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The importance of small knowledge intensive firms in European countries

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Abstract:

Smart, sustainable and inclusive growth is the basis for European 2020 strategy, in which small and medium-sized enterprises (SMEs) are considered the backbone of European countries economies. The present study aims to investigate the relationship between the main variables that characterises small knowledge intensive firms (SKIFs) and the importance of their business expenditure on research and development (BERD). To achieve this, European member states were analysed during the period between 2008 and 2012 using a clusters analysis. Through this study it is possible to conclude that countries that have high growth values on SKIFs also achieve growth in GDP and BERD.

Keywords: SKIFs, Innovation, European Countries, SMEs, BERD
JEL codes: L25, D83

1. INTRODUCTION

Research and development (R&D) is a key factor in European policy, being an important issue to the strategy for European 2020 related to innovation and growth (European Union, 2013). According to this strategy, innovation will create job opportunities for all, especially for young people; get the economy back on track; make companies more competitive in the global market; solve the challenges of an ageing population; secure resources like food and fuel; fight global warming; and improve smart and green transport. The low expenditure in R&D explains half of European Union (EU) gap with the United States (US), in 2010 when the executive summary of Europe 2020 policy was published, according to the EU Commission (2010, p.14) *"EU expenditure on R&D was below 2% while in US was 2.6% and in Japan 3.4%"*. In order to improve R&D expenditure, one of the flagships of European 2020 strategy was creating the Innovation Union

which main goals are to improve innovation conditions such has EU patent and enhance joint programing with member states regions.

The backbone of European economy are Small and Medium-Sized Enterprises (SMEs), these are a key driver for economic growth, innovation, employment and social integration according to the EU Annual Report on European SMEs (Gagliardi et al., 2013). From the same report, it can be observed that 99.8% of the European enterprises are considered SMEs, which are responsible for approximately two in every three employed persons in the private sector in Europe and also contribute in over half (57.3%) of the value added at factor costs by European enterprises. The programme Horizon 2020 actively supports SMEs with the goal of optimizing research, development and innovation environment for SMEs.

The relevance assumed by the European Commission (EC) about SMEs and the strategy of a competitive European economy based on smart, sustainable and inclusive growth leads to the importance of Small and Medium Knowledge Intensive Firms (SKIFs) in the European context. Most of the studies about SKIFs are generally about either internationalization properties of SKIFs, or about how SKIFs influence SMEs, however are scarce the studies that investigates the influence of knowledge intensive business services on European regions, and relate SKIFs directly with macroeconomic variables, such has Gross Domestic Product (GDP) or Business Expenditure on R&D (BERD). Therefore, the main objective of this study is to research the SKIFs proxy indicators and EU Countries GDP per capita and BERD. For this purpose it was analysed 24 member states, from 2008 to 2012, through a comparative and econometric analysis to study the relation between SKIF and macroeconomic variables. The database was retrieved from Eurostat, and is similar to the one used in Gagliardi et al. (2013). To complement this data it is used a database from 27 European member states, on the period 2009 to 2011, provided by Ecorys.

In this study were developed two different analyses. On the first analysis, it is used the Ecorys database where values for employment and value added growth of Knowledge Intensive Services (KIS) and High and Medium High Tech Manufacturing (HMHTM) were compared to SME numbers and then to GDP values. On the second analysis, the sample consists on EU-24 countries retrieved mainly from Eurostat, the base data is the same as in Gagliardi et al. (2013), after describing the evolution of SKIFs proxy variables such as number, employment, value added and productivity with this values it was made a cluster analysis to investigate where each country locates individually and if there are relevant differences between the cluster's groups.

The structure of this article is as follows. After this introduction, in section 2 will be presented the definition of SKIF and its environment, section 3 gives an overview of SKIFs employment related to SMEs and GDP; and section 3.2 is about the factors underlying the growth of SKIFs and their influence on GDP and BERD growth. In each one of the sections is presented the data, methodology and results for each analysis made. Section 4 concludes.

2. LITERATURE REVIEW

2.1. THE CONCEPT OF SMALL AND MEDIUM KNOWLEDGE INTENSIVE FIRMS (SKIF)

To study the economic role of the SKIFs, first is needed to begin by its concept. To define a SKIF, two main aspects have to be combined, the size, and the knowledge intensive. Due to these, SKIFs can have several definitions. About the size, in Europe the SMEs are defined according to the European Recommendation 2003/361. This recommendation considers a SME as an enterprise that have to abide three criteria, the first one is relating to employed workers, the enterprise has to have less than 250 employees; the second criterion is related to optional restrictions, enterprises either have to have a total turnover of less than 50 million or a total balance sheet of less than 43 million, this option on the second criterion is given in order for firms in different types of activity to be treated fairly, for example trading enterprises have, by nature a high number of sales that may not reflect their wealth. And, the third criterion is related to the independence of companies. To be an independent enterprise, the enterprise in question has to have a holding of less than 25% of the capital or voting rights (whichever is the higher) in one or more other enterprises outside its own and/or outsiders do not have a stake of 25% or more of the enterprise in question.

On Table 2.1 it can be seen that there are different definitions for SME, which will translate in a lot of different definitions for SKIF depending on the country. For our study the considered countries are from EU, meaning, that it will be based on European statistics about SMEs therefore the chosen definition will be the one used in Europe.

After defining the size component of SKIFs in this study, it is needed to present the concept of a KIF. In this case, there are also different definitions. It has superseded the terms 'high-technology firm' and 'technology-based firm' in studies about software firms but this is not enough to define what a knowledge intensive firm is, Alvesson (1995) defined a KIF as '*a company where most work can be said to be of an intellectual nature and where well-qualified employees form the major part of the workforce*'. Elkjaer (2000, p. 344) sees a KIF as 'a company of knowledge workers' where 'human competencies are the main assets'. According to Robertson & Hammerlsey (2000, p. 241) '*KIFs have always been in the business of managing knowledge – knowledge being their primary asset and source of competitive advantage'*.

According to Wymega et al. (2012), KIS sectors function as a facilitator, carrier or source of innovation, and through their symbiotic relationship with client firms, some KIS function as co-producers of innovation. The growing role of services and its complementarities with the more traditional manufacturing sectors suggest that productivity growth in KIS. Several studies have divided KIF into High and Medium High Tech Manufacturing (HMHTM) and KIS. On the present study are considered SKIFs the companies that joint both of these two concepts.

In the same way, a SKIF will be considered a firm with less than 250 employees and which knowledge is their main asset or source of competitiveness, while it's easy to get data about SMEs, in the case of SKIFs it is more difficult to know when to consider if a firm is knowledge intensive. So for data analysis purposes, the European Commission indicated which sectors would be considered knowledge intensive and which wouldn't[1].

