Family Firms and Regional Innovation Activity: Evidence from the German Mittelstand

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4 February 2011

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Family firms are important not only for a region but for the economy as a whole. In particular, the long-term orientation and the local embeddedness of family firms suggest a positive effect on regional innovation activity. Yet, despite the widely acknowledged importance of family firms for the economy, little research exists on this issue. This paper analyses the effect of family firms on regional innovation. Using a dataset of 326 German regions, our regressions show that regions with a higher share of family firms also show higher levels of innovation activity, as measured by the number of successful patent applications. The implications of these findings for policy and research are discussed.

Keywords: innovation; family firms; geography; Mittelstand; patents

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1. Introduction

The role of family firms in the economy has been a widely debated issue in the academic literature. In *The Visible Hand: The Managerial Revolution in American Business* (Chandler 1977) and *Scale and Scope: The Dynamics of Industrial Capitalism* (Chandler 1990), Chandler argues that large firms run by a cadre of salaried managers are managed better and care more about their long-term competitive advantage than "personal enterprises", that is, those "firms managed by individuals or by a small number of associates, often members of founder's families, assisted by only a few salaried managers" (Chandler 1990). Chandler, among others, attributes Britain's industrial decline relative to the U.S. and Germany before World War II to the strong persistence of family firms in that country.[1] He further argues that the shift toward salaried managers running large enterprises is responsible for the growth and strength of U.S. industries in the early years of modern capitalism (1850-1920). Referring to British family firms, Chandler states that their "goal […] appears to have been to provide a steady flow of cash flow to owners – owners who were also managers" (1990). Short-term income was preferred to long-term growth, dividend payments were high and retained earnings were low. By contrast, "in American managerial firms the basic goals appear to have been long-term profit and growth" (Chandler 1990). Chandler argues that salaried managers are more capable of dealing with "dividend-hungry owners" than managers who are also members of the ownership family because the latter are more vulnerable to pressure from family members who are not involved in the business and who therefore favour high dividends.

Other scholars go even further than Chandler, arguing that family firm owners engage in political rent seeking; thus, these owners have a negative effect on economic development (Morck and Yeung 2004). Similar arguments have been advanced by Fogel (2006), who finds

[1] This argument has been criticized by some business historians for overstating the number of family firms in Britain while understating the number of family firms in the U.S. For criticism from various perspectives, see, e.g., Alford (1994), Church et al. (1990), Church (1993).

that greater oligarchic family control of large enterprises is associated with negative social economic outcomes. Wealthy families are argued to allocate capital inefficiently and prefer to maintain the status quo rather than invest in innovation and growth (Morck, Wolfenzon, and Yeung 2005).

In his work *The Competitive Advantage of Nations* (Porter 1998), Porter presents a different perspective. He argues that the U.S. system of allocating investment capital is failing (Porter 1992). U.S. firms invest too little in the assets and capabilities required for competitiveness, including research and development (R&D), employee training, and supplier relations. This underinvestment places U.S. firms at a competitive disadvantage relative to German or Japanese firms. The main reason for underinvestment is the short-term relationship between U.S. firms and external capital providers. Approximately 60% of the total equity of large U.S. firms is owned by institutional investors who have highly diversified portfolios with only small stakes in each firm. The average holding time of shares is only 1.9 years. Such investors, therefore, focus on financial goals over the short term. They base their investment choices on limited information oriented toward predicting short-term stock price movements, and they focus on easily measurable figures such as current earnings. This is not the situation in Japan or Germany. Porter argues that firms in these two countries have 'dedicated owners' who act as principals rather than as agents. These owners "hold significant stakes, rather than small fragmented positions […] and seek long-term appreciation of their shares, which they hold in perpetuity" (Porter 1992). Although Porter did not explicitly refer to family owners as a group, family owners resemble, in many aspects, Porter's group of dedicated owners.[2] In particular, family owners possess the desire to pass the firm on to the next generation, leading these owners to think of the long term (Casson 1999; Guzzo and Abbott 1990; James 1999; Tagiuri and Davis 1992). For these and other reasons explained below, scholars in the fields

[2] Other important block holders in Germany have been banks and insurance companies. In Japan, suppliers and customers own large stakes in each other to cement their business relationship.

of business history (e.g., Berghoff 2006; Casson 1999), economics and finance (e.g., Anderson and Reeb 2003; Bertrand and Schoar 2006; James 1999), and management (e.g., Le Breton-Miller and Miller 2006; Lumpkin, Brigham, and Moss 2010; Zellweger 2007) argue that family firms are more oriented toward the long term than non-family firms.

The empirical studies to date have analysed the effects of family ownership on innovation and growth on the firm level (e.g., Block 2010b; Casillas and Moreno 2010; Chen and Hsu 2009; Munari, Oriani, and Sobrero 2010). Despite the extensive discussion in the literature about the role of family firms in the economy, there are few empirical papers about the *macroeconomic* or regional effects of ownership structure (Gatti 2009). To the best of our knowledge, our paper is the first to analyse the impact of family firms on *regional* innovation activity. Using a dataset of 326 German districts (*Kreise*, NUTS 3-level), we find a positive relationship between the share of family firms in a particular region and the innovation activity in that region. Innovation activity is measured by the number of successful patent applications (Acs and Audretsch 1989; Ejermo 2009). To avoid confounding the effects of family capitalism with other determinants of regional innovation activity (Fritsch and Slavtchev 2008; Koschatzky and Sternberg 2000), we include several controls in our regressions, such as regional industry structure, regional levels of human capital, start-up activity and R&D investments. Hence, the key result of our study is that the higher the family firm intensity in a particular region, the greater the innovation activity in that region. Prior research suggests that a higher level of regional innovation activity shall also have a positive effect on regional economic development (Aghion and Howitt 1992; Audretsch and Thurik 2001; Romer 1990; Schumpeter 1942; Vaz and Nijkamp 2009).

