the crisis. If one takes a closer look at the graph for the DAX30 index (in the appendix), it is possible to see that the German market recovered at a rapid pace. This might have been due to investors moving from countries, which were sorely effected by the crisis, to countries, which were more stable, in a European perspective this could give incentive for investors to move capital to the German markets. This is generally known as the flight to security effect, and it is also a behavior often associated with financial or economic crises. BEL20 was the index, which performed the worst during this period in terms of mean return with its value of -0.72%. The reason for this might be the Belgian banking crisis, which was a consequence of the larger crisis around the world, a number of banks stocks plummeted during 2008-2009. It is very likely that this is what is responsible for the low mean return during this period.

The standard deviation has gone up during this period compared to the previous one, which is logical considering the financial development during this period.

The fourth and final sub period is Jan 2011-Dec 2014, the development which we saw between the first two periods seems to be repeating itself and can once again the result conclude that all of the indices have positive mean returns. In this time-period MSCI almost doubles the return of the STXE index which is remarkable even though the relationship between the two was similar during the previous time period (2007-2010). The reason for this might be as previously the euro currency crisis since it also stretches into the last time-period and therefore affects its statistical values.

Looking at the standard deviations it is clear that they have fallen significantly compared to the previous sub period, which is to be expected.

## 5.2 Seasonality

This section is used for the purpose of looking for seasonality in our selected national indices. First table presented is a seasonality table for the whole period using the indices prices, or the level value of the indices, thereafter the results of the returns on the indices follows, for a de-trended value. An important detail for the test is that we use December as the base month (m12). First, we will focus on the entire time-period (Jan 1999-Dec 2014) and then on the different sub periods, the tables for the latter can be found in the appendix.

Table 2: Seasonality, 1999-2014, Index prices

| Time Period | Jan1999-Dec2014 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Constant | 529.004*** | 2929.198*** | 4861.128*** | 4304.554*** | 1226.372*** |
| m1 | 5.0250 | 77.7670 | 10.5805 | 44.4624 | 48.4047 |
| m2 | 0.6180 | 51.7135 | -6.1607 | 16.0615 | 43.5345 |
| m3 | -4.8140 | 23.7789 | -49.9107 | -55.9474 | 64.1239 |
| m4 | 0.5070 | 73.5362 | 25.6395 | 11.2330 | 65.2946 |
| m5 | 8.8731 | 98.1441 | 119.4040 | 146.3153 | 71.8371 |
| m6 | 3.7770 | 50.8670 | 84.7340 | 101.7751 | 59.6484 |
| m7 | 2.4350 | 13.9180 | 27.3009 | 40.8399 | 47.6022 |
| m8 | -2.8706 | -2.5622 | -21.3634 | -29.6084 | 48.7742 |
| m9 | 2.5994 | 60.8907 | 19.1129 | -110.0424 | 37.0342 |
| m10 | -11.0260 | 23.1786 | -79.8008 | -231.4145 | -12.6882 |
| m11 | -3.5425 | 12.3115 | -22.46760 | -126.6392 | -13.9007 |
| trend | -1.1813*** | -1.0885* | -6.1357*** | 17.8733*** | 1.2881*** |
| Obs. | 192 | 192 | 192 | 192 | 191 |

When testing for seasonality for indices prices, or level values, we can see that there is a strong significant trend present during the sample period. The constants for all indices are strongly significant to the 1% level, and all indices have trends in the 1% level, except BEL20, which only is significant to the 10% level. These results show that our indices are strongly trending

values. Therefore, it is necessary to de-trend the indices by instead utilizing the returns on the indices, as previously specified to get better estimates.

When testing for seasonality on the returns of the indices, we are looking for statistical significance here since we are focusing on financial market fluctuations, which implies that even if the betas are very small, they are still economically significant.

Table 3: Seasonality, 1999-2014, Index returns

| Time Period | Jan1999-Dec2014 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | 0.0011 | -0.0111 | 0.0073 | 0.0198 | 0.0266 |
| m1 | -0.0134 | 0.0331* | 0.0187 | 0.0008 | 0.0157 |
| m2 | -0.0266 | -0.0012 | -0.0097 | -0.0258 | -0.0127 |
| m3 | 0.0065 | -0.0080 | -0.0196 | -0.0395* | -0.0096 |
| m4 | 0.0119 | 0.0228 | 0.0111 | -0.0098 | -0.0227 |
| m5 | -0.0162 | 0.0174 | 0.0151 | 0.0103 | -0.0123 |
| m6 | -0.0106 | -0.0092 | -0.0162 | -0.0293 | -0.0294 |
| m7 | -0.0111 | -0.0046 | -0.0183 | -0.0284 | -0.0213 |
| m8 | 0.0035 | 0.0038 | -0.0137 | -0.0298 | -0.0185 |
| m9 | -0.0387 | 0.0268 | 0.0015 | -0.0344 | -0.0295 |
| m10 | 0.0101 | -0.0104 | -0.0314 | -0.0501* | -0.0608 |
| m11 | 0.0000 | 0.0004 | 0.0094 | 0.0035 | -0.0190 |
| trend | 0.0225 | 0.0001 | 0.0000 | 0.0001 | 0.0000 |
| Obs. | 191 | 191 | 191 | 191 | 190 |

The first significant result when testing seasonality for the returns of the indices is found in January (m1) in the BEL20 index, it tells us that there is a positive trend during this month. It is significant at a 10% level, making it the only significant result for January regardless of which index one is looking at. In March (m3), the German DAX30 index is presenting a negative trend, also significant at a 10 % level. For the record, the other indices are also indicating negative trends during this March but none of them shows any significant results. October (m10) also shows significant results at a 10% level, which indicate a negative trend for DAX30.