Table 2.1. Different SME's definitions around the world

Country	SME CRITERIA
Australia	Has to employ less than200 employees
Canada	Has to employ less than 500 employees
China	Has to employ less than 2000 people, or with annual revenue less than RMB 300 million (45,681,292.63€), or with total assets less than RMB 400 million (around 60,908,390.17€)
Egypt	Has to employ less than 50 employees
India	Investment in plant and machinery does not exceed Rs.10 crore (around 1,518,000.00 €) For services industry : Investment in equipment does not exceed Rs. 5 crore (around 759000.00€)
Japan	Manufacturing: ¥300 million or less and 300 or fewer employees Wholesale ¥100 million or less and 100 or fewer employees Service industry ¥50 million or less and 100 or fewer employees Retail ¥50 million or less and 50 or fewer employees
Kenya	Has to employ less than 100 employees
New Zealand	Has to employ less than 20 employees.
Nigeria	Asset base between N5 million (around 23,821.41€) and N500 million (around 2,382,140.54€), Has to employ less than 300 employees
Russian Federation	The subjects of small business sector are: 1. Commercial organizations. Legal entities, in which: - The share of participation of the Russian Federation and federal subjects ownership, municipal ownership, ownership of public and religious organizations, charity and other funds does not exceed 25 percent of the authorized capital (the share according to the above partners of ownership are not totalled). The share of one or several legal entities, that are not small entrepreneurship, should not exceed 25 percent of authorized capital (if several founders are founders, their share are totalled); - The average number of employees (including part-time workers and persons working under sub-contracts) does not exceed the following maximum levels: ▪ in industry, building and transport – 100 employees; ▪ in agriculture, science and technological field: 60 employees; ▪ in retail trade and consumer services: 30 employees; ▪ in other field of activities: 50 employees. 2. Farm enterprises; 3. Persons, who perform entrepreneurial activities, but are not legal entities (individual entrepreneurs)

Source: Based on several sources presented on the footnotes at the end of the page, own elaboration.

[1] See the sectors that Eurostat considered knowledge intensive and the ones less knowledge intensive in http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf

The SKIFs use knowledge as their main source of advantage, they operate in environments with rapid changing technology, they invest a lot in research and ever shortening product life cycles meaning they have to be constantly innovating otherwise they would easily disappear from the market, their environment is highly competitive which may be a driver to seek strategic alliances and network relationships this environment is also marked by strong rivalry which is also a driver for innovation.

2.2. THE CONCEPT OF SMALL AND MEDIUM KNOWLEDGE INTENSIVE FIRMS (SKIF)

The SMEs play an important role in innovation (Almeida, 1999) and have been described as agents of change (Audretsch, 1999), creators of radical innovation (Acs et al., 1999) and carriers of new ideas (Carlsson, 1999).

Despite their lower individual visibility, SMEs collectively play an important role in the economy. SMEs represent an important source of dynamism in the economy, accounting for a large share of both gross job gains and gross job losses each year. SMEs are often said to be a conduit that introduces new and innovative products and processes into the economy (Acs et al., 1999) due to serving specialized market segments that large firms may find unprofitable, by adopting flexible production processes that are capable of offering personalized products. SMEs also play an important role in the early stages of the product life cycle; taking advantage of their close relationships with their customers, SMEs are often better positioned to take the basic technical innovations made by large firms and turn them into new products.

The following Figures 2.1 to 2.4 analyses the importance of SMEs compared to large enterprises (LEs).

In terms of demography of companies, Figure 2.1 shows that European SMEs follow a different path from LEs. In 2008-2009, the number of LE dropped by almost 1,800 units to near 42400. Their number began to grow again only in 2010 and by the end of 2012 had not yet recovered to its 2008 level. The number of SMEs grew between 2009 and 2010 by almost 1 million firms, after a relatively small drop in 2008-2009. From 2010 onwards, the total number of SMEs started to fall, in 2012, the number of SMEs returned to the levels of 2008.

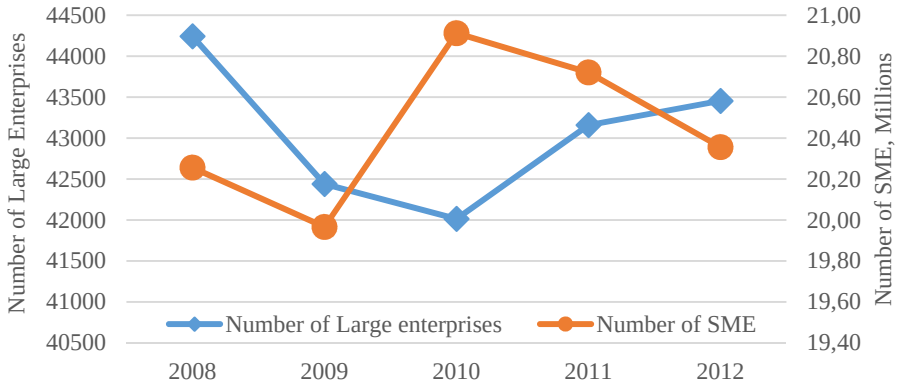

Figure 2.1. Number of LEs and SMEs
Source: Eurostat, own elaboration.

The Figure 2.2 shows that the dynamics of gross value added (GVA) was similar for SMEs and LEs in 2009, LE lost around 10% (260 billion euros) of added value relating to the previous year; SMEs lost marginally less in percentage terms (9%), but consistently more in absolute terms: €330 billion. After the dip in 2009, the value added recovered but only sluggishly throughout 2010. All companies were hit in 2012: the output loss of SMEs was 1.3%, while LEs lost 0.3% of the value added with respect to the previous year.

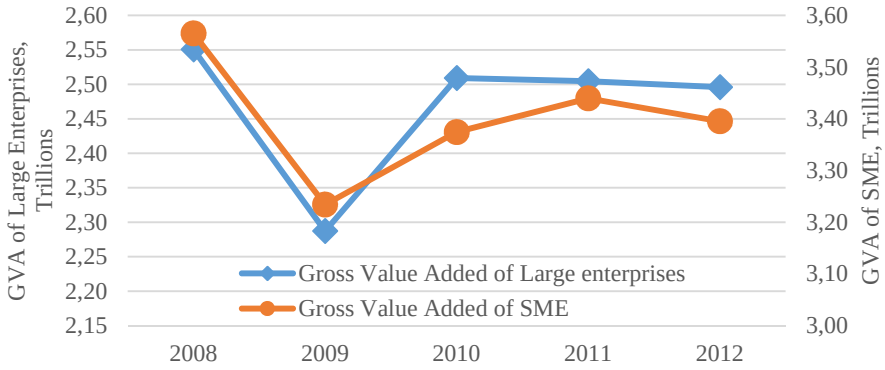

Figure 2.2. Gross value added of LEs and SMEs
Source: Eurostat, own elaboration.

