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The nexus between financial development and economic growth: A panel-VAR evidence

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Dedication

In memory of

Mia

Maria José do Couto Guterres

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Resumo

Este estudo examina a relação entre crescimento económico, inflação, abertura económica e financeira, desenvolvimento do sector bancário e do mercado de ações, através da elaboração de um painel de seis países (Espanha, França, Grécia, Irlanda, Itália e Portugal), para o período de 1990-2015, com a utilização de dados anuais. Os dados foram obtidos através da base de dados dos indicadores de desenvolvimento mundial (WDI) e de desenvolvimento financeiro global (GFDD), publicados pelo World Bank e pelo fundo monetário internacional (FMI). Através do procedimento de análise de componentes principais (PCA), elaborou-se duas novas variáveis para medir o desenvolvimento do setor bancário e o desenvolvimento do mercado acionista (compostos por diversas variáveis). As restantes variáveis em estudo são o PIB per capita, a inflação, o comércio e o investimento direto estrangeiro proposto como medida de facto, utilizando um modelo em painel PVAR, para testar a causalidade à Granger e interdependência entre as variáveis, assim como a presença entre as variáveis de causalidade unidirecional e/ou bidirecional. Este estudo tem como foco uma melhor compreensão na relação entre as variáveis em estudo assim como um grupo de países afetados pela crise do *subprime*, ainda não estudados em conjunto. Conclui-se que o desenvolvimento do setor bancário do mercado acionista e o grau de abertura económico contribui positivamente para o crescimento económico, não se detetando causalidade do grau de abertura financeiro para o crescimento.

Palavras-chave

Desenvolvimento Financeiro; Crescimento Económico; Abertura Financeira; Abertura Económica; Painel-VAR

Resumo alargado

Os fatores que estimulam e influenciam o crescimento económico, são de particular interesse para os investigadores. O desenvolvimento financeiro é, desde os pioneiros estudos realizados por Schumpeter (1911), identificado como impulsionador positivo de crescimento económico, posteriormente estudos realizados por McKinnon (1973) e Shaw (1973) reforçaram o aspeto positivo desse *output*. Predominantemente estudos realizados em contexto macroeconómico são para determinar fatores de crescimento económico (Bassanini, Scarpetta and Hemming, 2001; Goldsmith, 1969; Levine, 1991; Pagano, 1993).

Com as constantes alterações evolutivas existentes, sejam elas provocadas pelos avanços tecnológicos, pelo desenvolvimento dos países, surgimento de novos mercados, etc…, os fatores que potenciam o crescimento económico, são diversificados. Assim Barro e Sala-i-Martin (1995), Romer (1998) or Yucel (2009) realizaram estudos sobre abertura e crescimento económicos. Foram ainda construídos índices compostos por um leque de variáveis para analisar o impacto do desenvolvimento do setor bancário e do mercado acionista no crescimento económico (Fink, Haiss, & Vuksic, 2009; Beck & Levine, 2004; Levine & Zervos, 1998; Yartey, 2008). Importa ainda destacar estudos empíricos que relacionam a inflação com o crescimento económico (Barro, 2013, Boujelbene & Boujelbene, 2010 e Jalil, Tariq, & Bibi, 2014).

Contudo, os investigadores deparam-se com a dificuldade em identificar as relações de causalidade entre as variáveis (o crescimento económico é potenciado pelas variáveis ou vice-versa). É possível identificar, na literatura em termos de direção, quatro tipos de hipóteses: hipótese neutra (sem relação de causalidade), *supply-leading* e *demand-following* (existência de causalidade unidirecional) e a hipótese *feedback* (causalidade bidirecional), (Pradhan et al., 2013, 2014 e 2017).

Com base nas premissas anteriores, este estudo investiga a causalidade entre o crescimento económico, a inflação, a abertura económica e financeira e de duas componentes financeiras: desenvolvimento do setor bancário e desenvolvimento do mercado de ações. Elaborou-se um painel de seis países europeus (Espanha, França, Grécia, Irlanda, Itália e Portugal) selecionados pelas suas semelhanças culturais e históricas, assim como pelo fato de serem economias afetadas pela crise do *subprime,* com recolha de dados anuais para o período de 1990-2015.

Os dados utilizados foram recolhidos da base de dados dos indicadores de desenvolvimento mundial (WDI) e de desenvolvimento financeiro global (GFDD), publicados pelo World Bank e pelo fundo monetário internacional (FMI). As variáveis usadas em estudo foram transformadas em valores *per capita*, seguido dos logaritmos naturais e em primeiras diferenças, e são: o PIB per capita, a inflação, o comércio e o investimento direto estrangeiro proposto como medida

de facto. Foi ainda possível elaborar duas novas variáveis para medir o desenvolvimento do setor bancário e o desenvolvimento do mercado acionista, com incorporação de cinco componentes no BSD e de quatro no SMD (uma das componentes foi rejeita pelo PCA). Esse procedimento foi efetuado com recurso à análise de componentes principais (PCA), utilizando-se o teste de Bartlette e o teste de adequabilidade de Kaiser-Meyer-Olkin, como avaliação da adequabilidade do PCA. Salientar a inclusão de duas *shift dummy* com o valor 1 para capturar os efeitos da adesão dos países à União Monetária, e os efeitos da crise do *subprime*. Foram ainda realizados outros testes preliminares como: o teste Pesaran, que testa a dependência seccional - *cross section dependence,* o teste VIF para testar a multicolinearidade e ainda o teste de Hausman, para testar a opção entre efeitos fixos ou aleatórios.

Para testar a causalidade à Granger, a interdependência entre as variáveis e a presença de causalidade unidirecional e/ou bidirecional entre as variáveis, utilizou-se um modelo em painel desenvolvido por Love & Zicchino (2006) - PVAR (painel vetor autorregressivo). Este modelo tem implícito como estimador o Método Generalizado dos Momentos (GMM). Destacar que a validação dos dados foi efetuada pela função impulso-resposta, pela condição de estabilidade *eigenvalue* e pela previsão-erro decomposição da variância.

Após execução dos testes de diagnostico, estimou-se o modelo e procedeu-se à validação dos resultados, concluindo-se que o crescimento económico contribui positivamente para o desenvolvimento do setor bancário do mercado acionista e para o grau de abertura económico (hipótese *feedback*), não se detetando causalidade (hipótese neutra) do crescimento económico para o grau de abertura financeiro. O resultado de hipótese neutra obtido, deve-se em muito pelo fato de o indicador sere fortemente influenciado pelos mercados e investidores estrangeiros, uma vez que o investimento direto estrangeiro foi utilizado como *proxy* para medir a abertura financeira.

Da análise efetuada ao teste função impulso-resposta destacar que as variáveis apresentam na generalidade uma resposta positiva aos choques, e que após a ocorrência do mesmo, a maioria das recupera num período de 4 anos (salvo alguma exceção). Da previsão-erro decomposição da variância é ainda possível destacar que as variáveis são autoexplicadas, e que o PIB per capita, a inflação e o desenvolvimento do mercado acionista recuperam mais de 60% após o choque num período de 8 anos. Exceção feita ao desenvolvimento do sector bancário e do mercado acionista, o PIB per capita é a variável que melhor responde aos choques.

