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Evidence of Stock Market Integration and Short-Term Active Portfolio Opportunities in the EMU Countries With a Gaussian Markov-Switching Test

Evidências da Integração do Mercado de Ações e Oportunidades Ativas de Portfólio de Curto Prazo nos Países da UEM Com um Teste Gaussiano de Mudança de Markov

Oscar De la Torre-Torres
oscar.delatorre.torres@gmail.com
Saint Nicholas and Hidalgo's, Michoacán State University -UMSNH, Morelia, México

José Álvarez-García
pepealvarez@unex.es
Financial Economy and Accounting Department
Faculty of Business, Finance and Tourism, University of Extremadura, Cáceres, Spain

Evaristo Galeana-Figueroa
e_galeana@hotmail.com
Saint Nicholas and Hidalgo's, Michoacán State University -UMSNH, Morelia, México

Abstract/ Resumo

In this paper we tested, with a two-regime Gaussian Markov-switching model, the weekly performance of the euro valued MSCI EMU index and the MSCI EMU indices that exclude each country member. We did this in order to test the long-term market integration and to identify potential short-term opportunities for active portfolio management activities. Our results suggest that even if the EMU stock markets are integrated in the long-term, when we filter the data in two regimes (one for normal time periods and another for crisis ones) we found strong evidence in favor of active portfolio management activities by potentially increasing the portfolio performance if we exclude Finland, Italy, Spain and Portugal in normal time periods and Italy, Spain, France and Finland in the crisis ones. This last result is of interest because France is the second biggest EMU economy and, as Finland, is not considered a "peripheral" country.

Neste artigo, testamos, com um modelo Gaussiano Markov de comutação de dois regimes, o desempenho semanal do índice MSCI EMU avaliado em euro e os índices MSCI EMU que excluem cada país membro. Fizemos isso para testar a integração de longo prazo do mercado e identificar possíveis oportunidades de curto prazo para atividades ativas de gestão de portfólio. Os nossos resultados sugerem que, mesmo que os mercados de ações da EMU sejam integrados no longo prazo, quando filtramos os dados em dois regimes, um para períodos normais e outro para períodos de crise, encontramos fortes evidências em favor de atividades ativas de gestão de portfólio, potencialmente aumentando o desempenho da carteira se excluirmos a Finlândia, Itália, Espanha e Portugal em períodos de tempo normais e Itália, Espanha, França e Finlândia em períodos de crise. Este último resultado é interessante, porque a França é a segunda maior economia da UEM e, tal como a Finlândia, não é considerada um país "periférico".

Keywords: Markov-Switching models; Active portfolio management; financial market integration; EMU stock markets integration

Palavras-Chave: Desindustrialização, Cidade Pós-industrial, Península Ibérica, Barreiro, Novos Espaços Industriais, Políticas para espaços industriais.

*JEL Codes***:** C24; C58; G14; G15

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1. INTRODUCTION

Portfolio theory is based in the assumption that a wide and well-diversified portfolio is preferable to a less diversified and smaller one (in terms of number of assets) or sub-set. Thanks to the pioneering work of Markowitz (1959; 1952), Sharpe (1963, 1964), Tobin (1958) and Lintner (1965), the asset management industry had an explosive evolution and nowadays is one of the main basis of the financial industry. Given this theoretical evolution, a wide practice is the construction of portfolios that must track or at least be benchmarked with theoretical market portfolios or indexes. Following this, one of the most widely used practices in portfolio management is "passive management" through index or market portfolio tracking that consist in closely following the performance of a selected market index. As a theoretical example, an investor who wants to invest part of her capital in European stocks (as the case studied in this paper) could follow a stock index that models the performance of the most representative companies in the continent, and compare her investment results against that benchmark portfolio (or index). This practice, along with active portfolio management that seeks to create *alpha* or "extra" returns from the market portfolio or index, is one of the issues of interest for us in this paper. More specifically, we want to test if the Morgan Stanley Capital International (MSCI) European Monetary Union (EMU) index is well diversified or if is possible to exclude one specific country member in order to enhance the performance of an Euro based investor[1].

The definition of the market portfolio is an issue of wide theoretical and practical discussion by the fact that the theoretical definition of this portfolio is not clear, given the heterogeneous investment goals and expectations among investors[2]. Sorting this issue, the assumption of a "proxy" with a market index is acceptable[3] if this index is a good representation of the performance of the entire market or the investment assets set for the portfolio manager. This is, in part, what we want to test for the MSCI EMU index versus the MSCI EMU indexes that exclude each of the EMU members.

Given this need of defining a proper market index, several well-known companies have developed important stock indexes[4] for the financial industry. They do this in order to give a statistical performance of their corresponding markets. One of the most well-known ones is Morgan Stanley Capital International (known nowadays as simply MSCI). This American financial data provider measures the performance of stock markets around the world and also publishes the performance of a world index (the MSCI world index) that is a proxy of the entire performance of a "world portfolio". There are also other well-known rating and index companies such as the Financial Times, Markit, Stoxx or Standard & Poors-Dow Jones that offer similar indexes. We have decided to choose MSCI by the fact that its global and regional stock indexes are the most used in the portfolio management industry and also because the MSCI world and MSCI EMU are among the most used equity benchmarks (Maggin, Tuttle, Pinto, and McLeavey, 2007, pp. 734–735).

Following this practice for global diversification in the portfolio industry, MSCI Inc. and Standard & Poors Dow Jones indexes developed a methodology known as Global Investment Classification Standard (or GICS). They did this in order to measure indexes that are representative, well diversified and not-overlapped in the industry classification. This issue leads MSCI to develop the Global investable market indexes methodology (MSCI Inc., 2018b) that included the calculation of the aforementioned MSCI World index and some other regional indices (sub-indices) such as the ones of Europe

[1] In brief we will discuss the theoretical motivations of this paper. Please refer to section 2.1 for this last purpose.

[2] Contrary to a core assumption in Sharpe's (1963,1964) proposal and his so-called Capital Asset Pricing Model or CAPM, that assumes that all the investors have homogeneous expectations and a high degree of informational efficiency.

[3] As Roll (1977) and Roll and Grauer (2001) suggest.

[4] The type of security of interest in this paper.

(with the EMU index of interest herein), North-America or Asia-Pacific stock (just to mention some of them).

The rationale in our paper is: if we show no evidence of mean-variance loss between each MSCI EMU indexes that exclude each country members against the MSCI EMU (all country members), we will show the benefits of diversification in this particular case. In the contrary case, if we find no statistical difference, we will find evidence of close market correlation (that means financial markets integration) and no diversification benefits in the developed EMU countries.

