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INCUMBENT PARTICIPATION IN OPEN INNOVATION: Supporting or Suppressing SME Performance?

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Supporting or Suppressing SME Performance?**

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Abstract

Recent years have seen an increasing shift towards open innovation approaches across a wide range of types and sizes of companies, as well as a surge in the interest from academics into the topic. Accessing knowledge and resources otherwise unavailable through interactions with external partners is generally regarded as highly valuable to the development and commercialization of innovations. However, this paper explores a potential dark side of open innovation. Based on well-established theory, differences between the interests of incumbents and SMEs are hypothesized to influence the future survival and performance of the SME partners. Findings support the hypothesis that open innovation engagement with incumbents has a negative impact on future survival and performance, moderated by radicalness and technological maturity. This elaborates on open innovation by increased understanding of drawbacks and worthwhile considerations of contingencies in partner choice.

1. Introduction

Recent years has seen increasing interest in collaborative and open innovation strategies, with extensive research analyzing such approaches and documenting their positive effects on firms' innovativeness and performance (Chesbrough, 2003). Findings show that increases in performance can be traced back to the levels of breadth and depth of strategies and collaborations (Laursen and Salter, 2006), and that different types of search channels can influence the types of innovations produced by firms (Köhler et al., 2012). While evidence is given of diminishing returns to openness and collaboration beyond a certain point (Laursen and Salter, 2006), the general story of such innovation has been, and still is, largely a positive one, and one focused on the large firm perspective (Spithoven et al., 2013). The potential costs and threats of opening up remain relatively underexplored compared to the extensive focus on the gains and benefits (Dahlander and Gann, 2010). Beyond understanding the diminishing returns of openness (Laursen and Salter, 2006), the threat of strengthening competitors (Fosfuri, 2006) and warnings of overreliance on external sources (Vanhaverbeke et al., 2002), and thus complacency of internal efforts to complement these and absorb knowledge (Cohen and Levinthal, 1990), little research has explicitly explored other potentially negative aspects. This paper seeks to expand the current boundaries of open innovation by focusing on an underexplored potential drawback and focusing on the small firm perspective by exploring whether misaligned incentives to innovate between incumbents' and SMEs' might negatively influence the SMEs' future performance.

The fundamental assumption is that partners in open innovation projects participate to maximize the innovation output. Logic would have it that any actor's participation in and commitment of time, effort and capital to an innovation project must be born out of a desire to maximize innovation output. Given the fundamental nature and centrality of this assumption in the open innovation literature, it merits critical exploration. This paper argues that in fact certain actors may have relevant, but underappreciated incentives, which violate the fundamental assumption of aligned and symmetrical goals between partners. These incentives include the urgency of protecting large sunk cost investments in, competences building on and assets related to the current technology and regime (Geels, 2002). This incentive is particularly strong for incumbents, as they have typically made such investments, and possess these competences and assets (Henderson and Clark, 1990), which are often enhanced over time due to lock-in and path dependency (Arthur, 1989). The argument of misaligned innovation goals thus emerges from the knowledge that radical innovations have destructive effects on such investments, competences and assets, which contribute to fundamental alterations of the industry environment, dramatically changing the power and position of incumbents (Dosi, 1982; Tushman and Anderson, 1986). Based on such misaligned incentives to innovate, the author questions whether SME openness toward incumbents will negatively impact the SME's future performance.

To answer this question of a potential dark side to open innovation the author analyses a dataset covering more than 1,400 applications for EU funding of collaborative R&D projects in the energy sector, containing more than 7,000 different actors. To determine the destructive potential of the innovation on the incumbent, and thus their incentive to suppress innovation, the author measures each incumbent's existing investments in, competences within and assets related to the relevant technology. This is done by collecting data on the incumbent's investments into production based on the technology and combining this with patent applications from the Derwent database related to, as well as a media search on previous R&D projects or collaborations within, the relevant technology. To determine the hypothesized effect on SMEs, the post-project performance of SMEs with

and without incumbent collaboration is analyzed using register data on survival and growth collected from the Orbis database.

A deeper understanding of the dark sides of open innovation is achieved by exploring whether incumbent collaboration negatively influences the future performance of SMEs. By exploring and understanding such tradeoffs between advantages and disadvantages, the paper contributes to the further development and enunciation of a more nuanced open innovation paradigm. Beyond the relevant implications for both the open innovation and strategic management literature, practitioners engaging in open innovation benefit from a richer understanding of potentially negative effects from their choice of partner. The paper begins with a review of relevant literature on open innovation and industrial dynamics to build hypotheses. The data and methodology section follows, before the analysis. Subsequently the results are presented and discussed, leading into the final section with conclusions, limitations and suggestions for future research.

