U.PORTO

FEP FACULDADE DE ECONOMIA UNIVERSIDADE DO PORTO

STOCK MARKET AS A LEADING INDICATOR OF THE GDP GROWTH RATE: EVIDENCE FROM EUROPE

Rodrigo Nuno Costa Vaz Pinto de Sousa

Dissertation
Master in Finance

Orientado por
Júlio Fernando Seara Sequeira da Mota Lobão, Ph.D.

2019/2020

Abstract

This dissertation aims to address the empirical evidence in leading indicator studies of European countries and examine the causal relationship between stock markets and economic growth using the Granger-causality test.

The goal of this study is to understand if the stock markets "Granger-cause" the economic activity for the six countries selected in Europe (France, United Kingdom, Germany, Portugal, Ireland and Greece) during the period from 1995 to 2017 and considering further the causality relationship between the variables excluding the years of most impact of the world wide crisis of 2008.

The findings presented in this study suggest a causality relationship between stock markets to GDP for five out of the six countries tested (France, Germany, Portugal, Ireland and Greece), being the United Kingdom is the only country with an opposite causality (GDP to Index). The results support the empirical evidence on the ability of stock markets to help forecast the economic growth for most of the countries tested. However, the results obtained on the analysis of subperiods with and without the impact of the 2008 worldwide crises suggest that this causality relationship may change over time, as observed in the case of France and Portugal which displayed a causality relationship from GDP to Index for the subperiod "with crisis".

In summary it is plausible that, considering the results suggested from this study, the evolution of stock markets can indeed help forecast the evolution of the GDP for most European countries in the near future.

Key Words: Leading indicator, Stock market indexes, Economic growth (GDP), Granger-Causality, Europe

JEL Codes: C15; D11; G11; G12; G14; G17; O11; O47

Table of Contents

Index of Figures

Index of Tables

1. Introduction

The main intent of this dissertation is to investigate whether the stock markets are leading indicators of economic activity.

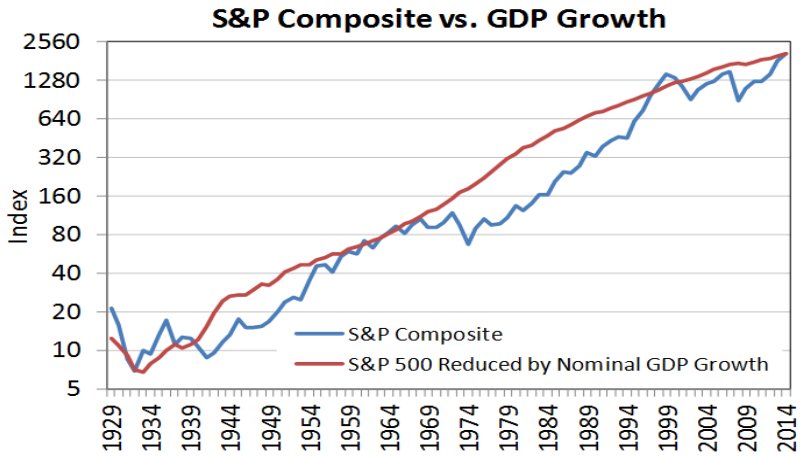
The stock markets' ability to work as an indicator or to "cause" economic growth has been widely debated between several authors in the past due to the close relationship displayed between both variables. Traditionally, the stock markets have been viewed as an indicator for the economy growth assuming that large variations in stock markets will further be reflected on the variation of economic activity (Schwert, 1989; Fama, 1990). However, this subject does not come without controversy. Many authors have refuted this hypothesis pointing various reasons to doubt the stock market's ability to help forecast economic growth (Peek and Rosenberg, 1989).

One of the most mentioned reasons pointed that contradict the leading indication ability of stock markets on economic activity is the strong economic growth that followed the 1987 stock market crash. Other historical predictions that went the opposite way are also pointed as failure of this causality relationship (Barro, 1989).

Despite the fact that many authors have demonstrated cases where the stock markets have failed to predict economic growth, there are still theoretical reasons to believe in this hypothesis including the traditional equity valuation model by Brealey and Myers (1988) and the "Wealth Effect" (Paiella, 2007; Simone, 2009), both coming up as the most common theories supportive of the leading indication power of stock markets on GDP.

Below we can see the close relation between stock markets and economic growth in the US between the period from 1929 and 2014.

Figure 1 – Economic Growth versus S&P's performance, 1929 – 2014



Source: https://econompicdata.blogspot.com/2015/04/is-there-relationship-between-economy.html

The purpose of this study is therefore to research this hypothesis and to answer the main following research question:

Do stock markets display a causality relationship on the variation of economic growth in the sense that present variations in stock markets will better explain the variation of real Gross Domestic Product variation in the near future?

In order to investigate our hypothesis, we will perform a time-series analysis, testing statistical causality between stock prices and the economy for the period between 1995Q2 and 2017Q4 on six different countries from Europe, applying the "Granger-causality" test proposed by Granger (1969) which tests the statistical hypothesis of one time series be useful in forecasting another.

Later in the dissertation we rerun the Granger-causality test purging the impact of the worldwide crisis of 2008 considering two new subperiods of our sample, from 1995Q2 to 2007Q4 and 2014Q1 to 2017Q4 as the period "without crisis" and secondly the subperiod from 2008Q1 to 2013Q4 as "with Crisis".

The results of this study suggest a causality relationship between stock markets to GDP for five out of the six countries tested, being the United Kingdom the only country with an opposite causality (GDP to Index). However, from the findings on the analysis of subperiods proposed in this dissertation suggest that the causality relationship may change over time, as observed in the case of France and Portugal whith a causality relationship from GDP to Index for the subperiod "with crisis", opposite to the relationship presented in the subperiod "without crisis".

It is worth mention that given the controversy surrounding the Granger causality test and the true capacity of stock markets increase the accuracy of forecasting the economic growth, the empirical results presented later in the dissertation and its conclusions must be considered suggestive rather than absolute.

The dissertation is organized as follows. Chapter 2 presents the theoretical literature review and empirical evidence on the topic of study. In chapter 3, the methodology and data are presented while the descriptive statistics and diagnostic tests, including lag selection, unit root and Granger causality tests, are discussed in chapter 4 and 5. Section 6 concludes the dissertation.

2. Literature Review

The financial system is considered to be the key to economic development. A growing body of literature has stated the importance of the financial system in economic growth from their facilitation on capital allocation, investment and growth (McKinnon, 1973; Mishkin, 2001).

Stock markets in particular have assumed a developmental role in global economics following the impact they have exercised on economic activity and corporate finance. Paudel (2005) has stated that stock markets have played an important role in helping to determine the level of economic activities due to their liquidity, which enables firms to acquire capital quickly.

The increasingly forecasted base of monetary policy determinations has generated a growing importance of search for economic indicators, that can better predict the future path of economic activity.

Leading indicators tend to perform better than benchmark autoregressive models in forecasting economic growth (Stock and Watson, 2003) however, the time series must have a stable relationship with the business cycle, published on a timely manner, must be final data and should be available on a monthly basis (Moolman and Jordaan, 2005). Stock markets meet three of the four listed requirements.

The stock market is the single most important market with respect to corporate investment decisions once stock prices provide key price signals to managers (Fischer and Merton, 1984). Even so, leading indicators should not be used in isolation. Their signals should be understood collectively as Mitchell and Burns (1983) emphasized when developed the system of leading indicators.

Stock markets have traditionally been seen as a reliable indicator for economic growth and so representing a forecasting power to predict real economic activity in the near future. However, this concept has been widely discussed between authors in the past decades.

The aim of this section is to collect the main theories and critics for the pertinence of the study.

2.1 Main Theories and Relevant Definitions

Fama (1990) noted three pivotal explanations for the relation observed between stock prices and real economic activity. Firstly, information about future real activity may be

mirrored in stock prices well before it has occurred. Secondly, changes in discount rates may affect stock prices and real investment simultaneous, yet the output from real investment does not appear for a period after it has been made. Finally, the wealth effect theory, which states that changes in stock prices are potentially changes in wealth, and this can affect the demand for consumption and investment and consequently impact the economic growth.

There are at least four theoretical approaches that support the stock market's ability to forecast economic activity, such as fundamental equity valuation models, the cost of raising equity capital, the financial accelerator and finally the wealth effect (see table 1).