Table 4: Seasonality 1999-2002, Index returns

| Time Period | Jan1999-Dec2002 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | 0.0703* | 0.0197 | 0.0774 | 0.0806 | 0.1262 |
| m1 | -0.0005 | 0.0299 | 0.0095 | 0.0106 | -0.0069 |
| m2 | -0.0710 | -0.0604 | -0.0374 | -0.0223 | -0.0367 |
| m3 | -0.0496 | -0.0289 | -0.0591 | -0.0660 | -0.0608 |
| m4 | -0.0464 | -0.0135 | -0.0283 | -0.0502 | -0.1174 |
| m5 | -0.0096 | -0.0119 | -0.0059 | -0.0173 | -0.0605 |
| m6 | -0.0796** | -0.0333 | -0.0599 | -0.0857 | -0.1117 |
| m7 | -0.0484 | -0.0027 | -0.0477 | -0.0514 | -0.0967 |
| m8 | -0.1181* | -0.0480 | -0.0963 | -0.1053 | -0.1089 |
| m9 | -0.0168 | 0.0152 | -0.0280 | -0.0551 | -0.1152 |
| m10 | -0.1413*** | -0.0821** | -0.1198** | -0.1571*** | -0.2102** |
| m11 | 0.0283 | 0.0073 | 0.0395 | 0.0396 | -0.0719 |
| trend | -0.0012 | -0.0004 | -0.0017** | -0.0015* | -0.0016* |
| Obs. | 47 | 47 | 47 | 47 | 46 |

Focusing on the first time-period (Jan 1999-Dec 2002), the most noticeable results are the ones from October (m10). These are showing negative trends, which are significant even on a 1% level for two of the indices, the ones being AEX and DAX30. CAC40, LuxX and BEL20 also show negative trends during this month, although these are only significant at a 5% level. Other significant results worth mentioning in this time-period are the negative trend results found in AEX in June (m6) and August (m8), these are significant at a 5% level and 10% level respectively. This is also the only sub period in which there are significant results for our trend variable, they indicate a negative trend for three of our five indices.

Table 5: Seasonality, 2003-2006, Index returns

| Time Period | Jan2003-Dec2006 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | 0.0064 | 0.0134 | 0.0081 | 0.0282 | 0.0303 |
| m1 | -0.0258 | 0.0016 | -0.0144 | -0.0418 | -0.0179 |
| m2 | -0.0029 | 0.0012 | 0.0052 | -0.0237 | -0.0082 |
| m3 | -0.0286 | -0.0213 | -0.0127 | -0.0377 | -0.0146 |
| m4 | -0.0411 | -0.0219 | -0.0178 | -0.0421 | -0.0500* |
| m5 | -0.0004 | 0.0125 | 0.0083 | 0.0157 | -0.0259 |
| m6 | -0.0205 | -0.0259 | -0.0066 | -0.0239 | -0.0409 |
| m7 | 0.0046 | -0.0073 | -0.0023 | -0.0079 | 0.0038 |
| m8 | 0.0030 | 0.0083 | 0.0030 | -0.0087 | 0.0022 |
| m9 | 0.0063 | 0.0112 | 0.0109 | -0.0143 | -0.0143 |
| m10 | -0.0154 | 0.0157 | -0.0038 | -0.0189 | -0.0065 |
| m11 | -0.0020 | -0.0001 | 0.0020 | 0.0053 | 0.0022 |
| trend | 0.0004 | 0.0002 | 0.0002 | 0.0001 | 0.0002 |
| Obs. | 48 | 48 | 48 | 48 | 48 |

The second sub period (Jan 2003- Dec 2006) only has one result, which is significant at a 10 % level. This one is the LuxX index in April (m4), it indicates a negative seasonal trend.

Table 6: Seasonality, 2007-2010, Index returns

| Time Period | Jan2007-Dec2010 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | -0.0657* | -0.0836 | -0.0493 | -0.0216 | -0.0606 |
| m1 | 0.0969 | 0.1024* | 0.0769* | 0.0654 | 0.0821* |
| m2 | 0.0224 | 0.0482 | -0.0146 | -0.0533 | 0.0195 |
| m3 | -0.0097 | 0.0151 | -0.0087 | -0.0366 | 0.0279 |
| m4 | 0.1074** | 0.1242* | 0.0986* | 0.0744 | 0.0974** |
| m5 | 0.0899* | 0.0940 | 0.0767 | 0.0718 | 0.0741 |
| m6 | 0.0667 | 0.0610 | 0.0420 | 0.0436 | 0.0553 |
| m7 | -0.0012 | 0.0013 | -0.0196 | -0.0329 | 0.0092 |
| m8 | 0.0753 | 0.0755 | 0.0736 | 0.0420 | 0.0440 |
| m9 | 0.0505 | 0.0903 | 0.0472 | 0.0024 | 0.0420 |
| m10 | 0.0270 | 0.0425 | 0.0351 | 0.0089 | 0.0096 |
| m11 | -0.0013 | 0.0156 | 0.0087 | -0.0171 | -0.0228 |
| trend | 0.0007 | 0.0008 | 0.0004 | 0.0005 | 0.0008 |
| Obs. | 48 | 48 | 48 | 48 | 48 |

The third sub period (Jan 2007-Dec 2010) has more significant results than the previous one had. Yet again, we find the majority of these in April (m4). Four out of the five indices show significant results, all of them indicating positive seasonal trends. The only one not presenting a significant result is the DAX30 index. There are also significant results in January (m1), in which BEL20, CAC 40 and LuxX all have a positive trend. However, these are only significant at a 10% level. These are the only results, which indicate a January effect of any substance in our tests.

