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Agglomeration Economies and Clustering – Evidence from German Firms

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*Agglomeration Economies and Clustering – Evidence from German Firms**

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Abstract

The paper quantifies the impact of agglomeration economies on the clustering of German firms. Therefore, I use the 2006 Innobarometer survey, which focuses on cluster characteristics and activities of German firms, to empirically identify agglomeration economies derived from the New Economic Geography and Marshall externalities. At the industry specific level, I find that within-industry spillovers are important for German low-tech firms but not for high-tech firms or knowledge intensive firms. At the department level, Marshall externalities such as hiring skilled labor and technological spillover effects are empirically confirmed for some departments like Human Resources or R&D but rarely for others like Production.

JEL Classification: C20, D21, F12, R12

Keywords: Agglomeration Economies, New Economic Geography, Externalities, Cluster Analysis, Logistic Regression

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1 Introduction

The importance of firm clusters is best shown by the vast number of clusters initiatives, which rank on top on the national and regional government agenda. The German government, for example, has recently defined objectives of 17 cutting-edge fields in its "High-Tech Strategy for Germany" and is willing to fund them with approximately 15 billion Euros until 2009. Moreover, specific national cluster strategies for objective-driven research programs, such as "BioProfile" and "BioIndustry 2021" in the case of biotechnology for example, are launched by target-oriented investments to make Germany the leading nation in the field in Europe. Turning to a regional level, almost all 16 German federal states have initiated cluster programs in recent years. Bavaria, for example, has recently launched an ambitious cluster program to promote clusters in 19 areas with a high economic and scientific potential.[1] In short, the European Cluster Observatory (2007) lists Germany's recent cluster programs and policies at a national and regional level. The common objective of all programs is to build up firm clusters within innovating and economically promising areas and to promote cooperation and networking amongst firms, universities, and research institutions. Empirical knowledge about the driving forces and underlying mechanisms of the clustering of firms increasingly plays a crucial role for public authorities.

According to Audretsch and Feldman (2004), regionally established firm clusters attract other firms and mobile factors leading to self-reinforcing processes of within-industry clustering and innovation dynamics. Such processes are not limited to the field or business area, where clustering first started. In fact, Combes and Overman (2004) conclude that regions benefit in general from clustering as economic activity increases leading to between-industry interactions and further agglomeration. However, Duranton and Puga (2004) state that "*empirically identifying and separating these mechanisms becomes very difficult*". Spillover effects, for example, considered by the literature as one of the major drivers for regional clustering, are left unexplained in many empirical studies as residual. While there are some empirical studies focusing on such externalities for the case of US-firms and industries, such as Henderson's (2003), data limitation causes major problems when estimating externalities for their EU counterparts. Accordingly, Combes and Overman (2004) state that regional or area-based studies focusing on European countries are either descriptive or limited due to data

[1] Updated information is given at http://www.hightech-strategie.de, http://www.biotechnologie.de and http://www.allianzbayerninnovativ.de/, respectively.

problems and methodological errors. Hence, given that externalities are empirically difficult to identify and that no empirical work for Germany has been conducted so far, I make use of a recent survey amongst German firms, which explicitly discriminates amongst these externalities. In doing so, the survey relates cluster characteristics and activities to German firm operating in a cluster environment and therefore allows empirical evaluation of the underlying agglomeration economies in Germany.

The paper is organized as follows. The next section discusses agglomeration and industry location by giving an empirical overview. Section 3 presents the theoretical framework of agglomeration economies. Section 4 introduces the data and the empirical method. Descriptive evidence of cluster characteristics and activities of German firms is given in section 5. Empirical estimations of logistic models are conducted in section 6. Section 7 concludes.

2 Agglomeration and Industry Location

Agglomeration and industry location have firstly been addressed by (neo) classical contributions relying on natural advantages such as Thünen's (1826) market-place, Ricardo's (1817) localized technological knowledge and Heckscher's (1918) and Ohlin's (1933) uneven factor distribution.[2] However, a significant change in the main source of spatial agglomerations should consequently lead to different patterns of industrial and economic activity.[3] According to Ottaviano and Thisse (2004a), these features, which are commonly labeled as *first nature* since Krugman's (1993) contribution, help to explain economic history and the early economic development. However, they fail to explain the course of further industrialization and specializations of regions as a result of individual decision making. Here, Krugman's (1993) concept of *second nature* comes into play as it focuses on human being's action and its driving forces like gaining access to raw materials, optimizing consumption, and enhancing returns of investments. Given that *first nature* and history matters as a starting point, the spatial configuration of economic activity today is mainly the outcome and balance of *second nature* pulling and pushing consumers, firms, and production factors.

[2] See Ottaviano and Thisse (2004b) for a discussion of the early works of economic geographers and location theorists.

[3] At the beginning of the 20th Century, the 10 largest cities in the USA were all seaports according to Fujita and Mori (1996). Although the economic importance of water transport has been permanently diminished, most of these cities have remained economically important with a high share of industrial and economic activity.

According to Fujita Fujita and Thisse (2002), there is a wide range of examples for agglomerations and clusters of economic activities, which are less dependent of natural advantages. Clusters of economic activities occur at many geographic levels: from the core-periphery structure at the global stage like NAFTA, EU, and East Asia, via regional agglomerations, such as Silicon Valley in California (USA) or High-Tech-clusters in Bavaria (Germany), to commercial and financial districts at a inner city stage, e.g. Soho in London, Wall Street in New York, or Ginza in Tokyo.

Empirical Evidence on Agglomeration

Head and Mayer (2004) and Rosenthal and Strange (2004) have recently reviewed empirical studies on the nature and source of agglomeration economies from regression analysis and case studies. Accordingly, there are several studies providing empirical evidence on the clustering of firms and its driving forces for urban and industrial concentrations to be build up. In particular, Head and Mayer (2004) find limited support in the literature for the interaction between trade and transport costs and firm-level scale economies as a source of agglomeration. The literature analyzed by Rosenthal and Strange (2004) provides evidence on the micro-foundation of external economies of scale (i.e. labor market pooling, input sharing, and knowledge spillovers), which are commonly attributed to Marshall (1890), as sources for agglomeration and regional specialization.

Contrary to such empirical tests of theories of agglomeration economies, area-based studies focus mainly on the location of economic activity across countries within a specific region such as the EU, USA or ASEAN. According to Combes and Overman (2004), these studies deal with the correlation between industry (firm) characteristics and the observable spatial concentrations, but, at least in the case of the European countries, are limed in their contribution to the literature due to data problems and methodological errors. Breaking down to case studies, empirical work for New York City and Detroit by Glaeser and Ponzetto (2008) or for Silicon Valley by Saxenian (1994), for example, offer fruitful insights on how agglomeration and dispersion took place given their specifics. However, they do not overcome the lack of empirical identification of the underlying agglomeration sources in general.

As mentioned by Puga and Duranton (2004), it is difficult to empirically identify and separate the underlying mechanisms and therefore to detect the main drivers for regional agglomeration. To do so, I use a data sample of German firms from the European Commission and its subdivisions, which have carried out several “Innobarometer” surveys trying to identify the major drivers of innovation in Europe. The 2006 Innobarometer survey amongst top

managers deals with the specific characteristics of firms and industries operating in a cluster-like environment and was conducted for European countries at the national level.[4] As the 2006 Innobarometer survey discriminates between different sources of agglomeration economies, identifying and separating empirically the mechanism of agglomeration forces is possible.

3 Theoretical Framework: Agglomeration Economies

Economic models of agglomeration have been initiated by Fujita (1988), Krugman (1991) and Venables (1996) in order to explain the clustering of firm in geographical space and have been widely extended and applied since then. The new economic geography (NEG) emerged as a new framework using general equilibrium models with monopolistic competition from Spence (1976) and Dixit and Stiglitz (1977).[5] Following Fujita and Mori (2005), spatial agglomeration by the NEG-models rely mainly on the trade-off between various forms of increasing returns, which are essential for firms to choose production within one location, different types of mobility costs, which are important for productive factors and consumers to choose location, and trade and transportation costs, which make location matter for production. Moreover, externalities, which have been firstly addressed by Marshall (1980), also play an important role in explaining firm clusters. Accordingly, specific input factors and technological knowledge, for example, are likely to concentrate in economically active regions, which attract even more firms. Leading to self-reinforcing processes, the literature considers both, NEG and Marshall (1890), as the main theoretical source for agglomeration economies.