Table 1 – Main Theories on the Stock Markets leading indicator ability of GDP

Main Theories	Determinants/ Assumptions	Limitations	Bib. References
Forward looking fundamental equity valuation models	Stock prices depends on future expectations of profitability of a firm & profitability depends on economy so -> stock prices should predict GDP.	Creation of expectations subject of human error and misevaluations.	Brealey and Myers (1988), Comincioli (1996), and Stock and Watson (2003)
The cost of Raising Capital	If cost of Equity is lower -> Weighted Average Cost of Capital is Lower -> More investment opportunities -> Economic Development	Assumptions about the optimal capital structure and cost of equity misevaluations;	Fazzari (1988) and, Baker (2000)
The Financial Accelerator	Rising Stocks Prices -> Improve Balance Sheets -> increases creditworthiness -> Stimulation of Investment and Consumption	Questions concerning the "Wealth Effect" Phenomena	Fazzari (1988), and Bernanke (1996)
Wealth Effect	Increase on Stock Prices -> Increase Investors perception of Wealth and increase of asset values -> stimulation on Investment and Consumption	Questions concerning the "Wealth Effect" Phenomena	Comincioli (1996), Paiella (2007), and Simone (2009)

Fundamental equity valuation models recognize the value of a common share as the present value of future expected dividends. The traditional equity valuation model developed by Brealey and Myers (1988) consists in the idea of a forward-looking stock market valuation where financial assets price represent the present value of a company's expected future profitability.

This forward-looking property of stock markets defends that stock prices and other asset prices would perform well as leading indicators (Stock and Watson, 2003). In short, if stock prices depend on expected dividends and dividends expected depend on profitability of

firms, then stock prices should aggregate investors' expectations regarding the level of economic activity.

It is widely accepted that the optimal capital structure consists of a mix of debt and equity, which leads us to assume that equity cost of capital represents a significant portion of most firms weighted average cost of capital. When issuing equity in order to obtain investment funds, firms must take into account the required return on their equity but also the cost of flotation, which leads firms to have a better interest on issuing equity when stock prices are higher in order to maximize the proceeds. Despite the fact that some academics such as Ritter (1991), Baker and Wurgler (2000) and Hirshleifer (2001) stated that firms consciously sell overvalued equity to investors, which violates some of the principles of the efficient market hypothesis, there is no doubt that higher stock prices reflect a lower cost of equity for firms. Considering this statement, if the cost of equity is lower, then the weighted average cost of capital will be lower, and more capital projects will become plausible and so, a positive relationship could be established between stock markets and economy.

The "Financial Accelerator" is a financial theory that suggests that a small change in financial markets can produce a large change in economic conditions. When applying this concept into the purposes of the study, the financial accelerator results from the impact of rising stock prices which lead to improvement in companies balance sheets and households which in turn improves their creditworthiness (Fazzari, 1988 and Bernanke, 1996). This increase in creditworthiness translate in lower borrowing costs and higher borrowing capacity of both players stimulating the investment and consumption and so, stimulating the economic development. This leads us to the last approach addressed in this dissertation, the "wealth effect".

The "Wealth Effect" is the premise that when the value of investment assets increases, investors feel more comfortable and secure about their wealth, leading them to change the amount and distribution of their consumption, assuming that consumption does not only depend on income but on the perception of increased value of investors assets. This theory suggests that an increase (decrease) on stock prices is followed by an increase (decrease) of wealth perception and creditworthiness that in turn results on increase (decrease) of aggregate consumption and investment spending. Because consumption and investment are a very relevant engine of economies, their variation will be followed by a direct variation on economic development and growth rate.

Using micro data for the US economy, Bostic (2009) found "an important role for both

financial wealth and housing wealth in the determination of household consumption patterns. The results suggest the estimation of significant coefficients in both cases; the implied elasticity with respect to total consumption is .02 percent for financial assets, and .04 percent for house values. House values were much more important for non-durable and food consumption and financial assets were much more important for durable consumption" p.14. The wealth effect was perceptible in the United States before the 2008 worldwide crises began where, families were using home equity loans to tap the rising values of their homes to fund consumption spending. The consequent collapse of US consumption, caused by the 2008 crisis, following the devastation of asset prices presents the operation of the wealth with rising as well as falling asset values. However, it is important to state that there is more empirical evidence on the wealth effect in the US than in several European nations (Paiella, 2007; Simone, 2009).

There are some limitations to these theoretical approaches, such us the stock prices being built by human perception of future profits of corporation's and so, subject to human error. Although, based on the market efficiency theory, the opportunity found by some investors to outperform markets, is the main tool to bring markets to efficiency and to approximate the stock prices to its real economic value.

Pearce (1983) studies on Stock Prices and US Economy concluded that variations in stock prices are believed to increase consumption through the vary of household wealth and so, once the fluctuations on stock prices have a direct effect on aggregate consumption, the stock markets can lead to economic growth. "Stock prices movements appear to be a valuable, but not infallible, leading indicator of business fluctuations" p.22.

Despite the fact that the theories presented above provide theoretical argument for stock prices to act as a valuable indicator of economic growth, this statement does not come without some controversy and critics of those theories arguing that the causations are different. There are two main arguments critics point out that question the ability of the stock markets' forecasting power.

The main question marked about stock markets ability to act as indicator of economic growth has come with the strong economic growth that followed the 1987 stock market crash where stock markets failed to predict future economic growth, since the economy continued to grow until the early 1990's.

While studying for periods after the crash, authors have found evidence that stock markets failed to lead economic growth.

Peek and Rosenberg (1988) have found evidence on the S&P's composite index of 500 stocks where stock prices have failed to predict the future economic growth 5 out of 11 times in which the index declined more than 7 percent. This means that, during the period analysed (1955 – 1986), only six out of eleven times was a decrease of more than 7 percent in stock prices followed by an economy recession.

Barro (1989) found that stock prices predict three recessions that have not occurred in 1963, 1967 and 1978 in the US Stock and Watson (1989) showed that in the US the relationship between stock returns and economic growth has in fact not been stable over time, and that the predictive information of stocks prices for future activity is also contained in other financial variables such as yield spreads between 10 years, government bonds and 3 month T-Bills.

The fundamental equity valuation models' principles are the other argument used by sceptics concerning the creation of future expectations by investors. Investors do not always anticipate correctly, and so stock prices will sometimes present an increase before the economy enters a recession and vice-versa. This means that expectations about future economic growth are subject to human error and so may cause stock prices to deviate from their real value, resulting in stock markets misleading the direction of GDP growth.

Stock prices are highly dependent on investors' expectations of future earnings potential of corporations and since a firm's profits are directly linked to real economy, stock prices will be affected by expectations of future economy wealth.

There are numerous adaptive and rational expectations models that attempt to explain how investors form their expectations of future economy such as DeBondt and Thaler (1985) and Pearce and Roley (1985). The adaptive approach suggests that expectation is built on past experience and the rational approach proposes that expectations are developed using all information available. This means that recent experiences can make the investor change his perception of future economic wealth and change his expectation.

To the extent that these models are true, it is fair to believe that economy may also lead stock markets and not the opposite. Nevertheless, Schwert (1989) found that there was weak evidence that macroeconomic volatility could lead stock return volatility and instead, financial assets' volatility helps to predict future macroeconomic volatility. This comes considering the markets efficiency hypothesis developed by Fama in the semi-strong and strong form where prices of financial assets should react quickly to new public information. Schwert (1989) also concluded that stock volatility is affected by financial leverage and that

there is a relationship between stock volatility and trading activity which affects the investor's perception of potential future profits of corporations and therefore, stock prices.

Even assuming that stock prices can indeed forecast economic growth or that stock prices "Granger-cause" economic growth, another question arises concerning time lag on this causality. Pearce (1983) found evidence for the period between 1956 and 1983 of stock prices usually starting to "fall" two to four quarters before recessions began and starting to grow before the economy experienced an expansion period.

In summary, even though stock markets can fail to predict economic growth a few times, it is fair to believe that stock prices can be a valuable leading indicator for GDP growth.

2.2 Empirical Evidence on Stock Prices as Leading Indicators

The focus of this study will be to test if stock prices can explain future real output as measured by gross domestic product (GDP).

Fama (1981, 1990), Fischer and Merton (1984) and Barro (1990) found that the stock market substantially contributed to forecasting the growth rate of real GNP (gross national product) in the United States. Fischer and Merton (1984) further explained that the correlation between changes in current stock prices and future changes in GNP, results from the markets' attempt to predict future earnings, which are correlated with GNP. Geske and Roll (1983) and Schwert (1990) also confirm the high correlation between stock prices and future real economic activity.

Fama (1981), Geske and Roll (1983), and Fischer and Merton (1984) have regressing stock returns on future growth rates of real economic activity to estimating the variation in stock returns due to expectations of future cash flows. Atje and Jovanic (1993) using cross-sectional regression also conclude that stock markets have long-run impacts on economic growth and Levine and Zervos (1996) further found evidence that stock markets influence growth, through a number of channels such as, liquidity, risk diversifications, acquisition of information about firms, corporate governance and savings mobilization.

Estrella and Mishkin (1998) compared several financial and macroeconomic indicators as predictors of the numerous US recessions and noted the useful role of both stock prices and spreads in predicting US recessions. The stock prices tended to perform well over one to three quarters forecasting horizons and even managed to beat term spreads as a predictor of the US recessions for one quarter lead forecasts.