Abstract

This study examines the relationship between economic growth, inflation, economic and financial openness, banking sector development and stock market development through a panel of six countries (France, Greece, Ireland, Italy, Portugal and Spain) for the period 1990-2015, using annual data. The data was gathered from the GFDD (Global Financial Development Database), WDI (World Development Indicators) both published by the World Bank and from IMF (International Monetary Fund). By using principal component analysis (PCA) was possible to construct two new measures, one for banking sector development, and other for stock market development, with several component's each, the rest of the variables are the GDP per capita, inflation, trade, foreign direct investment proposed as a de facto measure. A panel vector auto-regressive (PVAR) model was used to test Granger causalities and the interdependence between variables as well as the presence of unidirectional and bidirectional causality between the variables. This study contributes for a better understanding between the relationship of the variables used and with a role of countries affected with the *subprime* crises, not yet studied together. Results show that the economic growth have a positive contribute to banking sector development, stock market development and to economic openness, however there was no causality from economic growth to financial openness.

Keywords

Financial Development; Economic Growth; Financial Openness; Economic Openness; Panel-VAR

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Acronyms List

BSD - banking sector development

CPI – consumer price index

FDI – foreign direct investment

GDP - gross domestic product

GFDD – global financial development database

GMM - generalized method of moments

IMF - international monetary fund

INF – inflation

MU – monetary union

OECD - organisation for economic co-operation and development

PCA - principal component analysis

PVAR - panel vector auto-regressive

SMD - stock market development

VIF - variance inflation test

WDI – world development indicators

1. Introduction

Economic growth, during the last decade's academic researchers, gave a great deal of attention to this subject, analysing and connect it with several economic outputs to better comprehend and perceive it. Along with economic growth, financial development has also been a very important subject for researchers, since the begging of the 20th century, when Schumpeter (1911) presented his work in which he shows the positive linkage between them, later also McKinnon (1973) and Shaw (1973) when studied the welfares of financial repression related economic growth and finance, almost every study in macroeconomic context, relate empirical determinants of economic growth (e.g. Bassanini, Scarpetta and Hemming, 2001; Goldsmith, 1969; Levine, 1991; Pagano, 1993).

Never the less, with the constant changes in the world regarding the improvements in technology, better communications (e.g. WWW[1]), advances in transport, emergence of new markets (e.g. EU[2]), that leads to global markets the economic growth subject is now wider than ever, so studies like Barro and Sala-i-Martin (1995), Romer (1998) or Yucel (2009) over trade openness is now very important. As important measure, there is also SMD (Stock Market Development), and BSD (Banking Sector Development), each one with their components, identify by the empirical literature as related with economic growth (Fink, Haiss, & Vuksic, 2009; Beck & Levine, 2004; Levine & Zervos, 1998; Yartey, 2008).

Economic researchers like Barro (2013), Boujelbene & Boujelbene (2010) or even Jalil, Tariq, & Bibi (2014), agree that inflation has consequences for economic growth (e.g. studies demonstrate that a controlled and stable inflation facilitates investments and business decisions).

It is also worth mentioning more recent studies that link economic growth with financial openness, by using financial indicators à de facto developed by Lane and Milesi-Ferretti (2007) like the study from Herwartz and Walle (2014), Zhang, Zhu & Lu (2015) or à de jure proposed by Chinn and Ito (2006), like the study of Andreasen and Valenzuela (2016), Rodriguez (2017).

The contribution of these study has two major aspects, the first is that analyses a panel of six European countries who suffered from the subprime mortgage crisis started in the USA[3], and the time span allows to assay the impact of becoming a member of the euro area. The second

[1] WWW – World Wide Web.
[2] EU - European Union – political and economic union of 28 country members located in European continent.
[3] USA – United States of America.

aspect is that the study seeks to find the relation between economic growth, economic and financial openness, baking sector development and stock market development.

The number of variables used by the researchers to analyse this matters is so wide, like trade openness, government expenditure, inflation, foreign direct investment, gross capital formation imports of goods and services, infrastructures (see, for instance, Fischer 1993; Mankiw, Romer & Weil, 1992), so to realize this study was used GDP to capture the economic growth, and other important variables, such as inflation, trade openness to measure economic openness, foreign direct investment to measure financial openness, and used principal component analysis (PCA) to create two single variables to assess stock market development and banking sector development. These variables are studied over a period of twenty-six years (1990-2015) and to a panel of six country's (France, Greece, Ireland, Italy, Portugal and Spain) by using a panel vector auto-regressive (VAR) model to capture the impulse-response functions and variance decomposition to see the shocks variables suffer in a certain time interval.

The structure of this study is divided as follows. Section 2 is dedicated to the literature review, in Section 3 shows the data, methodology, construction of the composite measures BSD and SMD and the diagnostics tests, Section 4 shows the empirical results and finally on Section 5, the concluding remarks.

2. Literature Review

Since it's such a wide and interest subject to study, many researchers focus their attention in economic growth and his connexion with all the others economic variables, such as baking sector development, stock market development, inflation, trade, foreign direct investment. Several studies, with different time spans and different countries where realize, which generate a sizable body of literature, so the results of the casual effect direction are vast. To better show these mixed findings throughout the literature, it's presented a resume over the tables below.

The analyse of the interaction between economic growth and other variables has been the focus since the seminal work of Schumpeter (1911), followed by Goldsmith (1969), McKinnon (1973) and Shaw (1973), who focus in the link between economic growth and financial sector development and generate an intensive debate. After, the works of Lucas (1988) shows that financial sector only respond to economic growth. But recent literature, see Levine (1997) or Bertocco (2008) highlights the positive causality between a healthy financial system and economic growth.

However other studies like Liu and Hsu (2006), Li (2007), Cole, Moshirian and wu (2008), Rousseau and Yilmazkuday (2009) or Montes and Tiberto (2012), stress that in the long-run, stock market development is key in fostering economic growth. Inflation is also a variable often use to investigate causality between economic growth, Boujelbene & Boujelbene (2010), Barro (2013) and Jalil, Tariq, & Bibi (2014) defend that controlled and stable inflation promotes business and investment decisions. So, it's obvious that inflation and stock market development are related.

According all the vast literature is difficult to identify if it is economic growth that drives all other variables (e.g. inflation, trade openness, foreign direct investment, banking sector development, stock market development), or if is the other way around. This way it's possible to categorise in terms of direction of causality between the variables, four types of hypotheses

- Neutrality hypothesis – when there is no causality between variables, means that the variables are independent of each other;
- Supply-leading hypothesis – when exists unidirectional causality between variables, means causality running from variables to economic growth;
- Demand-following hypothesis - when exists unidirectional causality between variables, means causality running from economic growth to one or more variables;
- Feedback hypothesis - when there is a bidirectional causality between variables, means that the causality runs in both directions.

According these proposition of causal relationships, between variables and economic growth, the tables below provides a synopsis of studies confirming one or several of this hypothesis. The tables are resumed by independent variable and economic growth, so was necessary to produce five tables, to identify relationship between each variable and economic growth.

Some authors elaborate tables with resume studies regarding the economic growth nexus, e.g. Pradhan, *et al* (2017), inspired in those authors table 1 below highlighted the aspects of the literature in which studies confirmed causality between the variables (inflation, trade, foreign direct investment, banking sector development, stock market development) and economic growth. It is also indicated in the table 1 the four types of causality direction that the authors determine for each relation between the variables.

Table 1: Resume of the studies on causality between several variables and economic growth.