Table 7: Seasonality, 2011-2014, Index Returns

| Time Period | Jan2011-Dec2014 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | 0.0021 | -0.0075 | 0.0119 | 0.0315 | -0.0085 |
| m1 | 0.0327 | 0.0170 | 0.0099 | -0.0222 | 0.0275 |
| m2 | -0.0003 | 0.0174 | 0.0009 | -0.0117 | -0.0044 |
| m3 | -0.0169 | 0.0127 | -0.0041 | -0.0246 | 0.0119 |
| m4 | 0.0075 | 0.0110 | -0.0136 | -0.0273* | -0.0185 |
| m5 | -0.0311* | -0.0174 | -0.0235 | -0.0343 | -0.0347 |
| m6 | -0.0302 | -0.0320 | -0.0444 | -0.0558 | -0.0188 |
| m7 | 0.0038 | -0.0043 | -0.0069 | -0.0253 | 0.0002 |
| m8 | -0.0038 | -0.0165 | -0.0378 | -0.0506 | -0.0100 |
| m9 | -0.0254 | -0.0061 | -0.0264 | -0.0731 | -0.0296 |
| m10 | -0.0248 | -0.0153 | -0.0387 | -0.0349 | -0.0355 |
| m11 | 0.0155 | -0.0201 | -0.0131 | -0.0145 | 0.0168 |
| trend | 0.0004 | 0.0007 | 0.0004 | 0.0004 | 0.0008 |
| Obs. | 48 | 48 | 48 | 48 | 48 |

For the last sub period (Jan 2010- Dec 2014) there are only two results significant at even a 10% level, the two being, April (m4) for DAX30 and May (m5) for AEX. The first one indicates a negative seasonal trend for the German index, the second shows a positive counterpart for the Dutch index.

As previously mentioned, there is only one sub period (1999-2002) which has significant results for the trend variable when testing for seasonality on the returns of the indices. All other periods, including the total sample period, reject the notion of a time trend. This tells us that there are few statistically significant trends, which distinguish these indices from random behavior, which is in line with the random walk theory. The size of the trend variables are so miniscule since we are using the returns on the indices rather than the indices pricing for the second test of the whole period and the sub-periods.

## 5.3 Augmented Dickey-Fuller test

The augmented Dickey-Fuller (DF) -test for unit root is to see if there is any signs of stationarity or unit root in our time series. The result of DF-test for the level values of the indices show low negative t-values, ranging from -0.528 for the DAX30 to -1.683 for the CAC40, with p-values in the interval of 0.4400 to 0.886. This leads to, when testing for stationarity using level values, we fail to reject the null-hypothesis of unit root present at the 10% critical level, in all the indices using level values. But, as expected, when doing the DF-test for the return on indices of European region- and world-markets, the coefficients show very large negative t-values, -12,071 and -11,582 for the STXE and MSCI respectively, with p-values of 0,000 for both indices which is well and enough to reject the null-hypothesis of unit root in our time series, and instead bring us to the conclusion of stationarity in the overlying market indices returns with great economic and statistical significance.

The DF-test for the return on the European equity markets all show very economical and statistically significant results, varying from -10,24 for the LuxX up to -13,312 for the AEX, all returns for indices show a p-value of 0,000, so the null-hypothesis is rejected in favor of stationarity for all index returns in our test with high significance.

Table 8: Augmented Dickey-Fuller test, Level and returns

| Critical levels | 1 % Critical Value -3.480 | | 5 % Critical Value -2.884 | | 10 % Critical Value -2.574 | | |
|---|---|---|---|---|---|---|---|
| Levels | AEX | BEL20 | CAC40 | DAX30 | LuxX | STOXX EUROPE | MSCI World |
| Test statistic | -1.682 | -1.553 | -1.683 | -0.528 | -1.603 | -1.379 | -0.938 |
| P-value | 0.4405 | 0.5070 | 0.4400 | 0.8864 | 0.4823 | 0.5921 | 0.7751 |
| Obs. | 191 | 191 | 191 | 191 | 190 | 191 | 191 |
| Returns | | | | | | | |
| Test statistic | -13.312 | -11.551 | -12.851 | -12.716 | -10.24 | -12.071 | -11.582 |
| P-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Obs. | 190 | 190 | 190 | 190 | 190 | 190 | 190 |

## 5.4 Correlations and Jorion-Schwartz test

The correlations between the European markets and the regional and world index shows that over time the correlations between the markets and the overlying markets indices have been rising over time, only to decrease in the period after the financial crisis, albeit with a very small amount. The correlations for the whole time period shows that the European markets are somewhat highly correlated to both the regional and the world index, where the AEX, CAC40 and DAX shows a correlation higher than 0,9 and 0,8 with the regional index and world index, respectively.

Table 9: Correlation between markets, 1999-2014

| Jan1999-Dec2014 | AEX | BEL20 | CAC40 | DAX30 | LuxX | STOXX Europe 50 | MSCI World (euro) |
|---|---|---|---|---|---|---|---|
| AEX | | | | | | | |
| BEL20 | 0,8339 | | | | | | |
| CAC40 | 0,9096 | 0,8133 | | | | | |
| DAX30 | 0,8755 | 0,7292 | 0,9187 | | | | |
| LuxX | 0,7951 | 0,6860 | 0,7592 | 0,7816 | | | |
| STOXX Europe 50 | 0,9056 | 0,7852 | 0,9537 | 0,9137 | 07620 | | |
| MSCI World | 0,8460 | 0,7000 | 0,8437 | 0,8430 | 0,7247 | 0,9125 | |

Correlation graphs for the sub-periods are included in the appendix. In the first time period (1999-2002) the correlations vary from about 0,6 to 0,9 when correlating to STXE, and the correlations to the MSCI varies from 0,5 to 0,8. It shows early that the European markets do not correlate with the world market index as much as the European regional market index.