Mauro (2003) found the relationship between output growth and lagged stock returns in

several countries. Univariate correlation between real economic growth and real stock returns was positive in all the countries in the sample except for India and significantly positive in 5 out of 8 emerging markets and 10 out of 17 advanced countries. An increase of 10% in real stock returns is typically associated with higher real economic growth of 0,35%.

On the other hand, there have been studies documenting a breakdown in the relationship between real stock prices and GDP. Barro (1990) found that the stock market was incorrect by forecasting three recessions that never occurred in 1963, 1967 and 1978 in the US.

Cheung and Ng (1998) also found a weak relationship between the stock market and real GNP and Stock and Watson (2003) showed that the relationship between stock returns has not been entirely stable over their sample period.

Several studies of advanced economies have found stock prices to be a reliable predictor of GDP growth. Because of its leading role to predict business cycles, most of the studies have been done on the US economy. However, resulting from the increasing importance of search reliable indicators for economic activity, studies on other advanced economies are becoming more prevalent in the literature, as the leading indicator approach becomes more widely adopted. Even though the leading indicator approach has become widely adopted, studies of emerging markets are much less common mainly due to data inadequacies. Aylward and Glen (2000) report, the results for the developed markets seem to be more encouraging than the emerging markets.

Tables 2 and 3 presented bellow contains a brief summary of the main studies from advanced economies and emerging economies on the subject of this dissertation analysis, the Stock Markets ability to act as a leading indicator for the economic growth.

Table 2 – Empirical Evidence from Advanced Economies

Author	Country	Time Period	Periodicity	Main Conclusions
Fama (1981)	US	1953 - 1987	Monthly, Quarterly, Annual	Stock prices led all real variables
Pearce (1983)	Canada, France, Germany, U.K & US	1955 - 1983	Quarterly	Stock prices tend to rise midway through recession
Huang and Kracaw (1984)	US	1962 - 1978	Quarterly	Stock prices led GDP by four quarters.
Campbell (1989)	US	1953 - 1989	Quarterly	Stock prices and Yield Curve led GDP.
Comincioli (1996)	US	1970 - 1984	Quarterly	Stock prices Granger-cause GDP with lags of one to three quarters.
Otoo (1999)	US	1980 - 1999	Monthly	Stock prices are leading indicator.
Choi, Hauser and Kopechy (1999)	Canada, France, Germany, Italy, Japan, U.K. Y US	1957 - 1996	Monthly	Stock prices useful for forecasting only in US, Canada, U.K. & Japan.
Burgstaller	Australia, Japan & US	1976 - 2002	Monthly	No predictive power from stock prices, weakly affect consumption
Gan, Lee, Young and Zang (2006)	New Zealand	1990 - 2003	Monthly	Causality relationship from GDP to Index
Foresti (2007)	US	1959 - 1999	Quarterly	Stock prices had predictive power with lags of up to five quarters.
Auret and Golding (2012)	South Africa	1969 - 2010	Quarterly, Annual	Stock prices show a superior ability when compared with quarterly information, rather than annual.

Table 3 – Empirical Evidence from Emerging Economies

Author	Country(s)	Time Period	Periodicity	Main Conclusions
Leigh (1997)	Singapore	1975 - 1991	Quarterly	Granger causality from Stock prices to GDP
Nishat and Shaheen (2004)	Pakistan	1973 - 2004	Quarterly	Stock prices led Industrial Production by one quarter.
Jefferis, Okeahalam and Matome (2001)	Botswana, South Africa & Zimbabwe	1985 - 1996	Quarterly	Stock prices led GDP
Mauro (2003)	Argentina, Chile, Greece, India, Mexico, South Korea, Thailand & Zimbabwe	1971 - 1998	Quarterly, Annual	Stock prices led GDP in all nations except India from 1 to 4 quarters of lag; stronger signal in higher market capitalization countries
Atmadja (2005)	Indonesia, Malaysia, the Philippines, Singapore & Thailand	1997 - 2003	Monthly	Stock prices Granger-caused GDP in Singapore and Thailand; no causality in Malaysia and the Philippines.
Mun, Siong & Thing (2008)	Malaysia	1977 - 2006	Annual	Stock prices Granger-caused GDP with a lag of two years.
Bahadur and Neupane (2006)	Nepal	1988 - 2005	Annual	Market capitalization Granger caused GDP with a four-year lag
Pilinkus (2009)	Lithuania	1999 - 2008	Monthly	Stock prices Granger-caused GDP.

Even though there are numerous points that contradict the main statement of this study, considering the results of the relevant studies presented above, we found that there are mixed empirical evidence on the subject, but mostly supportive of the hypothesis that stock prices can act as leading indicator for economic activity. Therefore, we can assume that stock prices have a sound theoretical basis for leading economic activity and accept that stock markets volatility can indeed cause the volatility in GDP in the near future.

Among advanced countries, with Anglo-Saxon backgrounds, stock markets tend to be stronger leading indicators, perhaps because stock markets tend to play larger roles in their economies of such nations (Choi, Hauser and Kopechy, 1999; Stock and Watson, 2003a). Among emerging economies, stock prices tend to become stronger leading indicators as the economy develops and financial markets become larger in relation to GDP (Mauro, 2003; Atmadja, 2005).

It is also possible to verify that in most of recent studies about the concern, authors found

unstable results and weak evidence of forecasting power of stock markets on GDP. On the other hand, studies performed before the globalization started to take place in financial markets or even before the 1987 stock market crash, tend to present more stable results.

A question arises if the globalization or even the big crash of financial sector in 1987 somehow changed the relationship between stock markets and economic growth or if somehow increased volatility making investors less confident on their own signals and so more volatile to others opinions.

3. Data and Methodology

3.1 Data

This dissertation analyses the economic and financial data from six countries in Europe selected considering the aim to include three larger economies (Germany, United Kingdom and France) and three periphery economies (Portugal, Ireland and Greece). Because some of the countries included in our sample only started recording their real economic activity growth on 1995, the sample data of this study cover the period between 1995Q2 to 2017Q4, containing a total of 546 quarterly observations, 91 quarterly observations for each variable tested.

The variables used to measure the stock market growth are the quarterly percentual changes of each selected country most representative capitalization-weighted index such as DAX30 (Germany), FTSE100 (United Kingdom), CAC40 (France), PSI20 (Portugal), ISEQ (Ireland) and Athex20 (Greece), which are assumed to be a representative measure of their respective country stock market, containing at least 80 percent of their market capitalization. And to measure the economic activity, the quarterly percentual changes in real Gross Domestic Product (GDP) of each given country is used, with the year 2000 as the base year for the implicit price deflator. Other studies approach different variables as their proxy for economic growth, such as the percentage change in the Industrial Production Index (IPI) however, there is no empirical evidence that those proxies represent a more reliable measure of economic growth.

The data used in this dissertation was collected from "Thomson Reuters Eikon" for the Indexes and "AllThatStats – Eurostat Statistics" for the GDP of each country.

Both variables (GDP and Index) will be presented further in the dissertation as $GDP_{\_x}$ or $Index_{\_x}$, being x the respective countries presented as "Germ" (Germany), "UK" (United Kingdom) "Fra" (France), "Pt" (Portugal), "Irl" (Ireland) and "Gree" (Greece).

3.2 Methodology

The methodological approach adopted to determine whether the stock market is a leading indicator of economic activity for each country is the Granger-causality test (Lee, 1992; Comincioli, 1996; Atmadja, 2005; Pilinkus, 2009).

Granger (1969) proposed a time-series data approach to test statistical causality between two variables where a variable X causes Y, if the second can be better predicted from past

values of Y and X rather than Y by itself. In other words, the stock market "Granger-causes" the real economic growth if the stock market statistically improves the accuracy of economic activity forecasts. Thus, the two following equations are specified

$$\textbf{3.1 -}\ (GDP_x)_t = \alpha + \sum_{i=1}^{n} \beta_i (GDP_x)_{t-i} + \sum_{y=1}^{n} \tau_i (Index_x)_{t-y} + \mu_{1t}$$

$$\textbf{3.2 -}\ (Index_x)_t = \omega + \sum_{i=1}^{n} \delta_i (Index_x)_{t-i} + \sum_{y=1}^{n} \gamma_i (GDP_x)_{t-y} + \mu_{2t}$$

where, GDP represents the economic growth and Index the stock market growth for each given country.

Based on the estimates OLS coefficients for equations (3.1) and (3.2) four different hypotheses regarding the relationship between GDP and economic growth can be formulated as follows:

->Unidirectional "Granger-causality" from Index to GDP, where the Index improves the prediction of economic activity but the economic activity does not improve the prediction of the Index growth. Thus $\sum_{y=1}^{n} \tau_i \neq 0$ and $\sum_{y=1}^{n} \gamma_i = 0$.

->Unidirectional "Granger-causality" from GDP to Index if the GDP improves the prediction of Index growth but Index does not improve the prediction of GDP. Thus $\sum_{y=1}^{n} \tau_i = 0$ and $\sum_{y=1}^{n} \gamma_i \neq 0$.