The Figure 2.3 shows the employment by SMEs proved to be more resilient to crisis than employment by large firms. In only one year, 2008-2009, large firms lost approximately 1.7 million jobs, whilst SMEs lost around 680,000 jobs, the period of 2010-2012 however proved rather challenging for SMEs. At the EU-27 level, employment in SMEs did not exhibit a particularly pronounced swing, but

during the whole period of 2008-2012, it showed a declining trend, while employment in large firms showed signs of recovery.

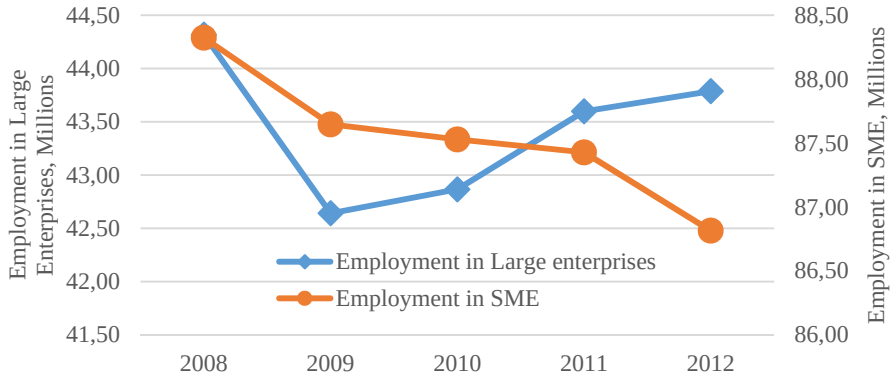

Figure 2.3. Number of person employed in LEs and SMEs
Source: Eurostat, own elaboration.

The Figure 2.4 shows that productivity per worker by both SMEs and LEs droped significantly in 2008-2009, and then grew in 2009-2010 resulting in, for LEs, the levels of 2010 beeing higher than the levels of 2008. After 2010 the productivity of LEs started to drop while on SMEs the producitvity levels continued to rise in 2010-2011 and then droping on 2011-2012.

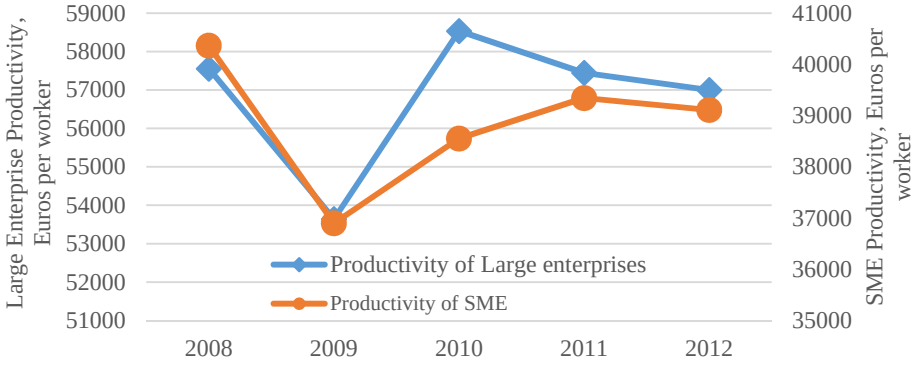

Figure 2.4. Productivity of LEs and SMEs
Source: Eurostat, own elaboration.

The same kind of comparisson as in the previous figures is made in Figure 2.5 between SKIFs and Large Knowledge Intensive Firms (LKIFs). The results in terms of trend where quite similar, the main diference was on employment.

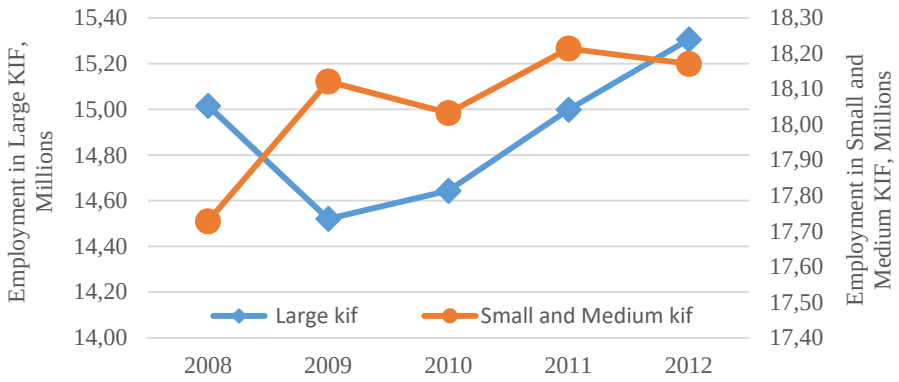

Figure 2.5. Number of persons employed in Large KIFs enterprises and SKIFs
Source: Eurostat, own elaboration.

In the Figure 2.5 can be seen that on LKIFs there was a dip in employment in 2008-2009 after that employment on LKIFs showed a growing trend. On SKIFs it can be seen that the employment grew by 0.4 million people on the crisis period, 2008-2009, showing a shacky yet growing trend during the whole period.

2.2.1. KNOWLEDGE INTENSITY, INNOVATION AND COMPETITIVENESS

Innovation is very important for the sustainability and survival of SKIFs, this is supported from their own definition; since on the concept of knowledge intensive firm, knowledge is their main source of competiveness that they have to be constantly innovative.

According to the Oslo Manual (OECD, 2005, p. 46) innovation is defined as the "implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations".

A more common description to innovation is the creation of something new or that makes a significant improvement to something existent, which can be a product, a process, marketing or organization that adds value to society, governments or markets.

However, there are different ways of classifying innovations. Booz et al (1980) distinguish innovations between the ones that are new to the company and those that are new to the market. The innovation's classification of Booz et al. (1980) is focused on the impact of the innovation and labels it as incremental, semi-radical or radical. Other authors classify innovations as belonging to product, process, or market paradigms (Francis & Bessant, 2005).

The SKIFs tend to born global or internationalize at a fast rate. ICT-intensive firms internationalize faster and more extensively than less ICT-intensive firms. It seems that ICT is important, making it possible for small, technology advanced firms with strong international visions to follow niche strategies in international markets.

It is then, reason to conclude that ICT plays an important role in small firm internationalization-both as a channel for opportunity identification and as a powerful tool in the execution of an international strategy (Aspeund & Moen, 2004).

