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# LIBERALIZATION OF EUROPEAN TELECOMMUNICATIONS AND ENTREPRENEURSHIP: WHY GERMAN AND PORTUGUESE EXPERIENCES ARE SO EQUAL AND SO DIFFERENT?

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## ABSTRACT

The paper aims to investigate the impact of the liberalization of European Telecommunications Markets, on the Business Ownership Rate, the Employment, the Gross Domestic Product, and the Investment in ICT, in two European countries: Germany and Portugal. For this purpose, a Cointegrated Vector Autoregressive (CVAR) approach is developed, in order to identify the impacts that are originated from the adoption of this kind of public policies. In the case of Germany, a surprising causality relationship is detected, in the sense that Gross Domestic Product precedes decreasing Business Ownership Rates. In the case of Portugal, the Business Ownership Rate pulls for additional investments in ICT. Besides, a creative entrepreneurial destruction is somehow ratified, since the Business Ownership Rate impacts, negatively, on the level of employment.

**KEYWORDS**: Entrepreneurship, Information and Communication Technologies, Cointegration, Vector Autoregressive Model.

## 1. Introduction

In recent years, entrepreneurship has been considered a fundamental engine for enhancing economic development (Audretsch and Thurik, 2004). The role that entrepreneurship plays in the economy has changed dramatically over the last half century (Van Stel *et al.*, 2006). According to Audretsch and Thurik (2004) the increased importance of entrepreneurship is clearly recognized by politicians and policy makers. Audretsch (2003) considers entrepreneurship as the fundamental engine for economic and social development throughout the world.

A broad range of determinants explains the level of entrepreneurship, including economic and social factors and many studies have been conducted to explain the level of entrepreneurship (Ronen, 1983; Sexton and Bowman, 1987; Veciana, 1996; Fayolle, 1999). Prior cross-country empirical work in the area of entrepreneurship has mainly focused on different factors that explain the level of entrepreneurial activity within a country, with attention devoted to the role of economic, political and psychological factors (Grilo and Thurik, 2004). Bowen and Clerq (2005) expanded this perspective by examining the role of institutional factors guiding the nature, rather than the level, of entrepreneurial activity. They make a distinction between specific resources embedded in the institutional environment (financial capital and human capital); and the rules governing the undertaking of economic activities within the environment (regulatory protection, regulatory complexity and the level of corruption). In a special issue, edited by Freytag and Thurik (2007), the authors suggest that institutional cultural aspects such as economic freedom and post-materialism may both exert influence on the preference for self-employment.

Van Stel *et al.* (2006) advocate that the determinants of entrepreneurship may be displayed in two different groups: (i) the presence of administrative burdens, or entry

regulations (Djankov *et al.*, 2002); and (ii) the presence of governmental support or financial assistance.

In the study of Djankov *et al.* (2002) about the regulation of entry of start-up firms in 85 countries, the main results have pointed out that regulation is not in the public interest, suggesting a lighter business regulation.

Capelleras *et al.* (2005) have compared two cases: a lightly regulated country (Great Britain), and a more heavily regulated country (Spain), and they did not find substantial differences between the two countries, in terms of the average age of a firm, the initial start-up size, and the employment growth.

According to Verheul *et al.* (2002) two distinct sides about the determinants of entrepreneurship, and of regulation practices, should be considered: the demand; and the supply. The first side embraces the creation of entrepreneurial opportunities through the final demand. For its turn, the second one provides entrepreneurs that will interact over the referred opportunities.

In the European Union (EU), public policies have been oriented to reinforce the levels of entrepreneurship, in order to assure the growth of the number of firms located in Europe, and the number of new entrepreneurs (European Commission, 2003). A national capacity for entrepreneurship is argued to be the key factor in successful national economies (Smith *et al.*, 2005). Governments have recently oriented their support for the creation and development of Small and Medium Enterprises (SME), by launching sets of measures which include grants, tax relief and new education schemes (Storey, 2003).

The rise of entrepreneurship in favored locations should be considered in the context of policy change at national, regional, and local levels, and in terms of institutional changes within organizations (Storey, 2003).

One of the most important factors associated with the demand side of entrepreneurship is technological development, which has been strategically prosecuted through the investment in Information and Communication Technologies (ICT). The OECD report (2004) pointed out that recent public policies oriented to the investment in ICT, namely, in technologies for greater dissemination of telecommunications' networks, have had substantial impacts on economic performance and the success of individual firms. After the World Summit on Information Society (WSIS) that has taken place at Geneva, in 2003, countries all over the world were designated to develop new tools for the measurement of the progress of Information Society, including the fundamental ICT indicators (UN, 2005).

In this sense, it is relevant to evaluate and analyze if the impact of regulation actions oriented to telecommunications liberalization has been, successfully, translated to improved levels of business ownership rate, employment, economic growth, and investment in ICT, at an aggregate level. It is also important to determine the distinct causality directions and impacts, which are related to the adoption of this kind of regulatory actions, in different European countries.

In this context, the paper aims to analyze the relation between the Business Ownership Rate and the investment in ICT. For this purpose, a comparative analysis between German and Portuguese economies is developed, by presenting a Cointegrated Vector Autoregressive (CVAR) approach, in order to identify the impacts that are originated from the adoption of public policies oriented for the liberalization of telecommunications' markets, on business ownership rate, employment, economic growth, and investment in ICT.

The present paper adds to the entrepreneurship eclectic framework, and it presents an innovative approach since it makes use of a CVAR to develop a dynamic analysis, by taking into consideration the results obtained through the application of two forecasting techniques: the variance decomposition of Cholesky, and the impulse response functions. This provides a

forecasting analysis about the interrelations established between the Business Ownership Rate, the Employment, the Gross Domestic Product (GDP) and the level of Investment in ICT. Moreover, the impacts of telecommunications' liberalization in Europe are analyzed, in terms of the contrasts of the Granger causalities that are identified for the economic variables included in a comparative study about two European countries: Germany and Portugal.

The organization of this paper is as follows. After the present introduction, in section two, conceptual perspectives on entrepreneurship research and ICT are reviewed. In section three the econometric methodology is presented as well as the main results in terms of significant causalities detected for the economic variables in study. Finally, the conclusions and the guidelines for future researches are presented.

## 2. Conceptual Perspectives on Entrepreneurship Research and ICT

### *2.1. What is Entrepreneurship and Where do we Find it?*

Entrepreneurship is today defined and understood in various ways. Several intersections lead to understanding entrepreneurship, and possibly to more intersections or future paths of the concept. Over time, there has been a variety of researchers who have offered views on what entrepreneurship means and the role that entrepreneurs play in economic and, more recently, social regeneration (Lowe and Marriott, 2006).

Nowadays this area of entrepreneurship deals with an enlarged range of theories and approaches and it has been studied in many different ways, with very distinct purposes. Researchers from all fields of social sciences – economics, management, sociology, anthropology, psychology, history and politics – have been giving contributions to this area of studies. The research field of entrepreneurship is considered to be the target of the most

diverse areas of study and it is developing very fast (Ronen, 1983; Sexton and Bowman, 1987; Davidsson, 1989).

