Integration of the equity market in the European Economic and Monetary Union

An Investigation of Common Risk Factors

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Frank Nobel (416138)

Erasmus University Rotterdam (EUR)

Thesis Supervisor: Dr. Eisert

Erasmus School of Economics (ESE)

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Abstract

The purpose of this paper is to determine whether equity markets show the same reversals of the trend towards integration as documented in the literature. The mutually reinforcing crises of the euro zone that went hand in hand with monetary integration have affected its effect on financial integration. I find, by comparing asset pricing models in which returns are explained either by domestic or regional risk factors, that the former outperforms the latter model in terms of both mispricing and explained variation. The relative performance of these models over time show a reversal of the increasing trend towards integration after 2007. The results suggest that not only the quantity, but also the quality of financial integration plays an important role in the euro area.

Keywords: Financial integration, Euro crisis, Asset pricing, International financial markets

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1. Introduction

Economic integration is a key aspect of the European continent. It all started after the Second World War with the Treaty of Paris in 1951 creating the European Coal and Steel Community, which developed all the way to the European Economic and Monetary Union (EMU) with the Treaty of Maastricht in 1992. This meant that the member states adopted the euro as a common currency in 1999, and full monetary integration would be completed.

Economic integration means a reduction or elimination of trade barriers, to the extreme of monetary integration, where monetary and fiscal policies are coordinated. This means that in the integrated region the law of one price holds and cash flows converge. Strongly related is financial integration. For financial markets, full integration means that assets with the same risk should have identical returns, irrespective of the market (Bekaert & Harvey, 1995). For a market to be fully integrated, three necessary conditions need to be met. First, a single monetary policy that minimizes exchange rate premiums and transaction costs (Jappelli & Pagano, 2008). Second, the harmonization of regulation, taxes and subsidies resulting in convergence of the after-tax cost of capital (Jappelli & Pagano, 2008). Third, information asymmetries need to be resolved (e.g. Karolyi & Stulz, 2002).

With the introduction of the euro the first condition is satisfied, but there is also a downside to a common fiscal and monetary policy if financial integration is not combined with strong institutions and sound macroeconomic policies (Edison, Levine, Ricci, & Slok, 2002). Country-specific crises cannot be solved anymore using monetary policy measures because the individual country autonomy is lost (Shambaugh, 2012). The recent developments in monetary and fiscal policy harmonization with the Single Supervisory Mechanism (SSM) and Single Resolution Mechanism (SRM) of the European Banking Union are meant to combat that that downside and prevent a the severe crises we have seen in the euro zone. According to Andrade and Chhaochharia (2012), there are three mutually reinforcing crises, for which the stage was set by the monetary integration of the euro zone: 1) the competitive/growth crisis which affected the so-called GIIPS countries (Greece, Ireland, Italy, Portugal and Spain) asymmetrically, 2) the banking crisis, fuelled by the global financial crisis (GFC), which originated 3) the sovereign debt crisis (ESDC).[1]

Economic and monetary integration may thus result in more financial integration, but what was the role of the three crises in this relation. Beale, Ferrando, Hördahl, Krylova, and Monnet (2004) measure the state of financial integration of five key euro area markets (money,

[1] For further reading about the relation between the monetary union and the three crises see Shambaugh (2012).

credit, equity, corporate bond, and government bond market) and find that the markets all show increasing integration, but have a different development of the integration. Since then, the ECB each year publishes information on financial integration indicators. Studies that include the crisis period have different results. Bekaert, Harvey, Lundblad, and Siegel (2013) document that the increasing trend continues, while Andrade and Chhaochharia (2012) and Everaert and Pozzi (2016) show a reversal in the trend.

In this paper, I focus on the financial integration of the equity market to add to this discussion about the state and process of integration and the influence of the crises on it. First I investigate: how financially integrated is the EMU equity market after the introduction of the euro? Then, I will compare two sub-periods to find out if different levels of financial integration are apparent in different states of the economy, and whether groups of euro zone countries show different levels of integration. What was the impact of the competitiveness/growth, banking, and sovereign debt crisis on the development of financial integration in the euro area equity market?

More integration would mean a shift from a country-specific to a common EMU pricing kernel (Baele et al., 2004). In theory, if financial markets are perfectly integrated, the same international factors should fully explain all stock returns. Therefore, the explained variance of country stock returns by common global factors (in a multi-factor model) should be a good measure of integration (Pukthuanthong & Roll, 2009). To measure the financial integration of the EMU equity markets, I investigate the relative importance of country-specific risk factors versus EMU-wide risk factors in an asset pricing setting. I test the relative power of three different asset pricing models, with risk factors measured on a different geographical scale. First, the domestic model with risk factors based on the country return index and firm characteristics. Second, an international country model in which both domestic and foreign risk factors try to explain the returns. Third, the regional model including risk factors measured on a regional scale. I test the relative performance of the models with two criteria which are commonly used in the literature. First, the explained variation of the stock returns by the risk factors, measured by the adjusted R-squared. The model with a higher adjusted R-squared is expected to do a better job explaining the expected stock returns. Second, the average mispricing of the model, measured by Jensen's alpha. The lower the mispricing, the more effective the factors.

My findings can add to the discussion of researchers, which investigate if risk factors are global, regional or country-specific and with it conclude about the state of integration of certain regions (e.g. Fama & French, 2012; Griffin, 2002; Moerman, 2005). This paper also tries to find new evidence about the disruptions in equity market integration due to crises in the (real) economy. For investors, results on regional integration (based on comovement of international returns) can be informative about the opportunity to diversify across countries. If the EMU markets are segmented, international diversification can still be beneficial for the 'mean-variance optimizer'. Especially in the aftermath of the crisis, investors want to know if and how the financial integration continues.

The paper is structured as follows. The next section discusses the literature relevant for this paper. Section 3 explains the research design and the method, and specifies the different models I test in this paper. In Section 4, I describe the sample and data, and construct the risk factor and test portfolios. Section 5 presents and discusses the empirical results. Finally, Section 6 concludes and provides suggestions for further research.

2. Literature review

The literature relevant for this paper writes about financial integration, asset pricing, and the combination of the two. I first discuss advantages and disadvantages of financial integration and how to measure financial integration. Then I discuss the theories about common risk factors and how these theories can be used to measure financial integration. The last subsection discusses previous literature about the state of financial integration in the euro area after the introduction of the euro.

2.1 Financial integration

Baele et al. (2004) define that a financial instrument is fully integrated if "all market participants face a single set of rules […], have equal access […], and are treated equally when they are active in the market" (p. 6). This is one of the goals of the EMU, as it ensures efficient transmission of monetary policy. We see that the full convergence of monetary policy and harmonization of fiscal policies of the EMU already eased access to equity and bond markets (De Santis & Gerard, 2006), removing a direct barrier to international investments. Another positive effect of financial integration, is the sharing and diversification of risk (e.g. Adjaouté & Danthine, 2003; De Santis & Gerard, 2006), which works two ways. First, investors can more easily invest in foreign companies, and second, an equity share of the average local firm is more diversified because the firm has easier access to foreign capital and can more easily operate globally. Therefore, the EMU also led to more homogeneous valuation of equities (Baele & Van der Vennet, 2001). Specific to asset pricing, Ferson and Harvey (1999) find that exchange rate risk exposure decreased to near zero due to the planned monetary convergence of the euro area, which is consistent with the evidence of Fratzscher (2002) who finds that exchange rate volatility and uncertainty reduced.

There is also a downside to increased financial integration in the EMU. The increasing correlation of returns results in low diversification benefits for cross-country investments (e.g. Fratzscher, 2002; Goetzmann, Li & Rouwenhorst, 2005). Due to increased comovement in prices, there is also higher vulnerability to macroeconomic shocks and financial crises (Jappelli & Pagano, 2008). However, this vulnerability is expected to be less threatening in countries with strong institutions and sound macroeconomic policies (Edison et al., 2002) and developed financial systems (Lane & Milesi Ferretti, 2006), which may not be said for all EMU countries. In addition, if there is not enough financial integration, the monetary policy used to combat such crises may not be adequately transmitted to the member countries (Sola Perea & Van Nieuwenhuyze, 2014). Thus, both the level and the quality of financial integration are important to prevent a crisis.

The integration of financial markets can be tested in three different ways (Baele et al., 2004). First, quantity-based measures investigating the home bias of domestic investors, second, news-based measures investigating common reactions to news and the transmission to other stocks, and third, models investigating the relative importance of country versus sector effects on stock prices (price-based measures). Related to the third method (and applied in this paper), to investigate a common pricing kernel also country effects on stocks are compared with regional effects (e.g. Griffin, 2002). Because this method uses asset pricing, it is interesting to look which factors are currently generally accepted as common risk factors.

2.2 Evolution of common risk factors

Sharpe (1964) and Lintner (1965) are the first to discuss a common risk factor explaining equity returns and propose the Capital Asset Pricing Model (CAPM), in which equity returns are explained by the covariance of a stock with the respective country index, or market beta. Other researchers find additional factors that influence equity returns. Banz (1981) finds that stocks of larger firms earn on average higher returns, and Basu (1983) investigates the difference between growth and value stocks and find that the latter earns a premium. Building on this evidence, Fama and French (1992) show that these size and value effects are more important than the market beta explaining the cross section of stock returns. They propose the well-known three-factor model (3FM) adding the excess returns of a small-minus-big (SMB) portfolio (mimicking the size factor) and a high-minus-low (HML) portfolio (mimicking the value factor) to the excess returns of the market (Fama & French, 1993). The momentum effect is the last factor that is extensively discussed and tested in the literature. Jegadeesh and Titman (1993) investigate in detail a trading strategy with a six month holding period, based on past six month ‘winners’ and find that these stocks outperform stocks that performed worse in the past six months (‘losers’). This forms the basis of the Carhart (1997) four-factor model (4FM), which includes a momentum effect (based on a holding period of one year) in addition to the three Fama-French factors.

2.3 International common risk factors and financial integration

To find international common risk factors, one needs an additional assumption regarding integration. Harvey (1991) assumes that world markets are perfectly integrated, so that equity returns should be explained by a world market index instead of the country market index. He finds that the average excess returns of 14 out of 17 countries can be explained by his version of the world CAPM, hence concludes that it holds. This idea is also supported by Bekaert and Harvey (1995) and Stulz (1999) who argue that if a country or company becomes more integrated with the world market, its market risk premium or cost of capital should depend more on its world market beta.

Internationally, research also finds that multifactor models outperform the CAPM. Fama and French (1998) test a two factor model with a world market and world HML factor, Korajczyk and Viallet (1989) find a size effect in both domestic and international models, and Hou, Karolyi, and Kho (2006) find that a momentum, cash-flow/price, and a global market risk factor are important. The value and size effect are also present in Europe, according to Bauer, Cosemans, and Schotman (2010) and Heston, Wessels and Rouwenhorst (1999). Multi-factor asset pricing models are, however, found to be more effective in explaining the stock returns in domestic models rather than regional or global models (Griffin, 2002; Mirza & Afzal, 2011; Moerman, 2005). Firms may thus be (partially) integrated, the main sources of risk still originate from the domestic country.

Fama and French (2012) provide the most comprehensive tests of size, value and momentum effects in international stock returns, and find evidence of a global value premium and momentum effect. Investigating both global and regional versions of the CAPM, the three-factor model, and the four-factor model, they also find that global models cannot explain regional portfolio returns and that local models do a better job in explaining local portfolio returns (for the size-B/M portfolio). This suggests that the risk factors may still be country-specific.

2.4 Financial integration in the EMU

Regarding the state of integration in the EMU, researchers find mixed evidence. In favour of integration, Fratzscher (2002) finds increased integration since 1996 due to the drive towards the EMU. Also, after the introduction of the euro, research shows that there is increased comovement and market dependence, which is specific for the EMU (Bartram, Taylor, & Wang, 2005; Bekaert, Hodrik, & Zhang, 2009; Cappiello, Kadareja, & Manganelli, 2008; Kim, Moshirian & Wu, 2006). In contrast, Jappelli and Pagano (2008) argue that this increased commonality in return does not necessarily reflect integration, because the common patterns can be caused by common world-wide shocks. Sontchik (2004) also presents evidence against integration since the introduction of the euro when looking at the pure pricing level after, but Adjaouté and Dantine (2003) say financial integration cannot yet be detectable at that level.