2. Literature Review and Hypotheses

2.1. The Rewards of Opening Up

A firm seeking to establish a competitive advantage is required to possess a unique resource base, which, among others, should be inimitable to competitors (Barney, 1991). However, as the surge in application of open innovation strategies witnesses, firms are increasingly unlikely to enjoy a sufficient amount of such resources to be competitive without ties to other actors. Rather, the combination of such resources through firm interaction is argued by the relational view as the source of competitive advantage and profits (Dyer and Singh, 1998). This aligns well with the argument of Teece (Teece, 1986) that a prerequisite for profiting from innovation is the necessary complimentary assets, and that such access to these may take place through collaborative efforts. An attractive SME strategy can thus be to develop valuable, rare, inimitable and non-substitutional resources (or VRINs) such as e.g. a strong, unique technological knowledge and capability (Barney, 1991), and access the complementary assets needed for appropriation of value (Teece, 1986) or otherwise combine the VRINs with external resources to generate profits (Dyer and Singh, 1998). This idea is conceptualized by the open innovation paradigm, which states that during recent years the increasing level of knowledge and its dispersion across a large number of firms and sources has made collaboration all but obligatory for any firm (Chesbrough et al., 2006). Put simply, not all the smart people work in any one firm and no one firm will possess all the assets and resources necessary for successful development and commercialization of innovations. Thus, in modern society firms must collaborate to prosper and appropriate value from innovations. This is the case for both incumbent actors and SMEs, who stand to reap both similar and individual rewards from opening up. While incumbents possess a large set of resources and complementary assets (Teece, 1986), these actors often experience lock-in and path-dependencies (Arthur, 1989) which might be counterproductive to identifying new opportunities developing innovations (Henderson and Clark, 1990). As such, they may find the innovative and entrepreneurial mindset of SMEs a valuable source for moving beyond their inveterate habits, ways of thinking and perceptions of the market and its opportunities (Rothaermel, 2001).

From the perspective of an SME the opportunity to collaborate with these incumbents appears attractive as well in the open innovation perspective. SMEs often face significant resources constraints in terms of capital, non-core capabilities and knowledge, market access and similar, and access such resources through external relations can be the difference between success and failure (Spithoven et al., 2013; Vanhaverbeke et al., 2002). This can

be argued to particularly be the case in capital intense industries and industries in which few incumbent actors may hold very strong, central positions. This is very much the case in the energy sector, which this paper studies, in which developing and introducing new technology is costly, time demanding and highly dependent on the willingness of incumbent actors to enable market access. With the incumbents at the center of a highly interconnected and interdependent system, any market access and commercialization is very much contingent on their collaboration and acceptance. As a consequence, firms looking to enter the industry with new products or technologies will find such entry hampered by high entry barriers. These barriers are argued in open innovation to be surmountable among other through collaboration with the existing incumbent actors (Chesbrough et al., 2006). While the existence of entry barriers and collaboration as a tool for reduction of these are well-understood, the unexplored challenge for the SME lies in the motivation, or lack thereof, for incumbents to collaborate towards the supposedly shared goal of innovation, given their below argued reluctance.

2.2. Supporting vs. Suppressing Innovation

Implicit to the above arguments for opening up is the assumption of a shared goal of creating innovative technologies or products. It is expected that both sides of the collaboration are engaging with each other to reap the maximum benefits of a successfully developed and commercialized innovation. While drawbacks such as the costs and resources associated to management and control of open innovation efforts, the risk of internal neglect and consequences for both the future ability to innovate (Vanhaverbeke et al., 2002) and the ability to absorb the external knowledge available (Cohen and Levinthal, 1990), as well as the risk of indirectly strengthening competitors (Fosfuri, 2006), there has been no exploration of whether this fundamental assumption of a shared goal might be violated at times and thus constitute a significant drawback and risk of open innovation. As argued in the following, it is reasonable to suspect that such a violation might occur under certain circumstances and that for the SMEs this may negatively influence future performance.

The assumption of shared incentives to realize innovations from collaborating seems to emerge from a somewhat neglected consideration of the individual actor and its place in the larger setting of the industry in question, and how this may influence the desire for innovation and change to occur, or the lack thereof. A review of the literature on industry composition and competitive environment contributes to reflections on the potential disincentive for realizing certain innovations, which may be present with incumbent actors. This disincentive will violate the assumption of aligned goals in open innovation and is hypothesized to potentially result in a suppression of the future performance of SMEs. Geels argues that due to large sunk costs and competences tied to the current regime, technology and knowledge base, incumbents will seek to preserve the status quo and are reluctant to embrace radical innovations and the subsequent dramatic changes to their industry (Geels, 2004). Such reluctance is arguably a result of the “disastrous effects on industry incumbents” which Henderson and Clark argue might occur from innovations beyond their area of expertise and capabilities (Henderson and Clark, 1990). Henderson and Clark argue that incumbents will often find incremental innovations desirable as they reinforce their competitive position, while more radical innovations will have destructive effects on their capabilities and thus are undesirable. From the early establishment of a dominant design (Utterback and Abernathy, 1975) the actors in an industry will adapt practices, procedures, problem-solving strategies and more which center on this design (Henderson and Clark, 1990). This has the reinforcing effect of a path-dependency, which will make radical changes to the establishment increasingly destructive and thus less desirable for the incumbents. Indeed Tushman and Anderson find that incumbents tend to favor incremental innovations are unlikely to promote radical innovations which may have a destructive impact on them (Tushman and Anderson,