The importance of KIFs to economy is in great part justified not only because of their own added value but also due to high spillover effects. Spillover effects on innovation occurs when an innovation by one specific firm causes unintended benefits to other firm or opens new market segments knowledge. The occurrence of spillovers is one of the main reasons why governments should oriented their policies to incentive firms to innovate.

When comparing SMEs to SKIFs, SKIFs where more resilient to 2008 crisis as shown by Figure 2.6, SKIFs number grew from 2008 to 2010 while SMEs number decreased from 2008-2009.

2.2.2. THE ENVIRONMENT AND INTERNATIONALISATION CONTEXT OF SKIFS

The most studied internationalisation models applied to SKIFs are the Uppsala Model (Johanson & Wiedersheim-Paul, 1975), the Network Theory (Johanson & Mattsson, 1988) and the International Entrepreneurship Theory (McDougall & Oviatt, 2000). In their study, Masum & Fernandez (2008) concluded that almost all firms tend to base their foreign endeavour on networking, for gathering market knowledge and information in particular; SMEs heavily on network relationships. SKIFs are no exception, they are highly involved in international markets and for these good network relations are needed (Prashantham & Berry, 2004). Network relations refer to all the relationships that the firm has with customers, suppliers, competitors, alliance partners, universities, government bodies, industry associations and others. The personal relations of the entrepreneur also count for these network relations (Katz et al., 2004) since most authors consider the Network Theory as essential for the study of the concept of SKIFs in the economy.

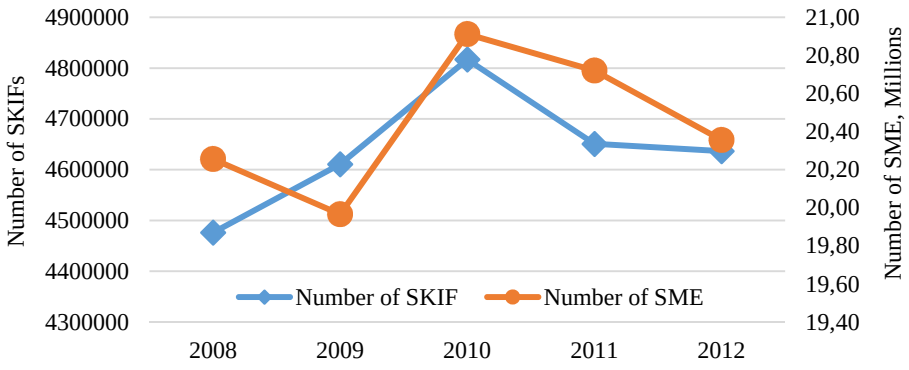

Figure 2.6. Number of SKIFs and SMEs
Source: Eurostat, own elaboration.

The concept of Network Relationships was first presented in the 1980s as an internationalization model by Johanson & Mattsson (1988) as stated in Ojala (2009:51) when it became evident that most of the firms used various networks to facilitate and improve their internationalization activities (Narayanan, 2015). For main difference between incremental internationalization models, for example the Uppsala Model and the Network Model, is that the Network Model is not gradually progressing in nature. Also in the Network Model there is nothing about psychic distance or about the countries in which a firm is entering into. Instead, it conceptualizes internationalization as being related to relationships establishment and building (Johanson & Vahlne, 2003). According to Johanson & Mattsson (1988), a company is dependent on resources controlled by other companies and can get access to these resources by developing its position in a network. In these networks, firms have common interests in developing and maintaining relationships with each other in a way that provides them mutual benefits (Johanson & Mattsson, 1988, 1992; Johanson & Vahlne, 2003).

According to Network Model, internationalization occurs when a firm starts to develop relationships with another firm in a foreign country. There are two different approaches to the network internationalization, active and passive networking (Ojala, 2009): in active networking, the initiative is taken by the seller, whereas in passive networking the initiation comes from the buyer's direction.

The efficacy of Network relationships is based in the different established relationships. These can be divided into formal relationships, informal relationships, and intermediary relationships (Ojala, 2009). The literature concerning this conceptualization division could differ according different authors. Formal relationships are the relations hierarchically established within the firm as well as the relations with stakeholders defined in the tasks of each work position, and informal relationships are the relations established outside the hierarchical defined tasks for inside and outside the company, as relations between friends, orders follow outside the defined tasks from the company, etc. For Birley (1985) formal relationships are related to financial sources available whereas informal relationships refer to contacts between other business actors, friends, and family members. By other way, the study of Dubini & Aldrich (1991) suggests that extended (formal) relationships consist of relationships between all the employees of each firm whose role is boundary-spanning, whereas personal (informal) networks are related to all persons that an entrepreneur can meet directly. The simple discretion is: the formal relationship refers to the relationship with other business actors, whereas informal relationships are related to social contacts with friends and family members. In the intermediary relationship, there is a third party that connects the buyer and the seller.

Ojala (2009) found that SKIFs are actively seeking for opportunities in the foreign markets and, thereafter, develop new networks or utilize existing networks to reach these opportunities and Jenssen & Nybakk (2013) stated that smaller knowledge-intensive firms have fewer resources and less information-gathering

and information-processing capacity than larger firms that are less knowledge intensive; thus, SKIFs that seek to be innovative must develop a larger and more diverse set of external relationships.

2.3. THE IMPORTANCE OF SKIFS IN MODERN ECONOMIES

SKIFs are important for modern economy due to their contribution to innovation, employment and technological development. According to the Wymega et al. (2012) knowledge-intensive service sectors function as a facilitator, carrier or source of innovation, and through their symbiotic relationship with client firms, some KIS function as co-producers of innovation.

The KIS sector also can be considered as an important driver of employment growth (Schricke et al., 2011). For other side, the productivity of SMEs involved in both high-and medium high-tech manufacturing and knowledge intensive sectors was above that of SMEs (Wymenga et al., 2012), and the average growth rate of VA by SMEs in EU countries with above average KIS shares is higher in this period than the EU average and that of the group of countries with below average KIS SME shares (Wymenga et al., 2012).

So, SKIFs create a large proportion of new jobs and contribute both to innovation and technological change (Jensen & Nybakk, 2009), as well as they are key players in the renewal of economy (Jensen & Nybakk, 2013). For Gagliardi et al. (2013, p. 22*) "the SME sector has acted as a buffer for the economic crisis in Europe, where the SMEs of the manufacturing sector are struggling to improve their performance in the context of declining share of manufacturing value-added in GDP, and SMEs active in the services sector are set on an upward productivity trend, especially in the segment of knowledge-intensive services"*.

5. DATA, METHODOLOGY AND RESULTS

The main objective of this study is to investigate the influence of SKIFs on macroeconomic indicators. With this propose, two analyses were made.