Bekaert et al. (2013), who show that in their sample (1990-2012), using industry valuation differentials across European countries, integration is EU-wide and not EMU-specific. Interestingly, covering the 2007-2011 period and using a similar measure of segmentation, Andrade and Chhaochharia (2012) find evidence against equity market integration. Everaert and Pozzi (2016) use a time-varying measure for the degree of integration and also find a reversal in the trend due to the GFC and ESDC, but starting in 2010.[2] Using price-based indicators, the yearly ECB reports on financial integration in Europe find that equity market integration is at a lower level than before the crises. The reports also show divergence of the integration in 'distressed' and 'non-distressed' countries since 2011.[3] Using seven different measures of stock market integration Sehgal, Gupta, and Deising (2016) compare the degree of financial integration for different states of the economy. They find that the crisis affected the convergence process in the EMU, while large-sized EMU countries showed better integration than the rest of the EMU.[4]

Evidence investigating the relative importance of country and industry effects for the pricing of European stocks is less ambiguous about the impact of the euro on integration. The reasoning is as follows: if domestic factors are more important for returns, most benefit for international diversification can be achieved with geographical diversification. Theoretically,

[2] In an earlier version of this paper, Everaert and Pozzi (2014) use a sample till 2012 instead of 2015 and document a reversal in the trend in 2007. The difference is however not discussed in the 2016 version.
[3] The ECB categorises Spain, Ireland, Italy, and Portugal as distressed and Austria, Belgium, Germany, France, Luxembourg, and the Netherlands as non-distressed.
[4] Sehgal et al. (2014) split 17 EMU countries in groups based on their economic size. The large EMU countries are Belgium, France, Germany, Italy, the Netherlands, and Spain. I should however note that as they use R-squares of a regional (euro area) asset pricing model only, their finding may be caused by correlation simply due to contagion effects. This issue is discussed in more detail by Pukthuanthong and Roll (2009).

integration should decrease the importance of domestic factors, as this risk can then be more easily diversified, and returns should be increasingly determined by industry factors. This strand of literature started with Heston and Rouwenhorst (1995), who find that till 1995 country-specific sources of return variation are dominant in explaining the stock returns. This finding is confirmed by more empirical studies for samples up to 1998 (e.g. Griffin and Karolyi, 1998; Rouwenhorst, 1999). With samples up to 1999, Beckers, Connor, and Curds (1996) and Hardouvelis, Malliaropulos, and Priestley (2007) do already find decreasing importance of country factors relative to industry and international factors, indicating some degree of integration before the introduction of the euro. After the introduction of the euro, the literature reports an increase in relative importance of industry factors versus country factors. Isakov and Sonney (2002) and Flavin (2004) show that both are almost equally important, while Baele et al. (2004) find increasing importance of (industry) sector effects. This evidence suggests increased financial integration within the EMU after the introduction of the euro.

However, this evidence can be questioned. Brooks and Del Negro (2004) find that in their sample, the integration is due to the IT bubble, and Adjaouté and Danthine (2004) question the validity of the assumptions for the method of Heston and Rouwenhorst (1995). The assumptions that 1) a firm belongs only to one country and one industry, and 2) that all stocks have the same exposure, are disputable. Therefore, researchers should in addition investigate the relative importance of country versus global factors.

Griffin (2002) compares a world three-factor model to country-specific three-factor models. He concludes that, for a global sample, domestic models explain more time-series variation and have lower pricing errors. This paper is most similar to the paper of Moerman (2005), who applies the method of Griffin (2002) to the EMU to investigate equity market integration. In his sample (1998-2002), he finds that the domestic Fama-French 3FM outperforms the regional (EMU) model, but that the performance of the latter is increasing after the introduction of the euro. In these studies, the assumption about the degree of market integration is very important. Bekaert and Harvey (1995) mention that tests of integration require the testing of three different hypotheses about market efficiency, effectiveness of the asset pricing model, and the degree of integration in the market. The focus of this paper is on the integration hypothesis.

My contribution to the literature on financial integration is to show the current state and process of equity market integration in the euro area, and to investigate if the increasing integration documented after the introduction of the euro, has continued or slowed down during the ‘crisis’ period starting in 2007. Also, due to the method of research I choose, I can add to the literature discussing whether the three Fama-French risk factors are still country-specific, and/or if regional (market) risk factors should be used in asset pricing and cost of capital calculations. Based on previous research, I expect to find that the euro area cannot yet be regarded as a fully integrated market. The comparison between the normal state and a crisis state of the economy could provide additional results, which I expect to show that financial integration did not improve during the crisis period. More interesting is the trend in the most recent years, which can be expected to increase while we recover from the crisis period and the politics focus more on the quality of financial integration with the SSM and SRM.

3. Methodology

Testing financial market integration with asset pricing models requires the testing of joint hypotheses. Fama (1970) discusses testing of the joint hypotheses about the efficiency of the market in combination with the effectiveness of the model, and its implications for the alpha of the modelling test. Harvey and Bekaert (1995) later discuss the joint testing of three hypothesis, adding the hypothesis of integrated financial markets to the two described by Fama (1970).

In this paper I do not discuss any implications of the asset pricing models for market efficiency. I test the other two hypotheses with different model specifications, regarding 1) the inclusion of risk factors and 2) the geographical level at which the risk factors are measured. The main asset pricing model I use for the conclusions is the Fama and French (1993) 3FM. The general thought of all factor models in asset pricing is that stocks (or portfolios) are exposed to different risk factors, and that the loading of these risk factors explains the expected return on the stock (Cochrane, 2005). First, to ensure results are not determined by the effectiveness of the factors in the asset pricing models, I use in total four risk factors in different specifications. The four risk factors are related to the firm’s covariance with the market index, the firm’s size, its book-to-market ratio, and momentum returns, which I test in the CAPM of Sharpe (1964) and Lintner (1965), the Fama-French (1993) 3FM, and the Carhart (1997) 4FM. Second, I test the main hypothesis of this paper, regarding market integration, using a domestic, international, and regional version of the asset pricing model. In these versions, I try to explain the returns using the (excess) returns of regional risk factors, domestic risk factors, or domestic and foreign risk factors together. In this way, I thus apply the same methodology as Griffin (2002) and Moerman (2005).

3.1. Asset pricing models[5]

3.1.1 Capital Asset Pricing Model

The CAPM is a one-factor asset pricing model, in which the excess returns are determined by the covariance with the market portfolio, or market beta. Empirically, the equation looks as follows:

$$r_{i,t}^{e} = \alpha_i + b_i(MRF_t) + \varepsilon_i, \tag{1}$$

where $r_{i,t}^{e}$ is the monthly return of a stock in excess of the risk-free rate $(r_{i,t} - r_{f,t})$, MRF_t is the monthly return of the market in excess of the risk free rate $(r_{m,t} - r_{f,t})$, b_i the market beta, α_i the pricing error, and ε_i the error term.

3.1.2 Fama-French Three-Factor model

The 3FM explains the monthly excess returns with the exposure to: 1) the return on the market index in excess of the risk-free rate (MRF), 2) the difference between the return on a portfolio with small market capitalisation stocks and a portfolio with large market capitalisation stocks (Small Minus Big, or SMB), and 3) the difference between the return on a portfolio including stocks with a large book-to-market (BTM) ratio and a portfolio including stocks with a low BTM-ratio (High Minus Low, or HML). Empirically, the equation looks as follows:

$$r_{i,t}^{e} = \alpha_i + b_i(MRF_t) + s_i(SMB_t) + h_i(HML_t) + \varepsilon_i. \tag{2}$$

In this equation, $r_{i,t}^{e}$ is the monthly excess return of stock i, the coefficients b_i, s_i , and h_i, are the unconditional risk factor loadings, α_i is the pricing error, and ε_i the error term.

3.1.3 Carhart Four-Factor model

Third model includes a fourth risk factor, in addition to the three factors of Fama and French. It captures the (anomaly) effect of momentum returns. The thought behind this factor is that stocks that performed well over the past 12 months ('winners') outperform stocks that lost market value over the past 12 months ('losers'). The premium on the 'winners minus losers' factor is the difference between the return on a portfolio with positive momentum return and a portfolio with negative momentum return. Equation 3 below therefore is the same as Equation 2, but with the WML factor included:

$$r_{i,t}^{e} = \alpha_i + b_i(MRF_t) + s_i(SMB_t) + h_i(HML_t) + w_i(WML_t) + \varepsilon_i. \tag{3}$$

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[5] I discuss three asset pricing models here, but will use the Fama-French 3FM as the main model of this paper, for comparison with Griffin (2002) and Moerman (2005), and because it does a better job explaining the returns than the CAPM and is a more established asset pricing model in the literature than the Carhart 4FM.

3.2 Degree of integration

I test the hypothesis regarding market integration with three versions of the 3FM described above. The three versions are a regional model, an international model, and a domestic model. The regional model assumes a highly integrated capital market, which means that there is only one set of regional common risk factors explaining the expected returns in all countries. In this regional model, the risk factors are calculated on EMU level:

$$r_{i,t}^{e} = \alpha_i + b_i(EMRF_t) + s_i(ESMB_t) + h_i(EHML_t) + \varepsilon_i. \quad (4)$$

Following Moerman (2005), I decompose the EMU risk factors in risk originating from the domestic country and originating from foreign countries. The euro area excess market return is then the value-weighted average of the domestic excess market return ($DMRF_t$) and the foreign excess market return ($FMRF_t$):

$$EMRF_t = w_{D,t-1} * DMRF_t + w_{F,t-1} * FMRF_t, \quad (5)$$

where the weight $w_{D,t-1}$ is the country's total market capitalisation as a fraction of the total EMU market capitalisation in the previous month, and $w_{F,t-1}(= 1 - w_{D,t-1})$ the fraction of all foreign stocks. While in Equation 4 domestic and foreign risks are modelled to have the same impact on stock returns, the decomposition of Equation 5 allows the international model to have a different impact of both:

$$r_{i,t}^{e} = \alpha_i + b_{Di}(w_{D,t-1} * DMRF_t) + s_{Di}(w_{D,t-1} * DSMB_t) + h_{Di}(w_{D,t-1} * DHML_t)$$
$$+ b_{Fi}(w_{F,t-1} * FMRF_t) + s_{Fi}(w_{F,t-1} * FSMB_t) + h_{Fi}(w_{F,t-1} * FHML_t) + \varepsilon_i \quad (6)$$

A potential problem for the estimation of this model is the possible multicollinearity when there is a high degree of integration (i.e. the domestic and foreign risk factors are very similar). In the application of this model I therefore assume partially integrated financial markets. If financial markets are segmented, foreign risk factors are not expected to have any influence on the domestic stock returns. The last model, the domestic model, tests the influence of domestic risk factors if the foreign risk factors are irrelevant, i.e. have a zero weight in Equation 5:

$$r_{i,t}^{e} = \alpha_i + b_{Di}(DMRF_t) + s_{Di}(DSMB_t) + h_{Di}(DHML_t) + \varepsilon_i. \quad (7)$$

Because of the turbulent times on the EMU financial markets since 2007, it is also interesting to see how the process of financial integration evolved after 2007. I split the sample in two sub-samples of 85 and 60 months and investigate the change in performance of the three models. The pre-crisis simple starts in July 2000 and ends in July 2007.[6] The crisis period is from August 2007 to July 2012. The real answer to which month the crisis period should end is debatable. One can argue that the first 3-year long-term refinancing operations (LTROs) that started in December 2011 were the end of the crisis (e.g. Popov & Van Horen, 2013), but most studies include 2012 as well (e.g. Acharya, Eisert, Eufinger & Hirsch, 2014; Broner, Erce, Martin & Ventura, 2013). I choose the announcement of the outright monetary transactions (OMT), and with it, the end of the liquidity injections of the Securities Market Programme (SMP), as the end of the crisis period. In this, I follow Erce (2015), who shows that since the OMT announcement the (sovereign and bank) risk indicators decreased. With these sub-samples, I can compare the relative performance of the models over the different periods, and test if the disintegration hypothesised by Andrade and Chhaochharia (2012) is also visible in the asset pricing models. To have a closer look at the process of financial integration, I also perform a rolling regression of the domestic and the regional model, based on the idea of Seghal et al. (2014), who perform rolling regressions of a regional model and investigate the R-squared only. Each year, I run a regression over the previous three years (i.e. 36 months), so I end up with 15 periods in the sample. The trend of these 15 outcomes can provide insights in the development of financial integration.

