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New Business Formation and Incumbents' Perception of Competitive Pressure

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Abstract

We investigate the relationship between new business formation and the level of competitive pressure perceived by manufacturing incumbent establishments. The perceived pressure of competition is stronger the higher the level of entries in the respective industry. This relationship holds not only for start-ups located in the same region of the incumbent, but also for start-ups across all regions of Germany. The productivity level of an incumbent moderates the extent of the perceived competitive pressure from start-ups. Highly productive incumbents are less threatened by new business formation. Such a moderating effect cannot be found for incumbent size and regional population density.

JEL classification: L26, L60, D20, O12, R11

Keywords: New business formation, competitive pressure, regional competition, incumbent firms, manufacturing industries

1. Introduction[1]

The pressure that newly entering businesses impose on the incumbents is at the core of the Schumpeterian perspective of entrepreneurship often characterized as creative destruction.[2] As a reaction to this competitive pressure generated by entry, some incumbents will improve their performance by introducing innovations, while others may be forced to downsize or even exit the market. A number of empirical studies have investigated the effect of entry on the performance of industries, growth of regions, and also on single incumbent firms or establishments.[3] The majority of these studies find that the complex market process initiated by the newly emerging competitors results in more or less pronounced positive effects for the respective industry and region that often become apparent only with a time lag of several years. This finding is not limited to the particularly challenging entry of advanced, innovative, or large establishments,[4] but also holds for new business formation in general (for an overview see Fritsch 2013). But still, the way in which the positive effects influence growth are not very well understood.

Given that most new businesses are rather small scale (Schindele and Weyh 2011) and show relatively low productivity levels (Wagner 2009), it is unclear to what extent general entry (not just the entry of particularly challenging or large firms) is able to pose a significant competitive challenge on the incumbents. Moreover, it is rather unclear what type of incumbent is more likely to associate newly emerging firms with high levels of pressure from competition. Is the competition between

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[2] For formalizations of the concept of creative destruction (Schumpeter 1934, 1942) see Aghion and Howitt (1992, 1998) and Aghion, Howitt and Mayer-Foulkes (2005).

[3] See Section 2 for an overview of the available empirical evidence.

[4] See for example Aghion and Bessonova (2006), Aghion et al. (2009), Czarnitzki, Etro and Kraft (2008), and Greenstone, Hornbeck and Moretti (2010).

entry and incumbents mostly between smaller businesses (Hannan and Freeman 1977), or do large firms perceive similar levels of competitive pressure from start-ups? An answer to such questions can be detected only by an analysis at the micro-level of firms or establishments.

This paper analyzes the relationship between new business formation and the competitive pressure that is perceived by incumbent businesses at the micro-level of establishments in manufacturing industries. Investigating the perceived competitive pressure should be particularly revealing for at least two reasons. First, in the cognitive logic of decision making, the perceived pressure of competition is a first step of the market interaction between the newcomers and the incumbents (Fouskas and Drossos 2009; Kemp and Hanemaaijer 2004; Tang 2006). In particular, it can be regarded as a good predictor of competitive responses. Hence, analyzing competition at this rather early stage will reveal the impact of new business formation on incumbents more clearly than investigating this relationship with innovation and productivity responses from incumbents that often becomes apparent only after a longer time lag (Fritsch 2013). Second, an analysis of the effect of entry on the performance of firms, industries or regions after a certain period of time may reflect the competitive pressure of new business formation only incompletely, because it disregards exits of poorly performing firms during the observation period.

In this paper we specifically contribute to three questions. First, at the micro-level of establishments we analyze the extent to which new business formation in general (not only the entry of particularly large and innovative firms) affects the competitive pressure that is perceived by incumbent businesses. Second, we investigate if the perceived pressure of competition is more intense in highly urbanized regions, and if it is moderated by incumbent internal characteristics such as size and productivity. In particular, we are interested in determining if this perceived pressure is more intense for the smaller and less productive incumbents. Finally, we test whether or not the potential effect of new business

formation is restricted to or more pronounced in the region where it occurs, as it has been widely argued in the literature.

We find robust evidence that the effect of new business formation on an incumbent's perceived pressure of competition is positive and statistically significant for start-ups in the respective industry and region. More importantly, this positive effect of general new business formation is not limited to the region where the new businesses are established. The analysis also reveals a number of the characteristics of the incumbents that have a statistically significant effect on the generally perceived pressure of competition. These characteristics include the size of a business, its productivity level, the qualification of the workforce, export intensity, as well as the state of machinery. While the pressure of competition imposed by start-ups on incumbents is similar across incumbents regardless of their size or the population density of the region where entry occurs, we find evidence that more productive incumbents are less threatened by start-ups than low productive incumbents.

The remainder of the paper is organized as follows. Section 2 provides an overview of related empirical evidence, and in Section 3 we discuss factors that may shape incumbents' perceived pressure of competition. Section 4 describes the methodology, data and variables. The results and their interpretation are presented in Section 5. The final section concludes and identifies some important avenues for further research.

2. Evidence of previous studies

There is a widespread belief that new business formation plays an important role for economic development (see, for example, Aghion and Howitt 1992; Baumol 2004; Schumpeter 1934). Indeed, several empirical studies based on aggregated data find a positive and significant effect of general new business formation on average productivity and employment in the respective industry[5], region, or country[6]. This improved performance

[5] E.g., Baldwin (1995); Caves (1998); Disney, Haskel and Heden (2003); Foster, Haltiwanger and Syverson (2001); Foster, Haltiwanger and Krizian (2006).

is partly a result of market selection, i.e., more productive newcomers replacing less productive incumbents, and is partly due to improvements made by the incumbents. Disney, Haskel and Haden (2003), in an analysis based on data from the UK, estimate that about 50 percent of the increased total factor productivity in manufacturing industries in the 1980-92 period is due to entry and exit of firms. The remaining 50 percent is generated by incumbent firms (see also Nickell 1996). Based on a regional analysis of West Germany, Fritsch and Noseleit (2013a) estimate that about 60 percent of the overall positive effect of start-ups on employment occurs in incumbent firms, indicating that employment generated by start-ups constitutes less than 50 percent of new employment. This clearly indicates that the competitive pressure that new business formation imposes on incumbents plays an important role for the positive effect of start-ups on economic development.

Empirical micro-level evidence on the effects of market entry on incumbent firms is rather scarce and mostly limited to entry of highly efficient or large firms. For example, Aghion et al. (2004, 2009) investigate the effect of entry of multinational firms on the productivity and innovation output of domestic incumbents in the UK. They find a positive and significant relationship between foreign firm entry and a subsequent increase of labor productivity of incumbents. However, not all incumbent firms react to the competitive pressure imposed by the entrants in the same way. Aghion et al. (2004; 2009) conjecture that the type of reaction to the competitive threat of entries depends on the distance of a firm from the technological frontier. They state that: “Threat of technologically advanced entry encourages incumbent innovation and productivity growth in sectors that are initially close to the technological frontier, whereas it may discourage incumbents in sectors further behind the frontier.” (Aghion et al. 2009, 31). Greenstone, Hornbeck and Moretti (2010) focus on particularly challenging entry by investigating the effect of 47 newly set up

[6] E.g., Bosma (2011); Bosma, Stam and Schutjens (2011); Brixy (2014); Callejon and Segarra (1999); Carree and Thurik (2008); for an overview on the empirical evidence at the level of regions see Fritsch (2013).

manufacturing Million Dollar Plants in the US on all incumbent manufacturing plants in the respective region (county). Comparing the development of incumbent productivity in similar regions that did not experience the opening of a Million Dollar Plant, they find that incumbent productivity five years after the opening of the new plants is about 12 percent higher than in the comparison regions.

