INDUSTRY CONCENTRATION AND MARKET VOLATILITY

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Abstract

In this paper our aim is to gain a better understanding of the relationship between market volatility and industrial structure. As conflicting results have been documented regarding the relationship between market industry concentration and market volatility, this study investigates this relationship in the time series. We have found that this relationship is only significant and positive for Spain. Our results suggest that we cannot generalize across different countries that market industrial structure (concentration) is a significant factor in explaining market volatility.

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Keywords: *Industry concentration; Volatility; European stock markets.*

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1. INTRODUCTION

The volatility of financial assets is a crucial variable in the analysis of market risk and portfolio construction dynamics. Stock markets with high volatility are associated with instability and can adversely affect the economy, constituting a barrier to investment. It is therefore a research area which is still being developed, particularly in terms of valuation models and econometric models for forecasting volatility.

In accordance with the finance modern theory there should be a significant relationship between industrial structure and market volatility. In fact, on the one hand, we know that certain industries are more volatile than others, and that markets oriented to more volatile industries should also have greater volatility. On the other hand, industrial concentration in the market may also play a relevant role and, the greater the concentration level, the lower the diversification (higher risk) of the market portfolio.

Since, typically, the mean correlation coefficient between assets is positive, then higher concentration leads to lower gains from portfolio diversification, that is, a higher variance of the portfolio. For example, Roll (1992) documented the importance of the industrial structure of the market as a factor behind volatility, presenting evidence that approximately 40% of market volatility can be explained by the industrial structure.

Evidence pointing to the increasing importance of industry factors in equity markets is presented by Cavaglia *et al.* (2000), Brooks and Catão (2000) and Carrieri *et al.* (2004), among others, although such studies often have distinct scopes of analysis. However, when we consider the role of industrial concentration and its association with volatility, the evidence is not extensive, nor very consistent. Xing (2004a) reported contradictory results in the cross-section analysis and presents evidence on time series for several countries.

Thus, we intend to develop the following question: "What are the effects of industry concentration on market volatility?" To answer the above question we intended to increase knowledge, at both a conceptual and empirical level, regarding the influence of the industrial structure of the markets, measured by the industrial concentration level, on the behavior of the stock market's volatility, and to what extent this variable has explanatory power for the selected countries.

We find that the relationship is only significant and positive for one of the countries studied. Our results suggest then that we cannot generalize for the different countries that make up our sample that the market structure, determined by industry concentration, is a significant factor in explaining the volatility of the market.

The remainder of this chapter will be structured as follows. In section 2 we intend to introduce a basic theoretical framework, to present the motivation for basing our assumptions and the link between industrial concentration and market volatility. In section 3 we will present the main methodological aspects and the data. The next section, section 4, examines the main results and their interpretation. Finally, in section 5 we present the main conclusions.

2. THEORETICAL FRAMEWORK

2.1. VOLATILITY

One of the most important issues in finance is the evolution of risk of financial assets over time. Reaching a decision to invest is to try to predict the risk of investment, and this risk can be understood as the volatility of unexpected results, or more generally, it refers to possible losses in financial markets.

The decision taken by the investor or portfolio manager, regarding how to structure a portfolio of assets, depends on the profitability or forecast of future gains in the acquisition of such assets and, therefore, of the risk to which this return is associated. To ascertain the risk there is a need to measure the volatility of the asset, or more precisely, the performance of that asset's returns over time.

Indeed, the idea that stock markets are volatile is not new. All agents have the perception of volatility, even those that are less familiar with the capital market. It is therefore necessary to carry out more or less sophisticated estimation methods depending on the objectives of the investigation.

The expected future volatility of financial assets has a major role in the finance theory. Many of the formulas for pricing financial assets are associated with the

volatility as a relevant variable. Also, in the portfolio dynamic constitution and diversification, assessing the level of expected volatility of each asset available is one of the first steps to determine the efficient frontier of portfolio risk and expected return.

The volatility of the stock market varies from country to country, especially when the economic structures of countries are more diverse, reflecting the volatility of its main indicators. In general, a market's volatility is associated with the volatility of the company's activities that make up this market.

In a market where listed companies are representative of the entire economy, the volatility of the capital market depends on the volatility of GDP. The volatility of the capital market also usually depends on the volatility of economic policy, either in terms of fiscal or monetary aspects. In addition, market volatility is very dependent on the market's maturity and structure.

So when it is necessary to estimate the volatility of certain assets, one of the ways that researchers and investors use is to analyze the past behavior of its prices and trust that this behavior should be maintained in the near future.

Obviously, there are several critics who oppose this approach, specifically the fact that the past behavior of the assets will be maintained in the future, even when we examine the very near future. Thus, an alternative to this approach is to consider that markets are efficient and, therefore, the prices of the latest negotiations are fairly priced and have absorbed all the public information.

One way to estimate the expected volatility in the market of certain assets is to make a collection of the market prices of various financial options and the prices of the underlying assets. So far it is argued that if the options markets are efficient, the implied volatility derived from the price of an option must be a better indicator of future market volatility than that derived from models based on historical data.

The implied volatility contains the market participants' expectations about future events, and incorporates information that is not strictly historical, such as, for example, the publication of new indicators of economic policy in the near future.

Crucially, the value of options depends on the expected future volatility of its underlying asset: the higher the expected volatility of the underlying asset, the greater the value of the option.

The most widely used models for calculating the volatility are standard deviation, simple moving average, exponential smoothing (EWMA - Exponentially Weighted Moving Average) and the various models of GARCH (Generalized Autoregressive Conditional Heteroscedasticity): ARCH, GARCH, EGARCH and TGARCH.