I test the relative power of the three models from Equations 3, 6, and 7 with two measures, following previous literature (e.g. Fama & French, 1993; Griffin, 2002; Moerman, 2005). First, Jensen's alpha, which is called the 'pricing error'. If all assumptions of the model hold, the alpha should be zero. The model with a lower (mean absolute) pricing error indicates more effective performance of the risk factors. It is a test of how well the common factors capture the cross-section of the returns (Fama & French, 1993). Second, the average adjusted R-squared of the model, where a higher R-squared means that the variation in the factors explains more of the variation in excess returns. I expect to find a better performance of the domestic models, based on the two measures. In the pre-crisis period, I expect that the performance of the regional model will improve, i.e. increasing trend in the adjusted R-squared in the rolling regressions and a decreasing trend in absolute alphas, but that this increasing trend will slow down after 2007 due to the mutually reinforcing crises.

[6] Seghal et al. (2014) use July 2007 to split their sample, based on Angelini et al. (2011) and Trichet (2010).

4. Sample and data description

I perform the analysis of the stock returns on 11 EMU countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain.[7] I exclude Luxembourg due to the low number of listed stocks in the country, which makes it difficult to perform the analyses and ensure its robustness. The analysis covers the period 2000-2015. This period thus includes the years after the introduction of the euro, the internet bubble, and the GFC and ESDC.

4.1 Sample construction and screening

I compile my dataset of European companies following Smidt, Arx, Schrimpf, Wagner, and Ziegler (2014). This methodology includes more firms in the analysis than e.g. Moerman (2005). Although this could make it more difficult to compare results, it increases the robustness of the analysis. I download all data I use in this paper from the Thomson Reuters databases. I download all listed stocks from Worldscope lists and research lists, and also include dead stocks lists to prevent a survivorship bias.[8] I then download all stock related data provided by Datastream and accounting information provided by Worldscope.[9] For all firms I obtain the monthly return indices (which includes adjustments for dividends and corporate actions), the book value of equity, and the market value equity. I use the same euro area risk-free rate for all countries, which is the 3-month euro overnight indexed swap.[10] This has two reasons: first, there is practically no counter part of the U.S. T-bill rate available for the euro area; second, while the EMU-wide risk-free rate deviates from the specific country risk-free rate (and could bias the observed market risk premium), it ensures that bond market integration, i.e. the convergence of interest rates in the EMU, does not influence the results (Hardouvelis, Malliaropulos & Priestley, 2007)

To minimize the errors in the dataset, I download additional information to apply the static and dynamic screens described by Schmidt et al. (2014), which I describe in the Appendix. I end up with in total 4434 firms, 45,039 firm-years and 437,710 firm-months for the 15 portfolio years (see Table 1). There is a wide spread in the quantity of firms per country. Germany and France, the largest countries of the region, also have the highest number of stocks included in the portfolio construction each year with a representation of 30.65% and 27.18%

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[7] Greece joined the euro since 2001, so data from 2000 are converted in euro by Datastream.
[8] See Table A.1 in the Appendix for the constituent lists per country.
[9] Specific codes and definitions of the variables are reported in Table A.2 in the Appendix.
[10] Hull and White (2013) conclude that an overnight indexed swap is a good measure for the risk-free rate.

respectively. Ireland and Portugal have the smallest representation in the sample, with on average 35 and 63 stocks included in the portfolio construction each year.

4.2 Construction of risk factors

4.2.1 Market risk premium

I construct the risk factors for each stock as in the original paper of Fama and French (1993). The first risk factor is the MRF. This is the return on the market index in excess of the risk-free rate ($r_{m,t} - r_{f,t}$). For each country I calculate the monthly value-weighted market index returns using all stocks in the sample (excluding negative book equity firms) with the following formulas:

$$r_{i,t} = \frac{RI_t - RI_{t-1}}{RI_t} \qquad and \qquad r_{m,t} = \frac{\sum w_i * r_{i,t}}{\sum w_i},$$

where RI and RI_{t-1} are the closing return index of the current and previous month respectively, and the weight of a stock at the beginning of the month is the market value of the stock as a fraction of the total country market value. For the monthly return I use the holding period return of a stock as in the equation above, and for the monthly risk free rate I divide the annual risk free rate by 12 (as is common for statistical estimates with historical data).

The summary statistics for the country indices (Table 2) show that on average the returns of the weighted market index are positive for all countries, except for Greece. The standard deviation in the sample is also the highest for Greece. Both show that the crises were more severe in Greece than in the rest of the euro area (using stock market variance as a measure of risk). When you compare the market capitalisation weight (Table 2) with the weight based on the number of stocks included (Table 1), you can observe that especially for Germany, Spain, Greece, and the Netherlands the weights differ much. For Germany and Greece the weights based on market capitalisation are lower, indicating more small stocks (or smaller average market cap) relative to the other countries. The Netherlands and Spain on average have larger companies based on their higher value-weighted than equally-weighted presence in the sample.

4.2.2 Risk factor portfolios

The asset pricing models also include risk factors based on accounting data. To ensure the accounting data is available to investors to create their strategies and adjust their holdings (and thus ensure causation from the risk factors to the return they need to explain), I analyse the returns of a portfolio year starting in July of calendar year t, with accounting information from December year t-1. Within the sample I can create 15 portfolio years, starting July 2000 and ending June 2015, for which I can perform monthly regressions of excess returns the risk factors.

To be included in a portfolio year, a stock must have a stock price for for June of year t, a market value for June of year t, and a BTM for December of year t-1. Negative BTM firms are excluded from the portfolio creation. Then, each year in June, stocks are (independently) sorted in portfolios based on 1) their size, which is the market value of June year t, and 2) their BTM-ratio, which is the value of book equity on December year t-1 divided by the market value of the same month. I create two size-sorted portfolios, small (S) and big (B), using the median as cut-off point and create three BTM-sorted portfolios, low (L) medium (M) and high (H), using the 30th and 70th percentile as cut-off points.[11] The stocks are in a portfolio for one portfolio year, (from July of calendar year t to June of year t+1), and then in the last month the portfolios are rebalanced and sorted on size and BTM, using the same method, for the next portfolio year. The monthly value-weighted returns of the six portfolios are:

$$R_{p,t} = \frac{\sum w_i * r_{i,t}}{\sum w_i},$$

where $r_{i,t}$ is the monthly return index of the stock sorted in portfolio *p*, and w_i its market value of June year t as a fraction of the total market value of the stock. I then calculate the monthly SMB as the difference between the simple averages of the return on the three small (S) and big (B) portfolios, and the monthly HML as the difference between the simple averages of the return on the two high (H) and low (L) portfolios:

$$SMB = \frac{(R_{SH} + R_{SM} + R_{SL})}{3} - \frac{(R_{BH} + R_{BM} + R_{BL})}{3},$$

$$HML = \frac{(R_{SH} + R_{BH})}{2} - \frac{(R_{SL} + R_{BL})}{2}.$$

The WML risk factor, which is the monthly return difference between a portfolio with past year winners and a portfolio with past year losers. The construction of the WML factor uses six two-way sorted portfolios based on size and lagged momentum return, where the two size portfolios are created as above, and the momentum portfolios are created similar to the BTM portfolios: I indicate the bottom 30% momentum returns as losers (L), the middle 40% as

[11] Due to the low average number of stocks in the border portfolios Small-Low and Big-High for Ireland (only 2) and Portugal (only 4), I decide to split the stocks in these countries in two BTM portfolios using the median as a cut-off. This significantly lowered the standard deviation of the average HML returns for both countries, but also decreased the average HML returns for Portugal (from 0.63% to 0.160%). For Ireland the change was minimal (from -0.41% to -0.40%).

neutral (N), and the top 30% as winners (W). In contrast to the size-BTM portfolios, the size-momentum portfolios are rebalanced monthly at the end of each month t-1. I follow Schmidt et al. (2015), and sort the portfolios based on the stock's mean return for month t-12 to t-2. The return differential is then the simple average of the two winners-portfolios minus the two losers-portfolios:

$$WML = \frac{(R_{SW} + R_{BW})}{2} - \frac{(R_{SL} + R_{BL})}{2}.$$

To create the different geographical versions of the asset pricing models, I first create the (domestic) risk factors for each country. Then for the calculation of the regional risk factors (EMRF, ESMB, and EHML from Equation 4) I use the value-weighted average of the country risk factors of all EMU countries. The creation of foreign risk factors (FMRF, FSMB, and FHML from Equation 6) for each country uses the value-weighted average of all EMU country risk factors excluding the domestic country.

Table 3 displays the monthly average returns of the risk factor portfolios per country (Panel A), the correlation of the domestic risk factors with its regional counterpart (Panel B), and the correlation of the domestic risk factors with its foreign counterpart (Panel C). Despite the long crisis period, the excess market returns are generally positive. Consistent with the evidence of Fama and French (2012), who investigate 15 countries from Europe, I also find that the performance of the HML portfolios is large and positive for all EMU countries. The SMB returns show mixed evidence about the sign of the size effect in the EMU. In Germany, Belgium, Spain and Greece big firms earn a premium over small firms, in the rest of the countries there is a small firm premium. On average returns on the SMB portfolios are small but negative. The largest negative SMB return is for Germany (-0.29%). This may be due to the large number of small firms we find in that country, which apparently were not able to perform well during the crisis period. This is consistent with Table 1, which shows that the number of firms in Germany decreased from 1039 in 2007 to only 799 in 2014. Momentum returns are positive and high, thus stocks that performed well in the previous month performed well in the following month.[12]

Overall, the average monthly returns in the sample are very similar to the returns Fama and French (2012) find for Europe in their sample from November 1990 to March 2011. Market

[12] Note that these momentum returns are constructed in a slightly different way than Carhart (1997) and Jegadeesh and Titman (1993) do. The portfolios are constructed the same (monthly based on previous year's cumulative return), but the explanatory returns are only a single monthly return observation instead of the cumulative of multiple monthly returns.

returns are 0.37% higher (they may be sensitive to the period and region), but SMB returns are also negative and small (only 0.06% lower), and HML and MOM returns are also positive and high (0.10% and 0.02% lower respectively).

The correlation between the domestic and regional factors is especially high for the MRF portfolios, indicating comovement in market returns. Despite the relatively large presence in the sample based on stocks (8.42%, see Table 1), Greece has the lowest correlation of its domestic factors with the regional factors. The correlation of the domestic SMB and HML factors with its regional counterpart is quite high for some countries, which reflects that the factor is constructed from (weighted) country components. Panel C can already provide some information on the expected relative power of including foreign factors in the international country model. The analysis of the correlation of the country and international risk factors is useful for the empirical analysis, but cannot yet imply anything about structural changes in the financial markets leading to integration. The correlations for the SMB and HML factors are not that high as you would expect in an integrated area. The correlation is especially high for the domestic and foreign MRF factors (70-97%), but as Baele et al. (2004) note, this correlation may be caused by (the synchronisation of) the business cycles.

Table 4 shows the correlation between the independent variables of the domestic model. In line with the results of Fama and French (1992) who find that a large part of the variation in beta can be explained by firm size, in this sample all countries have a negative correlation between the SMB portfolio and the excess market returns. Positive returns of large firms are thus observed in periods of positive excess market returns. The correlation between the SMB and HML factors are negative for most countries (only Belgium and Finland have a positive correlation), suggesting that both thus can be expected to proxy for different underlying state variables (Fama & French, 1998).

4.3 Test portfolios

For the empirical tests, I also divide the explanatory returns in characteristics-based portfolios. Due to the low number of stocks per country compared to the U.S. or other large countries, I use 9 portfolios rather than the 25 portfolios Fama and French (1993, 2008, 2012) use for their portfolios independently sorted on size and BTM. Using too much portfolios would result in very few stocks in each portfolio, hence will not reduce the idiosyncratic (firm-specific) risk, which is my purpose of testing portfolio returns instead of individual stock returns. The same is true for portfolios sorted on a single characteristic or divided in a small number of tranches. If stocks are sorted in a low number of tranches, it could favour the country model because the test portfolios, consisting of domestic stocks, are then more correlated with the risk factor portfolios, which are constructed from the same domestic stocks (Moerman, 2005). I therefore choose to use six portfolios for the main analyses.[13]

5. Empirical Results

5.1 Financial integration of the region

Table 5 presents the performance criteria I obtain from the time-series regression of the regional, international and domestic model. In Panel A you can find the first result of this paper. The equally-weighted averages of the absolute country-specific alphas and adjusted R-squared show that the domestic model outperforms the regional model in all three portfolios. When the returns of size-sorted portfolios are explained in a regional model instead of a domestic model, the alphas almost double (from 0.170% to 0.324%) and the regression explains almost 20% less of the variation in returns (77.6% versus 59.7%). For the group of big countries in terms of market capitalisation (France, Germany, Spain, Italy, and the Netherlands), the models overall do a better job explaining the stock returns. Especially for the regional model, where the model mispricing almost decreases with 50% (vis-à-vis the regional model for all countries) and the adjusted R-squared increases from 52-60% to 68-75%. The domestic model still performs better based on the adjusted R-squared measure, but in terms of alphas the difference between the two models is less robust. The alphas of the domestic and regional model are closer together for the big country group, and for the Size-BTM sort even slightly lower (0.279% versus 0.273% respectively). The group of GIIPS countries shows higher 'disintegration' than the average of all countries. The performance of the domestic model is almost equal, but the regional model has especially higher pricing errors for the Size (0.324% versus 0.452%) and BTM (0.417% versus 0.554%) portfolios. These results show that over the period 2000-2015, the big countries are on average more integrated and the GIIPS countries are less integrated in the euro zone than the average country is.