While it seems plausible to assume that the entry of technologically advance or large firms imposes competitive pressure on the incumbent suppliers in the market, there is no empirical evidence indicating the extent to which new business formation in general is able to impose such pressure. We are aware of only two related studies that have empirically analyzed the effect of new business formation in general on the performance of incumbents at the micro-level of firms or establishments. Both studies (Andersson, Braunerhjelm and Thulin 2012; Fritsch and Changoluisa 2016) find a positive effect for start-ups in the region where the incumbent is located, but they differ with regards to the spatial scope of this effect. While Andersson, Braunerhjelm and Thulin (2012) ignore the possibility that incumbent productivity could be influenced by start-ups from other regions, Fritsch and Changoluisa (2016) present evidence that new business formation in the same industry does have an effect on the performance of incumbent establishments in other regions. This latter result, however, seems to contradict the available analyses of the effect of new business formation at the aggregate level of regions that clearly show that this effect is highly concentrated in the region where the new businesses are set up (Fritsch 2013).

The reasons for such a regional concentration of the effects of entry on incumbent establishments are, however, not entirely clear. Bosma, Stam and Schutjens (2011) argue that competitive challenges by newly emerging firms are better recognized if entry occurs in close proximity. This consideration is in line with Braha et al. (2011) who argued that the probability of two firms being direct competitors declines with geographical distance. Fritsch and Changoluisa (2016) argue that a regional

concentration of the effects of new business formation is mainly due to the additional competition of the newcomers for local inputs such as the labor market and the market for floor space, while the effect of competition on output markets is not particularly concentrated in the respective region.[7] Since our indicator for the pressure of competition as perceived by representatives of manufacturing incumbent establishments clearly reflects the competition on the output market, we cannot analyze the effect of additional competition on the input market here.[8]

3. Entry and competition—Hypotheses

3.1 The effect of entry on the perceived pressure of competition

While the few mentioned micro-studies investigate the effect of entry on the factual performance of incumbents, we are not aware of any empirical evidence that addresses the effect of new business formation on the perceived pressure of competition. Based on the available evidence for the effects of new business formation on the performance of incumbents, we expect that the level of entry in the respective industry increases the perceived intensity of competition. Following Fritsch and Changoluisa (2016), we assume that this effect is not limited to start-ups in the same region, but applies to all start-ups in the same industry. Hence, we will test the following hypotheses:

Hypothesis 1 Output market competition: The higher the level of new business formation in an industry the higher the perceived competitive pressure of incumbents that operate in that industry.

[7] Fritsch and Changoluisa (2016) distinguish between competition on the output market and competition on the input markets. They assume that entries into the same industry primarily represent competition on the output market since establishments that are affiliated with a certain industry tend to have similar products. Hence, new businesses in other industries should indicate competitive pressure mainly on markets for inputs. Fritsch and Changoluisa (2016) find that the effect of new business formation in the same industry (competition in the output market) on incumbent productivity is not limited to the respective region but applies for start-ups in all regions. In contrast, the effect of new businesses in all other industries (competition on the markets for inputs) is limited to the respective region.

[8] Indeed, we find no meaningful pattern between the perceived pressure of competition and new business formation in other industries.

Hypothesis 2 Regional concentration of output market competition: Same-industry start-ups that locate in the respective region of the incumbent are able to impose a more pronounced competitive pressure.

3.2 Incumbent's internal characteristics and regional density

There are two internal characteristics of incumbents that might moderate the effect of entry on competitive pressure: establishment size and productivity level. A main reason to expect that the perceived pressure of competition from start-ups is stronger for smaller businesses is that new businesses tend to begin at a relatively small scale and compete more intensively with other small firms rather than with larger ones (Hannan and Freeman 1977; Ranger-Moore et al. 1995; Bothner 2005). In line with this reasoning, Fritsch and Noseleit (2013b) found that the relationship between new business formation and regional growth is more pronounced in regions with a high employment share in small businesses. The authors argue that the reason for the stronger effect of start-ups on growth in small business regions is a higher intensity of competition between the newcomers and small incumbent firms. The respective hypothesis that we test states:

Hypothesis 3 Moderating effect of business size: The effect of same-industry start-ups on incumbents' perceived competitive pressure is moderated by the size of the incumbent; larger incumbents perceive lower levels of competitive pressure from start-ups.

Empirical research shows that new ventures generally show low productivity levels (Geroski 1995; Caves 1998; Disney, Haskel, and Heden 2003). Based again on the general argument that competition is more remarkable between firms of similar characteristics, we assume stronger competition between new firms and low productive incumbents. As a result of this stronger competition, we expect that incumbents with low productivity levels should perceive a higher competitive pressure from start-ups.

Hypothesis 4 Moderating effect of incumbent productivity level: Incumbent's productivity level moderates the degree to which start-ups impose competitive pressure. More productive incumbents perceive lower levels of competitive pressure from start-ups.

Since agglomerations have larger internal markets with a higher number of entries, as well as other incumbents located close by, the perceived competitive pressure in such regions should be generally higher than in sparsely populated rural areas. Diversified and thick input markets (Helsley and Strange 2011), a large knowledge base that provides rich opportunities for spillovers and abundant possibilities for personal face-to-face contact are typical characteristics of highly populated regions. These very characteristics may benefit the quality of start-ups making them more capable of imposing high levels of competitive pressure on the incumbents. Accordingly, the share of start-ups in high-technology and knowledge intensive industries in densely populated regions tend to be relatively high (Bade and Nerlinger 2000; Fritsch and Aamoucke 2013). Assuming that quality and number of entries is also higher in more densely populated regions, we expect that incumbent establishments located in such regions perceive relatively high competitive pressure that can be attributed to new businesses. Hence, if there is a positive relationship between population density and the challenging quality of start-ups, then, density could have a moderating role in the sense that the effect of new business formation on the perceived competitive pressure is stronger in agglomerations than in rural regions.

Hypotheses 5 Moderating effect of density: The effect of new business formation in the same industry is moderated by regional population density; the higher the population density the higher the perceived level of competitive pressure imposed by entrants.

4. Methodology

4.1 Data and spatial framework

We investigate the relationship between the level of new business formation and the competitive pressure that is perceived by incumbent

manufacturing establishments, particularly by those incumbents in the respective industry and region. The data for the incumbents' perceived level of competitive pressure and for the establishment level control variables are taken from the IAB Establishment Panel, a yearly survey conducted by the German Institute for Employment Research (Nuremberg) (for details see Kölling 2008). The IAB Establishment Panel is unbalanced due to some fluctuation of the establishments participating in the survey. The survey provides information on a representative sample of private-sector establishments from 1993 to 2012.[9] However, information about the level of competitive pressure perceived by representatives of the establishments, the dependent variable in our analysis, is only available for 1998, and from 2008 to 2012.

We classify those establishments that are at least 10 years old as incumbents. Information on yearly new business formation for the different manufacturing industries in the planning regions was obtained from the Establishment History File of the German Social Insurance Statistics. We use the specific industry classification of the Establishment History Files (WZ1973). Based on this industry classification system we distinguish 13 manufacturing industries; the level of aggregation is comparable to the NACE two-digit level. The identification of start-ups is based on newly emerging establishment numbers and on workflow analysis (for details, see Hethey and Schmieder 2010). The data originate from the notification process of the social security system and the internal procedures of the Federal Employment Agency. Since the Social Insurance Statistics only contains establishments with at least one employee (for a detailed description, see Spengler 2008), businesses that are run by just the founder with no dependent employees (solo self-employment) are not

[9] The average number of establishments in the survey is about 15,000 each year. Since we restrict the analysis to manufacturing establishments that are at least 10 years old, and due to missing values for independent variables, the average number of observations in our analysis is 6,040.

included.[10] Data on the number of incumbent establishments are taken from the Establishment History File of the German Social Insurance Statistics. Information on population density as well as on sales change at the industry level is taken from the publications of the German Federal Statistical Office.