Article	Period	Country(ies)	Causality studies	Main finding(s)
Andres, Hernando, and Lopez-Salido (2004)	1961-1993	OECD countries	INF and EC	F
Asteriou and Spanos (2018)	1990-2016	26 EU countries	FD and EC	S
Awokuse (2006)	1993-2002	Argentina, Colombia, Peru	TRD and EC	F
Baillie, Chung, and Tieslau (1996)	monthly	10 countries	INF and EC	F
Baldwin *et al*. (2005)	1979-1991	9 OECD countries	FDI and EC	S
Batuo, Mlambo and Asongu (2018)	1985-2010	41 African countries	FD and EC	B
Billmeier & Massa (2009)	1995-2005	17 MECA[4]	INF and EC	N
Bojanic (2012)	1940-2010	Bolivia	TRD, BSD and EC	S
Chaiechi (2012)	1990-2006	South Korea, Hong Kong, UK	BSD and EC	S
Chakraborty and Nunnenkamp (2006)	1987-2000	India	FDI and EC	N
Chandran and Munusamy (2009)	1970-2003	Malaysia	TRD and EC	S
Cheng (2012)	1973-2007	Taiwan	SMD and EC	F
Chow and Fung (2011)	1970-2004	69 countries	BSD and EC	F
Chowdhury (2002)	1950-1997	Indonesia	INF and EC	N
Chowdhury and Mavrotas (2006)	1969-2000	Chile, Malaysia, Thailand	FDI and EC	N
Darrat (1988)	1955-1985	3 Asian countries	INF and EC	S
Darrat *et al*. (2006)	1970-2003	4 MENA	SMD and EC	F
De Gregorio (1992)	1950-1985	12 Latin American countries	FDI and EC	S
De Mello (1999)	1970-1990	32 developed and developing countries	FDI and EC	S
Ductor and Grechyna (2015)	1970-2010	101 developed countries	FD and EC	S
Durusu-Ciftci (2017)	1989-2011	40 countries	FD and EC	F
Enisan and Olufisayo (2009)	1980-2004	7 SSA countries	SMD and EC	S
Hossain (2011)	1971-2007	NICs[5]	TRD and EC	S
Hou and Cheng (2010)	1971-2007	Taiwan	SMD and EC	F
Hsueh *et al*. (2013)	1980-2007	10 Asian countries	BSD and EC	S

[4] MECA - Middle East and Central Asia.
[5] NICs - Newly-industrialized countries.

Ibrahim and Alagidede (2018)	1980-2014	29 SSA[6] countries	FD and EC	F
Jayanthakumaran and Verma (2008)	1967-2005	ASEAN[7] 5	TRD and EC	D
Kar *et al*. (2011)	1980-2007	15 MENA countries	BSD, SMD and EC	D
Kar, Nazlioglu, and Agir (2011)	1980-2007	MENA[8] countries	INF and EC	F
Khaliq and Noy (2007)	1998-2006	Indonesia	FDI and EC	D
Kim, Lim and Park (2013)	1985-2002	Korea	INF and EC	D
Kolapo and Adaramola (2012)	1990-2010	Nigeria	SMD and EC	S
Konya (2006)	1960-1997	24 OECD countries	TRD and EC	F and D
Liu and Sinclair (2008)	1972-2003	China	SMD and EC	D
Manuchehr and Ericsson (2001)	1970-1997	4 countries	FDI and EC	N
Menyah *et al*. (2014)	1965-2008	21 African countries	BSD and EC	S
Nguyen and Wang (2010)	1991-2006	Taiwan	INF and EC	D and F
Odhiambo (2008)	1969-2005	Kenya	SMD and EC	D
Odhiambo (2010)	1969-2006	South Africa	BSD and EC	D
Ono (2017)	1999-2014	Russia	FD and EC	D
Ouyang and Li (2018)	1996-2015	30 Chinese provinces	FD and EC	S
Panopoulou (2009)	1995-2007	5 countries	BSD, SMD and EC	D
Pradhan *et al*. (2018)	1989-2015	23 EU countries	FD and EC	S
Pradhan, Arvin and Bahmani (2018)	1961-2014	49 EU countries	FD and EC	F
Pradhan, Arvin *et al*. (2013)	1988-2012	16 Asian countries	SMD and EC	S
Pradhan, Arvin *et al*. (2014)	1960-2011	Asian countries	BSD and EC	F
Pradhan, Arvin, and Bahmani (2015)	1960-2012	34 OECD[9] countries	INF and EC	S
Pradhan, Dasguta *et al*.(2013)	1989-2011	5 BRICS[10] countries	BSD and EC	F
Pradhan, Mukhopadhyay *et al*. (2013)	1961-2011	15 Asian countries	BSD and EC	D
Rashid (2008)	1994-2005	Pakistan	SMD and EC	F
Ruiz (2018)	1991-2014	116 countries	FD and EC	S
Sarkar (2007)	1970-2002	51 less developed countries	FDI and EC	N
Shahbaz (2012)	1971-2011	Pakistan	TRD and EC	S and D
Shaikh (2010)	1981-1999	47 developing countries	FDI and EC	D
Tang and Chea (2013)	1972-2008	Cambodia	TRD and EC	F
Tsouma (2009)	1991-2006	22 MMs[11] and EMs[12]	SMD and EC	S
Vaona (2012)	1960-1999	167 countries	INF and EC	N
Wolde-Rufael (2009)	1966-2005	Kenya	BSD and EC	F
Zhang (2001)	1984-1998	China	FDI and EC	S

Note(s): D: demand-following hypothesis; F: feedback hypothesis; N: neutrality hypothesis; S: supply-leading hypothesis. EC: economic Growth; INF: inflation; TRD: trade; FDI: foreign direct investment; FD: financial development; BSD: banking sector development; SMD: stock market development.

[6] SSA - sub-Saharan African
[7] ASEAN - Association of Southeast Asian Nations.
[8] MENA - Middle East and North Africa region.
[9] OECD - Organisation for Economic Co-operation and Development.
[10] BRICS - Brazil, Russia, India, China and South Africa.
[11] MMs – Mature Markets.
[12] EMs - Emerging Markets.

The table 1, shows that the relationship between economic growth and other variables, is a major concern for the researchers, since it has been widely studied along these recent years. Among the countries and group of countries studied researchers found causality relationship between economic growth and variables (indicate to each in the table) in several directions, i.e. depending the country and the variable it's possible to see for ex. in Pakistan for a period 1971-2011 Shahbaz (2012), find a relation of demand-following and also supply-leading hypothesis between economic growth and trade, or, for ex: Nguyen and Wang (2010) in Taiwan for a period from 1991-2006 find a demand-following and a feedback hypothesis between inflation and economic growth. Highlight that in the most recent studies (2017, 2018) researchers give more attention to the relationship between financial development and economic growth, i.e. financial indicator it's not segmented by banks or markets. The next section 3, present the data and methodology.

3. Data and methodology

To test the relationship between economic growth, inflation, economic and financial openness, banking sector development and stock market development, are the main aspects of this study, so to detect the causality between variables, the estimation it's realized by using a panel vector auto-regressive (see Abrigo and Love 2015) with the intention to test the following three hypotheses:

- H1 - Banking sector development in the presence of stock market development granger causes economic growth, it's expected to have a positive sign (i.e. BSD impulse economic growth);
- H2 - Stock market development in the presence of baking sector development granger causes economic growth, it's expected to have a positive sign (i.e. SMD impulse economic growth); and
- H3 - Financial openness in the presence of economic openness granger causes economic growth, it's expected to have a positive sign (i.e. FDI impulse economic growth).