We also want to test the mean-variance efficiency of the studied indices in a two-regime scenario because even if we find evidence of integration in these markets, we want to identify potential short-term investment opportunities. As a given example, we want to identify if there is a potential loss-reduction or mean-variance increase if we exclude a given EMU country during crisis periods or enhance the potential profits in the portfolio by excluding another one in normal periods.

Therefore, our main goal herein is to determine if there is a degree of integration in the EMU stock markets and to determine if, despite this, there are some potential short-term opportunities for active portfolio management.

Once we have presented our two main goals in this paper, we will present, in the next section, a literature and theoretical review that relates and motivates the present paper. In the next section where we will discuss how did we process the MSCI stock EMU indexes data and the main results found in our tests. Finally, in the last section, we will conclude and we will suggest the potential extensions and applications of our results and findings.

2. LITERATURE REVIEW

2.1 The theoretical motivations of this paper: a brief portfolio theory review

Previous to the literature review, we want to give a brief introduction to the math and geometry of portfolio theory. This in order to give a stronger support of the rationale behind our test.

Portfolio Theory started with the pioneering work of Markowitz (1959; 1952) in which, given an investment level vector $\mathrm{w} = w_i$ with the investment proportions in each asset w_i, an expected asset returns vector $r = [\overline{r_i}]$ and a covariance matrix[5] $\mathbf{C}$, the expected return E_P and risk exposure σ_P in a portfolio can be estimated with the next expressions respectively:

$$E_P = \mathrm{w}'\mathrm{r} \quad (1)$$
$$\sigma_P = \sqrt{\mathrm{w}'\mathrm{C}\mathrm{w}} \quad (2)$$

Departing from these two portfolio parameters[6], an interesting feature of C is the potential presence of some negative covariances (given their corresponding negative correlations). This feature is a very important one for potential portfolio risk reduction and shows the benefits of a diversified investment strategy. That is, if there are enough negative covariances, given an enough large number (N) of securities in the portfolio, the portfolio risk σ_P will reduce as N increases.

Departing from this seminal idea (that developed the field of Financial Economics and the investment industry), it is of interest to invest in a large number of securities in which some covariances should be negative. Therefore, if a given security is not included in the portfolio and it happens to be one with negative covariances, there could be a potential performance reduction and also a potential mean-variance (risk-return) efficiency loss. In order to show this effect, we simulated 30 theoretical assets with 250 multivariate Gaussian realizations, and we calculated the expected return **r** and covariance C matrix as in (1) and (2). Following this, we determined the efficient set, that is the set of all the feasible portfolios[7] in which each portfolio has the lowest risk level σ_P, given a portfolio return $E_P^* \in [\min(\mathrm{r}), \max(\mathrm{r})]$. This efficient set is represented with a red set o point[8] in Figure 1, along with the 30 simulated securitie tie

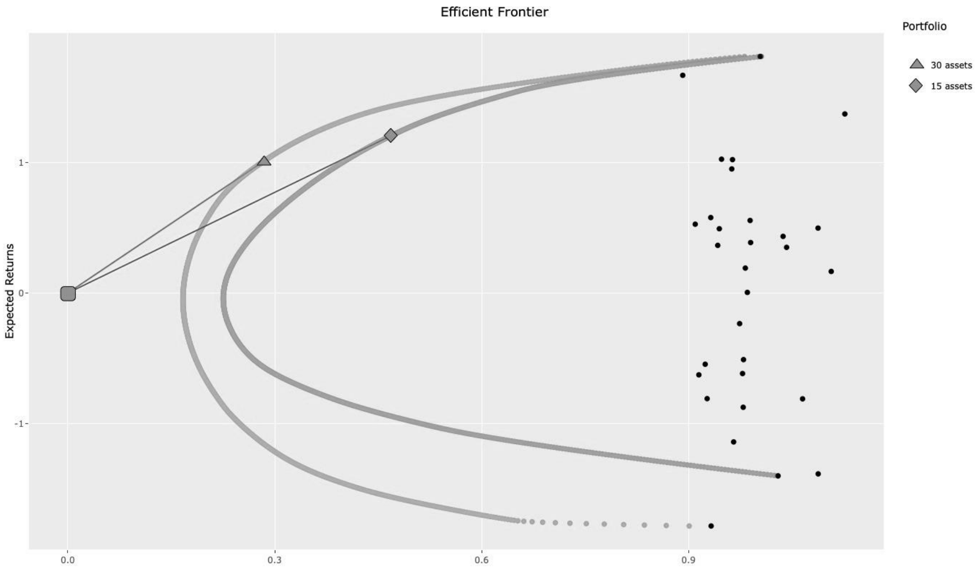
[5] With the variance σ_i^2 of each asset in the diagonal and the covariance $\sigma_{i,j}$ of each pair of assets in the non-diagonal entrances.

[6] Even though Markowitz (1952) didn't suggested a specific multivariate function to model this multivariate phenomenon, these parameters are closely related with the ones of a Gaussian or elliptic multivariate probability density function.

[7] Given a max and minimum investment level for **w**, determined in the investment policy.

[8] This graphical representation of the efficient set is known as the efficient frontier in Portfolio Theory.

Figure 1. The mean-variance efficiency of two simulated efficient frontiers (sets) with 30 and 15 securities in which the subset is the less efficient and pays no short-term alpha.



Source: Own elaboration.

As noted in that figure, by investing in several portfolios that fulfill the previous risk-return restriction, there is an observed risk reduction (the x axis shows the simulated level of risk σ_P and the y axis, the expected return one or E_P^*). Also, by following Tobin's (1958) two-fund separation theorem for asset pricing, we present the Security Market Line (SML) in which we relate the tangency portfolio (A) with a theoretical 0% risk-free asset (rf). The SML is a line that shows all the risk and return levels achieved by the investor, given an investment level (Ω) in A and the one ($\Omega - 1$) in rf. As noted, the optimal portfolio selection reduces to first determine the efficient set and then, from this set of portfolios, to determine the tangency portfolio (A) that has the highest slope in its SML. This slope is known as the Sharpe (1966) ratio (SR) and is calculated given the risk-free asset return rf, the expected portfolio's return E_P and the portfolios risk exposure σ_P, as follows:

$$SR = \frac{E_P - rf}{\sigma_P} \quad (3)$$

Once that the tangency portfolio is determined, the investor must decide, in a second step and given a personal utility function, how much of her capital (Ω) will invest in the tangency portfolio A and how much will she left in the risk-free asset rf.