2.2. INDUSTRIAL CONCENTRATION AND VOLATILITY

Will the industrial concentration be a determining factor in the variability of equity returns? This question, introduced by Lessard (1974) has long been discussed.

According to the finance theory the relationship between market structure and market volatility should be intuitive. However, several empirical studies conducted over the last few years have yielded conflicting results. Some suggest that the market structure (measured by the industry concentration) is indeed an important factor in explaining the market's volatility.

Studies that analyze the behavior of the stock indices returns and volatilities time series, through the principles of the portfolio diversification, are relevant in this context in that industrial concentration is associated with a portfolio diversification.

From the portfolio theory perspective, the study by Roll (1992), and various studies that quote Roll (1992), raises the question: what is more important, industrial diversification or geographic diversification?

If a line of thought argues that globalization and the increasing integration of the markets allows the dominating predominance of the industry/sector factor in the portfolios' profitability and their variances, another line of thinking has extensive evidence to suggest that the country factor is even more relevant than the industrial or sector factors.

On this issue, and considering the major European markets, the importance of the industry factor in financial markets it is well established in literature. Below we will concisely discuss the main conclusions of the most relevant of these studies.

Roll (1992) uses data from 24 countries, published daily in the London Financial Times (*FT Actuaries/Goldman Sachs International Indexes*) to investigate the relationship between returns and the volatility of market indices and a number of different factors, which encompass the industrial composition of the index, and consider its industrial concentration. The author concludes that the industrial structure plays a relatively important role in explaining the price formation of the indices and that the national indexes reflect, therefore, the idiosyncratic characteristics of the industrial structure of each country.

Generally, the article shows that the volatility of the global index of a country is inversely related to the number of firms that constitute the index and is positively related to the Herfindahl index of concentration. These results represent an additional motivation element to this study.

Several other studies have been published citing the work of Roll (1992), each supporting his conclusions regarding the dominance of the industry factor, while others pointed to a greater relative importance of the country factor.

Heston and Rouwenhorst (1994) used a data set of 829 companies included in the MSCI indexes of 12 European countries for the period between 1978 and 1992, grouped in the same sector categories used by Roll (1992) and, using the same methodology, to achieve very similar conclusions regarding the importance of industry factors on returns. However, these authors criticized Roll's methodology and, when they included changes in the methodology they reached opposing conclusions, verifying a diminishing effect of the industry.

In another study, Griffin and Karolyi (1998) based on the previous studies, extended the study to include 25 countries and 66 industrial classifications, for the period between 1992 and 1995. Using a model with a dummy variable, they decomposed the daily return of the Dow Jones World Stock Index on specific industry and country components. As for the results, in line Heston and Rouwenhorst (1994) and contrary to

Roll (1992), they suggested that the factors specific to each country take precedence over specific factors of the sector, achieving a better portfolio diversification.

Griffin and Karolyi (1998) also check that when, within each country, industry sector portfolios are created relatively large and comprehensive, the variance of the portfolio is reduced to 21.9% of the variance of the average firm, and industrial diversification, without geographic diversification can reduce the variance of the shares by about 78.1% on average. However, diversification in different countries, considering the same industrial clustering can reduce the portfolio variance in only 8.4% of the average individual variance, that is, a reduction of 91.6%.

The authors draw attention to the complexity of this analysis, considering the possibility of distinguishing two categories of industries, those who produce and are active internationally (e.g. Oil & Gas) and those that produce goods that are primarily consumed internally. The issue is even more complex considering that the structure of covariances in global equity market returns is not stationary over time.

More recently, Isakov and Sonney (2004) indicated a trend of change and, although historically the country factor has dominated the returns and variance in most markets, data for recent years indicates a reversal of this situation (found through the practices of financial professionals and institutions, that have begun to use portfolio allocation strategies based on industrial sectors, leaving the geographical criterion). Isakov and Sonney (2004) conducted their analysis using weekly data relating to a sample of 4,359 firms from 20 countries during the period from June 1997 to December 2000.

Of the studies that examine the relationship between systematic risk and idiosyncratic components of the stocks of a market portfolio, we call attention to Campbell *et al*. (2001), and several other later studies that used the same framework.

Campbell *et al.* (2001) decompose the total return and, therefore, the volatility of the constituting stocks. They decompose the return of a stock into three components (market, industry and firm components). By decomposing the total volatility into the three parts, they conclude that market volatility is responsible for 16% of the total volatility, the volatility of the industry is responsible for 12% and the company-specific volatility contributes 72% to the total volatility. Most of the variation in volatility is

associated with the variation of market volatility and is firm specific, while the volatility associated with the industry is more stable over time.

However, if as we have seen, the importance of industry seems to be increasingly indisputable, the relationship between market structure (as measured by industry concentration levels found in markets) and the volatility of the same does not seem to be that linear.

In this respect, Xing (2004a), after noting that studies on this relationship in the cross-section show conflicting results, performs an analysis on this relationship in time series of industrial concentration and market volatility, using data from 21 developed countries, and finds a significant relationship for about 61% of countries, within the time frame between 1973 and 2000.

The author also finds evidence for the existence of a causal relationship between market concentration and its volatility, for about 70% of the analyzed markets, thus emphasizing the influence of industrial structure on market volatility.

However, Chelley-Steeley (2008) also studied the concentration of the stock market in the UK between 1984 and 2001 and found no association between concentration and volatility. The author compared the variance of profitability, using different rules of construction, with different levels of concentration and found that the movement of the concentration level has very little impact on the index volatility.