Agglomeration and NEG-Models

When choosing the location of (additional) plants and start ups, firms have to weight large scale production against proximity to customers and suppliers. Hence, there is a trade-off between savings from production costs, which favor a concentration of production, and trade/transport costs, which raise the question where to put plants and how many of them.

According to Hirschmann (1958), cost and demand linkages arise as firms are able to use intermediate goods more cheaply and to face a greater consumer demand where other firms and consumers are concentrated. These effects are magnified in the presence of increasing re-

[4] For further information about the 2006 Innobarometer survey refer to Gallup (2006).
[5] NEG-models are discussed in detail by Fujita, Krugman, and Venables (1999) and Balwin et al. (2003). Moreover, Fujita and Krugman (2004) give a literature review and a foresight of the NEG-framework.

turns of scale leading to a concentration of employment in one location. As a result, local demand increases and gives rises to Krugman's (1980) home-market effect: as transport and trade is still costly and local demand is increasing, more firms are attracted by larger markets leading to a clustering of industrial activity. With a higher share of economic activity, rising employment implies that more income is spent on an increasing variety of goods. This leads to self-reinforcing agglomeration effects of industrial activity and to a clustering of firms (agglomeration forces). At the same time, competition in product and factor markets increases with the number of locally concentrated firms and leads to higher good and factor prices. Hence, increasing competition amongst goods and factors as well as mobility and transport costs work against industrial agglomeration (dispersion forces). In short, the trade-off between these two forces determines the pattern of industrialization and the distribution of mobile factors. According to Fujita, Krugman, and Venables (1999), spatial concentration of industry occurs when trade/transportation costs are at an intermediate level, whereas with high and low trade/transportation costs industrial activity is more likely to be equally distributed.

Agglomeration and Externalities

Following Fujita and Thisse (2002) and Ottaviano and Thisse (2004a), externalities by Marshall (1890) arise mainly due to:

(1) mass-production and the use of inputs (whose production involves increasing returns of scale and therefore reduces costs at the firm level),
(2) the formation of specialized labor force and labor market pooling (which facilitates the match between employers' need and employees' qualification),
(3) the production of new ideas and its spillover effects,
(4) the availability of specialized input services, and
(5) modern infrastructure provided by public authorities.

For Marshall (1890), externalities are crucial for the formation of industrial agglomeration and the clustering of firms. Accordingly, a specialized labor pool, technological knowledge, input services, and modern infrastructure increase the incentives for firms to spatially and economically concentrate. Where such concentrations and networking of industrial activities exist, innovations are more likely to occur, thus driving economic development and regional prosperity. Self-reinforcing processes then arise, leading to clusters of firms and industries. Studies such as from Feldman and Florida (1994) emphasize the link of skilled labor, R&D

activity, and the clustering of firms. Hence, innovation is more likely to cluster in regions/countries where R&D-oriented firms and universities are established. As such regions become more attractive, further concentration of firms and mobile factors occur, pushing a region's capacity to innovate and grow.

The comparison of agglomeration sources from both, NEG-framework and Marshall (1890), leads to the following three categories.[6] First, increasing returns of scale of the NEG-framework correspond to Marshallian externalities (ME for short) of type (1) giving rise to the first category: *internal scale economies*. Second, within-industry interactions like Hirschmann's (1958) cost and demand linkages refer to ME of type (2), (3) and (4) and define the second category: *within-industry economies*. Finally, between-industry interactions like the NEG home-market effect cover ME of type (2) – (5), as they typically depend on the size of agglomeration and the provision of public goods. Hence, this comparison leads to the third category: *between-industry economies*. Empirical analysis refers mainly to the second and third category.

4 Methodology and Data

The choice of methodology and empirical proceeding depend on the kind of data used to describe and analyze cluster characteristics and activities. As the 2006 Innobarometer survey was conducted by randomized interviews of top managers from European companies, the data is mostly non-metric and estimation techniques are chosen accordingly.

4.1 Data and Empirical Proceeding

The data to analyze the role of clusters for German firms and its driving forces is from the survey "2006 Innobarometer on cluster's role in facilitating innovation in Europe" requested by the Directorate General Enterprise and Industry as a subdivision of the European Commission. The survey was conducted by the Gallup Organization Hungary and Gallup Europe in a two-step sampling approach. In the first step, firms from innovation intensive industry sectors

[6] A similar approach is given by Eberts and McMillan (2004), who also distinguish three categories of agglomeration economies: internal scale economies, economies due to within-industry interactions ("localization economies"), and economies due to between-industry interactions ("urbanization economies").

and with at least 20 employees were chosen randomly in a set of European countries[7] for a screener questionnaire over telephone. Accordingly, over 20,994 randomly selected firms across countries have been interviewed and screened in such a way, that only firms working in a cluster-like environment were selected for the main questionnaire. Therefore, the 2006 Innobarometer survey defined cluster-like environment mainly according to the discussed key features of the NEG-framework: strong local linkages amongst firms and suppliers; contact with firms, universities, and administration bodies; high density of firms operating in the same or in different business sectors (i.e. within and between industry spillovers respectively). In addition to these four NEG-cluster characteristics, the managers' awareness of the concept of clusters was prompted by the survey as well. All five cluster characteristics are thought to define a cluster-like firm: a score of at least four points of the maximum score of five points classifies a firm to be cluster-like.[8] Hence, the main questionnaire was carried out among 3,528 firms across Europe.

Breaking down the sample to German firms, 821 randomly selected firms were interviewed in the first step and it was screened whether they were cluster-like or not. As a result of screening and classifying, the German subset reduces in the second step to 151 innovation firms operating in a cluster-like environment.[9] By the use of both, screener and main questionnaire, two different approaches are promising: the screener data can be used to estimate the impact of cluster characteristics and therefore agglomeration economies on German firms in general, whereas estimates by the use of the main data focus on firm characteristics and activities within clusters. Therefore, I split the data into four different sector categories according to firms' degree of technology and knowledge intensity as agglomeration forces differ between industries. Firms are allocated to aggregated sectors according to 2-digit NACE codes. Hence, firms belong either to high and medium tech industries, low and medium low tech industries, knowledge intensive services or less knowledge intensive services. Table B.2 in the appendix gives specific information about the different sector categories and their classifications.

By the 2006 Innobarometer survey, different options for answering each question are given to the top-manager, where each option corresponds to a specific number. There is no common knowledge how to define binary variables from questionnaires and to deal with the

[7] The 2006 Innobarometer survey was carried out in the 27 member states of the EU, in two candidate countries (Croatia and Turkey) as well as in Norway, Switzerland and Iceland.
[8] If all five cluster characteristics apply to the firm according to top managers' opinion, then the maximum score of five points is given. If none of them apply, the score is zero.
[9] Details about firms' classification according to the screener and main questionnaire are given in Table B.1 in the appendix.

problem of selectivity of non-metric data. In some cases, it might be ambiguous to define binary variables: it is appropriate then to define different binary variables using a broader and narrower range of the given options. Logistic regression models (Logit-Models) are then used as estimation techniques. Hence, with binary data, empirical results are interpreted as the logarithmic chance of the independent variable with specification "success", which means a binary value of "1", on the dependent variable with specification "success" (i.e. binary value of "1").