For the second period (2003-2006) there is an increase of the correlations between the European markets and the STXE and the MSCI to varying degrees, the markets which previously had an

higher correlation with the overlying indices (AEX, CAC40, DAX), now show an decrease of correlation with STXE and miniscule changes in correlation to the MSCI for the CAC40 and DAX.

For the last two time-periods, the correlations of the European markets with the STXE are more similar. All the markets, with the exception the LuxX, an outlier in several results, show a high correlation with the STXE, and similar results for the MSCI correlation during the period 2007-2010. The period after the financial crisis and now going into the European sovereign debt crisis indicates a decrease of correlations for all markets, which can be explained by the proximity of the economic crisis now underway in the European region. A more domestic financial instability has a larger effect on the European financial markets, and a flight-to-quality pattern could probably be detected. This indicates a greater focus on national financial stability and lower investor market speculations during the time-period of prolonged economic instability.

The results of the correlation matrix could be an approximate indicator of the direction that the European equity market integration has had during the time period studied. The results are not unexpected since the European markets are expected to have high integration levels to the European region and therefore high correlation, and somewhat lower to the world market. Something that was not expected is the stagnation of market correlations during the period including the financial crisis, compared to the previous sub-period. The results of the correlation are not a conclusive answer for the integration of the European markets but we can see the market trends over time increase in correlating movements. For more definitive answer about the levels of integration, a more rigorous test is needed, as in our case by using the Jorion-Schwartz test.

The Jorion-Schwartz test is divided into 5 parts as previously discussed, the first test is comprising of the whole time period, from 1999 to 2014, the rest comprises of the subsequent sub periods, 1999-2002, 2003-2006, 2007-2010 and 2011-2014. All tests are run with the independent variables; Risk premium for the European markets, European regional equity index STOXXEUROPE 50 (STXE) and MSCI World. And the dependent variable is the return of the national equity markets. The table presented below shows the results of the Jorion-Schwartz-test for the full time period, the tables of the results for the four sub periods are available in the appendix.

The results of all the tests show that the European regional market index (STXE) has a far larger and more significant effect on the return on the national equity markets than both the MSCI

World index and risk premiums during almost all periods in this thesis, with the exception of BEL20 during 2011-2014. There are a few scattered points in during this test when the other variables show significance at different levels, albeit there are no consistent patterns during the sub periods. Other points of notice are that several national market indices show a negative relationship to the MSCI World, especially during the earlier sub periods, which implies a negative correlation with several European national equity markets. The only national index that indicates a positive MSCI World relationship is the Luxembourgish LuxX, which is positive for all sub-periods and even strongly significant during the last sub-period.

Table 10: Jorion-Schwartz test, 1999-2014

| Time period | Jan1999-Dec2014 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | .0021 | .0004 | -.0010 | .0050* | .0121*** |
| | (.0025) | .0024 | (.0016) | (.0026) | (.0039) |
| STOXXEUROPE | 1.1489*** | .8623*** | 1.0907*** | 1.2468*** | 1.0256*** |
| | (.0480) | (.0679) | (.0269) | (.05178) | (.0791) |
| MSCI World | .0994 | -.0066 | -.1337*** | .0263 | .1442 |
| | (.0813) | (.0901) | (.0495) | (.0757) | (.1254) |
| Risk Premium | -.0888 | .0966 | .1467 | .1309 | -.6302* |
| | (.2087) | (.2617) | (.1030) | (.1639) | (.2696) |
| $R^2$ | 0..8207 | 0.6136 | 0.9081 | 0.8363 | 0.5941 |
| Obs. | 191 | 191 | 191 | 191 | 169 |

During the tests, especially during the early sub-periods, the results for the risk premium show us that the risk premiums of, for example, Germany and France have a positive relationship with the equity markets, which could be explained by external effects such as the IT-crash of 2000s. As time goes, more and more national equity markets show a negative relationship to the risk premiums of European bonds. This implies that the higher the risk premium, the less willing are the investors to invest in European equities. This is the expected result, since higher risk validates a higher premium, and the market is probably more volatile than a market with lower risk premiums, such as the US market.

From the results of the regressions, we can deduce that the European equity markets are highly integrated with the European regional index during the full time period, as well as the sub periods. With scattered results for the relation to the world market, it is indicating a low integration level of the European markets towards the world market. In several cases, even market segmentation, as in the case of CAC40 during the whole period 1999-2015, when the coefficient shows a high statistical and economic market segmentation, albeit a lower value.

All tests display during all time periods a moderate to high value of $R^2$, indicating high levels of goodness of fit.

Table 11: Jorion-Schwartz test, 1999-2002

| Time period | Jan1999-Dec2002 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | -.0120 | -.0192* | -.0067 | -.0036 | .0091 |
| | (.0078) | (.0094) | (.0051) | (.0098) | (.0181) |
| STOXXEUROPE | 1.0670*** | .5140*** | 1.0640*** | 1.2262*** | .9953*** |
| | (.0870) | (.1017) | (.0465) | (.0818) | (.1784) |
| MSCI_World | -.2836* | -.3495* | -.2460** | -.0802 | .0906 |
| | (.1574) | (.2093) | (.1234) | (.1945) | (.3951) |
| Risk Premium | .5470* | .6485 | .1263 | .1201 | -.3659 |
| | (.3083) | (.4613) | (.1882) | (.3139) | (.6284) |
| $R^2$ | 0.8419 | 0.4196 | 0.9245 | 0.8533 | 0.4836 |
| Obs. | 47 | 47 | 47 | 47 | 46 |

During the sub periods, the results are mostly consistent with results from the whole time-period. For the first time-period (1999-2002), there are strong indications for European market integration, and significant low market segmentation towards the world market, with the exception of the LuxX.