The remainder of the paper is organized as follows. Section 2 conceptualizes the link between family capitalism and regional innovation activity. Section 3 describes the context of our empirical study, the German *Mittelstand*. Section 4 introduces the data and the methods used in

the empirical analysis. A map illustrates regional family firm and patenting intensity in Germany. Section 5 provides the regression results and a number of robustness checks. Finally, Section 6 concludes and discusses implications for theory and practice.

2. Family capitalism and its effect on regional innovation activity

2.1 Regional innovation systems

We shall use the concept of regional innovation systems to conceptualize the link between family capitalism and regional innovation activity. The concept of regional innovation systems can be used to explain patterns and processes of innovation at the regional level (Acs 2000; Cooke 2001). A regional innovation system can be described as a system in which firms and other organizations learn systematically and interactively through an institutional environment of a particular region (Cooke, Uranga, and Etxebarria 1998). The institutional environment leads firms to accept common norms, values, expectations, attitudes and practices (Gertler, Wolfe, and Garkut 2000). Different factors are found to support the development of regional innovation systems. Most importantly for our paper, innovation is regarded as a *social process*; innovation is the result of constant interaction among different economic actors (Dosi 1988; Edquist 1997). These actors include (small and large) firms, universities and research institutes, technology transfer agencies, local government, and (public and private) funding institutions (Cooke, Gomez Uranga, and Etxebarria 1997). Frequent and constant interaction among these actors favours the development of regional innovation networks, clusters and research cooperatives (Asheim 2002). A cooperative culture, learning orientation and quest for consensus have a positive impact on the potential of regional innovation systems, whereas a competitive culture, individualism and a 'not invented here' attitude have a negative impact (Cooke 2001). At the organizational level of the firm, Cooke (2001) further argues that firms with trusting labour relations, shop floor cooperation, worker welfare orien-

tation and openness to external knowledge favour the development of regional innovation systems. In particular, through bi- and multilateral cooperation with universities and other research institutes, firms can gain access to basic knowledge and competencies outside their own domain. Prior studies suggest positive effects of R&D cooperation on innovation and firm performance (Becker and Dietz 2004; De Propris 2002; Faems, Van Looy, and Debackere 2005; Okamuro 2007).

2.2 The role of family firms in regional innovation systems

Family firms differ from non-family firms regarding their levels of long-term orientation and local embeddedness. Both aspects lower the transaction and coordination costs of research cooperatives (Becker and Dietz, 2004; Okamuro, 2007). As a result, research cooperatives become more likely and more lasting, and the probability for a productive regional innovation system increases.

One of the great attributes of family firms is their ability to think of the long term. Dedicated family firm owners aim to transfer ownership from one generation to the next (James 1999; Le Breton-Miller and Miller 2006). Following this goal, family firm owners care more about the firm's long-term perspective than other owners do; they do not strive to maximize the firm's short-term profits. Long-term orientation is important for innovation. The fruits of research and innovation are uncertain and risky and often occur years after the investments in innovation have been made (Scherer 1998; Scherer and Harhoff 2000). In other words, the costs of innovation are incurred in the near term, whereas the payoffs from innovation are likely to occur only over the long term. This situation can lead to a problem of managerial myopia in which an underinvestment in R&D may occur (Hall 2002; Narayanan 1985). As noted above, successful research cooperatives require a long-term perspective. A longer time horizon leads to a decrease in transaction and coordination costs for the research

cooperatives (Becker and Dietz 2004; Okamuro 2007). Family firm owners, as 'dedicated owners' (Porter 1992; Porter 1998), will seek to develop lasting research cooperatives with other local firms and organizations. Their strong degree of long-term orientation also makes family firms attractive partners for research cooperatives. For example, in times of financial stress, family firms are considered reliable cooperative partners that are less likely to cut investments in research and end promising cooperatives. Because of their local roots and their strong ties to local partners, they are also less likely than other firms to act opportunistically.

Our second argument refers to the social interrelation between family firms and their regional environment. We argue that family firm owners have stronger ties to their local environments and are thus more locally embedded relative to other firm owners (Astrachan 1988; Block 2010b; Déniz and Suárez 2005). Most family firm owners grew up in the region in which their firm is located. They are well known to the local community in which their firm is located and, over the years, the families have developed strong relationships with the regions in which they live. As with long-term orientation, local roots and a strong embeddedness in the region help to identify valuable sources of knowledge and strengthen the regional system of innovation, which then leads to a higher level of innovation activity (Cooke, 2001).

3. Background: The German "Mittelstand"

To understand the context of our study, a short introduction to the term *Mittelstand* and its characteristics is provided. The term *Mittelstand* dates back to the Middle Ages when the German word *Stand* described an individual's socio-economic status. Three levels of status were distinguished: clergy, nobility and stand, the bourgeoisie and the farmers. Later, the bourgeoisie were called *Mittelstand* to differentiate them from the farmers (Meyer-Stamer and Wältring 2000). Today, the term *Mittelstand* is often associated with the German *Wirtschaftswunder* (Germany's post-war economic success) and the success of the German

economy in general (Simon 1996). The *Mittelstand* was crucial to the development of structurally weak regions such as *Bavaria* and *Hesse* in post-war times (Ambrosius 1996). The *Mittelstand* is closely intertwined with the *Soziale Marktwirtschaft* (social market economy), which focuses on both social and market principles, stresses close bank-industry relationships and favours a system of private sector governance (Vitols 1997). In contrast to Germany, for example, France favoured the development of large firms (so-called national champions) and indicative planning (Parker 1999). International comparisons provide evidence for the high degree of importance of the *Mittelstand* in the German economy. Acs and Audretsch (1993, Table 12.1), for example, find that in the U.S., firms with fewer than 500 employees account for 35.2% of manufacturing employment; the share in the UK is 39.9%, and the share in Germany is 57.9% (Fritsch 1993). In a similar vein, Klein (2000) reports that close to 60% of all companies in Germany can be categorized as family firms.[3]