4.2 Logistic Regression

The logistic regression equation is given by:

$$\ln\left(\frac{pr(y_i=1)}{1-pr(y_i=1)}\right)=\beta_o+\beta_1 x_{1,i}+...+\beta_K x_{K,i}+\varepsilon_i\,, \qquad i=1,...,N\,, \tag{1}$$

with pr as the probability of the dichotomous variable y $(y_i=1,0)$, K as the number of regressors x and N as the number of firms. Note, that the left hand side of equation (1) is the logarithm of the odds defined as the ratio of $pr(y_i=1)$ to $(1-pr(y_i=1))$. Interpretation of the β-coefficients is such that an increase of x by one entity leads to an increase of the logarithmic chance of y by β. Hence, in order to determine $pr(y_i=1)$, equation (1) can be rewritten as:

$$pr(y_i=1)=\frac{1}{1+e^{-(\beta_o+\beta_{1,i}x_{1,i}+...+\beta_{K,i}x_{K,i})}}\,, \tag{2}$$

The parameters of the logistic regression equation are best estimated by maximum likelihood. Taking into account equation (2), maximization of the LogLikelihood function (LL):

$$\underset{\beta_j}{Max}\,(LL)=\sum_{y_i=1}\ln(pr(y_i=1)+\sum_{y_i=0}\ln(1-pr(y_i))\,, \qquad j=0,...,K \tag{3}$$

leads to the β_j coefficients of equation (1). Note, that equation (1) is specified and discussed in section 6 according to the empirical setting.

5 Descriptive Evidence of Firms Cluster

I give a short descriptive overview of cluster characteristics and activities from the 2006 Innobarometer survey. In doing so, I analyze in section 5.1 the overall relevance of cluster characteristics for German firms by the use of the screener questionnaire of 821 interviewed firms. In section 5.2, I turn to cluster-like firms in Germany and discuss firm activities within clusters using a sub-sample of 151 firms.

5.1 Cluster Characteristics and German Firms

Like heterogeneity among firms matters for firms' individual success, belonging to a cluster or operating in a cluster-like environment differs between industries as well. Hence, Figure 1 gives in addition to total firms each sector category and shows the distribution of top manager's opinion whether

Q1: the firm has strong linkages with suppliers and service providers (Strong Linkages),
Q2: the firm has contacts with firms, universities and administration bodies (Contacts),
Q3: the firm is located in a region with a high concentration of firms working in the same business sectors (Concentration of Firms),
Q4: the management is aware of the cluster concept (Concept of Clusters), and
Q5: there are clusters active in their region (Active Clusters) or not.

First, strong linkages of firms with suppliers and service providers that are geographically close to others are thought to be essential – especially in the presence of increasing returns of scale – as intermediate goods and services are more easily accessible and cheaper giving rise to *within-industry economies*. More than 50 percent of the all top mangers agreed that their companies have strong linkages. Such linkages are even more important for firms belonging to knowledge intensive services, where 60 percent of all top managers agree. Surprisingly, technology intensive firms from high and medium tech industries and low and medium low tech industries do not differ in their rating according to their top managers.

Second, contacts with firms, universities and administration bodies as to share opportunities and to join projects should create remarkable externalities amongst firm belonging to the same or different industries. By Figure 1, the agreement with regard to contacts with other

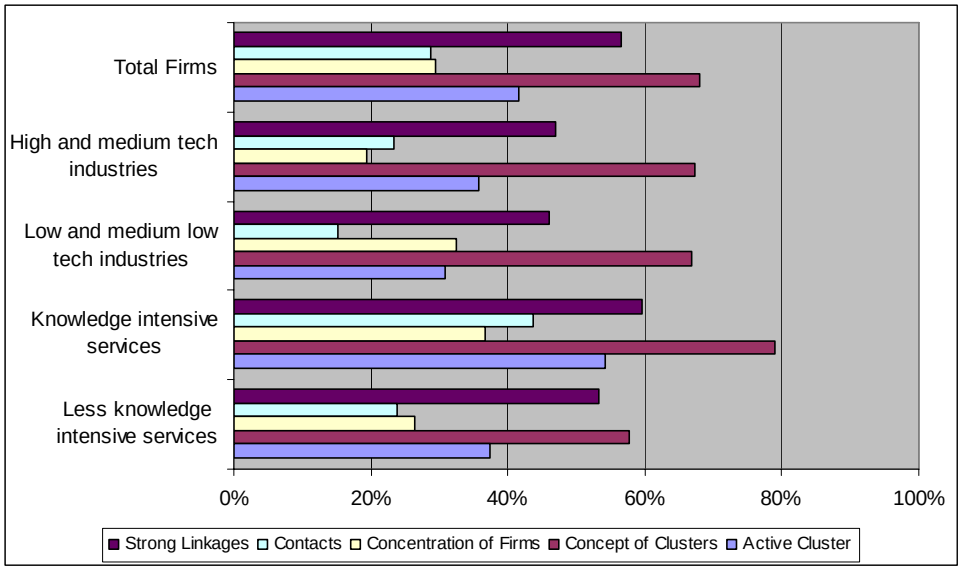
firms and institutions to be relevant is relatively low and does not exceed 30 percent – except for firms belonging to knowledge intensive services. Hence, more than 40 percent of the top managers from knowledge intensive firms confirm that their companies have contacts and operate in networks.

Next, although competition among input factors and market shares is stronger in regions with firms working in the same business, firms benefit from *within-industry economies* such as the formation of specialized labor force, technological diffusion, or specific input services. More than 30 percent of the top managers from companies belonging either to low and medium low tech industries or to knowledge intensive sectors agree with regard to the existence of *within-industry economies*. Interestingly, top managers from high and medium tech industries agree with them by less than 20 percent.

Fourth, the capability of top managers to deal with the concept of clusters has been questioned as well. To the extent that top managers can distinguish the cluster concept from self-declaration of cluster membership, firms benefit from belonging to a cluster as opportunities and advantages (and also disadvantages) are taken into account by the management. Figure 1 shows an overall confirmation of the awareness of the cluster concepts with ratings of almost 60 percent or more according to the industry. Once again, almost 80 percent of the top managers of the knowledge intensive services are aware of the cluster concept, whereas confirmation rate for the less knowledge intensive services is given by less than 60 percent.

Finally, the question about active clusters focuses on *between-industry economies* and their benefits for firms which are located within an economic actively region. Technology intensive firms from both sectors agree that their business takes place in an active cluster by a rate of less than 40 percent. The highest approval rate (54 percent) is given by top managers from firms of knowledge intensive services, which benefit not only from intra-industry spillover effects – as discussed above – but also from inter-industry related spillover effects.

To sum up, firms from knowledge intensive services benefit most from being and operating in a cluster-like environment (i.e. from agglomeration economies), where strong linkages, contacts with public and private actors, and spillover effects within and between different industries create sufficient gains to overcome sharp competition inside the same business area.



Source: 2006 Innobarometer Survey of 821 firms by the use of the following questions:
Q1. Does your company have significantly stronger linkages with suppliers and service providers that are geographically close than with others?
Q2. In your region, does your firm have contacts with other firms, universities and administrative bodies to discuss common problems or potential shared opportunities?
Q3. Is your firm located in a region where the concentration of firms working in the same business sector as yours is higher than elsewhere in the country?
Q4. Are you aware of the concept of cluster?
Q5. Are there clusters active in your region, in your field of activity?

Figure 1: Cluster Characteristics of German Firms

5.2 Cluster's Main Activities and Cooperation Forms

Cooperation and networking are at the very heart of the cluster paradigm as they lead to externalities due to intra- and inter-industry interactions: firms that frequently cooperate and actively participate in business networks are more likely to exchange information on technology and markets and to develop partnerships on specific business projects. Hence, the diffusion of technological knowledge and the availability of specialized input services are likely to occur. Moreover, according to Eberts and McMillen (2004), public authorities provide high-quality highways, public utilities, communication facilities, and the like, lowering the costs to all firms of doing business in the area. In doing so, public authorities trigger the formation of clusters.