According the above hypotheses, this study aims to explore the economic growth nexus with, banking sector development and stock market development, for a panel of six countries (France, Greece, Ireland, Italy, Portugal, and Spain). It's important to highlight in this study the choice of the variables where the linkage of economic growth is expanded not only to stock and banking markets, but also to economic and financial openness, and the choice of six European countries who were very affect with the subprime crises. Also significant is the use of impulse response function analysis to verify variables response to shocks. This following section 3 it's organized in subsection 3.1 – data, variables source and description, and 3.2 – methodology applied and is explanation.

3.1. Data

First, the data was obtained from three main sources, from GFDD[13] (*Global Financial Development Database*) and WDI[14] (*World Development Indicators*) both published by the World Bank and from OECD database and it covers a period from 1990-2015 (restricted to this time span because of available data).

[13] GFDD - database of financial system characteristics for 214 economies, and it contains annual data, starting from 1960.
[14] WDI – database of statistical data for over 200 economies, and it contains over 1500 development indicators with annual data starting from 1960.

Second, to create the data panel, was selected six countries to analyse: France, Greece, Ireland, Italy, Portugal and Spain. The three main reasons to use these selected countries is the fact that they all are European countries with similar culture and history, they all suffered from economic and political changes along the analyses period, changes like joining the Monetary Union (MU), officially called the euro area, and finally because the six of them suffered the subprime crises (more depth crises in Greece and Portugal with the need of foreign assistance from IMF[15]) that caused serious damage to the financial markets and infected the real economy.

Third, is important to highlight the use of dummies tool in this study, to capture the effects of two main situations: (i) integration of the six countries in the Monetary Union (MU), because for all of them was necessary to have monetary stability (relevant for integration); issues created by the physical change of the currency, etc…; (ii) economic distortion caused by the subprime crises which leads to foreign assistance in some cases (Portugal and Greece). The dummies (ID[16] and SD[17]) used to absorb structural framework impacts were applied to year 2000/2001 to capture (i) effects and adopts the number 1 value, for the (ii) effects applied a dummy with a number 1 value for the year 2008 – 2010.

Fourth, the principal variable of this study is the real gross domestic product per capita at constant LCU[18] used as a proxy to measure economic growth, followed by the other variables selected such as inflation measured by consumer price index (CPI[19]) as a proxy to measure inflation. The trade (i.e., exports plus imports) % of GDP used to proxy economic openness. As a proxy to financial openness its used the sum of foreign assets and liabilities over GDP constructed with the foreign direct investment, net inflows (% of GDP) plus the foreign direct investment, net outflows (% of GDP), proposed as de facto measure by Lane and Milesi-Ferretti (2007), that has been adopted instead of a de jure measure because of the available data and because is less vulnerable to endogeneity. Finally, to distinguish between the two components of financial sector (BSD, SMD), it's created an index derived from other measures (commonly used measures over the literature) using the principal component analysis. Since the financial sector is multifaceted, any credible measure of financial development must incorporate four financial dimensions, such as depth, efficiency, stability and others to get a better accuracy of measurement.

So considering all the aspects above, the composite measure for the banking sector development (BSD) is created with: (i) bank credit to bank deposits (%) – stability dimension; (ii) bank deposits to GDP (%) – other dimension; (iii) credit to government and state-owned enterprises to GDP (%) – efficiency dimension; (iv) domestic credit to private sector (% of GDP) – depth dimension; (v) liquid liabilities to GDP (%) – depth dimension; and the stock market development (SMD) is created with: (i) number of listed companies per 1,000,000 people - other

[15] IMF - International Monetary Fund.
[16] ID – impulse dummy
[17] SD – shift dummy
[18] LCU – local currency.
[19] CPI – consumer price index.

dimension; (ii) stock market capitalization to GDP (%) - depth dimension; (iii) stock market total value traded to GDP (%) - depth dimension, a part of begin referred over the literature, this variable was not used in this composite because it was not accept by the PCA, (iv) stock market turnover ratio (%) - efficiency dimension; (v) volatility of stock price index - stability dimension.

The variables were transformed in per capita values except inflation rate, foreign direct investment (constructed variable), number of listed companies per 1,000,000 people, and volatility of stock price index. After they were transformed in their natural logarithm form, following by their first differences for estimation, except inflation rate, number of listed companies per 1,000,000 people and volatility of stock price index.

Table 2 shows the variables definition and source, three of the variables were selected from World Development Indicators and another three from the Global Financial Development Database, both published by the World bank, only one of the variables was gather from Organisation for Economic Co-operation and Development.

Table 2: Variables description.

Variable	Definition	Source
GDP	GDP per capita (constant LCU)	WDI
INF	Inflation measured by consumer price index (CPI)	OECD
FDI	Foreign direct investment, net inflows + net outflows (% of GDP)	WDI
TRD	Trade (% of GDP)	WDI
BSD	Composite index of banking sector development (using five variables)	GFDD
SMD	Composite index of stock market development (using five variables)	GFDD

Note(s): WDI - World Development Indicators, published by the World Bank, GFDD - Global Financial Development Database, published by the World Bank, OECD - Organisation for Economic Co-operation and Development.

Through the mathematical procedure of principal component analysis that transforms a previous group of correlated variables into a small group who keeps most of the possible variance from the first group (i.e. this technique creates a single variable, with the essential information removed from each variable). So, to create a composite index through PCA for BSD and SMD, it's used the variables indicated in table 3 and 4.

In table 3, it is highlighted the variables used to create the composite index of banking sector development, source definition (all of them gathered from the Global Financial Development Database, published by the World Bank) and correspondent financial dimensions.

Table 3: Description of variables used in composite index of banking sector development.

Variable	Definition	Dimension	Source
BCB	Bank credit to bank deposits (%)	Stability	GFDD
BDG	Bank deposits to GDP (%)	Other	GFDD
BCG	Credit to government and state-owned enterprises to GDP (%)	Efficiency	GFDD
BDC	Domestic credit to private sector (% of GDP)	Depth	GFDD
BLL	Liquid liabilities to GDP (%)	Depth	GFDD

Note(s): The GFDD – Global Financial Development Database, published by the World Bank.

In table 4, it is highlighted the variables used to create the composite index of stock market development, source definition (all of them gathered from the Global Financial Development Database, published by the World Bank) and correspondent financial dimensions.

Table 4: Description of variables used in composite index of stock market development.

Variable	Definition	Dimension	Source
SNL	Number of listed companies per 1,000,000 people	Other	GFDD
SMC	Stock market capitalization to GDP (%)	Depth	GFDD
SMT	*Stock market total value traded to GDP (%)* ***-not accepted by PCA***	Depth	GFDD
STR	Stock market turnover ratio (%)	Efficiency	GFDD
SVP	Volatility of Stock Price Index	Stability	GFDD

Note(s): The GFDD – Global Financial Development Database, published by the World Bank.

The figure 1 shows the relationship between variables, correspondent definitions, the circles correspond to the primary variables under study, the squares figures indicates the variables that compose the PCA.