What constitutes the typical *Mittelstand* firm? The term *Mittelstand* is often used with regard to *medium-sized firms*. However, to focus only on firm size as the defining characteristic falls short of an adequate description of the typical *Mittelstand* firm and may even be misleading. The corporate governance and socio-cultural factors, rather than the firm size (measured by number of employees or number of sales), describe the typical *Mittelstand* firm (Berghoff 2006). The large majority of *Mittelstand* firms are family-owned and/or family-managed. The management and control functions are usually combined, either assumed by one person or carried out by several persons belonging to the same family (Berghoff 2006). Thus, in contrast to large, publicly quoted firms, managers and owners in a *Mittelstand* firm are usually independent from the stock market and its influences. Because of their private ownership structure, many (relatively) large family firms that are market leaders in their respective fields still see themselves as part of the *Mittelstand*.

[3] Faccio and Lang (2002), La Porta, Lopez-de-Silanes and Shleifer (1999) and Maury (2006) provide further international comparisons.

The factors that contribute to the success of the *Mittelstand* are its long-term orientation, its embeddedness in the region, its close contact to customers, and its constant focus on innovation (Böttcher and Linnemann 2008; Simon 2009). Typical *Mittelstand* firms tend to concentrate on profitable niche markets in which high quality and customer-specified products are demanded (Berghoff 2006). In this regard, the term *hidden champions* has also been used. The term describes firms that are less well known to the public yet are very successful. They are often market leaders in their respective markets and almost always belong to the *Mittelstand* (Simon 2009). They employ approximately 2,000 people, and their key success factor is the high motivation of the employees, which is a result of a high degree of identification with the firm and its business. Over the last ten years, several *hidden champions* have grown and turned into large firms. As with other firms, they have internationalized their business and created many jobs abroad (Simon 2009). Their roots, however, are still in Germany and their respective region.

4. Data and method

4.1 Data sources and sample

Our units of observation and our sample are the 326 districts (*Kreise*) in West Germany (excluding West Berlin) in the year 2004 (NUTS 3-level). We restrict our analysis to West Germany because most of the East German districts are not comparable to West German districts in terms of firm structure (Kronthaler 2005). The centrally planned economy in socialist East Germany between 1945 and 1989 did not lead to an East German *Mittelstand* (Kaiser 1990). In fact, many family firms were taken over by the state and transformed into state-owned firms. In the robustness checks section, we show the results of regressions that combine East and West German data. The results are very similar.

For the 326 West German districts, we collected data such as regional population density, employment level and regional industry structure. The information is available from the Federal Office for Building and Regional Planning in Germany (*Bundesamt für Bauwesen und Raumordnung*). Additional regional data about regional firm density and start-up rate are included and were obtained from the *Gründungsatlas* (Fritsch and Brixy 2004). To measure regional innovation activity, we used the OECD REGPAT database to construct regional patent count variables (Maraut et al. 2008). REGPAT was created by the OECD and provides comprehensive information on patent applications. The data are linked to regions according to the inventor's and applicant's locations and can be categorized by the application and grant year. REGPAT relies on European Patent Office (EPO) data. For Germany, more than 99% of all patent applications are linked to a particular district.

Regional family firm density is calculated using data from the *Amadeus Database* (Bureau van Dijk 2010). The database includes all stock market-listed firms in Europe (42 countries) as well as the 250,000 largest European firms in terms of sales and assets. To obtain the proportion of family firms in the respective region, we focus on firms in which a family owns at least 25% of the equity (base year 2004).[4] The *Amadeus Database* reports the percentages of ownership of individual investors or families in the respective firms. The database reports also the locations of the headquarters. A manual search on the company websites and in the encyclopaedia of German family firms (Langenscheidt et al. 2009) was conducted to exclude firms owned by private equity investors or founders (Block 2010a; Miller et al. 2007; Scholes et al. 2009). Finally, to concentrate on firms in research-intensive industries, we consider only firms in *textile mills* (SIC 22), *chemicals* (SIC 28), *fabricated metals* (SIC 34), *industrial machinery* (SIC 35), *electronics* (SIC 36), *transportation equipment* (SIC 37), *in-*

[4] The legal structure is *not* a criterion. Moreover, the database includes both private and publicly listed family firms (Westhead and Howorth 2007).

struments (SIC 38), *manufacturing* (SIC 39) and *communications* (SIC 48). In sum, the selected family firms can be considered typical examples of the German *Mittelstand*.

The next section provides a detailed description of the family firms included in the sample.

4.2 Family firm data

We identified 513 West German family firms in innovative industries. The median firm has 173.5 employees (mean: 192.5 employees) and sales of €27.7 million (mean: €33.9 million). Many firms are active in the *industrial machinery* (SIC 35; 160 observations) and *fabricated metal*s industry (SIC 34; 150 observations). *Electronics* (SIC 36) ranks third with 70 observations. Regarding the legal form, 249 firms are organized as *GmbH & Co KG,*[5] 193 firms as *GmbH,*[6] 34 firms as *KG*, and 30 firms as *AG*. Only 16 firms are publicly quoted. In sum, these numbers show the representation of the family firm data for the population of German family firms or the *German Mittelstand* (Klein 2000).

4.3 Geographic distribution of family firms and innovation activity in West Germany

Figure 1 shows the geographic distribution of family firms in Germany. To this end, we calculate the *family firm intensity per district* (number of family firms per 10,000 inhabitants). There exists considerable variation in the number of family firms per district. A high family firm intensity exists, for example, in *North Rhine Westphalia*, where several districts have a family firm intensity larger than 0.3 (e.g., *Märkischer Kreis*, *Olpe*, *Solingen,* and *Hagen*). Among the 20 districts with the highest family firm intensity in Germany, 7 districts are located in *North Rhine Westphalia*. Additionally, there are several regions in *Bavaria* and *Baden-Württemberg* that indicate a family firm intensity larger than 0.3. In contrast to *North*

5 *GmbH & Co KG* is the German abbreviation for a limited partnership with a limited liability company as general partner.