A comparison between the domestic and international country model shows that neither one of the models clearly outperforms the other. Both performance measures are quantitatively the same for all countries and the big or GIIPS countries separately. I thus can conclude that allowing foreign factors to have a separate influence on returns does not clearly statistically improve the model. This low influence of foreign risk factors on the performance measures

[13] I can say that the tercile and decile portfolios generally show the same trends, unless noted differently.

shows that they have low additional explanatory power over the locally created factors. As noted before, all results discussed here are robust to the number of portfolios.

Panel D shows the results for individual countries, which are the numbers I use for the calculation of the group averages. The most integrated countries are Spain and the Netherlands. Although the domestic risk factors explain more of the variation in the domestic returns (they do so by construction), the euro area model shows lower average pricing errors than the domestic model for both countries (for Spain only the tercile BTM portfolios shows a lower domestic pricing error). Greece is the country for which the regional model performs the worst. The average pricing errors are very high and the euro area factors explain only 31-38% of the return variation. The overall worst performance of the asset pricing models is in Ireland. For Ireland, even the domestic model produces pricing errors ranging from 0.442-0.570%.

We can thus observe from Table 5 that the performance of the asset pricing models can quite differ from one country to another. Overall the table does provide clear results for the outperformance of the domestic model over the regional model, which is consistent with the hypothesis that integration of the stock market in the EMU is not yet completed. When I compare my results with previous research of Moerman (2005) I come to the same conclusion about the better performance of the domestic model, but I find that the relative outperformance is lower.[14] Financial integration thus may have increased in the long-term. I do have to be careful interpreting the results for the whole sample, because it includes a ‘crisis’ period in which markets behaved different from the relatively ‘normal’ sample period of Moerman (2005), that only includes the IT bubble. Markets behave differently during crisis periods (e.g. higher comovement), which can be expected to have its effects on the results from the different asset pricing models. I discuss the different states and trends of financial integration during normal and crisis periods in the next subsection.

5.3 Financial integration in a normal and crisis period

During a crisis period, financial markets may move more together and react to the same (external or internal) shocks. In periods of high volatility, different behaviour of investors in turn (e.g. through lower cross-border holdings) can affect the degree of integration. In Table 6 I present the result for the subsamples of the normal period (July 2000 to July 2007) and the crisis period (August 2007 to July 2012). It is interesting to look at the change in average adjusted R-squared of the domestic model relative to change in adjusted R-squared of the

[14] I should note here that there may be some small data differences which could reduce the power of the comparison I pose here. Still, on a high level, I believe this comparison is possible.

regional model. Both models have a higher R-squared in the crisis period, indicating possible presence of spillovers and contagion, but the R-squared increase is consistently larger for the regional model, suggesting the presence of common shocks that spillover in the region and not in the local country. Because this effect is present, I cannot use this performance measure to conclude about integration.

The pricing error measure is less prone to commonality in shocks. To easily compare this measure for the different models and groups, I use the data from Table 6 to create Figure 1. Here I lend the k-indicator from Moerman (2005), who defines it as the ratio of the country to the euro area average absolute pricing error:

$$k_{dom,eur}\frac{\frac{1}{n}\sum_p\left|\alpha_{p,dom}\right|}{\frac{1}{n}\sum_p\left|\alpha_{p,eur}\right|}\ .$$

For the group of all countries, these graphs do not show significant increase or decrease of the level of integration during the crisis. The size and size-BTM portfolios show an increase in the integration indicator, and the BTM portfolios a decrease, but they are not that large. What you can clearly see, is that the big countries have a large decrease in the k-indicator, which is evident across all three portfolio sorts (ranging from a 9% decrease in size-sorted portfolios to 29% decrease for BTM-sorted portfolios). During the crisis period there apparently was lower integration of the equity markets than the period of the introduction of the euro up to the financial crisis. This is consistent with the findings of Andrade and Chhaochharia (2012). The result presented here is however not true for all countries. When I use size-sorted portfolios I find that the level of integration in GIIPS countries drastically increased during the crisis period, which would be opposite of the findings of Andrade and Chhaochharia (2012).

However, as discussed before, the definition of the precise crisis period is debatable and may influence the results presented here. Thus to check this limitation and provide further insight in the process of integration rather than the state of integration, I perform rolling regressions for 15 periods of three years (36 months). The results of these regressions are graphed in Figure 2-4. We can see that for all countries together, the first three periods the pricing error of the euro zone model remain relatively constant. The following two periods (the years 2005:07-2007:06) show a higher integration due to a lower pricing error of the euro zone model.[15] This trend towards integration stops when I include the first crisis year (2007:07-

[15] Important to check if the increasing integration (k-indicator) is due to a decreasing EMU or increasing domestic model pricing error. The former would c.p. be an indication of integration. The latter may indicate ‘false’ integration simply due to lower performance of the domestic model.

2008:06). During the crises period (indicated by the shaded area) all three portfolio-sorts show a decrease in in the level of integration. This decreasing trend stops when the first 'recovery' year after the crisis is included (2012:07-2013:06). This is in line with the hypothesis that the three crises in the euro area reversed the increasing trend towards integration on the equity markets. The sharpest increase in integration is in the recent years, where we see that the level of integration is back at the level it was before the crises.

Again, I show the results for the big and GIIPS countries separately. The graphs show that the big countries were already more integrated relative to the country average than the GIIPS countries were, and that in the years leading up to the crisis, the GIIPS countries catch up. During the crisis period, we see that for both country groups there is segmentation of the equity market. This segmentation is however more extreme for the more distressed GIIPS countries. There is a downward trend in the k-indicator, until the first year after the crisis is included in the rolling regression. After the crisis, the GIIPS countries become more integrated and we see the same convergence of the state of integration for the country groups as before the crisis period.

5.4 Additional tests

5.4.1 Asset pricing robustness

In the methodology section I mention the joint testing of hypotheses regarding efficient financial markets, the asset pricing model and the degree of integration. Here I test the robustness of the results regarding the different asset pricing models. The most important takeaway from Table 7 is that we see the same performance of the domestic model relative to the regional model. The pricing errors are lower and the explained variation is higher. For all portfolio sorts and asset pricing models, the regressions show the same results. The relative performance of the CAPM, 3FM and 4FM are also as expected, with the best performance for the last mentioned, based on the two performance measures.[16] Though this table shows only the results for the full sample, I can say also sub-sample tests of the CAPM and 4FM are quantitatively similar to the results discussed in the main part of this paper.

Panel A also addresses an important question for investors, about whether they should use a different geographical scale for the beta used in cost of capital calculations. The results clearly show that relatively the regional model does not outperform the domestic model.

[16] The model alpha and adj. R-squared may not be the best performance measure to compare models with different number of variables (e.g. Akaike or Bayesian information criterion may be better), so I will not draw any conclusions from this outperformance of the 4FM.

Domestic market returns only are also a better predictor of stock returns than domestic and foreign market returns together. This provides no reason to change the currently common approach for cost of capital calculations, so still a domestic market beta rather than an international market beta should be used in these calculations.

5.4.2 European market risk

I pose in this paper that the risk factors determining stock returns originate locally. The performance of the foreign HML and SMB risk factors is generally low in the individual portfolio regressions. The market risk factor however, consistent with the correlations I find in Panel C of Table 3, has higher statistical significance (lower p-values, unreported). This provides a reason to perform additional tests of a new asset pricing model, where I augment the local country model with the foreign market risk factor (FMRF). Risk originating on foreign markets might spillover to local markets, so can be argued to be priced in local stocks next to local factors.

Table 8 shows that, based on the R-squared measure, the international market model explains more of the variation in domestic stock returns than the domestic or international country model do. This may however, be caused simply by the higher correlation due to increased volatility of the market. The pricing error is lower for the BTM and size-BTM portfolios, but not for the size portfolios. No clear conclusion can thus be drawn from the table, hence also the market risk factor is not from regional origin.

6. Conclusion

In this paper I investigate the state and process of integration of 11 countries in the EMU over the period 2000-2015. For different group compositions, I test the relative performance of asset pricing models, in which risk can originate from the domestic or foreign country, and I show the performance of these models over time. I find, using the k-indicator, that overall the integration is higher for the big country group, and that the level of integration varies from one country another. I show that since the crisis starting mid 2007 the euro zone stock markets have segmented until the end of the sovereign debt crisis, when the OMTs started. In the recovery period following, the increasing trend towards integration continued and the level of integration now is back at the levels from before the crisis.

I can partly confirm the hypothesis that integration has increased since the introduction of the euro, but I have to note that this increasing trend is only apparent in normal states of the economy. The results are in line with the hypothesis that the three mutually reinforcing crises segmented the stock markets in the euro zone. This is against the findings of Bekaert et al. (2013), but similar to the results found by Andrade and Chhaochharia (2012) and Everaert and Pozzi (2016), although the latter paper finds that the trend decreases from 2010 onwards. In addition, the results show that during the 2000-2015 period, the Fama-French risk factors are still domestic in the EMU, confirming that the results of Moerman (2005) are still valid and that Griffin's (2002) results against a global 3FM also apply to the regional 3FM.

The results have implications for both investors and policy makers of the EMU. Not only the state but also the quality of financial integration is important to prevent segmentation as seen during the crisis. The level of stock market integration was quite high before the crises period, but thus also requires strong institutions and convergence of macro-economic policies (especially aimed at the efficient transmission of monetary policy) to make sure the current stock market integration will prove to be a blessing rather than a curse for the EMU. The increased financial integration since 2012 means that investors have less and less opportunities to diversify on a country scale. Country stock returns are increasingly explained by regional sources of risk, hence diversification across industries may provide better results for the 'mean-variance optimizer'. However, the results from CAPM regressions show that cost of capital do still need to be done using the country beta rather than a regional beta.

The results presented in this paper have three limitations. First the above mentioned implications for investors are limited, as the performance of industry effects are not investigated in this paper. Only if industry effects are investigated as well, one can more completely conclude about the optimal diversification strategy and not only suggest. Another limitation, mentioned by for example Pukthuantong and Roll (2009), is that volatility in factors during a crisis increases correlation and in turn erroneously implies integration. I see that indeed the explained variation of returns increases, but try to overcome this limitation of my result with the use of pricing errors. The third limitation is regarding the assumption of efficient financial markets affecting the pricing error. Financial markets may behave differently during a crisis or may have a different level of efficiency in certain countries. Still, I believe this impact is rather limited as the efficiency may be assumed quantitatively equal because I only compare developed economies in this paper.

Further research could use the same methodology to compute the k-indicator for integration on the stock market for each country individually, and use it as a dependent variable in a second-pass regression. This requires a larger sample than the 2000-2015 period and one has to be careful with the error-in-variable bias, but then could investigate more specifically the differences between country groups or effects of policy measures, taking into account not only the quantity but also the quality of financial integration.