Although of the topic's popularity, there is not yet a universally accepted theory that defines accurately the field of actuation of entrepreneurship, which is, presently, developed under transversal approaches that integrate different knowledge areas (Virtanen, 1997). Theories and methods used vary a lot, depending on the research area in which a study is conducted. The same occurs for the level of analysis (the individual, the firm, the industry and the country), in the definition of entrepreneurship and for the role it can assume as an independent or dependent variable (Davidsson and Wiklund, 2000).

Due to lack of consensus about the definition of entrepreneurship, its significance becomes complex (Bull and Willard, 1993; Carland *et al*., 1995). Bull and Willard (1993) confirm that definitions continue to be problematic given that many researchers adopt their own definitions of entrepreneurship and create their own terms within the area.

However, theories of entrepreneurship had their origins in economics. The first reference to the concept was accomplished by Cantillon (1734), who considered that the term entrepreneurship meant self-employment with an uncertain outcome. Following Cantillon, Say (1803) among others, extended its definition to include in the concept, a combination of productive factors, adding that the entrepreneur should have special abilities. They were among the first economists that have included the risk content in the topic of entrepreneurship. Cantillon and Say belonged to a French school of thought known as the 'physiocrats'. Cantillon saw entrepreneurs as having individual property rights as capitalists. Say also saw the entrepreneur as a catalyst for economic development, viewing their role as one of bringing together the different productive factors, by moving resources from less to more productive areas.

The early understanding of entrepreneurship was followed by the traditions dominated by the Austrian School and the work of Joseph Schumpeter (1680-1950). He considers the entrepreneur as someone special, an innovator, who brings something new to the process (Schumpeter, 1934). Carl Menger (1840-1921) was a founder of the Austrian tradition of economic thought. He proposed a methodological individualism, seeing economic activity as a result of individuals' actions (Corbetta *et al*., 2006).

Looking back at the agenda of entrepreneurship research, we can observe that our knowledge about entrepreneurship seems to have been developed with a certain chronological regularity. Landström (2005) identified four 'swarms' at the following points in time and their contributions (Table 1).

*Please insert Table 1 here.*

The Landström's explanation for these swarms of entrepreneurship researches appear at certain periods in time is that there is a strong link between societal development and interest in entrepreneurship research, that is, periods of recession and crises give rise to demands for change and creation of new ways of thinking.

### *2.2. Public Sector Support*

In general terms, governments are aware of the importance of entrepreneurship and innovation in the economy, and seek to support it through a range of measures. Pinto (2005) addresses five dimensions of the policy challenges confronted by the governments in South Eastern Europe: (i) institutional development; (ii) regulatory reform; (iii) simple taxation; (iv) access to finance; and (v) services for developing businesses and start-ups.

There are different visions about the optimal way to support the creation of firms, and the actual measures taken vary among countries and over time within regions, cities, and local

communities. It is a point of debate whether is a case for public intervention in entrepreneurship at all. According to Lowe and Marriott (2006) it is difficult to prove causality in any event, as initiatives brought in by government are just one part of many changes that have occurred in the structure of the economy and attitudes in society in general, such as the decline of the industries manufacturing based and the change on employment expectations.

There are also qualitative considerations such as the nature of jobs created and how long they are likely to last, and whether there is a legacy in terms of improved workforce skills when we assess impact (Parker, 2005). The investment of business itself in both time and money will always dwarf the investment that a government can make, and so it can always be argued that the achievements should be credited to the business themselves. Given the difficulty in proving causality, some argue that the public sector should concentrate upon offering direction and coordination rather than intervening directly (Lowe and Marriott, 2006). If we accept that government intervention is desirable, what type of support generates the bigger impact?

Over time there has been a wide range of initiatives designed primarily to encourage business start-ups and growth (Lowe and Marriott, 2006), namely: (i) creation of enterprise zones; (ii) subsidized workspace; (iii) technology transfer schemes; (iv) a variety of grant schemes to promote innovation; (v) support for export and internationalization; (vi) training schemes to support business planning for new start-up businesses; (vii) subsidized consultancy services; and (viii) a range of information services.

According to Audretsch and Thurik (2001) the central goals of public policy common among all OECD countries are the generation of economic growth and especially the creation of employment. As the comparative advantage in Western Europe and North America has become increasingly based on new knowledge, public policy towards business has responded

in two fundamental ways. The first is based on the firms' freedom to contract, through the progressive introduction of broad changes in terms of regulation, competition policy, and public schemes of business ownership. This has resulted on waves of deregulation and privatization along with the decreased emphasis of competition policy throughout the OECD countries. The second fundamental shift involves the locus of such enabling policies, which are increasingly at the state, regional or even local level.

*2.3. Measuring Entrepreneurship*

The relationship between entrepreneurship and economic growth is rooted in several strands of the economic literature. Van Stel (2006) reviews four strands in the economic literature: (i) the general understanding of the role of entrepreneurship in modern economy; (ii) the mathematical modeling of economic growth; and (iii) the empirical modeling and measurement of the relation between entrepreneurship and economic growth.

The consequences of entrepreneurship, in terms of economic growth, have generated an extensive empirical literature. A broad range of determinants explains the level of entrepreneurship, including economic and social factors and many studies have been conducted to explain the level of entrepreneurship (Ronen, 1983; Sexton and Bowman, 1987; Veciana, 1996; Fayolle, 1999). The impact of entrepreneurship on economic growth is currently receiving increased attention in both empirical and theoretical economics literature (Carree and Thurik, 2006).

A considerable body of research has sought to understand the determinant factors of the supply side of entrepreneurial activity (Brock and Evans, 1989; Audretsch and Thurik, 2001; Grilo and Thurik, 2004; Storey, 1999; Thurik and Wennekers, 2004; Bowen and Clercq, 2005). Bowen and Clercq (2005) concentrated in country's institutional characteristics that influence the allocation of entrepreneurial efforts. Grilo and Thurik (2004) focused on

different factors that explain the level of entrepreneurial activity within a country, with attention devoted to the role of economic, political and psychological factors.

However, lacking a universally agreed set of indicators to measure entrepreneurship, the measurement and comparison of entrepreneurial activity for different countries is a complex process (Grilo and Thurik, 2004; Bowen, 2005) and the ideal measures of entrepreneurship remain to be developed (Audretsch, 2003).

According to Thurik and Grilo (2005) entrepreneurship is a multidimensional phenomenon spanning different units of observation ranging from individual to the firm, region, industry, or even country. This multidimensionality is reflected both in the mode it is defined and in the way it is measured. According to Van Stel (2006) each measure represents four different aspects of entrepreneurship: (i) entrepreneurship as owning and managing an incumbent business (number of self-employed or business owners as measures); (ii) entrepreneurship as to the extent in which markets are penetrated by new entrants (number of new-firm start-ups as measure); (iii) entrepreneurship as the process of starting a new business, including activities required in the pre-start-up phase (called entrepreneurial activity); and (iv) entrepreneurship as the share of small firms in total value-of-shipments of an economy.