The German planning regions form the spatial framework of our analysis. These regions are defined as functionally integrated spatial units in the sense of travel-to-work areas. The advantage of conducting the analysis at the level of planning regions as compared to smaller spatial units such as districts (Kreise) is that planning regions contain at least one core city and the surrounding area. Using these larger spatial units allows us to account for economic interactions between a center and the respective surroundings.[11]

4.2 Key variables

The *dependent variable* for all estimations of our analysis is the incumbent's perceived level of competitive pressure. This information is based on the individual responses of establishments' managers to a specific question in the IAB Establishment Panel as a categorical variable assuming values from "1 = no pressure of competition" to "5 = competition endangers the continued existence of the establishment".[12] As already mentioned in the introduction, this type of indicator has a number of advantages when compared to alternative measures. In particular, the

[10] Even though our data does not include solo self-employed, we do not consider this to be a problem since this phenomenon is very rare in manufacturing due to the considerable minimum efficient size in this sector.

[11] There are actually 97 planning regions in Germany. For administrative reasons, the cities of Hamburg and Bremen are defined as planning regions even though they are not functional economic units. In order to avoid distortions, we decided to merge these cities with adjacent planning regions. Hamburg is merged with the region of Schleswig-Holstein South and Hamburg-Umland-South. Bremen is merged with Bremen-Umland. Thus, the number of regions in our sample is 94.

[12] The respective question in the survey is: "How do you rate the pressure of competition that your establishment has to deal with? Is there... (1) no pressure of competition at all, (2) minor pressure of competition, (3) medium pressure of competition, (4) substantial pressure of competition, (5) competition endangers the continued existence of your company."

perceived pressure of competition is a first step of the market interaction between the newcomers and the incumbents in the cognitive logic of decision making and can, therefore, be regarded as a good predictor of competitive responses (Fouskas and Drossos 2009; Kemp and Hanemaaijer 2004; Tang 2006). Compared to indicators of market concentration such as the Herfindahl index or concentration ratios it considers the whole distribution of firms and is not limited to the upper tail (Deutsch and Silber 1995; Tang 2006). Since the levels corresponding to the perception of competitive pressure cannot be assumed to be equidistant among the range of respondents, the variable for the perceived pressure of competition is of ordinal character.

On average, the manufacturing establishments of our sample indicate a perceived level of competitive pressure of 3.53 (see Table A1 in the Appendix)[13]. Eighteen percent of the respondents perceive the highest level of competitive pressure, “endangering the continued existence of the establishment” (see Figure A1 in the Appendix). Thirty-three percent of the respondents perceive a substantial level of competitive pressure, the second highest in scale, and around 37 percent of the establishments perceive a medium level of competitive pressure. Only 3 percent perceive no pressure of competition. It is remarkable that the standard deviation of this variable at the establishment level is 0.99 (see Table A1) as compared to a value of only 0.122 for the variation across industries. This clearly indicates rather pronounced differences of the perceived competitive pressure within manufacturing industries. Due to this high intra-industry variation an analysis at the micro-level of establishments can be regarded as particularly relevant and revealing, as it allows us to capture the nature of these differences between establishments.

The number of start-ups in a certain region tends to parallel the size of the regional workforce that represents the pool of potential entrepreneurs. To avoid a possible correlation between the number of new

[13] Figures A1 and A2 in the Appendix are the overall averages of the available data for all of the years included in this study (1998, and 2008-2012).

businesses and the size of the regional workforce or population, we calculate start-up rates. The start-up rate is the number of start-ups in a certain industry divided by the workforce in the respective spatial category (the region, all regions, all other regions).[14] The measure for new business formation in a certain industry is the moving average of the start-up rates over the 10 years (t-1 – t-10) that preceded the measurement of an incumbent's perception of competitive pressure. The main reason for considering start-up activity over a period as long as 10 years is that new businesses require time to establish and reach a competitive level similar to that of incumbents (Geroski 1995). It is only after achieving this competitive level that new businesses will be able to impose pressure on the incumbents in the respective industry. In this sense, Verhoeven (2004) identified that start-ups in The Netherlands require a period of 7 to 8 years to reach the average productivity level of incumbents, and Wagner (2009) identified that start-ups in Germany require up to 10 years to attain the productivity level of the average incumbent (Fritsch 2013). Moreover, previous analyses of the effect of entry on productivity at the national, industry, or regional level find that a productivity increase often becomes visible only after several years. The start-up rate is included as a moving average in order to avoid multicollinearity problems that could arise from the strong correlation between start-up rates in successive years if the rates of each period would be included separately in the estimation.

[14] This methodology is in accordance with the labor market approach (Audretsch and Fritsch 1994).

4.3 Control variables

A number of additional factors may have an effect on the incumbents' perceived competitive pressure that cannot be specifically attributed to new business formation, but that should be controlled for in the empirical analysis. One such factor is the *size of the incumbent business* as measured by the number of employees. Since larger firms tend to operate in geographically larger and more diverse markets (Redding 2011, Wagner 2012) and are more likely to export, they are expected to have a greater number of competitors and experience generally higher competitive pressure. We explicitly account for export activities by including an incumbent establishment's *export intensity*. Another factor is the *incumbent's productivity level*. This factor can be expected to influence the generally perceived competitive pressure because incumbents with higher levels of productivity might deal with diverse market dynamics more successfully than incumbents with low productivity (Iacovone 2012). An incumbent's *state of machinery* may also play a role in the level of incumbents' perceive competitive pressure in general. It may be expected that incumbents with more modern machinery generally perceive lower levels of competition than those with machinery tending to obsolescence. Another measure for an establishment's competitiveness could be the *human capital intensity*, measured, for example, by the share of employees with a tertiary education. One may expect that establishments with a high level of human capital are generally better able to deal with the challenges of the competitive process. Hence, establishments with a high share of well qualified employees may perceive lower pressure of competition.

We include two variables that control for the general intensity of competition in an industry. One of these variables is the *number of incumbents in the respective industry*. Assuming that a large number of incumbent competitors leads to a relatively high intensity of competition in the respective industry, we expect this variable to have a positive effect on the perceived competitive pressure. The *overall development of an*

industry, as measured by the yearly change in sales,[15] may have an effect in at least two respects. First, it may reflect the level of technological and/or market opportunities, as well as the stage of an industry in its life cycle (Klepper 1997). According to the life cycle model one may expect that more dynamic industries at an early stage of development are characterized by rapid technological developments and provide relatively rich opportunities for improvement of productivity performance. Second, industries with growing demand may be characterized by a lower intensity of competition than industries that are faced with stagnant or shrinking demand.

The literature argues that high-density regions are characterized by more intense levels of competition (Duranton and Puga 2004; Glaeser and Gottlieb 2009). High *population density* may also indicate diverse factors of the regional environment, such as market thickness and level of input prices. Moreover, high specialization of a certain industry in a specific region, as indicated by the *location quotient* of that industry, may lead to relatively high levels of competition in that industry (Glaeser et al. 1992; and Ejermo 2005). The location quotient corresponds to the share of employment *Emp* in a 2-digit industry *s* and region *r* and time *t* over total employment in region *r*, relative to the share of employment in industry *s* over total employment at national level.

$$LQ_{s,r,t} = \frac{\left(\frac{Emp_{s,r,t}}{Emp_{r,t}}\right)}{\left(\frac{Emp_{s,t}}{Emp_{t}}\right)}$$

Furthermore, we include a dummy for a location in former socialist East Germany in order to capture the specific economic conditions in the two parts of the country, particularly those conditions that emerged from the transformation of the eastern part after reunification in 1990 (for details see Kronthaler 2005). In addition, we account for unobserved regional

[15] The information on the sales in manufacturing industries in Germany follows the WZ1973 classification and was obtained from the German Federal Statistical Office. We abstained from deflating this variable since industry-specific price indices are rather debatable and may add some additional noise to the data.

characteristics by including regional dummies. Finally, we consider year dummies to control for time-specific effects.