Table 12: Jorion-Schwartz test, 2003-2006

| Time period | Jan2003-Dec2006 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | .0080 | -.0007 | .0031 | .0026 | .0200* |
| | (.0056) | (.0070) | (.0036) | (.0077) | (.0110) |
| STOXXEUROPE | 1.4153*** | .9281*** | 1.1011*** | 1.5283*** | 1.066*** |
| | (.1199) | (.1629) | (.0836) | (.1229) | (.1780) |
| MSCI_World | .4354** | -.4488* | -.01503 | -.0839 | .2081 |
| | (.1859) | (.2449) | (.1365) | (.2957) | (.3070) |
| Risk Premium | -.6499* | .7373* | .1439 | .3741 | -.2399 |
| | (.3511) | (.4237) | (.2379) | (.5241) | (.3728) |
| $R^2$ | 0.8426 | 0.6533 | 0.8831 | 0.8438 | 0.5401 |
| Obs. | 48 | 48 | 48 | 48 | 48 |

In the second sub period (2003-2006), the coefficients for the European market increase, indicating an increased level of integration. The results of MSCI World shift in new directions, where the AEX and LuxX shows integration meanwhile, the others still show market segmentation with the world markets. It is not until the third sub period (2007-2010), during

the years of a major financial crisis that most of the markets exhibit positive coefficient values, indicating some market integration with the world market. A notable point of interest are the negative coefficient between CAC40 and the world index. The results of LuxX is also interesting during this sub period, due to its significance levels of all coefficients.

Table 13: Jorion-Schwartz test, 2007-2010

| Time period | Jan2007-Dec2010 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | .0103* | .0044 | -.0023 | .0129** | .0370*** |
| | (.0060) | (.0056) | (.0032) | .0053 | (.0070) |
| STOXXEUROPE | 1.1218*** | 1.0963*** | 1.0560*** | 1.1034*** | 1.0206*** |
| | (.0795) | (.0844) | (.0445) | (.0615) | (.0970) |
| MSCI_World | .2204 | .2029 | -.1092 | .0226 | .4974*** |
| | (.1595) | (.1647) | (.0824) | (.1283) | (.1861) |
| Risk Premium | -.4953 | -.5224 | .1988 | -.1750 | -1.7163*** |
| | (.4309) | (.4412) | (.2167) | (.2220) | (.5465) |
| $R^2$ | 0.8365 | 0.8316 | 0.9462 | 0.8874 | 0.7800 |
| Obs. | 48 | 48 | 48 | 48 | 48 |

During the last sub period, the effect of the world market on the European equity markets returns to a more inconsistent result indication. The BEL20 and CAC40 signal an increasing rate of segmentation towards the world market, while at the same time having a similar value of integration to the European regional market as the other national equity markets. The risk premium returns to its anticipated value, since it is expected to have a negative outcome on the equity markets.

Table 14: Jorion-Schwartz test, 2011-2014

| Time period | Jan2011-Dec2014 | | | | |
|---|---|---|---|---|---|
| | AEX | BEL20 | CAC40 | DAX30 | LuxX |
| Cons. | .0011 | .0069* | .0009 | .0030 | .0006 |
| | (.0033) | (.0037) | (.0031) | (.0046) | (.0065) |
| STOXXEUROPE | 1.1548*** | .8487*** | 1.1662*** | 1.3630*** | 1.1919*** |
| | (.0918) | (.1637) | (.1115) | (.1706) | (.1288) |
| MSCI_World | .1728 | -.2148 | -.2519* | .2218 | .3801 |
| | (.2694) | (.2289) | (.1526) | (.2518) | (.3307) |
| Risk Premium | -.2394 | -1.7809* | -.3689 | -.1673 | -.6190 |
| | .4990 | (.9436) | (1.0646) | (.7655) | (.5650) |
| $R^2$ | 0.8087 | 0.7019 | 0.8288 | 0.7646 | 0.6872 |
| Obs. | 48 | 48 | 48 | 48 | 48 |

The conclusion of the regression results is that they show a high level of European market integration, which is consistent during the whole sample period, with significance to the 99% levels. Meanwhile the national equity markets show a very non-conclusive integrational pattern with the world market. In addition the risk premium effect the national equity markets is somewhat non-uniform during the time-period, and not enough significance to give any valid signs of effect on the national markets in most cases, with the exception of LuxX.