3. METHODOLOGY AND DATA

3.1. VOLATILITY AND INDUSTRIAL CONCENTRATION

Following Roll (1992) and Hou and Robinson (2006), we will proceed through the measure of industry concentration using Herfindahl-Hirschman's concentration index as a proxy for the industrial concentration of each market.

Industry concentration is evaluated in all selected industries according to the Industry Classification Benchmark (ICB). Specifically, the industry concentration in each country/market, each week, is calculated as follows:

$$IND_{it} = \sum_{j=1}^{n} \left(\frac{MVIND_{ijt}}{CAP_{it}} \right)^2 \quad (1)$$

where, IND_{it} is the industry concentration in country *i* at week *t*; $MVIND_{ijt}$ is industry *j* *(j = 1, 2, …, n)* market value in country *i* at week *t*; and CAP_{it} is the total capitalization of the market *i* at week *t*.

Thus, this measure of concentration assesses the degree of dispersion of firms in a given market for the industries considered. The higher the value of this measure, the greater the concentration of the listed firms. The industrial concentration in each market will have values ranging from 0.1 (all listed companies are equally distributed in the 10 industries) to 1 (all listed companies are concentrated in one of the 10 industries).

As mentioned earlier, the GARCH (Bollersev, 1986) have been relatively successful in modeling the conditional volatility. However, the conventional GARCH models fail to capture the asymmetric effect of positive or negative returns in volatility.

This effect, shown by Black (1976) occurs when an unexpected fall in price increases volatility more than an unexpected increase in price of similar magnitude. The existence of this asymmetric effect implies that a symmetric specification of the conditional variance function, as in the conventional GARCH model is theoretically inappropriate. In an attempt to solve this problem, Nelson (1991) introduced the EGARCH (Exponential Generalized Autoregressive Conditional Heteroscedastic) model.

In this work, we take advantage of the EGARCH model to examine the time series relationship between industry concentration and market volatility. Specifically, we estimate the following modified EGARCH model, which includes the market industry concentration (IND):

$$R_{it} = \alpha_i + \beta_i \, IND_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} = \sqrt{h_{it}} \, e_{it} \quad (2)$$

$$e_{it} \sim N(0,1)$$

$$\log(h_{it}) = \alpha_{0i} + \beta_i \log(h_{i(t-1)}) + \alpha_{1i} \left| \frac{\varepsilon_{i(t-1)}}{\sqrt{h_{i(t-1)}}} \right| + \gamma_i \frac{\varepsilon_{i(t-1)}}{\sqrt{h_{i(t-1)}}} + \varphi_i \ IND_{it}$$

where, R_{it} is the market/country i return at week t; h_{it} is the conditional variance of return at week t; and IND_{it} is the market industry concentration in country i at week t.

Since the coefficient of $\varepsilon_{t-1} / \sqrt{h_{t-1}}$ is typically negative, the EGARCH model is asymmetric, that is, all else being equal, positive return shocks generate less volatility than negative return shocks.

The coefficient φ in the variance equation can be interpreted as a measure of the incremental information which market industry concentration contributes to changes in the conditional variance of return over time. Therefore, the hypothesis that market industry concentration is significantly related to market volatility can be tested by examining the statistical significance of the estimate of φ.

We agree with Xing (2004a) and also consider it important to know whether there is a causal relationship between industry concentration and market volatility. If market industry concentration is a significant factor affecting market volatility, we would expect market industry concentration to cause market volatility. Thus, an investigation of the causality will provide further evidence of the true relationship between market industry concentration and market volatility. To examine the causal relationship, we apply the following bivariate, 24th order vector autoregressive (VAR) model:

$$\begin{cases} VOL_{it} = \omega_i + \sum_{j=1}^{24} \alpha_{ij} \ VOL_{i(t-j)} + \sum_{j=1}^{24} \beta_{ij} IND_{i(t-j)} + \varepsilon_{it} \\ IND_{it} = \omega'_i + \sum_{j=1}^{24} \alpha'_{ij} \ VOL_{i(t-j)} + \sum_{j=1}^{24} \beta'_{ij} IND_{i(t-j)} + \varepsilon'_{it} \end{cases} \quad (3)$$

where, VOL_{it} is the EGARCH market volatility for country i at week t; and IND_{it} the market industry concentration for country i at week t. Similarly, $VOL_{i(t-j)}$ and $IND_{i(t-j)}$

are the market volatility and industry concentration for country *i* at week *(t−j)*, respectively. $\omega_i, \omega'_i, \alpha_{ij}, \alpha'_{ij}, \beta_{ij}, \beta'_{ij}$ are simply constants.

After estimating the VAR model, we use F tests to assess the predictive power of lagged industry concentration on market volatility and vice versa.

3.2. DATA

In this study the sample is comprised of a total of 11,164 firms, from nine European countries, which are the four countries within the Euronext (Belgium, France, Netherlands and Portugal), Germany, Spain, Italy, Switzerland and the UK, each of which is assigned to one of 10 industries, according to the ICB (Industrial Classification Benchmark).

Table 1 shows the industrial disaggregation considered in this study in further detail. These countries were selected according to their relevance in the European financial markets landscape.

We used weekly returns[1] and the total capitalization of companies from nine countries during the period from January 1990 to December 2008.[2] This period includes 992 weekly returns, with the values expressed in Euros for all countries. Data was collected from the Datastream database[3], where each firm is integrated in one of 10 industries. We considered the use of this breakdown in ten industrial categories since Griffin and Karoly (1998) have shown that using a more detailed breakdown would not cause significant changes to the results.