6 *GmbH* is the German abbreviation for a limited partnership.

Rhine Westphalia, the family firm distribution in *Baden-Württemberg* is more homogeneous. In *Bavaria*, several districts do not include any family firms at all (e.g., *Deggendorf*, *Miesbach*, *Amberg,* and *Freyung-Grafenau*).

Figure 2 depicts the geographic distribution of innovation activity in Germany as measured by the *patenting intensity per district* (number of successful patent applications per 10,000 inhabitants). As with the family firm intensity, there exists substantial regional variation in patenting intensity. In general, the patenting intensity is higher in the south than in the north of Germany. The result is mostly driven by the two federal states of *Bavaria* and *Baden-Württemberg*. The latter state shows the highest patenting intensity around the district of *Rottweil* in the southwest and in the strip from *Stuttgart* to *Mannheim*. In *Bavaria*, a high patenting intensity can be found in the districts of *Ingolstadt*, *Augsburg*, *Garmisch-Partenkirchen* and *Munich*. Apart from the south of Germany, a high patenting intensity can also be found in *North Rhine Westphalia*, in particular in the districts of *Gütersloh*, *Oberbergischer Kreis*, *Mettmann*, and *Leverkusen*.

Figures 1 and 2 here

4.4 Variables

4.4.1 Dependent variable

The *number of granted patents* in the respective district is used as a proxy to measure regional levels of innovation activity. We use the applicant's location rather than the inventor's location to determine the respective district.[7] The applicant is usually a firm and not an individual person. As a basis for time, we use the application year of the granted patent. The

[7] The regression results may deviate because the inventor is not necessarily living in the same district as the firm in which s/he works. In 2001, the mean distance between the home and the employer was 17 kilometers (Kloas and Kuhfeld 2003).

time lag between the application year and the year in which the patent is granted is approximately four years (Hall, Jaffe, and Trajtenberg 2005). We use the application and not the granted year because we are interested in the innovation activity that leads to the patent application and not the legal process that follows.

In addition to the absolute number of patents per district, we calculate a patenting intensity variable (*patenting intensity*) by dividing the number of patents per district by the number of inhabitants in that district.

4.4.2 Independent variables

Our main independent variables are those concerning family firms. To allocate the family firms to a particular district, the zip code from the company's headquarters is used and assigned to one of the 326 districts. The variable *family firm intensity* refers to the number of family firms in a particular district divided by the number of inhabitants in that district.

To isolate the effect of family firm intensity on regional innovation activity, we include a number of control variables in our regressions, which have been used in prior research regarding the determinants of regional innovation activity (Fritsch and Falck 2007; Kronthaler 2005). Most importantly, we aim to control for the effect of large firms on regional innovation activity by constructing the variable *large public firm intensity*, which refers to the respective number of firms in the German stock market indices DAX, MDax, SDAX, and TechDAX divided by the number of inhabitants in that district. Further control variables are the following: the district population is measured by the number of inhabitants (*inhabitants*); the variable *population balance* shows how the population changes between 2002 and 2007. Furthermore, the variables *GDP per employed person* and *household income* (in €) refer to the economic situation in the various districts. *Start-up rate* indicates the entrepreneurial activity in a given region and can be seen as a mechanism of how knowledge spillovers are used

(Audretsch and Feldman 2004). *Firm density* reports the total number of firms per square kilometre. The variables *unemployment rate*, *industry structure* and *R&D employee rate* are included in the regression to control for local labour market characteristics. The variable *student rate* shows how many students are enrolled at a university divided by the district's number of inhabitants and is used as an indicator for human resources and potential firm-university knowledge spillovers. Finally, nine industry intensity variables are calculated as the number of firms in the particular industry divided by the total number of firms in that particular district. Table 1 explains the construction of our variables in detail.

Table 1 here

4.4.3. Method

The level of innovation activity is measured through granted patents. The variable *number of granted patents* has a count-data character, i.e., the outcome is a non-negative integer variable. To that end, three different regression models are estimated. First, we use an ordinary OLS model with the natural logarithm of *number of granted patents* as the dependent variable. The logarithm used as the distribution of the variable *number of granted patents* is strongly skewed and non-normal (kurtosis is 127). Second, to address the count-data character, a negative binomial regression is estimated. A poisson regression cannot be used as the likelihood ratio tests indicate a strong overdispersion ($p<0.01$) (Verbeek 2008). Third, we estimate an OLS regression using the natural logarithm of *patenting intensity* as the dependent variable.

5. Results

5.1 Descriptive analysis

The following descriptive results apply to 326 districts in West Germany. There are, on average, 18.4 granted patents per district. However, the distribution is highly skewed: the kurtosis is 127.5 (skewness is 10.2) and the median is 7 patents. The variable *patenting intensity* is calculated by dividing the number of granted patents per district by the number of inhabitants in that district. The variable shows a mean of 0.76. That is, on average, 0.8 patents are granted per 10,000 inhabitants. The highest number can be found in *Ludwigshafen am Rhein* (9.6 granted patents per 10,000 inhabitants), which is not surprising; BASF, one of the world's largest chemical companies, has its headquarters in that district.

The variable *family firm intensity* shows an average of 0.07 family firms per 10,000 inhabitants. Of the 326 districts, 112 do not contain any of the 513 identified family firms. The highest family firm density can be found in the district of *Märkischer Kreis, Northrhine-Westphalia* (0.78 family firms per 10,000 inhabitants).

