Erasmus School of Economics

Agglomeration economies and Firm Financial Performance: Evidence from Central and Eastern Europe

Master Thesis

ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

MSc Economics and Business

Industrial Dynamics and Strategy

Abstract: Strategic management studies' main focus is to find the root cause for the difference in firms' performance. Notwithstanding the large body of research that has shown the effects of agglomeration economies on economic growth, findings on how firms' geographical locations affect profitability remain ambiguous. Aggregate analyses on both a region, city or industry levels appear insufficient and the information on micro-level effects is lost. Applying a multi-level approach of hierarchical linear modelling, the firm-, club-, and region-specific effects on two profitability indicators of approximately 168,000 firms for 2015 are estimated. The establishments are active in the manufacturing industry and are located across fifty-five NUTS 2 regions of eleven Central and Eastern European countries. The results reveal that the dominance of the total variance in firm accounting profitability is attributed to firm-level effects, while club- and region-level effects contribute with up to 1.7% and 1.1% to the total variance respectively. Moreover, agglomeration economies, as measured by urbanization and localization economies, were found to be significant firm profitability drivers in the regions under investigation. Although, club and regional effects cannot explain a substantial part of the variance in firm profitability, these effects should not be underestimated since even 2-3% variance can lead to a significant variance in the aggregate profit in a highly concentrated region.

Keywords: Agglomeration economies; Micro–macro link; Multilevel analysis; Profitability; Central and Eastern Europe

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31-01-2019

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1. Introduction

The concept of agglomeration is related to the spatial concentration of people or economic activity. With the increase of the concentration of firms in a particular location, externalities, specific for the industry are being developed, which in turn fosters the formation of "common pools" of factors of production unique for this industry and spread along all companies in this cluster. By sharing these pools of factors, companies can reduce their average costs per person per unit (Carlino, 1978).

How agglomeration economies impact the localized economic growth and whether the firms can benefit from the formed external economies by co-location has been the focal research topic for various empirical studies (Glaeser et al., 1992; Rosenthal and Strange, 2004; Van Oort et al., 2012; Combes & Gobillon, 2015). In the regional science literature, the main focus is the effect that agglomeration has on total factor productivity. It has been argued that spatial proximity fosters knowledge spillovers and other externalities, which in turn increases the performance of the enterprises located in that cluster without having to pay (full) compensation for acquiring those benefits (Van Oort et al., 2012). As found out in Rosenthal and Strange (2004), the elasticity of productivity to city and industry size typically ranges between 3% and 8%.

However, it should be pointed out that, the co-location of companies should not be driven only by the positive relationship between agglomeration economies and productivity as the concentration of firms and labor force could lead to an increase in the two main operating costs of companies: real estate costs and wages (Jennen & Verwijmeren, 2010). Therefore, alongside the positive effects for firms located in geographical agglomerations, the negative performance effects have been also studied and empirically supported (Knoben et al., 2016; Jennen & Verwijmeren, 2010). As found by Jennen & Verwijmeren (2010), who based their researched on a sample of Dutch firms, doubling the employment density will lead to a decline in the average return on assets by more than one percentage point. These contradictory findings underlie the need for a qualification of the agglomeration economies-performance relationship and show that agglomeration economies differ across sectors, space, and time and that they do not affect the performance of all firms equally (Knoben et al., 2016).

The tendency of regional science research to focus on total factor productivity is caused by fact that productivity gains are thought to lead to an increase in the regional growth. Yet, it should not be concluded that the positive agglomeration economies-productivity relationship is connected to the positive agglomeration economies-financial performance relationship as productivity gains are not always followed by high profitability (Stavropoulos & Skuras, 2016).

As research shown agglomeration economies are not homogeneous and their various dimensions have to be studied. Therefore, separate proxies should be identified in order to segregate the various forces of agglomeration economies since firm performance might be influenced differently by the combinations of those forces (Carlino, 1978). In this context, agglomeration economies can be explained by two different forces: one of them is urbanization economies, which is often associated with the tendency people and economic activity to concentrate in cities or regions; the other, localization economies, is related to the fact that firms operating in the same or similar industries tend to locate in a close proximity to each other, which is often referred to as clusters or clubs (Malmberg & Maskell, 2002). Opting for reducing this ambiguity, agglomeration economies will be represented in this paper by two proxies for localization and urbanization economies differentiating between the above-mentioned forces.

The effect of the proximity among companies both in terms of geography and activity, has been examined by a large body of literature for many years. However, most of the studies have focused on the macroeconomic factors determining agglomeration economies and their effect on firm performance mainly due to data limitations and confidentiality restrictions. Only in the recent years the development of firm-level datasets has unblocked the possibility of investigating and quantifying the role of firms in agglomeration economies as the theories (e.g. New Economic Geography) that underlie agglomeration economies are microeconomic in nature (Martin et al., 2008; Duranton & Kerr, 2015; Jacobs et al., 2013).

Overall, these streams of literature generally suggest that due to the concentration of firms and factors of production, spatial proximity is beneficial for the firms located in clusters, which should result in their better financial performance. However, as mentioned above firms are not homogenous on how much and how they are affected by agglomeration effects. There is also a lack of solid empirical evidence when examining accurate performance measures at the firm level within the same industry and the empirical research conducted is not conclusive (Kukalis, 2010).

Based on the above points, the aim of this study is to investigate the net effect of agglomeration, represented by localization and urbanization economies, on two financial performance indicators (Returns on Total Assets and Profit Margin). My analysis will be performed using firm, club (or cluster) and regional level data. Hence, I will be able to segregate and identify how much of the firm performance indicators is explained by each of those levels by the usage of variance decomposition analysis. Moreover, following a rather new strand of research I will employ a hierarchical linear modeling (HLM), which allows for simultaneously incorporating micro- and macro-level specific variables rather than using single level models (Hirsch & Schiefer, 2016; Burger et al., 2008).

As noted in Stavropoulos, Burger & Skuras (2015), the main focus of the variance decomposition literature on accounting profitability has been on industry effects and there has been a lack of sufficient research on location effects. As a result, by including in the scope of this study firm and club (cluster) effects, I am filling this gap in the analysis of the link between firm accounting profitability and agglomeration economies. In addition, in the research conducted previously, the empirics have been mainly based on developed countries, whereas the context of agglomeration economies in other less developed countries might differ. Therefore, I will test empirically whether those effects are in accordance with the theoretical underpinnings when looking at 11 less developed countries in Central and Eastern Europe.

The remainder of this paper is organized as follows: **Section 2** contains the theoretical framework behind agglomeration economies and its effects on firm performance. Next, in **Section 3** elaborates on the econometric approach of this research, focusing on the model and data used. Hereafter, **Sections 4 and 5** comprise the results of the empirical analysis and the robustness checks performed, followed by **Section 6** where discussion of the unexpected findings is introduced. Lastly, conclusions are drawn and limitations and suggestions for future studies are made.

2. Literature Review

2.1. Definition of and forces behind agglomeration economies.

The questions why industry agglomerations emerge and how they are affecting firms' competitiveness has been researched extensively and found to be of an extreme importance for understanding their role in regional economy. Pioneered by Marshall (1890) who first mentioned the concept of "external economies of scale" in effort to explain the growth in productivity due to external forces to the firm. Ever since Marshall's theory was published, increasing number of economic geographers and economists have devoted research efforts into recreating and rediscovering the concept of agglomeration (e.g., Harrison, Kelly, & Grant, 1996; Krugman, 1991; Porter, 1998a; Storper, 1989). Isard (1956) acknowledged that the phenomenon of agglomeration economies can be explained by internal and external economies of scale in the form of localization and urbanization economies. Internal large-scale economies arise when plant's growth is a result from its scale of production at a certain point of time

(Carlino, 1978). Therefore, the production cost efficiencies realized are due to the concentration of employment in a few large firms, while no spatial concept is involved when defining those economies. However, external economies of scale can be qualitatively differentiated in terms of their cause and core.

Benefits stemming from total output of all firms located within the same or closely related industries at a single location, are referred to as localization economies (Carlino, 1978; Malmberg & Maskell, 2002). According to Marshall (1890) the knowledge flows are constrained only to the specific location and to firms operating in similar or inter-linked activities. These can be also referred to as Marshall-Arrow-Romer (MAR) externalities (Lengyel & Szanyi, 2012). He addressed externalities that can become available to the firms located in a spatially concentrated sector such as access to developed labor pools, the availability of local non-traded inputs and knowledge spillovers (Kukalis, 2010; Lengyel & Szanyi, 2012).

On the other hand, advantages gained through the enlargement of the total economic size (e.g. population, income, output, or wealth) for all firms in all industries at a single location, usually cities or industrial core regions, apply to urbanization economies. Jane Jacobs (1969) revealed that knowledge flows in the form of a dense social network and diverse economic activities can be exchanged between different industries which refers to urbanization economies or also called Jacobs externalities. They can be found in more populated and easily approachable areas, where also many universities, research laboratories and different associations and institutions tend to be situated. Thus, on one hand, stimulating disruptive innovations, absorptive capacity of firms and interregional growth, while on the other hand, may also lead to increases in wages, rents, community amenities and pollution, the so called urbanization diseconomies (Burger et al., 2008).

Concerning the mechanisms behind agglomeration economies, they have been extensively researched and various classifications have been proposed. Starting from Marshall (1890) who separates agglomeration effects to labour pooling, intermediate input linkages and knowledge spillovers, to one of the more recent studies by Duranton and Puga (2004) who defines agglomeration economies as sharing, matching, and learning effects. In order to fully understand the concept behind these classifications of agglomeration effects, the way they affect firms will be described.

As for the former, labour market externalities of a very skilled pool of labour force with a specific to the industry knowledge which moves among firms results in reduced searching costs and flexibility when hiring new employees, but can also result in higher wages (Burger et al., 2008; Lorenzen & Frederiksen, 2008). Furthermore, better access to specialized suppliers and distributors is provided in a spatially concentrated sector which in turn reduces the reaction time and the transaction costs compared if they were in isolation and increases efficiency (Ketels, 2003). Finally, owing to the close interaction and communication between customers and firms and among firms within an industry or a region, the creation of new ideas and improvements as well as innovative thinking are being stimulated. When the knowledge is spread among the plants within the industry agglomeration, higher profits and lower costs for experimenting can be witnessed (Ketels, 2003).

When it comes to the latter, and the effects mentioned by Duranton and Puga (2004), sharing effects refer to the benefits stemming from the greater diversity of inputs, the common use of indivisible goods and facilities and risk sharing (Combes & Gobillon, 2015). Matching effects are connected to the continuous enhancement of the quality or quantity of the matches between firms and employees, while learning effects can be associated with generation, spreading and accumulation of knowledge (Combes & Gobillon, 2015).

As stated above, localization externalities represent the benefits of a region specializing in one industry and its related activities. Those externalities can be divided into static and dynamic. The static externalities represent the benefits from the coordination between firms, and due to the closely related products and knowledge base, this leads to advantages for firms, such as networks, value chains, collaborations (Marshall, 1890; Lorenzen & Frederiksen, 2008). While dynamic externalities refer to the knowledge spillovers, which are related to the learning effects and imitation that are a common practice among firms. Competition in such setting is beneficial due to the raise in the productivity levels, as described in Porter (2000) and Lorenzen & Frederiksen (2008).