The main questionnaire lists a number of cooperation forms, which are supposed to matter for cluster-like firms and to represent the area of clusters' main activities. Among those are exchange of information on technology and markets, development of partnerships and access to input factors such as skilled labor, capital, land, and technological knowledge, as well as infrastructure. Apparently, the main questionnaire has broken down Marshall's (1890) exter-

nalities into these activities. To keep things manageable, Figure 2 lists aggregated results for all firms and shows the distribution of top managers' opinion with regard to

Q14: each of the [following] activities and areas and if they are characteristic for the cluster/region the firm belongs to or not.

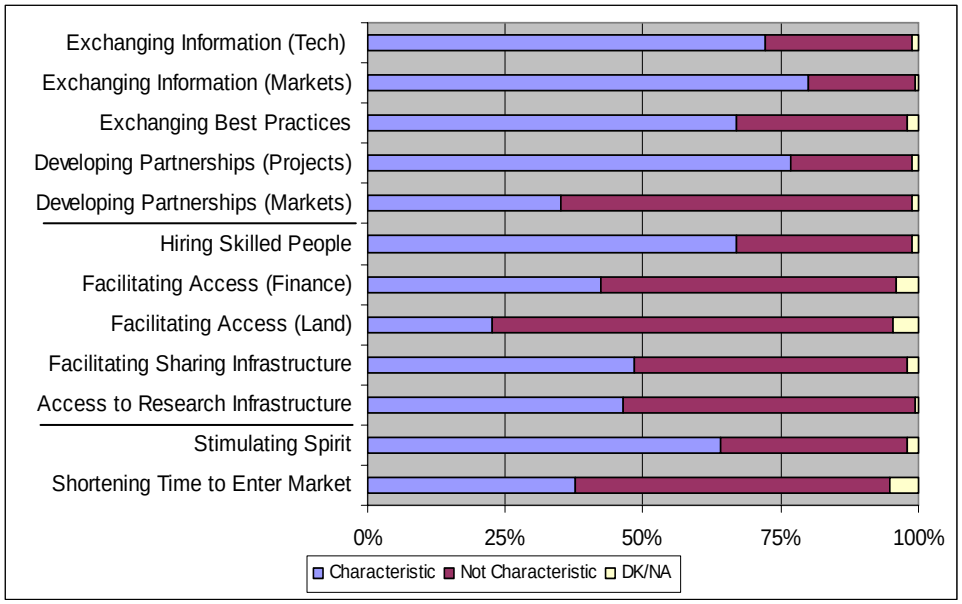
First of all, the exchange of information on technology and markets as well as of best practices is relevant to more than 60 percent of the German companies being part of a cluster. Accordingly, sharing information as the "softest" form of cooperation considered to be one of the main cluster activities. Especially the transfer of information about markets takes place between more than 80 percent of the firms within the same cluster. Not surprisingly, top managers agreed – at almost the same percentage – that their firm develop partnerships on specific business projects: with a higher degree of information shared, partnerships amongst firms are likely to increase. However, such partnerships are developed for specific business projects rather than for the purpose to compete on the European market. The approval rate for developing partnerships to compete abroad dropped to 35 percent. Hence, partnerships seem to be more business-related rather than market-related.

Figure 2 also shows top managers' estimation of the role of input factors (e.g., skilled labor, finance, and land), sharing infrastructure (e.g., buildings, training facilities), and access to research infrastructure (e.g., universities). Almost seven out of ten (68 percent) find that their cluster is hiring skilled labor as valuable input factors. Access to financial funding is confirmed by 44 percent of the top managers, whereas only 24 percent find that their cluster facilitates access to land. Hence, land as a strategic input factor for firms to cluster is not confirmed by the top management. Access to infrastructure either by sharing building or training facilities or by interacting with universities and research laboratories are characteristic for almost 50 percent of the interviewed cluster companies.

With regard to entrepreneurship and the stimulating impact of clusters, the main questionnaire confirms a stimulus effect (66 percent) and therefore an immaterial valuable asset for firms belonging to a cluster. Finally, shortening time to market access is only relevant for less than 40 percent of the firms as is the role of developing partnerships to compete on the European market.

In short, exchanging information on technology/markets/best practices (i.e. ME of type (3)), developing business related partnerships (i.e. ME of type (4)) and hiring skilled labor (i.e. ME of type (2)) are considered to represent most clusters' main activities. Hence, the ex-

change of information is likely to enhance business related partnerships, which in turn requires a specific kind of skilled labor.



Source: 2006 Innobarometer Survey of 151 firms by the use of the following question:
Q14. Please tell me for each of the following activities and areas if they are characteristic for your [cluster/region]?

Figure 2: Cluster Activities within Clusters

6 Empirical Results: Clustering of Firms

This section analyzes empirically the impact of agglomeration economies on German firms in two steps. First, I use the full-sample of 821 German firms and discuss the overall relevance of agglomeration economies. Second, I turn to cluster-like firms using the sub-sample of 151 German firms, and focus on the relevance of agglomeration economies for firm departments by questioning how beneficial they are for particular departments.

6.1 Screener Questionnaire: Randomly Selected Firms

I start with the impact of cluster-like environment (e.g., strong linkages, contacts, firm concentration, and active clusters) as well as the awareness of the cluster concept on turnover and therefore with the question whether successful firms are cluster-like or not. Firms' turnover is used as a proxy for success on a firm level and is defined as the annual income within the last

two financial years.[10] According to Audretsch and Feldman (2004), regionally established clusters lead to self-reinforcing processes of within-industry clustering and innovation dynamics, where sharp competition separates out unsuccessful firms. Being a driver of regional economic development, such cluster-like firms should be successful on a firm level as well.

Regression Equation: Firms' Turnover

The empirical proceeding is to use all five cluster characteristics from section 5.1 as regressors to quantify the impact on the change of firms' turnover. With regard to the dependent variable, I define and recode three variables as to cope with a broader range of different changes of firms' turnover: *Turnover* is coded as "success" if there was an overall increase in turnover, *High Turnover* is coded as "success" if there was an increase by 6 percent or more and *Highest Turnover* covers an increase of turnover by more than 25 percent.[11] It is tested whether the empirical results depend on turnover's specification or not – similar to a robustness test. Equation (1) then can be specified as:

$$\ln\left(\frac{pr(y_i=1)}{1-pr(y_i=1)}\right)=\beta_o+\sum_{k=1}^{5}\beta_k x_{k,i}+\varepsilon_i, \qquad i=1,...,821, \qquad (4)$$

with *y* as firms' turnover, which itself depends on the increase of turnover within the last two completed financial years (*Turnover*, *High Turnover*, *Highest Turnover*), and x_k as cluster characteristic *k*, which is specified as variable *Ck* respectively. Agglomeration economies suggest that strong linkages to upstream and downstream firms decrease costs on a firm level whereas contacts to other firms, universities, and administration bodies increase technology and human capital transfers leading to *within- and between-industry economies.* All of which should increase firms' turnover significantly. I therefore expect the sign of the β_k-coefficients in equation (4) to be positive.

Total Firms

Table 1 shows the empirical results of equation (4) from 719 randomly selected German firms. Estimates are given for three different definitions of firms' turnover according to the change of turnover in the last two financial years.

[10] Detailed information is given in Figure A.1 in the appendix.

[11] In the case of the independent variables, "success" (i.e. binary value of "1") for cluster characteristic "strong linkages", for example, means that the firm has strong linkages with suppliers and service providers. Otherwise, binary value "0" is assigned. The other four cluster characteristics are recoded in a similar way.

In the case of *Turnover* and *High Turnover*, only the awareness of the cluster concept (*C4*) has a significant impact on firms' turnover at a 1%-level: firms whose top managers are aware of the cluster concept have a nearly 0.58 higher logarithmic chance for an overall increase of turnover than those without, whereas the logarithmic chance for an increase of turnover by 6 percent or more is almost 0.47 higher. Surprisingly, there is no significant positive effect of strong linkages (*C1*) or contacts with firms, universities, and administration bodies (*C2*). Moreover, concentration of firms operating in the same (*C3*) or in different business sectors (*C5*) is not statistically related to firms' turnover neglecting any *within- and between industry economies*. However, results change in the case of *Highest Turnover*, where *within-industry economies* (*C3*) are confirmed statistically at a 10%-level.