[1] We use weekly data because it is less "noisy" than daily data and more informative than monthly data. In fact, we consider that daily returns would be less appropriate because there are differences in the timing of negotiations among the countries considered in our sample. Conversely, monthly data is not used because important information could be lost. In order to avoid problems associated with the Monday and weekend effect our returns are calculated from Wednesday to Wednesday.

[2] The time horizon was defined to ensure that information is available for all countries and over the selected time horizon, since the data for the Portuguese market only started in January 1990.

[3] It has coverage of approximately 90% of the total market capitalization of each country.

Table 1 – Industries and sectors studied

The industry composition follows the DataStream Global Indices Database (based on ICB - Industry Classification Benchmark).

Industries / Sectors		
Industry	Code	Sector
0001	0580	Alternative Energy
Oil & Gas	0530	Oil & Gas Producers
	0570	Oil Equipment & Services
1000	1350	Chemicals
Basic Materials	1730	Forestry & Paper
	1750	Industrial Metals & Mining
	1770	Mining
2000	2710	Aerospace & Defense
Industrials	2350	Construction & Materials
	2730	Electronic & Electrical Equipment
	2720	General Industrials
	2750	Industrial Engineering
	2770	Industrial Transportation
	2790	Support Services
3000	3350	Automobiles & Parts
Consumer Goods	3530	Beverages
	3570	Food Producers
	3720	Household Goods & Home Construction
	3740	Leisure Goods
	3760	Personal Goods
	3780	Tobacco
4000	4530	Health Care Equipment & Services
Health Care	4570	Pharmaceuticals & Biotechnology
5000	5330	Food & Drug Retailers
Consumer services	5370	General Retailers
	5550	Media
	5750	Travel & Leisure
6000	6530	Fixed Line Telecommunications
Telecommunications	6570	Mobile Telecommunications
7000	7530	Electricity
Utilities	7570	Gas, Water & Multiutilities
8000	8350	Banks
Financials	8770	Financial Services (Sector)
	8570	Life Insurance
	8530	Nonlife Insurance
	8630	Real Estate Investment & Services
	8670	Real Estate Investment Trusts
9000	9530	Software & Computer Services
Technology	9570	Technology Hardware & Equipment

For selected markets, we used the global market indices - TOTMK (Total Market) in each country, directly extracted from the Datastream, obeying a fundamental criterion: the methodology for calculating all the indices should be the same.

Thus, representing the most important markets in Europe, we selected the following indices: TOTMKBE (Belgium); TOTMKCH (Switzerland); TOTMKDE (Germany); TOTMKES (Spain); TOTMKFR (France); TOTMKGB (United Kingdom); TOTMKIT (Italy); TOTMKNL (Netherlands) and TOTMKPT (Portugal).

As for industries, the industrial classification used was based on the criteria of the ICB (Industry Classification Benchmark) which, as was mentioned above, is widespread in major global equity indices. This aggregation by industry sector is also directly supplied by Datastream.

Another advantage of this methodology of industrial classification is its universal structure, which allows it to be used in any stock market. Thus, we sought the use of a reliable standard and tested methodology saving time and resources in building criteria of classifications that could present flaws and exceptions.

As for the overall total and industry indices, and regarding the data considered in this study, they have different capitalization start dates by country and sector, as can be seen in Table 2.

Indeed, we found that all countries global indices TOTMK start in January 1990. However, there are sectors with later start dates and different dates between countries, especially the Oil & Gas, Telecommunications, Technology and Utilities sectors.

In panel A of Table 3 there is a set of descriptive statistics relating to industry concentration in the nine considered markets. We found that, in general terms, there is considerable time series instability in the industry concentration variable. For example, in Portugal, this variable takes values from 0.163 to 0.718, while in France these values only vary between 0.117 and 0.145.

Table 2 – Dates of the initial capitalization of the total and industrial indices

This table shows the dates of the initial capitalization of the total and industrial indices (Basic Materials; Consumer Goods; Consumer Services; Financials; Healthcare; Industrials; Oil & Gas; Technology; Telecommunications; and Utilities) in all selected counties.

Indices	**Countries**								
	BE	CH	DE	ES	FR	GB	IT	NL	PT
Total Market	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90
Basic Materials	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Feb-90
Consumer Goods	Oct-96	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Mar-90
Consumer Services	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Apr-90
Financials	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	May-90
Healthcare	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jun-90
Industrials	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jul-90
Oil & Gas	Jun-96	Dec-06	May-06	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Oct-06
Technology	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jan-90	Jul-99
Telecommunic.	Jan-90	Sep-98	Jan-90	Nov-99	Oct-97	Jan-90	Jan-90	Jun-94	Jun-95
Utilities	Jan-90	Jan-90	Jan-90	Jan-90	Jul-00	Jan-90	Jan-90	Jan-90	Jun-97

From another perspective, the level of industry concentration also varies between countries, with the lowest value (mean) in France (0.132) and the higher value in Switzerland (0.347). Panel B of Table 3 shows the pattern of industrial distribution in each of the considered geographical markets.

The distribution among the 10 industries, measured by the ratio of market value of all listed companies in an industry over the market value of all listed companies in a given market (country), also shows some differences from country to country. The financial sector is the most relevant sector in all countries, except Switzerland which highlights the healthcare sector with about 50% of total capitalization. For example, in countries such as Portugal and Italy about 45% of the total capitalization is concentrated in the financial sector, while in France this figure falls to 18%.

