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Abstract This paper proposed a time-series method involving a structural vector autoregressive model based on shift-share (SS) decomposition of the European market stock returns into regional, country, industry factors and a new factor known as national industry factor. Based on post-European Union (EU) data for 10 sectors and 19 countries, the relative importance of the four factors driving Euro stock returns has varied over time following financial integration, the global financial crisis and Euro debt crisis. We find: (1) regional effect dominates the behavior of all EU and non-EU members stock returns; (2) the crises decrease both country and industry effects; (3) the crises have led to greater importance in regional factor characterizing country stock returns especially amongst countries which are more integrated with the EU; (4) national industry factor is more pertinent than the other factors and provides a portfolio's risk reduction strategy; and (5) the regional effect dominantly explains UK stock returns variation thus generating concerns over Brexit.

Keywords: European Union; Crisis; Regional effect; Country effect; Industry effect.

JEL Codes: F36, G11, G15

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1. Introduction

Despite the seminal work of, firstly, Solnik (1974) showing that substantial advantages in risk reduction can be achieved through international portfolio diversification, and secondly, the work of Roll (1992) emphasizing the significance of industrial structure, there has been a dearth of studies on the importance of country versus industry effects in explaining stock returns. Although earlier literature documents that country effects dominate industry effects (Griffin and Karolyi, 1998), hence supporting the proponents of international diversification, a consensus has emerged that industry effects have grown in importance relative to country effects in the last three decades (Baca et al., 2000; Cavaglia et al., 2000; Phylaktis and Xia, 2006). This reversal in the trend in explaining equity market co-movement is due to a number of important developments: globalization of the world economy, financial market integration (Campa and Fernandes, 2006); the rapid advances in information technology since the 1990s (Brooks and DelNegro, 2004); regional economic and financial integration of the European Union (EU) (Flavin, 2004; Ferreira and Ferreira, 2006); and the recent EU sovereign debt crisis (Chou et al., 2014; Pieterse-Bloem et al., 2017).

This paper contributes to the burgeoning literature on country versus industry effects of stock returns by using a different method from those which have been widely employed in the literature. Past studies have relied on the regression method developed by Heston and Rouwenhorst (1994) which presupposes that equity return is driven by industry, country and global (euro area) factors. Huberman and Kendal (1987) develop the mean-variance spanning and intersection test, which is employed by Moerman (2008) to study the impact of the adoption of a single currency in the EU on the mean-variance frontiers of investors. Eiling et al. (2012) employ the returns-based style analysis and focus on estimating country-specific and industry-specific variances. This

paper employs a different method, known as the shift-share decomposition approach, which originates from the regional economics literature.[1] This method is sufficiently general and allows the decomposition of regional, country and industry factors, but further allows the study of a new effect – the national industry effect – in explaining European countries' stock returns. This new factor provides portfolio managers with an alternative strategy of diversifying portfolio risk other than the usual country or industry portfolio diversification strategy. We show by comparison to both industry and country strategies that the national industry strategy leads to the highest portfolio risk diversification. More importantly, the assessment on the time-varying effects of the four factors driving European stock returns is performed using a time series approach involving the structural vector autoregression (SVAR) model, which relies on this decomposition method to arrive at certain restrictions on the coefficients of the contemporaneous correlation matrix. This matrix is then multiplied to the reduced-form innovation to identify the structural shocks associated with the factors. In so doing, the two methods underpinning our analytical framework provide an alternative and robust approach when studying the relative importance of regional, country, industry and national industry factors in explaining stock returns.

Using monthly data spanning the period from January 1999 to May 2017, we provide empirical evidence about the impact of economic and financial integration stemming from the adoption of a single currency as well as the effects of financial crises on the relative importance of country and industry effects in European countries' stock returns. Our findings show some interesting outcomes: the core EU members in the euro or non-euro zone reveal that industry effect is significant relative to country effect, while countries with poor economic fundamentals or new EU member countries

[1] Shift-share analysis has been widely used in many different fields, for example, employment (Coulson, 1993), international trade (Dinc and Haynes, 1998) and housing inflation (Chiang, 2016). This decomposition is similar to Forbes and Chinn (2004).

experience higher country effect relative to industry effect. Our findings which reveal the importance of industry effect in economies with stronger economic fundamentals and which are more integrated with the EU, concur with the results documented in some recent studies, for example Chou et al. (2014) and Eilling et al. (2012). More importantly, using the SS decomposition, we are able to obtain a new factor: the national industry effect which captures the importance of national industry's uniqueness in explaining stock returns. Our estimation results indicate that this new effect outperforms both industry and country effects based on the forecast error variance decompositions. An important implication of our results is that a portfolio manager looking at investing in the EU should explore the unique industries in each country and strategically invest in those industries to efficiently reduce the portfolio's risk.

The unfolding of the global financial crisis and the euro debt crisis may have altered the relative importance of industry and country effects in explaining European stock returns. Chou et al. (2014) show for the first time that a factor reversal has taken place since the onset of the subprime crisis, returning to the rising importance of country effects. This factor reversal continued during the global financial crisis and right through the euro debt crisis. Their findings are based on a sample which ends in 2011. Our study, on the other hand, uses a longer sample period which extends to mid-2017 and thus captures the variation in the two factors returns more accurately. We show that for the period after 2007, there has been a weakening in both country and industry effects in better explaining the variation of nation-industry stock returns. Our results also point to the rising importance of the EU regional effect especially in countries that are more integrated with the EU. This is a new contribution to the literature which has primarily examined the relative importance of country versus industry factors in influencing European stock returns during the crisis period (see Chou et al., 2014; Pieterse-Bloem et al., 2016).

Furthermore, our study also demonstrates the returns dynamics of new EU member countries like Hungary, Poland and the Czech Republic, which have rarely been discussed in the literature. It is not surprising that in the pre-GFC period, prior to them becoming members of the EU, we find that country factor relative to industry factor dominates the stock returns of these economies. Following their accession to the EU in 2004, we do not find that there has been an improvement in the industry factor driving stock returns. We do find, however, that these countries have become more integrated with the EU as judged by the proportion of stock returns variation which is explained by EU regional factor and the country factor during the GFC and post-GFC periods.

Finally, we examine the contributions of regional, country and industry factors in three economies – Greece, Ireland and the UK – to show the result of the GFC and euro debt crisis on the factors' time-varying effect on these markets' stock returns. Of significant interest is the difference in results between Greece and Ireland. While the two countries are amongst the PIIGS identified by Eiling et al. (2012) and Chou et al. (2014) as having weak macroeconomic fundamentals, they respond very differently in terms of the factors characterizing stock returns.[2] Irish stock returns are largely driven by the regional factor, but Greek stock returns which are driven by the country factor in pre-GFC become dominated by regional factor as the crisis unfolded. As for the UK, we find that both industry and regional factors constitute the major driver behind the variation of its stock returns before the crisis, but the regional factor begins to dominate the industry factor in the crisis period. These results pose concerns about the outcome of the referendum for the UK to exit the EU, particularly given that Britain's equity market returns are so heavily reliant on the EU regional factor.

The remainder of the paper is organized as follows. Section 2 describes the data used in this paper. Section 3 discusses the shift-share decomposition method and the SVAR

[2] PIIGS countries comprise Portugal, Ireland, Italy, Greece and Spain.

model to study the relative importance of factors driving European stock returns. Section 4 discusses the empirical results and their implications for portfolio managers and policy-makers. Section 5 concludes the paper with a summary of the main themes covered here.

2. Data Description

Our study uses a long span of monthly data for the period January 1999 to May 2017 obtained from Bloomberg. The series comprises the Morgan Stanley Company International (MSCI) European equity index, the MSCI 19 country equity indices and 10 sectoral indices. The MSCI European index captures large and mid-cap representation across 15 developed countries in Europe. The index has 455 constituents and covers approximately 85% of the free float-adjusted market capitalization across the European developed markets' equity universe. The sectoral indices follow the global industry classification standard (GICS) used by Standard & Poor's (S&P) and MSCI in the EU.[3]

Figure 1 plots the MSCI European index. It can be seen that there are two incidents when the index fell sharply; the period 2000-2002 is marked by the dotcom bubble or the "tech wreck" and the period 2007-2009 caused by the global financial crisis and the euro debt crisis. Figure 2 illustrates the plot of the individual sector equity index. It can be seen that there is significant heterogeneity in the movement of the sectoral equity indices. Notably, the energy, financials, materials, utilities and industrials sectors experienced a steep increase and downward revision in their index between 2003 and 2008. The movements of information technology and telecommunication services

[3]These 10 sectors are consumer discretionary (CD), consumer staples (CS), energy (EN), finance (FN), health care (HC), industry (IN), information technology (IT), telecommunication services (TC) and utilities (UT), respectively.

sectoral indices have remained largely flat following the burst of the dotcom bubble post-2002. Figure 3 shows 19 countries' equity indices. Like the sectoral equity indices, there is significant variation amongst the country equity indices. The aforementioned stylized facts of these indices may indicate that diversification across both industries and countries can help reduce a portfolio's risk. Yet it remains to be seen whether a national industry strategy will deliver as good a reduction in the portfolio's risk as diversification across industries and across countries.