In Verheul *et al*. (2002) two kind of indicators are suggested: (i) static indicators (business ownership and self-employment); and (ii) dynamic indicators (nascent and start-up activity).

Carree and Thurik (2006) investigated the impact of changes in the number of business owners on three measures of economic performance: (i) employment growth; (ii) GDP growth; and (iii) labor productivity growth.

In sum, operationalising entrepreneurship for empirical measurement is difficult. The level of difficulty involved increases exponentially when cross-country comparisons are involved (Audretsch, 2003). According Audretsch (2003) different studies are deployed a

variety of proxy measures, spanning self-employment rates, business ownership rates, new-firms start-ups (births), as well as other measures of industry demography, such as turbulence (turnover), or the extent of simultaneous births and exits, and net entry.

### *2.4. The Entrepreneurial Environment and ICT*

The starting point for any entrepreneurial firm exploiting an opportunity and developing a strategy that will ensure survival and growth is to have an understanding of the market environment in order to identify the threats and opportunities that might affect the current and future prospects of the firms (Lowe and Marriott, 2006).

The business environment is usually analyzed in terms of macro factors, constituting the global trends that affect all firms, and also the micro factors, which influence firms in one area of the business environment (for example, a particular market or a certain geographical area). Macro environmental analysis is usually carried out under a series of headings, typically including political, legal, economic, social, cultural, and technological factors (Audretsch and Thurik, 2001; Bosma *et al*., 2003; Grilo and Thurik, 2004; Lowe and Marriott, 2006). Lowe and Marriott (2006) include different issues, such as, the increasing globalisation of communications, the evolution of regional trading blocks (for example, EU, ASEAN and NAFTA), the changing attitudes of consumers in their purchasing and usage behavior, and the prospects for the national and global economy that might affect demand and consumption (Boyer, 2004).

Perhaps the most significant driver of globalization is the Internet. The economy is entering into a world that is ruled by a new technological paradigm. ICT is a pervasive new technology which will radically change the functioning of the economy (Wennekers and Thurik, 1999; Van Stel, 2006). According to these authors, a wave of micro-inventions and

innovations based on ICT is gaining momentum and will sweep the world in the forthcoming decades.

According to Bosma *et al*. (2003) the last quarter of the 20th century brought the advent of new technological paradigms, especially, the ICT revolution, which has provoked a wave of process and product innovation. ICT tends to decrease internal scale economies, thus creating opportunities for micro and small firms. It may also decrease transaction costs, thus stimulating the trend towards outsourcing and favoring networks of independent producers above large corporations (Bernardt and Muller, 2000). Furthermore, the wave of new products means that an increasing share of products is positioned at an early stage of product life cycle; and this again stimulates entrepreneurship (Carree and Thurik, 2005).

The joint effects of globalization and the ICT revolutions have drastically reduced the cost of shifting not just capital but also information out of the high-cost locations of Europe and into lower-cost locations around the globe (Audretsch and Thurik, 2000; Wennekers *et al*., 2005). This means that economic activity in a high-cost location is no longer compatible with the development of tasks, in a routine basis (Carree and Thurik, 2005). According to these authors, the globalization has shifted the comparative advantage of high-cost locations to knowledge-based activities, which cannot be transferred without incurring in additional costs. This ICT revolution makes it increasingly necessary to distinguish between information and knowledge. On the one hand, information will become more cheaply and readily available, and in some cases this will weaken existing entrepreneurial edges. On the other hand, information has to be selected, upgraded and combined with other information in order to become useful for economic application. Only then it may be called knowledge (Wennekers and Thurik, 1999). Knowledge as an input into economic activity is inherently different from land, capital and labor and it is characterized by high uncertainty, information asymmetries across people and is costly to transact (Carree and Thurik, 2005). The increased importance of

knowledge as a source of competitiveness for OECD countries suggests that the organization of innovative industries will be linked to higher economic growth rates (Audretsch and Thurik, 2001).

It is deeply embedded in the current European policy approach that creativity and independence of the self-employed contribute to higher levels of economic activity; this is, particularly, observable in niche markets, as it happens in the ICT sector where a great variety of organizations is involved in making innovative products (Carree *et al*., 2002).

Piatkowski (2004) shows the contribution of investments in ICT for the growth in GDP and labor productivity in European Community (EC) countries, EU-15 and the US during 1995-2001. The author argues that ICT had a large contribution to GDP and labor productivity growth in EC countries and are also likely to stimulate productivity growth through spillover effects. However, ICT will not be productively used without changes in the structure, organization and business models of firms and without improvement in ICT skills of the labor force.

The ICT have their impact on economic growth and labor productivity through four major channels (Perminov and Egorova, 2005): (i) producing the ICT-goods and services (computers, electronics, communications, and programming) directly contributes to the overall economic growth and productivity; (ii) using the ICT capital as an input for the production of other goods and services (for example, at the expense of a more effective usage of resources, cutting of current stocks); (iii) the ICT-services (programming, computer and information services, consulting, and Internet) play the most important role in these spheres and now ensure labor productivity growth in existing firms; and (iv) the ICT favor the spreading of knowledge in a wide sense and the increasing of labor productivity.

For Piatkoowski (2004, 2005) the public sector could contribute to the realization of this potential by stimulating a favorable business environment and promoting ICT's use by

ranking public productivity and growth rates. The public sector should also accelerate the development by whole public sector and all private firms willing to participate in public tenders.

## 3. Econometric Methodology

### *3.1. Empirical Evidence*

The empirical evidence linking unemployment to entrepreneurship is uneasy with ambiguities (Audretsch and Fritsch, 1993; Thurik and Grilo, 2005; Baptista and Thurik, 2007). This state is argued by others researchers. While some studies find that greater unemployment serves as a vehicle for stat-up activity (Reynolds *et al*., 1994), still others have found that unemployment reduces the amount of entrepreneurial activity (Audretsch and Fritsch, 1994; Audretsch *et al*., 2001). Some authors try to reconcile these ambiguities (Baptista and Thurik, 2007).

Cowling and Bygrave (2002) explored the relationship between necessity of entrepreneurship and unemployment in a large number of countries using empirical data collected as part of the Global Entrepreneurship Monitor (GEM) project. They observed that there is a tremendous variation in necessary entrepreneurship rate across countries; and the key to high growth in necessary entrepreneurship rates appears to be high, but with falling levels of unemployment.

Baptista and Thurik (2007) examine the relationship between entrepreneurship (which is measured through the variation in business ownership rates) and unemployment and they conclude that the nature of entrepreneurship is different in the Portuguese case. The reasons that were suggested are the high proportion of micro-businesses created for subsistence which

have little impact on growth and employment. This prevalence would suggest that the model should consistently over-estimate the negative effect of business ownership increases on unemployment.

Preliminary evidence produced by Audretsch and Fritsch, in 1992, for West Germany suggests that a lower and not a higher rate of start-up activity is associated with subsequent growth rates (Audretsch and Fritsch, 1993).