On the first analysis the aim is to study the SKIFs composing sectors, the KIS and the HMHTM (SKIFs are usually divided in KIS and in HMHTM and as shown on annex A2), and their influence on SMEs variables, like gross value added and employment growth. Most of the previous studies on SKIFs field study them divided by these two categories, and their relation with SMEs. In this part it is also compared the countries with high employment shares of SKIF per SME and the country GDPpc. To this analysis were considered the 27 EU member states, from 2009 to 2011, using the data from Wymenga et al. (2012) provided by Ecorys. This preliminary analysis goal is to demonstrate the positive influence of SKIF on SME and also on Gross Domestic Product (GDP). The section 3.1 develops this first analysis and presents an overview of the data the description, the methodology, and a discussion and analysis of the results obtained.

On the second analysis the aim is to study the relation between SKIF variables growth and GDP or BERD growth, by other way, how SKIF variables contribute to macroeconomic growth. To this analysis were considered 24 EU member states from 2008 to 2012, using an EU firms Database provided by EU and also used on Gagliardi et al. (2013) and Eurostat (the database doesn't contain values for Denmark, Greece and Germany) and it was made a cluster analysis to investigate where each country locates individually and if there are relevant differences between the cluster's groups. In section 3.2, the second database is presented followed by methodology and results.

3.1. OVERVIEW OF SKIFS EMPLOYMENT RELATED TO SMES AND GDP

3.1.1. DATA DESCRIPTION

The data on the present section consider the SKIFs divided in KIS and in HMHTM and related to SMEs. With the database containing EU 27 member states, from 2009 to 2011, was calculated an average of the growth over the three 3 years (2009-2011) of the percentage share of KIS SME employment in total SME employment and the same for HMHTM employment and then the averages were compared with the average growth of total SME employment and SME value added, the goal of this analysis is to get an idea of the weight KIS and HMHTM firms have on SMEs, the base data was provided by ECORYS and is the same as the one used in Wymenga et al. (2012).

From the Table A1, in Annex A1, it can be seen that every country that had above average growth in employment in both small and medium KIS and HTHTM also had an above average growth in SME value added and employment during 2009-2011, except Slovenia that had a negative growth in employment but an above average growth in value added by SMEs.

To have a broader point of view the countries were split into two groups and considering their share of KIS/HMHTM employment on total SME employment it is calculated the average growth in value added by SMEs and the average growth in employment by SMEs for member states with above average KIS/HMHTM employment values and for member states with below KIS/HMHTM employment average values firms.

For this section gVA – means percentage growth in value added by SMEs; gEMP – percentage growth in total SME employment; GDP average – average of real gross domestic product per capita in euro per habitant; KISemp – percentage share of KIS SME employment in total SME employment HMHTMemp – percentage share of HMHTM SME employment in total SME employment SKIFemp above/below: group of member states that have both KISemp and HMHTMemp above/below average.

3.1.2. DISCUSSION OF RESULTS

According to Table 3.2.3, most of the analysed studies only compare knowledge intensive firms variables with SME variables, so following the most conventional studies it was reached similar results as Wymenga et al. (2012), where member states

with higher shares had higher growth on SMEs values, in this analysis the conclusions for growth of employment and KIS shares per SME were different. Additionally for this analysis, since the aim of the study is to compare SKIFs with macroeconomic variables, Tables 3.1.4 and 3.1.5 serve to see the SKIFs influence on GDP.

The Tables 3.1.1 to 3.1.5 are based on the database provided by ECORYS with the aim is to analysis the effects of SKIFs on SMEs. The results in the tables are showed in percentages. If the KIS, HMHTM and SKIF influence positively SMEs then it can be inferred that on average a country with higher SKIFs values will also have higher SME values, and by connecting SKIFS to SMEs it can be expected that SKIF effects on national economies will have the same signal as SME effects on national economies which will be tested on section 3.2.

Table 3.1.1. KIS share and gVA and gEMP of SMEs

	gVA %	gEMP %
KISemp above	2.3	0.05
KISemp below	1.39	0.33
EU 27 Average	1.83	0.20

Source: own elaboration, based on Table A1.1 in Annex A1.

On Table 3.1.1 EU member states with an above average share of KIS employment tend to have higher gVA by SMEs, surprisingly tough they tend to have less employment growth of SMEs.

Table 3.1.2. HMHTM share and gVA and gEMP of SMEs

	gVA %	gEMP %
HMHTMemp above	3.07	0.96
HMHTMemp below	0.96	-0.22
EU 27 Average	1.83	0.20

Source: own elaboration, based on Table A1.1 in Annex A1.

Based on Table 3.1.2 EU member states with an above average share of HMHTM employment tend to have higher value added growth by SMEs, and also they tend to have more employment growth of SMEs.

Table 3.1.3. SKIF share and gVA and gEMP of SMEs

	gVA %	gEMP %
SKIFemp above	2.98	0.42
SKIFemp below	1.50	0.13
EU 27 Average	1.83	0.20

Source: own elaboration, based on Table A1.1 in Annex A1.

In the Table 3.1.3 the EU member states with an above average share of SKIF employment tend to have above average value added growth by SMEs, and also they tend to have above average SMEs employment growth.

Table 3.1.4. SKIF share and GDP

	GDP average
SKIF above	25840
SKIF below	14777
EU 27 average	21470.37

Source: own elaboration, based on Table A1.1 in Annex A1.

Through Table 3.1.4 EU member states with an above average number of SKIFs tend to have above average real GDP per capita.

Table 3.1.5. HMTM share GDP

	GDP average
HMHTM above	24750
HMHTM below	24750
EU 27 average	21470.37

Source: own elaboration, based on Annex A1 table A1.2.

Since the percentage of each member state KIS SME was much higher than the percentage of HMHTM SME, it was also checked if the GDP was higher for members with an above average HMHTM checking Table 3.1.5 it can be seen that the conclusion is similar.

3.2. GROWTH OF SKIFS FACTORS AND THEIR INFLUENCE ON GDP AND BERD GROWTH

3.2.1. DATA DESCRIPTION

The data retrieved for section 3.2 is data about SMEs in Europe from the database available on the European commission website and the one used in the European Commission annual report on SMEs in 2013. The initial aim of the present study was to develop an analysis based on the EU27 countries, but since there was missing data on Denmark, Greece and Germany the study will focus on the analysis of EU 24 countries from 2008 to 2012; the earliest year is 2008 due to NACE rev 2 being implemented since 2008, to transform the database into SKIFs data the points in NACE rev 2 (see annex A2) were used, but due to data unavailability, the points K- financial and insurance activities; O- public administration and defence, compulsory social security; P- education; Q- human health and social work activities; and R- arts, entertainment and recreation, are not included.