->Bidirectional or a feedback relationship when both GDP and Index "Granger-causes" the other. Thus $\sum_{y=1}^{n} \tau_i \neq 0$ and $\sum_{y=1}^{n} \gamma_i \neq 0$.

->Independent, if no causal relationships between stock market and the economic activity exists. Thus $\sum_{y=1}^{n} \tau_i = 0$ and $\sum_{y=1}^{n} \gamma_i = 0$.

To compute the test, the restricted regression must be calculated first which consists on the regression of the dependent variable (GDP in equation 3.1) on its past values without the lagged independent variable (Index in equation 3.1). Secondly, the lagged terms of the independent variable are included in the regression in order to achieve the unrestricted regression.

The null hypothesis is, GDP does not Granger-cause the stock market ($\tau_i = 0$) in equation 3.1 or, Index does not Granger-cause GDP ($\gamma_i = 0$) in equation 3.2.

To test the null hypothesis the F-test is applied, defined as

$$\textbf{3.3 - } F = \frac{[(SSR_r - SSR_u)/n]}{[SSR_u/(m-y)]}$$

where, n is the number of lagged terms, y is the number of parameters and $SSR_r \; and \; SSR_u$ are the residual sum of squares of the restricted and unrestricted models, respectively.

If the F-value exceeds its critical value at the chosen level of significance then the null hypothesis is rejected and so the lagged independent variable belongs in the regression which would imply that GDP Granger-cause the Index, in equation 3.1.

The Granger-causality test is performed on EViews, which automatically computes the F-test for both equations (3.1 and 3.2) expressed above.

Furthermore, an important assumption in any time-series analysis is that variables being tested are stationary, Dickey and Fuller (1976) show that the last squares estimator tends to move downwards in the presence of unit roots. Since the Dickey-Fuller bias can be expected to reduce the accuracy of forecasts and that during the period of our sample from 1995 to 2017, both the GDP and the Indexes of each country display a trend, we estimate the monthly percentual changes in all variables and test for their stationarity using the Augmented Dickey Fuller (ADF) test., given by the following equation.

$$\textbf{3.4 - } \Delta V_t = \mu + \delta V_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta V_{t-1} + \gamma_t + \varepsilon_t$$

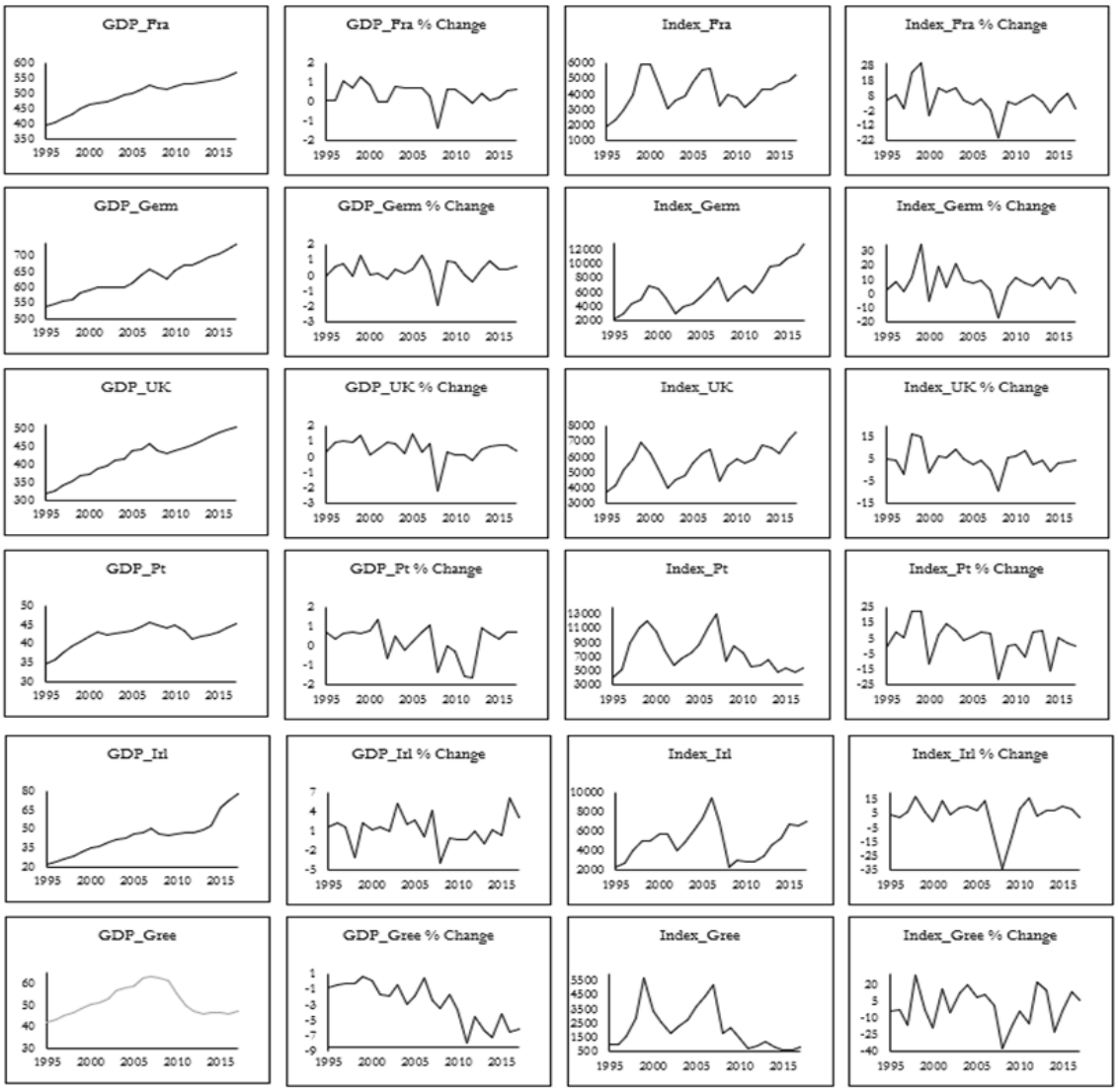
Its purpose is to test the presence of a unit root in the time series being the null hypothesis (δ =0) which means the time series is non-stationary. If the critical value at the chosen level of significance is exceeded ($\delta \neq 0$) the null hypothesis is rejected which mans the time series is stationary.

4. Descriptive Statistics and Supportive Tests

4.1 Descriptive Statistics

Figure 2 contains graphical representations of the variables and their quarterly growth rates. All countries exhibit an upwards trend of their GDP while the stock indexes exhibit an upward trend for all countries except the Portugal and Greece stock market Index which displays a small downwards trend along the period. Considering the existent trends on our variables, we used the quarterly percentual changes in order to make the time series stationary.

Figure 2 – Time series graphical representation



Source: Own Author

Descriptive statistics for the twelve time series show that their quarterly growth rates are negatively skewed with exception with for the GDP from Ireland and the Indexes from Portugal and Greece display a positive skewed, result of their downward trend during the sample period. All the variables exhibit fat tails, judging by the Kurtosis, highlighting the GDP from Germany and Ireland which express a sharp presence of outliers.

Table 4 – Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Skewness	Kurtosis	Var. Coef./a	Obs
GDP_Germ	0.363	0.410	0.804	-2.543	16.534	2.216	91
GDP_UK	0.527	0.578	0.603	-1.797	9.415	1.146	91
GDP_Fra	0.406	0.421	0.467	-1.452	7.567	1.150	91
GDP_Pt	0.328	0.443	0.802	-0.697	3.674	2.448	91
GDP_Irl	1.490	1.224	2.947	3.525	25.627	1.977	91
GDP_Gree	0.477	0.699	6.436	-0.141	1.797	13.478	91
INDEX_Germ	2.874	4.087	12.131	-0.524	4.330	4.221	91
INDEX_UK	1.255	2.184	7.282	-0.343	3.627	5.802	91
INDEX_Fra	1.727	2.505	10.553	-0.367	4.191	6.111	91
INDEX_Pt	1.026	1.075	12.148	0.374	3.946	11.836	91
INDEX_Irl	2.129	4.096	11.229	-0.667	4.011	5.273	91
INDEX_Gree	1.250	2.340	16.339	0.196	3.037	13.069	91

/a represents the variation coefficient, estimated by the division of the standard deviation for the time series mean.

During the sample period all variables had a positive mean whit the spotlight on the indexes from Germany and Ireland with mean quarterly returns above 2% and an economic growth of approximately 1,5% on the Ireland GDP.

Considering the high standard deviations observed on some of the time series we have computed the variation coefficient in order to better understand the volatility implicit in each variable. The higher standard deviation observed on the indexes is partly explained by the higher mean of those variables however in the case of Portugal and Greece, this is reflection of higher volatility in the stock markets indexes of those countries. The same is observed in the GDP from Greece which shows a high volatility during the sample period mainly due to the struggles the country has been subject to in the sample period. It is worth mention that this higher volatility is observed in two of our three smaller economies selected which have been challenged since the entrance in the European Union and the implantation of the Euro in the early 2000.