By following Sharpe (1963, 1964) and Lintner's (1965) assumption of homogenous expectations and information among investors, it could be theoretically accepted that portfolio A is hold by all the investors in the market and this portfolio is the same for all. Therefore, A could be understood as the market portfolio that, as Roll (1977) and Roll and Ross (1994) suggest, can be proxied with a public acceptable and replicable stock index or benchmark (2007). Therefore, this type of index can be used for a passive investing strategy (index performance replication) or as a benchmark for active investing. This in order to create "alpha" or extra returns from the index.

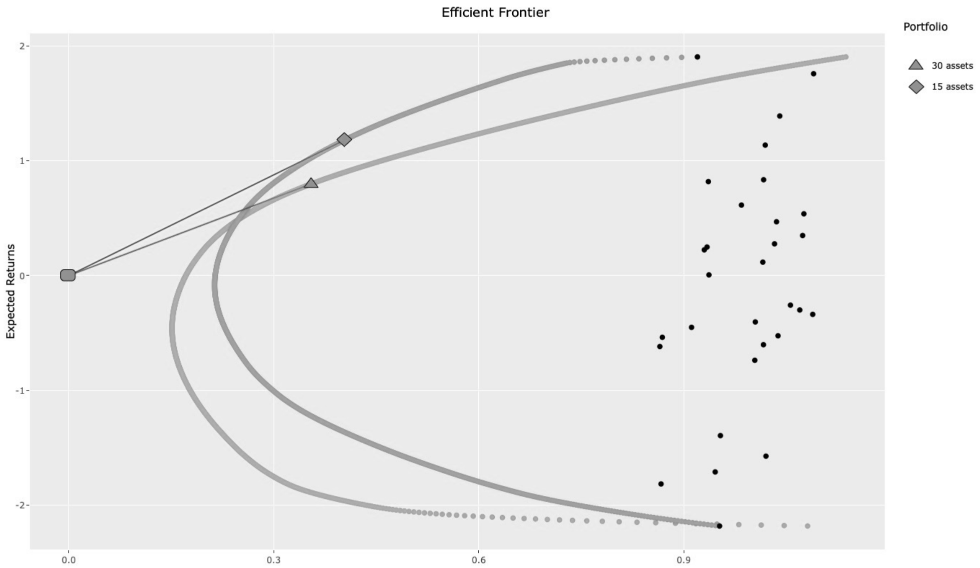
An interesting feature that we show from the simulation of Figure 1, is that we made another portfolio or subset with 15 securities instead of the 30 original ones. As noted, the corresponding efficient set (the blue efficient frontier) has lower risk-return or mean-variance efficiency, leading to a risky or market portfolio with a lower Sharpe ratio than the one of the original set. As noted, this subset, given a lower diversification and the reduction in the number of negative covariances, has a poorer risk-return tradeoff than the 30 assets original set.

Despite this, there is a short-term possibility, given de security selection, that a portfolio subset could present a better risk-return relation, leading to a better (even if is less diversified) performance than the wider and more diversified 30 assets portfolio. This is shown in the simulation of Figure 2.

Departing from this theoretical motivation, we want to test if, from an euro based perspective, there is either a worst, better or equal performance in a portfolio that excludes a given country from the MSCI EMU index. That is, we want to test if the exclusion of Germany or Portugal (as a given example) from the MSCI EMU has an impact in terms of mean-variance efficiency or not.

Why should we expect that there is no impact if we exclude one of these countries from the MSCI EMU index? Because that result could show a degree of financial markets integration and, therefore, no diversification benefit in the full MSCI EMU portfolio. Another reason for expecting this result is the fact that one portfolio could have assets that move in the same direction (positive or negative) together in bad-performing or "crisis" times[9] and assets that have a heterogeneous performance that offset the losses of other securities in normal ones.

Figure 2. The mean-variance efficiency of two simulated efficient frontiers (sets) with 30 and 15 securities in which the subset is the more efficient and pays short-term alpha.



Source: Own elaboration

For these key reasons, it is useful to test if the Euro based investor has a properly diversified portfolio with the MSCI EMU index and, if not, if there are some short-term opportunities for active portfolio management.

2.2 Academic literature that motivates this paper

Among the several test made herein, we used a two-regime Markov-switching filter. The reason of this is because a well-known result in finance (portfolio management) is the aforementioned degree of integration in the financial markets around the globe. A first study that deals with the downside effects of integration between markets and the impact in the correlation levels in distress periods, is the one of Ang and Bekaert (2002). They study an internationally diversified portfolio with Markov-switching covariance matrixes, showing more evidence of higher correlations, among assets and countries in a U.S. investor perspective. Their study and conclusions are based in the results of Ang and Chen (2002) who find evidence of higher joint downside movements between U.S. stocks and the U.S aggregate market. This quantitative issue, along with the degree of market integration has led to a reduction in the diversification and show that the negative covariances in (2) are smaller in magnitude or even positive in crisis periods, leading to a lower risk reduction and a lower mean-variance efficiency in the performance of the portfolio. A first study that deals with this issue with an international stock markets perspective is the one of Baele and Inghelbrecht (2008). These authors found evidence of a convergence in the performance

[9] That is, for the purpose of this paper, when markets and the economic conditions behave properly, and the price movements are behaving in a stable manner.

of different markets (especially among the European ones), due to the aforementioned integration between them. Even though they found this convergence, they still give evidence in favor of the international diversification practices in the portfolio selection process. Following the European case, Wang and Moore (2008) test the level of integration of the three central eastern Europe stock markets (Czech Republic, Hungary and Poland) between them and with the EMU countries by using a Dynamic Conditional Correlation-Generalized Autorregresive Conditional Hetersokedasticity (DCC-GARCH) correlation model with data from 1994 to 2006. In their results they found evidence of higher correlations during distress periods (due to external shocks) in the studied markets and found strong integration of these three markets with the EMU ones either in normal or crisis times.

Also Chiou (2009) test, from a U.S. perspective, the benefits of international diversification with investment level restrictions by using the monthly returns, from 1988 to 2005, of 34 stock indexes. From these 21 are indexes of developed countries and 13 of developing ones. The results show that the inclusion of restrictions is beneficial to U.S. investors and that also international diversification is of use. In a similar fashion to Baele and Inghelbrecht (2008), we found the work of Égert et. al. (2011) that study the co-movements of France, Germany and the U.K. stock markets (as European developed countries) and the Czech Republic, Hungary and Poland (as emerging European stock markets) with 5-minute intraday data from 2003 to 2006. By using a bivariate Generalized Autorregresive Conditional Hetersokedasticity (GARCH) model, they tested for the level of European integration and they found that the integration is strong only in the European developed markets (a result that is in line with our paper) and they found no-intraday integration in the developing ones.