In regards to the control variables, the following results stand out. The average number of inhabitants is 201,500. The population decreased by an average of 17 inhabitants between 2002 and 2007. The variables *household income*, *unemployment rate*, *start-up rate* and *industry structure* show a normal distribution, whereas the variables *GDP per employed person*, *firm density*, *R&D employee rate*, *student rate* and *innovation programs* are skewed. Table 2 shows descriptive statistics.

Table 2 here

5.2 Multivariate regression results

Table 4 shows OLS regressions for log (*patents*) and log (*patenting intensity*) as the dependent variables and a negative binomial regression for *number of patents* as the dependent variable. Table 3 shows a correlation matrix and the variance inflation factors (VIFs). The highest VIF is 2.01 (variable *household income*). The dependent variables in the regressions refer to the patenting activity in the respective region, our measures of regional innovation activity. To summarize our main result, the regressions show that regional family firm intensity has a positive influence on regional patenting activity.

Using log (*number of granted patents*) as the dependent variable, the variable *family firm intensity* shows a significant positive effect (Model I: β=1.04, $p<0.05$). That is, increasing the family firm intensity from 0.1 to 0.2 leads to a 10% increase in granted patents. When using log (*patenting intensity*) as the dependent variable, the effects are similar; the variable *family firm intensity* shows a significant positive effect (Model III: β=0.40, $p<0.05$).

A number of control variables show significant results. The variables *GDP per employed person*, *firm density*, and *R&D employee rate* have a significant positive effect on regional patenting activity. A higher unemployment rate shows a significant negative effect (Model I: β=-0.05, $p<0.05$; Model II: β=-0.06, $p<0.05$; Model III: β=-0.03, $p<0.01$). The variable *household income* has a significant positive effect in Model II, and the variable *student rate* shows a significant positive effect in Models I and II. Thus, a high level of education is positively associated with high regional innovation activity (Acs and Audretsch 1989). The variable start-up rate has a significant negative effect in Model II (β=-0.39, $p<0.05$). The variable *innovation programs* does not show significant effects in any of the models. Finally, the regions with a large share of firms in the *chemicals* and *industrial machinery* industries record a higher level of patenting activity than other regions. In sum, the results regarding the control variables confirm the results of previous studies regarding the determinants of regional inno-

vation activity (Acs, Anselin, and Varga 2002; Buesa et al. 2006; Fritsch and Slavtchev 2008; Koschatzky and Sternberg 2000).

Table 4 here

5.3 Robustness checks

We conducted two robustness checks (see Table 5 for an overview). First, we changed the size of the sample and included the districts from former East Germany (increasing the sample size from 326 to 438 districts). Second, we excluded districts with more than 500,000 inhabitants. The results of the two robustness checks are similar to the results of our main analyses (Table 4). The variable *family firm intensity* indicates a significant positive influence of regional family firm intensity on the level of patenting activity.

Table 5 here

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6. Conclusions

To summarize, our regressions show a positive relationship between regional family firm concentration and regional innovation activity while controlling for alternative explanations such as regional firm density and industry structure as well as levels of knowledge spillovers, entrepreneurship and human capital (Buesa et al. 2006; Fritsch and Slavtchev 2008; Koschatzky and Sternberg 2000). This result holds for various model specifications and changes in the family firm data used to calculate the family firm intensity variable.

This paper's findings refute the idea that family firms have a *negative* effect on economic development, as suggested by many prior works (e.g., Chandler 1977, 1990; Fogel 2006; Morck, Wolfenzon, and Yeung 2005; Morck and Yeung 2004). To the contrary, our findings suggest that family firms have a *positive* impact regarding regional economic development. To the best of our knowledge, our study is one of the first studies to analyse the effect of family firm intensity on a macro-level variable, namely regional innovation activity. Most prior research in the field of family business has been conducted at the level of the firm. This is surprising given the extensive discussion in the literature about the effects of family firms on the economy as a whole. Several avenues for further research exist. For example, it may be interesting to analyse the effects of family firm concentration on regional wealth or income disparity.

Our study points toward a *family firm innovation paradox*: on the firm level, past research has found that family ownership is associated with *lower* levels of innovation *input* that are measured by the degree of R&D spending (Block 2010a; Chen and Hsu 2009; Munari, Oriani, and Sobrero 2010) and lower levels of innovation *output* that are measured by the number of patents and patent citations (Block et al. 2010). The results of this paper, however, go in a different direction. Using regional level data, we find that family firms have a *positive* effect on regional innovation activity. We explain that this positive effect is due to family firms being more long-term oriented and more locally embedded than other types of firms (Astrachan 1988; Block 2010b; Déniz and Suárez 2005; e.g., Le Breton-Miller and Miller 2006; Lumpkin, Brigham, and Moss 2010; Zellweger 2007). Through their local embeddedness and long-term orientation, family firms constitute attractive and reliable research partners for local institutions such as universities, research institutes or other small and large firms. We argue that family firm concentration favours the development of regional innovation systems (Cooke 2001; Cooke, Uranga, and Etxebarria 1998), thus having a positive effect

on regional innovation activity. Further research is needed to explain the discrepancy between the differing effects of family ownership at the regional and firm levels. For example, it may be that family firms have a stronger community orientation and act less opportunistically in research cooperatives than do other firms, suggesting that they patent less on their own and are more willing to share the fruits of their joint research with their cooperative partners. It may also be that family firms rely more on other mechanisms, such as secrecy, to appropriate rents from innovation (Arundel 2001). More detailed research about the innovation strategies of family firms and their embeddedness in the local environment may shed more light on this issue.

The results of our study can help policy makers at the regional and national levels to develop successful innovation and growth strategies (Landabaso 1997; Landabaso and Reid 1999). From a policy perspective, family firms constitute attractive partners. Contrary to many large multinational firms, family firms are proud of their local roots and want to be strongly embedded in the local economy. The strong interrelation between the family firm and the local economy can lead to synergies in the creation and exploitation of innovation. Regional innovation policy may take advantage of these characteristics of family firms and promote networks between family firms and other institutions of regional innovation, such as universities, public research institutes, technology transfer agencies and innovation funding agencies. Creating an intensive and sustainable network between the *Mittelstand* and the local economy may constitute an effective innovation policy.