Carree and Thurik (2006) studied the lag structure of the impact of changes in the number of business owners on three measures of economic performance (employment growth, GDP growth and labor productivity growth) using country level data. The lag structure of the impact of the change in the number of business owners on employment change was described in three stages (a direct positive effect one followed by a negative effect and a positive stage). The results showed also that there is no evidence for a cumulative negative effect on productivity. The authors recommended additional research into distribution of time lags for different countries and industries to provide further support to these evidences.

According to Thurik and Grilo (2005) future research about entrepreneurial activity should concentrate on the explanation of the country differences, in order to what extent are cultural aspects, sector composition of economic activity, market legislation, tax environment, bankruptcy law, job security and social security regimes.

In this sense, the present study aims to provide an impact analysis about the liberalization of telecommunications markets in Europe, by making a comparative analysis between two European cases: Germany and Portugal. Taking into consideration the relationships provided by the economic theory and the results previously reviewed in the empirical evidence, the referred selected set of variables, which include the Business Ownership Rate (*BOR*), the Employment (*EMP*), the Gross Domestic Product (*GDP*), and the Investment in ICT (*IICT*); is used to develop a CVAR approach.

This kind of econometric methodology provides, on the one hand, the possibility to accomplish longitudinal case studies and, on the other hand, the development of a dynamic analysis. This makes it possible to identify the cointegration relations and the causality relationships that are established among the variables. Additionally, it provides the identification of different types of impacts that are originated by the variables considered in the selected model specification (Juselius, 2007).

In the present approach two databases are used in the period: 1976 - 2002, namely, the COMPENDIA – Comparative Entrepreneurship Data for International Analysis, and the ITU World Telecommunication Indicators database.

After reviewing the reference empirical evidence, the econometric methodology follows an outline of four sequential steps, that is: (i) the selection of an initial model specification; (ii) the study of the integration order of the variables; (iii) the estimation process of the CVAR model; and (iv) the dynamic analysis.

### *3.2. The Initial Model Specification*

The *BOR* (defined as the number of self-employed or business owners) is a metric for measuring entrepreneurship used in some studies (Audretsch and Thurik, 2001; Carree and Thurik, 2006; Van Stel, 2006). The Employment (defined as the total number of employees in the economy) and the Gross Domestic Product (used as the metric for the economic growth) that were incorporated in the study developed by Baptista and Thurik (2007) are also considered in the initial model specification.

According to Audretsch (2003) the *BOR* measure has two significant advantages: (i) while not being a direct measure of entrepreneurship, it is a useful proxy for entrepreneurial activity; and (ii) it is measured and can be compared across countries and over time.

In this sense, the VAR model applied to the cases of Germany and Portugal presents as differentiating element the inclusion of the variable of investment in ICT. Besides that, a dummy variable related to the implications of the liberalization of European telecommunications markets, is included.

The initial model specification is represented through a system of five equations by considering five endogenous variables.

$$\begin{bmatrix} BOR_t \\ EMP_t \\ GDP_t \\ IICT_t \\ LIB_t \end{bmatrix} = \begin{bmatrix} \alpha_{1t} \\ \alpha_{2t} \\ \alpha_{3t} \\ \alpha_{4t} \\ \alpha_{5t} \end{bmatrix} + \begin{bmatrix} \beta_{1,1} & \sigma_{1,2} & \theta_{1,3} & \Omega_{1,4} \\ \beta_{2,1} & \sigma_{2,2} & \theta_{2,3} & \Omega_{2,4} \\ \beta_{3,1} & \sigma_{3,2} & \theta_{3,3} & \Omega_{3,4} \\ \beta_{4,1} & \sigma_{4,2} & \theta_{4,3} & \Omega_{4,4} \\ \beta_{5,1} & \sigma_{5,2} & \theta_{5,3} & \Omega_{5,4} \end{bmatrix} \times \begin{bmatrix} BOR_{t-p} \\ EMP_{t-p} \\ GDP_{t-p} \\ IICT_{t-p} \\ LIB_{t-p} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \\ u_{5t} \end{bmatrix} \quad (1)$$

Where: the $BOR_t$, $EMP_t$, $GDP_t$ and $IICT_t$ are the variables that represent: the Business Ownership Rate, the Employment, the Gross Domestic Product, and the Investment in ICT. The $LIB_t$ is the dummy variable that represents the liberalization of the European Telecommunications Markets. The number of lags is given by: $p = 1,...,k$, where *k* corresponds to the optimal number of lags $(p_{\max})$; *t* corresponds to the year; and $u_{it}$ are the errors or the random disturbances.

The first variable to enter is the *BOR* of the country that represents a metric for the level of Entrepreneurship. The second variable corresponds to the Employment (*EMP*) of the country in study. The third variable of Gross Domestic Product (*GDP*) represents a metric for the economic growth. The fourth variable represents the national level of investment in ICT (*IICT*). The fifth is a dummy variable that is a simplified representation of the liberalization of the European Telecommunications markets (*LIB*). This variable assumes a value equal to zero, for the previous period to the liberalization. Whereas, starting from the initial impact period of the European liberalization of the Telecommunications Markets, it assumes a value equal to one.[1]

[1] For both cases, we consider a value equal to one, starting in 1999, due to the lag in the impact of the liberalization process.

*3.3. The Study of the Integration Order*

The first step in the determination of the kind of relationship that is established between the variables in study is the application of the unit root tests that lead to the detection of the integration order of the economic variables. The procedures that are widely used to detect the existence of a unit root make use both of the Augmented Dickey-Fuller Augmented (*ADF*) Test and of the Philips Perron (*PP*) Test. In what concerns to the *ADF* test, this can be expressed by the following condition:

$$\Delta \boldsymbol{X}_t = \alpha + \gamma t + \lambda^* \boldsymbol{X}_{t-1} + \delta_1 \Delta \boldsymbol{X}_{t-1} + \delta_2 \Delta \boldsymbol{X}_{t-2} + ... + \delta_{p-1} \Delta \boldsymbol{X}_{t-p+1} + \boldsymbol{\mu}_t \qquad (2)$$

The previous expression corresponds to a parametric correction. It consists of adding lagged terms of the variable $\Delta X_t$ in order to correct the correlation of upper order. The application of the $ADF(\gamma)$ test consists of testing the null hypothesis $H_0 : \gamma = 0$, against the alternative hypothesis $H_1 : \gamma < 0$. When $\gamma$ is non-significant, the null hypothesis cannot be rejected. From this we conclude that the series is non-stationary (that is, the series is integrated), or that it presents a unit root (Dickey and Fuller, 1979).