They also found no synchronization in the movements between the studied emerging markets and the developed ones, due to local innovation and not due to transferred swings. This result, as they suggest, could lead to a short-term diversification benefits that are prone to disappear with the future development of these emerging markets and the integration of these countries to the Euro zone. This last paper and also the one of Baele and Inghelbrecht (2008) are a starting motivation for this paper because we want to focus our attention in the EMU developed countries, in order to know if this integration is observed in a EMU portfolio in times of calm (normal periods) and also in crisis ones. Also the paper of Chiou (2009) is a motivation of the present paper because even if we find evidence of strong integration in the developed markets of the EMU zone, we want to identify potential short-term investment opportunities in normal or crisis periods for active portfolio management.

In a similar motivation but focused in the European Government bond markets, we found the work of Abad, Chuliá and Gómez-Puig (2014) who tested the level of integration that the non-EMU, the new-EU countries (Czech Republic, Hungary and Poland), the non-EMU (Denmark, Sweden and U.K.), the peripheral EMU developed countries (Greece, Italy, Ireland, Portugal and Spain) and the developed EMU central ones (Austria, Belgium, Finland, France and the Netherlands) have with the Government bond market of Germany. Their results, that use Bekaert and Harvey's (1995) Capital Asset Pricing Model (CAPM), suggest that the integration of the eurozone depend of some domestic factors (relative to Germany) and found that the integration to Germany is stronger in the EMU countries (an issue that we also found in our results). They found also that, since the crisis in 2007, the non-EMU countries (especially the non-EU ones) reduced their integration level and the EMU ones preserve it, especially the peripheral ones (a result that we in part contradict for the stock markets case, given our two-regime test).

These last three aforementioned works are an important reference and motivation of the present one by the fact that they study the integration and co-movements between EMU markets and because they find evidence of it during the crisis or bad-performing time periods. Despite their results, these works do not test the level of integration with an asset exclusion in the portfolio management perspective during normal and crisis time periods. Also none of them try to identify short-term opportunities that would represent the exclusion of a given country from the EMU portfolio, an issue that we do test here as an extension of these previous works.

From another Markov-switching perspective, we mention de paper of Aslanidis, Christiansen and Savva (2016) who follow a similar Euro and U.S. Markov-switching macro factor model as in Abad, Chuliá and Gómez-Puig (2014). The key difference is that they apply the test to the stock markets of Germany, France, Italy and the U.K. They also found evidence of some level of integration by the fact that the risk-return trade-off is negative for the European markets in normal times and less weak in crisis or "unusual" times.

This last result is one that we want to extend for the entire EMU countries in Table 2 by testing, from an euro based investor perspective in normal and in crisis time periods, the mean-variance impact if we exclude a given EMU country from the MSCI EMU index. The core idea is that if there is no integration among EMU countries, the exclusion in the portfolio of countries "in troubles" (as was the case of Italy, Portugal or Spain) could lead to an improvement in the EMU stock portfolio performance. If we find no significant change in the performance and mean-variance efficiency, we will find signs of stronger integration and no potential short-term opportunities for active portfolio management activities.

3. EMPIRICAL TEST

3.1. Data processing

Before we describe how the index data will be processed, we want to mention why did we test the MSCI EMU family index and why did we test only the developed countries of the EMU area. As a starting point, we previously mentioned that we chose the MSCI index family by the fact that is one of the most used for international asset allocation and performance measurement. A departing definition of need herein is the one of the developed country, a term that can be understood in different manners in different Economic or Financial contexts. In Table 1 we present the criteria used by MSCI in order to define what is a frontier, a developing and a developed country.

Departing from these criteria, we will test the performance of the EMU countries that are considered developed ones. That is, those that are mentioned in Table 2. The MSCI EMU index, for the purpose of this paper and the European investment industry, is understood as a well-diversified EMU portfolio and we want to test, as the main goal of this paper, that the exclusion of one of the countries of Table 2 in the MSCI EMU portfolio has a significant impact in terms of performance and mean-variance efficiency. We perform our test by filtering the risk-return efficiency results in "normal" (or "good-performing") and "crisis" (or "bad-performing") time periods in the EMU stock markets.

A necessary methodological (an theoretical) note at this point is the fact that, following Brooks and Persand (2001), Ang and Bekaert (2002, 2004), Alexander and Dimitriu (2005), Kritzman, Page and Turkington (2012) and Hauptman et. al. (2014), it will be understood in this paper a "crisis", or "bad-performing" time period ($s = 2$) as one that shows a high volatility or standard deviation level and (as theoretically expected) a lower or even negative expected return or mean[10]. This in comparison to the observed levels in a "normal" or "good-performing" times ($s = 1$).

In order to test if there is a significant impact in the performance and mean-variance efficiency in the studied indexes of Table 2, we used the weekly historical Euro price $P_{i,t}$ time series data from October, 11, 1999 to April 30, 2018 (a total of 968 weeks). With these historical prices we calculated the continuous time percentage variation with the next expression:

$$r_{i,t} = \ln(P_{i,t}) - \ln(P_{i,t-1}) \quad (4)$$

With this return time series we calculated the location and scale parameters (mean μ_i and standard deviation σ_i) an also the single regime Gaussian log-likelihood function:

$$LLF_{single} = -\sum_{t=1}^{T} \ln\left[\frac{1}{\sqrt{2\pi}\sigma_{s=i}} e^{-\frac{1}{2}\left(\frac{r_{i,t}-\mu_{s=i}}{\sigma_{s=i}}\right)^2}\right] \quad (5)$$

In order to test the performance in a good-performing (normal) and a bad-performing (crisis) scenario, we used a two-regime Gaussian Markov-Switching model or Hamilton's (1990; 1989) filter, where $\omega_{s=i}$ is a mixing law that determines the proportion of the data in the time series that corresponds to a given regime or state of nature ($s = i$) and the filtered probability $\xi_{s=i,t}$ of each realization being generated in that regime[11] at t:

[10] The proper economic or financial theoretical definition of "crisis" is set aside by the fact that is wide and heterogeneous among theorist. We present this definition because is in line with the financial portfolio performance and mean-variance efficiency concepts.