Table 1: Definition of variables

Variable	*Definition*	*Expected sign*
Establishment-level variables		
Incumbent's perceived level of pressure of competition $_{t=0}$	Level of the pressure of competition that an incumbent has to deal with. 1 (= no pressure of competition at all) to 5 (= endanger the continued existence).[a]	Dependent variable
Size (log) $_{t=0}$	Total number of employees.[a]	-
Export intensity (log) $_{t=0}$	Share of sales to foreign countries.[a]	+
Productivity level (log) $_{t=0}$	Value added per employee.[a]	-
State of machinery $_{t=0}$	Four dummy variables for the overall technological state of the plant and machinery based on an ordered categorical variable ranging from 1 (= state of the art) to 5 (= obsolete).[a]	+
Human capital (log) $_{t-0}$	Share of employees with a tertiary degree.[a]	-
Industry-level variables		
Number of incumbents (log) $_{t=0}$	Total number of incumbent establishments in the respective manufacturing industry and year in Germany.[c]	+
Industry sales change (log) $_{t=0}$	Change is real sales of the industry, t=0 - t-1 [c]	-
Regional-level variables		
Population density (log) $_{t=0}$	Total population per km^2.[c]	+
Localization economies (log) $_{t=0}$	Location quotient.[b]	+
Dummy location in East Germany $_{t=0}$	0 = incumbents located in West Germany and 1 = incumbents in East Germany.	+
Regional-industry-level variables		
Start-ups in the same industry and *region* (log) $_{t-1}$	10-year (*t-1 - t-10*) moving average of the start-up rate (number of start-ups in the same industry and region of the incumbent over number of employees in the respective region) in the respective industry and region of the incumbent.[b]	+
Start-ups in the same industry across all regions (log) $_{t-1}$	10-year (*t-1 - t-10*) moving average of the start-up rate (number of start-ups in the same industry of the incumbent over number of employees across all regions) in the respective industry of the incumbent across all regions in Germany.[b]	+
Start-ups in the same industry in all other regions (log) $_{t-1}$	10-year (*t-1 - t-10*) moving average of the start-up rate (number of start-ups in the same industry of the incumbent but in all other regions over number of employees in all other regions) in the respective industry of the incumbent in all other regions.[b]	+

Data sources: a: Establishment Panel; b: Establishment History File; c: German Federal Statistical Office.

Table 1 provides an overview of the variables in the analysis and the expected sign of the estimated coefficient based on the considerations in Section 3. For descriptive statistics and correlations between these variables see Table A1 and Table A2 in the Appendix.

4.3 Model specification

We investigate the relationship between new business formation and the level of competition perceived by incumbent establishments. Performing the analysis at the establishment level is particularly important for identifying regional effects.[16] Given that our dependent variable is measured on an ordinal scale, we employ ordered probit analysis (Greene 2012). We perform panel estimations with random effects that include dummies for the respective region, industry, and year in order to control for unobserved effects. The baseline empirical model is:

$$PC_{i,r,s,t}^{inc} = \alpha + \beta_1 start\text{–}up\ rate_{s,r,t} + X_{i,t} + Z_{r,t} + W_{s,t} + \mu_s + \gamma_r + \varepsilon_{r,t}$$

where $PC_{i,r,s,t}^{inc}$ represents the perceived pressure of competition of establishment *i* of industry *s* located in planning region *r* in year *t*. The 10-year (from t-1 to t-10) moving average of the *regional start-up rate* is our main explanatory variable. $X_{i,t}$ is a set of control variables at the establishment level, $Z_{r,t}$ is a set of control variables at the regional level, and $W_{s,t}$ represents control variables at the industry level. γ_r, μ_s, and λ_t are dummies to control for unobserved characteristics of the respective region, industry, and year; $\varepsilon_{r,t}$ is the error term.

In order to explore the importance of spatial distance between the new businesses and the incumbents, and to determine the degree to which the effect on incumbent perceived competitive pressure is more pronounced in the region where start-ups are located, we run separate models. The main explanatory variable for the first type of model includes the level of new business formation in the same industry as the incumbent

[16] In a firm-level analysis, the effects cannot be clearly assigned to regions if there are firms with plants in several different regions.

across all regions (Hypothesis 1: Table 2, models I and II). In a second step, this variable is substituted by the level of new business formation in the same industry and in the same region as the incumbent (Hypothesis 2: Table 2, model III). Finally, we also test for the effect of new business formation in all other regions, namely, start-ups in all regions except the region of the location of the incumbent.

5. Results

Table 2 presents the results of models that estimate the relationship between incumbents' perceived level of competitive pressure and the start-up rate in the respective industry in different spatial definitions. While Models I and II account for same-industry start-ups across all regions of Germany (Hypothesis I), Model III includes start-ups only in the region where the incumbent is located (Hypothesis II). Model IV includes the new businesses in all regions except the region of the incumbent and Model V considers only the start-ups that are located in adjacent regions (Hypothesis I).

We find a highly significant positive relationship between the number of start-ups in the same industry across all regions of Germany and an incumbent's perceived level of competitive pressure (Models I and II). If the measure of new business formation in the same industry is restricted to the start-ups in the region where the incumbent is located (Model III) the coefficient for the relationship with the perceived pressure of competition is considerably smaller. Excluding the start-ups in the same region as the incumbent, but accounting for new business formation in all other regions (Model IV) leads to about the same size of the estimated coefficient as in the models with the start-ups in all regions (Models I and II). In line with Hypothesis I, these results clearly indicate that the higher the level of new business formation in an industry, the higher the level of competitive pressure perceived by the incumbents of that industry. The results also show that this effect is nether restricted to nor is more pronounced for the start-ups that occur in the same region. In fact, in line

with Hypothesis I, the perceived pressure of competition is affected by new business formation in the industry in all regions.

There is a relatively high correlation between an establishment's size, its export intensity, and its share of employees holding a tertiary degree (human capital). In other words, larger incumbent establishments tend to be more export oriented and have a higher share of employees with tertiary degree. To avoid potential concerns that might arise from the relatively high correlation between these variables, we start the analysis with a model that does not include the control variable establishment size (Model I in Table 2) and include this variable only in Models II to IV. Accounting for establishment size leads to insignificance of the indicators for export intensity and human capital but the productivity level of the incumbent becomes statistically significant. However, the results for our main variable of interest, the level of new business formation, remains rather unaffected.