To understand the variables there are basic definitions that need to be mentioned:

– g stands for growth rate it is calculated with the formula: $\frac{t-t_{-1}}{t_{-1}} x100$ where t is the year;
– SKIF Small (or Medium) Knowledge Intensive Firm Repeating the definitions given on chapter 2 a SKIF is a firm with less than 250 employees and which knowledge is their main asset or source of competitiveness;

- ENT- number of enterprises. The number of enterprises in a given year;
- EMP- employment. In the Eurostat database total employment is the number of persons of 15 years and above who performed any work at all, in the reference period, for pay or profit (or pay in kind), or were temporarily absent from a job for such reasons as illness, maternity or parental leave, holiday, training or industrial dispute. Unpaid family workers who work for at least one hour, as well as work related to auto-consumption connected with the production process should be included in the count of employment, although many countries use a higher hour limit in their definition. Professional members of the armed forces should be included among persons employed;
- VA -Gross Value added. Gross value added (VA) is equal to final output minus intermediate consumption, plus subsidies minus taxes linked to production measured in millions of euros;
- PROD -Productivity. Productivity is commonly defined as a ratio between the output volume and the volume of inputs. In other words, it measures how efficiently production inputs, such as labour and capital, are being used in an economy to produce a given level of output. For this study it was considered important to see the productivity of SKIFs in Euros per worker so the formula to make this variable was: $\frac{VA*1000000}{EMP}$;
- BERD – Business Expenditure on Research and Development. This variable is derived from Gross domestic expenditure on R&D (GERD) includes expenditure on research and development by business enterprises, higher education institutions, as well as government and private non-profit organizations. To reach a conclusion about SKIFs influence to national economies.
- GDP – Real gross domestic product per capita. Levels of GDP per capita are obtained by dividing GDP at current market prices by the population; growth in the production of goods and services is a basic determinant of how the economy fares. By allocating total production to each head of population, shows the extent to which the total production of a county can be shared by its population. The growth in real GDP per capita indicates the pace of income growth per head of the population. As a single composite indicator it is a powerful summary indicator of economic development. Note that it does not directly measure sustainable development but it is a very important measure for the economic and developmental aspects of sustainable development.

The variables used in the study are aggregations of the previous concepts; for example gSKIFENT is the growth in the number of SKIF enterprises.

The Table 3.2.1 shows a list of relevant papers to support our applied study. However, none of them covers the entire scope of this study, for example Schricke (2012) study only the influence of knowledge intensive services by regions and Gagliardi et al. (2013) studies the influence of SMEs in general for national economies briefly referring to SKIFs positive effects.

Table 3.2.2 presents the descriptive statistics of the variables, and one can observe that only gSKIFPROD and gGDP have a negative mean value on the period analysed, this is probably due to the 2008-2009 financial crises, has it can be seen by the median that is positive on these two variables.

On table 3.2.3 one can see that the correlation between variables is low with the exception of gSKIFPROD and gSKIFVA, gSKIFVA was not used in the models due to low statistical significance and high correlation with gSKIFENT.

Table 3.2.1. Reference Studies

Author	Object	Methods	variables
Gagliardi et al. (2013)	Provide an overview of the current status of European SMEs, their structure and contribution to employment and to wealth of the EU. Analyses how and to what extent SMEs are recovering from the economic crisis and what the outlook is for the SME sector in the future.	Regression, Cluster analysis	Number Value added Employment
Innovation Union (2011)	Overviews of economic structure and KIF in Europe becoming more knowledge intensive	Graphic analysis	Employment R&D, BERD
Kuusisto And Meyer (2003)	Explore the role of services in relation to technology development and innovation	Cluster analysis	BERD Employment Labour productivity Services imports and exports
Marzocchi and Gagliardi (2013)	Present country-level indicators, showing the variation between 2008 and 2012 in the number of SMEs, employment by SMEs and SME value-added.	grouping service sectors activities	Number Value added employment
Saarenketo et al. (2003)	Identify how the development of knowledge and capabilities may contribute to the fast and extensiveness of internationalisation.	Development of a model	Model variables
Schricke et al. (2012)	Overview and analysis of service activities in Europe	Cluster analysis	KIS employment share GDP per capita BERD Share of pop with edu3 (age 25-64) Growth of GDP
Wymenga et al. (2012)	Overview of the current status of European SMEs. Insights into the key drivers of growth and competitiveness, such as the role of high-tech manufacturing and knowledge-intensive service	Regression, Cluster analysis	Number Value added Employment

Source: own elaboration.

In Figure 3.2.1, the EU 24 countries growth increased from 2008-2009 to 2009-2010 on all variables; Gent was the variable to achieve the highest growth of 25% this high value was in part due to Slovakia huge growth in SKIF numbers on this period which was over 400 % as mentioned above; in 2010-2011 only GDP had an increase in the growth rate, still BERD was the variable that grew more,

over 10%, also on this period SKIFs had a decrease in productivity and number; in 2011-2012 the SKIFs number and productivity went back to positive growth their GVA saw a higher growth then on the previous period and while BERD had a lower growth rate this rate was still the highest, GDP and employment on SKIFs had a slightly negative growth.

Table 3.2.2. Descriptive statistics of variables

	gSKIFENT	gSKIFVA	gSKIFEMP	gSKIFPROD	gBR&D	gGDP
Mean	6.0	0.4	0.8	-0.4	6.8	-0.6
Median	0.8	-0.1	-0.2	0.1	3.9	0.4
Standard deviation	42.9	13.5	7.9	11.1	19.2	4.4
Min	-21.27	-26.1	-14.1081	-21.0	-18.711	-15.7
Max	412.7	80.2	54.7	69.6	108.2	9.6

Source: own elaboration.

Table 3.2.3. Correlation between variables

Correlation	gSKIFVA	gSKIFENT	gSKIFPROD	gSKIFEMP	gGDP	gBERD
gSKIFVA	1					
gSKIFENT	0.3724	1				
gSKIFPROD	0.8306	-0.0310	1			
gSKIFEMP	0.5350	0.7310	-0.0238	1		
gGDP	0.5420	0.0836	0.4585	0.2998	1	
gBERD	0.1732	0.3587	0.2205	0.3437	0.3591	1

Source: own elaboration.