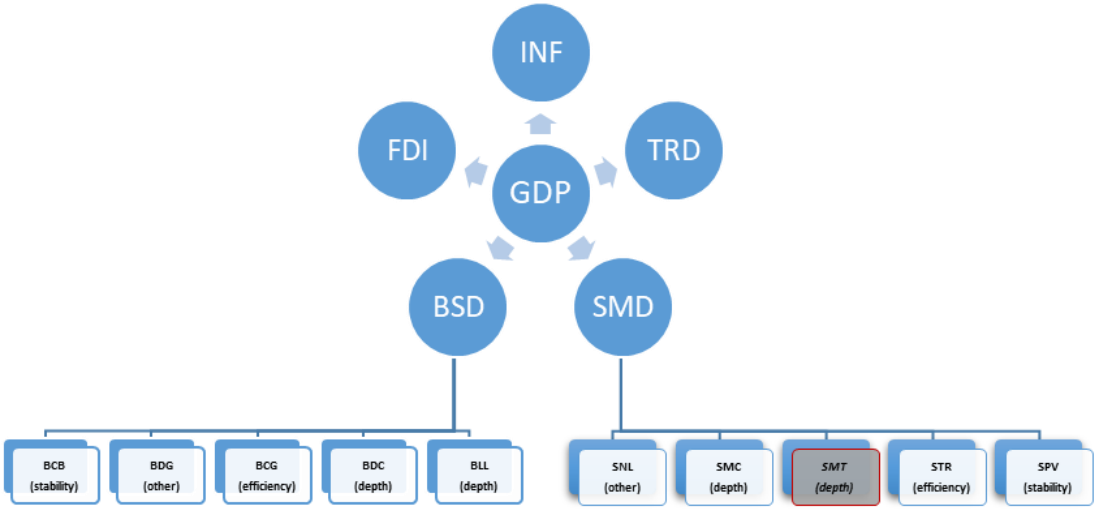


Figure 1: Relationship between all variables[20].

The robustness of the composite index Banking Sector Development (BSD) was verified by the application of Bartlett's test for sphericity (Bartlett, 1950) and Kaiser-Meyer-Olkin of sampling adequacy (Kaiser, 1970), table 5 present the results of the test.

Table 5: Test of sphericity and sampling adequacy for construction of BSD.

Construction of BSD	
Bartlett test of sphericity	
Chi-square	1199.706
Degree of freedom	10
p-value	0.000
Determinant of the correlation matrix	0.000
Kaiser-Meyer-Olkin measure of sampling adequacy	
0.624	

[20] SMT – PCA did not accept this variable as a composite for SMD

For the BSD index the Kaiser-Meyer-Olkin[21] measure of sampling adequacy indicates a value of 0.642, so it's possible to apply the PCA. In the case of the Bartlett's[22] test for sphericity the null hypothesis was rejected with a p-value less than 5% (0.000) and a Chi-square distributed it's statistical significant and it shows that the variables are significant correlated.

The robustness of the composite index Stock Market Development (SMD) was verified by the application of Bartlett's test for sphericity (Bartlett, 1950) and Kaiser-Meyer-Olkin of sampling adequacy (Kaiser, 1970), table 6 present the results of the test.

Table 6: Test of sphericity and sampling adequacy for construction of SMD.

Construction of SMD	
Bartlett test of sphericity	
Chi-square	58.202
Degree of freedom	6
p-value	0.000
Determinant of the correlation matrix	0.667
Kaiser-Meyer-Olkin measure of sampling adequacy	
0.569	

For the SMD index the Kaiser-Meyer-Olkin measure of sampling adequacy indicates a value of 0.569, so it's possible to apply the PCA. In the case of the Bartlett's test for sphericity the null hypothesis was rejected have a p-value less than 5% (0.000) and a Chi-square distributed it's statistical significant and it shows that the variables are significant correlated.

3.2. Methodology

In this study is applied a technique that combines the regular VAR approach, that treats as endogenous all the variables in the system, with the unobserved individual heterogeneity from a panel-data approach (Grossmann et al., 2014). The application of a panel data vector autoregressive (PVAR) model was developed by Love & Zicchino (2006), and it's used the same methodology. The mentioned model, a first-order PVAR, uses an equation stated as follows in eq. 1:

$$z_{it} = \Gamma_0 + \Gamma_1 z_{it-1} + f_i + d_{c,t} + e_t \quad (1)$$

Where, z_t is vector variables, in this study they are: dlGDP, INF, dlTRd, dlFDI dlBSD and dlSMD. All variables are in natural logarithm following by their first differences except INF (inflation), dlGDP denotes gross domestic product per capita, proxy for economic growth; INF represents inflation measured by consumer price index, proxy for inflation; dlTRD the ratio of trade to GDP as a proxy for economic openness; dlFDI foreign direct investment (% GDP) as proxy for financial openness; dlBSB and dlSMD is a created index for banking sector development and stock market development respectively. Γ_0 correspond to the constant vector, $\Gamma_1 z_{it-1}$ to the

[21] Result value between 0 and 1 and if the output is below 0.5 the PCA must not be applied.
[22] The null hypothesis is that variables are not intercorrelated.

matrix polynomial, f_i the fixed effects in the model, $d_{c,t}$ the effects of time, and the term of random errors is e_t.

A technique applied by Love & Zicchino (2006) called "Helmert Procedure" (Arellano & Bover, 1995), to solve the problem of fixed effects correlated with the regression related to delays of the dependent variables, usually average differentiation procedure is used to eliminate fixed effects, is also used in the model to avoid occur biased coefficients.

Once it's very important econometric analysis and it requires several tests before and during the estimating the model, figure 2, describes the methodology used in this study.

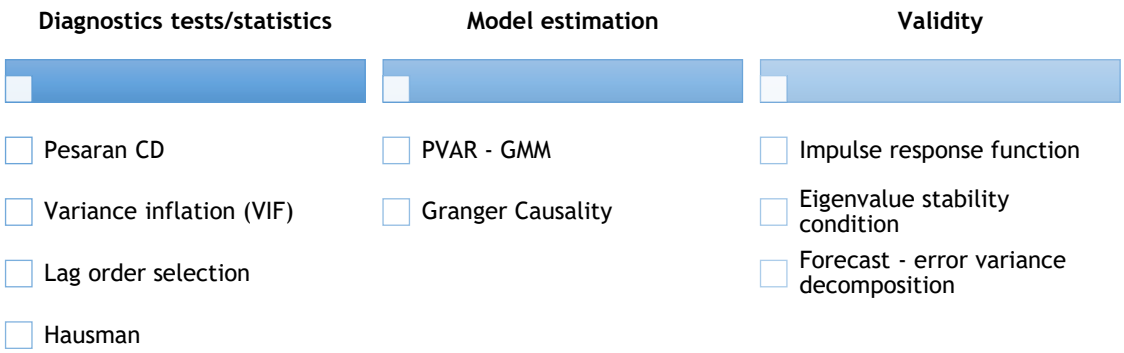


Figure 2: Econometric test and methodology realized.

To improve the construction and estimation of the PVAR model it's necessary to conduct preliminary analysis. Starting with the test for panel cross-sectional dependence, through the CD[23] test Pesaran (2004). Table 7, presents the descriptive statistics and cross-sectional dependence.

Table 7: Descriptive statistics and cross-sectional dependence.