# 6. Analysis & Discussion

Our purpose with the seasonality testing was to find out if there were any significant trends among the European equity markets during the time period 1999-2014, and to identify whether they are commonly shared between the markets or not. While we do find some significant trends in our results, none of them are constantly reoccurring during several sub periods. This is somewhat in line with what Büttner and Hayos find in their study. This is to be expected since markets like these are well developed and tend to follow a random walk. BEL20 is the only index to have a significant January effect during the entire time-period. We do find a mutual January effect during the time-period Jan 2007-Dec 2010, in which 3 out 5 markets experience a weak form of a positive trend. During the same time-period, it is also possible to conclude that the same three indices plus the AEX experiences a positive trend in April (m4), this is one of the more significant trends, which several of the indices share in our test. Another one can be found during the first sub period (Jan1999-Dec2002) in October, this is the only time where all 5 indices indicate a negative trend which is statistically significant. However, as we can see in the line graphs (in the appendix), and as we mentioned in the descriptive part, this trend is most likely due to the September 11$^{th}$ attacks in New York which function as an external effect in this case. This is interesting since the other shared trends are mainly found in the 2007-2010 period during the financial crisis, therefore we can conclude that the market indices seem to react in a more similar way during turbulent times than the more normal ones. This does confirm that the European markets seems to be highly integrated with each other since they are obviously affected by the same external effects. However, it is harder to find the level of integration between them when looking at our results since they seem to indicate that external effects are vital for the seasonal trends, as in the case of m10 of 1999-2002.

In the other two sub periods, 2003-2006 & 2011-2014, there are less signs of seasonality in our test results. As previously mentioned, this is to be expected since there would otherwise be

consistent arbitrage opportunities on these European markets during the more ordinary development periods.

The result of the DF-test is as expected, when changing the variables from prices to returns the presence of unit root a. There is need no for further analysis, and discussion, since the test is more for confirmation that our tests show our estimates correctly.

Our results for the Jorion-Schwartz test finds that the integration levels towards the European regional market index are far greater and more significant than the integration towards the world market. Which is somewhat different from the results concluded by Baele et al. (2004) where they find that the European markets show higher levels of integration with the world, not only with a European market. We find that even though the European equity markets have large correlation with the world market, the levels of integration are significantly lower, or in some cases, show tendencies towards segmentation. This implies that there are possibilities for international investors to diversify assets by placing them in European equities in times of financial instability.

As we have established from the results from Fratzscher (2002) and others, the trends of increasing equity market integration seem to continue after the introduction of euro. Our results align with previous studies in this regard, and imply a continuation of European equity integration during our sample period. The effect of the financial crisis on integration seems to have been a miniscule slowdown of the integration process. Although with higher correlations between the European equity markets and the world market index during the financial crisis, this implies similar market movements in spite of low levels of integration. This implication is further strengthened by our seasonality test in which we were able to conclude that there were significant co-movements during this period.

Our results seem to follow along the intuition given by Hardouvelis et al. that the integration process seems to be a more regionally based process rather than being a globally based process. Other remarks worthy of note is the similarities of market correlation and the effect of the European market index has on the national indices. This corresponds with the results noted in earlier years by Büttner and Hayos in their study, even though they use different measurement models to come to this conclusion.

The results from the Jorion-Schwartz test helps us come to the conclusion that the European equity markets are highly integrated since the introduction of the common currency, and are still increasing with a very high correlation rate, and standing at a somewhat neutral position

towards the world market. The result of the risk premiums during the sub periods, are as previously mentioned, somewhat non-uniform. The premiums during the earlier sub periods show a positive relationship with the national indices, and it is not until 2011-2014, that all premium coefficients are negative. This could be explained by the increasing instability and volatility of the European economies after the 2008 financial crisis and the oncoming European sovereign debt crisis.

There are a couple of limitations in our essay, which needs to be addressed. First, our time span does not allow us to compare the level of integration before the introduction of the Euro with the time after its introduction. Our reason for this choice is that there already seems to be a large portion of research allocated to this time-period, from this we can conclude that the integration levels were increasing during this period due to, among other things, the notion of entering a common currency union. A suggestion for future research is to consider the data frequency. One might use, for example, weekly data in order to do more precise measurements of fluctuations. Furthermore, future researchers could also use a larger sample of markets. A couple of suggestions would be to look at non-Euro countries, which are still member states of the European union, e.g. Great Britain or Sweden. Another approach would be to look at markets such as the US markets, Japanese markets or perhaps the Chinese markets. This could prove helpful in order to do enhanced measurements of the integration levels towards the World market indices. One of the issues we encountered early on, was the fact that we did not have sufficient experience within this specific research area to be able to use and comprehend the more complex data models. These could help future studies to calculate integration levels on a more precise and significant basis. One example of a model, which could be beneficial, would be the different variations of GARCH-models, which several of the previous studies have used. This goes hand in hand with the fact that time was a limiting factor, otherwise it surely would have been possible to construct a more complex and extensive paper.

# 7. Conclusion

The purpose of this thesis was to measure the integration of European equity markets towards a regional and world market index by using a Jorion-Schwartz test and a seasonality test. The results from the tests show that the integration process of the markets is increasing since the introduction of the euro. Economic disruptions such as the financial crisis seem to have a smaller effect on the integration levels than previously expected. Furthermore, our evidence suggests that there is a favoring of regional integration over world market integration for the European markets, or in some cases evidence of market segmentation towards the world market.

The results from the seasonality test show little evidence of seasonal patterns in the European equity markets during the period 1999-2014, with isolated cases of seasonality which seems to be more of a product of external effects or economic instabilities, rather than regularly occurring trends.

Overall, the results of this thesis indicate that the European equity markets are highly integrated regionally, and there are little to no possibilities for large diversification of assets, or arbitrage opportunities inside the European Monetary Union.