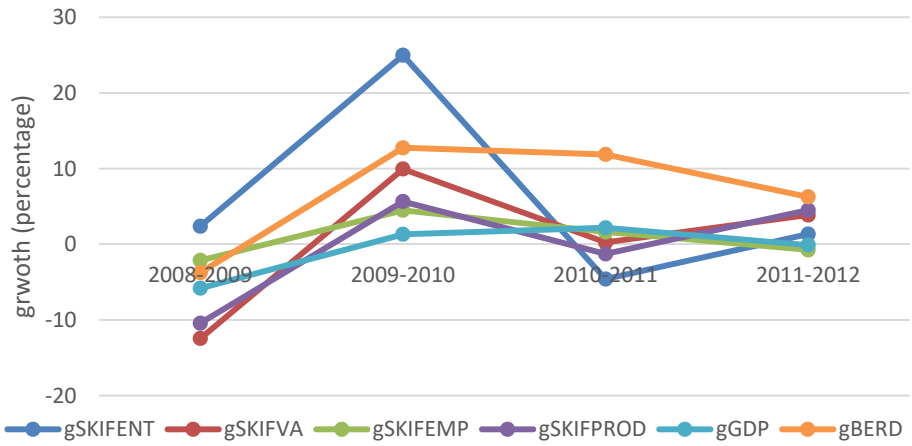

Figure 3.2.1. European Union 24 average growth
Source: own elaboration.

3.2.2. SPATIAL PATTERNS OF SKIFS – CLUSTER ANALYSIS

The cluster analysis is an analytical technique that aims to classify a sample of entities, individuals or objects, in a smaller number of mutually exclusive groups

based on similarities between entities (Hair et al., 1995). Grouped objects in the same cluster are quite similar to each other, so that the resulting groups are characterized by a large internal homogeneity and high external heterogeneity. Allowing them to classify and simplify the sample data and identify relationships between different entities (Hair et al., 1995).

There isn't a procedure that is unanimous to all researchers to determine the exact number of clusters. Therefore, the choice made should be based on the nature and the objectives pursued by the study, focusing on theoretical concepts and practical considerations (Hair et al, 1995). Thus, as there is no hierarchical aggregation procedure that is considered the best, it is recommended to use several methods simultaneously, and if they yield similar results, then it is possible to conclude the existence of "natural" clusters (Maroco, 2003). Meaning, factors obtained were exposed to different procedures to obtain clusters and the obtained results were similar.

The interpretation of clusters may be made using the discriminatory analysis, and analysis of the variance multivariable and univariable or Kruskal-Wallis. The differences between clusters of the different variables under study were analysed using the Kruskal-Wallis method and the Chi-square tests.

The variables were subjected to a hierarchical cluster analysis, which was used as a measure of similarity between intervals/cases the square of the Euclidian distance, and as agglomeration the Ward's method, with the aim of maximizing homogeneity in each cluster by minimizing the variance within each group and to avoid the problem of "chaining" of observations that might occur in other clustering methods (for example the shortest distance (Single linkage) method selected by default in software SPSS) (Hair et al, 1995). In the method of Ward the distance between two clusters is the sum of the squares between two clusters added all variables. At each step in the agglomeration process, the internal sum of squares of each cluster is minimized in all partitions, obtained by combining two clusters from a previous stage. This procedure tends to combine clusters with a small number of observations (Hair et al., 1995). The Ward method retains the clusters, from the all possible, to minimize the sum of squared errors (Maroco, 2003).

The software SPSS was used to obtain clusters analysis applied to the present study. The SPSS provides the values of closeness among the items that form the clusters, given by the coefficient of agglomeration. A sharp increase in the value of this coefficient generally indicates the number of clusters that should be retained (Hair et al., 1995). For confirmation, the number of clusters suggested by this indicator was then faced with a visual choice made to the Dendogram, which allows to perform a visual inspection of the outliers (Hair et al., 1995), also provided by SPSS.

By observing the Dendogram in Figure A2, in Annex A2, and the relative variation of the coefficients of agglomeration, it was chosen five clusters. This clustering procedure aims to detect possible patterns and types of European Countries according to their knowledge-intensive sectors. The analysis includes characteristic of European countries, such has the GDP and BERD per capita – as well as industrial characteristics – such as SKIF variables and their shares per SME. Variables refer to the year 2012, for more detail see Table 3.2.1.

Table 3.2.1. Cluster variables

Variable	Unit
Number of SKIF enterprises	Number of enterprises
SKIF Gross Value added	Millions of Euros
Number of persons employed in SKIFs	Number of enterprises
Productivity of SKIFs	Euros per worker
GDP	Euros per inhabitant
BERD	Euros per inhabitant
Share of SKIF enterprises per SME	Percentage
share of GVA of SKIFs per SME	Percentage
Share of Number of persons employed on SKIFs per SME	Percentage

Source: own elaboration.

3.2.3. CLUSTER ANALYSIS RESULTS

From the five clusters obtained (Table 3.2.2), the cluster 1 is composed by six west and north European countries: Austria, Belgium. Finland, Luxembourg and Netherlands. Cluster 2 is the biggest cluster of the sample with ten Eastern European countries: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Cluster 3 and 5 are the smallest clusters of the sample, they are composed only by two countries: Cyprus and Ireland (cluster 3) and Malta and Portugal (cluster 5). Cluster 4 is composed by four countries: France, Italy, Spain and United Kingdom of Great Britain and Northern Ireland. This cluster is the cluster with the highest share of SKIF VA per SME.

Table 3.2.2. Cluster Analysis

Clusters	Country	SKIFENT	SKIF VA	SKIF EMP	SKIF PROD	GDPpc	BERDpc	Share ent	Share VA	Share emp
1	Austria									
1	Belgium									
1	Finland									
1	Luxembourg									
1	Netherlands									
1	Sweden	119179	24045	417969	64488	36267	695	29	26	24
2	Bulgaria									
2	Czech Republic									
2	Estonia									
2	Hungary									
2	Latvia									
2	Lithuania									
2	Poland									
2	Romania									
2	Slovakia									
2	Slovenia	90083	5133	286316	18792	11770	128	18	23	18
3	Cyprus									
3	Ireland	20324	7049	20792	61204	20050	225	19	25	18
4	France									
4	Italy									
4	Spain									
4	United Kingdom	567554	114939	2080299	53835	25200	281	23	27	22
5	Malta									
5	Portugal	69760	4849	181603	27357	13900	96	19	22	17

Source: own elaboration.

It can be verified that cluster 1 has the highest share of SKIF enterprises per SME and SKIF employment per SME and it is also the cluster that presents highest GDPpc and BERDpc followed by cluster 4 which presents also high shares (above 20%) and second highest GDPpc and BERDpc, the clusters 5 and 2 are the clusters with lowest shares followed by the lowest BERD and GDP respectively, even though cluster 3 is the cluster where there are less SKIF enterprises it is the cluster where SKIFs have high productivity making it the second cluster with most productivity on the sample.