Descriptive statistics						Cross-sectional dependence (CSD)		
Variable	Obs	Mean	Std. Dev.	Min	Max	CD-test	Corr	Abs(corr)
dlGDP	150	0.0141657	0.0337247	-0.0942879	0.2181435	12.00***	0.699	0.699
INF	156	3.199252	3.326068	-4.478103	20.43349	11.49***	0.787	0.787
dlFDI	144	0.0427203	0.6799524	-2.442108	2.889361	1.83**	0.101	0.202
dlTRD	150	0.0327228	0.0773082	-0.2638502	0.2559261	11.76***	0.680	0.680
dlBSD	147	0.1302538	0.2522549	-0.3591483	1.191323	11.51***	0.678	0.678
dlSMD	141	0.0768329	0.4020746	-1.468099	1.238657	8.07***	0.474	0.474

Note(s): ***, **, * denote statistical significance level of 1%, 5% and 10%, respectively. CD test has N (0,1) distribution, under the H0: cross-sectional independence.

Through table seven, it's possible to verify that in all variables exist the presence of cross-sectional dependence (CSD), consistent with the null hypothesis CD ~ N (0,1). Next, to analyse if the initial requirements of the model are verified it's performed the VIF[24] test to detect the

[23] CD - cross-sectional.
[24] VIF - Variance Inflating Factor.

multicollinearity. The average VIF statistic should be below 10% to continue with the analysis. Table 8, describe the results of the VIF test.

Table 8: VIF test.

Variable(s)	VIF	1/VIF
dlTRD	1.26	0.794283
dlFDI	1.19	0.842199
dlBSD	1.15	0.866703
dlSMD	1.10	0.910409
INF	1.03	0.974425
Mean VIF	**1.14**	

Analysing the table eight, shows that the collinearity is not a concern, the means VIF stays under the limit value of 10%. The following table 9, show the results for the checking lag order selection procedure that is used to determinate the overall coefficient (CD).

Table 9: Lag order selection.

lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	.9146926	43.71402	.1765465	-124.5078	-28.28598	-67.29304
2	.9816666	.	.	.	.	.

The table nine, have the results for lag order selection that indicates MBIC and MQIC values are lower at one lag, so a first order PVAR is selected as previous stated, see Grossmann et al. (2014) procedure.

It is important to point out the existence of a structural brake on the panel that not allows to capture the Unit Root, i.e. the test doesn't confirm the real stationary effect of the variables, so it was not performed. Apart that, Hausman test was performed to determine whether fixed effects are present, see table 10 with the results of the test.

Table 10: Hausman test.

	Chi^2	Prob > Chi^2
Hausman	13.29	0.0208
Hausman, sigmamore	16.55	0.0054

The results of the test validate that exits fixed effects, with the variables in their first differences, consistent with the null hypothesis – difference in coefficients are not systematic. Next in section 4, the empirical results are presented.

4. Empirical results

In the previous section 3, a preliminary analysis was performed to verify if the PVAR model was the most appropriate. Thus, was confirmed that the PVAR test was the most appropriate to analyse this nexus. Note that, the PVAR model was estimated using one lag and that all variables are in natural logarithms in their first differences. According Holtz-Eakin et al. (1988) the gmmst option (command) was used in the estimation (that changes missing values with zero). The PVAR Granger causality test is evaluated through a Wald test. In table 11, is possible to see the test results. The null hypothesis of the test is that excluded variable does not granger-cause equation variable.

Table 11: Results estimation.

		PVAR		Granger causality		
Equation	Excluded	Coefficient	P>|z|	Chi2	df	Prob>chi2
dlGDP	INF	-.0021589	0.041	4.194	1	0.041
	dlFDI	.0008805	0.843	0.039	1	0.843
	dlTRD	-.1224589	0.013	6.140	1	0.013
	dlBSD	.051574	0.001	10.379	1	0.001
	dlSMD	.0274667	0.000	38.904	1	0.000
	All			68.443	5	0.000
INF	dlGDP	-.8187067	0.860	0.031	1	0.860
	dlFDI	.234934	0.033	4.522	1	0.033
	dlTRD	-4.861428	0.052	3.790	1	0.052
	dlBSD	1.607545	0.000	15.690	1	0.000
	dlSMD	.4671281	0.014	6.049	1	0.014
	All			28.858	5	0.000
dlFDI	dlGDP	-54.24429	0.000	16.205	1	0.000
	INF	.0304582	0.590	0.290	1	0.590
	dlTRD	8.581462	0.005	7.968	1	0.005
	dlBSD	4.102907	0.000	16.029	1	0.000
	dlSMD	.2331883	0.484	0.489	1	0.484
	All			24.500	5	0.000
dlTRD	dlGDP	-2.629902	0.000	22.900	1	0.000
	INF	-.0038736	0.225	1.475	1	0.225
	dlFDI	.0019875	0.875	0.025	1	0.875
	dlBSD	.2323123	0.000	25.531	1	0.000
	dlSMD	.0764127	0.000	29.106	1	0.000
	All			64.834	5	0.000
dlBSD	dlGDP	3.533515	0.000	16.868	1	0.000
	INF	-.007779	0.013	6.106	1	0.013
	dlFDI	.0250994	0.163	1.950	1	0.163
	dlTRD	-1.564174	0.000	40.640	1	0.000
	dlSMD	.1929291	0.000	18.449	1	0.000
	All			71.200	5	0.000
dlSMD	dlGDP	-5.787793	0.001	11.216	1	0.001
	INF	.0041849	0.753	0.099	1	0.753
	dlFDI	.0567808	0.195	1.679	1	0.195
	dlTRD	.3570372	0.442	0.590	1	0.442
	dlBSD	.9154552	0.000	26.696	1	0.000
	All			31.430	5	0.000

Note(s): Statistical significance of 1%, 5% and 10%, respectively.

Figure 3, below, present a resume scheme between the variables under analyse for better clarification according the statistical significance. The blue arrow (line) indicates 1% significance, the orange arrow (dashed) 5% significance, and the green arrow (filed) 10% significance.

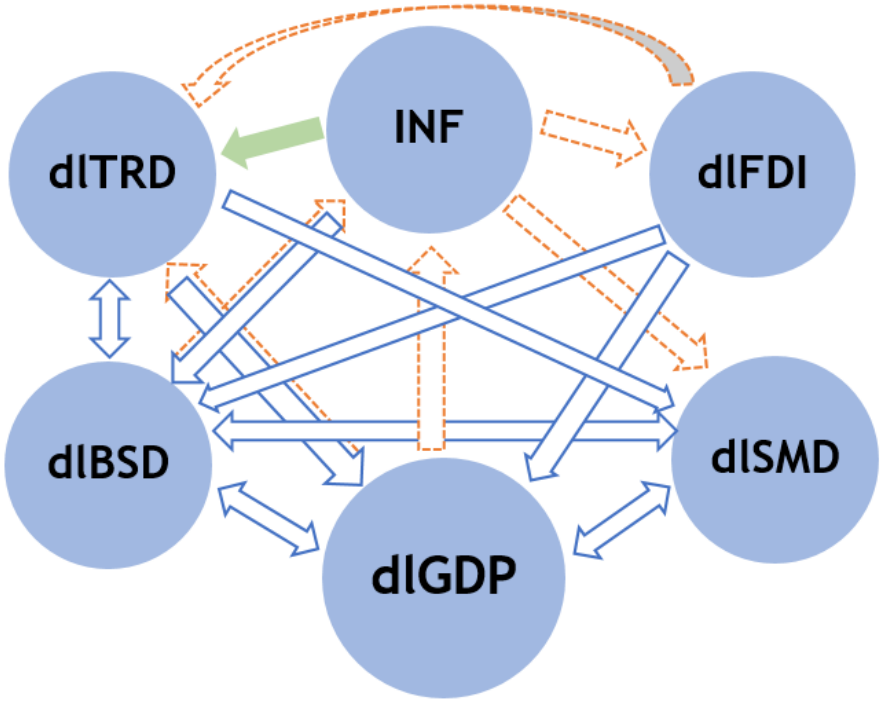


Figure 3: Causality resume between the variables – according statistical significance.