2.2. Agglomeration economies: micro- or macro-level phenomenon?

Each one of the above-mentioned mechanisms of agglomeration economies can explain why in general regions where agglomeration of economic activities can be observed tend to have higher economic growth than regions where those mechanisms are absent (Burger et al., 2008). Since Marshal's theory, most of the empirical studies examining the connection between agglomeration economies and regional growth has focused on macro-level data, while the theory behind agglomeration consists of both micro- and macro-level factors (Burger et al., 2008; Rosenthal & Strange, 2004).

The development of firm-level datasets has opened up the possibility of analyzing the role of firms in clusters and quantifying the performance boost which they provide. Until recently research on establishment-level data has not been conducted systematically and thoroughly, even in strategic management literature where the main goal is to find the reason behind firm performance differences. First, using predominantly aggregated data on region, city or industry levels provides limited insights on the effect of agglomeration economies on firm performance and the found effects are not necessarily replicated on firm level as the information on the between-firm variance is lost (Van Oort et al., 2012). Second, not all opportunities and constraints of companies can be associated with macro-level effects such as firm size, age, entrepreneurship, risk aversion and etc.

Applying multilevel modelling enables researchers to identify to what extent the macro/micro-level link is existent and to assess how much of firm performance can be attributed to between-firm variance, between-club variance, or between-region variance (Stavropoulos, Burger & Skuras, 2015). In support of the arguments stated, Van Oort et al. (2012), who studied the effects of agglomeration economies on firm survival and employment growth at the city level in the Netherlands, partitioned the variance of survival and employment growth in regional, sectoral, and cross-classified regional-sectoral levels and found that while firm performance (survival and growth) is mainly affected by internal characteristics (more than 90% of the total variance), location effects account for about 4 - 5% of the variance in new firm performance.

2.3. The link between agglomeration economies and firm performance.

Agglomeration economies are based on three key pillars, namely, geography, value creation and the business environment surrounding them (Ketels & Memedovic, 2008). Geography is the spatial concentration of firms within a region or a city, which is one of the main driving forces of clusters. The next pillar, value creation, is based on the fact that companies located in the proximity of each other share analogous goods and services which are valued by the customers. When it comes to the business environment, individual firms, on one hand, are affected by the government agencies, universities and other institutions within the national and regional boundaries, but on the other hand, are also contributing to strong business environments (Lundvall, 1992; Cooke et al., 2000; Cooke, 2001; Ketels & Memedovic, 2008).

Based upon the aforementioned pillars, a number of valuable benefits can be identified for the firms located in clusters. Amongst them, as already discussed, are better access to specialized inputs and suppliers on a short notice, shared costs for infrastructure and interfirm skilled labor force mobility and social interactions (Ketels & Memedovic, 2008; Kukalis, 2010). Thus, leading to cluster members having an access to tacit knowledge and information exchanged locally, stimulating them to innovate and experiment more at lower costs in the cluster surroundings. Drawing on those factors, companies in clusters should operate with higher efficiency and with improved organizational performance.

A growing body of literature has examined the effect of agglomeration economies on economic and firm performance. As evident from these studies externalities emerging from the spatial concentration of activity within specific industries and/or regions are crucial for the increase in the different performance dimensions of firms located within them (Rosenthal & Strange, 2001; Duranton & Kerr, 2015). However, one must not confuse the three different dimensions of firm performance: productivity, growth and profitability. The former two are mainly discussed by the economics and economic geography literature, while the latter is covered in the international business and management literature (Stavropoulos & Skuras, 2016).

Although it is presumed that productive efficiency via profitability "naturally" leads to growth, there is a lack of empirical evidence supporting the theoretical presumptions behind it. Bottazzi et al. (2008) has made one of the few attempts to empirically test the correlation between the three indicators. While he found no statistically significant productivity-growth and profitability-growth relationship, there was an evidence of a positive productivity-profitability correlation independent of financial conditions and sectors of activity. Based on theory, an explanation might be that through growth the needed resources such as knowledge and increasing returns are obtained to further boost efficiency and investments in innovations, which in turn results in higher profits (Coad, 2007). This can be as a result of other firm-specific characteristics and non-linearities defining this relation, however, there is a lack of empirical analysis of this link.

Both profitability and productivity performances are crucial dimensions of firms' structure and dynamics. While growth in terms of market shares unveils an important part of performance indicators, a prerequisite to sustained growth is the ability of firms to earn profits since a sound accounting profitability acts as a source for internal financing and simultaneously determines firms' attractiveness to external financing (Bottazzi et al., 2006). It has been postulated in previous research that when factors of production are concentrated and developed within a cluster, the additional benefits of spatial proximity become self-reinforcing through a dynamic process of increasing returns (Kukalis, 2010).

Combes et al. (2012), using French establishment-level data and a new quantile approach, finds evidence that firms in denser areas are, on average, about 9.7 percent more productive than those in less dense areas. Establishments in denser areas were found to be more productive due to agglomeration economies which stimulate interactions, thus in turn lead to an increase in productivity levels.

By performing an empirical research of the effect of spatial proximity of activities on plant-level total factor productivity of French firms, Martin et al. (2011) finds that plants benefit from localization economies, while little – if any – evidence is found for urbanization economies.

By contrast, evidence in the same stream of literature also shows that cluster benefits come with costs owing to congestion effects, which results in increased wages and salaries, capital and land rents and costs of labor poaching (i.e., loss of some key workers due to competition between plants that would have a negative impact on the productivity) (Combes & Duranton, 2006; Martin et al., 2011). Additionally, negative externalities can be caused in case of competition for scarce input resources or if there are certain kinds of knowledge spillover (in that superior firms do not benefit when their knowledge spills to weaker firms) (Kukalis, 2010; Martin et al., 2011).

Conducting a research on thirty-one years of performance firm-level data from the semiconductor and pharmaceutical industries, Kukalis (2010) finds no significant differences between clustered and non-clustered firms in the early stages of the industry life cycle, while in the late stages isolated (non-clustered) laggards outperformed clustered laggards.

Hence, a logical question that arises is whether an individual firm which is located in the geographical propinquity of other firms, tends to benefit (financially) from doing so. The net effect of these agglomeration benefits should be visible from the accounting profitability of the firm. In support of this argument, in Zouaghi et al. (2017) the authors estimate the firm-, industry-, and region-specific effects on profitability of 3,273 agri-food firms operating in different Spanish districts. By applying a multi-level approach of hierarchical linear modeling, they find that firm-specific effects which contribute up to 48.8% to the variance in firm profitability are predominant, while the contribution of industry effects (0.8-4.2%), geographical location (0.1-1.8%), and year effects (0.1-2.5%) is rather small. Moreover, firm size, risk, proximity to technological institutes as well as the degree of urbanization of the region in which an establishment is located turn out to be significant profit drivers at the firm level. Similarly, by conducting a various decomposition analysis of a cross-sectional sample of firms in 191 NUTS 2 regions of 15 European Union member states, Stavropoulos & Skuras (2016) find that the between-region variance explains from 1.5 up to 3 per cent for two profitability indicators, thus even though regional characteristics contribute with a small part to the total variance in firm profitability, when accumulated location still plays a role and can elevate the financial performance of firms.

As previously mentioned, one of the pillars of agglomeration economies is the surrounding business environment. Clusters are part of and interdependent on the general business environment and the better this environment is, the higher the possibility is clusters to emerge and develop fully on this specific location. Furthermore, the stronger the cluster, the higher the level of productivity and innovation that companies located in it can reach (Ketels & Memedovic, 2008). Therefore, it can be concluded that the nature and depth of clusters depends on the state of development of the economy. The regional development goes through input-driven, investment-driven, and innovation-driven phases, as described in Porter (2003), and while developed regions are more innovation based, less developed ones rely more on cost efficiency mechanisms. Consequently, the business environment and phases of development might alter from those in the Western European developed countries.

The point of departure of this paper is to contribute to the better understanding of whether the agglomeration concepts based on observations from advanced economies which have evolved until now are valid in countries at a different stage of economic development. The countries of interest and in the scope of this study are situated in Central and Eastern Europe. Next to that, the ability of agglomeration economies to stimulate firms' healthy financial performance, as postulated in the theoretical underpinnings, will be analyzed and tested. Hence the following hypotheses are proposed:

Hypothesis 1: *Localization economies have a positive effect on firm profitability.*

Hypothesis 2: *Urbanization economies have a positive effect on firm profitability.*

3. Data & Methodology

3.1. Data sources and sample

In order to test the stated above mentioned hypotheses and examine the effect of agglomeration economies on firm profitability indicators, the data needed for the empirical analysis in this paper was collected from several sources. On a firm level the information used for composing the variables included was retrieved from Orbis[1]. Orbis is a commercial

[1] Orbis Database. (n.d.). Retrieved September 26, 2018, from https://orbis4.bvdinfo.com/version-20181028/orbis/Companies

database provided by Bureau van Dijk and it contains annual financial and economic data including balance sheet and income statement items on public and private firms located in almost all of the EU countries. Only active companies which are publicly quoted have been included in the dataset. On a regional level the data is collected from the Structural Business Statistics (SBS)[2] and REGIO[3] Databases provided by Eurostat available at the Nomenclature of Units for Territorial Statistics (NUTS) level 2. As stated in Stavropoulos & Skuras (2016), no clear consensus on the spatial scale for measuring agglomeration economies has been made in the previous strategic management studies, NUTS 2 was chosen as a regional level data, since a link can be found between the findings on this level and the policies implemented by the regional authorities in the European countries being investigated in this study. Furthermore, the firm level data covers all manufacturing industries according to the NACE Rev. 2 classification and geographically at the NUTS 2 level for the countries of interest, and the information on both levels can be coupled using the NUTS 2 Code.

The main focus of this paper are firms located in Central and Eastern Europe in the manufacturing industry. Countries included are Bulgaria (BG), Czech Republic (CZ), Croatia (HR), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Poland (PL), Romania (RO), Slovenia (SK) and Slovakia (SK). Other countries situated in the chosen region such as Albania, Montenegro, Serbia and Macedonia (FYROM) were excluded from the sample due to the unavailability of data in the SBS dataset.

A one-year three-level hierarchical model rather than a panel sample covering longer time period was chosen since the efforts to conduct a dataset with a 5 years span (2010 - 2015) were resulting in a loss of more than 40% of the sample. When the period was reduced to three years the number of observations dropped by approximately 30%. Therefore, an unbalanced panel data would not substantially alter from a pooled sample as mentioned in Stavropoulos & Skuras (2016). Moreover, when applying multilevel modelling, due to its asymptotic nature, the sample size must be sufficiently large and have a sufficient number of observations per group within a component since if this condition is not met, it can result in an overestimation of the found effects (Stavropoulos, Burger & Skuras, 2015). Therefore, only clubs with more than 10 firms per each club were included, as this is the recommended minimum (Stavropoulos, Burger & Skuras, 2015; Maas & Hox, 2004).