Table 3 – Market industry concentration and industrial distribution for the 9 selected countries

This table presents the main descriptive statistics on industrial concentration (panel A) and average market share of each sector/industry in each country (panel B). In each week considered, during the sample period, we calculate the industry concentration for each market using the Herfindahl index, as follows:

$$IND_{it} = \sum_{j=1}^{n} \left(\frac{MVIND_{ijt}}{CAP_{it}} \right)^2$$

where IND_{it} is the industrial concentration for country i at week t, $MVIND_{ijt}$ is the market value of industry j ($j = 1, 2, ..., n$) in the country i at week t, and CAP_{it} is the total capitalization of the market i in week t. The market share of each industry in each country is measured by the ratio of the market value of all firms in an industry over the market value of all firms in a given country. We use data from the Datastream, which groups all the firms in 10 major industry groups (according to the ICB classification). The period under consideration is January 1990 to December 2008.

Panel A

Country		Industry Concentration (Average)	Industry Concentration (StdDev)	Industry Concentration (Min)	Industry Concentration (Max)
BE	Belgium	0.298	0.055	0.204	0.441
CH	Switzerland	0.347	0.064	0.204	0.454
DE	Germany	0.177	0.033	0.126	0.240
ES	Spain	0.211	0.013	0.186	0.251
FR	France	0.132	0.006	0.117	0.145
GB	United Kingdom	0.161	0.015	0.136	0.189
IT	Italy	0.265	0.055	0.197	0.429
NL	Netherlands	0.219	0.028	0.166	0.290
PT	Portugal	0.336	0.165	0.163	0.718
	Average	0.238	0.048	0.167	0.351

Panel B

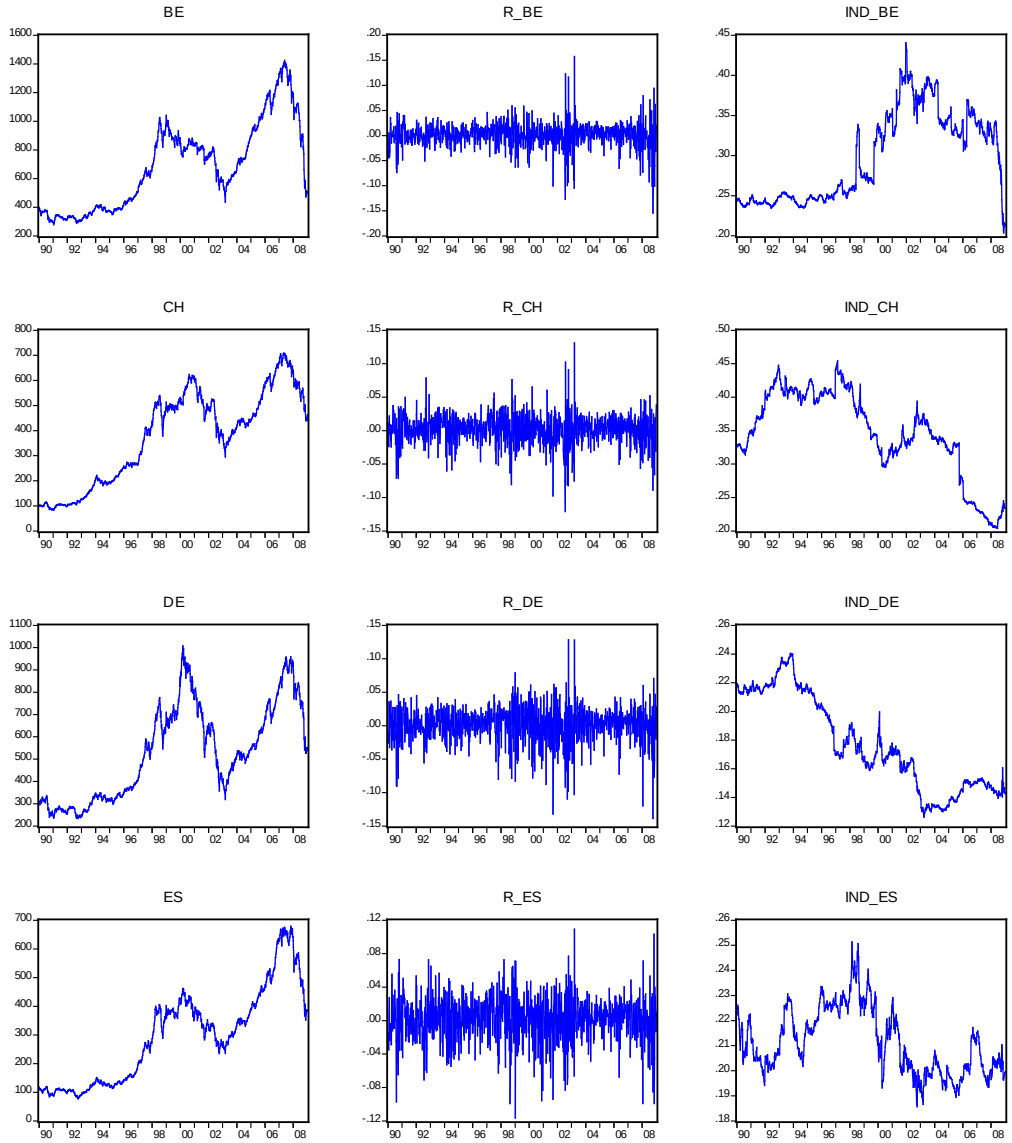
Country		Industries									
		BSM	CSG	CSS	FIN	HTC	IND	O&G	TLC	UTL	TEC
BE	Belgium	0.128	0.025	0.055	0.449	0.074	0.060	0.001	0.024	0.180	0.005
CH	Switzerland	0.044	0.050	0.029	0.260	0.497	0.084	0.000	0.016	0.014	0.005
DE	Germany	0.127	0.111	0.048	0.288	0.060	0.189	0.001	0.070	0.059	0.048
SP	Spain	0.067	0.009	0.061	0.339	0.029	0.044	0.082	0.161	0.202	0.007
FR	France	0.086	0.090	0.113	0.184	0.149	0.135	0.106	0.041	0.028	0.068
UK	U. Kingdom	0.070	0.022	0.171	0.237	0.169	0.050	0.135	0.085	0.050	0.011
IT	Italy	0.031	0.090	0.054	0.439	0.012	0.052	0.097	0.147	0.069	0.008
NL	Netherlands	0.060	0.043	0.102	0.325	0.120	0.069	0.220	0.036	0.000	0.023
PT	Portugal	0.130	0.011	0.080	0.455	0.001	0.050	0.011	0.154	0.105	0.003
	Average	0.083	0.050	0.079	0.331	0.124	0.081	0.073	0.081	0.079	0.020