An alternative approach to the problem of the autocorrelation in $\mu_t$ is the one proposed by Philips and Perron (1988). This approach is a non-parametric one, and it follows an autoregressive process that can be enunciated as follows:

$$\Delta \boldsymbol{X}_t = \alpha + \gamma t + \lambda^* \boldsymbol{X}_{t-1} + \boldsymbol{\mu}_t \qquad (3)$$

The asymptotic distribution of the estimators of the regression, as well as their *t* ratios, depend on the parameters $\sigma^2$ and $\sigma_u^2$. In practice $\sigma^2$ and $\sigma_u^2$ are not known, and so it is necessary to proceed with their estimation, in a consistent way (Table 2).[2]

*Please insert Table 2 here.*

First, we have studied the order of integration of the time series. From here, we had to transform some of the series, by differentiating it, in order to estimate the models just with *I(1)* variables. After this transformation, once having differentiated the time series, the null hypothesis is rejected, that is, the series are stationary and integrated of order one, or *I(1)*.

*3.4. The Estimation Process of the CVAR Model*

In the selection process of the optimal number of lags ($p_{max}$), the values of five different information criteria are computed. After detecting the inexistence of error autocorrelation, through the use of Lagrange Multiplier (*LM*) tests, with one lag and two lags respectively, and considering only the results obtained through the use of the Akaike Information Criterion (*AIC*), we retain that, in the estimation process of the VAR models, two lags should be considered (Table 3).[3]

*Please insert Table 3 here.*

In what concerns the process of detecting error autocorrelation, we present the results obtained through the use of *LM* tests, with one and two lags.[4]

[2] For a consentaneous example of the estimation process, see Newey and West (1987).
[3] For a discussion about the use of different information criteria, consult Lütkepohl (1999, 2004).
[4] Since the sample is constituted by annual observations.

The analysis of error autocorrelation was made through the simulation of two different estimation processes. For both cases, two lags were considered in the estimation of VAR models.

In order to detect the number of cointegrating relations, we follow Johansen and Juselius (1990). The principle of the maximum likelihood is taken into consideration, by using the Trace Statistic and the Max-Eigenvalue Statistic.

*Please insert Table 4 here.*

According to the observed values of the tests previously presented in Table 4, we reject the first null hypothesis of nonexistence of cointegrating relationships among the variables. For the remaining lines of test, the procedure adopted states that if the observed values are smaller than the correspondent critical values, then the null hypothesis can not be rejected. From this, we consider, in the case of Germany, just one cointegrating vector, whereas in the case of Portugal, we consider two cointegrating vectors in the subsequent estimation process of the CVAR model, using the correspondent error correction terms (*ECT*), that is, *ECT1*, in the first case, and *ECT2* and *ECT3*, in the second case.

### *3.5. The Dynamic Analysis*

The dynamic analysis embraces the evaluation of the causality relationships, and the analysis of the residuals of each equation that is considered in the model specification.

In order to perform a dynamic analysis about the interrelations established among the variables in study, the *ECT* are incorporated. In order to evaluate the existence of causality relationships among the variables, the causality concept originally proposed by Granger

(1969) is used. In the application of the causality tests for each pair of variables, the Wald statistic is applied.

*Please insert Table 5 here.*

Firstly, in the case of Germany, only unidirectional causalities are detected. It should also be noticed that the variables *GDP* and *IICT* are totally exogenous, since they do not present a causality relationship with other variable. Although in what concerns the *ECT1* the coefficient relative to the *LIB* is significant, so it helps to accomplish the adjustment mechanism in relation to the deviations that are observed in the equilibrium relationship in the long term.

For a significance level of 5%, it should be enhanced that, in individual terms, the *GDP* variable has a significant importance in predetermining the behavior of the dependent variable that represents the *BOR*.

The joint causality evidenced by the variables *EMP*, *GDP*, *IICT* and *LIB*, for a significance level of 5%, reveals the importance of including this set of variables in the selected model specification.

Moreover, for a significance level of 10%, the *BOR* predetermines the behavior of the *EMP* variable. For its turn, the *GDP* contains specific information, in a Grangerian sense, about the behavior of the *EMP* variable, at a significance level of 5%. The block of variables also causes *à la Granger* the *EMP* variable, at a significance level of 5%, what once again reinforce the importance of having selected the present set of variables.

Secondly, in the case of Portugal, both bidirectional and unidirectional causalities are detected. By making use of the results obtained for the contrasts of the Granger causalities, only the variable *BOR* may be considered as totally exogenous.

A bidirectional relationship between the variables *GDP* and *IICT* is detected, at a significance level of 5%. This is an important result since an interactivity relationship is detected for these two economic variables.

In terms of the unidirectional relationships, at significance level 5%, the results provided the detection of an interesting set of causalities directions. This way, the *BOR* predetermines the behavior of the *EMP* variable, as it happened in the case of Germany. Furthermore, the *IICT* and the dummy variable *LIB*, both predetermine the *GDP* variable. Whereas, the *BOR*, the *GDP*, and the *LIB*, cause *à la Granger* the *IICT* variable, which represents one the most important variable in terms of the results for the contrasts of the Granger causalities, in the Portuguese case.

Also for a significance level of 5%, the block of variables predetermines the behavior of the economic variables: *EMP*, *GDP* and *IICT*. This result also ratifies the importance of including the same set of selected variables in the model specification.

Besides, it should be stressed that the *IICT* and the *LIB*, in the *ETC2*, and the *EMP*, in the *ECT3*, accomplish the adjustment mechanism in relation to the deviations that are observed in the equilibrium relations in the long term.

The dynamic analysis that is based only on the results obtained through the Granger causality tests may be considered insufficient. According to Sims (1980), Goux (1996), and Lütkepohl (1999, 2004), this kind of analysis should be complemented by the analysis of the Variance Decomposition of Cholesky (VDC) and the Impulse-Response Functions (IRF).

Table 6 only presents the results regarding the significant causalities relationships. It makes use of the variance decomposition of the forecasting error of Cholesky, and of the coefficients obtained through the simulation of impulse-response functions.

*Please insert Table 6 here.*

*3.6. Empirical Findings*

According to the results previously presented in Table 6, in the case of Germany, the *GDP* causes the *BOR*, in a Grangerian sense. After two years, the *GDP* does not present a significant importance, since it has a weight lesser than 5%. Nevertheless, after the third year, the *GDP* starts to have a growing and persistent importance on the determination of the *BOR*. The detection of a negative sign for the accumulated percentage weight should be enhanced. The existence of a negative causality relationship between the *GDP* and the *BOR* was not an expected result, although it was ratified through the impact analysis now performed. In the case of Germany, the bigger the *GDP* is, the smaller the *BOR* will be.

In what respects the causality relationship established between the *GDP* and the *EMP*, after two years, we detect a direct effect which is just about 0,1%. Starting from the third year, a significant improvement on the explanatory power of the *GDP* is also detected. Furthermore, it assumes a growing and persistent nature, around 42%, starting from the sixth period. According to the analysis of the coefficients provided by the simulations of the impulse-response functions, in terms of this specific causality relationship, a positive sign was detected. This means that the past values of *GDP* precede increasing levels of *EMP*, in Germany. The results also revealed that the liberalization of the telecommunications in Europe caused in a Grangerian sense the level of *EMP*, although, the significance of its impact was not ratified through the forecasted coefficients, by using the technique of Variance Decomposition of Cholesky.