This dissertation addresses 91 observations for each of the selected Countries from

Europe which represent a total of 546 quarterly observations for the period between 1995 and 2017.

4.2 Test of Stationarity

The test statistics may usually show a significant relationship between variables in the regression model although there is not a long-term relationship between them. This case is often known as "spurious regression" (Patterson 2000) where the variables are not causally related even though they may show the opposite due to a presence of an unseen factor or just coincidence. This case occurs due to the existence of bias in the time.

Granger (1986) suggests that a co-integration test of the variables can be used as a pre-test to avoid the situations of "spurious regression" by testing for their long-term relationship although, this test is not performed in this study considering the widely acceptance that there is a long term relationship between stock markets and macroeconomic variables as been reported in the past by the studies of Adjasi and Biekpe (2005), Rousseau and Wachtel (2000) and Demetriades and Hussain (1996).

Granger-causality test assumes that the times series are stationary. Considering the graphical representation expressed in table 4 on the previous section, we conclude that our absolute variables display a trend in their sample period, for that reason, the data set considered in this study test is the quarterly percentual change of the time series and in order to verify the stationarity of the variables, the Augmented Dickey Fuller (ADF) test is computed for all variables considered.

The ADF tests is given by equation 4 expressed in section 3.2 and tests the null hypothesis $\delta = 0$, which means the time series is non-stationary against $\delta < 0$ where the time series is stationary. Attending to the fact that the ADF test is sensitive to the characteristics of the time series being testes, we first investigate the existence of tendency and interception (Ten. & Int.), interception or none on the time series and proceed with the ADF test including in the test equation the characteristics of each time series.

In this section the ADF test is performed for all sample periods considered, as determined above in the dissertation where the period during the worldwide crisis, considered comprehended between 2008 and the end of 2013 is ruled out for the test of a subperiod "without crisis" and latter tested exclusively to compute the Granger-causality for the subperiod "with crisis".

Total Period Sample

Table 5 shows the results of the Augmented Dickey Fuller test on GDP UK, FTSE 100, GDP Germ, DAX 30, GDP Fra, CAC 40, GDP Pt, PSI 20, GDP Irl, ISEQ, GDP Gree and Athex 20 for the total sample period comprehended between 1995Q2 and 2017Q4.

Table 5 – Stationarity test for the total Sample period

Country	Variables	Include in test Eq.	Test at	t_Statistic	P-Value
France	Gdp	Ten. & Int.	Level	-4.7846***	0.0010
	Index (CAC40)	None	Level	-8.9924***	0.0000
Germany	Gdp	None	Level	-5.8275***	0.0000
	Index (DAX30)	None	Level	-9.3445***	0.0000
United Kingdom	Gdp	Ten. & Int.	Level	-4.8932***	0.0007
	Index (FTSE100)	None	Level	-9.0963***	0.0000
Portugal	Gdp	Ten. & Int.	Level	-6.4057***	0.0000
	Index (PSI20)	None	Level	-8.4215***	0.0000
Ireland	Gdp	Intercept	Level	-10.6954***	0.0000
	Index (ISEQ)	None	Level	-7.7738***	0.0000
Greece	Gdp	None	Level	-2.0195**	0.0422
	Index (Athex20)	None	Level	-7.4745***	0.0000

** and *** show that the null hypothesis is rejected at 5% and 1% level of significance, respectively.

The results of the ADF tests presented above on the level for the total sample period analysis suggest a strong rejection of the null hypothesis for most of the variables at either ten, five or one percent level of significance, with exception for the GDP growth from Greece with a one-side p-value of 0.0422.

Even though the GDP_Gree cannot reject the null hypothesis at one percent level of significance, considering that the 5% level is widely accepted as sufficiently strong indicator and the most common used level of significance considered in statistical tests, the variables are considered stationary at level for the total sample period with includes data from 1995Q2 to 2017Q4.

Without Crisis - Subperiod

Table 6 presents the results of the rerun of ADF test on all variables considered in the study. Although as mentioned previously in the dissertation, this subperiod ruled out the data from 2008Q1 to 2013Q4 in order to test a sample period prevented of a period of more uncertainty and instability in the stock markets and in the economic development considering the austerity times followed by the worldwide crisis of 2008. The subperiod "Without crisis"

will consider than data from 1995Q2 to 2017Q4 plus the period considered as "post" crisis comprehended between 2014Q1 to 2017Q4.

Table 6 – Stationarity test for the subperiod "Without crisis"

Country	Variables	Include in test Eq.	Test at	t_Statistic	P-Value
France	Gdp	Intercept	Level	-4.7854***	0.0002
	Index (CAC40)	None	Level	-8.2206***	0.0000
Germany	Gdp	Intercept	Level	-7.0696***	0.0000
	Index (DAX30)	None	Level	-8.2832***	0.0000
United Kingdom	Gdp	Ten. & Int.	Level	-6.566***	0.0000
	Index (FTSE100)	None	Level	-8.143***	0.0000
Portugal	Gdp	Ten. & Int.	Level	-7.6465***	0.0000
	Index (PSI20)	None	Level	-7.6633***	0.0000
Ireland	Gdp	Intercept	Level	-10.3715***	0.0000
	Index (ISEQ)	Intercept	Level	-8.9104***	0.0000
Greece/1	Gdp	None	1st Diff.	-11.4374***	0.0000
	Index (Athex20)	Intercept	Level	-6.9902***	0.0000

*** show that the null hypothesis is rejected at 1% level of significance.
/1 denotes that for the Greek GDP, the first differences had to be performed in order to make the time series stationary.

The test at level of the variables considered conclude that while all variables are stationary at their level I(0) based on a one percent significance level, excepting the Greek GDP time series.

Nonetheless unit root tests are known to have low power, one can reasonably proceed on the assumption that "GDP_Gree" is I(1) series, non-stationary at its level however, at the first degree of difference operator the time series can be made stationary rejecting the null hypothesis at either ten, five or one percent level of significance based on the MacKinnon critical values.

Note that, despite the fact that "Index_Gree" has presented to be stationary at level, for the purpose of the study in computing the Granger-causality test, both variables to be included in the model (GDP and Index from Greece) must be considered at their first degree of difference operator. For that matter, the first difference was computed for the "Index_Gree" time series which provides consistent results from the test at level suggesting the time series is stationary at one percent level of significance with a one-side p-value of 0.0000.

Crisis - Subperiod

Table 7 presents the results of the ADF tests considering exclusively the period of crisis on our total sample. The period classified as "with crisis" is as mention previously determined considering the year where the worldwide crisis of 2008 had its biggest impact on economies and stock markets. The period select comprehends the quarterly observations from 2008Q1 to 2013Q4 which in this study was considered, based on the data collected, from the period where the indicators of stock markets and economic activity fall to the period where those indicators achieve similar results from the years prior to 2008.

Table 7 – Stationarity test for the subperiod "With crisis"

Country	Variables	Include in test Eq.	Test at	t_Statistic	P-Value
France	Gdp	Intercept	Level	-2.3820**	0.0196
	Index (CAC40)	None	Level	-3.9667***	0.0004
Germany	Gdp	Intercept	Level	-2.9412***	0.0052
	Index (DAX30)	None	Level	-4.1993***	0.0002
United Kingdom/1	Gdp	Ten. & Int.	1st Diff	-5.8211***	0.0006
	Index (FTSE100)	None	Level	-2.3799***	0.0205
Portugal	Gdp	Ten. & Int.	Level	-2.6234***	0.0112
	Index (PSI20)	None	Level	-3.3300***	0.0019
Ireland	Gdp	Intercept	Level	-4.7343***	0.0051
	Index (ISEQ)	Intercept	Level	-4.9738***	0.0047
Greece/1	Gdp	None	1st Diff	-18.4051***	0.0001
	Index (Athex20)	Intercept	Level	-3.3974***	0.0218

** and *** show that the null hypothesis is rejected at 5% and 1% level of significance, respectively.
/1 denotes the existence of time series not stationary, the first differences had to be performed in order to make the time series stationary.

The results of the ADF test for the subperiod of crisis present that the time series for "GDP_UK" and "GDP_Gree" are I(1) series so, non-stationary at level but can be made stationary with the difference operator of degree one with a one-side p-value of 0.0205 and 0.0218, respectively which means the null hypothesis is rejected at either ten or five percent level of significance while all the remaining time series are stationary at level I(0) based on a one percent level of the MacKinnon critical values.

For the "Index_UK" and "Index_Gree", the first differences were performed in order to verify the stationarity at the difference operator of degree for the purpose of the Granger-causality test. Both time series are stationary at I(1) with a strong rejection at one percent level of significance with p-values of 0.0006 and 0.0036, respectively.