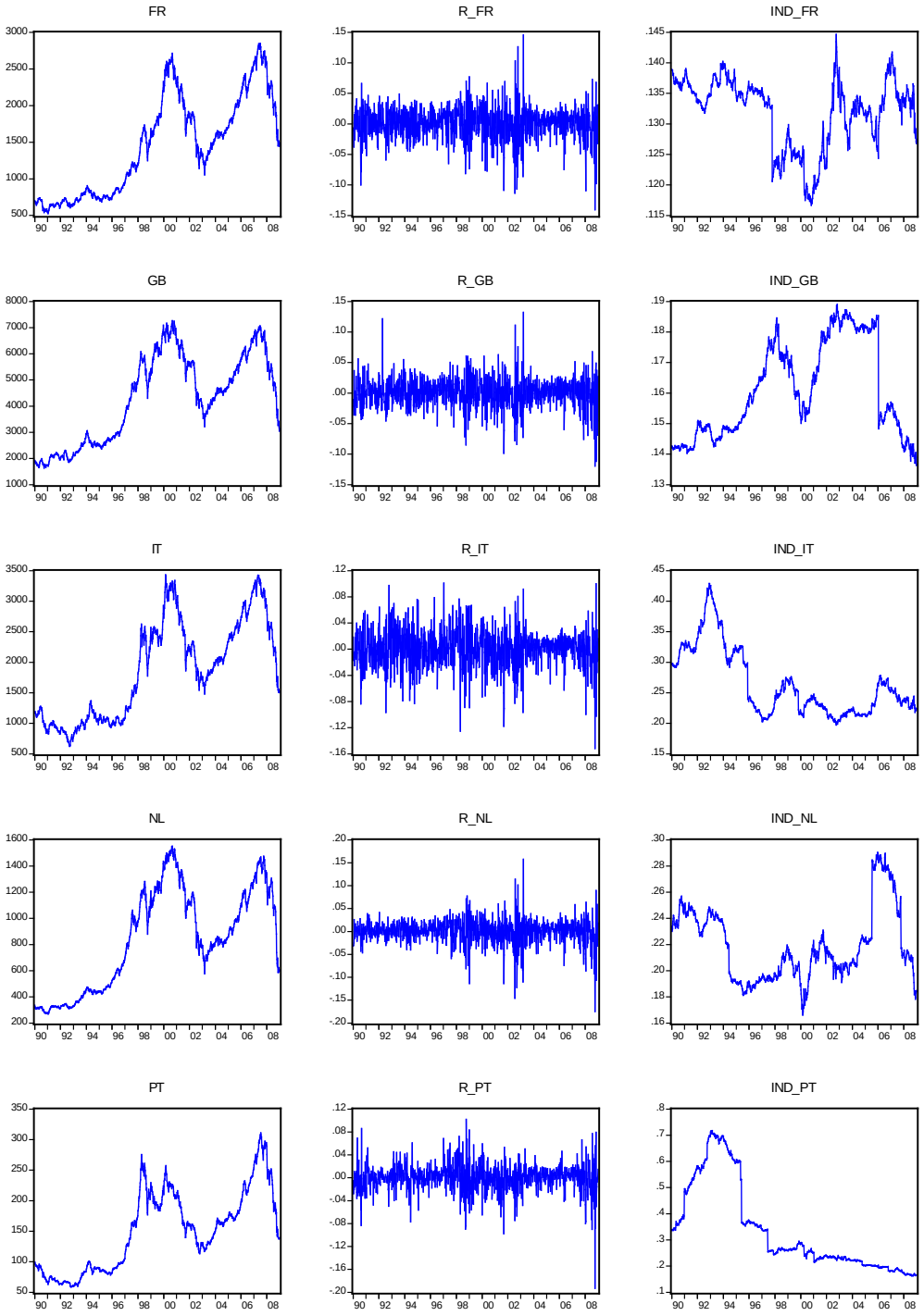
In Figure 1 we can also verify the general improvement in price indices and their returns over time (from January 1990 to December 2008) as well as changes in levels of the Herfindahl concentration index for all considered markets: BE - Belgium CH - Switzerland DE - Germany ES - Spain FR - France GB - United Kingdom IT - Italy NL - Netherlands, PT - Portugal.