Therefore, according the resume on table 3, the relations between variables shows that exist a bidirectional causality (feedback hypothesis) between: (i) dlGDP and dlTRD; (ii) dlGDP and dlBSD; (iii) dlGDP and dlSMD; (iv) INF and dlBSD; (v) dlTRD and dl dlBSD; (vi) dlBSD and dlSMD, statistical significance at 1% level, except from dlGDP to dlTRD and from dlBSD to INF both statistical significance at 5% level. It also shows that exist unidirectional causality (supply-leading hypothesis) between: (i) dlGDP to INF; (ii) INF to dlFDI, dlTRD and dlSMD; (iii) dlFDI to dlGDP, dlTRD and dlBSD; (iv) dlTRD to dlSMD, statistical significance at 5% level, except from dlFDI to dlGDP, dlFDI to dlBSD and dlTRd to dlSMD statistical significance at 1% level and from INF to dfTRD statistical significance at 10% level. And finally, no causality between: (i) dlGDP to dlFDI; (ii) INF to dlGDP; (iii) dlFDI to INF, and dlSMD; (iv) dlTRD to INF and dlFDI; (v) dlBSD to dlFDI; (iv) dlSMD to INF, dlFDI and dlTRD.

So, the variable with less causality relationship is dlTRD and dlSMD, this can be explained by the fact that they are two measures that have more influence from foreign policies. In the other side the variables with more bidirectional causality connexion is dlGDP and dlBSD, this can be explained by the fact that GDP, being the proxy for economic growth should be connect with other macroeconomic variables, and BSD because have an important role over developed

economies, where the bank system has a huge influence over the economy (positive or negative).

In resume, is possible to mention that trade openness (dlTRD), banking sector development (dlBSD) and stock market development (dlSMD) granger-cause economic growth. Then according the previous hypotheses H1 and H2 can be proved, for H3 not valid.

In addition, it's possible to observe the impulse-response function. This function reveals how a variable reacts to an exogenous shock, its reactive system to measure the periods for a variable return to is equilibrium by a harmonic movement. Through the graphical analysis present in figure 4, it's possible to verify the necessary time after a shock for a variable to return is normal form.

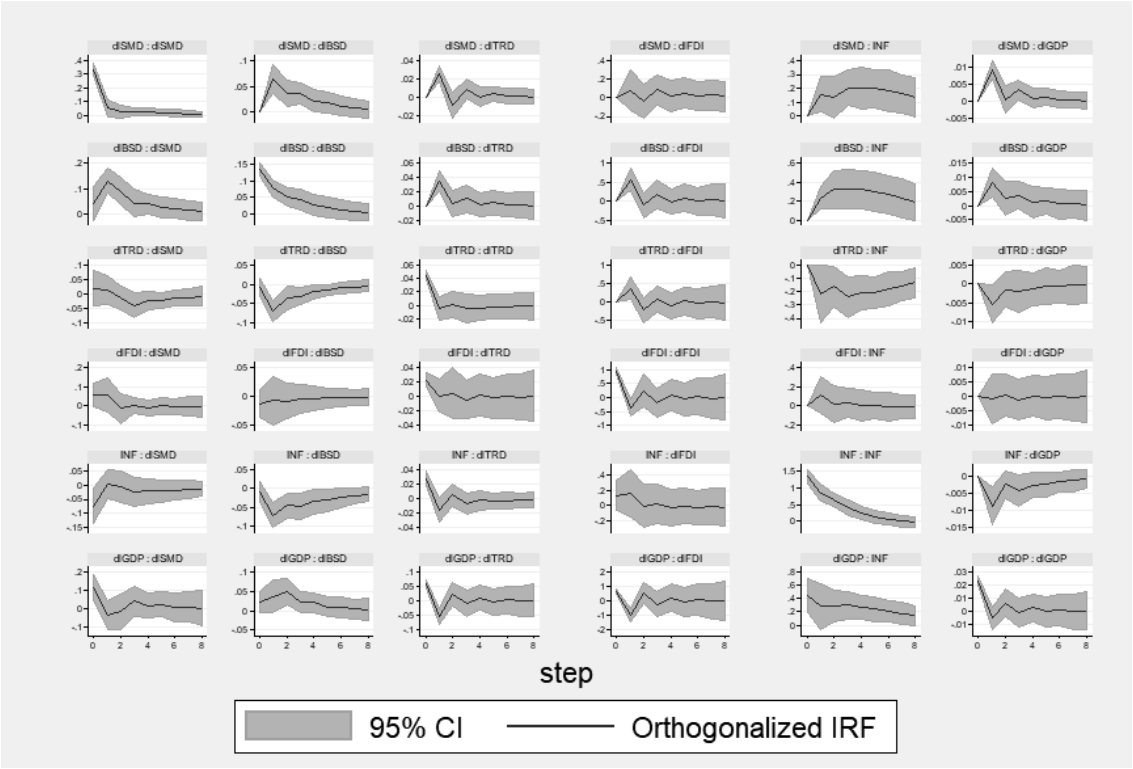


Figure 4: Impulse response functions.

In general, most variables after a shock recover in a 4 years' time span. Exceptions does exist in variants but do not exceed 8 years to recover. Note that, through this graph it's possible to verify that the variables have a positive respond to shocks, in more detail, dlGDP to trade, dlBSD and dlSMD, so it's according to the preliminary analysis, present in the previous section. After performed a Forecast-Error Variance Decomposition (FEVD[25]) to show how a variable react to shocks in a specific variable (Marques, Fuinhas & Marques, 2013). The FEVD determines how much of the variance of the prediction error of each of the variables can be explained by shocks

[25] FEVD - Forecast-Error Variance Decomposition – commonly used to help in the interpretation of a vector autoregression (VAR) model once it has been fitted.

exogenous with the various variables under study. Table 12, indicate with more detail this decomposition of the FEVD.

Table 12: Forecast-error variance decomposition.