[Insert Figures 1, 2 and 3]

Table 1 reports the EU member countries which are included in our sample. We exclude a number of countries due to data paucity and the lack of a long time series data that are available. These EU member countries are Bulgaria which joined the EU in 2007, Croatia in 2013, Cyprus in 2004, Estonia in 2011, Latvia in 2014, Lithuania in 2015, Malta in 2008, Romania in 2007, Slovakia in 2009, and Slovenia in 2007. Only three new member countries, Hungary, Poland and the Czech Republic are included in our sample. Two non-EU member countries are also included in our sample, namely Norway and Switzerland. They are included for the purpose of analyzing the effect of regional, country and industry factors in these economies' stock returns. Of the 17 EU member countries, we follow Eiling et al. (2012) and Chou et al. (2014) by further classifying them into countries with and without weak macroeconomic fundamentals and categorized them as PIIGS and non-PIIGS countries in the euro zone, respectively. We also categorize the EU member countries in the non-euro zone as the original member countries ("Old") and the 3 new EU-member countries which joined in 2004 ("New").

For the purpose of analyzing the time-varying impact of the crises on the factor

importance of stock returns, we follow Chou et al. (2014) by splitting our sample into the pre-GFC period (1999:1-2007:12) and the GFC and post-GFC period (2008:1-2017:5); the two periods are denoted "I" and "II", respectively, in our empirical results. Each period covers approximately 9 to 10 years. To ensure that we have adequate data to implement a time-serious estimation in both periods, in cases when the number of data in any period is less than 60 observations, we exclude that sector in the country. Table 2 provides a summary of the data distribution across both sectors and countries and for the two periods. It can be seen from Table 2 that some sectoral data are missing in certain countries. For example, there are no energy sectoral data for Belgium, Switzerland, the Czech Republic, Germany, Denmark, and Ireland. Other industries like health care, information technology and utilities are geographically concentrated in some countries. In our empirical results, the average measure accounts only for industries which are included in the estimation.

[Insert Tables 1 and 2]

3. Empirical Framework

We discuss the shift-share decomposition approach which breaks down national and industry stock returns into its own idiosyncratic factor (shift component) including national industry factor and the other external factors (share component) comprising regional, country and industry factors. The decomposition method is further used to create a structural vector autoregression (SVAR) model to evaluate the relative importance of all these factors.

3.1 The Shift-Share (SS) Decomposition Method

The SS analysis can be used to decompose stock returns of industry *j* located in country *i*, namely, R_{ij} into regional, country and industry effects, and the national industry effect. This concept is summarized in Figure 4 which shows how the regional stock market return can be influenced by a single internal effect (i.e. shift or national industry factor) and three external effects (i.e. share or regional, industry and country factors). Referring to equation (1) below it can be seen that the stock return variation of industry *j* in country *i* is explained by return attributed to the regional effect, R_{EU} , return attributed to industry effect $\left(R_j - R_{EU}\right)$, return attributed to country effect $\left(R_i - R_{EU}\right)$ and national industry effect given by $\left[\left(R_{ij} - R_i\right) - \left(R_j - R_{EU}\right)\right]$.

$$R_{ij} = R_{EU} + \left(R_j - R_{EU}\right) + \left(R_i - R_{EU}\right) + \left[\left(R_{ij} - R_i\right) - \left(R_j - R_{EU}\right)\right] \qquad (1)$$

From Figure 4, it can be seen that both industry and country stock returns are constituents of the EU stock market; hence it is natural that the regional effect systematically affects both industry and country stock returns. For this reason, in capturing both industry effect and country effect it is essential to subtract the influence of regional effect from both industry and country stock returns (R_j and R_i). Similarly, the national industry return is a constituent of the industry, country and wider regional EU market stock returns. Accordingly, industry, country and EU factors are likely to systematically affect national industry returns. As such, the national industry effect is obtained by subtracting regional, industry and country effects from the return of this national industry as shown in equation (2).

$$
\begin{aligned}
national\ industry\ effect &= \left[\left(R_{ij} - R_i\right) - \left(R_j - R_{EU}\right)\right] \\
&= \left[R_{ij} - \left(R_i - R_{EU}\right) - \left(R_j - R_{EU}\right) - R_{EU}\right] \\
&= R_{ij} - country\ effect - industry\ \ effect - regional\ effect
\end{aligned} \tag{2}
$$

Unlike past studies, this decomposition yields a new factor which deserves further elaboration. First, this residual effect is referred to as the national industry effect, which captures the extent by which national industry factor drives country stock returns.[4] Secondly, this new factor is associated with Potter's (1990) belief that a nation's competitiveness depends on the capacity and speed of its industry to innovate and upgrade, rather than relying on the natural endowment, labor pool, or other macroeconomic factors. This is particularly true in an era of globalization in which competitive advantage pertains to strategic industries which are important for national economic growth in the face of global competitive pressure. It is important to recognize that this national industry factor relates to the development of strategic industries in each country to improve its national competitiveness ability. This new effect is different from regional, industry and country factors, and yet it is vital for portfolio diversification. We show in the empirical results section that a national industry strategy can lead to greater portfolio risk reduction relative to country and industry strategy.

Solnik (1973) and Roll (1992) propose the notion of portfolio risk diversification through country and industry strategy. Heston and Rouwenhorst (1994) and Griffin and Karolyi (1998) employ the dummy variable approach and show that there are significant differences between country and industry factors driving stock returns. We propose the use of shift-share decomposition to calculate country and industry effects obtained from

[4]For a detailed discussion of shift-share analysis in regional economics, the reader is referred to Coulson (1993). An application by Chiang (2016) shows how the method can be used to study China's rising residential rents.

the difference between country and EU returns and the difference between industry and EU returns, respectively. With regard to national industry effect, since regional (EU) effect, country effect and industry effect influence the national industry as illustrated in Figure 4, it is appropriate to derive the national industry effect by deducting all these three effects from the returns of national industry. Accordingly, the shift-share decomposition provides three strategies, namely, country, industry and national industry strategy in diversifying portfolio risk.

While the shift-share decomposition points to different diversification strategies based on the country, industry and national industry factors driving EU stock returns, it remains an open question as to which factor provides the greatest portfolio risk diversification. To address this question, we employ the variance decomposition of the structural VAR approach based on the shift-share decomposition to evaluate the relative importance of all four factors: the regional (EU) effect and three other effects, namely country, industry and national industry effects. By determining the relative significance of country, industry and national industry effects, we can propose portfolio risk diversification through country, industry or national industry strategy. The related econometric analysis is presented in section 3.2.

3.2 A Structural Vector Autoregressive Model

Although SS analysis permits stock returns to be decomposed into the four effects, namely regional, country, industry and national industry effects, the relative significance of these four effects is best determined by drawing inference from a structural vector autoregressive model which captures the lead-lag relationships amongst the four factor returns. It is also important to recognize that the contribution of each effect based on the decomposition summarized in equation (1) is not independent and mutually exclusive of

each other. In other words, it is highly likely that the four effects are correlated with each other. For this reason, we cast the four return series in a vector autoregressive (VAR) model given by equations (3) (or (4) in matrix form):

$$\begin{bmatrix} R_{EU} \\ R_j \\ R_i \\ R_{ij} \end{bmatrix}_t = A(L) * \begin{bmatrix} R_{EU} \\ R_j \\ R_i \\ R_{ij} \end{bmatrix}_{t-1} + \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \end{bmatrix}_t \tag{3}$$

$$R_t = A(L) * R_{t-1} + e_t \tag{4}$$

where *e* is the reduced-form error from stock returns from EU, industry, country and nation-industry, respectively and *A(L)* is a 4×4 matrix of lag polynomials of a finite order in this model. However, estimating equation (3) or (4) does not utilize additional information which we know about the contemporaneous relationships amongst the four types of returns according to the SS decomposition in (1) as a theoretical underpinning. To this end, we define the contemporaneous matrix (W) which captures the contemporaneous relationships amongst the returns arising from the regional effect, country effect, industry effect and the national industry effect as shown in equation (1). This W matrix is multiplied to both sides of equation (3) and yields a structural VAR (SVAR) of equation (5) (or equation (6) in matrix form):

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 \\ -1 & 0 & 1 & 0 \\ 1 & -1 & -1 & 1 \end{bmatrix} \begin{bmatrix} R_{EU} \\ R_j \\ R_i \\ R_{ij} \end{bmatrix}_t = B(L) * \begin{bmatrix} R_{EU} \\ R_j \\ R_i \\ R_{ij} \end{bmatrix}_{t-1} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \end{bmatrix}_t \tag{5}$$

$$W * R_t = B(L) * R_{t-1} + \varepsilon_t \tag{6}$$

where *B(L)=W*A(L)*; and ε is the structural innovation from stock returns of the EU, industry, country and national industry. Compared to the VAR, it is clear that SVAR is a more complete model that can estimate the interrelationship amongst four variables by the past and "current" realization of all stock returns, so ε is regarded as the pure innovations in the four types of stock returns (Enders, 2010). Note that W is established from the SS decomposition in (1) so that $W * R$ is a column vector of the four types of returns. The first row of the product of $W * R_t$ shows that the return attributed to the EU regional effect, R_{EU} is made up of its lagged returns. The second row of the product of $W * R_t$ shows that the regional EU factor has a contemporaneous effect on industry factor return so that their difference yields the industry factor, $\left(R_j - R_{EU}\right)$. The third row shows that the EU factor return has a contemporaneous effect on country factor return so that to obtain the country effect we have $\left(R_i - R_{EU}\right)$. Finally, the last row of the product of $W * R_t$ shows that regional, industry and country returns all have contemporaneous effects on the return of national industry, hence the national industry factor is given by $\left(R_{ij} - R_i\right) - \left(R_j - R_{EU}\right)$. In summary, this approach not only tracks the interaction amongst the four factor returns, it also provides useful economic meaning by decomposing stock returns into regional, industry, country and national industry effects.