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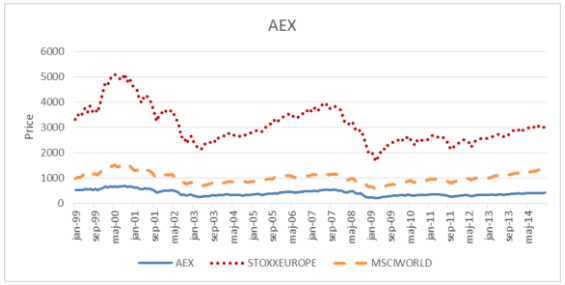
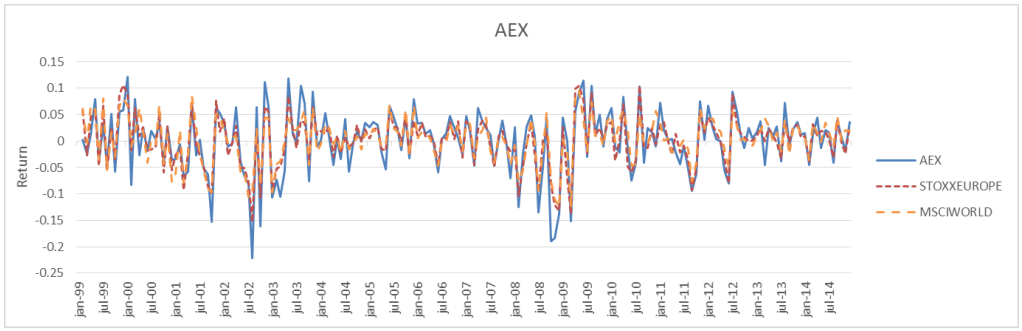
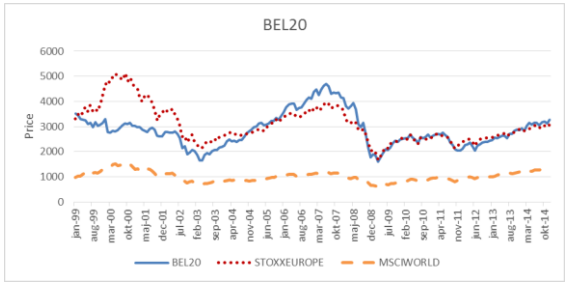
# Appendix

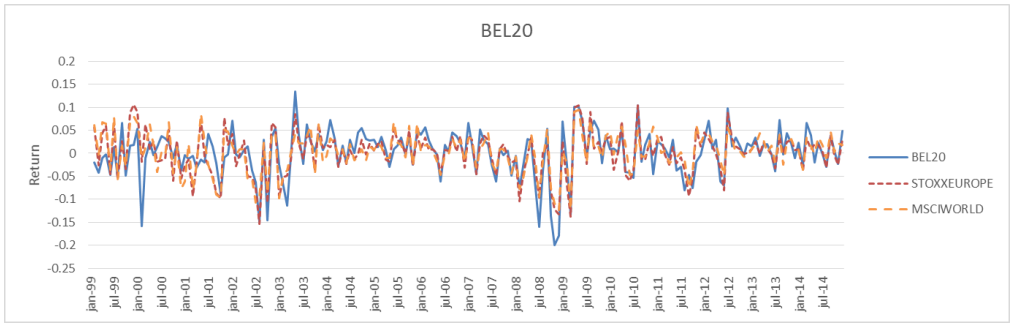
## Time Series Graphs – Monthly Returns

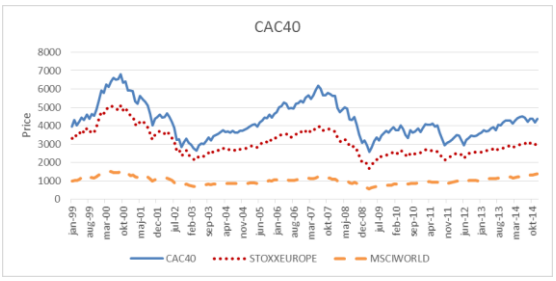
Graphs over the return during the whole sample period, 1999-2014, for the individual national equity market indices together with STOXXEUROPE50 and MSCI World. Both prices and returns.