The graphs show that the weekly returns series exhibit volatility clusters and that these occur at times of declines in asset prices. This situation is characterized by the pattern observed in that "valleys" in returns are "peaks" of volatility, indicating a higher sensitivity of volatility to average price reductions in the prices of assets of each specific country. We can also notice that there seems to be a direct relationship between the different countries, which is evident throughout the study period, at which high prices are shared by all the indices and fall times are also widespread among them.

Figure 1 – Evolution of global indices price, return and industry concentration levels, from Jan/1990 to Dec/2008

This figure shows, for the considered nine countries (BE - Belgium, CH - Switzerland, DE - Germany, ES - Spain, FR - France, GB - United Kingdom, IT - Italy, NL - Netherlands and PT - Portugal) the evolution of the general price level of the global indices, as well as the return evolution (R_). On the right side we present the Herfindahl concentration level evolution (IND_).




FR
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NL
R_NL
IND_NL
PT
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IND_PT

4. RESULTS

The EGARCH model estimation is performed by the method of maximum likelihood. In panel A of Table 4 the results for the regression coefficients in the variance equation are presented to explain the market's volatility over time.

The estimated EGARCH model shows the presence of asymmetry in the returns volatility, which can be confirmed by the coefficient γ that captures the asymmetric volatility, and is statistically different from zero (significance level of 1%, except in IT and PT), indicating that positive shocks on volatility do not have the same effect as negative shocks.

The leverage effect can be observed when the asymmetry coefficient γ of the estimated EGARCH model volatility is less than zero. Therefore, as the coefficient is presented as less than zero, there is the existence of the leverage effect.

The persistence coefficient β is high (above 0.888) and statistically significant at 1%, confirming that the volatility shocks weaken slowly. For the aggregate effect of industry concentration on market volatility, we analyze it while taking the value of the parameter φ into consideration.

We focus on the coefficient φ, related to industry concentration (IND), and find that in only one of the surveyed nine countries industrial concentration is significant and positive (Spain), but in France we have a negative coefficient with significance.

Also in panel B of Table 4, and specifically in addressing concentration variable (IND), we present the coefficient φ, for the total sample and two sub-periods (Jan. 1990 - Dec. 2000) and (Jan. 2001 - Dec. 2008). In this analysis it appears that there is no stability in either sign or significance of the coefficient, when comparing the sub-periods and the total sample.

Table 4 – Time series relationship between market industry concentration and market volatility: results of the EGARCH model estimation

This table shows the time series relationship between in the market industry concentration and market volatility, which was investigated by estimating the following modified EGARCH model, which includes the industry concentration of the market (IND):

$$R_{it} = \alpha_i + \beta_i IND_{it} + \varepsilon_{it}, \quad \varepsilon_{it} = \sqrt{h_{it}}\, e_{it}, \quad e_{it} \sim N(0,1);$$

$$\log(h_{it}) = \alpha_{0i} + \beta_i \log(h_{i(t-1)}) + \alpha_{1i} \left| \frac{\varepsilon_{i(t-1)}}{\sqrt{h_{i(t-1)}}} \right| + \gamma_i \frac{\varepsilon_{i(t-1)}}{\sqrt{h_{i(t-1)}}} + \varphi_i\ IND_{it}$$

where, R_{it} is the market/country i return at week t, h_{it} is the conditional variance of market return of country i at week t, and IND_{it} is the industry concentration in the market for country i at week t. In panel A of this table (sample period begins in January 1990 and ends in December 2008) we report the regression estimated coefficients in the equation and the variance and standard deviation (in parentheses). In panel B, we present the results of the φ coefficient, related to industrial concentration, for the entire period (1990-2008) and for two sub-periods (1990-2000) and (2001-2008).

***, **, * Statistically significant at 1%, 5% and 10% level respectively.

Panel A

Country		α_0	α_1	β	γ	φ
BE	Belgium	1.281*** (0.275)	0.340*** (0.056)	0.888*** (0.027)	-0.134*** (0.045)	0.498 (0.334)
CH	Switzerland	-0.829*** (0.185)	0.264*** (0.054)	0.922*** (0.020)	-0.125*** (0.035)	0.040 (0.175)
DE	Germany	-0.623*** (0.125)	0.244*** (0.052)	0.934*** (0.017)	-0.095** (0.039)	-0.340 (0.274)
ES	Spain	-0.795*** (0.205)	0.130*** (0.036)	0.945*** (0.017)	-0.104*** (0.028)	1.366*** (0.487)
FR	France	-0.369* (0.198)	0.232*** (0.050)	0.922*** (0.018)	-0.142*** (0.038)	-3.018** (1.515)
GB	U. Kingdom	-0.535*** (0.136)	0.155*** (0.038)	0.937*** (0.018)	-0.123*** (0.036)	-0.406 (0.407)
IT	Italy	-0.418*** (0.131)	0.219*** (0.048)	0.965*** (0.013)	-0.040 (0.032)	0.001 (0.123)
NL	Netherlands	-0.637*** (0.145)	0.307*** (0.050)	0.939*** (0.016)	-0.105*** (0.038)	-0.310 (0.356)
PT	Portugal	-0.483*** (0.165)	0.260*** (0.047)	0.961*** (0.019)	-0.035 (0.029)	-0.030 (0.050)

Panel B

Country		1990-2008	1990-2000	2001-2008
BE	Belgium	0.498	1.113**	0.156
CH	Switzerland	0.040	0.159	-0.060
DE	Germany	-0.340	-0.797	1.999
ES	Spain	1.366***	0.922	2.600**
FR	France	-3.018**	-4.491**	-1.111
GB	U. Kingdom	-0.406	1.090*	-0.829
IT	Italy	0.001	0.021	-0.737
NL	Netherlands	-0.310	-0.304	-0.391
PT	Portugal	-0.030	-0.118	-0.887

These findings question the conclusions drawn by the study undertaken by Xing (2004a) that showed, in general, a positive and significant relation. However, no confirmation of a clear link between the industry concentration in the indices and their volatility is consistent with the conclusions of Chelley-Steeley (2008) for the main index representing the UK market (FTSE 100).