Table 1: Impact of Cluster Characteristics on German Firms
(Data from the 2006 Innobarometer Questionnaire by the Eurobarometer Team of Directorate General Communication)

Logit-Model:	**(1) *Turnover***	**(2) *High Turnover***	**(3) *Highest Turnover***
Total Firms:			
C1: Strong Linkages	-0.186 (-1.19)	-0.238 (-1.5)	-0.300 (-0.86)
C2: Contacts	-0.41 (-0.23)	-0.052 (-0.28)	0.468 (1.25)
C3: Concentration of Firms	-0.0365 (-0.22)	0.021 (0.12)	0.619 (1.76)*
C4: Concept of Clusters	0.571 (3.34)***	0.469 (2.58)***	0.214 (0.5)
C5: Active Clusters	0.12 (0.71)	-0.008 (-0.04)	0.243 (0.64)
Constant	0.011 (0.06)	-0.738 (-4.05)***	-3.443 (-7.89)***
Likelihood Ratio χ_L^2	14.9 (0.01)	9.62 (0.09)	7.66 (0.18)
McFadden R^2	0.02	0.01	0.03
No. of Observation	719	719	719

Notes: The *t*-statistics of the coefficients are reported in parentheses. The probability for the Likelihood Ratio is also given in parenthesis. * (**) [***] denotes that the coefficient is significantly different from zero at a 10% (5%) [1%] level. Missing data reduces the number of 821 firms to 719 firms accordingly.

To sum up, cluster-like environment and its *within-industry economies* are only statistically important for firms with a turnover increase of more than 25 percent. In this case, however, the likelihood ratio χ_L^2 is relatively low, thus calling into question the overall explanation of the model. Moreover, McFadden's R^2 is relative low for all three specifications of firms' turnover.

Low and Medium Low Tech Firms and Knowledge Intensive Firms

Given the results above, cluster-like environment should be statistically relevant at least on an industry specific level. Table 2 shows estimates of equation (4) for low and medium low tech firms using a sample of 129 firms and for knowledge intensive firms using a sample of 207 firms.

For low and medium low tech firms, estimates confirm a significant impact of contacts (*C2)* and concentration of firms (*C3)* on *High Turnover* as well as *Highest Turnover* at least at a 10%-level. Hence, *within-industry economies* matter statistically for firms with an increase of turnover by more than 6 percent. Again, cluster-like environment is statistically not relevant for the first model with *Turnover* as the dependent variable. The goodness of the first two models is poor: the Likelihood Ratio and McFadden's R^2 are relatively low. However, the goodness of the third model (*Highest Turnover*) improves substantially.

Table 2: Impact of Cluster Characteristics on German Low and Medium Low Tech Firms and Knowledge Intensive Firms
(Data from the Innobarometer 2006 Questionnaire by the Eurobarometer Team of Directorate-General Communication)

Logit-Model:	**(1) *Turnover***	**(2) *High Turnover***	**(3) *Highest Turnover***
Low and Medium Low Tech Firms:			
C*1*: Strong Linkages	-0.189 (-0.51)	-0.186 (-0.49)	-0.691 (-0.84)
C2: Contacts	0.538 (1.01)	1.034 (1.96)**	2.056 (2.18)**
C3: Concentration of Firms	0.616 (1.43)	0.783 (1.82)*	1.925 (2.21)**
C4: Concept of Clusters	0.164 (0.41)	-0.16 (-0.4)	-0.705 (-0.88)
C5: Active Clusters	-0.644 (-1.45)	-0.903 (-1.9)*	-1.594 (-1.52)
Constant	0.332 (0.88)	-0.426 (-1.12)	-2.983 (-3.65)***
Likelihood Ratio χ^2_L	3.71 (0.59)	7.92 (0.16)	9.98 (0.08)
McFadden R^2	0.02	0.05	0.17
No. of Observation	129	129	129
Knowledge Intensive Firms:			
C*1*: Strong Linkages	0.059 (0.18)	-0.149 (0.47)	-0.433 (-0.72)
C2: Contacts	-0.508 (-1.59)	-0.555 (-1.76)	-0.562 (-0.93)
C3: Concentration of Firms	-0.339 (-1.08)	-0.25 (-0.80)	0.602 (1.06)
C4: Concept of Clusters	1.231 (3.18)***	0.872 (2.05)**	-0.38 (-0.53)
C5: Active Clusters	0.773 (2.37)**	0.418 (1.30)	0.889 (1.37)
Constant	-0.652 (-1.51)	-1.069 (-2.30)**	-2.661 (-3.24)**
Likelihood Ratio χ^2_L	19.09 (0)	9.74 (0.08)	3.93 (0.56)
McFadden R^2	0.07	0.04	0.04
No. of Observation	207	207	207

Notes: The *t*-statistics of the coefficients are reported in parentheses. The probability for the Likelihood Ratio is also given in parenthesis. * (**) [***] denotes that the coefficient is significantly different from zero at a 10% (5%) [1%] level.

For technology intensive firms, there is a significant positive effect from the awareness of cluster concepts (*C4*) in the case of *Turnover* and *High Turnover*. Moreover, externalities from inter-industry transactions (*C5*) are confirmed in the case of *Turnover*. Hence, for technology intensive firms, it seems to be beneficial to operate in economically active regions with a high share of firms from different sectors. However, this impact disappears for the second and third model using *High Turnover* and *Highest Turnover* instead. With respect to the goodness, the Likelihood Ratio for the first two models is large enough to underline that at

least one regressor has explanatory power, whereas for the third model the Likelihood Ratio is low. However, McFadden's R^2 is low for all models.

In short, there is some but limited empirical evidence for *within- and between-industry economies* on turnover of firms belonging to low and medium low tech industries or to knowledge intensive industries. However, the results depend on the specification of turnover. Moreover, for firms belonging either to high and medium tech industries or to less knowledge intensive industries, there is no empirical evidence at all. This is shown by Table B.3 in the appendix.

6.2 Main Questionnaire: Cluster-Like Firms

Estimates of agglomeration economies on firms' turnover are not encouraging so far. Things may be different and more promising, if one tries to figure out how beneficial it is for departments being in a cluster. Hence, accounting for the heterogeneity of departments and their needs for different labor skills, technology spillovers, and market strategies, there might be common factors for distinct departments worthwhile to look at. Cluster activities and its externalities that are essential for some departments might be not useful to others at all. Hence, the 2006 Innobarometer survey divided firms into six departments (i.e. R&D, marketing, sales, production, human resources, and procurement/acquisition/supply) and asked which departments benefit most from operating in a cluster and its agglomeration economies.[12] In distinguishing common factors and cluster activities, which are beneficial to distinct departments, top managers – but also public authorities – are able to strengthen the competitiveness of their firms and its cluster.

Regression Equation: Departments' Benefit

The empirical proceeding is to combine the information about firm departments with market and firm activities inherent to clusters. With regard to the dependent variable, I define two different variables for the benefit of firms' department: *Beneficial* is coded as "success" given the answers "highly beneficial" or "somewhat beneficial", whereas *Highly Beneficial* is coded as "success" for "highly beneficial" as an answer. [13] By section 5.2, I discussed 12 firm and

[12] A summarize of the answers by top managers is shown in Figure A.2 in the appendix.

[13] In the case of the independent variables, "success" (i.e. binary value of "1") for cluster activity "exchanging information on technology", for example, means that the firm exchanges such information. Otherwise, binary value "0" is assigned. The other eleven activities are recoded in a similar way.

market activities, which are thought to matter for cluster-like firms and to represent the area of cluster's main activities. Hence, I use these cluster activities as explanatory variables at the department level. Equation (1) is specified as:

$$\ln\left(\frac{pr(y_{j,i}=1)}{1-pr(y_{j,i}=1)}\right)=\beta_o+\sum_{k=1}^{12}\beta_{k,j}x_{k,j,i}+\varepsilon_{j,i}, \qquad i=1,...,151,\ j=1,...,6 \qquad (5)$$

with y_j as departments' *j* benefit (*Beneficial*, *Highly Beneficial*) belonging to a cluster and x_k as cluster activity *k*, which is specified as variable *Ak* respectively. Again, agglomeration economies suggest that the exchange of information, cooperation and networking and availability of specific input factors are essential for some department while for others not. I therefore expect the signs of the $\beta_{j,k}$-coefficients in equation (5) to be positive for some department while for others not.