The identification conditions given by the relationships between structural shocks (ε) and reduced-form innovations (e) are shown in equation (7), namely $e_t = W^{-1}\varepsilon_t \; or \; \varepsilon_t = We_t$. It is important to note that structural shocks are the contemporaneous matrix multiplied by reduced-form innovations, so they reveal shocks from regional, industry, country and national industry effects according to the SS decomposition, rather than the stock returns of EU, industry, country and national industry.[5] In other words, the structural shocks are the "pure" regional, industry, country

[5]For a detailed discussion of the SVAR, the reader is referred to Souki and Enders (2010).

and national industry effects obtained from the innovation accounting.

$$\begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \end{bmatrix}_t = \begin{bmatrix} 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 \\ -1 & 0 & 1 & 0 \\ 1 & -1 & -1 & 1 \end{bmatrix} \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \end{bmatrix}_t = \begin{bmatrix} \varepsilon_{regional\ \ effect} \\ \varepsilon_{industry\ effect} \\ \varepsilon_{country\ effect} \\ \varepsilon_{national\ \ industry\ effect} \end{bmatrix} \tag{7}$$

However, the contemporaneous restrictions derived from the SS decomposition dictate a one-for-one relationship between structural and reduced form innovations. For example, $\varepsilon_2 = e_2 - e_1$ implies that a structural shock from industry effect is equal to the reduced-form innovation minus the reduced-form innovation from the EU regional factor. As such, we remove these one-to-one restrictions except for normalization to generate a more general contemporaneous matrix $W^{/}$ in equation (8) to respond to possibly asymmetric effects. In this new matrix, we allow asymmetric effects of the EU regional factor on different industries, countries and national industry factors, which are given by w_{21}, w_{31} *and* w_{41}, respectively. Similarly, the asymmetric effects of industry and country factors on national industry factor are captured by w_{42} *and* w_{43}, respectively. More importantly, all these parameters can be estimated endogenously in the SVAR system. Finally, equation (8) still retains the structure of the SS decomposition in which both the pure industry and country effects account for the EU regional effect first; similarly, the pure national industry effect takes into account the three factors, namely regional, industry and country effects.

$$W^{/} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ w_{21} & 1 & 0 & 0 \\ w_{31} & 0 & 1 & 0 \\ w_{41} & w_{42} & w_{43} & 1 \end{bmatrix} \tag{8}$$

Since the parameters of interest, which are elements of the $W^{/}$ matrix can be estimated from the SVAR system, the forecast error variance decomposition can be employed to inform the proportion of forecast error variance. This can be attributed to each of the four factors. To obtain the forecast error variance, we can write equation (6) as:

$$R_t = W^{/-1} B(L) * R_{t-1} + W^{/-1} \varepsilon_t \tag{9}$$

$$\text{or } R_t - \overline{R} = \sum_{i=0}^{\infty} C_i \varepsilon_{t-i} \text{ where } C_i = W'^{-1} A^i(L) W'^{-1} \tag{10}$$

Thus, the structural forecast error variance decomposition is given in equation (11):

$$\theta_{ij}(n) = \frac{\sigma_{ii}^{-1} \sum_{l=0}^{n} \left(e_j^{/} C_l \sum e_j \right)^2}{\sum_{l=0}^{n} \left(e_i^{/} C_l \sum C_l^{/} e_i \right)^2} \text{ for} i, j = 1,2,\ldots, m. \tag{11}$$

The structural forecast error variance decomposition reveals to what extent stock return variation of a certain sector in its country can be explained by innovations from the four factors, namely, regional, industry, country and national industry effects in the system. It can be used to measure the relative importance of all four factors in driving stock returns in a particular sector in its country.

4. Empirical Results

In this section, we discuss the relative importance of regional, country, industry and national industry effects to stock returns of industry *j* in country *i* based on the outcomes

of the SVAR estimation followed by the forecast error variance decompositions (FEVDs). We use the FEVDs to evaluate the relative contribution of different effects on stock returns for different time periods like the pre-GFC versus post-GFC periods and different country classifications like the euro and non-euro member countries; PIIGS and non-PIIGS countries; and old and new euro member countries. This is done to explain the time-varying impact of integration, crisis and social and economic events on the relative importance of factors driving EU stock returns. These results also carry important policy implications.[6]

4.1 The EU regional effect in stock returns

Table 3 reports the EU regional effect for all 19 European countries. In each cell, it shows the average of the regional effect computed across all 10 industries for a specific country, which is the average of the forecast error variance attributed to regional effect and estimated from the SS decomposition and SVAR model using the pre-GFC for 1999:1-2007:12 and GFC and post-GFC for 2008:1-2017:5.[7] It is interesting to note that regional effects in the pre-GFC period dominate stock returns' co-movement in Switzerland (48.82%), Germany (36.25%), France (46.83%), the United Kingdom (37.88%), the Netherlands (31.62%), Norway (31.69%) and Sweden (32.04%). The results for Switzerland and Norway are surprising; these countries are non-EU members yet their country and industry stock returns are to a large degree influenced by the EU regional effect, mirroring a similar effect like some of the developed and dominant economies of the EU member countries. For countries like Austria, Belgium, Greece, and Portugal, the regional effect plays a minor role in explaining their stock returns,

[6] Estimation results are analyzed for the 1-month forecast period.

[7] Note that the average is computed based on the number of industries in a country that are included in the estimation. As discussed in the data section (Section 2), some industries/sectors are excluded in some countries due to data paucity (see also Table 2).

averaging in the mid-10%. Not surprisingly, for non-EU member countries like the Czech Republic, Hungary and Poland, the contribution of the regional effect on country stock returns is also small, 15.55%, 22.43% and 18.80%, respectively.

Compared to pre-GFC, there is a sharp increase in the contribution of regional effects in explaining country stock returns' co-movements in the GFC and post-GFC periods. It is interesting to note that in some EU member countries which have relatively smaller economies, like Austria and Belgium, the incremental increase in stock returns' regional effects is significantly large. For Austria (Belgium) it went from 13.51% (21.12%) to 50.82% (42.26%). The increase in the contribution of regional effects towards country and industry stock returns is also apparent in some larger economies like Germany, France, and the U.K. Even in non-EU member countries like Switzerland and Norway, we observe a sharp increase in regional effects exceeding 50% in the first month of forecast period. The contribution of the regional effects - while it adjusts downward in the 3 and 6 months forecast period - remains noticeably larger during the GFC and post-GFC periods. One reason for these observed results is that the sovereign debt crisis, while it stems from the PIIGS countries with poor macroeconomic fundamentals, poses a systemic risk to the deeper integration of the Euro zone. Therefore the regional effect appears to explain a large part of the movement in industry and country stock returns in the EU. The last column of results in Table 3 shows the average contribution of the regional effect across all 19 countries. By and large, we observe a steep increase in the contribution of regional effects in explaining stock returns' co-movements across all 10 sectors and 19 countries, irrespective of the forecast period.

[Insert Table 3]

Table 4 shows the proportion of stock return co-movement which is attributed to regional effects for countries with and without poor macroeconomic fundamentals. Chou et al. (2014) identified Portugal, Italy, Ireland, Greece and Spain (PIIGS) as countries which contributed to the euro-wider factor reversal during the sovereign debt crisis. Here, we classify euro member countries as PIIGS and non-PIIGS. It can be seen during the pre-GFC period that the contribution of regional effects to stock return co-movements of non-PIIGS is larger than those of PIIGS. On average, the contribution of regional effects is about 29.04% in non-PIIGS while that of PIIGS is about 22.55%. However, in the GFC and post-GFC period, the proportion of contribution explained by regional effects increases for both PIIGS and non-PIIGS, albeit the increase is larger in non-PIIGS than in PIIGS. This can rationalized by the fact that the EU region is largely made up of non-PIIGS economies. During the GFC and sovereign debt crisis period the risk of a domino effect caused by soaring sovereign debt in Greece is expected to spread to some of the PIIGS countries. The extent of the effect of a sovereign debt contagion is not restricted to the EU region. In fact it has a rippling effect globally as indicated by the rise in sovereign yield spread and credit default swap spread (Beirne and Fratzcher, 2013). The survival of the Euro bloc is also at risk thus increasing the sensitivity of financial markets to fundamentals, even more so in non-PIIGS than PIIGS particularly given that the non-PIIGS economies are more integrated into the EU than PIIGS.

[Insert Table 4]

With reference to the existing EU member countries, which we refer to as the result under the heading ‘Old’, the contributions of regional effects to stock returns in these countries and industries are larger than the new countries which joined the EU recently. These new countries comprise Hungary, Poland and the Czech Republic. Both sets of

countries, old and new, experience an increase in the regional effect contribution to stock returns during the GFC and post-GFC. Looking at the difference in the regional effect contribution across the two periods (i.e. II-I), by and large the increase in regional effect for 'New' countries is larger than that of 'Old' countries. Taken together, co-movements in stock returns amongst existing member countries and amongst new member countries experience a larger influence from the regional factor during the GFC and euro debt crisis. The last column reports the results for all 19 countries in Europe. It can be seen that by and large the crisis period heightens the influence that regional factor plays on explaining country and industry stock returns with the increment ranging between 15-16% for the 1-month ahead forecast period and 12-13% for the 6-month ahead forecast period.

4.2 Industry and country effects in stock returns

Many studies have documented the importance of industry factor over country factor in the period after the Euro zone was established. Flavin (2004) and Ferreira and Ferreira (2006) reported on the increasing importance of industry effects relative to country effects in the 1990s, with industry effects reaching a similar magnitude as country effects in the post-euro period. In particular, Ferreira and Ferreira (2006) show that the rising trend in industry effects is caused by nominal convergence in interest rates across EMU countries. Moerman (2008), using a mean–variance approach and a longer data set spanning the period 1995–2004, finds that a pure industry investment strategy yielded better diversification opportunities than a pure country strategy during the post-euro period 1999–2004, thus supporting the view that industry effects have gained greater importance than country effects in the Euro area.