[11] In our tests in the present paper, we will use the Quasi-Maximum Likelihood suggested by Hamilton (1994) with the MS_Regress_Fit R code of Perlin (2018).

$$P(r_{i,t}, \theta_{s=i}) = \sum_{s=1}^{S} \omega_{s=i} \cdot \left[\frac{1}{\sqrt{2\pi}\sigma_{s=i}} \; e^{-\frac{1}{2}\left(\frac{r_{i,t}-\mu_{s=i}}{\sigma_{s=i}}\right)^2} \right] = \sum_{s=1}^{S} \omega_{s=i} \cdot \; \xi_{s=i,t} \tag{6}$$

Table 1. The market classification framework of MSCI and in the present paper

Panel a. Economic development			
Criteria	***Frontier market***	***Emerging market***	***Developed market***
Sustainability of Economic development	No requirement	No requirement	Country GNI per capita 25% above USD 12,476 during 3 consecutive years
Panel b. Market size and liquidity requirements			
Criteria	***Frontier market***	***Emerging market***	***Developed market***
Company size (full market cap)	USD 763 M	USD 1,526 M	USD 3,053 M
Security size (float market cap)	USD 65 M	More than USD 763 M	More than USD 1,526 M
Security liquidity	2.5% of Annual traded value ratio /1	15% of Annual traded value ratio	20% of Annual traded value ratio
Number of minimum companies following the previous criteria in the market	2	3	5
Panel c. Market accessibility criteria			
Criteria	***Frontier market***	***Emerging market***	***Developed market***
Openness to foreign ownership /2	At least some	Significant	Very high
Ease of capital inflows and outflows /3	At least partial	Significant	Very high
Efficiency of the operational framework /4	Modest	Good and tested	Very high
Competitive landscape /5	High	High	Unrestricted
Stability of the institutional framework	Modest	Modest	Very high
/1 The annual traded ratio is the ratio that scores the level of liquidity of a given stock. It is measured with the 12-month average of the monthly division of the median of traded value (number of stocks traded multiplied with the close price) with the free float-adjusted security market capitalization.			
/2 Is a collection of MSCI proprietary indicators that describe the level of foreign ownership freedom in a country.			
/3 Is a country level measure of the level of capital flow (either local or foreign).			
/4 Is a composite country indicator of the level of informational efficiency, market regulation strength and speed of investment accounts set up.			
/5 This indicator measures the level of restrictions to some investors (or all) to access stock exchange's or financial product's design information. It also includes the level in which global or regional financial products are not in breach with local market rules or laws.			
/6 The level in which the markets in the given country can be considered "free-markets" and how enforced and strong is the rule of law in a given country.			

Source: MSCI Inc. (2018b)

Table 2. The EMU country members considered as "developed", according to MSCI classification framework.

Name of the excluded country in the EMU index	***MSCI Europe Index ticker used in this paper***	***Start date in the time series used in this paper***	***Country GDP (in USD billions)***	***Participation (%) in developed EMU GDP***	***Has had a recent fiscal, political or financial distress?***
European monetary union (All EMU countries)	EMU	1999-07-06	USD 11,424.55	100.0000%	----
Germany	EMUexGER	1999-10-11	USD 3,477.80	30.4414%	No
France	EMUexFRA	1999-10-11	USD 2,465.45	21.5803%	No
Italy	EMUexITA	1999-10-11	USD 1,859.38	16.2753%	Yes
Spain	EMUexSPA	1999-10-11	USD 1,237.26	10.8298%	Yes
Netherlands	EMUexNTL	1999-10-11	USD 777.23	6.8031%	No
Belgium	EMUexBEL	1999-10-08	USD 467.96	4.0961%	No
Austria	EMUexAUS	1999-10-08	USD 390.80	3.4207%	No
Ireland	EMUexIRE	1999-10-11	USD 304.82	2.6681%	Yes
Finland	EMUexFIN	1999-10-08	USD 238.68	2.0892%	No
Portugal	EMUexPOR	1999-10-11	USD 205.18	1.7960%	Yes

Source: Own elaboration with data of MSCI (2018a) and the World Bank Group (2017).

The advantage of using Hamilton's (1989,1990) filter as in (6) is that, contrary to the Gaussian likelihood function given in (5), the investor can have two time-varying location and scale parameters (that is two means and two standard deviations) corresponding to each regime or state of nature. That means to have a mean $\mu_{s=1}$ and standard deviation $\sigma_{s=1}$ for the good-performing, low-volatility or "normal" time periods $(s = 1)$ and a corresponding mean $\mu_{s=2}$ and standard deviation $\sigma_{s=2}$ for the bad-performing, high-volatility or "crisis" ones $(s = 2)$.

Another advantage of using a two-regime Markov-Switching model as in (6) is that the investor can determine the probability $(\xi_{s=i,t})$ of being in a normal or distress time period at t and also, as another output, to infer a transition probability matrix P for $t + n$. This matrix is one of the key features of Markov-switching models because the model assumes that the two (or more) regimes behave as an unobserved Markovian chain or process. That is, $r_{i,t}$ can come from determined regime $(s = i)$ but the fact of coming from that regime can be modeled in a time series that behaves as an unobserved S-state Markov Chain with either a transition probability $p_{s=i,s=i}$ of staying in a given regime $s = i$ at $t + 1$ or to change to another regime $s = j$, $p_{s=i,s=j}$. With this in mind, the output parameter vector (θ) that we determined in the two-regime Markov-Switching model given in (6) is[12]:

$$\theta = \left[\mu_{s=1}, \mu_{s=2}, \sigma_{s=1}, \sigma_{s=2}, \xi_{\ s=1,t}, \xi_{s=2,t}, \mathbf{P}\right],\ \ \mathbf{P} = \begin{bmatrix} p_{s=i,s=i} & p_{s=i,s=j} \\ p_{s=j,s=i} & p_{s=j,s=j} \end{bmatrix} \qquad (7)$$

From this parameter vector, it is of special interest the mean and standard deviation values, along with the smoothed probabilities. This last parameter is of use because we will categorize a return (at t) as generated in a bad-performing or crisis time period if $\xi_{s=2,t}\ \geq 0.5$. With the likelihood function in (6), we will calculate the log-likelihood function as in (5):

$$LLF_{MS} = -\sum_{t=1}^{T} \ln\left[\sum_{s=1}^{S} \varpi_{s=i} \cdot \left[\frac{1}{\sqrt{2\pi}\sigma_{s=i}} e^{-\frac{1}{2}\left(\frac{r_{i,t}-\mu_{s=i}}{\sigma_{s=i}}\right)^2}\right]\right] \qquad (8)$$

Given the log-likelihood function LLF_{single} of the single regime time series (without regime differentiation) and the two-state Markov-Switching model LLF_{MS}, we will calculate Akaike's (1974), Schwarz's (1978) and Hannan-Quinn (1979) criteria in order to determine if the two-regime model is more appropriate than the single regime case.