Firm Departments

Table 3 shows estimates of equation (5) for each of the six departments using *Benefical* as the dependent variable. Except for the production and human resources department, the goodness of each model given by the Likelihood Ratio as well as McFadden's R^2 is high and estimates are therefore reliable – especially in the context of the previous analysis. Estimation results of equation (5) using *Highly Beneficial* are given in Table B.4 in the appendix.

Turning to the R&D department first, there are at least three striking results. As expected, the logarithmic chance of exchanging information on technology (*A1*) and exchanging best practices (*A3*) is positive and confirmed empirically at a least at a 5%-level. However, hiring skilled labor (*A6*), which is considered essential for business-related R&D activity, as well as having access to research infrastructure (*A10*) is not confirmed at a significant level and somehow surprising. In contrast, facilitating access to infrastructure (*A9*) and shortening time to enter market (*A12*) are confirmed at a 5%-level. Hence, firm clusters with a research orientated profile, where technology spillovers are high and infrastructure is given, seem to be beneficial to R&D departments. However, estimation results by Table B.4 in the appendix using *Highly Beneficial* only confirm the exchange of information on technology.

Considering the marketing department next, one would expect that exchanging information on markets/best practices (*A2/A3*) as well as developing partnerships (*A4*) to be positively confirmed. However, Table 3 shows a positive logarithmic chance only for developing partnerships on specific projects (*A4*) at a 5%-level. Moreover, facilitating access to financial

sources (*A7*), sharing infrastructure (*A9*) and stimulating spirits (*A11*) are beneficial for the market department as well. Hence, marketing departments profit from a stimulating environment, where cooperation and partnerships take place and financial funding and access to infrastructure are provided. According to estimates in Table B.4 in the appendix, the result of developing partnerships on specific business projects and stimulating spirit are robust.

Table 3: Impact of Agglomeration Economies on German Cluster Firms; Logit-Model: Beneficial
(Data from the Innobarometer 2006 Questionnaire by the Eurobarometer Team of Directorate-General Communication)

Logit-Model: *Beneficial*	**R&D**	**Marketing**	**Sales**
Cluster-Firms:			
A1: Exchanging Information (Tech)	3.527 (2.86)***	-0.598 (-0.80)	-0.033 (-0.05)
A2: Exchanging Information (Markets)	0.361 (0.29)	0.611 (0.75)	1.702 (2.13)**
A3: Exchanging Best Practices	2.59 (2.01)**	1.036 (1.51)	0.16 (0.26)
A4: Developing Partnerships (Projects)	-1.312 (-0.87)	1.619 (2.02)**	1.208 (1.75)*
A5: Developing Partnerships (Markets)	0.033 (0.03)	-0.458 (-0.64)	-0.067 (-0.11)
A6: Hiring Skilled People	-0.849 (-0.79)	0.631 (0.99)	0.93 (1.66)*
A7: Facilitating Access (Finance)	1.026 (0.89)	1.62 (2.07)**	0.531 (0.85)
A8: Facilitating Access (Land)	-2.134 (1.44)	-0.144 (-0.17)	0.233 (0.32)
A9: Facilitating Sharing Infrastructure	2.5 (2.14)**	1.413 (2.07)**	0.836 (1.49)
A10: Access to Research Infrastructure	-1.856 (-1.60)	-0.718 (-1)	-1.382 (-2.2)**
A11: Stimulating Spirit	-0.62 (-0.58)	1.214 (1.86)*	0.164 (0.28)
A12: Shortening Time to Enter Market	3.83 (2.48)**	0.673 (0.94)	1.361 (2.07)**
Constant	-2.591 (-1.70)*	-2.801 (-2.51)**	-2.823 (-2.74)***
Log Likelihood	43.27 (0)	41.38 (0)	29.34 (0)
McFadden R^2	0.54	0.35	0.23
No. of Observation	70	110	102

Logit-Model: *Beneficial*	**Production**	**Human Resources**	**Procurement**
Cluster-Firms			
A1: Exchanging Information (Tech)	-0.667 (-0.97)	-0.599 (-1.14)	0.684 (1.32)
A2: Exchanging Information (Markets)	0.779 (0.94)	-0.485 (-0.78)	0.753 (1.17)
A3: Exchanging Best Practices	-0.399 (-0.60)	-0.044 (-0.09)	0.533 (0.99)
A4: Developing Partnerships (Projects)	-0.436 (-0.57)	1.167 (1.97)**	0.272 (0.41)
A5: Developing Partnerships (Markets)	-0.246 (-0.40)	-0.322 (-0.64)	-1.13 (-2.04)**
A6: Hiring Skilled People	-0.077 (-0.13)	1.218 (2.65)***	1.639 (3.18)***
A7: Facilitating Access (Finance)	-0.208 (-0.34)	0.01 (0.04)	-0.367 (-0.69)
A8: Facilitating Access (Land)	0.342 (0.47)	0.797 (1.35)	0.023 (0.04)
A9: Facilitating Sharing Infrastructure	1.926 (3.32)***	0.268 (0.6)	0.26 (0.54)
A10: Access to Research Infrastructure	-0.5 (-0.85)	-0.625 (-1.35)	-0.474 (-0.95)
A11: Stimulating Spirit	0.254 (0.44)	0.093(0.19)	0.481 (0.92)
A12: Shortening Time to Enter Market	0.82 (1.32)	0.233 (0.48)	-0.34 (-0.64)
Constant	-0.051 (-0.06)	-0.471 (-0.61)	-1.312 (-1.62)
Log Likelihood	17.69 (0.13)	16.66 (0.16)	25.01 (0.01)
McFadden R^2	0.16	0.11	0.18
No. of Observation	84	115	117

Notes: The *t*-statistics of the coefficients are reported in parentheses. The probability for the Likelihood Ratio is also given in parenthesis. * (**) [***] denotes that the coefficient is significantly different from zero at a 10% (5%) [1%] level. Missing data reduces the number of 151 firms with regard to the specific department accordingly.

Proceeding to the sales department, estimates confirm that exchanging information on markets (*A2*), developing partnerships on specific projects (*A4*), hiring skilled labor (*A6*) as well as shortening time to enter markets (*A12*) have a statistically positive effect at least on a 10%-level. Contrary to intuition, developing partnerships to compete on European markets (*A5*) is not significant. As expected, the benefit of sale departments does not rely on access to research infrastructure (*A10*), which has a negative coefficient at a 5%-level. Compared to Table B.4 in the appendix, the impact of developing partnerships on specific business project and hiring skilled labor are robust results.

As discussed, the goodness of the model given by the Likelihood Ratio and McFadden's R^2 for the production department is relatively poor and facilitating sharing infrastructure (*A9*) is the only statistically confirmed variable. Surprisingly, the variables covering exchanging information on technology (*A1*) as well as best practices (*A3*) are not significant. Estimation results for *Highly Beneficial* in Table B.4 in the appendix leads to almost the same results: facilitating sharing infrastructure is confirmed positively at a 1%-level.

The remaining two departments, human resources and procurement/acquisition/supply, are shown to be positively affected by hiring skilled labor (*A6*) at a 1%-level, which is not surprising. Moreover, human resources also statistically benefit from partnerships on specific business projects (*A4*) as human capital is more likely to exchange within business related partnerships. For procurement/acquisition/supply, there is no necessity for partnerships to compete on European markets (*A5*), which is negatively confirmed. Both effects are at a 5%-level respectively. According to Table B.4 in the appendix, the derived results for both departments are robust at least at a 10% -level.