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[2] Eurostat - Structural Business Statistics. (n.d.). Retrieved September 26, 2018, from https://ec.europa.eu/eurostat/web/structural-business-statistics/data/database

[3] Eurostat - REGIO Databse. (n.d.). Retrieved September 26, 2018, from https://ec.europa.eu/eurostat/web/regions/data/database

The analysis is conducted for 2015 as after this year the Eurostat data becomes largely unreliable for some of the regional level variables and the aim was the inclusion of maximum number of observations in order for the power of the estimation effects studies not to be lost. Additionally, sufficient number of observations is needed per each group within a component in order for the variance decomposition estimations to be valid and solid, and the problem of data sparseness to be restricted as much as possible (Stavropoulos, Burger & Skuras, 2015).

Overall the final sample consists of approximately 166,977 firms which are located across 55 NUTS 2 level regions in the above mentioned 11 countries, operating in 23 two-digit NACE 2 manufacturing industries. Initially firms active in all 24 manufacturing industrial sectors have been included, however, due to the limited number of observations from the "Manufacture of tobacco products" sector per club (less than 10), they were dropped from the sample.

3.1.1. Dependent Variables

In order to measure the profitability of firms two account-based indices were used in this study: returns on total assets (**ROTA**) and profit margin (**PRMA**). ROTA is calculated as the ratio between profits or losses before tax to total (fixed and current) assets, and PRMA is defined as the ratio of profits or losses before tax to operating revenue, including sales, stock variation, and other operating revenues but excluding VAT. The data for the calculation of the two indices is taken from ORBIS and only firms with a known value for the main indicators (Profit or losses before tax, total assets and etc.) were included in the dataset. Although there are multiple profitability measures, both ROTA and PRMA are used frequently in the strategic and management research (Stavropoulos & Skuras, 2016; Kukalis, 2010; Goldszmidt et al., 2011). While ROTA indicates how effective the firm's management is in utilizing its assets in order to generate profit, PRMA assesses a different dimension of firm's profitability which is independent of its asset intensity (Kukalis, 2010).

3.1.2. Independent Variables

Multiple approaches exist for the estimation of the various indices representing agglomeration economies but examining all of them is out of the scope of this paper. As mentioned in my theoretical framework, two types of agglomeration economies will be examined: localization economies and urbanization economies.

The data for the calculation of the **localization economies proxy (LQ)** was retrieved from Structural Business Statistics (SBS) provided by Eurostat. Following the approach of

Stavropoulos & Skuras (2016), where the authors are gauging the effect of industry specialization, I am estimating the location quotient for the region where the firm is operating and the manufacturing industry in which it is active:

$$\text{LQmj} = \frac{\text{E}mj}{\sum_m Emj} \Big/ \frac{\sum_j \text{E}mj}{\sum_j \sum_m \text{E}mj}$$

Where *Emj* is the employment as stated in SBS for region *j* and manufacturing industry *m*. *ΣmEmj* is the total employment in all manufacturing industries in region *j, Σj Emj* is the employment in manufacturing industry *m* in all regions, *Σj Σm Emj* is the total employment in all manufacturing industries and all regions (Stavropoulos & Skuras, 2016). The same approach is also adopted in Glaeser et al. (1992) and it counts for the spatially constrained economies of scale for all firms at a specific location and a single industry and therefore external to the firm but internal to the industry (Lengyel & Szanyi, 2012).

Following Nakamura (1985), Henderson (1986) and Bosma & Suddle (2008), population density is used as a measure of **urbanization economies (URBAN_ECON)**, or the ratio between the annual average population and the land area. The land area concept (excluding inland waters) should be used wherever available, if not available then the total area, including inland waters (area of lakes and rivers) is used. The data is retrieved from from Eurostat at the NUTS 2 level and this variable accounts for economies available to all firms at a single location but for all manufacturing industries taken together. Urbanization economies are stemming from an increase in the urban size and density (Burger et al., 2008). As mentioned in Kie (1997), the existence of locations with low population density but with large urban areas is possible. However, in his paper he is performing his analysis on US manufacturing industries on a state level, while in this analysis the main focus is on much smaller regions, therefore the population density is representing much more accurately the proportion of urban areas to the overall region.

Besides indicators for the various agglomeration economies, control variables related to the firm, club and NUTS2 region are introduced.

3.1.3. Firm-Level Control Variables

To assess the impact of firm-specific resources the following explanatory variables were added at the firm level: firm **SIZE** and **AGE** and two proxies to assess the impact of firms' financial risk (**ST_RISK** and **DEBT_LEV**). Firm size was measured by the total sales of the firm in 2015. Due to the expected differences in labour intensity between the manufacturing industries and the large amount of labour-saving innovations that have been introduced in some of them, estimation of size based on employment is likely to be biased (Stavropoulos & Skuras, 2016; Cohen & Klepper, 1996). The expected effect is positive as it is assumed that the bigger the firm higher the associated financial performance is. Age is measured as the difference between the year of the firm's establishment and 2015 and is expected to positively affect firm financial performance. However, the stage in the firm's life cycle and the possibility of path dependence (lock-in), where the firm is unable to adapt to new technologies may lead to older firms being less profitable (Woolthuis et al., 2005).

In regards to the two financial risk proxies, following Hirsch & Hartmann (2014) and Zouaghi et al. (2017), short-term risk (**ST_RISK**) is defined as the ratio of current liabilities to current assets (i.e.the reciprocal of a firm's current ratio (1/Curr)). The second risk proxy is debt leverage (**DEBT_LEV**) calculated as the ratio of long-term debt to total assets and it represents the long-term financial position of a company. According to risk theory higher risk levels should lead to better financial performance, however, as introduced in the "Bowman's risk-return paradox" higher risk increases profit fluctuations and might lead to decrease in the financial performance (Hirsch & Hartmann, 2014; Bowman, 1980).

3.1.4. Industry Sector-by-Region (Club)-Level Control Variables

To estimate the impact of structural characteristics and external economies stemming from each 2-digit NACE manufacturing industry in each NUTS 2 region, the following club level control variables were added using Eurostat's Structural Business Statistics and aggregates from firm level data: Herfindahl-Hirschman index for manufacturing sectors **(HHI)** and average establishment size in a sector in a region (club) depicting competition **(COMPETITON)**.

COMPETITION is measured as the natural logarithm of the number of establishments per worker in a regional sector. As this ratio increases, the local environment in the given club is thought to become more competitive (Glaeser et al., 1992). As noted in Porter (1990), local competition is thought to stimulate innovation by forcing firms to innovate or to face failure. Following this view, with the increase of the competition levels in a given club, higher financial performance of the firms is expected.

HHI is a measure of the market shares of the firms in relation to the manufacturing industry in which the firm is active and the NUTS 2 region in which it is located and it is an indicator of the amount of concentration in that club. The HHI is calculated by summing the squares of the individual market shares of all the firms in the industry sector within the NUTS2 region and ranges from 0 to 10000. Based on guidance from the European Commission[4] an HHI above 2000 signifies a highly concentrated market. The main assumption is that the more vital the efficiency differences among firms are, the higher the inequality between their market shares are and therefore the higher the market concentration is. However, it should be noted that higher market shares do not lead to higher profitability of firms, but rather the product and production efficiency advantages lead to an increase in both (Mueller, 1983; Schmalensee, 1985). With that being said, in smaller markets as the ones being investigated in this study, firms are developing more general competencies rather than niche ones, and therefore their focus is on obtaining economies of scale in R&D in order to enhance their organizational capabilities and production efficiency (Matraves & Rondi, 2007). Therefore, I would expect that with efficiency being one of the major factors on the markets included, the higher the concentrations is (reflected by market share and efficiency advantages) the higher the firm's profitability will be.

3.1.5. Regional Level Control Variables

Finally, several macroeconomic control variables are employed in order to capture the regional specific characteristics which might affect the financial performance of firms. All of them are taken from Eurostat REGIO Database.

Firstly, **HRST** (Human Resources in Science and Technology) is included as the number of people working in science and technology as a percentage of the active population in 2015. Secondly, R&D expenditures (**RD_EXP**) are introduced as the R&D expenditures of firms, research institutes and government agencies in 2015 in thousands euros. These two variables were included and are thought to be of a great importance when investigating agglomeration economies, since they are two of the main contributors to the spatial spillover effects. In addition, investments in R&D and attracting science and technology labor force are conducive to producing innovations and enhancing financial performance (Hall, 1999; Kukalis, 2010).

Finally, at the regional level, **GDP** in thousands of euros was employed, defined as the sum of all goods and services produced at NUTS 2 level over time at current prices in 2015, without double counting products used in other output. Overall, **GDP** is a key control variable

[4] EC Commission. (2004). Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings. *Official Journal of the European Union C, 31*, 5-18.

for localised growth potentials at the regional level in the period in question and is expected to have a positive effect on firm financial performance.

Table 1 presents a summary of the variables on all three levels included in my analysis and the number of observations, the mean, the standard deviation, the minimum and maximum values for each of them accordingly.

Table 1: Descriptive Statistics of Frim, Club and Regional Specific Characteristics.

Variable	Observations	Mean	Std. Dev.	Min	Max
Firm Level Variables					
ROTA	166977	10.20978	24.91081	-100	100
PRMA	166977	6.826669	22.68741	-100	100
LQ	166977	1.208179	.8267527	0	9.64
URBAN_ECON (Ln)	166977	4.696078	.8710106	3.411148	7.865073
AGE	166513	12.01513	10.00088	0	350
AGE^2	166513	244.3802	920.9682	0	122500
SIZE (Ln)	164839	5.158826	2.359073	0	16.85042
ST_RISK	160539	1.281784	4.553212	.01	100
DEBT_LEV	116814	.0689342	.3780126	-.73	57
Club Level Variables					
HHI	166977	564.3632	446. 8806	136.49	3839.09
COMPETITION (Ln)	166977	-2.567499	.4686883	-3.506558	1.07881
Regional Level Variables					
RD_EXP	166977	291159.9	324263.8	14368	1660118
GDP	166977	2.32e+07	1.55e+07	3074000	9.53e+07
HRST	166977	26.54752	7.257524	12.7	45.1

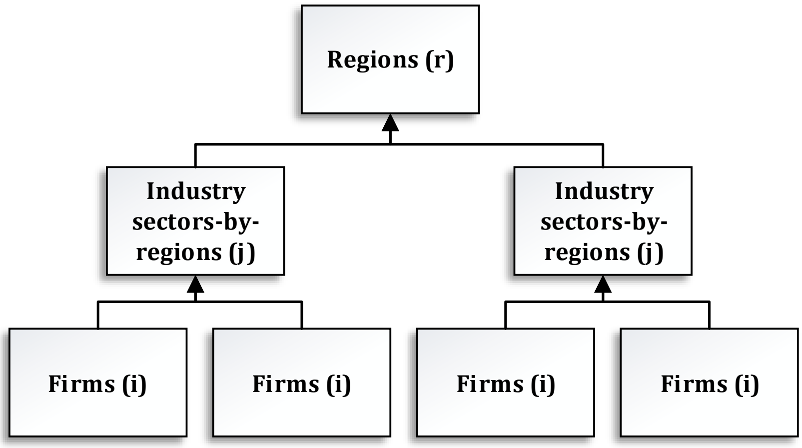
3.2. Methodology

In the majority of previous literature, focusing on the decomposition of the variance of financial performance into multiple levels, several estimation models have been used, including the nested analysis of variance (nested ANOVA) and components of variance (COV) (Goldszmidt et al., 2011; McGahan & Porter, 1997). However, in the most recent studies, the analysis has been performed mainly by using mixed hierarchical and cross-classified models (Misangyi et al., 2006; Zouaghi et al., 2017; Stavropoulos & Skuras, 2016; Burger et al., 2008). All of those models are suited to take into account the nested nature of the data as the firms included in my data are nested in industry sectors-by-regions (clubs) over NUTS 2 regions. However, looking at the nested analysis of variance (nested ANOVA) and components of variance (COV) models, both have some limitations due to their underlying assumptions. ANOVA assumes that there is an independence between effects, which in turn leads to inability to conclusively identify the size of each effect level (Misangyi et al., 2006). In addition, the order in which the effects are introduced in the model is affecting the results found. In regards to COV approach, it is also not taking into accounting that the different effect levels might be correlated between each other and next to that it assumes that they are randomly chosen from the population of levels (Misangyi et al., 2006; Zouaghi et al., 2017).