In the case of Portugal, the observance of a feedback relationship must be stressed, namely, between the *GDP* and the *IICT*. The results obtained through the Variance Decomposition of Cholesky ratify the significant impact of both variables. In this sense, the *IICT* has a direct and significant impact on *GDP*, but the past levels of *IICT* precede

decreasing levels of *GDP*. For its turn, the past levels of *GDP* present a positive impact in terms of the level of *IICT*, in forthcoming periods.

In terms of directions of unidirectional causalities, the results revealed that the *BOR* assumes a special importance in the present analysis, since it provides a positive and growing impact on the level of *IICT*. In the second period, the *BOR* explains about 14,3% of the forecasting error of the level of *IICT*. Additionally, the *BOR* presents a direct and significant impact on the level of *EMP*, but in this case we find a negative relationship. In a Schumpeterian sense, the past levels of *BOR* precede decreasing levels of *EMP*, and in a certain sense, it contributes for ratifying the creative entrepreneurial destruction.

## 4. Conclusions

The paper evaluates the impact of telecommunications liberalization in European Markets, in terms of the causalities relationships established among distinct economic variables: the Business Ownership Rate, the Employment, the Gross Domestic Product, and the investment in ICT. For this purpose, a CVAR approach is developed for two European Countries: Germany and Portugal.

The CVAR approach now presented allows ratifying contrasting results for the two European countries. In the case of Germany, a surprising causality relationship is revealed, in the sense that Gross Domestic Product precedes decreasing Business Ownership rates. Additionally, the Gross Domestic Product presents a positive impact, in terms of the employment behavior. These situations may be justified by the reunification of the country, which has taken place in 1989, with the fall of the Berlin Wall, and the subsequent increasing level of public expenditure. It must be stressed that both Gross Domestic Product and Investment in ICT are totally exogenous variables, since they do not present any kind of causality relationship with the other economic variables included in the model specification.

For its turn, in the case of Portugal, a feedback causality relationship between the Gross Domestic Product and the investment in ICT is ratified, although different signals of causality weights are detected. On the one hand, the level of investment in ICT presents a negative impact on the Gross Domestic Product. This fact may be justified by the investment effort made by the State, that is, the owner of the incumbent telecommunications operator, in expanding and upgrading the copper and the cable networks, during the decades of 80's and 90's. On the other hand, the Gross Domestic Product precedes increasing levels in ICT. This is justifiable by the public policies that were supported by European funding, which was conducted to public spending in telecommunications infrastructures, along the last two Decades of the 20$^{th}$ century.

One of the most interesting results provided by the Portuguese case is the fact that Business Ownership Rates pull for additional investments in ICT, which may be associated with the increasing level of services industries.

The last but not the least, still in the Portuguese case, the creative entrepreneurial destruction is somehow ratified in the sense that during the period in study, the Business Ownership Rates presents a negative impact on the level of employment. In a Schumpeterian sense, we may advocate that the creation of new micro firms of traditional activities and services precede the closing of large sized firms, whose activities have an intensive use of labour, at the industrial level.

Finally, we suggest the use of a similar model specification in different European countries, in order to produce comparative impact analyses of the liberalisation of telecommunications' markets, on business ownership rates, employment, economic growth and level of investment in ICT. Furthermore, taking into consideration other kind of public policies and regulation actions, we suggest exploring, the crossing impacts of two

determinants of entrepreneurship: the inflows of Foreign Direct Investment and the ICT investment; across distinct European countries.

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# TABLES

Table 1. The Swarms of Entrepreneurship Research

| Periods | Research | Focus |
|---|---|---|
| **1860-1880** | Austrian and German economists, Johann Heinrich von Thünen (1783-1850); Hans Emil von Mangolt (1824-1868); Carl Menger (1840-1921); Friedrich von Wieser (1851-1926); and Eugen von Böhm-Bawerk (1852-1914) based their research on a tradition rooted in political science and administration. | Entrepreneurship as a function of the market - the ability of entrepreneur to perceive opportunities for profit |
| **1890-1920** | Many of Joseph Schumpeter's (1883-1950) thoughts on entrepreneurship were developed during this period.<br>US economists such as Francis Walker (1840-1897); John Bates Clark (1847-1938); Leon Walras (1834-1910); and, at a slightly later stage, Frank Knight (1885-1972) had a major influence. | Entrepreneurship as a function of the market – the entrepreneur: a creator of instability and creative destruction. |
| **1950-1970** | Based on a strong behavioural science tradition, this period includes pioneers such as David McClelland (1917-1998); Everett Hagen (1906-1992); Seymour Martin Lipset; and Fredrik Barth. | The entrepreneur as an individual (traits) |
| **1985 - 2001** | There is an increased interest from researchers within small business economics and management studies, for example, David Birch (the role of small firms in employment; job creation); Zoltan Acs and David Audretsch (small firms and innovation); Giacomo Becattini and Sebastiano Brusco (small firms and regional development); Arnold Cooper (technology-based firms); Howard Aldrich (ethnicity and networks); Jeffrey Timmons and William Wetzel (the role of venture capital); Ian MacMillan, Peter Drucker, and Rosabeth Moss Kanter (entrepreneurship as a strategy); and Roy Thurik (economic growth). | Entrepreneurship as a process |

Source: Own elaboration.

Table 2. The ADF tests, and the PP tests, including a constant, and without tendency

| Variables | First Differences | | | |
|---|---|---|---|---|
| | Germany | | Portugal | |
| | ADF | PP | ADF | PP |
| **BOR** | -3.99818* | -4.88669* | -5.341469* | -7.003825* |
| **EMP** | -5.062716* | -5.139361* | -11.52517* | -7.202975* |
| **GDP** | -5.173418* | -7.180692* | -4.867041* | -4.867041* |
| **IICT** | -3.353705* | -3.381534* | -7.778336* | -5.290854* |

* It denotes the rejection of the null hypothesis that is related to the existence of a unit root.

Table 3. Selection of the optimal number of lags

| *Lags* | *LR* | *FPE* | *AIC* | *SBC* | *HQ* |
|---|---|---|---|---|---|
| | | | **Germany** | | |
| 0 | NA | 3.96e+21 | 63.92023 | 64.16400 | 63.98784 |
| 1 | 104.2441 | 1.27e+20 | 60.43370 | 61.89635* | 60.83937 |
| 2 | 41.11980* | 6.56e+19* | 59.49657* | 62.17810 | 60.24031* |
| | | | **Portugal** | | |
| 0 | NA | 2.30e+42 | 111.7306 | 111.9744 | 111.7983 |
| 1 | 113.3042 | 4.58e+40 | 107.7673 | 109.2299 | 108.1729 |
| 2 | 64.72724* | 4.38e+39* | 105.1439* | 107.8254* | 105.8876* |

* It identifies the optimal number of lags selected through each one of the information criteria.