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Tables

Table 1 - Number of firms

This table shows the number of firms that are included in the creation of the risk factor portfolios. A portfolio year starts in July of year t, hence the year 2000 corresponds to the first portfolio year from July 2000 to June 2001. The stocks have a stock price and market value for the portfolio sorting month (June), and a non-negative book-to-market ratio for the preceding December.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Avg.	Total	%
Germany	874	880	869	849	859	929	1020	1039	1022	1001	986	961	885	830	799	920	13803	30.65
Belgium	139	138	137	136	136	141	157	156	150	147	145	139	137	135	132	142	2125	4.72
Spain	170	171	163	155	144	146	153	152	146	146	144	149	146	145	144	152	2274	5.05
Finland	144	141	139	134	134	134	134	130	127	126	122	123	122	126	126	131	1962	4.36
France	912	908	875	825	798	839	877	868	834	810	775	759	730	724	706	816	12240	27.18
Greece	284	296	292	294	284	272	266	259	253	242	232	224	209	196	191	253	3794	8.42
Ireland	42	42	40	36	35	38	39	39	38	32	31	29	27	30	29	35	527	1.17
Italy	263	264	259	247	246	264	282	289	282	273	264	259	254	256	254	264	3956	8.78
Netherlands	194	179	161	155	147	141	139	136	122	119	111	111	107	102	101	135	2025	4.50
Austria	105	105	99	98	91	95	95	96	94	92	87	84	83	84	83	93	1391	3.09
Portugal	91	77	72	71	67	64	66	60	59	56	56	50	51	51	51	63	942	2.09
Total	3218	3201	3106	3000	2941	3063	3228	3224	3127	3044	2953	2888	2751	2679	2616	3003	45039	100

Table 2 - Summary statistics

July 2000 - June 2015

Summary statistics of the compiled value weighted market indices used in the paper. * and ** denote significance at the 5% and 1% significance levels for the Jarque-Bera (JB) test of normality. The first collumn shows the average weight of a country index in the EMU index based on market value. The last column shows the correlation of the returns of the compiled market index with the respective Datastream Total Market index.

	Weight	Mean	Median	St. dev.	Skewness	Kurtosis	JB	Corr.
EMU	1.000	0.354	1.040	4.890	-0.499	4.155	17.285**	0.996
Germany	0.225	0.402	0.864	5.549	-0.616	5.335	51.707**	0.982
Belgium	0.045	0.683	1.475	4.870	-0.980	6.612	125.277**	0.994
Spain	0.113	0.496	0.983	5.296	-0.207	3.521	3.289	0.990
Finland	0.036	0.240	1.275	7.658	-0.220	4.619	20.876**	0.990
France	0.316	0.388	0.998	4.888	-0.406	3.690	8.420*	0.994
Greece	0.016	-0.480	-0.237	8.812	-0.169	3.557	3.151	0.967
Ireland	0.010	0.835	1.010	6.386	-0.669	5.154	47.75**	0.890
Italy	0.108	0.239	0.969	5.295	-0.321	3.466	4.672*	0.992
Netherlands	0.103	0.360	1.240	5.212	-0.735	4.701	37.458**	0.980
Austria	0.017	0.692	0.939	5.559	-0.583	5.970	75.486**	0.989
Portugal	0.012	0.175	0.552	4.907	-0.767	4.653	37.726**	0.967

Table 3 - Summary statistics risk factors

July 2000 - June 2015

This table presents the average of the monthly excess returns for the full sample period in Panel A. Panel B and C show the correlation of the domestic risk factor with its regional or foreign counterpart. Panel C shows the correlation of the variables as they are included in Equation 6. The domestic risk factors are weighted by their respective country market value as a fraction of the euro-zone market value. The country-specific foreign factor is weighted by the total market value of the foreign countries as a fraction of the total eurozone market value. MRF is the market return in excess of the risk-free rate. SMB is the return of the SH, SM, and SL portfolios in excess of the BH, BM, and BL portfolios. HML is the return of the HS and HB portfolios in excess of the LS and LB portfolios. MOM is the return of the positive momentum portfolios in excess of the low/negative momentum portfolios.

Country	MRF	SMB	HML	MOM
Panel A: Monthly average portfolio returns per country				
All (EMU)	0.192	-0.013	0.646	0.942
Germany	0.239	-0.290	0.793	1.055
Belgium	0.521	-0.101	0.370	1.088
Spain	0.334	-0.193	0.710	0.477
Finland	0.077	0.267	0.853	0.986
France	0.225	0.083	0.711	1.148
Greece	-0.643	-0.162	0.443	0.942
Ireland	0.673	0.356	-0.398	0.010
Italy	0.077	0.145	0.551	0.885
Netherlands	0.198	0.157	0.321	0.614
Austria	0.530	0.184	0.587	1.081
Portugal	0.012	0.372	0.159	0.569
Panel B: Correlation of domestic with regional risk factor portfolios				
Germany	0.958	0.846	0.691	0.893
Belgium	0.828	0.488	0.494	0.725
Spain	0.859	0.620	0.605	0.753
Finland	0.758	0.544	0.452	0.612
France	0.985	0.908	0.850	0.933
Greece	0.676	0.158	0.153	0.444
Ireland	0.722	0.325	0.322	0.438
Italy	0.924	0.638	0.619	0.820
Netherlands	0.931	0.540	0.526	0.777
Austria	0.745	0.348	0.319	0.579
Portugal	0.772	0.219	0.244	0.359
Panel C: Correlation of domestic with foreign risk factor portfolios (weighted)				
Germany	0.921	0.695	0.490	0.784
Belgium	0.812	0.461	0.419	0.674
Spain	0.828	0.496	0.459	0.656
Finland	0.671	0.480	0.393	0.591
France	0.969	0.757	0.597	0.849
Greece	0.698	0.053	0.035	0.469
Ireland	0.713	0.321	0.277	0.368
Italy	0.913	0.516	0.526	0.800
Netherlands	0.905	0.436	0.364	0.713
Austria	0.709	0.362	0.311	0.492
Portugal	0.768	0.207	0.238	0.378

Table 4 - Correlation of risk factor portfolios

July 2000 - June 2015

This table shows the correlation of the montly returns on the domestic risk factor portfolios, which are the independent variables of domestic model (Equation 7). DMRF is the market return in excess of the risk-free rate. DSMB is the return of the SH, SM, and SL portfolios in excess of the BH, BM, and BL portfolios. DHML is the return of the HS and HB portfolios in excess of the LS and LB portfolios. DMOM is the return of the positive momentum portfolios in excess of the low/negative momentum portfolios.

	DMRF	DSMB	DHML	DMOM		DMRF	DSMB	DHML	DMOM
Germany					*Ireland*				
DMRF	1.000				DMRF	1.000			
DSMB	-0.598	1.000			DSMB	-0.458	1.000		
DHML	0.084	-0.324	1.000		DHML	0.353	-0.269	1.000	
DMOM	-0.508	0.144	0.080	1.000	DMOM	-0.357	0.409	-0.222	1.000
Belgium					*Italy*				
DMRF	1.000				DMRF	1.000			
DSMB	-0.604	1.000			DSMB	-0.395	1.000		
DHML	-0.183	0.119	1.000		DHML	0.188	-0.218	1.000	
DMOM	-0.548	0.293	0.037	1.000	DMOM	-0.520	0.201	-0.006	1.000
Spain					*Netherlands*				
DMRF	1.000				DMRF	1.000			
DSMB	-0.450	1.000			DSMB	-0.208	1.000		
DHML	0.130	-0.109	1.000		DHML	-0.102	-0.121	1.000	
DMOM	-0.460	0.133	-0.172	1.000	DMOM	-0.407	-0.054	0.076	1.000
Finland					*Austria*				
DMRF	1.000				DMRF	1.000			
DSMB	-0.668	1.000			DSMB	-0.531	1.000		
DHML	-0.556	0.209	1.000		DHML	0.239	-0.316	1.000	
DMOM	-0.482	0.323	0.458	1.000	DMOM	-0.372	0.186	-0.156	1.000
France					*Portugal*				
DMRF	1.000				DMRF	1.000			
DSMB	-0.514	1.000			DSMB	-0.354	1.000		
DHML	0.076	-0.230	1.000		DHML	-0.126	-0.219	1.000	
DMOM	-0.562	0.273	-0.042	1.000	DMOM	-0.242	0.180	-0.130	1.000
Greece									
DMRF	1.000								
DSMB	-0.408	1.000							
DHML	0.277	-0.271	1.000						
DMOM	-0.529	0.085	-0.110	1.000					

Table 5 - Financial integration in the euro area

July 2000 - June 2015

This table displays the statistics from the three models specified in Equation 4 (Regional), Equation 6 (International), and Equation 7 (Domestic). The statistics are the portfolio-average absolute alpha and the adjusted R-squared. The first column shows the characteristic on which the portfolio is sorted. Panel A shows the average of all country statistics, Panel B is the average of only the big countries (France, Germany, Spain, Italy and the Netherlands), Panel C displays the averages of GIIPS countries, and Panel D shows the statistics per country. The Size and BTM are divided in six portfolios and the Size-BTM independent sort is divided in nine portfolios. Because two of the five GIIPS countries have a low number of stocks (and therefore not a Size-BTM portfolio each year) the Size-BTM independent sort is not shown for the GIIPS country average.

	Domestic		**International**		**Regional**	
	$\lvert\alpha\rvert$	R^2	$\lvert\alpha\rvert$	R^2	$\lvert\alpha\rvert$	R^2
Panel A: All countries						
Size	0.170	0.776	0.188	0.768	0.324	0.597
BTM	0.302	0.717	0.291	0.703	0.417	0.552
Size-BTM	0.326	0.690	0.323	0.684	0.463	0.529
Panel B: Big countries						
Size	0.138	0.850	0.126	0.851	0.153	0.750
BTM	0.189	0.788	0.207	0.790	0.238	0.702
Size-BTM	0.279	0.776	0.266	0.779	0.273	0.685
Panel C: GIIPS countries						
Size	0.203	0.752	0.220	0.733	0.452	0.505
BTM	0.307	0.700	0.306	0.659	0.554	0.472
Panel D: Individual countries						
Germany						
Size	0.102	0.866	0.102	0.870	0.143	0.769
BTM	0.150	0.838	0.172	0.837	0.216	0.762
Size-BTM	0.198	0.830	0.197	0.829	0.229	0.730
Belgium						
Size	0.156	0.777	0.214	0.787	0.294	0.636
BTM	0.449	0.628	0.412	0.650	0.505	0.510
Size-BTM	0.348	0.678	0.339	0.698	0.439	0.551
Spain						
Size	0.182	0.809	0.160	0.811	0.136	0.647
BTM	0.189	0.750	0.210	0.760	0.173	0.594
Size-BTM	0.286	0.707	0.283	0.714	0.233	0.565
Finland						
Size	0.103	0.766	0.151	0.774	0.316	0.586
BTM	0.339	0.708	0.380	0.731	0.347	0.520
Size-BTM	0.257	0.678	0.265	0.692	0.289	0.500
France						
Size	0.085	0.888	0.080	0.890	0.104	0.844
BTM	0.171	0.846	0.202	0.851	0.239	0.826
Size-BTM	0.317	0.837	0.318	0.839	0.319	0.798
Greece						
Size	0.160	0.874	0.149	0.797	1.157	0.387
BTM	0.280	0.792	0.268	0.654	1.203	0.401
Size-BTM	0.280	0.795	0.333	0.704	1.223	0.336

Panel C: Individual countries - continued						
Ireland						
Size	0.442	0.603	0.431	0.584	0.490	0.376
BTM	0.678	0.545	0.477	0.494	0.695	0.303
Size-BTM*	0.570	0.507	0.545	0.492	0.895	0.306
Italy						
Size	0.132	0.882	0.152	0.874	0.256	0.760
BTM	0.216	0.824	0.288	0.807	0.386	0.719
Size-BTM	0.319	0.812	0.299	0.813	0.364	0.713
Netherlands						
Size	0.192	0.805	0.134	0.810	0.128	0.730
BTM	0.218	0.685	0.162	0.695	0.176	0.612
Size-BTM	0.276	0.694	0.232	0.701	0.218	0.617
Austria						
Size	0.221	0.673	0.282	0.654	0.325	0.482
BTM	0.458	0.682	0.348	0.678	0.333	0.482
Size-BTM*	0.290	0.578	0.308	0.562	0.404	0.409
Portugal						
Size	0.097	0.594	0.211	0.601	0.219	0.353
BTM	0.174	0.588	0.285	0.579	0.311	0.344
Size-BTM*	0.443	0.479	0.439	0.482	0.484	0.294

*For Ireland, Austria and Portugal not all nine size-BTM portfolios have 180 months of data due to the number of stocks. Ireland has no small size-low BTM portfolio for two years and no BH portfolio for three years. Austria has no big-high portfolio for one year. For Portugal 10 of the 15 years do not have a big-high portfolio and 2 of the 15 years have no small-low portfolio. Hence, these regression results are based on a lower number of observations (and a low number of stocks per portfolio).