In order to analyse the effect of agglomeration economies on firm performance a hierarchical linear modelling (HLM), also called multilevel modelling, was used in the current paper following strategic management literature examining firm performance. The HLM approach overcomes the above mentioned issues of ANOVA and COV as it is taking into account the interdependence between the various levels and allows for the examination of the extent to which accounting profitability can be attributed to between-firm variance, between-club variance, or between-region variance (Gaganis, Liu & Pasiouras, 2015; Burger et al., 2008). As a result, since HLM is focused on modelling variances, it is preferred also over OLS, which is modelling only the mean (Burger et al., 2008).

Therefore, in order to demonstrate the attribution of each of the levels to the variation of the dependent variable, a mixed 3-level hierarchical model is used. As mentioned in previous sections, it is assumed that due to the common agglomeration externalities, the financial performance of firms at a specific locational level is similar as opposed to the performance of firms that do not share the same external environment. As a result, as illustrated on Figure 1, in the utilized model I am distinguishing between three different levels: firm level observations are composing the first level of the data, these observations are then nested into the second level, which are the sectors-by-regions or clubs. The second level is further nested into NUTS 2 regions, which are composing the third level.

Figure 1: Three-Level Hierarchical Model.



As stated above, by the employment of a hierarchical linear model, the intra-class correlation coefficients (ICC) for each of its levels can be estimated. In turn, these coefficients allow to understand how much of the variation of ROTA and PRMA can be explained by each level of the model. The ICC is computed in several steps. First, an empty model, which is also called a "null" model, is estimated in order to compute the variance components (Eq. 1).

Following Misangyi et al. (2006) and Stavropoulos & Skuras (2016), at the first level of analysis, the mean ROTA/PRMA for each firm *i* within industry sector-by-region *j* and region *r* is modeled as function of mean ROTA/PRMA across firms plus a random error:

$$Y_{ijr}=\beta_{0jr}+e_{ijr} \tag{1a}$$

where the indices *i* (i = 1, 2, . . . ,N); *j* (j = 1, 2, . . . , 1101), and *r* (r = 1, 2, . . . , 55) denote firms, industry sectors-by-regions (clubs), and regions, respectively and Yijr is the financial performance indicator (ROTA/PRMA) for firm *i* in industry sector-by-region *j* in region *r*; β_{0rj} is the mean ROTA/PRMA across firms of club *j* nested in region *r*; and e_{irj} is the firm-level random error, which is normally distributed with mean zero and variance σ^2_e. Hence, σ^2_e, which is assumed to be uniform only for firms within the same club, reflects the variance between firms within industry sectors-by-regions.

At the second level of analysis, the mean ROTA/PRMA across firms, β_{0rj}, is simultaneously modeled as an outcome varying randomly around some region mean:

$$\beta_{0rj}=\delta_{00j}+u_{0jr} \tag{1b}$$

where δ_{00j} is the mean ROTA/PRMA of industry sector-by-region *j* in region *r*; and this level models its own random between-club residual, u_{0rj}, which is normally distributed, with a mean of zero and variance of τ^2_{u0}. Therefore, the model assumes that this variability is common across industry sectors-by-regions within each of the regions and represents the between-sector-by-region variance τ^2_{u0}.

At the third level of analysis, the intercept of the sector-by-region level model, δ_{00j}, is simultaneously modeled as an outcome varying randomly around a grand mean:

$$\delta_{00j} = \gamma_{000} + r_{00j} \quad (1c)$$

At this level, its own between-region residual, r_{00j}, is modelled and γ_{000} represents the grand mean of the sector-by-region (club) ROTA/PRMA. Here it is assumed that r_{00j} is normally distributed with mean zero and variance τ^2_{r00}; hence, τ^2_{r00} reflects the between-region variance.

Substituting equations 1b and 1c in 1a gives us the "null" model without any predictors:

$$Y_{ijr}=\gamma_{000}+r_{00j}+u_{0jr}+e_{ijr} \quad (1)$$

where Y is the dependent variable and ijr are the three nested levels (firms, sectors-by-regions and regions respectively) as mentioned above. γ_{000} is the constant term and the random effect terms at level 3 (NUTS 2 regions), level 2 (clubs) and level 1 (firms) are represented by r_{00j}, u_{0rj} and e_{irj} accordingly, which are assumed to be uncorrelated (Misangyi et al., 2006; Stavropoulos & Skuras, 2016). Based on the null model defined by equation (1), the total sum of variance attributable the independent variable can be measured by:

$$Var(y_{ijr})=\sigma^2_e+\tau^2_{u0}+ \tau^2_{r00} \quad (2)$$

where τ^2_{r00} measures the variation in regions, τ^2_{u0} measures the variation in industry sectors-by-regions (clubs), and σ^2_e measures the variation of ROTA/PRMA between firms.

The intra-class correlation coefficients (ICC) are then calculated applying the following formulas to each type of effect (Misangyi et al., 2006; Stavropoulos & Skuras, 2016; Zouaghi et al., 2017):

$$ICC_i=\sigma^2_e/(\sigma^2_e+\tau^2_{u0} + \tau^2_{r00}) \quad (3)$$

where ICC_i is the proportion of variance across firms (level 1) and it represents the percentage of variation explained by the firm level differences for firms in sector-by-region *j* and region *r*.

$$ICC_j=\tau^2_{u0}/(\sigma^2_e+\tau^2_{u0}+\tau^2_{r00}) \quad (4)$$

where ICC_j is the intra-class correlation coefficient at the club level (level 2), which denotes the percentage of variation explained by the sector-by-region level differences for firm *i* in region *r*.

$$ICC_r=\tau^2_{r00}/(\sigma^2_e+\tau^2_{u0}+\tau^2_{r00}) \quad (5)$$

where ICC_r is the intra-class correlation coefficient at the NUTS 2 region level (level 3), which represents the percentage of variation explained by the region level differences for firm *i* in sector-by-region *j*.

A HLM is employed then with a random intercept for firms at the lowest level and random intercepts for sectors-by-regions (clubs) and regions. Next, the null model is gradually loaded with independent and control variables at each level as predictors into the unconditional model presented in Equations 1a–1c in order to test the hypotheses. It is vital that the introducing of the explanatory variables is done at their adequate level. Following the approach of Chaddad & Mondelli (2013) the explanatory variables are introduced at their respective level, i.e. firm specific variables at level 1 (across firms), industry sector-by-region specific variables at level 2 (between clubs) and regions specific variables at level 3 (between regions). Therefore, firm level **ROTA/PRMA** for firm *i* in sector-by-region *j* and region *r* (Yijr) is first regressed upon the firm level predictors **Firm Size (SIZE), AGE**, **Short-Term Risk (ST_RISK)** and **Debt Leverage (DEBT_LEV)** indicators:

$$Y_{ijr}=\beta_{0jr}+\beta_{1jr}(X_1)_{ijr}+\beta_{2jr}(X_2)_{ijr}+\beta_{3jr}(X_3)_{ijr}+\beta_{4jr}(X_4)_{ijr}+e_{ijr} \quad (6)$$

where: Y_{ijr} is the dependent variable measured for firm *i* nested within sector-by-region *j*, X_1 denotes the value on the level-1 predictor, β_{0jr} is the intercept for the sector-by-region *j*, β_{1jr}.....β_{njr} are the regression coefficients associated with the *j*th level-2 unit, and e_{ijr}, as mentioned previously, is the firm-level random error. All of them were grand-mean centered and thus the intercept, β_{0jr}, represents the firm financial indicator for sector-by-region *j* in region *r*.

As a next step, β_{0jr} is modeled as the outcome in Equation 6 and regressed on the level 2 (sector-by-region) variables, namely localization economies **(LQ)**, Herfindahl-Hirschman index for manufacturing sectors **(HHI)** and competition, as measured average establishment size in a sector in a region **(COMPETITION)**:

$\beta_{0rj}=\delta_{00j}+\delta_{01j}(Z_1)_{jr}.....+ \delta_{0pj}(Z_p)_{jr} + u_{0jr}$ (6a)

$\beta_{1jr}=\delta_{10j}$ (6a1)

$\beta_{2jr}=\delta_{20j}$ (6a2)

$\beta_{3jr}=\delta_{30j}$ (6a2)

$\beta_{4jr}=\delta_{40j}$ (6a2)

The intercept of Equation 6a, δ_{00j}, thus now denotes the mean ROTA/PRMA, which is grand-mean centered of all sectors-by-regions in region *r* adjusted for these predictors, $\delta_{01jr,......,}\delta_{0pj}$ represent the regression coefficients associated with $Z_1,...,Z_p$ relative to level-2 intercept, $Z_1,...,Z_p$ are the values on the level 2 predictors and u_{0jr} is the random sector-by-region error term.

$\delta_{00j}=\gamma_{000}+\gamma_{001}(W_1)_j+....+\gamma_{00q}(W_q)_j+ r_{00j}$ (6b)

$\delta_{01j}=\gamma_{010}$ (6b1)

.

.

.

$\delta_{0qj}=\gamma_{0p0}$ (6b2)

$\delta_{10j}=\gamma_{100}$ (6b3)

.

.

.

$\delta_{p0j}=\gamma_{q00}$ (6b4)

Equation 6b simultaneously models δ_{00j} as a dependent variable regressed on the stable effects explaining the between-region variance: urbanization economies (**URBAN_ECON)**, human resources in science and technology (**HRST)**, R&D expenditures in thousands euro (**RD_EXP**) and **GDP** in thousands of euros. The intercept at this final level of analysis, $\gamma 000$, represents the grand mean of firm financial performance, $\gamma_{001,}....,\gamma_{00q}$ denote the regression coefficients associated with $W_1,...,W_q$ relative to level-3 intercept, $W_1,...,W_q$ are the values on the level 3 predictors and r_{00j} is the random region error term. As these equations including 6a1–6a4 and 6b1–6b4 demonstrate that HLM also models the slopes of the relationships at the firm and sector-by-region levels as outcome variables at the higher levels of analysis.