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Tables to be inserted in the text

Table 1: Description of variables

Variable	Description	Data source
Number of granted patents	Number of granted patents based on application year and applicant location (based on *grant* year or inventor location for robustness checks)	Maraut et al. (2008)
Log (number of granted patents)	Natural logarithm of (*number of granted patents* + 1)	Maraut et al. (2008)
Patenting intensity	*Number of granted patents* divided by *inhabitants* (in 10,000)	Maraut et al. (2008)
Log (patenting intensity)	Natural logarithm of (*patenting intensity* +1)	Maraut et al. (2008)
Family firm intensity	Number of family firms per inhabitants (in 10,000)	Bureau van Dijk (2010)
Large public firm intensity	Number of public firms that are listed in one of the German stock market indices (DAX, MDax, SDAX, TechDAX) divided by *inhabitants* (in 10,000)	Deutsche Börse Group (2004)
Inhabitants	Number of inhabitants (in 10,000)	Federal Office for Building and Regional Planning (2009)
Population balance	Difference between inhabitants in 2007 and 2002 divided by inhabitants (in 100) in 2002	Federal Office for Building and Regional Planning (2009)
GDP/employed person	Gross domestic product per employed person in €1,000	Federal Office for Building and Regional Planning (2009)
Household income	Household income in € per inhabitant	Federal Office for Building and Regional Planning (2009)
Unemployment rate	Number of unemployed persons divided by employed persons (in 100)	Federal Office for Building and Regional Planning (2009)
Start-up rate	Number of start-ups divided by inhabitants (in 1,000)	Fritsch and Brixy (2004)
Firm density	Number of firms divided by district area (in km²)	Fritsch and Brixy (2004), Statistische Ämter des Bundes und der Länder (2010)
R&D employee rate	Number of R&D employees divided by total employees (in 1,000)	Federal Office for Building and Regional Planning (2009)
Students rate	Number of students enrolled at a university divided by inhabitants (in 1,000)	Federal Office for Building and Regional Planning (2009)
Innovation subsidies	Granted loans (in €1,000) by the KfW Bankengruppe (German Development Bank) to support innovation divided by inhabitants	Federal Office for Building and Regional Planning (2009)
Industry intensity variables	Firms per industry divided by all firms; 9 categories (communications, manufacturing, instruments, transportation equipment, electronics, industrial machinery, fabricated metals, chemicals, textile mills)	Bureau van Dijk (2010)

Table 2: Descriptive statistics

Variables	Mean	Median	S. d.	Min.	Max.	Skewness	Kurtosis
Number of granted patents	18.4	7	52.69	0	743	10.19	127.48
Log (number of granted patents)	2.11	2.08	1.21	0	6.61	0.32	3.14
Patenting intensity	0.76	0.44	1.09	0	9.55	4.07	25.30
Log (patenting intensity)	0.46	0.37	0.40	0	2.36	1.62	6.36
Family firm intensity	0.08	0.05	0.10	0	0.67	2.17	10.27
Large public firm intensity	0	0.015	0.04	0	0.39	4.29	30.15
Inhabitants (in 10,000)	20.15	15.05	17.25	3.55	173.48	4.02	28.41
Population balance	-0.17	-0.20	2.06	-5.90	6.5	0.07	3.2
GDP per employed person	56.00	54.65	7.33	39.5	116.2	2.65	17.85
Household income	1,480.94	1,456.50	153.85	1,203.00	2,200.00	1.14	5.45
Unemployment rate	6.33	6.15	1.86	3.00	13.5	0.80	3.71
Start-up rate	1.73	1.66	0.33	1.00	3.07	1.05	4.59
Firm density	10.60	4.13	13.27	0.87	95.54	2.28	9.92
R&D employee rate	9.51	5.70	11.75	0	85.1	2.94	13.92
Students rate	20.54	0.20	41.47	0	235.3	2.76	10.92
Innovation subsidies	0.05	0.02	0.08	0	0.59	3.40	17.96
Textile mills intensity	0.01	0	0.03	0	0.20	4.73	27.53
Chemicals intensity	0.03	0	0.04	0	0.29	2.30	11.12
Fabricated metals intensity	0.06	0.05	0.07	0	0.67	2.80	20.77
Electronics intensity	0.03	0.01	0.04	0	0.30	2.36	10.98
Transportation equipment intensity	0.02	0	0.04	0	0.20	2.43	9.39
Instruments intensity	0.01	0	0.03	0	0.24	3.77	21.46
Manufacturing intensity	0.01	0	0.02	0	0.22	4.79	30.98
Communications intensity	0.00	0	0.01	0	0.06	6.17	44.34

N=326 districts; S. d.=Standard deviation

Data sources: Fritsch and Brixy (2004), Maraut et al. (2008), Federal Office for Building and Regional Planning (2009), Statistische Ämter des Bundes und der Länder (2010), Bureau van Dijk (2010)