4.3 Lag Selection

Mahdavi and Sohrabian (1991) have attempted a maximum lag length of ten quarters on their time series reporting that longer lags did not change the basic result in any significant way however, this study computes a VAR lag order selection criteria test using the most common choice of information criterion, the AIC (Akaike information criterion) is performed in order to determine the optimal lag to consider in each of the models computed on our total sample period.

Table 8 report the findings on the AIC of each model performed by country which provide us information on the optimal lag to consider.

Table 8 – Estimation of AIC for the Total sample period

Country / Lag	France	Germany	United Kingdom	Portugal	Ireland	Greece
1	8.305	10.130	8.233	9.938	12.660	15.040
2	8.247	10.138	8.234	9.926	12.736	13.986
3	8.298	10.232	8.229	9.957	12.821	13.842
4	8.343	10.261	8.305	10.043	12.876	12.769
5	8.421	10.276	8.358	10.140	12.938	12.748
6	8.479	10.369	8.426	10.187	13.009	12.837
Optimal/a	**2**	**1**	**3**	**2**	**1**	**5**

/a presents the lower AIC for each country, which represents the number of lags that strengthens the model considered.

As reported in the table above, the optimal lag for the time series being tested varies from one another being the time series from Greece those who expressed the highest optimal lag, up to 5 quarters. The remaining variables present lower optimal lags lengths such as Germany and Ireland with presenting 1 lag, France and Portugal two quarters lag and United Kingdom suggesting its optimal lag as 3 quarters.

The Granger-causality test performed further in the dissertation is computed from lag on to five (maximum lag length reported above) for all countries being testes considering the optimal lag reported above as reference on our total sample period testing.

This procedure is to be kept for the test of the subperiods identified above although, for the subperiod "with crisis" the lag length considered is reduced to 3 quarters considering that the sample tested only contains data from 2008 to the end of 2013 which would provide less than 20 observations on the Granger-causality test.

5. Granger-Causality Tests

The procedure used in this dissertation to test the statistical causality between stock markets and economic growth, for each of the selected countries in this study, is the Granger-causality test proposed by Granger (1969). This statistical test consists in determine the predictive content of one independent variable beyond that inherent in the dependent variable itself, using a bivariate regression as shown is equations 1 and 2 expressed in section 3.2.

To compute the purposed test, it is assumed that the variables to be tested are stationary. In the case of the study's data set, test statistic for unit root have already been reported in section 4.2 concluding that all the time series are stationary at level in the total sample and made stationary using the difference operator of degree one for the time series of GDP_Gree in the subperiod "Without crisis" and GDP_UK and GDP_Gree for the subperiod "With crisis". All remaining variables are stationary at level for each respective period sample tested.

This study used on of the most common choices of information criterion, the AIC (Akaike information criterion) which fund that the Granger-causality test was sensitive to the number of lags introduced in the model. In the previous section a VAR lag order selection criteria test were computed for all the time series considered to determine the optimal lag for each model computed considering the lowest AIC as the optimal lag for the model or in other words the lag that strength the model. The results reported in section 4.3 suggest that the optimal lag varies from one in the case of Germany and Ireland up to five in the case of Greece.

Considering the findings of Mahdavi and Sohrabian (1991), the test of Granger causality will be performed for lags one to five for all models performed and all subperiods tested with the exception of the subperiod "with crisis" considering that the sample tested only contains data from 2008 to the end of 2013 which would provide less than 20 observations on the Granger-causality test. The optimal lag computed previously will serve as reference for the diagnostic of results on the total sample tests.

This section presents the Granger-causality tests for all three sample periods purposed, testing first the total sample period, secondly the subperiod described as "without crisis" where the data comprehended between 2008Q1 and 2013Q4 is excluded and lately the subperiod "with crisis" where the data between 2008Q1 and 2013Q4 is tested exclusively.

Total Sample – Granger causality tests

Table 9 presents the results of the Granger-causality test performed on our total sample period which comprehends the data from the second quarter of 1995 to the fourth quarter of 2017. The test was computed for each of the six countries selected from Europe for this study for lags 1 to 5.

Table 9 – Granger test on Total sample

Country	nr. of Lags	From Index to GDP/1	From GDP to Index/2	Test Results/3
France	1	0.0004***	0.1806	Index causes GDP
	2/opt	0.0005***	0.0260**	Bi-directional causality
	3	0.0005***	0.0488**	Bi-directional causality
	4	0.0012***	0.0399**	Bi-directional causality
	5	0.0017***	0.112	Index causes GDP
Germany	1/opt	0.0183**	0.4758	Index causes GDP
	2	0.0104**	0.0843*	Index causes GDP
	3	0.0186**	0.2115	Index causes GDP
	4	0.0176**	0.2641	Index causes GDP
	5	0.0722*	0.0944*	Independent relationship
United Kingdom	1	0.2246	0.0465**	GDP causes Index
	2	0.2230	0.0104**	GDP causes Index
	3/opt	0.1832	0.0056***	GDP causes Index
	4	0.1671	0.0143**	GDP causes Index
	5	0.2441	0.0066***	GDP causes Index
Portugal	1	0.0018***	0.9590	Index causes GDP
	2/opt	0.0019***	0.8294	Index causes GDP
	3	0.0009***	0.9561	Index causes GDP
	4	0.0019***	0.9428	Index causes GDP
	5	0.0069***	0.9026	Index causes GDP
Ireland	1/opt	0.0406**	0.3767	Index causes GDP
	2	0.0769*	0.7160	Independent relationship
	3	0.2009	0.7993	Independent relationship
	4	0.0683*	0.9138	Independent relationship
	5	0.1389	0.4023	Independent relationship
Greece	1	0.2194	0.8951	Independent relationship
	2	0.0564*	0.9111	Independent relationship
	3	0.0018***	0.5695	Index causes GDP
	4	0.0269**	0.7744	Index causes GDP
	5/opt	0.0067***	0.5814	Index causes GDP

*,** and *** show that the null hypothesis is rejected at 10%, 5% and 1% level of significance, respectively.
/1 P-values for the null hypothesis "Index does not Granger cause GDP".
/2 P-values for the null hypothesis "GDP does not Granger cause Index".
/3 Test results based on a 5% level of significance.
/opt identifies the optimal lag for the model being tested.

The results presented above display that 5 out of 6 countries suggest a Granger-causality relationship from index to GDP on their respective optimal lag, which means the Index could be useful forecasting GDP growth. Although the Granger causality test for France suggests a bi-directional relationship at a 5% level of significance, it should be mentioned that together with Portugal, both countries suggest a strong rejection of the null hypothesis from equation 1 ("Index does not Granger cause GDP") for the total lag length tested. For the remaining countries where a causality from index to GDP has been reported, the results indicate that index does Granger causes the GDP for up to 1 year in Germany, from 3 to 5 quarters in Greece and only at 1 quarter for Ireland.

Those results are supportive of the 4 main theoretical explanations for the causality relationship from index to GDP presented previously in the dissertation such as the forward-looking fundamental equity valuation models where is believed that stock prices reflect expectations on economic growth and the wealth effect phenomena where fluctuations on stock markets represent a direct fluctuation on households and companies wealth which in turn will be reflected in the increase/ decrease of consumption and investment.

The results of table 9 also noted the existence of independent relationships for Ireland, suggesting that an independent relationship is observed at a 5% level of significance for a lag period higher than 1, and for Greece considering a lag of 1 or 2 quarters. This results may suggest that the variations on the time series are caused by other external factors not considered in the Granger-causality test and, especially for the case of Greece, this independent relationship, may also be a consequence of the higher volatility observed in this country time series which signals a period of more uncertainty and a more expectant position on the key players of the economy such as companies and households.

Regarding the United Kingdom Granger-causality test, the results suggest a strong rejection of the null hypothesis for equation 2 ("GDP does Granger cause the Index") for lags 3 (optimal lag) and lag 5 at a 1% level of significance although, for the remaining lags the results are consistent considering a 5% level of significance. Despite the fact that a causal relationship can be strongly observed in this economy, the relationship displayed is the opposite from the remaining economies tested suggesting that in the UK, considered the European economy with greatest stock markets development, the GDP does help forecasting future stock markets variation but stock markets do not help predicting future economic growth.

Without crisis sample

Table 10 presents the results of the Granger-causality test performed on the subperiod "without crisis" which contains data for the periods between 1995Q2 to 2017Q4 plus the period from 2014Q1 t0 2017Q4. The test was computed for each of the six countries selected from Europe for this study for lags 1 to 5.