Response variable and Forecast horizon	Impulse variable					
	dlGDP	INF	dlFDI	dlTRD	dlBSD	dlSMD
dlGDP						
1	1	0	0	0	0	0
2	0.6944455	0.0909081	0.0013237	0.0328449	0.079242	0.1012358
5	0.6564979	0.1123006	0.0029541	0.0029541	0.0916678	0.1002785
8	0.6448801	0.1215924	0.0033446	0.0364875	0.0930262	0.1006693
INF						
1	0.1028608	0.8971392	0	0	0	0
2	0.0961523	0.8555955	0.0049881	0.016041	0.0189746	0.0082485
5	0.1205561	0.723878	0.0036824	0.0394541	0.0848565	0.027573
8	0.1337634	0.6457957	0.0032795	0.0547405	0.118587	0.0438338
dlFDI						
1	0.3184112	0.011901	0.6696877	0	0	0
2	0.4727413	0.0144778	0.3582577	0.0448521	0.1076163	0.0020547
5	0.4986627	0.0123248	0.3258469	0.0575544	0.1013525	0.0042587
8	0.4974267	0.012371	0.3238347	0.0577903	0.1033776	0.0051998
dlTRD						
1	0.5212893	0.1157407	0.0731347	0.2898354	0	0
2	0.5432407	0.0869703	0.0428253	0.1706836	0.101153	0.0551271
5	0.5489375	0.0859042	0.0423606	0.1588654	0.1018734	0.0620588
8	0.5457575	0.0870325	0.0424485	0.1580461	0.1035715	0.0631439
dlBSD						
1	0.0277921	0.0036713	0.008945	0.0019144	0.9576771	0
2	0.04676	0.1232112	0.005449	0.1195792	0.6018261	0.1031745
5	0.0870359	0.1727172	0.0051312	0.1213055	0.4922387	0.1215715
8	0.0850621	0.1920858	0.0050949	0.1194472	0.4756978	0.1226122
dlSMD						
1	0.1041838	0.0397357	00227421	0.0030856	0.0129412	0.8173116
2	0.0957249	0.03374	0.0411343	0.0037751	0.1161645	0.7094613
5	0.0990173	0.0355354	0.0376958	0.0153291	0.1673925	0.6450299
8	0.1010135	0.0401822	0.0367291	0.0191793	0.1708765	0.6320193

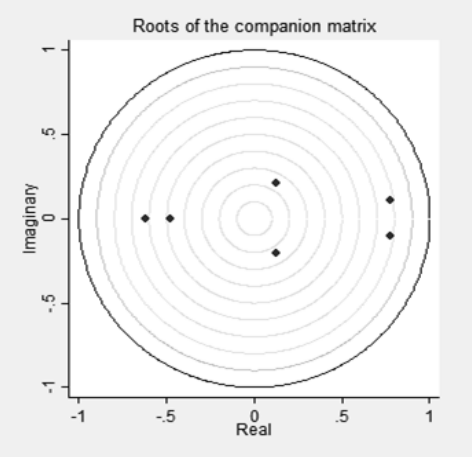
The Forecast-error variance decomposition shows that in the year period the variations of the variables are explained mainly by themselves and with significant values.

Analysing the table in detail, it's possible to find interesting situations, such as after a 2-year period, shocks to dlGDP variable explain about 69,4% of the forecast error variance, while the other variables have residuals percentages (INF – 9,1%; dlFDI – less than 1%; dlTRD – 3,3%; dlBSD – 7,9% and dlSMD – 10,1%). After an 8-year period the situation is similar, because the dlGDP stabilizes at 64,5%, and the other variables don't change it much also (INF – 12,2%; dlFDI – still less than 1%; dlTRD - 3,6%; dlBSD - 9,3 % and dlSMD - 10%). Looking at an 8-year period shocks to INF it explains 64,6% of the forecast error variance, while the lGdDP only 13,4%, dlFDI less than 1%, dlTRD 5,5%, dlBSD 11,6% and dlSMD 4,4%. By analysing the impact on dlFDI a 10-year period shock explains 32,4%, while in the other variables have the following values, dlGDP - 49,7%; INF - 1,2%, dlTRD - 5,8%; dlBSD 10,3% and dlSMD less than 1%. Looking at dlTRD an 8-year period shock explains 15,8% of the forecast error variance, while dlGDP 54,6%, INF 8,7%, dlFDI 4,2% dlBSD 10,3% and dlSMD only 6,3%. Concerning the last two variables, first checking

the dlBSD with a shock at an 8-year period, explains 47,6%, while the rest is explained at dlGDP 8,5%, INF 19,2%, dlFDI less than 1%, dlTRD 11,9% and dlSMD 12,3%, second the dlSMD for an 8-year period shock explains at 63,2%, while the other variables explains at dlGDP 10,1%, INF 4%, dlFDI 3,7%, dlTRD 1,9%, dlBSD 17,1%.

In resume the most autonomous variable is dlGDP, INF and dlSMD auto explains more than 60% after 8 years period shock, dlGDP is also the variable with best response to shocks even of it happens to some other variable, except if it's a shock regarding dlBSD or dlSMD.

A stability test was also conducted to check the estimations validation (Hamilton, 1994; Lutkephol, 2005). The results satisfy stability condition, because all eigenvalues are inside the circle unit. The eigenvalue test shows the real, imaginary and modulus values, details under figure 5.



Eigenvalue		
Real	**Imaginary**	**Modulus**
0.7776259	0.1050486	0.7846893
0.7776259	-0.1050486	0.7846893
-0.621331	0	0.621331
-0.4801577	0	0.4801577
0.122755	-0.2076135	0.2411891
0.122755	0.2076135	0.2411891

Figure 5: Eigenvalue stability condition.

After performing the diagnostic tests, and the estimation of the PVAR model, the section 4 has validate the results obtained, so next in section 5 is possible to present a results conclusion and the contribute of this study to the economy, it's also suggested a topic for future studies.

5. Conclusion

To study the dynamics and relationship between economic growth and the other variables (inflation, trade, foreign direct investment, banking sector development and stock market development) for a panel of six European countries (France, Greece, Ireland, Italy, Portugal and Spain) and a time span from 1990-2015, was applied a panel vector auto-regressive (PVAR) model to teste Granger causality, forecast-error variance decomposition and impulse-response functions.

By using a principal component analysis (PCA) mode, was possible to create two new measures, one for banking sector development (composite with a group of five variables) and other for stock market development (composite with a group of four variables), which includes four financial dimensions measures: depth, efficiency, stability and other, this way was possible to realize the study with a small set of variables and with a composite to identify specific financial markets: bank and stocks.

The variables were transformed in per capita, in their natural logarithms and in first difference for a better analyse of the causalities between them. The literature refers to four causality theories: neutrality hypothesis (no causality), supply-leading and demand-following hypotheses (unidirectional causality) and feedback hypothesis (bidirectional causality).

Remember that the following hypotheses were tested: Banking sector development in the presence of stock market development granger causes economic growth, H2 - Stock market development in the presence of baking sector development granger causes economic growth, and H3 - Financial openness in the presence of economic openness granger causes economic growth.

The estimation results respond to hypotheses according the existence of feedback hypothesis between economic growth, banking sector development, stock market development and economic openness (H1 and H2 are validate), however it also shows neutrality hypothesis between economic growth and financial openness, but a feedback hypothesis from financial openness to economic growth. So, to promote economic growth, the policies should induce a healthy and sustained external relations to help economic openness, and some good financial resources to support a good banking sector development and a healthy stock market that can captivate investors.

Seeing the impulse-response functions it's possible to confirm that in general, after a shock, most recover in a four years' time span (same exception in eight years). This test demonstrates that dlGDP, INF and dlSMD are the most independent variables, individual they auto explain

over 60% after an 8 years period shock, also the best variable reacting to shocks is dlGDP even if the shock happens to other variable, except if it's a shock to dlBSD or dlSMD.

As a main contribute, it's possible to refer the set of countries chosen, because they have suffered from the subprime crises, who had a huge impact over the economy and to refer the new aspect of including the economic and financial openness in the study.

For future studies is important to get a large set of countries and from different economics spheres to confirm the influence of the financial and economic openness over the economy and the contributes of the banking sector and stock market development.

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