4. CONCLUSIONS

The European Strategy 2020 reinforces the relevance of SMEs as a key driver for economic growth, innovation, employment and social integration. The relevance assumed by the EC about SMEs and the strategy of a competitive European economy based on smart, sustainable and inclusive growth leads to the importance of small and medium knowledge intensive firms (SKIFs) in the European context. Most of the studies about SKIFs are generally about either internationalization properties of SKIFs, or about how SKIFs influence SMEs, however are scarce the studies that researches the influence of knowledge intensive business services on European regions, or relate SKIFs directly with macroeconomic variables. Based on this, the present study intents to contribute to increase the scientific knowledge about this field considered so relevant to the progress of EU member state economies.

Some main conclusions can be draw from the findings of the study. Through the analysis conducted on section 3.1. it can be concluded that countries with above average share of employment and/or value added off SKIF have SMEs with higher employment and/or value added growth and also higher GDP; with the exception of countries that only have knowledge intensive services employment share higher than average, these had a growth in SME employment lower. Although to confirm this, a deeper study should be made; it might mean that if we focus too much on increasing employment for KIS firms in the future we can aggravate the employment situation of Europe. SKIF are highly beneficial to national European economies, the average GDP per capita of the countries that have above average share in SKIFs per SME is 25840€ which is approximately 15% higher than the EU 27 average and 43% higher than the average of the countries with bellow average share of SKIF employment.

The cluster analysis can confirm, in part, that SKIF Productivity and Employment growth has positive effects on both GDP and expenditure on BERD growth. The clusters with highest average of shares are also the clusters with higher GDPpc and BERDpc, in fact if we order them by average of the shares of SKIF values and by BERD we get the same order, and in terms of GDPpc only one cluster changes.

Every analysis points that SKIF employment growth and productivity growth are very important for the member states GDP and BERD growth, since SKIFs are highly dependent on human capital SKIFs benefit with indirect investments for example on education, EU strategy 2020 already attends to this with the goals regarding for example some of the seven flagships: youth on move and innovation union. The public policies under the EU strategy

2020 confirm the relation with our findings, however the investment and support for Services, even Knowledge Intensive Services should be thought more carefully or at least thought of supporting these KIS in a ratio with HMHTM support and development.

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Annex A1

Table A1. Share of KIS and HMHTM compared to GDP

	% share of KIS SME in total SME	% share of HMHTM SME in total SME	% share of SKIF in total SME	GDP per capita
Austria	25.26	1.22	26.48	32 100
Belgium	23.03	0.95	23.98	29 800
Bulgaria	13.99	0.98	14.97	3 700
Cyprus	11.49	0.50	11.99	18 100
Czech Republic	20.33	3.44	23.77	11 600
Denmark	23.26	1.50	24.76	37 500
Estonia	22.10	1.32	23.41	9 100
Finland	19.71	1.93	21.64	31 300
France	16.03	0.88	16.91	27 800
Germany	21.33	2.01	23.34	30 000
Greece	19.62	0.80	20.42	16 200
Hungary	29.27	1.25	30.52	8 900
Ireland	23.43	0.51	23.94	36 500
Italy	20.55	1.30	21.85	23 500
Latvia	20.50	0.98	21.48	6 400
Lithuania	15.05	0.70	15.75	7 700
Luxembourg	31.02	0.30	31.32	64 200
Malta	18.05	5.94	23.99	13 500
Netherlands	30.93	1.60	32.53	33 200
Poland	17.31	1.09	18.40	8 300
Portugal	20.08	0.67	20.75	14 700
Romania	16.59	1.16	17.75	4 600
Slovakia	17.68	2.77	20.46	9 200
Slovenia	25.71	1.90	27.61	15 400
Spain	17.97	0.85	18.82	20 600
Sweden	25.74	1.92	27.66	35 200
United Kingdom	29.10	1.92	31.02	30 600
EU27 average	21.30	1.50	22.80	21 470

Source: own elaboration.

Annex A2

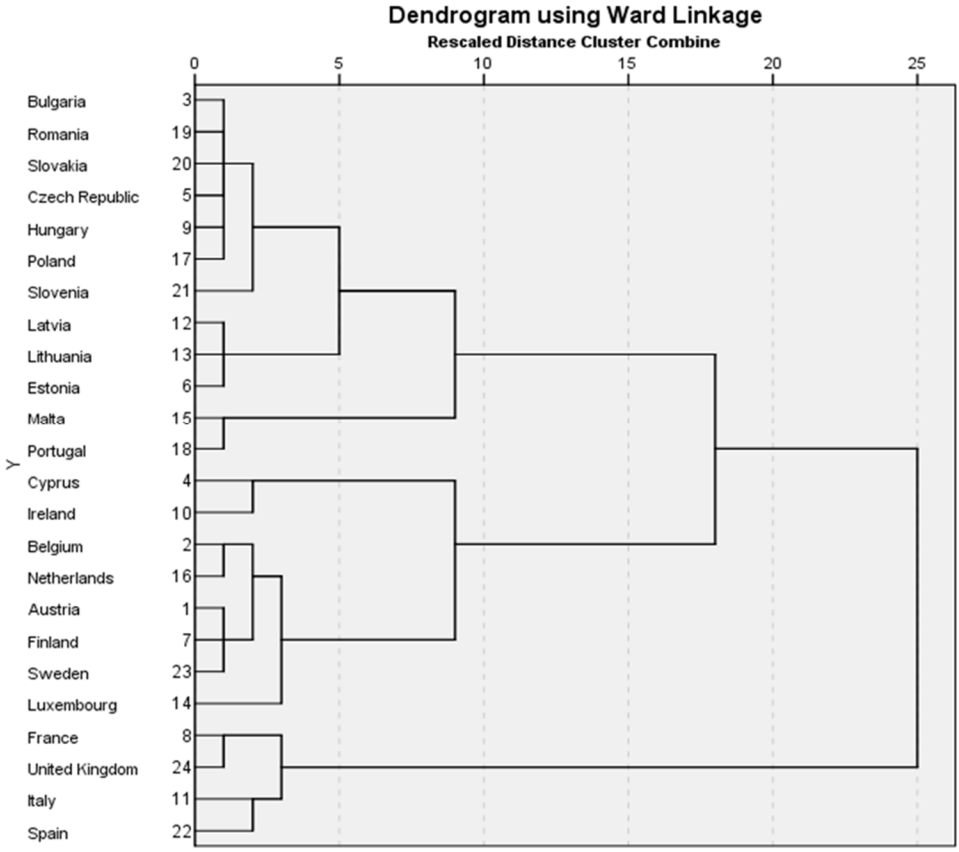

Figure A2. Clusters Analysis – Dendogram
Source: own elaboration.