Table 3: Correlations

	Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	VIF
(1)	Number of granted patents																							
(2)	Log (number of granted patents)	0.57																						
(3)	Log (patenting intensity)	0.57	0.84																					
(4)	Family firm intensity	0.03	0.21	0.22																				1.65
(5)	Large public firm intensity	0.26	0.31	0.29	0.02																			1.68
(6)	Population in 10,000	0.57	0.56	0.19	-0.02	0.22																		1.48
(7)	Population balance	0.25	0.27	0.22	-0.04	0.18	0.22																	1.99
(8)	GDP per employed person in 1,000 EUR	0.38	0.51	0.48	0.04	0.46	0.32	0.30																1.93
(9)	Household Income	0.30	0.46	0.39	0.32	0.27	0.30	0.33	0.44															2.01
(10)	Uneployment rate	-0.07	-0.17	-0.18	-0.19	-0.02	0.06	-0.41	-0.15	-0.38														2.62
(11)	Startup rate	0.19	0.10	0.17	-0.07	0.20	0.09	0.35	0.24	0.28	0.15													1.67
(12)	Firm density	0.51	0.38	0.34	-0.07	0.28	0.43	0.22	0.38	0.25	0.41	0.48												2.93
(13)	R&D employee rate	0.40	0.45	0.53	0.04	0.16	0.16	0.17	0.39	0.21	-0.12	0.02	0.22											1.33
(14)	Students rate	0.13	0.17	0.19	-0.05	0.19	0.08	0.27	0.07	0.04	0.24	0.31	0.50	0.15										1.63
(15)	Innovation subsidies	0.02	0.15	0.19	0.31	0.05	-0.07	0.10	0.04	0.18	-0.24	0.00	-0.06	0.13	-0.05									1.27
(16)	*Textile mills* intensity	-0.03	0.02	0.04	0.05	-0.08	-0.06	-0.06	-0.07	-0.03	-0.03	-0.02	-0.10	-0.04	-0.04	0.08								1.04
(17)	*Chemicals* intensity	0.04	0.17	0.18	0.02	0.02	0.05	0.15	0.18	0.10	-0.10	0.06	-0.02	0.05	0.01	0.00	-0.04							1.13
(18)	*Fabricated metals* intensity	-0.05	0.06	0.03	0.42	-0.08	-0.04	-0.19	-0.13	0.06	-0.20	-0.26	-0.20	-0.06	-0.15	0.15	0.07	-0.07						1.45
(19)	*Industrial machinery* intensity	-0.02	0.10	0.15	0.21	-0.13	-0.09	-0.05	-0.06	0.03	-0.11	-0.10	-0.09	0.05	-0.06	0.22	-0.01	-0.14	0.07					1.20
(20)	*Electronics* intensity	-0.01	0.06	0.05	0.22	-0.04	-0.02	0.00	-0.02	0.11	-0.09	-0.03	-0.10	0.08	-0.08	0.16	-0.07	-0.02	0.03	-0.05				1.15
(21)	*Transportation equipment* intensity	-0.03	-0.10	-0.02	0.06	-0.08	-0.10	-0.02	0.06	-0.02	-0.02	-0.08	-0.04	0.11	-0.04	-0.02	-0.01	-0.05	0.01	-0.04	-0.02			1.08
(22)	*Instruments* intensity	0.03	0.17	0.14	0.26	0.03	0.02	0.10	0.10	0.20	-0.22	-0.04	-0.08	0.11	0.02	0.22	0.03	0.07	0.22	0.07	0.14	0.01		1.19
(23)	*Miscellaneous manufacturing* intensity	-0.03	-0.02	0.00	0.06	-0.03	-0.08	-0.01	0.03	0.00	-0.08	-0.10	-0.10	-0.01	-0.12	0.11	0.01	-0.10	0.01	-0.04	-0.02	0.00	-0.03	1.08
(24)	*Communications* intensity	0.14	0.19	0.16	-0.01	0.50	0.16	0.17	0.27	0.25	-0.01	0.27	0.27	0.01	0.13	0.01	-0.05	-0.02	-0.07	-0.05	-0.04	-0.05	-0.02	1.44

Note: N=326 districts; absolute values larger than 0.11 are significant on a 5% level; VIF=variance inflation factor based on Model I in Table 4; correlations refer to the Pearson correlation coefficient.

Table 4: Regressions on innovation activity

	Model I: OLS			Model II: Neg. bin			Model III: OLS		
Dependent variables	**Log (number of granted patents)**			**Number of granted patents**			**Log (patenting intensity)**		
Independent variables	**Coeff.**	**SE**		**Coeff.**	**SE**		**Coeff.**	**SE**	
Family firm indicator									
Family firm intensity	1.04	(0.48)	**	1.20	(0.58)	**	0.40	(0.19)	**
Control variables									
Large public firm intensity	1.38	(1.35)		0.89	(1.56)		0.78	(0.66)	
Population in 10,000	0.03	(0.00)	***	0.03	(0.00)	***	0.00	(0.00)	
Population balance	-0.02	(0.03)		-0.01	(0.03)		-0.01	(0.01)	
GDP per employed person in €1,000	0.03	(0.01)	***	0.03	(0.01)	***	0.01	(0.00)	**
Household income	0.65	(0.42)		1.03	(0.42)	**	0.14	(0.16)	
Unemployment rate	-0.05	(0.03)	**	-0.06	(0.03)	**	-0.03	(0.01)	***
Start-up rate	-0.23	(0.17)		-0.39	(0.19)	**	0.03	(0.06)	
Firm density	0.01	(0.01)	***	0.02	(0.01)	***	0.01	(0.00)	***
R&D employee rate	0.02	(0.01)	***	0.03	(0.01)	***	0.01	(0.00)	***
Students rate	0.00	(0.00)	*	0.00	(0.00)	**	0.00	(0.00)	
Innovation subsidies	0.31	(0.57)		0.20	(0.60)		0.08	(0.23)	
Textile mills intensity	3.10	(1.97)		4.62	(2.21)	**	1.19	(0.84)	
Industrial machinery intensity	2.41	(0.64)	***	2.56	(0.76)	***	0.89	(0.23)	***
Chemicals intensity	3.96	(1.12)	***	3.62	(1.08)	***	1.46	(0.52)	***
Fabricated metals intensity	1.29	(0.84)		1.15	(0.98)		0.25	(0.30)	
Electronics intensity	1.14	(1.16)		0.65	(1.32)		0.20	(0.41)	
Transportation equipment intensity	-2.43	(1.21)	**	-2.90	(1.64)	*	-0.53	(0.43)	
Instruments intensity	1.07	(1.43)		0.48	(1.49)		0.10	(0.58)	
Manufacturing intensity	1.80	(1.36)		1.34	(1.81)		0.52	(0.54)	
Communications intensity	5.21	(8.15)		7.46	(8.82)		0.31	(3.49)	
Constant	-0.92	(0.73)		-1.36	(0.84)		-0.44	(0.26)	*
Diagnostics									
F-Test	21.59***						13.37***		
R^2	0.62						0.51		
Wald chi^2				405.59***					
Log pseudolikelihood				-1,052.16					
/lnalpha				-0.65	(0.10)	***			

Notes: N = 326 observations. Robust standard errors (SE) in parentheses.