Table 10 – Granger test on subperiod "without crisis"

Country	nr. of Lags	From Index to GDP/1	From GDP to Index/2	Test Results/3
France	1	0.0008***	0.3112	Index causes GDP
	2	0.0005***	0.6427	Index causes GDP
	3	0.0002***	0.8631	Index causes GDP
	4	0.0003***	0.7701	Index causes GDP
	5	0.0002***	0.7235	Index causes GDP
Germany	1	0.1819	0.2557	Independent relationship
	2	0.0393**	0.4073	Index causes GDP
	3	0.0788*	0.5161	Independent relationship
	4	0.0688*	0.5917	Independent relationship
	5	0.1883	0.0418**	GDP causes Index
United Kingdom	1	0.8550	0.0824*	Independent relationship
	2	0.9346	0.1526	Independent relationship
	3	0.6067	0.3396	Independent relationship
	4	0.3287	0.3038	Independent relationship
	5	0.3769	0.0916*	Independent relationship
Portugal	1	0.0072***	0.5985	Index causes GDP
	2	0.0254**	0.5691	Index causes GDP
	3	0.0431**	0.7825	Index causes GDP
	4	0.0702*	0.8036	Independent relationship
	5	0.1168	0.7249	Independent relationship
Ireland	1	0.3889	0.4714	Independent relationship
	2	0.6825	0.7550	Independent relationship
	3	0.5634	0.8640	Independent relationship
	4	0.5325	0.9153	Independent relationship
	5	0.3099	0.4041	Independent relationship
Greece/a	1	0.4315	0.1764	Independent relationship
	2	0.7342	0.4295	Independent relationship
	3	0.1412	0.5926	Independent relationship
	4	0.2852	0.7076	Independent relationship
	5	0.4152	0.7988	Independent relationship

*,** and *** show that the null hypothesis is rejected at 10%, 5% and 1% level of significance, respectively.
/1 P-values for the null hypothesis "Index does not Granger cause GDP".
/2 P-values for the null hypothesis "GDP does not Granger cause Index".
/3 Test results based on a 5% level of significance.
/a Granger test performed considering the first differences of the time series in order to make them stationary.

From the findings reported above, 3 out of 6 countries (UK, Ireland and Greece) present an independent relationship for all lags on their Granger-causality test at 5% level of significance, mainly due to the considerably smaller period sample where 6 of 22 years of quarterly observations were ruled out the sample resulting in the weakening of the model tested.

Considering the UK test, it is been previously reported a causality relationship from GDP to Index in the total sample period although, excluding the years considered as the most impactful years of the crisis, this relationship is only observed at 10% level of significance for lags 1 and 5.

The test performed on our subperiod seems to weaken the results achieved for all countries although, it should be highlighted that for the French economy, the exclusion of the crisis years strengthen the causality relationship observed before from Index to GDP, decisively rejecting the null hypothesis from equation 1 ("Index does not Granger-cause GDP") at either 10%, 5% or 1% level of significance suggesting a uni-directional causality from Index to GDP in the subperiod "without crisis".

The remaining economies (Portugal and Germany) present results consistent with the previously observed with a causality relationship from Index to GDP displayed in Portugal for lags 1 to 3 at 5% level of significance and for lag 2 in Germany.

Germany has displayed a causality relationship opposite to the previously identified presenting a uni-directional relationship from GDP to Index presented at 5% level of significance at lag 5 which ay suggest that although there is a causality relationship between the two variables tested, this causality may change over time.

With crisis sample

Table 11 presents the results of the Granger-causality test performed on the subperiod "With crisis" which comprehends data from the selected years of crisis considered to be between 2018Q1 to 2013Q4.

Table 11 – Granger test on subperiod "with crisis"

Country	nr. of Lags	From Index to GDP/1	From GDP to Index/2	Test Results/3
France	1	0.1021	0.8530	Independent relationship
	2	0.4472	0.0058***	GDP causes Index
	3	0.7530	0.0384**	GDP causes Index
Germany	1	0.0742*	0.7318	Independent relationship
	2	0.2571	0.3122	Independent relationship
	3	0.2542	0.4466	Independent relationship
United Kingdom/a	1	0.8283	0.2621	Independent relationship
	2	0.9932	0.6318	Independent relationship
	3	0.6841	0.4051	Independent relationship
Portugal	1	0.1308	0.0444**	GDP causes Index
	2	0.3965	0.1142	Independent relationship
	3	0.2411	0.0947*	Independent relationship
Ireland	1	0.1606	0.2199	Independent relationship
	2	0.3292	0.4121	Independent relationship
	3	0.4864	0.1403	Independent relationship
Greece/a	1	0.4880	0.5564	Independent relationship
	2	0.4029	0.4522	Independent relationship
	3	0.0603*	0.6954	Independent relationship

*,** and *** show that the null hypothesis is rejected at 10%, 5% and 1% level of significance, respectively.
/1 P-values for the null hypothesis "Index does not Granger cause GDP".
/2 P-values for the null hypothesis "GDP does not Granger cause Index".
/3 Test results based on a 5% level of significance.
/a Granger test performed considering the first differences of the time series in order to make them stationary.

In this section, attending to the very short period of sample data, the test is performed only for lags 1 to 3 considering that higher number of lags would provide less than 20 observation on the Granger causality test.

Considering the very short sample data tested in this subperiod, the results presented in table 11 suggests that there is no evidence of any causality relationship between the variables for UK, Germany, Ireland, and Greece. These results are mainly explained by the fact that only 20 observations were considered in the test. Another factor that may impact the results is the higher volatility observed in this subperiod, result of the period of austerity and greater uncertainty lived by most of European countries.

Although the results may not generate conclusive results for most economies being tested, the results presented in France and Portugal for the subperiod "with crisis" suggest that the null hypothesis can be strongly rejected for equation 2 ("GDP does not Granger-cause Index") at 1% level of significance for lag 2 in the French test and lag 1 for the Portuguese test. This results may indicate that despite the existence of a causality between the two variables (GDP and Index) this causality relationship may change over times considering the period being tested both economies display a causality relationship from GDP to Index, the opposite relationship showed in previous tests for the total sample and subperiod "without crisis" where a strong causality from Index to GDP was observed. This change in the causality relationship, verified in both economies can be indicative of a change in the investors' perceptions and expectations on times of more uncertainty and volatility in economy and stock markets.

6. Conclusions

This dissertation studies the role of stock markets as a leading indicator of economic growth and explores causal relationships between those two variables. This empirical study used formal tests of causality developed by Granger (1969) and quarterly data from six countries in Europe for the period between 1995Q2 and 2017Q4.

The results founded in this study are not unanimous through the selected countries. Despite the fact that all countries have showed a relationship between the variables, only five out of six indicated a causal relationship from stock markets to economic growth at their respective optimal lag length. The United Kingdom presented a causality relationship from GDP to Index in all lags tested at least 5% level of significance.

The test performed for France as presented a bi-directional relationship at 5% level of significance although the relationship is stronger from Index to GDP rejecting the null hypothesis at 1% level of significance for lags 1 to 5. These results are consistent with the test performed on the subperiod "Without crisis" where a reinforcement of this causality relationship from index to GDP is verified.

Even though the Granger-causality test on the subperiods determine as "with" and "without" crisis have presented some independent relationships of causality mainly due to the weakened of the model with shorter periods of sample, one conclusion must be highlighted. The tests performed on France and Portugal for the subperiod "With crisis" have presented the opposite relationship than the previously reported on the total sample and in the subperiod "without crisis". Considering that for the period considered as the years of crisis, from 2008 to the end of 2013, both economies displayed a causality relationship from GDP to Index, may suggest that although there is a causality relationship between the variables, this relationship can change over time. This fluctuation on the causality relationship observed can be a consequence of several external factors or other variables.

For that reason, it is worth mention that the model used in this study does not account for several other variables such as for instance, social-economic policies implemented in each country, the impact of the worldwide economy on the investors' perceptions or, in other words the impact of the globalization and several other factors, that may affect the accuracy of the results achieved. For that matter, considering the limitations and the controversy surrounding the Granger-causality test, the empirical results and conclusions reported in this study should be considered as suggestive rather than absolute.

In conclusion, the results of this study reveal that for the French, German, Portuguese., Irish and Greek economies the stock markets of each respective country do Granger cause the GDP which means that they can work as a leading indicator for their respective economic growth however, the relationship revelled for the British economy seems to be the opposite, with the variations of GDP helping forecasting the future stock markets variations.

A couple of issues regarding the subject that need further exploration are for instance, the identification of characteristics on each country that may improve the accuracy of the test and identify in each cases and conditions the stock markets can better perform a role in helping forecasting the economic growth. Another issue also noted by other authors is regards to the globalization. Recent studies of the subject tend to find fewer stable results than studies prior to the globalization or the 1987 stock market crash and so, it is worth investigate the impact of the globalization in the relationship between each country respective stock markets and economic growth.

7. References

Adajaski, C.K.D. and N.B. Biekpe (2005), "Stock Market Development and Economic Growth: The Case of Selected African Countries." *African Development Bank*, Working Paper.

Atje, Raymond and B. Jovanovic (1993), "Stock Markets and Development" *European Economic Review*, pp. 632-640.

Atmadja, A.S. (2005), "Granger Causality tests for Five ASEAN Countries' Stock Markets and Macroeconomic Variables During and Post the Asian Financial Crisis" *Jurnal Manajemen* & *Kuwirausahaan*, Vol. 7, No.1 pp. 1-21.