The negative coefficient for the incumbents' productivity level indicates that highly productive incumbents generally perceive lower levels of competitive pressure. Similarly, incumbents with high levels of human capital, as measured by the share of employees holding a tertiary degree, tend to perceive lower levels of competitive pressure (Model I, Table 2). Meeting our expectations, the coefficient for export intensity is significantly positive and statistically significant in Model I (Table 2) indicating that incumbents that are active in international markets generally face higher competitive pressure. An explanation for the positive relationship between the perceived pressure of competition and the share of exports could be that export markets face a higher number of competitors, and that this exposure to competition increases a firm's sensitivity to the activities of other firms in the market. The significantly positive coefficients for incumbents' size in Models II to V indicate that larger incumbents tend to

Table 2: Incumbents' perceived level of pressure of competition and new business formation in the respective industry

		I	II	III	IV
Start-ups in the same industry across all regions $_{t-1}$		0.244*** (2.72)	0.230*** (2.58)	-	-
Start-ups in the same industry and region (log) $_{t-1}$		-	-	0.124** (2.09)	-
Start-ups in the same industry in all other regions (log) $_{t-1}$		-	-	-	0.230*** (2.58)
Productivity level (log) $_{t=0}$		-0.018 (-0.49)	-0.089** (-2.24)	-0.091** (-2.25)	-0.089** (-2.24)
Human capital (log) $_{t=0}$		-0.062** (-2.24)	0.033 (1.01)	0.034 (1.06)	0.033 (1.01)
Export intensity (log) $_{t=0}$		0.083*** (4.43)	0.007 (0.37)	0.005 (0.27)	0.007 (0.37)
Size (log) $_{t=0}$		-	0.184*** (7.19)	0.186*** (7.28)	0.184*** (7.19)
Industry sales change (log) $_{t=0}$		0.004 (0.04)	0.005 (0.05)	-0.004 (-0.03)	0.005 (0.05)
Number of incumbents (log) $_{t=0}$		2.758** (2.21)	2.537** (2.06)	2.559** (2.08)	2.538** (2.06)
Population density (log) $_{t=0}$		2.757 (0.90)	2.426 (0.79)	2.036 (0.67)	2.444 (0.79)
Localization economies (log) $_{t=0}$		0.077 (1.27)	0.028 (0.46)	0.004 (0.07)	0.029 (0.47)
Dummy location (east=1) $_{t=0}$		1.167 (0.68)	1.091 (0.63)	0.860 (0.50)	1.101 (0.63)
State of machinery $_{t=0}$	1	Reference category			
	2	0.006 (0.10)	0.033 (0.58)	0.033 (0.58)	0.033 (0.58)
	3	0.182** (2.45)	0.254*** (3.50)	0.254*** (3.49)	0.254*** (3.50)
	4	0.307** (2.44)	0.395*** (2.99)	0.395*** (2.98)	0.395*** (2.99)
	5	0.806* (1.75)	0.972** (2.10)	0.972** (2.07)	0.972** (2.10)
Year, regional and industry dummies		Yes	Yes	Yes	Yes
Log likelihood		-7582.0	-7547.1	-7548.9	-7547.1

Notes: The dependent variable is incumbent's perceived level of pressure of competition in period t=0. Ordered probit random effects panel regressions. Robust standard errors clustered at the level of planning regions. T-statistics in parentheses. *** Statistically significant at the 1 percent level; ** statistically significant at the 5 percent level; * statistically significant at the 10 percent level. All dummies for year, region, and industry are jointly significant at the 1 percent level. The number of observations is 6040 in all models.

face higher levels of competitive pressure.[17] This may be again explained with the observation that larger firms tend to serve geographically larger markets with higher number of competitors.

There is a positive relationship between an incumbent's state of machinery and the perceived pressure of competition. This means that manufacturing incumbents that have machinery tending to obsolescence (categories 3, 4 and 5) tend to perceive greater levels of competitive pressure than incumbents with machinery that is state-of-the-art (category 1 = reference). Figure A2 in the Appendix shows the distribution of establishments' perceived level of pressure of competition aligned with the different categories of state of machinery. Generally speaking, this figure shows that the share of incumbents reporting the highest level of perceived pressure of competition ("competition endangers the continued existence of the establishment") sharply increases in the categories of state of machinery that tend to obsolescence (categories 3, 4 and 5). It is remarkable that 44 percent of the incumbents with state-of-the-art machinery (category 1) reported substantial levels of competitive pressure. This suggests that incumbents with state-of-the-art machinery are more aware of the competitive pressure (substantial level) but are less in danger of exiting the market.

The coefficient for the change of industry sales is not statistically significant in any of the estimations.[18] This suggests that the perceived competitive pressure is not the result of a general (positive or negative) trend of demand in the industry. The number of incumbents in the respective industry that is intended to control for the level of intra-industry competition arising from the other already established firms in the industry, has a significantly positive coefficient across all models.[19]

[17] Using the total sales of establishments as an alternative measure of size leads to very similar results.

[18] Using the change in sales over two years does not lead to any major change in the statistical significance of this variable.

[19] We also ran models that included the Herfindahl index of an industry as a further indicator for market structure. There was no significant correlation between the Herfindahl index and an incumbent's perceived level of competitive pressure in any of these models.

None of the regional-level control variables, namely population density of the region in which an incumbent is located, the dummy for being located in East or West Germany, and the measure for localization economies, turn out to be statistically significant across the models in Table 2. One possible reason behind this result is that the effect of these regional-level controls is absorbed by the regional dummies that are also included in our regressions.

One might argue that if industries follow a life cycle (Klepper 1997) that is characterized by a high number of entries in the early stages and a lower number of newcomers in later stages as the industry declines, the level of new business formation in our analysis could be induced by industry growth in early stages of the cycle that also affects the level of competitive pressure that incumbents perceive. This type of simultaneity problem should, however, not be relevant in our setting for two reasons. First, we control for the sales change of an industry and find that it is not statistically significant. Second, the results remain rather stable if industry dummies that account for unobserved characteristics of the industries are included. Therefore, it could hardly be argued that the start-ups in our sample are mainly motivated by an early-stage in the development of the respective industry.

If the decision to start a new venture should be motivated by a low perceived level of competition in a certain industry, this could lead to a problem of reversed causality. This could be specifically the case of start-ups in the same region as incumbents, given that opportunities occurring in close proximity can be recognized with relative ease. In order to minimize this type of problem we incorporated a lagged (t-4 – t-13) moving average of the regional start-up rate in the analysis and tested for its relation with the level of pressure of competition as perceived by incumbents (Table A3 in the Appendix). Because it seems unlikely that someone would be motivated to start a new venture by taking advantage

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Due to the high correlation between the Herfindahl index and the number of incumbents at the industry level, we decided to consider only the number of incumbents.

of low levels of competition four years in the future, we choose a lag of four years to assess the incumbent's perception of competitive pressure in t=0 . In the respective estimations (Table A3 in the Appendix), the further lagged start-up rate remains positive and significant across models and robust for regional and industry fixed effects.

Finally, we investigate if the perceived competitive pressure imposed specifically by the new ventures differs systematically according to incumbents' size, their productivity, and the population density of the region where the incumbent is located. In our discussion of the factors that might explain the perceived pressure of competition (Section 3) we mentioned the possibility that the competitive thread may be stronger for smaller, less productive incumbents, and for establishments that are located in high density areas. We test for such effects by adding variables that interact the start-up rate with incumbent's size, productivity level, and population density, respectively. The insignificance of the interaction term between new business formation and establishment size (Table A4) indicates that the effect of new business formation on incumbents' perceived level of competitive pressure is not dependent on the size of the incumbents. In other words, the pressure that start-ups in the same region or across all regions impose on the incumbents in their respective industries is perceived the same way by small, medium size and large incumbents.