Looking at the contribution of industry effects based on 1-month ahead forecast

error variance amongst the 10 sectoral stock returns, the contribution of industry effect ranges from a low 4.83% in the consumer discretionary (CD) sector to a high 18% in the telecommunication services (TC) sector and 20% in consumer staples (CS) sector. On average, the contribution of industry factor on sectoral stock return is about 11-15% for the 1-month to 6-month forecast error variance. During the GFC and post-GFC period, we observe a decline in the contribution of industry effect on sectoral stock returns. The decline is by as much as 3.68% for the 3-month forecast error variance and on average the contribution of industry effects in explaining sectoral stock returns declined by about 2%. This result resonates with the findings of Chou et al. (2017) who find that there is a decline in the contribution of industry effects as a consequence of the sovereign debt crisis and the GFC.

[Insert Table 5]

Table 6 reports the contribution of industry effects on PIIGS and non-PIIGS stock returns. It is apparent that in the period prior to the GFC, industry effects explained a larger proportion of the forecast error variance of non-PIIGS stock returns than those of PIIGS; about 16% (10%) of the forecast error variance of non-PIIGS (PIIGS) stocks returns is explained by industry effects. With the unfolding of the GFC and Euro debt crisis, we observe that the explanatory power of the industry effects on both PIIGS and non-PIIGS stock returns declines. However, the decline is seen to be steeper in non-PIIGS than PIIGS stock returns. The fall in non-PIIGS stock returns explained by industrial effects is about 3% relative to about 1% for PIIGS. For the non-euro zone, we find that it explains about 22% for old member countries prior to the GFC period. Compared to new member countries, the movement in old member stock returns attributable to industry effect is significantly larger, in fact close to four times larger.

During the crisis and post-crisis period, we find that the explanatory power of industrial effects on both euro and non-euro zone member countries' stock returns co-movement declines. Looking at the results in the last column, we find that by and large there is evidence supporting a reduction in the explanatory power of industrial effects for all European countries' stock returns co-movement. The fall in the proportion of stock returns which can be explained by industrial effects is on average about 3% across the three forecast periods.

[Insert Table 6]

Table 7 reports the contribution of country effect in explaining variation of sectoral stock returns across all 19 European countries. Looking at the percentage of contribution made by country effect in each sector relative to industry effect (see Table 5), we find that in some sectors like consumer discretionary, energy, financials, and utilities, the former dominates the latter in the period pre-GFC. In general, the period during the GFC and post-GFC is marked by a gradual decline in the contribution of country effect in explaining 10 sectoral stock returns. However, on average the decline in industry effect is less in magnitude relative to that of country effect. Across all measures and for the three forecast periods, the mean fall in the contribution of industry effect is by 3.23% compared to 3.67% for country effect. This outcome does not appear to concur with the findings of Chou et al. (2014) who find that there is a reversal in the importance of country effect regarding an explanation of EU stock returns during the GFC and sovereign debt crisis.

There are three possible reasons for the differences in findings. Firstly, our approach is different from theirs in that we account for the influence of regional effect and a new factor called the national industry factor. The finer decomposition approach

we adopt may yield different results from their approach which considers only decomposing stock returns into country and industry factors. Secondly, the dataset employed in this study is based on composite indices. Chou et al. (2014) use firm-level stock returns. The disaggregated data used by Chou et al. (2014) does not lead to the exclusion of industries in some countries which we encounter. In that regard, the contribution of industry factors obtained from these disparate datasets could yield marginally different results. Lastly, our sample period is longer than the one employed by Chou et al. (2014) and for this reason it is possible that the reversal to country effect may not have persisted in the latter part of the post-GFC period which is examined in our sample.

[Insert Table 7]

Table 8 reports the percentage of PIIGS and non-PIIGS stock returns co-movement which is attributed to country effects. It is interesting to note that the contribution of country effects in PIIGS is larger than non-PIIGS in the pre-GFC period. This result concurs with the intuition that in countries which are less financially integrated with the EU and display weaker macroeconomic fundamentals, their stock returns' co-movement is dominated by country effect. Chou et al. (2014) show that PIIGS display poor macroeconomic fundamentals, suffer from poorer institutional quality, and are less financially integrated than non-PIIGS countries. It is worth noting that during the GFC and post-GFC period, non-PIIGS countries experience a substantial drop in the contribution of country effect which explains co-movements in their stock returns. In fact, the magnitude of the fall in country effects is about double that of PIIGS. For both factors (industry and country), unlike PIIGS, non-PIIGS observe a decline in both factors' contribution to their stock returns co-movement.

[Insert Table 8]

Turning to the results for new EU member countries, we find that for Hungary, the Czech Republic and Poland, stock returns are explained to a large degree by country effects in the pre-GFC period. This is not surprising as these countries were not part of the EU in that period. Their accession to the EU does bring about a substantial decline in the importance of country effects during the GFC and post-GFC period. This result echoes earlier findings that economic and financial integration following the formation of the EU has resulted in the fall in country effects and the dominance of industry effects (Flavin, 2004; Ferreira and Ferreira, 2006).While we observe that the country effect of these new member countries decline in the GFC and post-GFC period, we do not observe an increase in industry effect in that same period. This is possibly due to the ongoing EU debt crisis, the slowdown in world economic growth following the GFC, and the need for these peripheral new EU member countries to further engage in economic and financial activities with their member counterparts for these to translate into higher country effects.

4.3 Relative importance of country and industry effects

We define a factor relative importance index (FRI) to demonstrate the relative importance of industry effect versus country effect in explaining sectoral stock returns co-movement. The FRI is the ratio of the proportion of sectoral stock returns explained by industry factor over country factor, which is:

$$FRI_{\mathrm{j}} = \frac{\mathrm{VD}\ of\ industry\ effect}{\mathrm{VD}\ of\ \ country\ effect}. \qquad (12)$$

An index of 1 implies that both industry and country effects are equally important. An index that is greater than 1 suggests that industry effect dominates country effect and that a portfolio manager is better off diversifying the portfolio across industries. In other words, the return of a portfolio that is not diversified across industries will, on average, deviate from the benchmark more than a portfolio that is not diversified across countries. The reverse is true for an index that is less than 1.

[Insert Table 9]

Table 9 shows that in certain sectors like consumer discretionary, energy, financials and industrials, the index is less than 1, suggesting that a portfolio manager could, on average, make better return by diversifying the portfolio across countries in these sectors. Comparing the FRI index across the two periods, we find that by and large there has been a decline in the index for most of the sectors but one, the financial sector. The fall in the index during the GFC and post-GFC is indicative that there has been a rise in the importance of country effects relative to industry effects, albeit this increase is not enough to cause the balance to tilt in favor of country factor over industry factor. It is interesting to note that in three sectors, materials, telecommunication services and utilities, the FRI index is larger than 1, implying that a portfolio involving stocks from these sectors should diversify across countries if managers are to seek higher returns. Finally, evaluating the average FRI index across all sectors and for the different measures and across three forecasting periods, the fall from 0.75 in the pre-GFC period to 0.73 in the GFC and post-GFC periods suggests that the relative importance of industry factor in explaining sectoral stock returns has fallen compared to country factor.

4.4 The national industry factor

The SS decomposition method gives rise to a new factor, known as the national industry effect and it allows the assessment of the difference between the three conventional factors (i.e. regional, country and industry effects) and the national industry factor. Based on the forecast error variance decomposition in which the sum of explained variabilities in the forecast errors attributed to all factors equal to unity, we can calculate the contribution of national industry effect on stock returns, which is reported in Table 10. The contributions of regional effects, country and industry effects on stock returns are reported in Tables 4, 6 and 8, respectively.

From Table 10, it can be seen that this effect plays an important role in explaining stock returns; the national industry factor explains more than 30% of the forecast error variance. This contribution is substantially larger than those of industry (see Table 6) and country (see Table 8) factors. This result has testable implications on whether a national industry strategy can yield greater diversification opportunities than the widely regarded country or industry strategies. Evidence exists that the national industry effect is more important for PIIGS relative to non-PIIGS countries in both periods. This finding is interesting as it implies that the national industry factor tends to characterize the stock return dynamics of PIIGS countries compared to non-PIIGS. This is in part driven by the fact that in PIIGS countries which suffer from poor economic fundamentals there are more opportunities to exploit the unexplored national industries compared to non-PIIGS. The established EU member countries' (i.e. "old" EU member countries) stock returns dynamic is attributed to more national industry effect relative to new member countries, particularly in the period before the crisis, although the pattern is reversed in the crisis and post-crisis periods. A possible explanation is that the

national industries are expected to be more severely affected during the crisis period in the established EU member countries thus causing a weakening of this effect relative to the new EU member countries. In general, there is a declining importance in national industry factor in explaining countries' stock returns in the crisis and post-crisis period.