Substituting Equations 6a and 6b into Equation 6 leads to the final model:

$$Y_{ijr} = \gamma_{000} + \gamma_{100} (X_1)_{ijr} + \gamma_{n00} (X_n)_{ijr} + \gamma_{010} (Z_1)_{jr} \ldots + \gamma_{0p0} (Z_p)_{jr} + \gamma_{001} (W_1)_j + \ldots + \gamma_{00q}(W_q)_j + e_{ijr}+u_{0jr}+r_{00j} \qquad (7)$$

where X1, X2, …, Xn, Z1,....,Zp and W1,.....,Wq are firm, industry sector-by-region (club) and region specific variables as specified in Table 1 showing the descriptive statistics of the variables under investigation, assuming that those variables are fixed with a similar impact on all firms. γ_{000} is the overall grand mean of firm *i* profitability in sector-by-region *j* and NUTS 2 region *r*, adjusted for the explanatory variables on each level, while the coefficients $\gamma_{100,\ldots}$, γ_{n00} , $\gamma_{010,\ldots\ldots}$, γ_{0p0} and $\gamma_{001,\ldots\ldots,}\gamma_{00q}$ capture the fixed effect of each independent and control variable on ROTA/PRMA.

$$Y_{ijr} = \gamma_{000} + \gamma_{100} (Lg\_SIZE_1)_{ijr} + \gamma_{200} (AGE_2)_{ijr} + \gamma_{300} (AGE_3^2)_{ijr} + \gamma_{400} (ST\_RISK_4)_{ijr} + \gamma_{500} (DEBT\_LEV_5)_{ijr} + \gamma_{010} (LQ_1)_{jr} + \gamma_{020} (HHI_2)_{jr} + \gamma_{030} (Lg\_COMPETITION_3)_{jr} + \gamma_{001} (Lg\_URBAN\_ECON_1)_j + \gamma_{002}(R\&D\_EXP_2)_j +\gamma_{003}(GDP_3)_j +\gamma_{004}(HRST\_ACTV\_POP_4)_j + e_{ijr} + u_{0jr} + r_{00j} \qquad (8)$$

HLM is a mixed model as it contains fixed ($\gamma_{100} (X_1)_{ijr} + \gamma_{n00} (X_n)_{ijr} + \gamma_{010} (Z_1)_{jr} \ldots + \gamma_{0p0} (Z_p)_{jr} + \gamma_{001} (W_1)_j + \ldots + \gamma_{00q}(W_q)_j$) and random part ($e_{ijr} + u_{0jr} + r_{00j}$). An assumption of HLM is that the random errors (e_{ijr}, u_{0jr} and r_{00j}) follow a normal distribution with a mean of 0 and a variance of σ^2_e, τ^2_{u0} and τ^2_{r00} (Woltman et al., 2012). This applies to any model using continuous outcome variables.

$E(e_{ijr}) = 0$; $Var(e_{ijr}) = \sigma^2_e$

$E(u_{0jr}) = 0$; $Var(e_{ijr}) = \tau^2_{u0}$

$E(r_{00j}) = 0$; $Var(e_{ijr}) = \tau^2_{r00}$

5. Results

4.1. Variance decomposition analysis

As mentioned in the previous section, decomposition of the variance, is one of the advantages of multilevel modelling and even though it serves more like a descriptive tool, it gives more information on how much regional or sector-by-regional (club) characteristics explain firm performance as compared to firm ones. Table 2 illustartes the percentage of the total residual variance that each of the discussed levels accounts for in explaining the ROTA and the PRMA.

Table 2: Variance components for ROTA and PRMA.

Percentage of total variance explained:	**Model 1: ROTA**	**Model 2: PRMA**
Firm level	97.7%	97.2%
Sector-by-region (Club) level	1.5%	1.7%
Regional level	0.8%	1.1%
Number of Observations	166,977	166,977
Number of clubs	1,101	1,101
Number of regions	55	55

As we can see from the table, the dominant driver of firm financial performance are firm-specific factors. The accross-firm variance explains approximately 97% of the total variance. To be precise 97.7% for ROTA and 97.2% for PRMA. The results also indicate that the between-club effects are explaining approximately 1.5% to 1.7% of the total variance in financial firm performance. When it comes to between-region effects, their impact is smaller with maximum contributions of 0.8 per cent to ROTA variance and 1.1 per cent to PRMA variance. Hence, the location effect explains approximately 2.7% in total of the variation in firm performance.

Similar results were found also in the previous literature. For example, as earlier introduced, Stavropoulos & Skuras (2016), who studied the effect of agglomeration economies on profitability and labour efficiency indicators of firms in 2005, partitioned country, regional, industrial, and cross-classified regional-industrial levels and found that regions explain less than 3 per cent for the ROTA and less than 1.5 per cent for the PRMA index. Another study from Zouaghi et al., (2017), applying a multi-level approach of hierarchical linear modeling on profitability of 3 273 agri-food firms operating in different Spanish districts over the period of 2006-2013 discovered also relatively small industry effects (0.8%-4.2%) and geographical location contribution (0.1%-1.8%).

From the findings it can be concluded that most of firm financial profitability can be explained by between-firm variance, therefore the highest impact can be attributed to internal factors to the firm. As indicated previously, agglomeration economies are defined as both regional (urbanization economies) and club (localization economies) associated, therefore based on the variance decomposition analysis performed I find that the external benefits arising from the club and regional related effects cannot explain a substantial part of the variance in firm profitability. Although the between-region and between-club variance retain relatively low with a marginally higher contribution stemming from externalities on the club level, these effects should not be underestimated as profit drivers since even 2-3% variance can lead to a significant variance in the aggregate profit in a highly concentrated region.

In spite of the fact that there is no substantial variation at the regional and club levels, multilevel model is to be preferred as compared to OLS regression as supported by by the LR test, which rejects the null hypothesis that linear regression is to be preferred at the 1% significance level. Moreover, the choice of an HLM is justified by the findings that even with a limited effect the external location factors act as a stand-alone drivers for firm profitability in the pool of diverse firms.

Next, the models are gradually incorporated with independent and control variables, which aim to test the hypotheses. All models are computed with robust standard errors in order to control for possible heteroscedasticity.

4.2. Agglomeration Economies and Firm Performance

As already mentioned, in this paper the effect of localization and urbanization economies on firm performance is tested and analyzed. In the previous sections the hypotheses were supported by theory, and the used methodology and variance decomposition analysis were introduced. Next the results will be presented and discussed as well as the robustness checks of the empirical findings.

Following likelihood-ratio tests and Wald tests the best model fit was chosen. Furthermore, the homoscedasticity and normality assumptions were tested using scatter plots of error terms and Q-Q plots respectively.

Another assumption behind the standard model is that the predictor variables at each level are not correlated with the error terms on the higher level (Misangyi et al., 2006; Stavropoulos & Skuras, 2016). In other terms, the firm-level predictor variables are uncorrelated with the club- and regional-level error terms and that the club-level predictor variables are uncorrelated with the regional-level error terms. Not correcting this issue might lead to inconsistent parameter estimates. As noted in Mundlak (1978) a solution for tackling with the endogeneity bias is the inclusion of club and regional means of the lower-level predictor variables in the regression model, also known as Mundlak (1978) correction.

Following Snijders and Berkhof (2006), who have also shown that the inclusion of such variables generates consistent estimates, all models are estimated using hierarchical multilevel modelling and enhanced with the endogeneity-robust Mundlak (1978) approach.

The results of the final models with included firm, club and regional level variables in the fixed part, Mundlak (1978) correction and random intercepts are presented in Table 3. Model 1 is the model on Return on Total Assets (ROTA) as a financial performance indicator and Model 2 represents the results on Profit Margin (PRMA).

As can be observed from the obtained results, the main independent variable of interest, localization economies (LQ), has a positive and statistically significant effect on both financial performance indicators - ROTA and PRMA, at the 5% and 10% significance levels respectively, which confirms my first hypothesis and the findings of the existing literature. Therefore, an increase in the effect of industry specialization, as measured by localization economies, leads to higher financial profitability of firms, ceteris paribus.

Looking at the second main independent variable of interest, the effect found of urbanization economies (URBAN_ECON) has positive and significant effect on ROTA at the 1% significance level and positive and significant effect on PRMA, however, at the 10% level. These findings confirm my second hypothesis and thus urbanization economies, represented by population density, is affecting positively firm financial performance, ceteris paribus.

In line with the previous literature, it can be concluded that agglomeration economies, as measured by urbanization and localization economies, generally are enhancing firm profitability in the regions under investigation.

Further, when looking at the first-level control variables, they are mainly significant, which is in line with the findings in the previous section that the majority of the variance explained in the firms' financial performance is coming from the firm-level characteristics.

All other factors held constant, AGE has a negative and significant effect on firm profitability at the 1% significance level in both models, which is opposite to my expectations. A quadratic term of AGE was also included in order to test the quadratic relationship between firm's age and financial performance. The quadratic term AGE^2, as can be seen in Table 3 has a positive and significant effect at the 1% level, which means that with the increase of the age of a firm, its financial performance is decreasing and after reaching a point the profitability of firms starts to grow again as firms become older. Therefore, it can be concluded that the relationship between ROTA (PRMA) and AGE is inverted U-shaped (life cycle effect). The initial negative effect might be due to path dependence of the firms as mentioned previously in this study, however, this effect will be further explained in the Discussion section.

The variable measuring the size of the firm has a positive and significant effect on ROTA at the 1% level, while positive but insignificant effect on PRMA in model 2. This confirms partially my expectations. The positive effect in Model 1 indicates that the bigger a firm is, the higher its ROTA index is, ceteris paribus. The insignificance not even at the 10% level in model 2 could be a result of a bias in the second model due to the denominator of the Profit Margin indicator which is capturing mainly the sales (turnover) of the firm and the SIZE variables which is also measured by the firm sales.

The two financial risk proxies (Short-Term Risk and Debt Leverage) are negative and statistically significant at the 1% level, which is confirming the “Bowman’s risk-return paradox” that higher risk is associated with higher profit fluctuations, keeping all other factors constant (Hirsch & Hartmann, 2014; Bowman, 1980).

Next, when observing the club-level variables, the Herfindahl-Hirschman index (HHI), representing the level of concentration on the market, statistically insignificant in both models. Therefore, it has no effect on the firm financial performance. However, surprisingly, COMPETITION is found to have negative and significant effect on firms accounting profitability at the 1% level in the two represented models. Thus, higher levels of competition in a club are associated with a lower accounting profitability of firms, ceteris paribus. Both effects are not in line with my assumptions that they will positively affect ROTA and PRMA, thus a possible rationale behind the found effects will be provided in the Discussion section.

At the regional level, the majority of the variables are found to have no impact on firm accounting profitability, which is in correspondence with the finding from the previous section that between-region variance explains a minor part of the firm profitability. The variable capturing firms’ R&D expenditures and the variable representing GDP at regional level are both statistically insignificant in the two models. Assuming that the other factors are held constant, the variable HRST, which depicts the percentage of human resources in science and technology, is negative and statistically significant at the 5% level in Model 1, while it is statistically insignificant in Model 2. These results are contradictory to my initial assumptions and the theory in the context of agglomeration economies, therefore will be further investigated in the Discussion section.