The interaction term between incumbent productivity level and start-ups turns out to be statistically significant with a negative sign in those models that are not restricted to new business formation in the same region or in adjacent regions (Table 3). This indicates that highly productive incumbents perceive lower levels of competitive pressure from start-ups. Finally, the interaction of the different variations of start-ups with the regional population density is not statistically significant (Table A5 in the Appendix). Therefore, we conclude that there is no evidence for a moderating effect of establishment size or regional population density on the relationship between new business formation and the competitive

Table 3: Moderating effect of incumbent productivity on the perceived competitive pressure from new business formation

		I	II	I	IV
Start-ups in the same industry across all regions (log) $_{t-1}$ x productivity level (log) $_{t=0}$		-0.082*	-0.094**	-	-
		(-1.75)	(-2.01)		
Start-ups in the same industry across all regions (log) $_{t-1}$		1.057**	1.145**	-	-
		(2.07)	(2.24)		
Start-ups in the same industry and region (log)$_{t-1}$ x productivity level (log) $_{t=0}$		-	-	-0.017	-
				(-0.41)	
Start-ups in the same industry and region (log)$_{t-1}$		-	-	0.292	-
				(0.63)	
Start-ups in the same industry in all other regions (log) $_{t-1}$ x productivity level (log) $_{t=0}$		-	-	-	-0.095**
					(-2.03)
Start-ups in the same industry in all other regions (log) $_{t-1}$		-	-	-	1.152**
					(2.26)
Productivity level (log) $_{t=0}$		-0.760*	-0.939**	-0.252	-0.945**
		(-1.85)	(-2.29)	(-0.69)	(-2.31)
Human capital (log) $_{t=0}$		-0.074***	0.015	0.015	0.015
		(-2.79)	(0.49)	(0.48)	(0.49)
Export intensity (log) $_{t=0}$		0.062***	-0.014	-0.014	-0.014
		(3.36)	(-0.70)	(-0.72)	(-0.70)
Size (log) $_{t=0}$		-	0.174***	0.175***	0.174***
			(7.34)	(7.49)	(7.34)
Industry sales change (log) $_{t=0}$		-0.030	-0.023	-0.041	-0.022
		(-0.30)	(-0.22)	(-0.41)	(-0.22)
Number of incumbents (log) $_{t=0}$		-0.090*	-0.047	-0.023	-0.048
		(-1.81)	(-0.98)	(-0.51)	(-0.99)
Population density (log) $_{t=0}$		2.842	2.510	2.355	2.518
		(0.95)	(0.83)	(0.78)	(0.83)
Dummy location (east) $_{t=0}$		1.236	1.147	1.057	1.151
		(0.73)	(0.67)	(0.62)	(0.67)
Localization economies (log) $_{t=0}$		0.101*	0.069	0.041	0.069
		(1.69)	(1.20)	(0.72)	(1.21)
State of machinery $_{t=0}$	1	Reference category			
	2	-0.0003	0.025	0.027	0.025
		(-0.01)	(0.45)	(0.48)	(0.45)
	3	0.177**	0.246***	0.249***	0.246***
		(2.38)	(3.36)	(3.38)	(3.36)
	4	0.308**	0.389***	0.390***	0.389***
		(2.33)	(2.80)	(2.80)	(2.80)
	5	0.832*	0.985**	0.991**	0.985**
		(1.82)	(2.13)	(2.12)	(2.13)
Year, regional and industry dummies		Yes	Yes	Yes	Yes
Log likelihood		-7603.1	-7571.0	-7574.5	-7571.0

Notes: The dependent variable is incumbent's perceived level of pressure of competition in period t=0. Ordered probit random effects panel regressions. Robust standard errors clustered at the level of planning regions. T-statistics in parentheses. *** Statistically significant at the 1 percent level; ** statistically significant at the 5 percent level; * statistically significant at the 10 percent level. The number of observations is 6040 in all models. Year, planning regions and industry dummies are jointly significant at the 5 percent level in all models.

pressure that is perceived by the incumbents. However, the level of perceived competitive pressure is shaped by an incumbent's productivity level. Less productive incumbents are more dramatically threatened by start-ups across regions.

6. Discussion

This paper examines the relationship between new business formation and incumbents' perceived level of competitive pressure. The measure of competitive pressure is based on self-evaluations by representatives of manufacturing incumbent establishments, and should be particularly revealing since in the cognitive logic of decision making, the perception of competition is a first step of market interaction between the newcomers and the incumbents (Fouskas and Drossos 2009; Kemp and Hanemaaijer 2004; Tang 2006). Specifically, this perception can be regarded as a good predictor of competitive responses.

The most important contribution of our analysis is that we present robust empirical evidence for a positive relationship between the competitive pressure that is perceived by incumbents and the level of general new business formation in the respective industry. This means that the competitive threat of entry is *not* limited to particularly innovative or large start-ups, but to new business formation in general. However, it is still plausible to assume that not all newly emerging businesses create this effect with the same level of intensity. Due to data limitations, we were not able to investigate the specific characteristics of new entrants that pose a particular competitive threat on the incumbents. It could be an important and promising avenue for further research to identify these challenging characteristics of start-ups.

Contrasting with a wide-spread belief (for an overview see Fritsch 2013), we find that the competitive pressure new business formation imposes on incumbents is not concentrated in the region where the entry occurs. This contradicts aggregate level analyses that identify a regional concentration of the effects of new business formation (e.g., Bosma, Stam

and Schutjens 2011; Fritsch and Noseleit 2013b; Schutjens and Stam 2003). An explanation for these differing results could be that our measure of the perceived level of competition pertains to competition on the output market and does not represent the competitive threat that may be caused by start-ups on markets for local inputs, such as labor and floor space. We also find that neither the size of the incumbents, nor regional population density has a significant moderating effect on the perceived level of competitive pressure. However, incumbents' productivity plays a role in the degree to which new business formation imposes competitive pressure. Highly productive incumbents perceive lower levels of competitive pressure by new business formation across regions. We also find that the effect of new business formation on incumbents' perceived competitive pressure is limited to entry into the same two digit industry. This finding clearly suggests that the subjective assessment made by the respondents pertains to competition in output markets, not to the situation in the local markets for inputs. Further research into the different dimensions of competition is necessary to clearly identify the varying effects of pressure on the input and output markets.

Our analysis also identified a number of incumbent characteristics that shape perceived competitive pressure. According to our estimates, a high productivity level and high human capital intensity are related to relatively low levels of perceived pressure of competition. Specifically for larger establishments, a high export rate and machinery tending to obsolescence increases the perception of competitive pressure.

In order to extend our understanding of competitive processes, it would be interesting to investigate how incumbent firms react to the perceived pressure of competition. Assuming that this reaction is not uniform, but varies from firm to firm, what are the reasons for such differences? Only a few analyses of this kind exist. Most of these studies focus on types of entry that are assumed to be particularly challenging. The reaction of incumbent firms to newly emerging competitors constitutes

an important part of the effect of entry on growth that is still not well understood.[20]

[20] The only studies of the effect of general entry on incumbents that we are aware of are Andersson, Braunerhjelm and Thulin (2012) and Fritsch and Changoluisa (2014).

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Appendix

Table A1: Descriptive statistics

		Mean	Median	Minimum	Maximum	Standard Deviation
Incumbent's perceived level of pressure of competition $_{t=0}$		3.53	3	1	5	0.99
Start-up rate in the same industry and region $_{t-1}$		16.97	12.1	0.1	108	15.44
Start-up rate in the same industry across all regions $_{t-1}$		1071.91	904.4	154	2663	582.42
Start-up rate in the same industry in all other regions $_{t-1}$		1054.95	895.1	147.2	2555	573.24
Start-up rate in the same industry in adjacent regions $_{t-1}$		60.12	48.7	0.5	241.8	45.01
Productivity level $_{t=0}$		60801.92	45185.78	27.59	1.76E+06	63599.87
Human capital $_{t=0}$		0.146	0.092	0	1	0.162
Export intensity $_{t=0}$		18.7	4	1	100	25.03
Size $_{t=0}$		240.98	40	1	46140	1493.77
Industry sales change $_{t=0}$		-6.15E+06	1.71E+06	-1.22E+08	4.73E+07	2.77E+07
Number of incumbents $_{t=0}$		17876.58	18958	2674	30142	9421.14
Population density $_{t=0}$		367.95	194.03	45.42	3868.17	669.06
Localization economies $_{t=0}$		1.16	0.98	0.07	9.2	0.84
Dummy location (East Germany = 1) $_{t=0}$		0.53	1	0	1	0.5
State of machinery $_{t=0}$	2	0.48	0	0	1	0.5
	3	0.33	0	0	1	0.47
	4	0.04	0	0	1	0.21
	5	0.08	0	0	1	0.05

Note: All 6,040 observations of the standard models (Table 2) included. In this table we present variables before log-transformation to allow for direct comparison of magnitude and variance.