[Insert Table 10]

To understand the implications of the national industry factor's large contribution in explaining Euro stock returns on portfolio diversification in the euro zone, we calculate a diversification ratio that can be achieved through alternative diversification strategies. A country (industry) strategy involves diversifying across countries' (industries') equity composite indices. The national industry strategy involves diversifying over national industries' composite indices. The diversification ratio for the alternative strategies can be computed as the portfolio variance relative to the average asset variance using equal weights, following Solnik (1974) and Heston and Rouwenhorst (1994):

$$\frac{Var(\sum_{i=1}^{N} R_i)}{\frac{1}{N}\sum_{i=1}^{N} Var(R_i)} = \frac{1}{N} + \left(\frac{N-1}{N}\right)\frac{\overline{Cov(R_i, R_s)}}{\overline{Var(R_i)}}, \tag{13}$$

where N denotes the number of composite indices and the upper bar indicates an average.[8] The diversification ratio calculated in (13) represents an equal-weighted naïve

[8] Heston and Rouwenhorst (1994, footnote 5 on p. 20) elaborate on risk diversification, and it is their methodology we follow. For the pre-GFC period, average composite index returns have a variance of 0.0063 per month. An equally weighted portfolio of N composite indices has a variance equal to 0.0063/N plus (N - 1)/N times the average covariance between these indices. The average covariance in a large group of indices is equal to the variance of an equally weighted index. When diversifying across national

portfolio diversification strategy, in which an investor allocates a fraction $1/N$ of his or her wealth to each of the N assets available for investment.

[Insert Figure 5]

Figure 5 demonstrates the benefits of international diversification against the number of composite indices (or assets). Here, we use a portfolio with 20 composite indices for the purpose of illustration. In the pre-GFC period, the strategy that diversifies across countries reduces portfolio variance to 36.9% of the average asset variance. Industry diversification, on the other hand, reduces the portfolio variance to 41.47%. The portfolio variance of the national industry strategy equals approximately 24.83% of the average asset variance. The figure demonstrates that of the three types of diversification strategy, national industry strategy followed by country strategy and industry strategy yield an increasing portfolio risk diversification benefit. In the GFC and post-GFC periods, both industry and country effects result in a similar level of portfolio variance reduction, suggesting that all things remaining unchanged, a portfolio manager would be indifferent to industry and country strategy in this period relative to

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industry indices in the euro zone, the average covariance is 0.0013. The variance of the equally weighted euro zone index is only 20.9% of the average variance of an individual composite index. The weighted average variance of equally weighted indices across countries (industries) is 0.0021 (0.0024), which is 33.6% (38.4%) of the average index return variance. For the GFC and post-GFC periods, the average composite index return has a variance of 0.0101 per month, the variance of the equally weighted euro zone index across national industries is 0.0020, and the weighted average variance of equally weighted indices across countries is 0.0031. Meanwhile the weighted average variance of equally weighted indices across industries is 0.0030.

the preferred country strategy in the pre-GFC period. In other words, during the crisis period, it can be seen that the dominance of country effect over industry effect has diminished. Nevertheless, when compared to the national industry strategy, it is apparent that investing in national industry composite indices does deliver a greater portfolio variance reduction. This result suggests that when investing in euro zone equity markets, the national industry portfolio approach could reduce risk and provide greater diversification benefits compared with the traditional country portfolio or the industry portfolio approach.

4.5 A Case Study of the UK, Greece and Ireland

The Euro debt crisis which started in late 2009 is marked by extensive structural weaknesses in the Greek economy and the discovery that data on government debt levels and budget deficits had been underreported by the Greek government. The impact of the debt crisis on the country's stock returns has been to decrease the country effect in the post-GFC period relative to that of the pre-GFC. At the same time, the regional effect begins to explain more of the variation in Greece's stock returns; the 6-month forecast period shows that the EU regional factor explains about 32% of the country's stock return relative to 19% in the pre-GFC period. The response of Ireland, an economy which has been identified by Chou et al. (2014) as also suffering from poor macroeconomic fundamentals, however, is very different from Greece. The Euro debt crisis does not give rise to an increase in the explanatory power of the EU regional factor on Irish stock returns; instead we observe a reduction in the regional effect. In

addition, the GFC and post-GFC period is defined by a mild reduction (increment) in the contribution of industry (country) effect in explaining the Irish stock returns. This seems to imply that national industry effect is especially critical for investing in the Irish stock market.

[Insert Table 11]

Of significant interest to the current debate on "Brexit" – an outcome of the UK referendum on 23 June 2016, when people voted to leave the EU– we find that a large proportion of the country's stock returns variation is explained by the industry and regional EU factors in the pre-GFC period. However, during the GFC and post-GFC, particularly at the time when the Euro debt crisis unfolded, UK stock returns variation has undergone significant shifts with a reduction in industry effect by about 12% and a similar magnitude of increase in the EU regional effect. While the 1-month forecast period observes a slight increase in the country effect, this impact does not persist with the increase of forecast period horizon. If at all, country effect experiences a slight reduction. Taken together, these results question the rationale of Brexit for a country whose stock returns are heavily influenced by the regional EU bloc, particularly in a period of crisis. It remains to be seen whether Brexit will bring about further changes in the dynamics of factors which drive UK stock returns in the future.

5. Conclusion

The purpose of this paper is to utilize a novel method involving shift-share decomposition analysis and the SVAR model to investigate the relative importance of factors driving European market stock returns. The method which stems from regional

economics is augmented and applied to study the time varying impact of regional, country, industry and national industry factors on European country and sectoral stock returns before, during and after the GFC. Some interesting results emerge about the relative importance and dynamics of factor returns.

The process of financial and economic integration in Europe is manifested through significant changes in the fundamentals underlying equity markets. Deeper EU integration since the adoption of a single currency in 1999 leads to a long-run evolution with diminishing industry and country effects; at the same time, a shift towards the superiority of national industry difference in euro zone equity markets. In other words, national industry effect is an important factor for portfolio management for the EU. Nevertheless, we also find that both effects have been diminishing in explaining Euro equity markets with factor importance leaning towards country effects following the onset of crises. For the first time, we showed that the EU regional effect plays a dominant role in characterizing European country and sectoral stock returns with the effect strengthening for countries that are more closely integrated with the EU. At the country level, we find that there are variations in the relative importance of the regional, country and industry factors amongst countries with weak macroeconomic fundamentals. A novel finding is that a new factor known as the national industry factor can explain a large part of euro zone stock returns' co-movement. An important implication of this is that investing in national industry composite indices can result in greater portfolio risk reduction than the country portfolio or industry portfolio diversification strategies. At the country level, we also show that Greece, the debt-stricken economy, is heavily influenced by country effect relative to regional effect. More importantly, the dominant regional effect driving UK stock returns casts doubt on the rationale for Brexit and poses serious concerns about its impact on the country's stock returns.

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Figure 1: MSCI European index

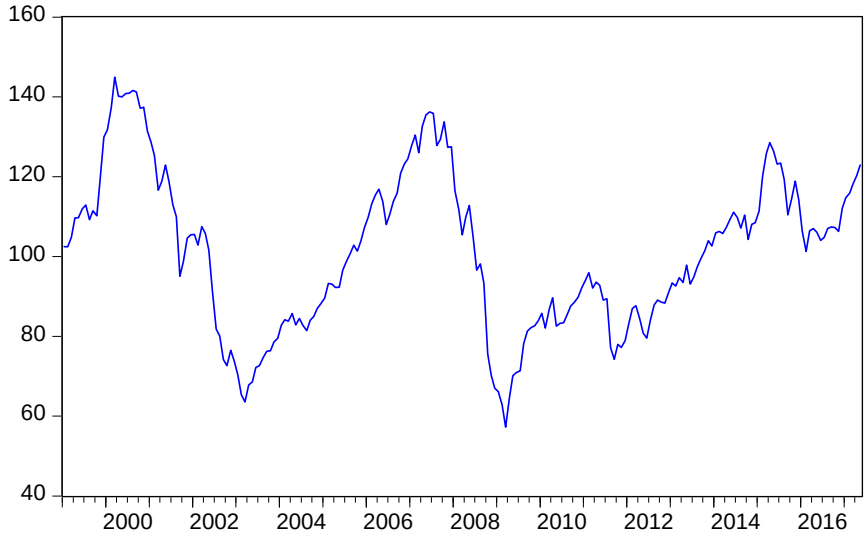

Figure 2: MSCI European 10 sectoral indices

Note: The ten Global Industry Classification Standard (GICS) sectors are consumer discretionary (CD), consumer staples (CS), energy (EN), financials (FN), health care (HC), industrials (IN), information technology (IT), materials (MT), telecommunication services (TC) and utilities (UT).