Departing from this, we will compare the expected return or mean and risk (standard deviation) levels of each index and also we will compare the Markov-switching Sharpe (1966) ratios $(SR_{s=i})$, given the next expression and a risk-free asset (rf):

$$SR_{s=i} = \frac{\mu_{s=i} - rf}{\sigma_{s=i}} \qquad (9)$$

This ratio measures the level of expected risk premium $(\mu_{s=i} - rf\ )$ that an investor will achieve, given the risk exposure in her portfolio. Our position, in terms of expected return $(\mu_{s=i})$ and Sharpe ratio $SR_{s=i}$, is that there is no impact or change in the expected return and Sharpe ratio levels by the fact that there is no significant increase in the risk exposure if a given country is not included in the EMU portfolio. This as a result of the integration in the EMU markets. If we find differences in the Sharpe ratio observed in each regime, given the exclusion of a given country in the EMU portfolio, we will have strong evidence of short-term active portfolio opportunities.

3.2. Observed results

In table 3 we show the likelihood fitting (panel a) of the return time series of each index in a single and in a two-regime scenario by using the Akaike (AIC), Schwarz (BIC) and Hannan-Quinn (H-Q) information criteria, given the log-likelihood functions in (5)mand (8).

[12] The filtered probabilities $\xi_{s=i,t}$ are smoothed, given a smoothing algorithm suggested by Kim (1994), in order to reduce noisiness and instability in the analysis.

Table 3. Goodness of fit, location and scale parameters of the indexes in a single-regime and two-regime Gaussian scenario.

Panel a. Goodness of fit of a Gaussian single regime v.s. two-regime on						
Ticker	***AIC (single regime)***	***AIC (2 regimes)***	***BIC (single regime)***	***BIC (2 regimes)***	***H-QC (single regime)***	***H-QC (2 regimes)***
EMU	-4117.9583	-4327.5338	-4113.0831	-4317.7834	-4116.1025	-4323.8221
EMUexGER	-4135.79	-4337.3177	-4130.9148	-4327.5673	-4133.9342	-4333.606
EMUexFRA	-4106.1124	-4317.7773	-4101.2371	-4308.0268	-4104.2565	-4314.0656
EMUexITA	-4113.8096	-4318.4051	-4108.9344	-4308.6546	-4111.9537	-4314.6934
EMUexESP	-4111.4883	-4325.8805	-4106.613	-4316.13	-4109.6324	-4322.1688
EMUexNTL	-4108.4083	-4306.2778	-4103.5331	-4296.5274	-4106.5525	-4302.5661
EMUexBEL	-4106.0131	-4314.1831	-4101.1379	-4304.4327	-4104.1572	-4310.4714
EMUexAUS	-4117.4045	-4325.7506	-4112.5292	-4316.0001	-4115.5486	-4322.0389
EMUexIRE	-4113.2373	-4323.1577	-4108.362	-4313.4073	-4111.3814	-4319.446
EMUexFIN	-4131.2727	-4354.1392	-4126.3975	-4344.3888	-4129.4168	-4350.4275
EMUexPOR	-4111.1516	-4321.5848	-4106.2764	-4311.8343	-4109.2957	-4317.873
Panel b. Expected mean return and standard deviation in a single or two-regime scenario (expressed in %)						
Ticker	***Single regime mean***	***Single regime Std.Dev.***	***Good-performing mean***	***Bad-performing mean***	***Good-performing Std. Dev.***	***Bad-performing Std. Dev.***
EMU	(8) 0.0209	**(3) 2.8825**	(6) 0.1788	(7) -0.9343	**(4) 2.1939**	(6) 5.2802
EMUexGER	(11) 0.0128	**(1) 2.8561**	(11) 0.1673	**(1) -0.8300**	**(2) 2.1667**	(11) 5.0733
EMUexFRA	(10) 0.0148	(10) 2.9002	(9) 0.1699	(10) -0.9598	(10) 2.2118	**(1) 5.3800**
EMUexITA	**(1) 0.0262**	(5) 2.8887	**(1) 0.1899**	(9) -0.9514	(8) 2.2036	(9) 5.2504
EMUexESP	(7) 0.0209	(7) 2.8922	**(3) 0.1849**	(11) -0.9614	**(3) 2.1902**	**(4) 5.2968**
EMUexNTL	(6) 0.0212	(9) 2.8968	(10) 0.1695	**(2) -0.8544**	(11) 2.2195	(10) 5.2369
EMUexBEL	(9) 0.0208	(11) 2.9004	(8) 0.1771	**(3) -0.9259**	(9) 2.2100	**(2) 5.3108**
EMUexAUS	(5) 0.0212	**(4) 2.8834**	(7) 0.1787	(5) -0.9323	(5) 2.1966	(7) 5.2788
EMUexIRE	**(3) 0.0224**	(6) 2.8896	**(4) 0.1799**	**(4) -0.9277**	(6) 2.1978	(5) 5.2909
EMUexFIN	**(2) 0.0224**	**(2) 2.8628**	**(2) 0.1857**	(8) -0.9382	**(1) 2.1478**	(8) 5.2682
EMUexPOR	**(4) 0.0215**	(8) 2.8927	(5) 0.1792	(6) -0.9330	(7) 2.2005	**(3) 5.3037**

Source: Own elaboration with data from our analysis

As noted, in all the cases and in the three information criteria, the Gaussian two-regime stochastic process is more appropriate to model the performance of all the studied indexes. This lead to accept the use of Hamilton's (1989,1990) filter or Markov-Switching models in our analysis. In panel b of the same Table 3, we present the mean and standard deviation (risk exposure) in a single and two-regime context and the corresponding parameters in each regime. In the single regime case, it is noted that excluding Germany from the EMU index leads to the lowest risk level observed in the eleven indices (we marked the ranking of the parameter in parentheses). This result is in line with the ones of Abad, Chuliá and Gómez-Puig (2014) because we found (in a single-regime scenario) a strong influence of Germany in the EMU stock portfolio. The same issue is observed during normal or good-performing time periods where the exclusion of Germany in the EMU portfolio leads to the second-best risk reduction, preceded by the exclusion of Finland that is the first place in risk reduction in this regime. The result of the specific German case suggest us a strong integration of the EMU countries with Germany, but especially among them.

In order to confirm this last statement, we ran the single-regime OLS regression[13] with the functional form of (10). We used each of the indexes as dependent variable and the EMU index or portfolio as the market portfolio (regressor variable). We present the results of this estimation for the index with each excluded country index in Table 4.

$$\Delta\%P_{t,i} = \alpha + \beta\Delta\$P_{t,EMU} + \varepsilon_{t,i} \qquad (10)$$

Table 4. Index by index OLS regression with the EMU (all countries) as market portfolio (regressor).