Table A2: Correlation Table

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Incumbent's perceived level of pressure of competition $_{t=0}$	1															
2	Start-up rate in the same industry and region $_{t-1}$	-0.004	1														
3	Start-up rate in the same industry across all region $_{t-1}$	0.040	0.806	1													
4	Start-up rate in the same industry in all other regions $_{t-1}$	0.040	0.806	0.980	1												
5	Start-up rate in the same industry in adjacent regions $_{t-1}$	0.016	0.670	0.812	0.811	1											
6	Productivity level $_{t=0}$	0.043	-0.167	-0.061	-0.061	-0.022	1										
7	Human capital $_{t=0}$	-0.073	0.133	-0.001	-0.002	0.004	-0.095	1									
8	Export intensity $_{t=0}$	0.089	-0.229	-0.146	-0.147	-0.102	0.410	-0.106	1								
9	Size $_{t=0}$	0.160	-0.196	-0.042	-0.042	-0.023	0.481	-0.415	0.618	1							
10	Industry sales change $_{t=0}$	0.002	0.021	0.031	0.031	0.041	0.006	-0.039	-0.068	-0.023	1						
11	Number of incumbents $_{t=0}$	0.022	0.518	0.688	0.688	0.535	-0.063	-0.068	-0.151	-0.088	0.017	1					
12	Population Density $_{t=0}$	0.066	-0.164	0.036	0.026	0.051	0.136	0.008	0.114	0.102	0.009	0.049	1				
13	Dummy location (East Germany = 1) $_{t=0}$	-0.080	0.446	0.012	0.012	0.012	-0.267	0.302	-0.245	-0.329	-0.002	-0.055	-0.287	1			
14	State of machinery $_{t=0}$	2 -0.034	-0.013	-0.022	-0.022	-0.007	0.082	-0.026	0.058	0.109	0.004	-0.032	-0.011	0.024	1		
		3 0.031	0.001	-0.004	-0.004	-0.006	-0.137	0.035	-0.069	-0.167	-0.008	0.002	0.011	0.004	-0.682	1	
		4 0.044	0.000	0.007	0.007	-0.003	-0.059	0.030	-0.040	-0.075	-0.016	0.007	0.018	-0.039	-0.208	-0.152	1
		5 0.014	-0.009	-0.020	-0.020	-0.027	-0.020	0.033	-0.012	-0.050	-0.003	-0.006	-0.011	0.015	-0.053	-0.039	-0.012

Note: All 6,040 observations of the standard models (Table 2) included.

Table A3: The relationship between the incumbents' perceived level of pressure of competition and the *lagged level* of new business formation

		I	II	III	IV
Start-up rate in the same industry and region (log) $_{t-4}$		0.121**	0.101**	0.133***	0.113**
		(2.59)	(2.25)	(2.73)	(2.00)
Productivity level (log) $_{t=0}$		-0.001	-0.066*	-0.052	-0.038
		(-0.03)	(-1.77)	(-1.32)	(-0.94)
Human capital (log) $_{t=0}$		-0.051*	0.032	0.035	0.054
		(-1.71)	(0.98)	(1.06)	(1.52)
Export intensity (log) $_{t=0}$		0.071***	-0.008	-0.015	0.0001
		(6.10)	(-0.44)	(-0.82)	(0.01)
Size (log) $_{t=0}$		-	0.160***	0.179***	0.193***
			(9.30)	(7.39)	(7.28)
Industry sales change (log) $_{t=0}$		-0.130	-0.023	-0.029	-0.029
		(-0.19)	(-0.25)	(-0.30)	(-0.30)
Number of incumbents (log) $_{t=0}$		-0.056	-0.02	-0.041	1.693
		(-1.16)	(-0.60)	(-0.86)	(1.38)
Population Density (log) $_{t=0}$		0.111**	0.104	-2.603	-2.673
		(1.66)	(1.55)	(-0.95)	(-0.97)
Dummy location (east) $_{t=0}$		-0.235**	-0.161	-2.237	-2.271
		(-2.25)	(-1.57)	(-1.42)	(-1.43)
Localization economies (log) $_{t=0}$		0.016	-0.006	-0.0001	-0.034
		(0.33)	(-0.12)	-(0.00)	(-0.66)
State of machinery $_{t=0}$	1	Reference category			
	2	0.021	0.044	0.075	0.085
		(0.36)	(0.75)	(1.32)	(1.44)
	3	0.227***	0.292***	0.340***	0.354***
		(2.97)	(3.89)	(4.66)	(4.83)
	4	0.386***	0.480***	0.542***	0.558***
		(3.11)	(3.90)	(4.81)	(4.97)
	5	0.423	0.588	0.460	0.633
		(0.92)	(1.27)	(0.96)	(1.31)
Year dummies		Yes	Yes	Yes	Yes
Regional dummies		No	No	Yes	Yes
Industry dummies		No	No	No	No
Log likelihood		-7275.2	-7246.0	-7188.4	-7167.5

Notes: The dependent variable is incumbent's perceived level of pressure of competition in period t=0. Ordered probit, random effects panel regressions. Robust standard errors clustered at the level of planning regions. T-statistics in parentheses. *** Statistically significant at the 1 percent level; ** statistically significant at the 5 percent level; * statistically significant at the 10 percent level. The number of observations is 5965 in all models. Year, planning regions and industry dummies are jointly significant at the 1 percent level in all models.

Table A4: Moderating effect of incumbents' size on the new business formation – incumbent perception of competition relationship

		II	III	IV
Start-ups in the same industry across all regions (log) $_{t-1}$ x size (log) $_{t=0}$		-0.019	-	-
		(-0.95)		
Start-ups in the same industry across all regions (log) $_{t-1}$		0.294**	-	-
		(2.29)		
Start-ups in the same industry and region (log)$_{t-1}$ x size (log) $_{t=0}$		-	-0.003	-
			(-0.18)	
Start-ups in the same industry and region (log) $_{t-1}$		-	0.137	-
			(1.28)	
Start-ups in the same industry in all other regions (log) $_{t-1}$ x size (log) $_{t=0}$		-	-	-0.019
				(-0.96)
Start-ups in the same industry in all other regions (log) $_{t-1}$		-	-	0.295**
				(2.30)
Productivity level (log) $_{t=0}$		-0.089**	-0.091**	-0.089**
		(-2.23)	(-2.25)	(-2.23)
Human capital (log) $_{t=0}$		0.033	0.034	0.033
		(1.03)	(1.03)	(1.03)
Export intensity (log) $_{t=0}$		0.007	0.005	0.007
		(0.36)	(0.27)	(0.37)
Size (log) $_{t=0}$		0.017	0.156	0.016
		(0.10)	(0.91)	(0.09)
Industry sales change (log) $_{t=0}$		0.008	-0.003	0.008
		(0.08)	(-0.03)	(0.08)
Number of incumbents (log) $_{t=0}$		2.532**	2.558**	2.532**
		(2.05)	(2.08)	(2.06)
Population density (log) $_{t=0}$		2.374	2.024	2.390
		(0.77)	(0.66)	(0.77)
Dummy location (east) $_{t=0}$		1.072	0.854	1.081
		(0.62)	(0.50)	(0.62)
Localization economies (log) $_{t=0}$		0.025	0.003	0.026
		(0.41)	(0.05)	(0.42)
State of machinery $_{t=0}$	1		Reference category	
	2	0.031	0.032	0.031
		(0.56)	(0.57)	(0.55)
	3	0.253***	0.254***	0.253***
		(3.49)	(3.49)	(3.49)
	4	0.395***	0.395***	0.395***
		(2.99)	(2.98)	(2.99)
	5	0.980**	0.973**	0.980**
		(2.12)	(2.07)	(2.12)
Year, regional and industry dummies		Yes	Yes	Yes
Log likelihood		-7546.7	-7548.9	-7546.6