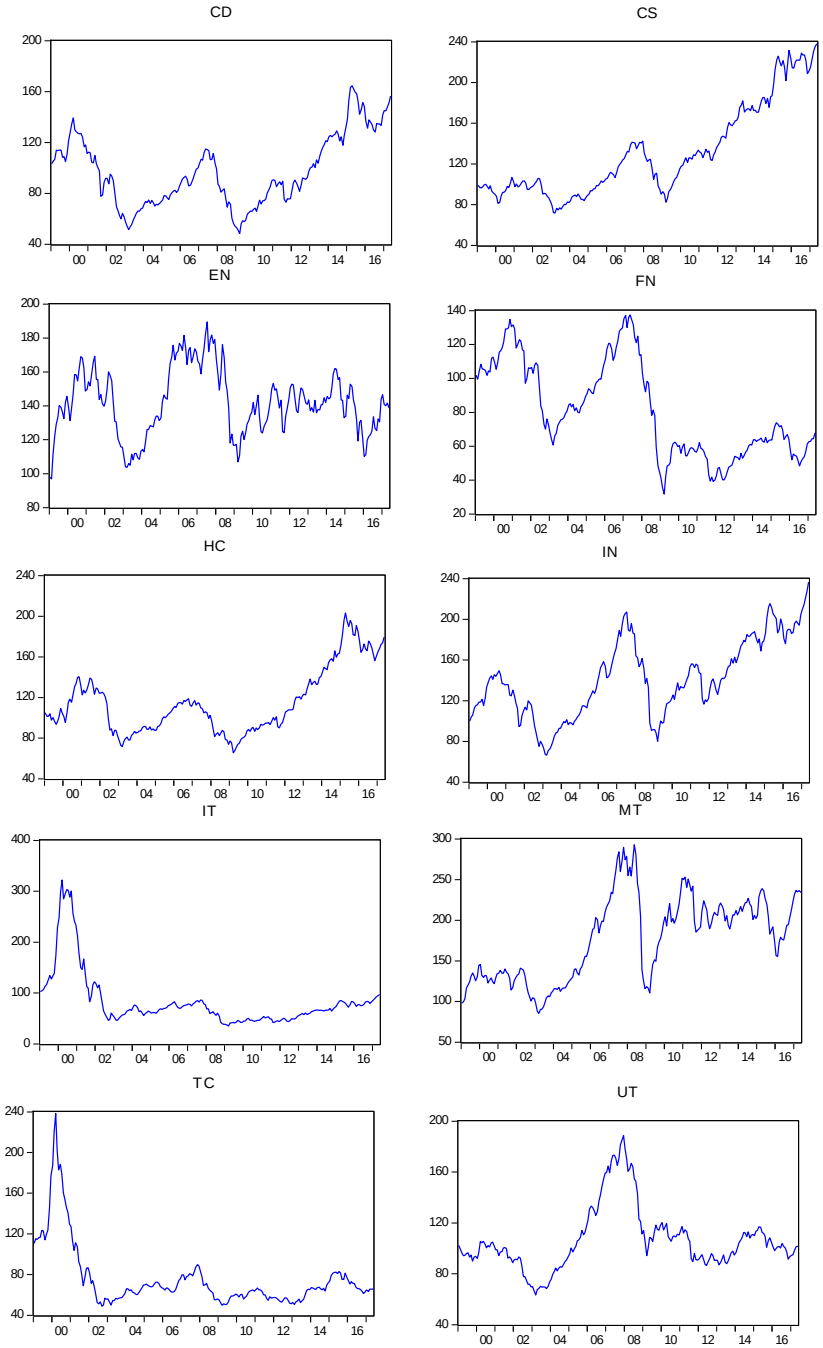

Figure 3: 19 European country indices

Notes: Member countries of the European Union include: Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Ireland (IE), Italy (IT), the Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE), and the UK (GB) before Brexit. The other three new member countries are Poland (PL), Hungary (HU), and Czech Republic (CZ). Both Norway (NO) and Switzerland (CH) are non-EU countries.

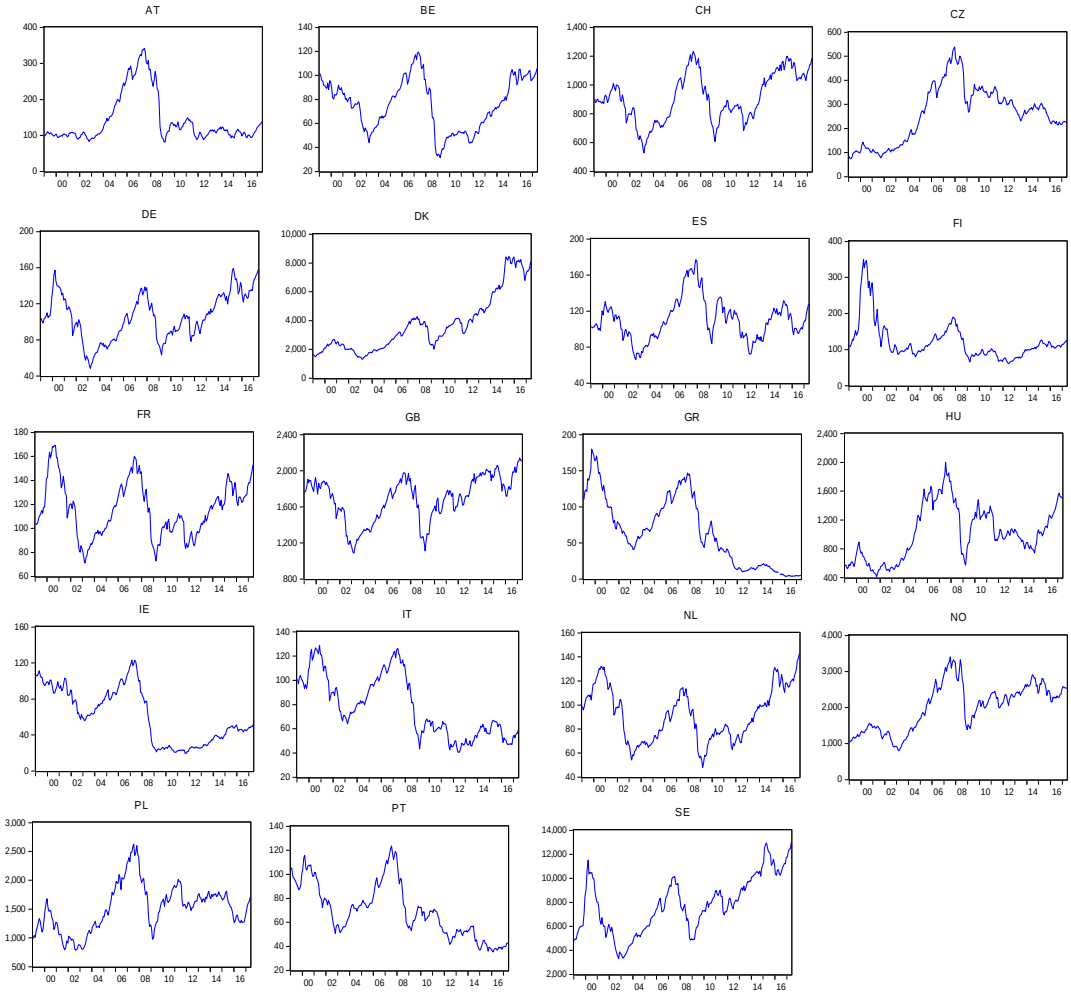

Figure 4: A concept map of industry-country stock return variation in the European Union

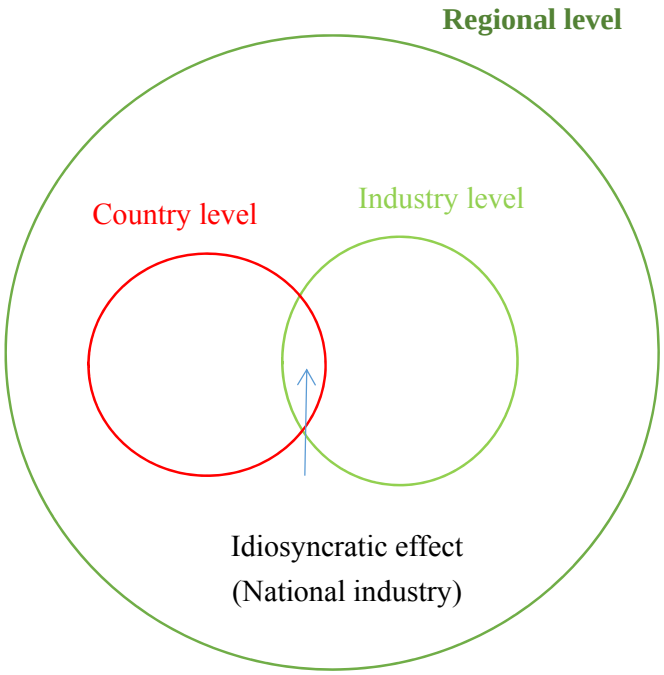

Figure 5: Benefits of international diversification against the number of composite indices.

Note: This figure gives the portfolio variance as the number of composite indices in the portfolio increases, expressed as a percentage of the variance of a typical composite index in the pre-GFC, GFC and post-GFC periods, respectively. The industry (country) strategy denotes a portfolio that diversifies across industries' (countries') composite indices. The national industry strategy diversifies across national industries' composite indices. In Panel A, the limits of diversification for country strategy, industry strategy, and national industry strategy are 36.9%, 41.47%, and 24.83%, respectively, in the pre-GFC period. In Panel B, the limits of diversification for country strategy, industry strategy, and national industry strategy are 33.98%, 32.65%, and 23.86%, respectively, in the GFC and post-GFC periods.