Auret, C., & Golding, J. (2012), "Stock prices as a leading indicator of economic activity in South Africa: Evidence from the JSE". *The Investment Analysts Journal*, Vol. 76, pp. 39–48.

Bahadur, S. and S. Neupane (2006), "Stock Market and Economic Development: A causality Test" *The Journal of Nepalese Business Studies*, Vol. 3, No. 1, pp. 36-44.

Baker, Malcom, and Jefferey Wurgler (2000), "The Equity Share in New Issues and Aggregate Stock Returns" *Journal of Finance*, Vol. 55, pp. 2219-2257.

Barro RJ. (1990), "The stock market and investment" *The Review of Financial Studies*, Vol. 3, pp. 115-131.

Bernanke, B., M. Gertler and S. Gilchrist (1996), "The Financial Accelerator and the Flight to Quality" *The Review of Economics and Statistics*, Vol. 78, No. 1, pp. 1-15.

Binswanger M. (2000), "Stock returns and real activity: Is there still a connection?" *Applied Financial Economics*, Vol. 10, pp. 379-387.

Bostic, R., S. Gabriel and G. Painter (2009), "Housing Wealth, Financial Wealth, and Consumption: New Evidence from Micro Data," *Regional Science and Urban Economics*, Vol. 39, pp. 79-89.

Bosworth B, Hymans S and F. Modigliani (1975), "The stock market and the economy" *Brookings Papers on Economic Activity*, pp. 257-300.

Brealey, Richard A. and Stewart C. Myers (1988), "Principles of Corporate Finance" 3rd *New York*, pp. 49-55

Burgstaller, J. (2002), "Are Stock Returns a Leading Indicator for Real Macroeconomic Developments?" *Jonaness Kepler University of Linz*, working paper no. 0207.

Campbell H.R. (1989), "Forecasts of Economic Growth from the Bond and Stock Markets," *Financial Analysts Journal,* September/October, pp. 38-45.

Case, K. E., J. M. Quigley, and R. J. Shiller (2005), "Comparing Wealth Effects: The Stock Market versus the Housing Market," *Advances in Macroeconomics*: Vol. 5, Article 1.

Choi JJ, Hauser S and Kopecky KJ (1999), "Does the stock market predict real activity? Time series evidence from the G-7 countries" *Journal of Banking and Finance*, Vol. 23, pp. 1771-1792

Comincioli, B. (1996), "The stock market as a leading indicator: An application of Granger causality," *The University Avenue Undergraduate Journal of Economics*, Sample Issue.

Demetriades, Panicos and K. Hussein (1996), "Does Financial Development Cause Economic Growth? Time-series Evidence From 16 Countries" *Journal of Development Economics*, Vol 51, pp. 387-41.

DeBondt, F.M. Werner and R. Thaler (1985), "Does the Stock Market Overreact?" *Journal of Finance*, July 1985, pp. 793-805.

Estrella A and Mishkin FS. (1998), "Predicting US recessions: Financial variables as leading indicators" *The Review of Economics and Statistics*, Vol. 80, pp. 45-61.

Fama E. (1981), "Stock returns, real activity, inflation and money" *The American Economic Review*, Vol. 71, pp. 545-565.

Fama E. (1990), "Stock returns, expected returns and real activity" *Journal of Finance*, Vol. 45 pp. 1089-1108.

Fazzari S., R. Hubbard and B. Peterson (1988), "Financing Constraints and Corporate Investment," *Brookings Papers on Economic Activity*, pp. 141-195.

Fischer S and Merton RC. (1984), "Macroeconomics and finance: The role of the stock market" *NBER Working Paper* 1291, pp. 1-63.

Foresti, P. (2007), "Testing for Granger Causality Between Stock Prices and Economic Growth" *Journal of Finance*, MPRA Paper No. 2962.

Gan, C., M. Lee, H. Yong and J. Zang (2006), "Macroeconomic Variables and Stock Market Interactions: New Zealand Evidence" *Investment Management and Financial Innovations*, Vol. 3, pp. 89-101.

Geske R and Roll R. (1983), "The monetary and fiscal linkage between stock Returns and inflation" *Journal of Finance*, Vol. 38, pp. 1-33.

Granger C. J. (1969), "Investigating Causal Relationships by Econometrics Models and Cross Spectral Methods", *Econometrica*, Vol. 37, pp. 425-435.

Hassapis C and Kalyvitis S. (2002), "Investigating the links between growth and real stock prices with empirical evidence from the G-7 economies" *The Quarterly Review of Economics and Finance*, Vol. 42, pp. 543- 575.

Hirshleifer, D. (2001), "Investor Psychology and Asset Pricing," Vol. 56, pp.1533- 1597.

Huang, R.D. and W. A. Kracaw (1984), "Stock Market Returns and Real Activity: A Note," *The Journal of Finance*, Vol. 39, No. 1, pp. 267-273.

Hodrick R and Prescott E. (1981), "Post-war US business cycles: An empirical investigation" *Journal of Money Credit and Banking*, Vol. 19, pp. 1-16.

Ibrahim MH. (2010), "An empirical analysis of real activity and stock returns in an emerging market" *Economic Analysis and Policy*, Vol. 40, pp. 263-271.

Lee, Bong-Soo (1992), "Causal Relations Among Stock Returns, Interest Rates, Real Activity and Inflation," *The Journal of Finance*, Vol. 47, No. 4, pp. 1591-1603.

Leigh, L. (1997), "Stock market equilibrium and macroeconomic fundamentals," I*MF Working Paper,* WP/97/15.

Levine, Ross and S. Zervos (1998), "Stock Markets, Banks, and Economic Growth" *American Economic Review*, Vol. 88, pp. 537-558.

Mahdavi, Saeid and A. Sohrabian (1991), "The Link between the Rate of Growth of Stock Prices and the Rate of Growth of GNP in the United States: A Granger Causality Test" *American Economist,* Fall, pp. 41 – 48.

Mauro P. (2003), "Stock returns and output growth in emerging and advanced economies" *Journal of Development Economics*, Vol. 71, pp. 129-153.

McKinnon, R. (1973), "Money and Capital in Economic Development" Washington DC:The Brookings Institution.

Mishkin, Frederic S. (2001), "The Economics of Money, Banking, and Financial Markets" 6th ed. New York : Addison Wesley Longman.

Mun, H.W., E. C. Siong and T.C. Thing (2008), "Stock Market and Economic Growth in Malaysia: Causality Test," *Asian Social Science*, Vol. 4, No. 4, pp. 86-92.

Nishat, M. and R. Shaheen (2004), "Macroeconomic Factors and the Pakistani Equity Market," *Pakistan Development Review.*

Otoo, M.W. (1999), "Consumer Sentiment and the Stock Market," Board of Governors of the Federal Reserve System paper.

Paiella, M. (2007), "Does Wealth Affect Consumption? Evidence for Italy," *Journal of Macroeconomics*, Vol. 29, pp. 189-205.

Park S. (1997), "Rationality of negative stock-price responses to strong economic activity" *Financial Analysts Journal*, Vol. 5, pp. 52-56.

Pearce, Douglas K. and V. Roley (1985), "Stock Prices and Economic News," *Journal of Business,* January, pp. 49 – 67.

Pearce, Douglas K. (1983), "Stock Prices and the Economy," *Federal Reserve Bank of Kansas City Economic Review,* November, pp. 7 – 22.

Pilinkus, D. (2009), "Stock Market and Macroeconomic Variables: Evidence from Lithuania," *Economics and Management*, Vol. 14, pp. 884-891.

Ritter, J. R. (1991), "The Long-run Performance of Initial Public Offerings," *Journal of Finance*, Vol. 46, pp. 3-27.

Rousseau, Peter and P. Wachtel (2000), "Equity Markets and Growth: Cross-Country Evidence on Timing and Outcomes" *Journal of Banking and Finance*, pp. 1933-1957.

Umstead, David A. (1977), "Forecasting Stock Market Prices," *Journal of Finance,* May, pp. 427 – 441.

Schwert, William G. (1989), "Why Does Stock Market Volatility Change Over Time?" *Journal of Finance Vol. XLIV,* NO. 5*,* December, pp. 1124 – 1135.

Seth, A.K. (2005), "Causal connectivity analysis of evolved neural networks during behavior" *Network: Computation in Neural Systems,* Vol. 16, pp. 35-55.

Simone, S. (2009), "Wealth Effect in the US: Evidence from Brand New Micro-Data" Working Paper, Department of Economics, University of Siena.

Stock JH and Watson MW. (1989), "New Indexes of Coincident and Leading Economic Indicators". *NBER Macroeconomics Annual*, Vol. 4, pp. 351-394.

Stock JH and Watson MW. (2003a), "How did leading indicator forecasts do during the 2001 recession" *NBER Working Paper*, 2003, pp. 1-25.