Table 6 - Financial integration during crises

July 2000 - July 2012

This table displays the statistics from the three models specified in Equation 4 (Regional), Equation 6 (International), and Equation 7 (Domestic), divided in subsamples. The 'normal' subsample runs from 2000:07-2007:07 and the 'crisis' subsample runs from 2007:08-2012:07. The statistics are the portfolio-average absolute alpha and the adjusted R-squared. The first column of the table shows the characteristic on which the portfolio is sorted. The second column the subsample period. Panel A shows the average of all country statistics, Panel B is the average of only the big countries (France, Germany, Spain, Italy and the Netherlands), and Panel C shows the statistics for only GIIPS countries (Greece, Italy, Ireland, Portgual, Spain). The Size and BTM are divided in six portfolios and the Size-BTM independent sort is divided in nine portfolios. Due to a data availability problem, Portugal is excluded from the tests with Size-BTM sorted portfolios.

		Domestic		**International**		**Regional**	
		$\lvert\alpha\rvert$	R^2	$\lvert\alpha\rvert$	R^2	$\lvert\alpha\rvert$	R^2
Panel A: All countries							
Size	Normal	0.243	0.767	0.255	0.767	0.628	0.552
	Crisis	0.290	0.813	0.369	0.807	0.684	0.684
BTM	Normal	0.391	0.694	0.305	0.701	0.572	0.507
	Crisis	0.432	0.756	0.528	0.740	0.730	0.616
Size-BTM	Normal	0.401	0.707	0.376	0.707	0.667	0.507
	Crisis	0.454	0.751	0.547	0.742	0.752	0.631
Panel B: Big countries							
Size	Normal	0.175	0.841	0.185	0.847	0.364	0.721
	Crisis	0.193	0.892	0.201	0.897	0.497	0.816
BTM	Normal	0.330	0.744	0.264	0.755	0.392	0.666
	Crisis	0.261	0.840	0.284	0.841	0.472	0.751
Size-BTM	Normal	0.403	0.768	0.362	0.774	0.461	0.655
	Crisis	0.329	0.817	0.342	0.821	0.540	0.740
Panel C: GIIPS countries							
Size	Normal	0.247	0.768	0.247	0.771	0.846	0.466
	Crisis	0.450	0.767	0.561	0.745	1.054	0.590
BTM	Normal	0.344	0.702	0.262	0.705	0.674	0.428
	Crisis	0.514	0.724	0.731	0.680	1.048	0.539
Size-BTM	Normal	0.451	0.736	0.373	0.732	0.898	0.436
	Crisis	0.577	0.715	0.787	0.682	1.135	0.557

Table 7 - Asset pricing model robustness

July 2000 - June 2015

This table displays the statistics from robustness tests regarding the risk factors included in the asset pricing model, for the three models specified in Equation 4 (Regional), Equation 6 (International), and Equation 7 (Domestic). The statistics are the portfolio-average absolute alpha and the adjusted R-squared (averaged for all countries). The first column of the table shows the characteristic on which the portfolio is sorted. Panel A shows the statistics for the Capital Asset Pricing Model (CAPM). These tests only used the DMRF, EMRF or separate DMRF and FMRF as risk factors. Panel B is the same as Panel A from Table 5, included for comparison. Panel C shows the statistics for the Four-factor model, which includes the same factors as the Three-factor model but with domestic, regional, and/or foreign momentum returns included. Because the Four-factor model includes a momentum factor, I used portfolios sorted on momentum and on size and momentum together to estimate the asset pricing model (and excluded the Size-BTM sorted portfolios from the table).

	Domestic		**International**		**Regional**	
	$\lvert\alpha\rvert$	R^2	$\lvert\alpha\rvert$	R^2	$\lvert\alpha\rvert$	R^2
Panel A: CAPM						
Size	0.307	0.600	0.325	0.605	0.418	0.493
BTM	0.387	0.641	0.393	0.630	0.468	0.500
Size-BTM	0.436	0.530	0.435	0.535	0.526	0.435
Panel B: Fama-French Three-factor model						
Size	0.170	0.776	0.188	0.768	0.324	0.597
BTM	0.302	0.717	0.291	0.703	0.417	0.552
Size-BTM	0.326	0.690	0.323	0.684	0.463	0.529
Panel C: Carhart Four-factor model						
Size	0.176	0.778	0.191	0.770	0.313	0.599
BTM	0.286	0.723	0.302	0.708	0.401	0.555
MOM	0.289	0.720	0.304	0.705	0.456	0.561
Size-MOM	0.190	0.814	0.199	0.804	0.332	0.637

Table 8 - International market model

July 2000 - June 2015

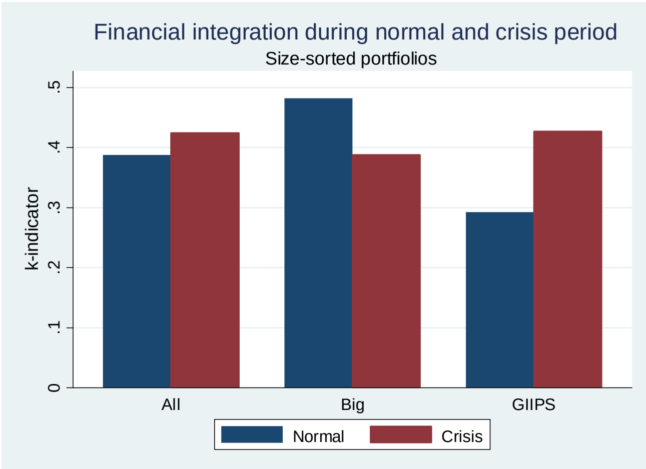
This table presents the results of an international market model, which is the domestic model (Equation 7) augmented with the FMRF. The first two collumns are the same as in Table 5, and included for comparison with the international market model.

	Domestic		**International**		**International market**	
	$\lvert\alpha\rvert$	R^2	$\lvert\alpha\rvert$	R^2	$\lvert\alpha\rvert$	R^2
Size	0.170	0.776	0.188	0.768	0.192	0.847
BTM	0.302	0.717	0.291	0.703	0.204	0.850
Size-BTM	0.326	0.690	0.323	0.684	0.328	0.696

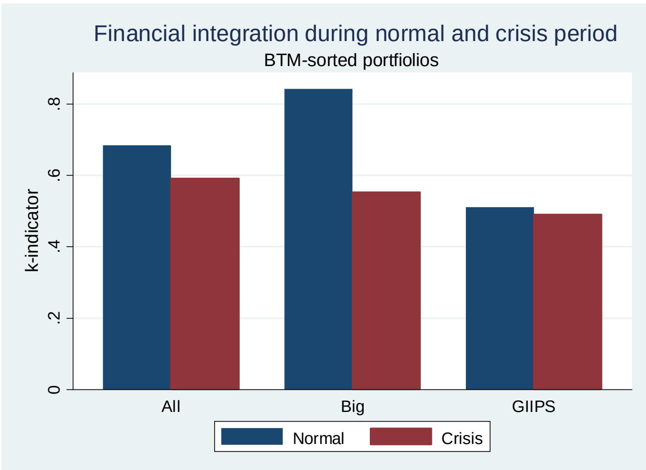
Figure 1

This figure displays the average k-indicator (as in Moerman, 2005) for all countries, the big countries group and the GIIPS countries group. The k-indicator is a measure of financial integration defined as the country average absolute alpha divided by the euro area average absolute alpha of the specific portfolios. A fraction closer to one thus indicates higher integration.

Panel A: Size-sorted portfolios



Panel B: BTM-sorted portfolios



Panel C: Size/BTM-sorted portfolios

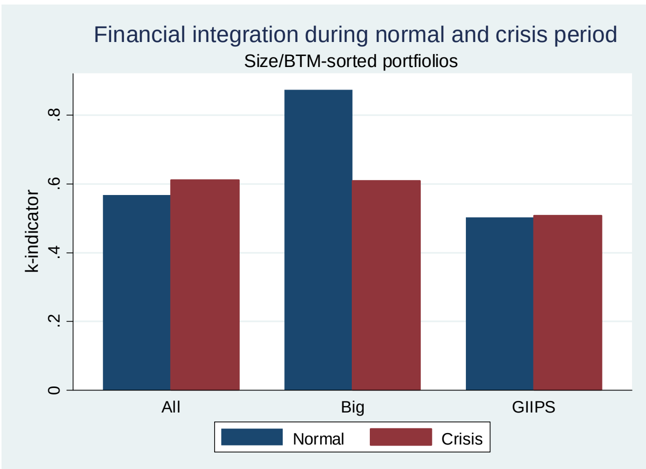
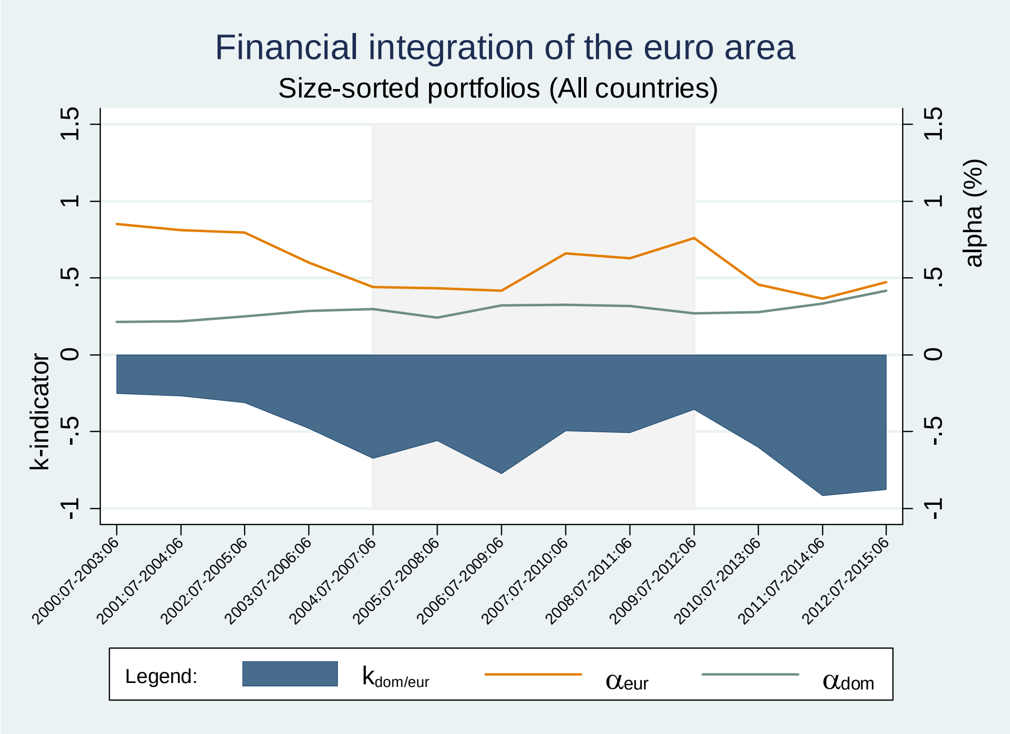


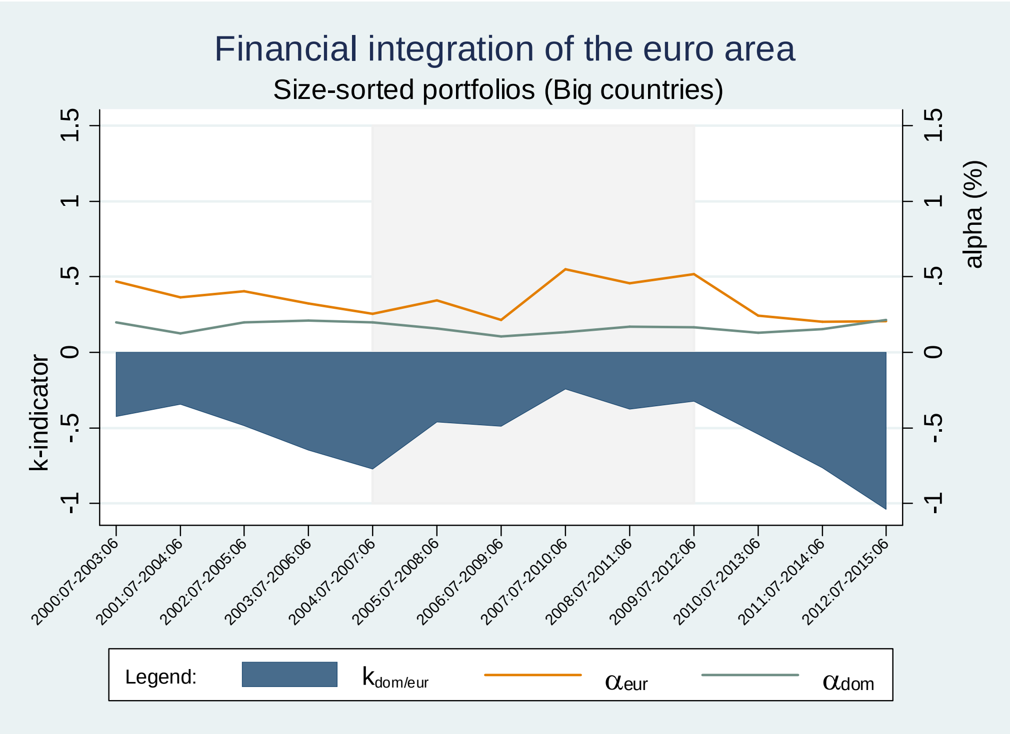
Figure 2

This figure shows the process of integration in the euro area, from asset pricing tests with portfolios sorted on size. The lines represent the alphas of the 3-year rolling regressions for the regional, or euro area, model (Equation 4) and the domestic model (Equation 7). The blue area represents the degree of financial integration (the larger the area, the more integration), which is the inverse of the k-indicator used in Figure 1.