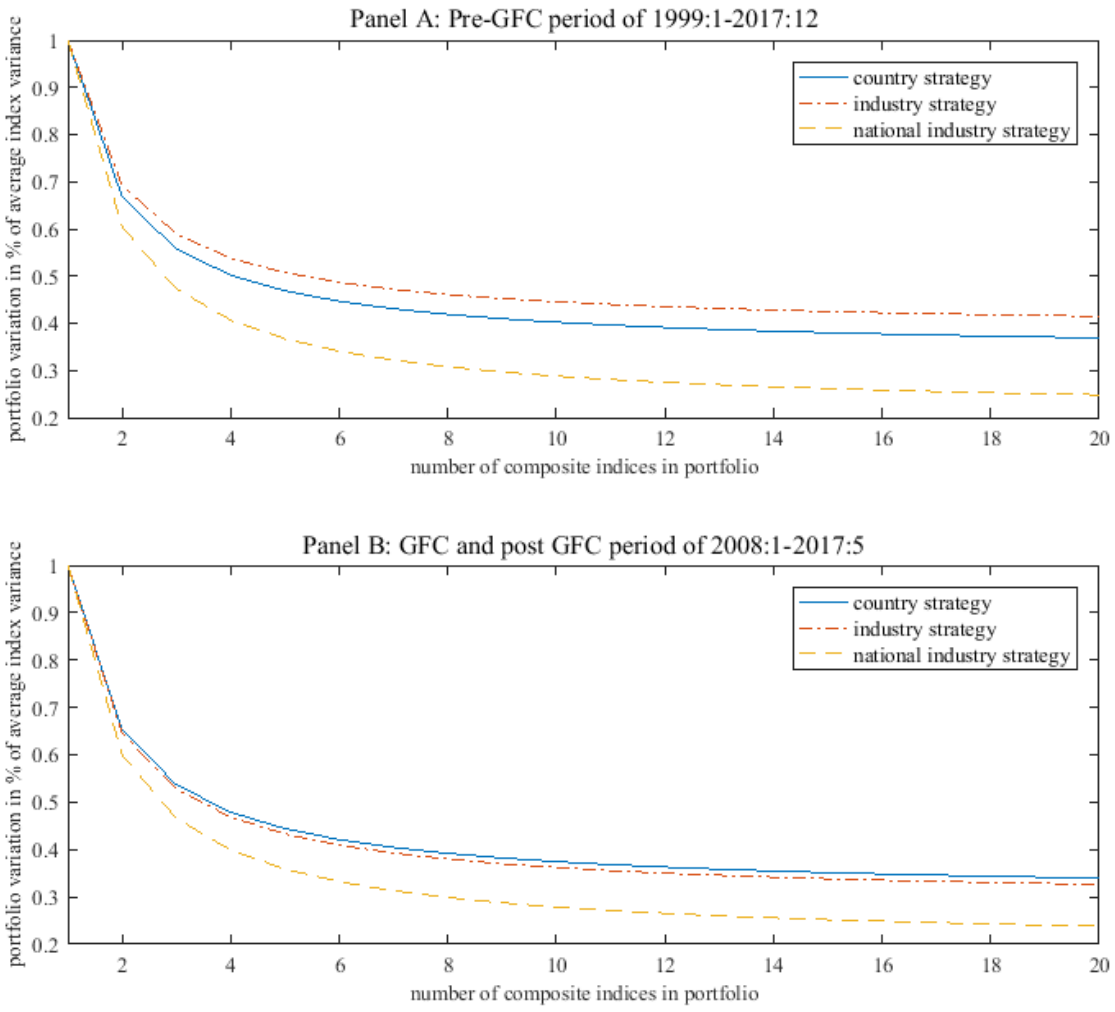

Table 1: European Union and non-Union Member Countries and their Classification

Note: Abbreviation of all countries follows ISO. Y (N) denotes yes (no) the country is (not) a member of the European Union. Entry denotes the year when the country joined the EU. Despite the fact that Luxembourg joined the EU in 1999, the MSCI excludes Luxembourg.

	Entry	Euro zone	Comments
Austria (AT)	1995	Y	
Belgium (BE)	1952	Y	
Czech Republic (CZ)	2004	N	New entrant
Denmark (DK)	1973	N	
Finland (FI)	1995	Y	
France (FR)	1952	Y	
Germany (DE)	1952	Y	
Greece (GR)	1981	Y	PIIGS
Hungary (HU)	2004	N	New entrant
Ireland (IR)	1973	Y	PIIGS
Italy (IT)	1952	Y	PIIGS
Netherlands (NL)	1952	Y	
Norway (NO)		N	Non-EU
Portugal (PT)	1986	Y	PIIGS
Poland (PL)	2004	N	New entrant
Spain (ES)	1986	Y	PIIGS
Sweden (SE)	1995	N	
Switzerland (CH)		N	Non-EU
United Kingdom (UK)	1973	N	Brexit in 2016

Table 2: Data distribution for 10 sectors in 19 countries

Note: "—"denotes no data or insufficient data (i.e. less than 5 years or 60 months) for this industry-country cell. I denotes pre-GFC period of 1999:1-2007:12 and II denotes post-GFC period of 2008:1-2017:5. The first column lists the ten Global Industry Classification Standard (GICS) sectors: consumer discretionary (CD), consumer staples (CS), energy (EN), financials (FN), health care (HC), industrials (IN), information technology (IT), materials (MT), telecommunication services (TC) and utilities (UT). The first row lists the 19 countries. Member countries of the European Union include: Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Ireland (IE), Italy (IT), the Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE), and the UK (GB) before Brexit. The other three new member countries are Poland (PL), Hungary (HU), and Czech Republic (CZ). Both Norway (NO) and Switzerland (CH) are non-EU countries.

	AT	BE	CH	CZ	DE	DK	ES	FI	FR	GB	GR	HU	IE	IT	NL	NO	PL	PT	SE	missing
CD	—	I	I, II	—	I, II	I	I, II	I, II	I, II	I, II	I, II	—	I	I, II	I, II	I	I, II	I	I, II	3
CS	—	I, II	I, II	I	I, II	I, II	I, II	I, II	I, II	I, II	I, II	—	I, II	—	I, II	I	II	I, II	I, II	3
EN	I, II	—	—	—	—	—	I, II	II	I, II	I, II	I	I, II	—	I, II	I, II	I, II	I, II	II	I, II	6
FN	I, II	—	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	1
HC	—	—	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	—	I	I, II	—	—	—	I	—	I, II	7
IN	I, II	I	I, II	—	I, II	I, II	I, II	I, II	I, II	I, II	I	I	I, II	I, II	I, II	I, II	I	I	I, II	1
IT	—	I	I	—	I, II	—	I, II	I, II	I, II	I, II	I	—	—	I	I, II	I	I, II	—	I, II	6
MT	I, II	I, II	I, II	I	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I	I, II	I	I, II	I, II	I, II	I	I, II	0
TC	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	I, II	—	I, II	I, II	I, II	I, II	I, II	I, II	0
UT	I, II	I	—	I, II	I, II	—	I, II	II	I, II	I, II	I, II	—	—	I, II	—	—	II	I, II	—	7
missing	4	3	2	5	1	3	0	0	0	0	1	4	4	2	2	2	0	2	1	

Table 3: EU regional effects of all 19 countries during pre-, GFC and post-GFC periods

Note: This table shows the average of the regional effect computed across all 10 industries for a specific country, which is the average of the forecast error variance and calculated from the SS decomposition and SVAR model using the specific sample period. I denotes pre-GFC period of 1999:1-2007:12 and II denotes GFC and post-GFC period of 2008:1-2017:5. Time denotes the forecast period which is for 1, 3 and 6 months. The first row lists the 19 countries. Member countries of the European Union include: Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Ireland (IE), Italy (IT), the Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE), and the UK (GB) before Brexit. The other three new member countries are Poland (PL), Hungary (HU), and Czech Republic (CZ). Both Norway (NO) and Switzerland (CH) are non-EU countries.

Period	time	AT	BE	CH	CZ	DE	DK	ES	FI	FR	GB	GR	HU	IE	IT	NL	NO	PL	PT	SE	average
	1	13.51	21.12	48.82	15.55	36.25	22.59	27.67	24.90	46.83	37.88	17.35	22.43	24.15	25.24	31.62	31.69	18.80	18.33	32.04	26.53
I	3	18.71	20.73	46.79	18.19	37.18	23.28	27.10	26.29	45.72	35.31	18.75	23.90	25.94	24.49	31.66	33.17	18.23	20.15	31.96	26.93
	6	18.67	25.46	44.81	18.16	36.57	24.09	25.82	25.14	45.93	35.41	18.91	23.37	25.51	20.42	24.02	32.99	17.42	17.00	28.79	26.06
	1	50.82	42.26	56.03	28.55	52.27	34.50	45.25	39.98	63.82	48.77	33.34	42.31	22.59	40.69	42.55	52.15	28.92	24.18	44.95	42.79
II	3	48.15	37.71	53.35	28.76	47.84	34.23	43.56	37.96	60.58	47.33	35.09	42.48	23.63	38.64	39.73	47.11	28.38	24.58	42.13	41.05
	6	46.97	34.96	53.25	29.52	45.38	33.84	42.41	38.40	57.73	47.23	32.35	40.32	22.82	31.14	28.19	45.75	28.09	22.55	41.03	39.04

Table 4: Regional effects for various country classifications during pre-, GFC and post-GFC periods

Note: This table shows the average of the regional effect computed across all 10 industries for various country classifications, which is the average of the forecast error variance and calculated from the SS decomposition and SVAR model. Note that in some countries, some industries are excluded from the estimation due to data paucity so the average is adjusted by the lack of industries in some countries. The sample period I denotes pre-GFC period of 1999:1-2007:12 and II denotes GFC and post-GFC period of 2008:1-2017:5. Time denotes the forecast period which is for 1, 3 and 6 months. 'Old' denotes existing Euro member countries while 'New' represents Hungary, Poland and the Czech Republic which joined the EU in recent years.

Period	Time	non-PIIGS	PIIGS	Old	New	All countries
	1	29.04	22.55	30.83	18.92	26.53
I	3	30.05	23.29	30.18	20.11	26.93
	6	29.30	21.53	29.43	19.65	26.06
	1	48.62	33.21	42.74	33.26	42.79
II	3	45.33	33.10	41.23	33.21	41.05
	6	41.94	30.26	40.70	32.64	39.04
	1	19.58	10.66	11.91	14.34	16.26
(II-I)	3	15.28	9.81	11.05	13.10	14.12
	6	12.64	8.73	11.27	12.99	12.98

Table 5: Industry effects for all 10 sectors during pre-, GFC and post-GFC periods

Note: This table shows the average of the industry effect computed across all 19countries for ten industries, which is the average of the forecast error variance and calculated from the SS decomposition and SVAR model using the specific sample period. Note that in some countries, some industries are excluded from the estimation due to data paucity so the average may not always be obtained for all 19 countries. The ten Global Industry Classification Standard (GICS) sectors are consumer discretionary (CD), consumer staples (CS),energy (EN), financials (FN), health care (HC), industrials (IN), information technology (IT), materials (MT), telecommunication services (TC) and utilities (UT).