Table 4. The Cointegration tests

| | Hypotheses | | $\lambda_{Trace}$ | | Hypotheses | | $\lambda_{Max}$ | |
|---|---|---|---|---|---|---|---|---|
| EV | $H_0$ | $H_1$ | Observed | Critical | $H_0$ | $H_1$ | Observed | Critical |
| | | | | **Germany** | | | | |
| 0.858782 | r=0 | r=1 | 92.28903* | 69.81889 | r=0 | r>0 | 46.97875* | 33.87687 |
| 0.673834 | r=1 | r=2 | 45.31028 | 47.85613 | $r \leq 1$ | r>1 | 26.88839 | 27.58434 |
| 0.390784 | r=2 | r=3 | 18.42188 | 29.79707 | $r \leq 2$ | r>2 | 11.89397 | 21.13162 |
| 0.237157 | r=3 | r=4 | 6.527909 | 15.49471 | $r \leq 3$ | r>3 | 6.496882 | 14.26460 |
| 0.001292 | r=4 | r=5 | 0.031027 | 3.841466 | $r \leq 4$ | r>4 | 0.031027 | 3.841466 |
| | | | | **Portugal** | | | | |
| 0.999108 | r=0 | r=1 | 251.7933* | 69.81889 | r=0 | r>0 | 168.5215* | 33.87687 |
| 0.912468 | r=1 | r=2 | 83.27183* | 47.85613 | $r \leq 1$ | r>1 | 58.45789* | 27.58434 |
| 0.432942 | r=2 | r=3 | 24.81393 | 29.79707 | $r \leq 2$ | r>2 | 13.61504 | 21.13162 |
| 0.355409 | r=3 | r=4 | 11.19889 | 15.49471 | $r \leq 3$ | r>3 | 10.53934 | 14.26460 |
| 0.027107 | r=4 | r=5 | 0.659553 | 3.841466 | $r \leq 4$ | r>4 | 0.659553 | 3.841466 |

[+] The first column corresponds to the Eigenvalues (EV).; [++] The critical values of the Trace Statistic and of the Max-Eigenvalue Statistic, at a 5% significance level, were collected from Osterwald-Lenum (1992); * It denotes the rejection of the initial hypothesis, at a 5% significance level.

Table 5. The contrasts of the Granger causalities

| Dependent / Independent | $\Delta BOR$ | $\Delta EMP$ | $\Delta GDP$ | $\Delta IICT$ | $\Delta LIB$ |
|---|---|---|---|---|---|
| | **Germany** | | | | |
| $\Delta BOR$ | - | 5.039998** | 1.164488 | 0.654588 | 1.091039 |
| $\Delta EMP$ | 1.221943 | - | 4.129072 | 1.302817 | 6.363989* |
| $\Delta GDP$ | 16.28541* | 8.165980* | - | 0.437421 | 3.451947 |
| $\Delta IICT$ | 0.382686 | 2.355557 | 0.830709 | - | 2.620785 |
| $\Delta LIB$ | 0.078431 | 6.590762* | 0.865178 | 1.075482 | - |
| Block | 39.72865* | 20.08987* | 6.921745 | 2.496017 | 14.92667** |
| ECT1 | -0.353791 | -1.41E+09 | -3.503429 | -6.53E+11 | 186.3557* |
| | **Portugal** | | | | |
| $\Delta BOR$ | - | 12.65186* | 0.340295 | 11.36491* | 15.33243* |
| $\Delta EMP$ | 0.142008 | - | 0.360243 | 1.752702 | 0.629445 |
| $\Delta GDP$ | 0.853387 | 4.172060 | - | 175.4107* | 1380.649* |
| $\Delta IICT$ | 0.527682 | 3.347953 | 16.74045* | - | 79.93560* |
| $\Delta LIB$ | 0.639244 | 2.769134 | 15.94505* | 6.610255* | - |
| Block | 7.323350 | 26.83089* | 19.56509* | 231.8007* | 2368.990* |
| ECT2 | 0.108293 | -86052.22 | 6597805. | 3.10E+12* | -9.364967* |
| ECT3 | 1.26E-10 | -2.279525* | -0.176736 | -4551.059 | -1.96E-09 |

[+] The contrasts of the causality of the variables are made by using the $\chi^2$ statistic, with one degree of freedom, while the contrasts of the significance of the error correction term (ECT) are made through the use of the *t* statistic.
* Significance level: 5%.
** Significance level: 10%.

Table 6. Dynamic analysis of the significant Granger causalities

| Causalities Relationships | Dynamic Analysis | 2 Years | 3 Years | 10 Years | The percentage weigh |
|---|---|---|---|---|---|
| | | **Germany** | | | |
| $\Delta GDP \rightarrow \Delta BOR$ * | VDC | 1.604181 | 15.67937 | 23.55621 | - |
| | IRF | 0.000110 | -0.000506 | -0.000332 | |
| $\Delta GDP \rightarrow \Delta EMP$ * | VDC | 0.107989 | 9.326449 | 39.17818 | + |
| | IRF | -104850.2 | 1306805. | 954340.2 | |
| $\Delta LIB \rightarrow \Delta EMP$ | VDC | 2.435213 | 1.345654 | 1.084942 | - |
| | IRF | 497906.3 | -8630.220 | 134832.1 | |
| | | **Portugal** | | | |
| $\Delta BOR \rightarrow \Delta EMP$ * | VDC | 47.08823 | 28.17260 | 36.25159 | - |
| | IRF | -1586785. | 362224.9 | -515581.5 | |
| $\Delta IICT \rightarrow \Delta GDP$ * | VDC | 17.10663 | 21.31892 | 16.20474 | - |
| | IRF | -1093698. | -1294047. | -245671.3 | |
| $\Delta LIB \rightarrow \Delta GDP$ | VDC | 0.173314 | 0.249742 | 0.173342 | - |
| | IRF | -110086.1 | -146664.6 | -23268.99 | |
| $\Delta BOR \rightarrow \Delta IICT$ * | VDC | 14.34011 | 19.22282 | 30.41944 | + |
| | IRF | 4.22E+09 | -1.27E+10 | 1.69E+10 | |
| $\Delta GDP \rightarrow \Delta IICT$ * | VDC | 15.93243 | 12.51950 | 31.39824 | + |
| | IRF | -3.47E+09 | -8.24E+09 | 2.70E+10 | |
| $\Delta LIB \rightarrow \Delta IICT$ | VDC | 0.399895 | 0.439986 | 0.141139 | - |
| | IRF | 1.49E+09 | 1.81E+09 | -1.74E+09 | |

Legend: VDC is the Variance Decomposition of Cholesky; IRF corresponds to the Impulse-Response Functions.
* We consider it significant when assumes an impact higher than 5% (Goux, 1996).
[+] The sign of the percentage weight is obtained through the sum of the coefficients of the first 10 periods (Goux, 1996).