Panel A: All countries



Panel B: Big countries



Panel C: GIIPS countries

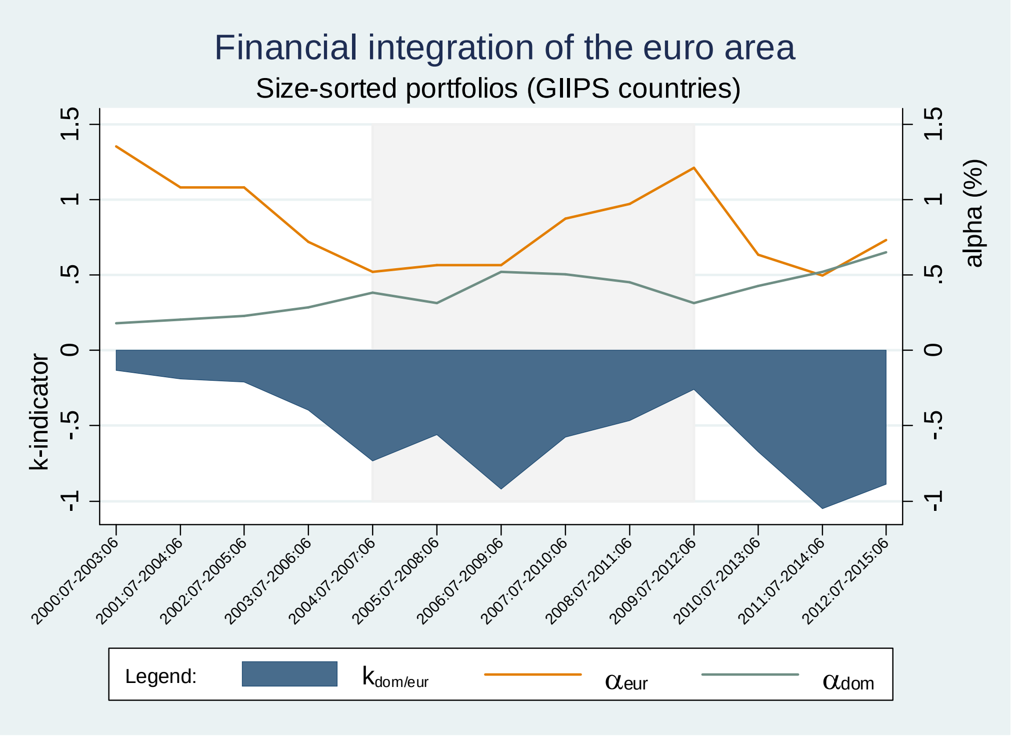
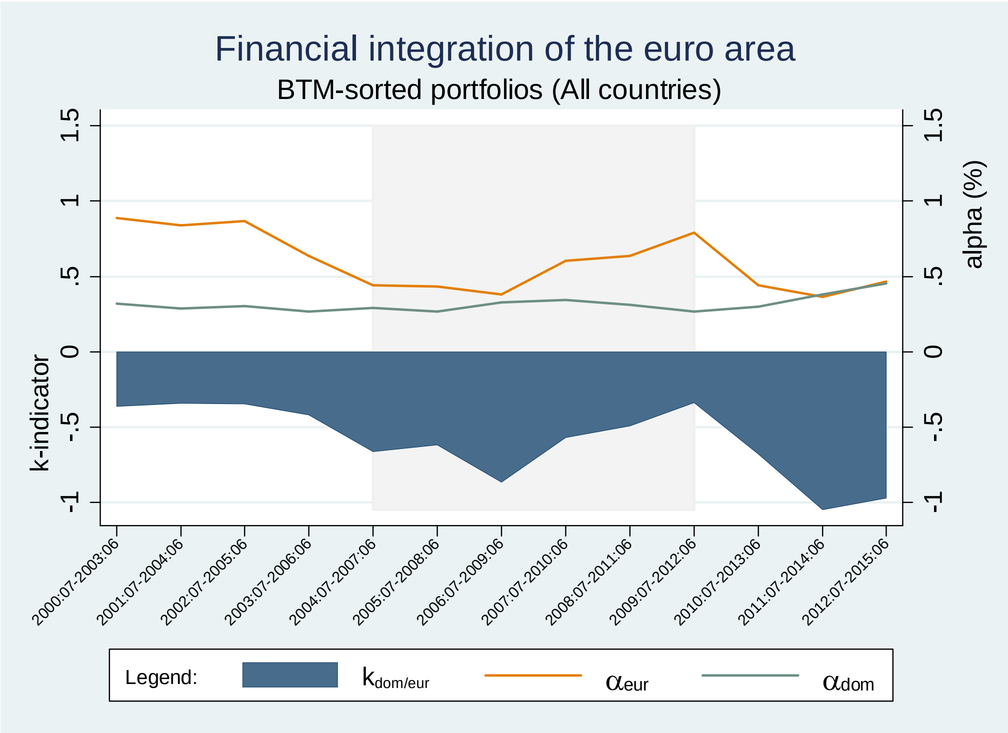


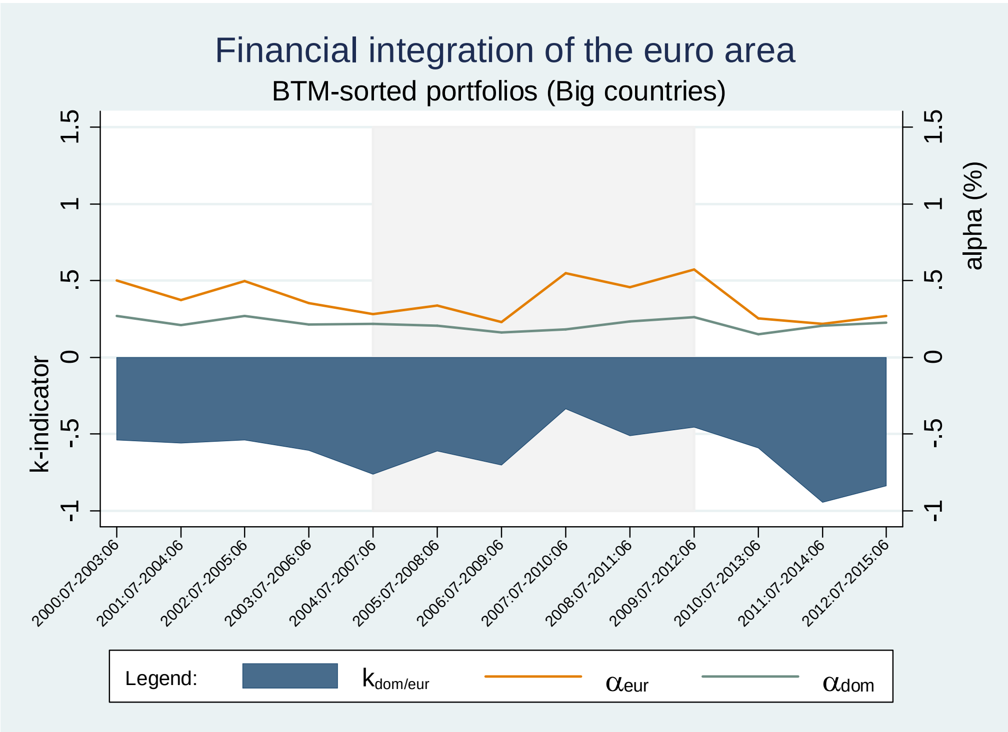
Figure 3

This figure shows the process of integration in the euro area, from asset pricing tests with portfolios sorted on book-to-market (BTM). The lines represent the alphas of the 3-year rolling regressions for the regional, or euro area, model (Equation 4) and the domestic model (Equation 7). The blue area represents the degree of financial integration (the larger the area, the more integration), which is the inverse of the k-indicator used in Figure 1.

Panel A: All countries



Panel B: Big countries



Panel C: GIIPS countries

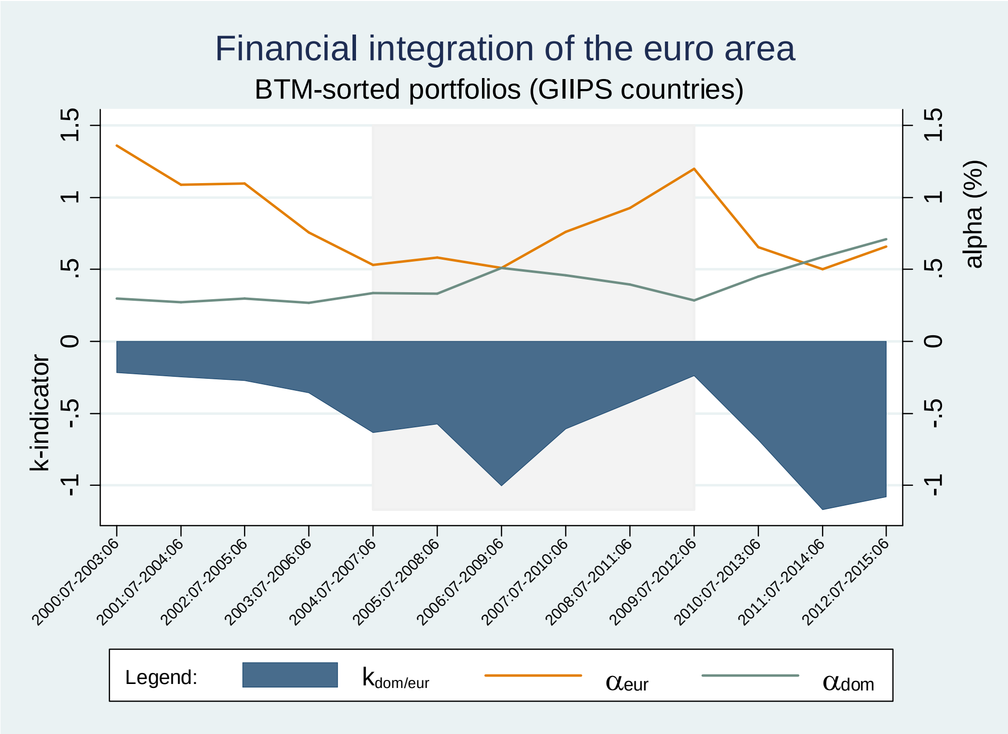
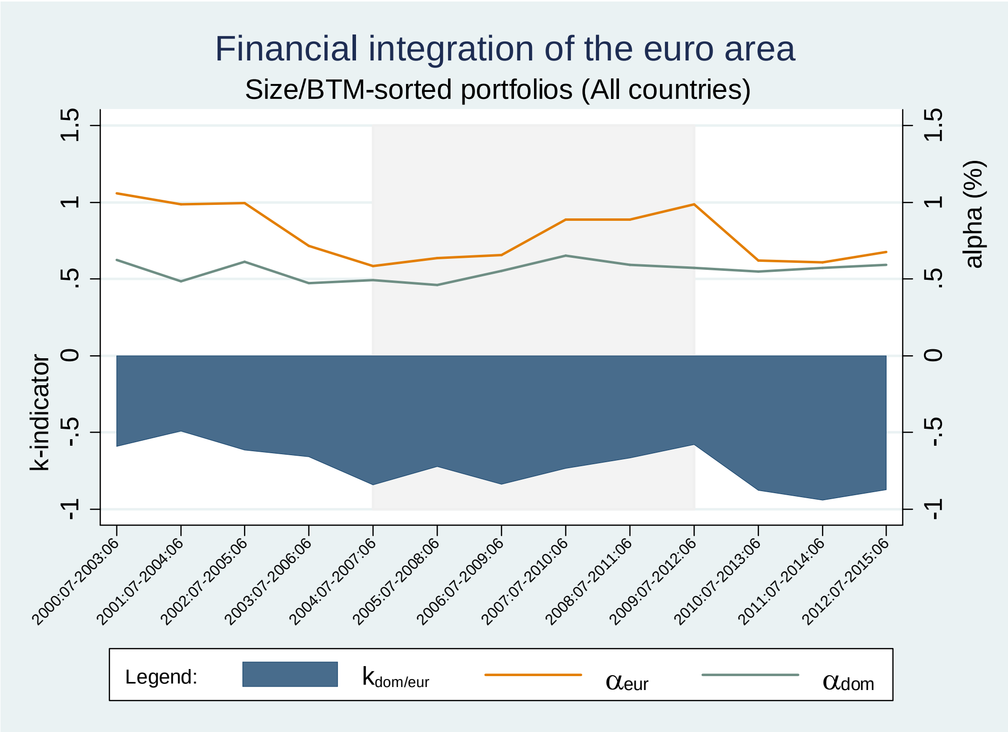