Significance levels: * $0.05 < p \leq 0.1$; ** $0.01 < p \leq 0.05$; *** $p \leq 0.01$; two-sided tests.

Table 5: Robustness checks

Model	OLS		Neg. bin.		OLS	
Dependent Variables	Log (number of granted patents)		Number of granted patents		Log (patenting intensity)	
Robustness checks and variable of interest	**Coeff.**	**SE**	**Coeff.**	**SE**	**Coeff.**	**SE**
East and West Germany combined (438 districts)						
Family firm intensity	1.00	(0.47) **	1.22	(0.56) **	0.43	(0.17) ***
Only districts < 500,000 inhabitants are used (309 districts)						
Family firm intensity	0.87	(0.46) *	0.97	(0.57) *	0.38	(0.19) **

Note:
N=326 districts; the same control variables as in Table IV are used; Robust standard errors (SE) in parentheses; significance levels: * $0.05 < p \leq 0.1$; ** $0.01 < p \leq 0.05$; *** $p \leq 0.01$; two-sided tests.

Figures to be inserted in the text
Figure 1: Geographic distribution of family firms in West Germany

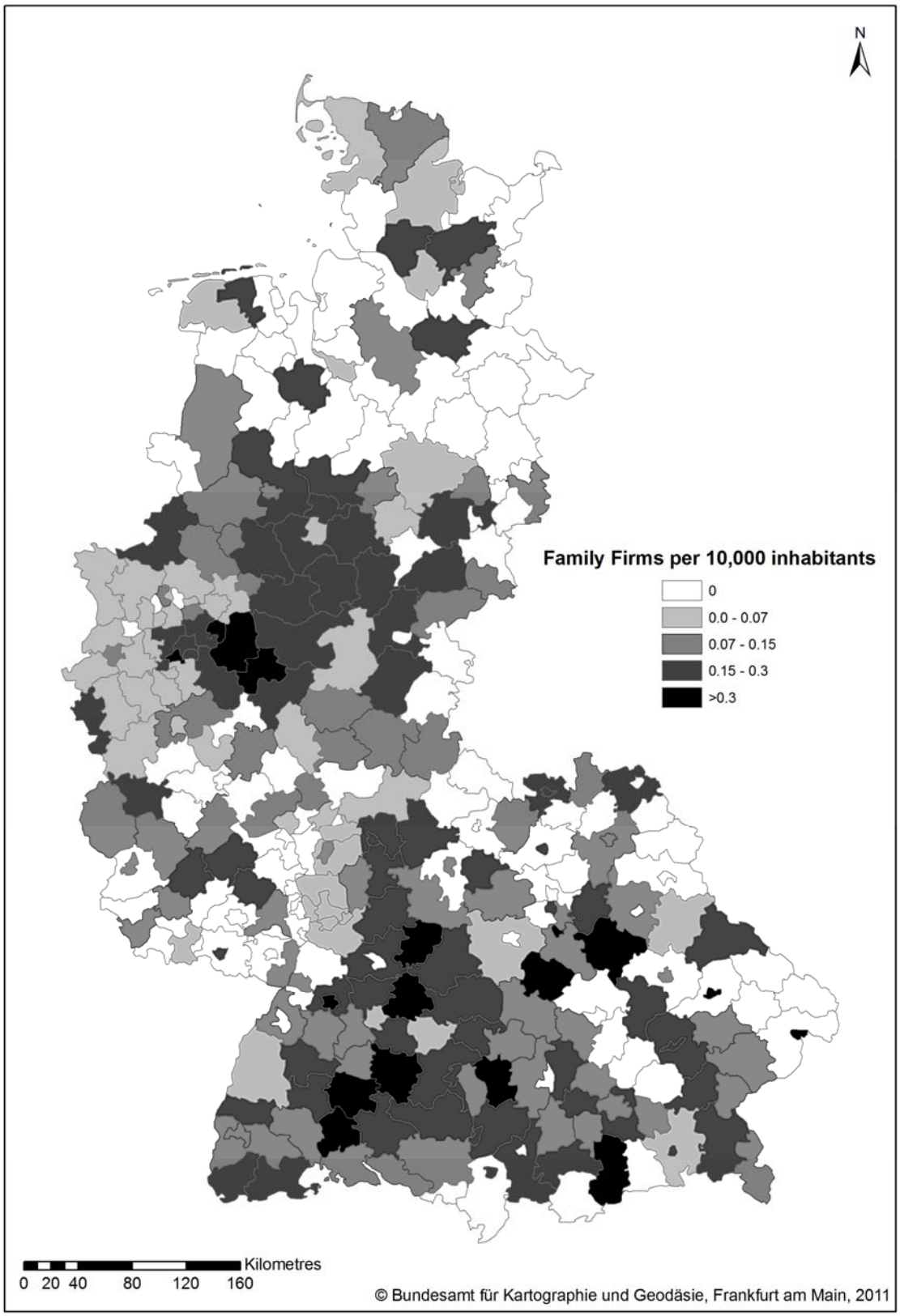

Figure 2: Patenting intensity in West Germany