Ticker	*α*	*β*	*P(α)*	*P(β)*	*H-K P(β)*	*R-squared*
EMUexGER	-0.0001	0.9851	Not significant	Significant at 1%	Significant at 1%	0.9885
EMUexFRA	-0.0001	1.0023	Not significant	Significant at 1%	Not significant	0.9924
EMUexITA	0.0001	1.0009	Not significant	Significant at 1%	Not significant	0.9975
EMUexESP	0	1.0013	Not significant	Significant at 1%	Not significant	0.9959
EMUexNTL	0	1.0026	Not significant	Significant at 1%	Not significant	0.9953
EMUexBEL	0	1.006	Not significant	Significant at 1%	Significant at 1%	0.9996
EMUexAUS	0	1.0003	Not significant	Significant at 1%	Not significant	0.9999
EMUexIRE	0	1.0013	Not significant	Significant at 1%	Not significant	0.9978
EMUexFIN	0	0.9912	Not significant	Significant at 1%	Significant at 1%	0.9961
EMUexPOR	0	1.0035	Not significant	Significant at 1%	Significant at 1%	1.0000

Source: Own elaboration with data from our analysis.

As noted, the exclusion of each country in each EMU index does not create alpha (non-significant α values) or extra returns by excluding the mentioned country in the ticker. On the other hand, the β values are significant even at a 1% of probability (the probability of being 0 in another sample is lower than 1%), confirming the strong relation that the full EMU portfolio, as a set, has with each portfolio or EMU subset, giving proofs of integration in the EMU country members in the EMU index. As a more robust test of the level of integration, we ran the Huberman and Kandel (1987) or *H-K* spanning-test that contemplates the next null-hypothesis: $H_0: \alpha = 0, \beta = 1$. As previously noted, the α values are not significant (that is, their asymptotic values are zero) because the probability $P(\beta)$ of having a value of zero with another sample is high. Complimentary, the probability of $\beta = 1$ is high. With this result ($\alpha = 0, \beta = 1$) we found evidence that suggest a level of integration between the studied EMU markets by the fact that a movement in the EMU all markets index represent a movement of similar magnitude in the index that excludes a given country member.

[13] We ran a two-regime Markov-Switching (MS) regression for each index but the Quasi-Maximum likelihood that we used generated indefinite standard errors in some regressors and the almost cero value of the alpha didn't allowed for a switching alpha. We left this MS regression results for further research with another inference method such as the E-M algorithm or the Markov-Chain-Monte Carlo.

Following the review of the results in Table 3, we present the results of the performance of the studied indexes in normal and crisis (or bad-performing) time periods. We found that investing in bad-performing periods in an EMU portfolio that excludes either France or Belgium[14] leads to the lowest risk exposure observed in the test, followed by Spain and Portugal, two peripheral countries who had fiscal and financial issues.

In order to have a more specific and practical view for portfolio management purposes, we calculated the Sharpe ratio as in (9) and we assumed a risk-free rate of zero by the fact that, since April 2015, the European benchmark rate and the related Euro LIBOR one are negative, given the monetary stimulus implemented by the European central Bank. In Table 5 we present these results. It is of interest that, as expected for the single-regime analysis, the exclusion of three of the four peripheral or distressed countries (Italy, Ireland and Portugal) in the EMU portfolio, lead to a higher mean-variance (risk-return) efficiency. That is, by excluding these countries, the investor would have had a better return without these countries in the portfolio. This result is in line with what it is expected, given the fiscal, financial and political issues that these countries had suffered during the period 2011-2013.

Also, as noted in Table 5, the two-regime analysis gives a wider perspective because the exclusion of Italy, Spain and Ireland (three peripheral countries), along with Finland, leads to a better risk-return profile in the normal or good-performing time periods. The interesting issue is that the exclusion of a non-peripheral country (Finland) that has shown no fiscal, financial or political distress, leads to one of the bests risk-return trade-off. This issue is also observed on the bad-performing or crisis time periods because the exclusion of Finland and now France (the second biggest Economy in the EMU area) are among the four-best risk-return profiles, preceded by Spain and Italy (first and second place respectively).

Table 5. The observed Sharpe ratios in good-performing and bad-performing time periods

Ticker	*Single regime mean*	*Good-performing time periods Sharpe ratio*	*Bad-performing time periods Sharpe ratio*
EMU	(7) 0.0073	(5) 0.0815	(5) 0.1769
EMUexGER	(11) 0.0045	(9) 0.0772	(10) 0.1636
EMUexFRA	(10) 0.0051	(10) 0.0768	**(3) 0.1784**
EMUexITA	**(1) 0.0091**	**(2) 0.0862**	**(2) 0.1812**
EMUexESP	(8) 0.0072	**(3) 0.0844**	**(1) 0.1815**
EMUexNTL	(6) 0.0073	(11) 0.0764	(11) 0.1631
EMUexBEL	(9) 0.0072	(8) 0.0801	(9) 0.1743
EMUexAUS	(5) 0.0074	(7) 0.0814	(6) 0.1766
EMUexIRE	**(3) 0.0078**	**(4) 0.0819**	(8) 0.1753
EMUexFIN	**(2) 0.0078**	**(1) 0.0865**	**(4) 0.1781**
EMUexPOR	**(4) 0.0074**	(6) 0.0814	(7) 0.1759

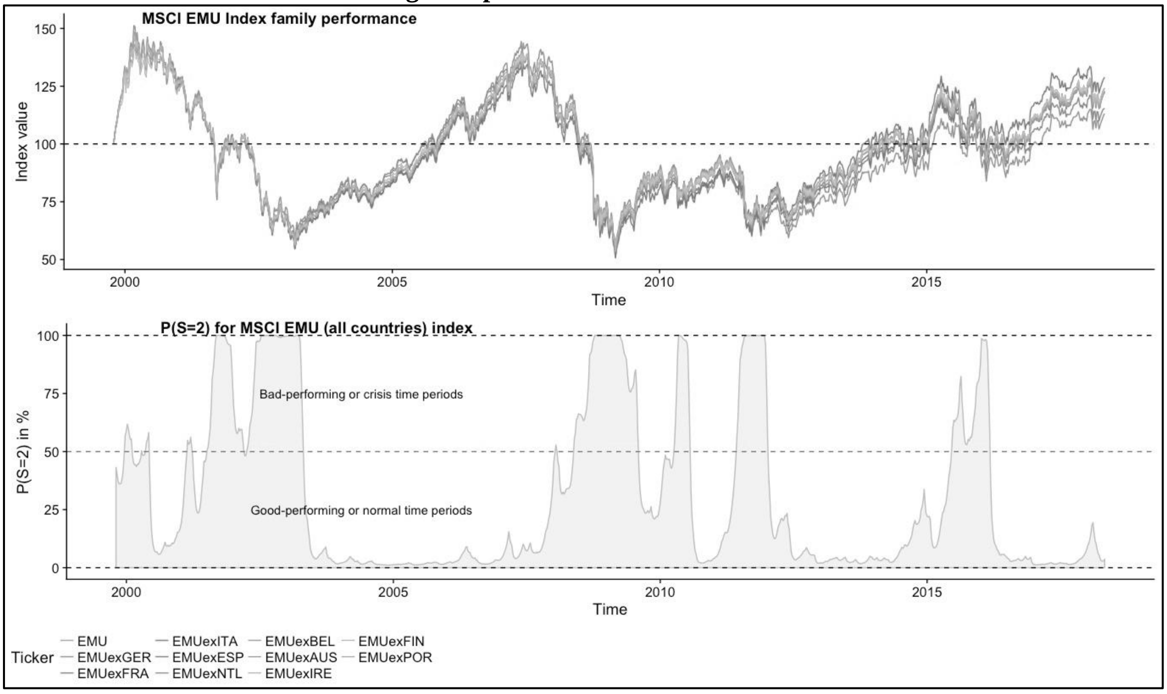
Source: Own elaboration with data from our analysis.