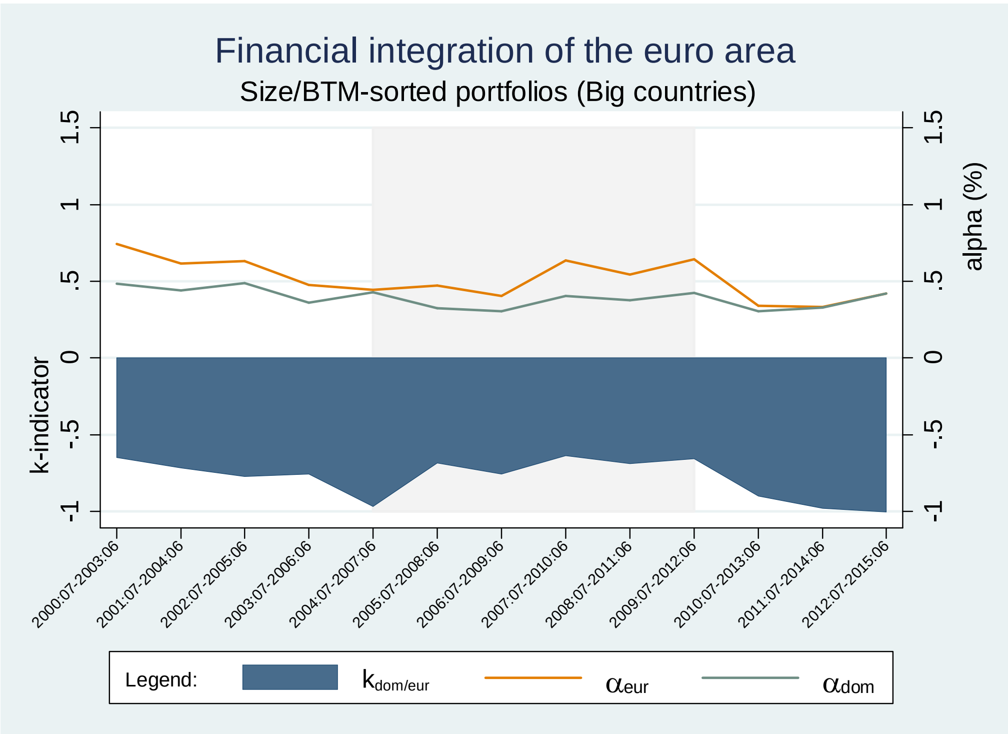
Figure 4

This figure shows the process of integration in the euro area, from tests with portfolios sorted on size and book-to-market (independent sort). The lines represent the alphas of the 3-year rolling regressions for the regional, or euro area, model (Equation 4) and the domestic model (Equation 7). The blue area represents the degree of financial integration (the larger the area, the more integration), which is the inverse of the k-indicator used in Figure 1.

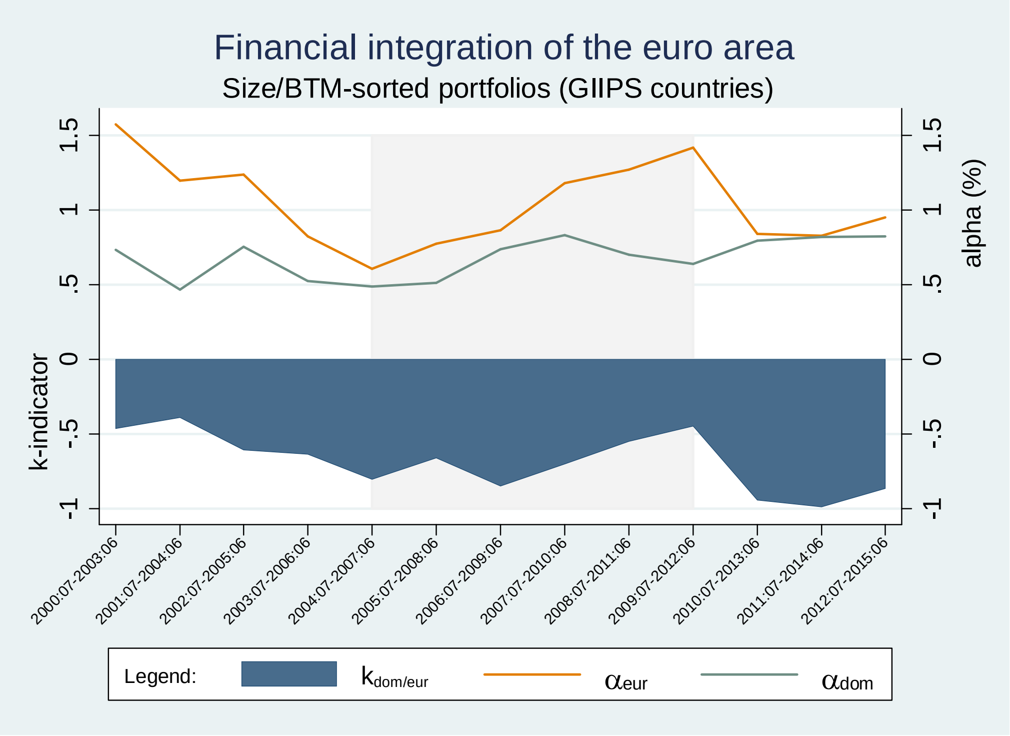
Panel A: All countries



Panel B: Big countries



Panel C: GIIPS countries



Appendix

A.1 Data selection and screening

The constituent lists I use to compile the sample of euro area stocks are reported in Table A.1. These lists in total contain 25615 International Security Information Numbers (ISINs). For comparison, I also download the DS Total Market constituent lists for the 11 countries, and find that all countries in these lists are included in the larger sample. Results for summary statistics on this DS Total Market sample also lead to approximately equal averages. I run a number of static and dynamic checks proposed by Ince and Porter (2006) and Smidt et al. (2014).[17] They compare stock price data retrieved from CRSP and Datastream, and find that there can be errors and large deviations in the numbers.

For the static checks, I keep only the domestic stocks (GEOGC) which are of the equity type (TYPE), are indicated as a major listing (MAJOR) on the domestic exchange, and are denominated in euro.[18] I also drop all American Depository Receipts from the sample and exclude suspended stocks because these are not traded. After these static checks, 5071 firms remain. A quick comparison with the DS Total Market constituent lists shows that 4094 firms are left from these lists.

There are errors in the time-series data which I need to check and need to correct for. I remove observations which have a missing adjusted price, an unadjusted price above one million euro or (for the whole sample) a price below the 5th percentile. Returns above 990% (as calculated from the total return index) are set to missing, and a high return (greater than 300%) which is reversed in the next month is set to missing as well. I drop the portfolio year for a firm with more than two zero return months in a portfolio year, following Lee (2005). I delete some firms by hand, if they show strange patterns (not explained by news events). Ince and Porter (2006) and Smidt et al. (2014) both mention errors in the dividend data for European companies. I find the same when observing the dividends, but by comparing the price index (which excludes re-investment of dividends) and total return index (which includes the re-investment of dividends) for that period I observed no strange patterns, so I am confident to use the total return index retrieved from Datastream to calculate the stock returns. After also removing firms which in the end have less than 12 observations in total, I end up with 4434 unique stocks (based on their ISIN), which are on average in the sample for 146 of the 180 months (July 2000-June

[17] Do-files containing all codes for the thesis, including the data screening, are available upon request. For a detailed description of the companies lost at each criterion, see Table A.2.

[18] As this is an important selection to test the regional integration in the EMU, I checked the firm names of the Dutch firms by hand to ensure I use the correct country selection method.

2015). Thus the analyses are performed with 437,710 firm months in total. For a more detailed description of the companies lost with each criterion, see Table A.2.

Table A.1 - Constituent lists

Country	Constituent lists
Germany	WSCOPEBD, FGER1, FGER2, DEADBD1-6
Belgium	WSCOPEBG, FBDO, DEADBG
Spain	WSCOPEES, FSPN, DEADES
Finland	WSCOPEFN, FFIN, DEADFN
France	WSCOPEFR, FFRA, ALLFF, DEADFR
Greece	WSCOPEGR, FGREE, FGRMM, FNEXA, DEADGR
Ireland	WSCOPEIR, FIRL, DEADIR
Italy	WSCOPEIT, FITA, DEADIT
Netherlands	WSCOPENL, FHOL, ALLFL, DEADNL
Austria	WSCOPEOE, ALLAS, DEADOE
Portugal	WSCOPEPT, FPOM, FPOR, FPSM, DEADPT

Table A.2 - Data definitions

DSCODE	Description
Panel A: Time-series data	
AP	Official closing price, adjusted for capital actions.
UP	Unadjusted price, actual or 'raw' closing price.
NOSH	Number of ordinary shares outstanding
VO	Turnover by volume, number of shares traded for a stock on a particular day.
RI	Total return index, assuming re-invested dividends
WC05102	Gross-dividend used in the calculation of the return index of Datastream
WC03501	Common equity (book equity)
MV	Datastream calculation of share price times number of ordinary shares in issue.
OIEUR3M-IR	Euro overnight indexed swap rate series.
TOTMK**	Datastream Total Market indices for the specific two letter country alpha code.
Panel B: Static data	
TYPE	Type of instrument (must be EQ - Equity)
WC06100	Entity type (cannot be ADR)
MAJOR	Major security flag, indicating most significant security in terms of market value and liquidity
EXNAME	Exchange name, source of the price datatypes for a given equity
GEOGC	Geographical classification of a company, specifying the home country of a security
WC07015	Inactive date
ISINID	Primary/secondary flag, indicating the domestic listing

Table A.3 - Detailed Screening

Variable	Condition	Firms deleted	Firms left
Panel A: Static checks			
			25601
CURRENCY	No euro currency	18612	6989
TYPE	Equity type	1149	5840
MAJOR	Major listing	424	5416
ISINID	Primary listing	110	5306
GEOG	Domestic stock	153	5153
BOURSENAME	Domestic exchange	7	5146
ENTITY	No ADRs	1	5145
SUSPENDED	Suspended status	74	5071
Panel B: Dynamic checks			
No data	Datastream did not return stock price data in the time-series request	88	4983
AP	If the adjusted price (unpadded) is missing or above €1,000,000	58	4925
UP	Remove 'penny' stocks (stocks with a maximum UP lower than €1 over the whole sample)	57	4868
RI	Returns above 990% are set to missing Return reversals are set to missing Maximum three zero-return months per portfolio year accepted	5	4863
MV	Market value is missing	2	4861
VO	Maximum trading volume in total sample period is lower than the 5% percentile	271	4590
RANDOM	Random checks of individual firms, which show strange or unexplained trends, and therefore are excluded from the sample	11	4579
MISSING_RET	If more than three months per portfolio year have a missing return, that year is dropped	13	4566
MAX_OBS	Constructed variable indicating firms with less than 12 observations in the sample	132	4434
Total			**4434**