Next the various robustness checks will be presented and further discussion regarding the effects which were not in accordance to the initial expectations will be introduced.

Table 3: Hierarchical Linear Model on ROTA and PRMA.

VARIABLES	**(Model 1)** ROTA	**(Model 2)** PRMA
Intercept	2.636	7.370**
	(3.693)	(2.772)
Fixed part		
LQ	0.680**	0.332*
	(0.318)	(0.199)
URBAN_ECON (Ln)	1.325***	0.731*
	(0.435)	(0.410)
Firm Level:		
AGE	-0.415***	-0.214***
	(0.056)	(0.036)
AGE^2	0.002***	0.001***
	(0.000)	(0.000)
SIZE (Ln)	0.796***	0.154
	(0.117)	(0.170)
ST_RISK	-0.642***	-0.508***
	(0.051)	(0.053)
DEBT_LEV	-4.397***	-3.281***
	(0.892)	(0.772)
Club Level:		
HHI	0.00010	0.00016
	(0.00042)	(0.00039)
COMPETITION (Ln)	-4.193***	-3.189***
	(0.732)	(0.537)
Regional Level:		
RD_EXP	-4.199	-1.178
	(1.878)	(1.544)
GDP	2.722	1.433
	(3.889)	(3.144)
HRST	-0.168**	-0.100
	(0.082)	(0.080)
Random part		
e_{ijr}	23.187	20.837
	(0.910)	(0.797)
u_{0jr}	2.516	2.639
	(0.179)	(0.215)
r_{00j}	1.762	1.285
	(0.225)	(0.183)
Mundlak correction	Yes	Yes
Observations	111,029	111,029
Number of regions	55	55
Number of clubs	1,101	1,101

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6. Robustness Checks.

In this section the robustness check performed will be presented and analysed. Two robustness checks are carried out in order to validate the results obtained from my main models.

Following the same approach as in my main empirical analysis, all models are computed using hierarchical multilevel modelling with random intercepts and robust standard errors aiming at controlling for possible heteroskedasticity. Next to that, Mundlak correction is augmented in all of the robustness checks conducted in order to generate endogeneity-robust results.

First, separate models for the High- and Medium-high technology manufacturing, Medium-low-technology manufacturing and Low-technology manufacturing are estimated, which aims to test whether identical effect of agglomeration economies is found depending on the differentiation of manufacturing on the basis of the knowledge and technology intensity among sectors (see Appendix C for definitions). The High- and Medium-high technology manufacturing were combined in order to capture a larger set of observations. The segregation of the manufacturing industries was done according to the Eurostat classification by technological intensity and based on NACE Rev.2 ("High-tech classification of manufacturing industries", 2018)[5].

Generally, as presented in Appendix F, the results indicate a high robustness of the estimation, as the results of the six different models do not considerably alter from my main findings. Yet, a noteworthy change can be observed in the main independent variables used for measuring agglomeration economies. Both variables for localization and urbanization economies are positive and significant in the two models for Low-technology manufacturing industries, whereas partially confirming my hypotheses in Models 2 and 5 for the Medium-low-technology manufacturing industries. As for the rest of the models, the effect of agglomeration economies on firm accounting profitability indicators is insignificant. Therefore, it can be concluded that since Central and Eastern European regions specialize mostly in the more traditional lines of production (i.e. low-tech manufacturing), agglomeration economies in those regions is following the same pattern and thus the effect is evident in low technology sectors. The partially found positive and significant effects when looking at the

[5] High-tech classification of manufacturing industries. (2018). Retrieved October 26, 2018, from https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries

Medium-low-technology manufacturing is reflecting possible restructuring processes towards more advanced lines of production in 2015. However, in order to confirm if such a trend is apparent, time effects should be included which is not in the scope of this paper.

A further point worth investigating is whether my main findings are also in line when Knowledge-Intensive Business Services (KIBS) industries are taken into consideration. The term KIBS was first introduced by Miles et al. (1995) to indicate private companies mainly occupied in collecting, creation, analysing, and spreading of knowledge. The other two key dimensions which KIBS industries have been associated with are innovation and spatial proximity (Muller & Doloreux, 2009). Therefore, firms involved in these kind of economic activities are also assumed to benefit from the concept of agglomeration economies. The industries included (see Appendix D) are based on the NACE Rev.2 and are defined in accordance with aggregation of Knowledge Intensive Activities by Eurostat[6] and following Burger et al. (2008). The two models are constructed following my main models and are presented in Appendix G, however, due to lack of SBS data for two of the KIBS industries, namely “Financial service activities” and “Insurance, reinsurance and pension funding”, the missing data was aggregated from the firm level data.

In general, the results regarding the control variables are following the same pattern in terms of signs and coefficients. However, this is not the case when looking at the club level variables and the main independent variables. These effects are noticeably contradicting to my findings for the manufacturing industries. As can be observed in Appendix G, localization economies are found to have a negative and significant effect on firm performance, while urbanization economies are insignificant in both models. This might be due to the possibility that the rationale behind agglomeration of business services is different than it is often understood in the analysis of manufacturing-related clusters, as a result of the mainly intangible nature of the output they supply (Jacobs et al., 2013). Therefore, a further research should be performed, taking into account the capacity of firms to absorb knowledge and talent, to create networks of exchange and to innovate.

Moreover, another factor vital for the performance of firms in KIBS industries is the degree of evolution of the regional service economies and the role of innovation and entrepreneurship in the regions they are located as those factors are to a large extent differentiating in the counties

[6] Knowledge Intensive Activity (KIA). (2016, October 6). Retrieved September 27, 2018, from https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Knowledge_Intensive_Activity_(KIA)

in the scope of this study and in the Western countries, which is a topic for further investigation (Jacobs et al., 2013; Hutton, 2009).

Overall, when considering the different technology intensity categories of the manufacturing industry, the estimations are predominantly coherent with my findings. It can be concluded that agglomeration economies are mostly evident in the low technology manufacturing with some exceptions in medium-low manufacturing since Central and Eastern European regions are more specialized in the traditional lines of production. Yet, my main hypotheses are not supported in KIBS industries, which might be due to the different nature of the output of those industries as compared to manufacturing and the role of different factors forming the regional service economies and fuelling the firm performance in such sectors.

7. Discussion.

My findings provide evidence that the firm level characteristics are the main contributors to the financial performance as this effect class explains approximately 97% of ROTA and PRMA variance. This is supported by earlier research done on the topic, demonstrating that firm resources and capabilities are the root of firm accounting performance (e.g. Zouaghi et al., 2017; Ketelhöhn & Quintanilla, 2012). Although the variance added to ROTA/PRMA by the between-region and between-club variance is relatively small, these findings are not surprising. Similar results were also obtained by Van Oort et al. (2012), who has also conducted a multilevel research on the relation between agglomeration and firm-level productivity, employment growth and firm survival at the city level in the Netherlands. Accordingly, Goldszmidt et al. (2011) illustrates that territory effects are higher for sectors such as agriculture rather than for firms active in manufacturing sectors.

Coming back to Table 3, I find that my two hypotheses were confirmed by the results from the two models and the coefficients of the control variables are mostly in line with my predictions.

As regards to the impact of structural variables at the firm-level, the generated negative effect of age on the two profitability indicators can be explained by the firm's life cycle and the possibility of path dependence (lock-in) as mentioned in the previous sections. This can lead to less flexibility and adaptability to new technologies and therefore to slower growth and outaded assets which in turn can have a negative impact on firm performance (Woolthuis et al., 2005; Hirsch & Hartmann, 2014). Similarly, Loderer and Waelchli (2010) finds a negative impact on firm financial performance which is connected to the corporate aging problem and the inability of companies to adapt to new economic circumstances.

With the inclusion of the quadratic term of age, which has a positive and significant impact on firm financial performance, I am showing that the effect of age on ROTA/PRMA is not linear but rather U-shaped. The positive effect of age after some point in time might be due to the realization of learning effects and the increase in the firms' existing knowledge base over time. As the knowledge base of a firm grows, the assumption is that it can better assess, access, and incorporate externally available knowledge, which might reduce the profit fluctuations and lead to higher long-run financial performance (Van Oort et al., 2012; Hirsch & Hartmann, 2014).

The classical risk theory states that higher risk levels should lead to higher firm performance. However, both of my risk proxies for short-term and long-term risk have a negative and significant impact on the financial indexes which supports the "Bowman's risk-return paradox" as mentioned previously. As found within the strategic management theory, good management practices can increase the financial performance of firms, but also reduce the financial risk (Bowman, 1980; Hirsch & Hartmann, 2014).

At the club level, Herfindahl-Hirschman index (HHI), which is measuring concentration of firms on the market, even though was expected to affect positively firm financial performance as supported also in the previous literature, is found to have no effect on ROTA/PRMA (Hirsch & Hartmann, 2014). As claimed by Schmalensee (1985), while market concentration is predicted to have a positive impact on firm profitability when investigated on the industry level, it is assumed to not have an effect when regressed on the firm level. As indicated earlier, the higher the importance of the efficiency differences between firms are, the less equal their profits are and thus the higher the concentration on the market is and the higher the profits of the leading firms are (the higher the industry average profitability levels) (Schmalensee, 1985). At the firm level, such a relationship is vague and hard to find, Ravenscraft (1983) finds a positive and significant relationship between market share and firm profitability, while a negative and significant one when taking into account market concentration. Furthermore, this relationship is dependent on the way of measurement of profitability, and is found to be inconclusive or even negative whenever the profit margin contains material costs or the denominator includes sales or gross output as it is in this study (Conyon and Machin, 1991; Stavropoulos & Skuras, 2016).

In regards to my second club-level control variable, COMPETITION, the coefficient is negative and significant as opposed to my expectations, which might be as a result of incomplete property rights (Marshall, 1890; Glaeser et al, 1992). As described previously, investments in R&D is one of the primary sources for increasing organizational capabilities and production efficiency on the markets included in this paper, therefore if not protected the firms can lose their competitive advantage, which will lead to a negative influence on their financial performance (Matraves & Rondi, 2007; Glaeser et al, 1992). Moreover, the negative effect of competition on firm performance might be interpreted as implying rivalrous interactions among firms rather than cooperation through price or non-price competition (Mueller, 1983).

Turning to the regional level variables, the majority are found to have no significant effect on firm financial performance, which is not surprising when taking into account the low variance of the profitability of firms which is explained by regional characteristics as shown from the variance decomposition analysis. The only variable at the regional level which has a significant effect on ROTA/PRMA is the variable depicting the human resources in science and technology as a percentage of active population. In contradiction to my predictions, I find that the increase in the percentage of HRST leads to a decrease in firm profitability. This effect might be a result of the predominance of low-tech manufacturing industries in my dataset in which there is no such a high demand for a highly qualified workforce.