These results suggest that even if there is a level of market integration in the countries of the MSCI EMU index, there are some potential short-term investment opportunities that could be exploited if an EMU portfolio excludes countries such as Italy, Finland, Portugal or Ireland, in normal or good-performing time periods and countries such as Spain, Italy, France or Finland in bad-performing or crisis time periods.

In order to review these short-term opportunities, Figure 3 shows the historical smoothed probability values (lower panel) of the bad-performing or crisis (s = 2) time periods in the MSCI EMU (all countries) index, along with the historical performance of each studied index (upper panel). In that figure, it is noted that, during the bad-performing periods, some indexes experience a different performance and a notably different one in good-performing ones, as is

[14] Two non-peripheral countries that, according to Table 1, had no recent fiscal, financial or political disruption.

Figure 3. The observed historical performance of each index against the probability of being in a bad-performing time period in the whole EMU index



Source: Own elaboration with data from our analysis, MSCI Inc and Reuters

the case of the portfolios that exclude Finland or Italy.

Also, these results give a proof against the diversification benefits of a big diversified portfolio, against a smaller and less diversified one. That is, given the financial portfolio math and theory, it is expected that the more diversified EMU portfolio or index should be more profitable or, at least, less risky than a smaller portfolio (sub-set) that excludes some of its country members.

Finally, in Table 6, we present the transition probabilities used in the Markov-Switching analysis for each index, along with the average time period in each regime. It is of interest to note that the number of weeks in both regimes have a mean value of 106.00 and 18.13 for normal and crisis time periods respectively (almost the same for all indexes). This is an interesting feature also for active portfolio management because an investor can observe similar number of weeks in all the indexes in both regimes and still perform active portfolio management activities.

Table 6. The observed transition probabilities and number of weeks in each regime

Ticker	$p_{s=1,s=1}$	$p_{s=1,s=2}$	$p_{s=2,s=1}$	$p_{s=2,s=2}$	*Periods in good-performing regime*	*Periods in Bad-performing regime*
EMU	99.0729	0.9271	5.489	94.511	107.8679	18.2182
EMUexGER	99.0368	0.9632	5.1291	94.8709	103.8231	19.4967
EMUexFRA	99.0955	0.9045	5.5777	94.4223	110.5566	17.9286
EMUexITA	99.0383	0.9617	5.6205	94.3795	103.9876	17.7919
EMUexESP	99.0407	0.9593	5.6162	94.3838	104.2480	17.8055
EMUexNTL	99.0289	0.9711	5.5945	94.4055	102.9721	17.8748
EMUexBEL	99.0781	0.9219	5.4602	94.5398	108.4671	18.3142
EMUexAUS	99.0701	0.9299	5.5105	94.4895	107.5375	18.1471
EMUexIRE	99.0703	0.9297	5.4843	94.5157	107.5599	18.2338
EMUexFIN	99.0044	0.9956	5.7514	94.2486	100.4443	17.3869
EMUexPOR	99.0787	0.9213	5.4567	94.5433	108.5443	18.3262

Source: Own elaboration with data from our analysis.

4. CONCLUSIONS

In the present paper we tested the level of integration and performance of the European Monetary Union (EMU) countries that belong to the Euro valued MSCI EMU stock index. We did this by using a Gaussian two-regime Markov-Switching model that will estimate, in weekly time periods, the mean and standard deviation parameters in "normal" (or "good-performing") and "crisis" (or "bad-performing") periods. One of the key areas of interest in the portfolio management process is the possibility of either perform passive portfolio management (tracking the performance of an index or benchmark portfolio) or to execute an active portfolio strategy. The last one consist of investing in a portfolio with different investment levels than the aforementioned index in order to generate alpha or extra returns.

If a set of countries is strongly integrated, there could be no evidence in favor to active portfolio management and the expected return, risk and mean-variance efficiency (risk-return efficiency or Sharpe ratio) levels would be equal between a full-diversified portfolio and some other portfolios that exclude a given EMU country.

An interesting result in our paper is that even though a linear regression suggests the presence of market integration in a single-regime analysis, in the short-term the performance of the different EMU countries is not as integrated as expected, leading to potential short-term opportunities. This happens especially when we analyze the performance of each index with a filtered good-performing (normal) and bad-performing (crisis) time periods perspective. With this kind of analysis, the investor could find some potential short-term opportunities by excluding a given country in the portfolio during good-performing time periods and another country (or countries) during bad-performing ones.

One of the limitations in our work is the fact that we are testing the level of integration and the short-term investment opportunities in a weekly periodicity, instead of a daily or intraday one. Also, we are using a constant (non-GARCH) volatility parameter in the Markov-switching model and we are assuming that the performance of the studied indexes should be modelled with a two-regime scenario.

This periodicity and Markov-switching GARCH limitation along with the use of another likelihood function (such as Student-t), the test of these results in three or even four regimes and another estimation method different to the Quasi-maximum likelihood used herein are the potential guidelines for future research that we suggest.

We also suggest to test the benefit of active portfolio management in an EMU portfolio, especially considering the potential impact of financial cost in the performance of the managed portfolio.

With the results presented in this paper we expect to contribute to the development of the European equity portfolio management industry by giving proofs that even though there is a strong integration between the EMU members in the long-term, some short-term opportunities could be exploited to perform active portfolio management activities by excluding some countries of the EMU portfolio in normal or good-performing time periods and another ones in the bad-performing or crisis regime.

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