Notes: The dependent variable is incumbent's perceived level of pressure of competition in period t=0. Ordered probit, random effects panel regressions. Robust standard errors clustered at the level of planning regions. T-statistics in parentheses. *** Statistically significant at the 1 percent level; ** statistically significant at the 5 percent level; * statistically significant at the 10 percent level. The number of observations is 6040 in all models. Year, planning regions and industry dummies are jointly significant at the 5 percent level in all models.

Table A5: Moderating effect of population density on the new business formation – incumbent perception of competition relationship

		I	II	III	IV
Start-ups in the same industry across all regions (log) $_{t-1}$ x population density (log) $_{t=0}$		-0.058	-0.062	-	-
		(-1.24)	(-1.43)		
Start-ups in the same industry across all regions (log) $_{t-1}$		0.553**	0.560**	-	-
		(2.05)	(2.20)		
Start-ups in the same industry and region (log)$_{t-1}$ x population density (log) $_{t=0}$		-	-	-0.060	-
				(-1.44)	
Start-ups in the same industry and region (log)$_{t-1}$		-	-	0.452*	-
				(1.94)	
Start-ups in the same industry in all other regions (log) $_{t-1}$ x population density (log) $_{t=0}$		-	-	-	-0.062
					(-1.43)
Start-ups in the same industry in all other regions (log) $_{t-1}$		-	-	-	0.560**
					(2.21)
Productivity level (log) $_{t=0}$		-0.017	-0.088**	-0.090**	-0.088**
		(-0.46)	(-2.21)	(-2.22)	(-2.21)
Human capital (log) $_{t=0}$		-0.062**	0.032	0.034	0.032
		(-2.27)	(1.00)	(1.05)	(1.00)
Export intensity (log) $_{t=0}$		0.083***	0.006	0.004	0.006
		(4.39)	(0.32)	(0.22)	(0.33)
Size (log) $_{t=0}$		-	0.184***	0.186***	0.184***
			(7.25)	(7.33)	(7.25)
Industry sales change (log) $_{t=0}$		0.007	0.009	-0.0002	0.008
		(0.06)	(0.08)	(-0.00)	(0.08)
Number of incumbents (log) $_{t=0}$		2.738**	2.516**	2.538**	2.516**
		(2.19)	(2.04)	(2.07)	(2.04)
Population density (log) $_{t=0}$		1.849	1.451	1.105	1.467
		(0.59)	(0.46)	(0.36)	(0.47)
Dummy location (east) $_{t=0}$		0.933	0.839	0.602	0.848
		(0.54)	(0.48)	(0.35)	(0.48)
Localization economies (log) $_{t=0}$		0.082	0.033	0.010	0.034
		(1.35)	(0.54)	(0.16)	(0.55)
State of machinery $_{t=0}$	1	Reference category			
	2	0.007	0.034	0.033	0.034
		(0.12)	(0.60)	(0.59)	(0.60)
	3	0.182**	0.254***	0.254***	0.254***
		(2.45)	(3.50)	(3.48)	(3.50)
	4	0.304**	0.392***	0.391***	0.392***
		(2.41)	(2.96)	(2.94)	(2.96)
	5	0.799*	0.965**	0.961**	0.965**
		(1.75)	(2.10)	(2.07)	(2.10)
Year, regional and industry dummies		Yes	Yes	Yes	Yes
Log likelihood		-7581.1	-7546.0	-7547.7	-7546.0

Notes: The dependent variable is incumbent's perceived level of pressure of competition in period t=0. Ordered probit, random effects panel regressions. Robust standard errors clustered at the level of planning regions. T-statistics in parentheses. *** Statistically significant at the 1 percent level; ** statistically significant at the 5 percent level; * statistically significant at the 10 percent level. The number of observations is 6040 in all models. Year, planning regions and industry dummies are jointly significant at the 5 percent level in all models.

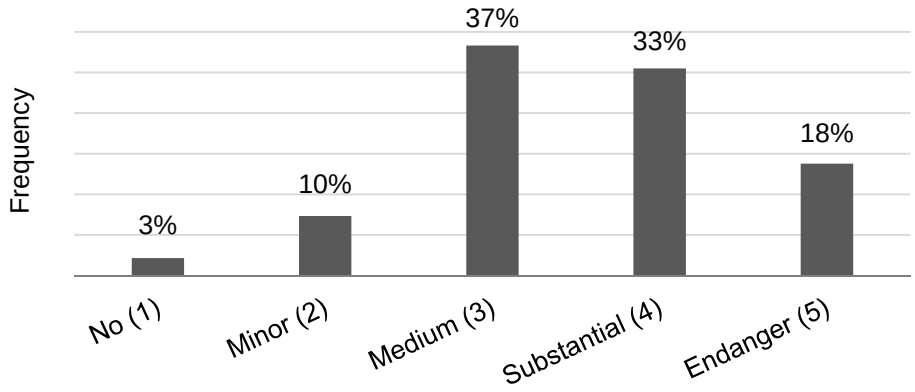

Figure A1: Distribution of perceived levels of competitive pressure

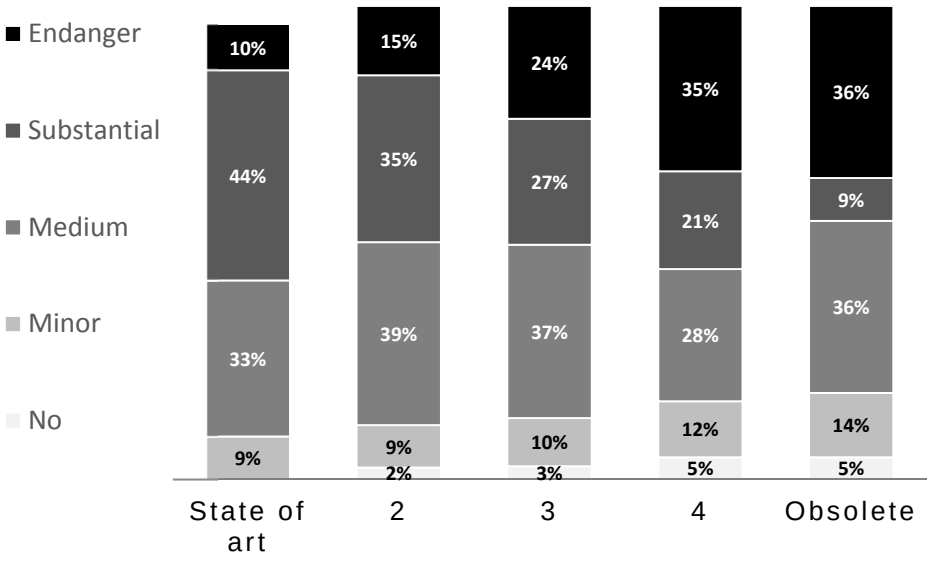

Figure A2: Distribution of pressure of competition by establishments' state of machinery