8. Conclusion.

How agglomeration economies impact the localized economic growth and whether the firms can benefit from the formed external economies by co-location has been the focal research topic for various empirical studies (Glaeser et al., 1992; Rosenthal and Strange, 2004; Van Oort et al., 2012; Combes & Gobillon, 2015). However, most of the studies have focused on the macroeconomic factors determining agglomeration economies and their effect on firm performance mainly due to data limitations and confidentiality restrictions. Aggregate analyses on a region, city or industry levels appear insufficient and the information on micro-level effects is lost. Only in the recent years the development of firm-level datasets has unblocked the possibility of investigating and quantifying the role of firms in agglomeration economies. In spite of that, the research results concerning the relation between clustering and firm performance due to externalities remain ambiguous. As mentioned in previous sections, agglomerations are not homogenous, and they vary along several dimensions. Yet, research on the effect of agglomeration level heterogeneity on the firm performance–agglomeration relationship has been equivocal (Van Oort, 2012).

In order to contribute to the better understanding of this relationship, I have employed a hierarchical linear modeling (HLM) which allows for simultaneously incorporating micro- and macro-level specific variables rather than using single level models. Applying a multi-level approach, I have revealed that the dominant driver of firm financial performance are firm-specific factors. The between-firm variance explains approximately 97% of the total variance. The results also indicated that the between-club effects are explaining approximately up to 1.7% of the total variance in financial firm performance, between-region effects contribute with a maximum of 1.1 per cent to total variance. Hence, the location effect explains approximately 2.8% in total of the variation in firm performance. These results are also supported in various studies, when studying the effect of agglomeration economies on frim performance and partitioning the effects on different levels (Misangyi et al., 2006; Burger et al., 2008; Van Oort et al., 2012; Stavropoulos & Skuras, 2016; Zouaghi et al., 2017).

Although I found that the external benefits arising from the club and regional related effects cannot explain a substantial part of the variance in firm profitability, these effects should not be underestimated as profit drivers since even 2-3% variance could still lead to a significant variance in the aggregate profit in a highly concentrated region. Hence, despite the dominance of firm effects, the results suggest that manufacturing firm managers should also take into account possible advantages from location-based resources in order to ensure competitiveness (Zouaghi et al., 2017).

Overall, in line with the previous literature, it can be concluded that agglomeration economies, as measured by urbanization and localization economies, generally are enhancing firm profitability in the regions under investigation. As found in this paper, both localization economies (LQ) and urbanization economies (URBAN_ECON), have a positive and statistically significant effect on both financial performance indicators - ROTA and PRMA, even though with a lower significance level in the model on PRMA. The results are robust across the different technology intensity categories of the manufacturing industry, mostly evident in the low technology manufacturing with some exceptions in medium-low manufacturing, since Central and Eastern European regions are more specialized in the traditional lines of production. Yet, my main hypotheses are not supported in KIBS industries, which might be due to the different nature of the output of those industries and separate factors stimulating firm performance as compared to manufacturing.

There are certain limitations in my study that should be noted. To begin with, a possible limitation of this study is the usage of area-based approach (or administrative spatial units) as a measurement for LQ due to the fact that they tend to "continuously evolve" as new firms and industries emerge and established ones might shrink, as pointed out in Martin & Sunley (2003). As suggested by Duranton and Overman (2005), an alternative approach is the non-parametric methodology (distance-based). However, due to data unavailability, as the exact locations of firms are needed for adopting this approach, this can be used as a starting point for a future research. Next to that, some limitations have to be accounted for the two financial risk proxies (ST_RISK and DEBT_LEV). Such indirectly indices associated with firm profitability might have limited comparability among different countries as by using depreciations and provisions for the calculation, different accounting methods are applied and therefore the comparability among different countries is reduced (Stavropoulos & Skuras, 2016).

Second, by being conducted only for one year my multilevel analysis hinders the examination of the dynamic effects of agglomeration economies, as those economies could be captured by firm growth, market share changes, entry rates, or exit rates and can be obtained by panel data with a longer time span. Efforts to include more years in my empirical analysis were leading to a highly reduced number of observations. As a result, this would have reduced the validity and statistical power of my results as insufficient number of observations per group within a component might result in an overestimation of the found effects (Stavropoulos, Burger & Skuras, 2015).

Third, another limitation of the current analysis is the lack of more variables on firm level such as absorptive capacity of knowledge spillovers, investments in R&D and human capital, entrepreneurship, participation in knowledge and innovation networks, and others that are thought to be of a high importance for agglomeration economies. However, there is limited possibility to find such type of data in the widely available public databases and should be taken into account as a point of improvement for the future research on this topic.

Fourth, the main findings of this research shall be treated with caution, particularly when drawing general or causal conclusions. The author acknowledges that this study is a correlational study, which does not necessarily convey causal interpretations. It should be argued that this paper should not suffer from reverse causality issues. It is unlikely that financial profit can lead to a specific localization of a single company towards other rivals. However, Baldwin & Okubo (2005) shows that agglomeration of productive firms might simply be a result of a spatial selection process, in which more productive firms are drawn to denser economic areas. Hence, the concentration of firms within a specific area can be the cause of the evident fast-growing locations, not local externalities or economies of scale. However, drawing conclusions about firms in such a possibility would be difficult when using cities or regions as lowest unit of analysis, which is not the current case.

Lastly, assumption behind the standard model is that the predictor variables at each level are not correlated with the error terms on the higher level. In other terms, the firm-level predictor variables are uncorrelated with the club- and regional-level error terms and the club-level predictor variables are uncorrelated with the regional-level error terms. Not correcting this issue might lead to inconsistent parameter estimates. Following Snijders and Berkhof (2008), who have shown that the inclusion of Mundlak correction generates consistent estimates, all models are estimated using hierarchical multilevel modelling and enhanced with the endogeneity-robust Mundlak (1978) approach.

This study offers several implications for further research. As aforementioned, an alternative approach as the non-parametric methodology (distance-based), suggested by Duranton and Overman (2005) can be used for comparison of the results with the methods used until now. Moreover, additional firm-level variables as absorptive capacity, investments in R&D and in human capital should be taken into account when conducting analysis on firm performance-agglomeration relationship.

A separate suggestion would be the segregation between agglomerations in terms of not only physical proximity, but also organizational and technological proximity – and foremost institutional and social proximity, as proposed by Rodríguez-Pose (2010). Further, an empirical assessment of the respective importance of each of the mechanisms behind agglomeration economies as mentioned in Section 2.1 (labour pooling, knowledge spillovers, sharing and matching effects and etc.) will be beneficial for understanding the various channels behind clustering when studying its effect.

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Appendix

Appendix A: Description and sources of the variables for each level.

Variable	Description	Source
Firm Level:		
ROTA	Return on total assets in percentage.	ORBIS
PRMA	Profit margin in percentage.	ORBIS
LQ	Location quotient calculated for the region and the corresponding industry in which the firm is operating.	Eurostat/Structural Business Statistics (SBS)
URBAN_ECON (Ln)	The ratio between the total population and the land area in km^2 of the region in natural logarithm.	Eurostat
AGE	Age of firm as difference between its founding year and 2015.	ORBIS
AGE^2	The quadratic term of AGE.	ORBIS
SIZE (Ln)	Sales of the firm in thousands of euros in 2015 in natural logarithm.	ORBIS
ST_RISK	Ratio of current liabilities to current assets.	ORBIS
DEBT_LEV	Ratio of long-term debt to total assets.	ORBIS
Club Level:		
HHI	Herfindahl-Hirschman Index for manufacturing industries within NUTS 2 regions.	Eurostat/Structural Business Statistics (SBS)
COMPETITION (Ln)	Average plant size for the whole manufacturing industry in natural logarithm.	ORBIS
Regional Level:		
RD_EXP	R&D expenditure by NUTS 2 regions in thousands of euros.	Eurostat
GDP	Gross domestic product (GDP) at current market prices by NUTS 2 regions in thousands of euros.	Eurostat
HRST	Persons employed in science and technology as a percentage of active population.	Eurostat

Appendix B: Summary statistics of the NUTS 2 regions used in the analysis of firm financial performance.

NUTS 2 Region Name	NUTS 2 Region Code	Freq.	Percent	Cum.
Severozapaden	BG31	1,711	1.02	1.02
Severen tsentralen	BG32	2,656	1.59	2.62
Severoiztochen	BG33	2,640	1.58	4.20
Yugoiztochen	BG34	2,688	1.61	5.81
Yugozapaden	BG41	7,501	4.49	10.30
Yuzhen tsentralen	BG42	5,385	3.22	13.52
Praha	CZ01	2,836	1.70	15.22
Strední Cechy	CZ02	1,411	0.85	16.07
Jihozápad	CZ03	1,875	1.12	17.19
Severozápad	CZ04	1,375	0.82	18.01
Severovýchod	CZ05	2,895	1.73	19.75
Jihovýchod	CZ06	3,124	1.87	21.62
Strední Morava	CZ07	2,220	1.33	22.95
Moravskoslezsko	CZ08	1,631	0.98	23.92
Eesti	EE00	6,398	3.83	27.76
Jadranska Hrvatska	HR03	3,096	1.85	29.61
Kontinentalna Hrvatska	HR04	7,057	4.23	33.84
Közép-Magyarország (NUTS 2013)	HU10	10,725	6.42	40.26
Közép-Dunántúl	HU21	2,984	1.79	42.05
Nyugat-Dunántúl	HU22	2,567	1.54	43.58
Észak-Magyarország	HU31	2,164	1.30	44.88
Észak-Alföld	HU32	2,796	1.67	46.55
Dél-Alföld	HU33	3,070	1.84	48.39

Lietuva (NUTS 2013)	LT00	1,538	0.92	49.31
Latvija	LV00	6,005	3.60	52.91
Lódzkie (NUTS 2013)	PL11	940	0.56	53.47
Mazowieckie (NUTS 2013)	PL12	2,636	1.58	55.05
Malopolskie	PL21	1,204	0.72	55.77
Slaskie	PL22	2,094	1.25	57.03
Lubelskie (NUTS 2013)	PL31	471	0.28	57.31
Podkarpackie (NUTS 2013)	PL32	671	0.40	57.03
Swietokrzyskie (NUTS 2013)	PL33	323	0.19	57.90
Podlaskie (NUTS 2013)	PL34	355	0.21	58.12
Wielkopolskie	PL41	2,312	1.38	59.50
Zachodniopomorskie	PL42	754	0.45	59.95
Lubuskie	PL43	471	0.28	60.24
Dolnoslaskie	PL51	1,544	0.92	61.16
Opolskie	PL52	449	0.27	61.43
Kujawsko-Pomorskie	PL61	1,073	0.64	62.07
Warminsko-Mazurskie	PL62	501	0.3	62.37
Pomorskie	PL63	1,543	0.92	63.30
Nord-Vest	RO11	6,416	3.84	67.14
Centru	RO12	5,788	3.47	70.60
Nord-Est	RO21	4,855	2.91	73.51
Sud-Est	RO22	4,068	2.44	75.95
Sud - Muntenia	RO31	4,046	2.42	78.37
Bucuresti - Ilfov	RO32	5,601	3.35	81.73
Sud-Vest Oltenia	RO41	2,730	1.63	83.36
Vest	RO42	3,481	2.08	85.45
Vzhodna Slovenija	SI03	5,929	3.55	89.00

Zahodna Slovenija	SI04	6,228	3.73	92.73
Bratislavský kraj	SK01	2,127	1.27	94.00
Západné Slovensko	SK02	4,584	2.75	96.75
Stredné Slovensko	SK03	2,731	1.64	98.38
Východné Slovensko	SK04	2,704	1.62	100.00

Appendix C: Description of the categories of the manufacturing industry sectors according to the technology intensity.