To sum up, hiring skilled labor representing ME of type (2) is statistically confirmed for the sales department, human resource department, and procurement/acquisition/supply department. Next, technological knowledge and its spillover effect are most important for the R&D department giving rise for empirical evidence for ME of type (3). Moreover, developing specific business projects, which are likely to generate specific inputs and knowledge to firms within the same business, is statistically relevant to the marketing department, sales department, and human resource department. Thus, there is empirical evidence of ME of type (4). Finally, facilitating sharing infrastructure matters for the production department and confirm the existence of *ME* of type (5) in this case. Estimation results show evidence for *within- and between industry economies* for almost every department according to Marshall (1890)'s distinction. However, the impacts of agglomeration economies on departments are quit different: externalities that are essential for some departments are not useful to others.

7 Conclusion

The paper quantifies the impact of agglomeration economies on the clustering of German firms. Using the 2006 Innobarometer survey, I empirically identify and analyze different agglomeration economies for German cluster-like firms. Therefore, I use two different agglomeration economies derived from the New Economic Geography framework and Marshall Externalities: *within*- and *between-industry economies*. Firms are grouped according to the industry they belong to and are divided into different departments. Hence, empirical analysis focuses on both, industry classification and department division.

Estimates show that agglomeration economies are more likely to be found at an industry specific level rather then for German firms in general. In particular, I find that *within-industry economies* are important for German low-tech but not for high-tech firms or knowledge intensive firms. Surprisingly, there is almost no empirical evidence for *between-industry economies* for firms, no matter which industry they belong to.

Accounting for the heterogeneity of departments and their need for different labor skills, technology spillovers, and market strategies, amongst others, there might be common factors for distinct departments that are essential for some departments but not for others. Estimation results provide evidence for *within*- and *between-industry economies* for almost every department according to Marshall's (1890) distinction. In particular, hiring skilled labor, for example, is empirically confirmed for departments such as human resources and procurement/acquisition/supply but rarely for others such as production or marketing. Technological spillover effects are most beneficial and statistically confirmed for the R&D department. Moreover, partnerships on specific projects, where cooperation and exchange of information and experience take place and specialized input services are available, are beneficial for the marketing department and sales department. Finally, infrastructure provided by public authorities is statistically relevant solely for the production department giving rise for a need of higher government spending in this case.

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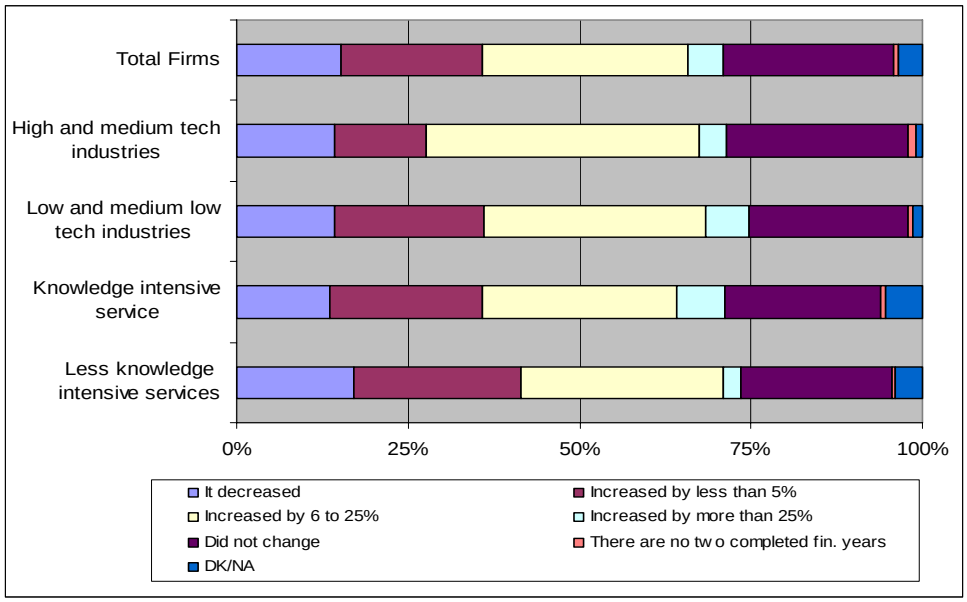
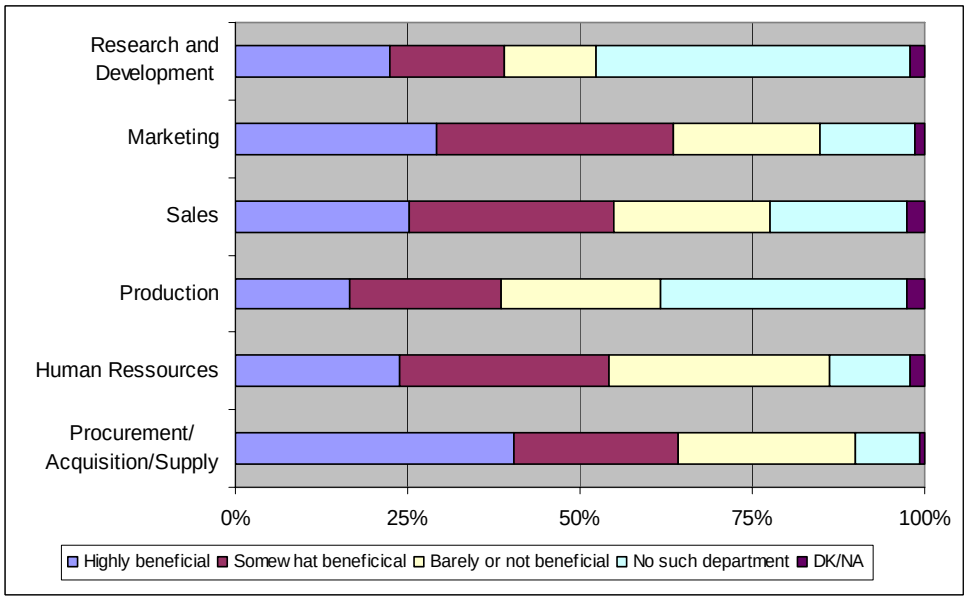
Appendix

(A) Additional Figures



Source: 2006 Innobarometer Survey of 821 firms by the use of the following question:
D3. Between the last two completed financial years, how did your turnover – that is, the annual income of your firm – change?

Figure A.1: Turnover of German Firms



Source: 2006 Innobarometer Survey of 151 firms by the use of the following question:
Q16. How beneficial is it for the various departments in your company being in a [cluster/region]?

Figure A.2: Benefits for Departments within Clusters

Table B.1: Classification of Geman Firms by Screener and Main Questionnaire

Screener Questionnaire			Company size			Year of establishment				Last year turnover...					
DE			Small (20-49 emp.)	Medium (50-249 emp.)	Large (250+ emp.)	Before 1986	Between 1986-2001	After 2001	DK/NA	Dec-reased	Increased up to 25%	Increased by 25%+	Did not change	...no two completed financial years	DK/NA
Total		821	371	291	159	412	369	35	5	125	415	42	204	6	29
Sector	High and medium tech industries	98	43	43	12	47	43	7	1	14	52	4	26	1	1
	Low and medium low tech industries	139	59	63	17	83	52	3	1	20	75	9	32	1	2
	Knowledge intensive service	243	86	75	82	115	117	11	0	33	123	17	55	2	13
	Less knowledge intensive services	227	119	75	33	119	101	6	1	39	122	6	50	1	9
		707	307	256	144	364	313	27	3	106	372	36	163	5	25
			707			707				707					

Main Questionnaire			Company size			Year of establishment				Last year turnover...					
DE			Small (20-49 emp.)	Medium (50-249 emp.)	Large (250+ emp.)	Before 1986	Between 1986-2001	After 2001	DK/NA	Dec-reased	Increased up to 25%	Increased by 25%+	Did not change	...no two completed financial years	DK/NA
Total		151	52	57	42	88	55	8	0	21	79	11	32	2	6
Sector	High and medium tech industries	8	2	3	3	3	3	2	0	1	6	1	0	0	0
	Low and medium low tech industries	15	2	8	5	13	2	0	0	3	8	0	4	0	0
	Knowledge intensive service	68	20	24	24	39	27	2	0	7	35	5	14	2	5
	Less knowledge intensive services	35	13	14	8	21	12	2	0	8	18	3	6	0	0
		126	37	49	40	76	44	6	0	19	67	9	24	2	5
			126			126				126					

Notes: Firms are allocated to aggregated sectors according to 2-DIGIT NACE codes.