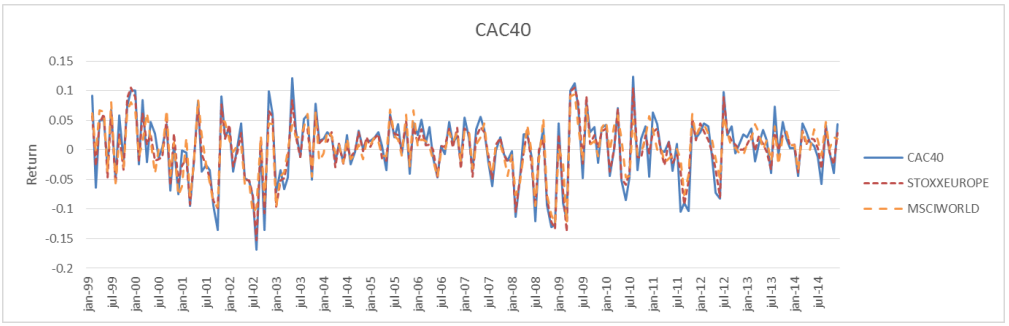



CAC40
Price
CAC40
STOXXEUROPE
MSCIWORLD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Return
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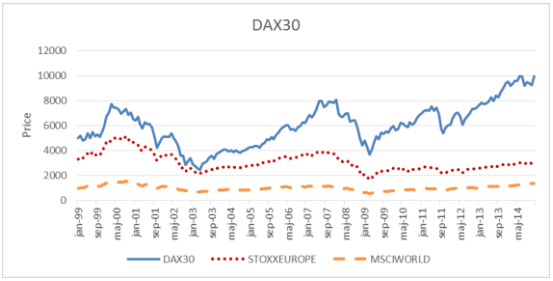
DAX30
Price
DAX30
STOXXEUROPE
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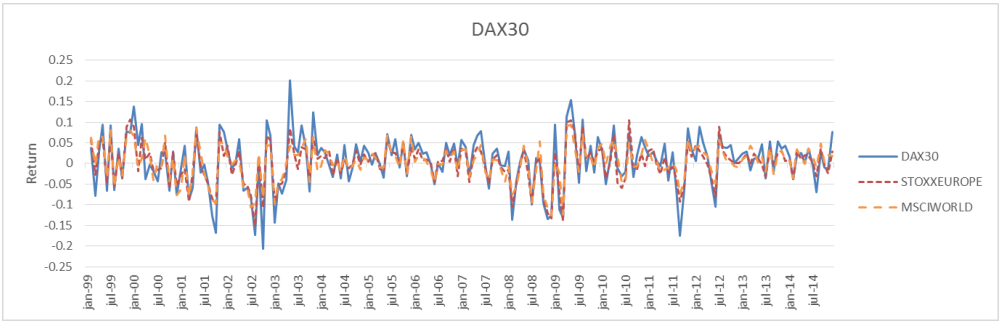
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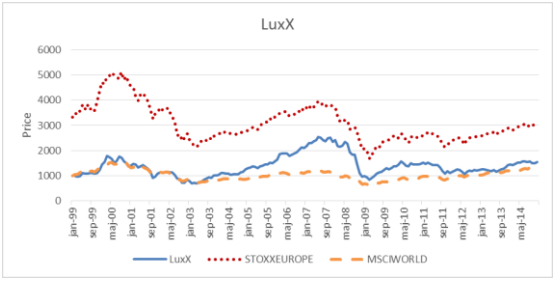
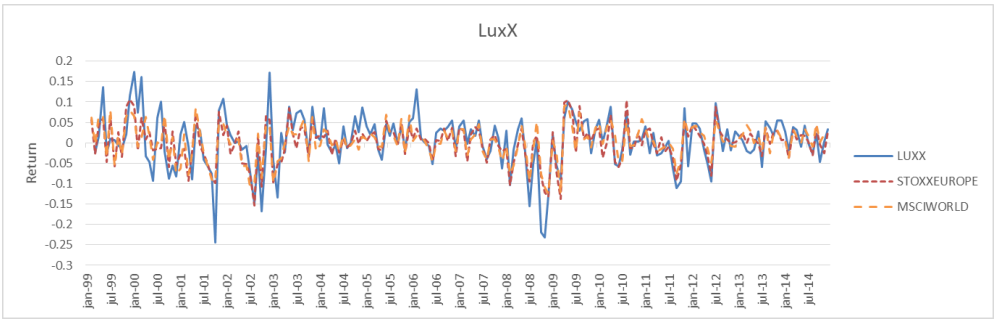

LuxX
Price
LuxX
STOXXEUROPE
MSCIWORLD


LuxX
Return
LUXX
STOXXEUROPE
MSCIWORLD

Correlations between markets, all sub periods.

| | AEX | BEL20 | CAC40 | DAX30 | LuxX | STOXX Europe 50 | MSCI World (euro) |
|---|---|---|---|---|---|---|---|
| Jan1999-Dec2002 | | | | | | | |
| AEX | | | | | | | |
| BEL20 | 0,7770 | | | | | | |
| CAC40 | 0,9203 | 0,6532 | | | | | |
| DAX30 | 0,9019 | 0,5914 | 0,9402 | | | | |
| LuxX | 0,7195 | 0,4560 | 0,7018 | 0,7978 | | | |
| STOXX Europe 50 | 0,9121 | 0,6239 | 0,9654 | 0,9229 | 0,6933 | | |
| MSCI World | 0,8108 | 0,5396 | 0,8538 | 0,8452 | 0,6487 | 0,9239 | |
| Jan2003-Dec2006 | | | | | | | |
| AEX | | | | | | | |
| BEL20 | 0,8176 | | | | | | |
| CAC40 | 0,9383 | 0,8271 | | | | | |
| DAX30 | 0,9081 | 0,7766 | 0,9395 | | | | |
| LuxX | 0,7532 | 0,6808 | 0,7190 | 0,7290 | | | |
| STOXX Europe 50 | 0,9086 | 0,7884 | 0,9387 | 0,9161 | 0,7317 | | |
| MSCI World | 0,8789 | 0,6397 | 0,8482 | 0,8255 | 0,6912 | 0,9011 | |
| Jan2007-Dec2010 | | | | | | | |
| AEX | | | | | | | |
| BEL20 | 0,9172 | | | | | | |
| CAC40 | 0,9083 | 0,9199 | | | | | |
| DAX30 | 0,8681 | 0,8434 | 0,9348 | | | | |
| LuxX | 0,9092 | 0,8967 | 0,8420 | 0,8059 | | | |
| STOXX Europe 50 | 0,9076 | 0,9063 | 0,9712 | 0,9414 | 0,8410 | | |
| MSCI World | 0,8821 | 0,8680 | 0,8793 | 0,8858 | 0,8301 | 0,9216 | |
| Jan2011-Dec2014 | | | | | | | |
| AEX | | | | | | | |
| BEL20 | 0,7750 | | | | | | |
| CAC40 | 0,8887 | 0,8801 | | | | | |
| DAX30 | 0,8023 | 0,7404 | 0,8512 | | | | |
| LuxX | 0,8110 | 0,6969 | 0,7626 | 0,7776 | | | |
| STOXX Europe 50 | 0,8966 | 0,8156 | 0,9070 | 0,8719 | 0,8041 | | |
| MSCI World | 0,8050 | 0,6798 | 0,7454 | 0,7853 | 0,7634 | 0,8624 | |