Period	Time	CD	CS	EN	FN	HC	IN	IT	MT	TC	UT	Average
	1	4.83	20.34	21.77	9.49	13.03	7.54	8.42	16.42	18.23	18.44	11.65
I	3	6.28	21.16	21.96	9.90	15.94	8.24	18.14	18.71	25.98	18.56	14.39
	6	6.14	20.73	20.54	9.89	17.21	8.70	20.05	19.63	25.66	18.11	14.63
	1	3.90	13.54	11.01	10.76	10.89	4.41	7.01	6.85	14.93	15.88	8.94
II	3	4.55	14.41	10.74	12.99	12.14	6.30	8.63	11.85	16.38	16.25	10.71
	6	4.34	14.38	11.22	12.74	12.45	6.82	9.01	13.35	16.52	18.65	11.33
	1	-0.93	-6.80	-10.76	1.27	-2.14	-3.13	-1.41	-9.57	-3.30	-2.56	-2.71
(II-I)	3	-1.73	-6.75	-11.22	3.09	-3.80	-1.94	-9.51	-6.86	-9.60	-2.31	-3.68
	6	-1.80	-6.35	-9.32	2.85	-4.75	-1.88	-11.05	-6.28	-9.14	0.54	-3.30

Table 6: Industry effects for various country classifications during pre-, GFC and post-GFC periods

Note: This table shows the average of the industry effect computed across all 10 industries for various country classifications, which is the average of the forecast error variance and calculated from the SS decomposition and SVAR model using the specific sample period. The sample period I denotes pre-GFC period of 1999:1-2007:12 and II denotes GFC and post-GFC period of 2008:1-2017:5. Time denotes the forecast period which is for 1, 3 and 6 months. 'Old' denotes existing Euro member countries while 'New' represents Hungary, Poland and the Czech Republic which joined the EU in recent years.

Period	Time	non-PIIGS	PIIGS	Old	New	All countries
	1	15.76	9.48	18.65	2.29	11.65
I	3	17.47	11.95	22.15	6.30	14.39
	6	16.70	12.07	23.12	7.75	14.63
	1	12.13	8.11	11.83	2.07	8.94
II	3	14.03	10.01	13.14	3.66	10.71
	6	13.94	11.18	13.82	4.60	11.33
	1	-3.63	-1.37	-6.82	-0.22	-2.71
(II-I)	3	-3.44	-1.94	-9.01	-2.64	-3.68
	6	-2.76	-0.89	-9.30	-3.15	-3.30

Table 7: Country effects of all 10 sectors during pre-, GFC and post-GFC periods

Note: This table shows the average of the country effect computed across all 10 industries, which is the average of the forecast error variance and calculated from the SS decomposition and SVAR model. Note that in some countries, some industries are excluded from the estimation due to data paucity so the average may not always be calculated using all 19 countries. The sample period I denotes pre-GFC period of 1999:1-2007:12 and II denotes GFC and post-GFC period of 2008:1-2017:5. Time denotes the forecast period which is for 1, 3 and 6 months.

Period	Time	CD	CS	EN	FN	HC	IN	IT	MT	TC	UT	Average
I	1	18.87	7.58	19.03	19.67	14.29	9.42	12.86	11.15	13.12	17.00	17.03
	3	19.64	9.20	18.99	19.19	13.42	9.58	13.04	11.17	13.32	16.99	16.87
	6	22.98	12.87	22.52	24.22	14.41	14.22	17.58	13.28	15.35	19.88	20.09
II	1	13.53	7.00	12.46	15.67	13.24	3.67	8.96	6.40	9.21	13.91	11.87
	3	16.26	8.51	13.15	16.46	14.33	7.26	10.13	8.49	10.69	16.34	13.39
	6	19.96	10.66	17.40	20.02	11.95	12.18	13.29	12.64	11.78	18.43	17.73
(II-I)	1	-5.33	-0.59	-6.57	-3.99	-1.04	-5.75	-3.90	-4.75	-3.91	-3.09	-5.16
	3	-3.37	-0.68	-5.84	-2.74	0.91	-2.32	-2.91	-2.67	-2.63	-0.66	-3.48
	6	-3.02	-2.21	-5.11	-4.20	-2.46	-2.05	-4.29	-0.64	-3.56	-1.45	-2.36

Table 8: Country effects for various country classifications during pre-, GFC and post-GFC periods

Note: This table shows the average of the country effect computed across all 10 industries for various country classifications, which is the average of the forecast error variance and calculated from the SS decomposition and SVAR model using the specific sample period. The sample period I denotes pre-GFC period of 1999:1-2007:12 and II denotes GFC and post-GFC period of 2008:1-2017:5. Time denotes the forecast period which is for 1, 3 and 6 months. 'Old' denotes existing Euro member countries while 'New' represents Hungary, Poland and the Czech Republic which joined the EU in recent years.

Period	Time	non-PIIGS	PIIGS	Old	New	All countries
	1	11.28	16.03	11.12	40.78	17.03
I	3	12.09	16.02	11.54	37.52	16.87
	6	16.28	21.88	13.22	37.78	20.09
	1	5.39	12.64	9.19	27.01	11.87
II	3	8.23	13.52	10.78	26.56	13.39
	6	13.25	18.08	9.92	25.20	17.73
	1	-5.89	-3.39	-1.93	-13.77	-5.16
(II-I)	3	-3.86	-2.50	-0.76	-10.96	-3.48
	6	-3.03	-3.80	-3.30	-12.58	-2.36

Table 9: Relative importance of industry and country effects during pre-, GFC and post-GFC periods

Note: Relative importance is calculated by the ratio of VDs of industry effects to country effects and it is referred to as the factor relative importance (FRI) index. Each cell reports an FRI index. An FRI index of 1 shows that both industry and country effects are equally dominant. Time denotes the forecast period which is for 1, 3 and 6 months. The sample period I denotes pre-GFC period of 1999:1-2007:12 and II denotes GFC and post-GFC period of 2008:1-2017:5.

Period	Time	CD	CS	EN	FN	HC	IN	IT	MT	TC	UT	Average
	1	0.26	2.68	1.14	0.48	0.91	0.80	0.65	1.47	1.39	1.08	0.68
I	3	0.32	2.30	1.16	0.52	1.19	0.86	1.39	1.68	1.95	1.09	0.85
	6	0.27	1.61	0.91	0.41	1.19	0.61	1.14	1.48	1.67	0.91	0.73
	1	0.29	1.93	0.88	0.69	0.82	1.20	0.78	1.07	1.62	1.14	0.75
II	3	0.28	1.69	0.82	0.79	0.85	0.87	0.85	1.40	1.53	0.99	0.80
	6	0.22	1.35	0.64	0.64	1.04	0.56	0.68	1.06	1.40	1.01	0.64

Table 10: National industry effects for various country classifications during pre-, GFC and post-GFC periods

Note: This table shows the average of the national industry effect computed across all 10 industries for various country classifications, which is the average of the forecast error variance and it is calculated from the SS decomposition and SVAR model using the specific sample period. The sample period I denotes pre-GFC period of 1999:1-2007:12 and II denotes GFC and post-GFC period of 2008:1-2017:5. Time denotes the forecast period which is for 1, 3 and 6 months. For non-euro zone countries, 'Old' denotes original Euro member countries while 'New' represents Hungary, Poland and the Czech Republic which joined the EU in recent years.

Period	Time	non-PIIGS	PIIGS	Old	New	All countries
	1	43.92	51.94	39.40	38.01	44.79
I	3	40.39	48.74	36.13	36.07	41.81
	6	37.72	44.52	34.23	34.82	39.22
	1	33.86	46.04	36.24	37.66	36.40
II	3	32.41	43.37	34.85	36.57	34.85
	6	30.87	40.48	35.56	37.56	31.90
	1	-10.06	-5.90	-3.16	-0.35	-8.39
(II-I)	3	-7.98	-5.37	-1.28	0.50	-6.96
	6	-6.85	-4.04	1.33	2.74	-7.32

Table 11: Regional, Industry and Country Factors of Greece, Ireland and the UK

Note: This table shows the average of the regional, industry, and country effects computed across all 10 industries for Greece, Ireland, and United Kingdom, which is the average of the forecast error variance and calculated from the SS decomposition and SVAR model using the specific sample period. Time denotes the forecast period which is for 1, 3 and 6 months. The sample period I denotes pre-GFC period of 1999:1-2007:12 and II denotes GFC and post-GFC period of 2008:1-2017:5. EU denotes EU regional factor, while Industry and Country denote industry and country factors, respectively.

Period	Time	Greece			Ireland			United Kingdom		
		EU	Industry	Country	EU	Industry	Country	EU	Industry	Country
I	1	17.35	2.05	39.16	24.15	9.48	14.72	37.88	37.97	8.62
	3	18.75	6.23	36.87	25.94	11.12	13.35	35.31	38.71	11.04
	6	18.91	6.81	37.12	25.51	10.75	14.20	35.41	37.62	11.79
II	1	33.34	1.56	27.49	22.59	6.94	12.36	48.77	24.77	10.55
	3	35.09	5.81	24.27	23.63	9.64	14.50	47.33	25.72	10.80
	6	32.35	12.82	23.37	22.82	9.63	18.34	47.23	25.29	10.80