Based on the results that we have extracted we must conclude that, for almost all of the countries surveyed, there is no support that concentration risk is associated with the levels of volatility of the indices.

Also, in Table 5, the results of the F test for the bivariate VAR model, in order to evaluate that causal relationship have been presented.

Here, a little more consistent with the findings of Xing's (2004a) study, but without the possibility of generalization, it appears that for the entire period, in only four out of the nine cases there is a significant statistic that demonstrates the existence of causality. The direction of this causality is considerably stronger from industry concentration to market volatility.

After this analysis we can conclude that the relationship between market industry concentration and market volatility, in the time series, should be examined by country, and without the ability to make generalizations.

Table 5 – F-tests from vector autoregressive (VAR) models for market industry concentration and market volatility

This table presents the causal relation between market industry concentration and market volatility which is investigated by estimating the following bivariate vector autoregressive (VAR) model:

$$\begin{cases} VOL_{it} = \omega_i + \sum_{j=1}^{24} \alpha_{ij}\, VOL_{i(t-j)} + \sum_{j=1}^{24} \beta_{ij}\, IND_{i(t-j)} + \varepsilon_{it} \\ IND_{it} = \omega'_i + \sum_{j=1}^{24} \alpha'_{ij}\, VOL_{i(t-j)} + \sum_{j=1}^{24} \beta'_{ij}\, IND_{i(t-j)} + \varepsilon'_{it} \end{cases}$$

where, VOLit is the EGARCH market volatility for country i at week t and INDit is the market industry concentration for country i at week t. The estimation period is from the first week of the starting year (1990) to December 2008. F-statistics are used to test the joint significance of lagged VOL(IND) in explaining IND(VOL). We also present the values for two sub-periods.

***, **, * Statistically significant at 1%, 5% and 10% level respectively.

Country		***F-Stat* - VOL**[a]		
		1990-2008	*1990-2000*	*2001-2008*
BE	Belgium	4,089***	1,430*	2,773***
CH	Switzerland	1,083	0,561	1,343
DE	Germany	2,425***	1,880***	3,342***
ES	Spain	2,304***	0,897	3,128***
FR	France	1,135	0,924	0,824
GB	U. Kingdom	2,029***	1,524*	1,441*
IT	Italy	1,159	0,887	1,797**
NL	Netherlands	1,143	1,284	1,026
PT	Portugal	0,201	0,428	0,932

Country		***F-Stat* - IND**[b]		
		1990-2008	*1990-2000*	*2001-2008*
BE	Belgium	1,557**	1,358	0,871
CH	Switzerland	0,867	1,149	1,65**
DE	Germany	1,426*	0,511	1,872***
ES	Spain	2,329***	1,406*	1,670**
FR	France	1,134	1,221	1,160
GB	U. Kingdom	0,785	1,761**	0,381
IT	Italy	0,796	0,722	1,116
NL	Netherlands	0,615	1,266	0,364
PT	Portugal	0,903	0,956	0,686

[a] These columns report the results of F-tests for the joint significance of lagged IND in explaining VOL.

[b] These columns report the results of F-tests for the joint significance of lagged VOL in explaining IND.

When considering the incongruous results, first we must consider the time horizons used in our study. Xing's study (2004a) which used a similar methodology, but with data from 1973 to 2000, with several countries in its sample, has a large number of cases with significant and positive relationships, with the exception of Spain. In our case, is only Spain that supports a positive and significant relationship between industrial concentration and market volatility, however, with a completely different horizon, in this case from 1990 to 2008. We are led to conclude that the relationship shown is not consistent with wide horizons, and that it is possible that it does not maintain robustness in times of crises and uncharacteristic events in the markets.

We still consider, however, that the structure and industrial composition of the markets should be taken into account still. But it is not enough to simply consider the industrial concentration level of each market to evaluate its relationship with market volatility because this relationship may be completely distorted if we consider that this concentration may be a concentration in industries focused on more volatile or less volatile industries. Indeed, this possibility is even referenced by Xing (2004a), although only to explain the exception found in the study.

5. CONCLUSION

The relationship between market volatility and the industrial structure has increasingly been observed in recent years. It was in this sense that we propose this work that comprises a study on the relationship between industrial clustering and concentration and volatility of the stock indices of the major European markets.

As we have seen inconsistent evidence about the relationship between industrial concentration and market volatility, this study investigates this relationship in time series using data from nine of the most important European markets. If the importance of the industry factor seems to be increasingly indisputable, also there does not seem to be a linear relationship between the market structure (measured by industrial concentration of markets) and the market volatility.

As we have seen, Xing (2004a), after noting that studies on this relationship in cross-section show conflicting results, has performed an analysis on the relationship in time

series of industrial concentration and market volatility, using data from 21 developed countries, and found a significant relationship for about 61% of countries. However, Chelley-Steeley (2008) also studied the concentration of the stock market in the UK and found no correlation between concentration and volatility in their study which considered the main representative market index (FTSE 100).

In our study, which used a very comprehensive database, we note that this relationship is only significant and positive for one of the nine countries examined, suggesting that we cannot generalize that in other countries the industry concentration is a significant factor in explaining the market volatility.

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