# FIGURES

Figure 1. Variance Decomposition of Cholesky (VDC) - Germany

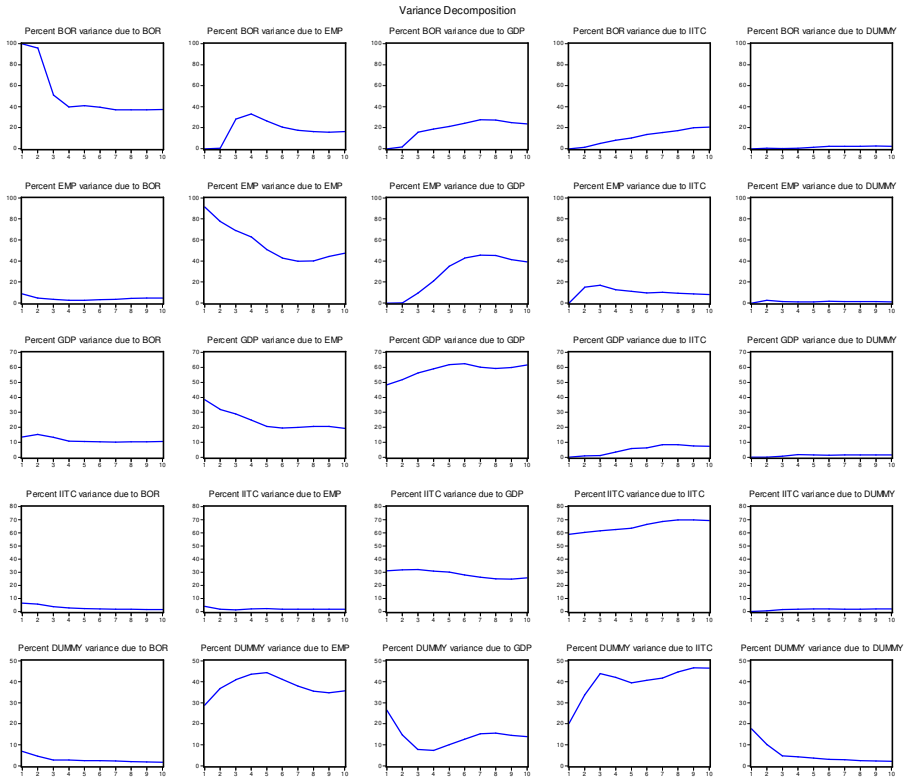


Figure 2. Accumulated Coefficients of Impulse Response Functions (IRF) – Germany

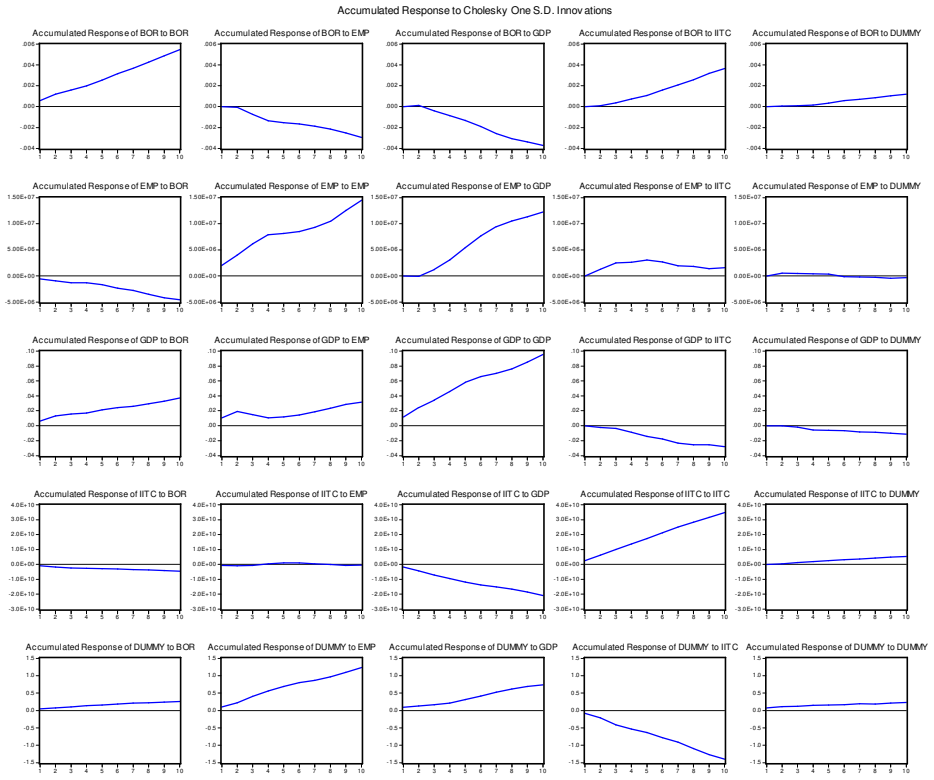

Figure 3. Variance Decomposition of Cholesky (VDC) - Portugal

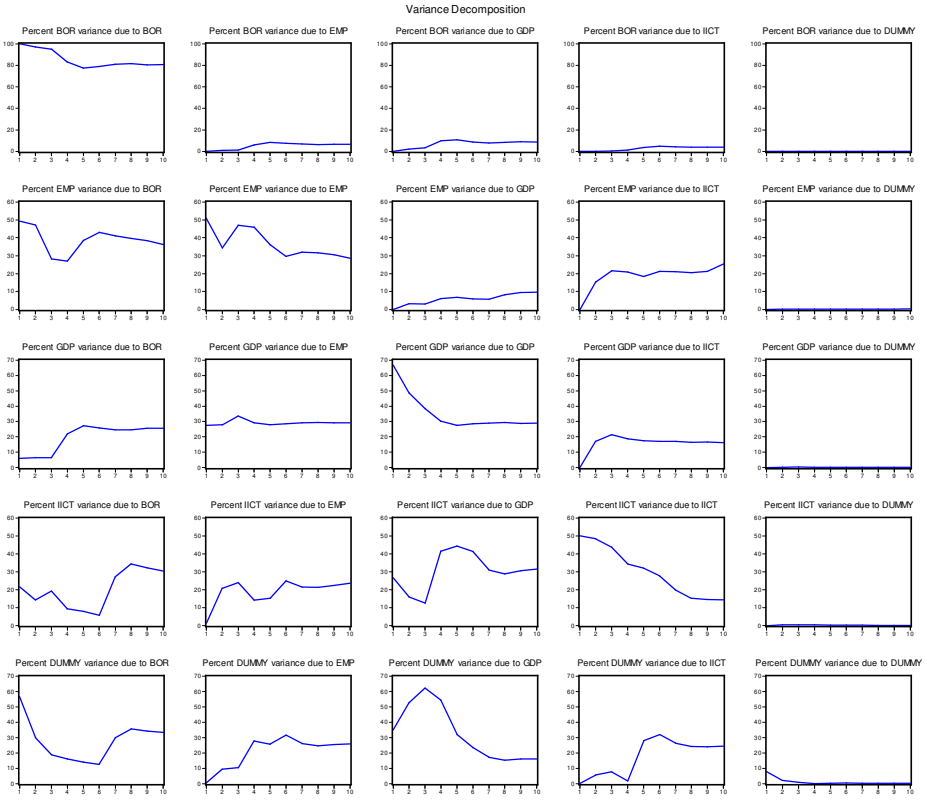


Figure 4. Accumulated Coefficients of Impulse Response Functions (IRF) – Portugal