Table B.2: Firm Allocation to Aggregated Sectors according to NACE
(Data from the Innobarometer 2006 Questionnaire by the Eurobarometer Team of Directorate General Communication)

	Number of Firms: Total / Cluster	**2-Digit NACE Codes**
High and Medium Tech Industries	98 / 8	24, 29-34
Low and Medium Low Tech Industries	139 / 15	15, 17-23, 25-28, 36
Knowledge Intensive Services	243 / 68	61, 64-67, 70, 72-74, 80, 85, 92
Less Knowledge Intensive Services	263 / 35	50-52, 55, 60, 63, 75, 91, 93
Total Firms	821 / 151	

Notes: The following 2-Digit NACE Codes are not allocated: 1, 14, 40, 41, 45.

Table B.3: Impact of Cluster Characteristics on German High and Medium Tech Firms and Less Knowledge Intensive Firms
(Data from the Innobarometer 2006 Questionnaire by the Eurobarometer Team of Directorate-General Communication)

Logit-Model:	**(1) *Turnover***	**(2) *High Turnover***	**(3) *Highest Turnover***
High and Medium Tech Firms:			
C1: Strong Linkages	0.39 (0.09)	-0.162 (-0.38)	0.185 (0.18)
C2: Contacts	-0.498 (-0.90)	-0.126 (0.24)	0.496 (0.45)
C3: Concentration of Firms	0.9 (1.38)	0.369 (0.65)	[0]
C4: Concept of Clusters	1.094 (2.19)**	0.659 (1.36)	[0]
C5: Active Clusters	0.369 (0.78)	0.248 (0.55)	0.231 (0.21)
Constant	-0.498 (-1)	-0.727 (-1.47)	-2.915 (-2.90)***
Log Likelihood	8.14 (0.149)	5.46 (0.49)	0.35 (0.95)
McFadden R^2	0.07	0.04	0.01
No. of Observation	93	93	53
Less Knowledge Intensive Firms:			
C1: Strong Linkages	-0.151 (-0.5)	0.098 (0.31)	0.059 (0.06)
C2: Contacts	-0.007 (-0.02)	-0.239 (-0.62)	-0.78 (-0.66)
C3: Concentration of Firms	-0.027 (-0.08)	0.216 (0.62)	1.442 (1.52)
C4: Concept of Clusters	0.337 (1.07)	0.441 (1.32)	0.856 (0.74)
C5: Active Clusters	-0.104 (-0.32)	-0.11 (-0.33)	0.542 (0.55)
Constant	0.304 (1.02)	-0.954 (-2.97)***	-4.982 (-3.93)***
Log Likelihood	1.39 (0.92)	2.38 (0.79)	3.91 (0.56)
McFadden R^2	0.01	0.01	0.08
No. of Observation	194	194	194

Notes: The *t*-statistics of the coefficients are reported in parentheses. The probability for the Likelihood Ratio is also given in parenthesis. * (**) [***] denotes that the coefficient is significantly different from zero at a 10% (5%) [1%] level. [+] ([-]) [[0]] denotes a positive (negative) [no] correlation as either binary value "0" or "1"of the independent variable predicts perfect failure of the dependent variable and there disallows estimation.

Table B.4: Impact of Agglomeration Economies on German Cluster Firms; Logit-Model: Highly Beneficial

(Data from the Innobarometer 2006 Questionnaire by the Eurobarometer Team of Directorate-General Communication)

Logit-Model: *Highly Beneficial*	**R&D**	**Marketing**	**Sales**
Cluster Firms:			
A1: Exchanging Information (Tech)	1.329 (1.71)*	0.413 (0.74)	0.642 (1.03)
A2: Exchanging Information (Markets)	-1.109 (-1.21)	0.277 (0.33)	0.458 (0.50)
A3: Exchanging Best Practices	0.418 (0.59)	0.458 (0.76)	-0.275 (-0.48)
A4: Developing Partnerships (Projects)	0.388 (0.44)	[+]	1.872 (2.15)**
A5: Developing Partnerships (Markets)	0.415 (0.65)	0.26 (0.45)	-0.651 (-1.16)
A6: Hiring Skilled People	0.25 (0.36)	1.04 (1.95)**	1.166 (2.10)**
A7: Facilitating Access (Finance)	-0.01 (-0.02)	-0.414 (-0.79)	0.085 (0.16)
A8: Facilitating Access (Land)	-0.411 (-0.43)	-0.303 (-0.52)	0.113 (0.19)
A9: Facilitating Sharing Infrastructure	0.4 (0.64)	0.049 (0.10)	0.393 (0.77)
A10: Access to Research Infrastructure	0.814 (1.31)	-0.521 (-1.06)	-0.601 (-1.18)
A11: Stimulating Spirit	-0.144 (-0.22)	1.175 (2.08)**	-0.042 (-0.08)
A12: Shortening Time to Enter Market	0.747 (1.24)	-0.799 (-1.49)	0.417 (0.80)
Constant	-2.375 (-2.06)**	-1.918 (-1.78)*	-3.732 (-3.09)***
Log Likelihood	17.21 (0.14)	13.02 (0.29)	16.47 (0.17)
McFadden R^2	0.18	0.10	0.13
No. of Observation	70	91	102

Logit-Model: *Highly Beneficial*	**Production**	**Human Resources**	**Procurement**
Cluster Firms:			
A1: Exchanging Information (Tech)	0.791 (0.96)	0.291 (0.49)	0.044 (0.09)
A2: Exchanging Information (Markets)	-0.546 (-0.59)	-1.199 (-1.68)*	0.946 (1.45)
A3: Exchanging Best Practices	-0.163 (-0.24)	-0.224 (-0.38)	0.333 (0.65)
A4: Developing Partnerships (Projects)	0.23 (0.26)	1.338 (1.66)*	0.942 (1.46)
A5: Developing Partnerships (Markets)	-1.416 (-1.83)*	-0.995 (-1.66)*	-1.599 (-2.92)***
A6: Hiring Skilled People	1.099 (1.58)	0.977 (1.65)*	1.363 (2.78)***
A7: Facilitating Access (Finance)	-0.825 (-1.17)	0.713 (1.33)	-0.178 (-0.37)
A8: Facilitating Access (Land)	1.447 (1.67)*	-0.379 (-0.66)	-0.241 (-0.46)
A9: Facilitating Sharing Infrastructure	2.648 (3.39)***	-0.027 (-0.05)	0.229 (0.52)
A10: Access to Research Infrastructure	-0.508 (-0.75)	-0.376 (-0.73)	0.29 (0.64)
A11: Stimulating Spirit	-0.867 (-1.23)	0.33 (0.59)	0.246 (0.50)
A12: Shortening Time to Enter Market	0.837 (1.18)	1.394 (2.57)***	0.724 (1.52)
Constant	-2.628 (-2.44)**	-2.683 (-2.55)**	-3.059 (-3.25)***
Log Likelihood	20.98 (0.05)	19.73 (0.07)	24.45 (0.02)
McFadden R^2	0.21	0.15	0.15
No. of Observation	84	115	117

Notes: The *t*-statistics of the coefficients are reported in parentheses. The probability for the Likelihood Ratio is also given in parenthesis. * (**) [***] denotes that the coefficient is significantly different from zero at a 10% (5%) [1%] level. [+] ([-]) [[0]] denotes a positive (negative) [no] correlation as either binary value "0" or "1"of the independent variable predicts perfect failure of the dependent variable and there disallows estimation.

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