"High- and medium-high-technology manufacturing"	Manufacture of basic pharmaceutical products and pharmaceutical preparations (21) Manufacture of computer, electronic and optical products (26) Manufacture of chemicals and chemical products (20) Manufacture of electrical equipment (27) Manufacture of machinery and equipment n.e.c. (28) Manufacture of motor vehicles, trailers and semi-trailers (29)
"Medium-low-technology manufacturing"	Manufacture of coke and refined petroleum products (19) Manufacture of rubber and plastic products (22) Manufacture of other non-metallic mineral products (23) Manufacture of basic metals (24) Manufacture of fabricated metal products, except machinery and equipment (25) Repair and installation of machinery and equipment (33)
"Low-technology manufacturing"	Manufacture of food products (10) Manufacture of beverages (11) Manufacture of textiles (13) Manufacture of wearing apparel (14) Manufacture of leather and related products (15) Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (16) Manufacture of paper and paper products (17) Printing and reproduction of recorded media (18) Manufacture of furniture (31) Other manufacturing (32)

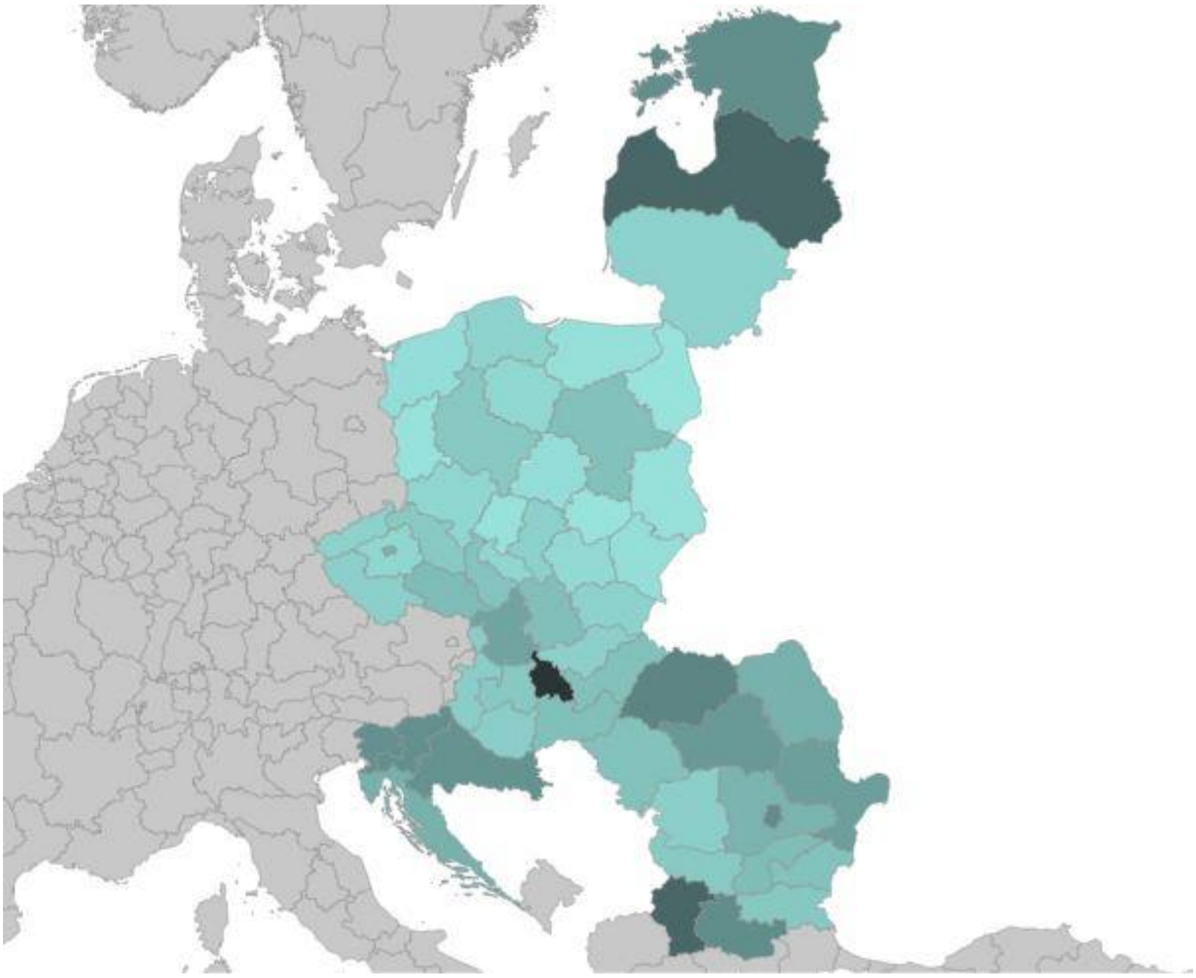
Source: High-tech classification of manufacturing industries. (2018). Retrieved October 26, 2018, from https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech_classification_of_manufacturing_industries

Appendix D: Sectors in KIBS used in analysis of firm performance.

KIBS NACE Code	KIBS Name (NACE Rev.2)
52	Warehousing and support activities for transportation
58	Publishing activities
61	Telecommunications
62	Computer programming, consultancy and related activities
63	Information service activities
64	Financial service activities, except insurance and pension funding
65	Insurance, reinsurance and pension funding, except compulsory social security
68	Real estate activities
69	Legal and accounting activities
70	Activities of head offices; management consultancy activities
71	Architectural and engineering activities; technical testing and analysis
72	Scientific research and development
73	Advertising and market research
74	Other professional, scientific and technical activities
77	Rental and leasing activities
78	Employment activities
81	Services to buildings and landscape activities
82	Office administrative, office support and other business support activities

Source: Knowledge Intensive Activity (KIA). (2016, October 6). Retrieved September 27, 2018, from https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Knowledge_Intensive_Activity_(KIA)

Appendix E: Mapped NUTS 2 regions according to the level of localization economies evident in those regions.



Note: NUTS 2 regions of interest appear in blue color. With the increase in the localization economies evident in a NUTS 2 region, the blue color becomes darker. The localization economies coefficients are taken from the dataset constructed for the empirical analysis of this study, whereas the geo-data is retrieved from GISCO (Geographic Information System of the Commission), Eurostat.

Appendix F: Robustness Check for the three manufacturing categories according to technology intensity.

	ROTA			PRMA		
	High-and Medium-high-tech	Medium-low-tech	Low-tech	High- and Medium-high- tech	Medium-low-tech	Low-tech
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	17.284***	9.602**	-3.908	-13.471***	11.091***	2.864
	(5.671)	(3.861)	(4.277)	(3.729)	(3.568)	(3.658)
Fixed Part:						
LQ	1.010	0.704	0.815***	0.343	0.922**	0.586**
	(0.663)	(0.471)	(0.237)	(0.368)	(0.447)	(0.233)
URBAN_ECON (Ln)	0.724	0.893*	1.617***	0.549	0.638	0.876**
	(0.515)	(0.507)	(0.475)	(0.478)	(0.466)	(0.472)
Firm Level:						
AGE	-0.294***	-0.489***	-0.424***	-0.139***	-0.246***	-0.226***
	(0.046)	(0.060)	(0.061)	(0.034)	(0.042)	(0.040)
AGE^2	0.002***	0.003***	0.002***	0.001***	0.001***	0.001***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
SIZE (Ln)	0.439***	0.724***	0.973***	0.020	-0.011	0.300
	(0.143)	(0.124)	(0.136)	(0.180)	(0.171)	(0.194)
ST_RISK	-0.895***	-0.773***	-0.567***	-0.860***	-0.678***	-0.409***
	(0.177)	(0.094)	(0.052)	(0.188)	(0.102)	(0.049)
DEBT_LEV	-5.789***	-5.581***	-3.366***	-5.154***	-2.994***	-2.994***
	(2.025)	(1.017)	(0.922)	(1.378)	(0.701)	(0.993)
Club Level:						
HHI	0.00029	-0.00034	-0.00020	0.00039	-0.00013	0.00003
	(0.00048)	(0.00041)	(0.00063)	(0.00052)	(0.00039)	(0.00048)
COMPETITION (Ln)	-2.101**	-4.017***	-5.384***	-2.542***	-3.641***	-3.427***
	(1.009)	(0.712)	(0.869)	(0.703)	(0.561)	(0.702)
Regional Level:						
RD_EXP	-3.478*	-4.278	1.300	-1.367	2.211	5.222
	(2.033)	(1.656)	(2.433)	(1.800)	(1.400)	(1.900)
GDP	5.300	1.700	2.811	2.089	9.033	5.944
	(4.378)	(3.367)	(5.156)	(3.811)	(2.778)	(3.967)
HRST	-0.074	-0.124	-0.200**	-0.045	-0.094	-0.115
	(0.084)	(0.084)	(0.093)	(0.079)	(0.063)	(0.104)
Random part						
e_{ijr}	20.101	22.308	24.685	19.115	20.243	21.767
	(0.634)	(0.897)	(0.970)	(0.793)	(0.860)	(0.786)
u_{0jr}	1.655	2.593	2.117	1.157	2.738	2.449
	(0.514)	(0.334)	(0.166)	(0.440)	(0.272)	(0.209)
r_{00j}	1.468	0.899	1.913	1.254	4.889	1.356
	(0.326)	(0.516)	(0.260)	(0.289)	(0.000)	(0.219)
Mundlak correction	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,579	39,684	53,766	17,579	39,684	53,766
Number of clubs	319	273	509	319	273	509
Number of regions	55	55	55	55	55	56

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix G: Robustness Check for Knowledge Intensive Business Services.

	(Model 1)	**(Model 2)**
VARIABLES	ROTA	PRMA
Intercept	36.231***	50.862***
	(9.345)	(9.839)
Fixed part		
LQ	-0.746*	-0.947**
	(0.422)	(0.466)
URBAN_ECON (Ln)	0.951	0.978
	(1.117)	(1.289)
Firm Level:		
AGE	-0.584***	-0.297***
	(0.090)	(0.072)
AGE^2	0.000***	0.000***
	(0.000)	(0.000)
SIZE (Ln)	1.891***	-0.249
	(0.174)	(0.481)
ST_RISK	-0.351***	-0.452***
	(0.046)	(0.051)
DEBT_LEV	-0.913**	-0.583***
	(0.370)	(0.185)
Club Level:		
HHI	-0.00032*	-0.00020
	(0.00017)	(0.00016)
COMPETITION (Ln)	1.203***	1.908***
	(0.242)	(0.331)
Regional Level:		
RD_EXP	-5.567	-1.733
	(4.300)	(4.933)
GDP	5.200	3.578
	(8.156)	(8.933)
HRST	-0.651***	-0.575***
	(0.155)	(0.161)
Random part		
e_{ijr}	28.011	31.586
	(1.274)	(0.902)
u_{0jr}	4.279	4.184
	(0.290)	(0.279)
r_{00j}	5.120	5.382
	(0.492)	(0.489)
Mundlak correction	Yes	Yes
Observations	255,994	252,422
Number of regions	55	55
Number of clubs	853	853

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1