1986),. Economies of both scale and scope (Panzar and Willig, 1977) create further incentives for incumbents to intensify the use of their core technologies, rather than diversifying and embracing new technologies. Investments in production equipment and facilities are significant, and not fully exploiting this capacity is counterintuitive to any profit-optimizing firm. Not only would embracing radically new technologies result in the incumbent under-exploit its existing, expensive production facilities, it would also, in the context of energy, replace a high profit margin from existing brown energy production with a lesser margin from the production based on new green energy technologies and capacities. Thus, the incentive for the incumbent to replace existing technologies with new innovations is marginal at best.

Despite this disincentive to support the development of innovations, there is a strong tendency for incumbents to engage in open innovation with SMEs. This is exemplified in the energy sector, where more than 60% of SMEs report collaboration efforts with the industry's incumbents (EIS, 2012), despite the significant incentives to suppress radical innovations, which may have game-changing consequences in the energy sector as transitions towards a more sustainable future will likely see the role of incumbents dramatically changed (Kern and Smith, 2008). The motivation for such counterintuitive collaboration is argued by the open innovation literature to be the increased knowledge and expertise in society and its dispersion among numerous actors due to among other increased educational levels. The effect of this has been that large firms no longer possess sufficient internal knowledge to develop innovations and hence need to open up towards external partners and sources of knowledge, such as specialized SMEs (Chesbrough et al., 2006). Chesbrough argues that this is enhanced by the rapid changes in technologies in modern society. The effect of this becomes shorter product life cycles and a faster deteriorating value of the knowledge a firm, e.g. an incumbent, possesses. For the incumbent then, the necessity to open up to remain aligned with a rapidly developing world by accessing external knowledge forces the somewhat counterintuitive open innovation collaborations. It is this dilemmatic situation of risking destruction by opening up, but nevertheless having to do so in attempt to avoid similar destruction, which leads to collaborations that the incumbent might be expected to avoid.

From the perspective of the SME the necessity to collaborate with the incumbents can be found in these actors' ownerships of the complementary assets necessary to profit from an innovation (Teece, 1986). This paper argues an inherent dilemma for the innovative SME due to the necessity of accessing these assets: The incumbents' ownership of indispensable complimentary assets makes collaboration with them necessary (Pisano, 1991), however, the above argued reluctance of incumbents to stimulate potentially self-destructive radical innovations is at odds with the goals of the innovative SME. The author thus argues a risk from the point of view of the SME that open innovation efforts with an incumbent might suppress rather than support future performance. To explore whether this risk merits attention, the first hypothesis of this paper is:

H1: Incumbent collaboration negatively influences future SME performance

2.3. Incremental vs. Radical

As discussed above and established in a significant amount of literature on collaboration and open innovation, there is a noteworthy amount of collaboration taking place between incumbents and SMEs. When considering the first hypotheses of this paper, such collaboration comes across as counterintuitive and unproductive for any rational SME. The author argues that this counterintuitive behavior comes from firstly the necessity and rewards for SMEs as they attempt to overcome resource constraints (Spithoven et al., 2013) and access the needed complementary assets (Teece, 1986), and secondly from the hope that their innovation be viewed as

complimentary to the status quo by the incumbent, i.e. incremental, and thus reinforcing the incumbents position rather than destroying it (Henderson and Clark, 1990; Tushman and Anderson, 1986).

As such, this paper expects that particularly radical innovations will experience suppression by incumbent actors, while the reinforcing effects of incremental innovations on the position of such incumbents (Tushman and Anderson, 1986) will lead to less suppression. The radicalness of an innovation is therefore believed to moderate the level of incumbent suppression experienced by the SME, with higher levels of radicalness believed to result in more negative impact on future SME performance. The incumbent actors in the energy sector have invested billions of Euros into existing production and transmission equipment, facilities and infrastructure. To an almost entire degree, this is exclusively tied to the traditional production methods such as coal, gas and oil based fuels. The facilities used to produce electricity from these sources, such as a coal fired power plant, is incompatible with production from sources such as wind, waves and sun. A similar issue concerns the transmission and infrastructure, which is geared towards centralized production from the existing large-scale facilities, and thus needs significant billions of Euros in investments to accommodate decentralized production from private homes, small-scale power plants or even larger-scale plants such as offshore wind, which presents challenges by e.g. fluctuating production periods.

While these investments clearly disincentive radical changes to the existing system for the incumbents, further discouragement is found in the market developments of recent years. In the European Union the consumption of electricity has stagnated in recent years and reductions are increasing as the European Commission's pledge of a 20% reduction on the projected 2020 levels of consumption is being pursued¹. With the significant investments, stagnating consumption and a homogeneous end-product (i.e. electricity from the power socket), the incumbents are faced with a choice of either i) cannibalizing on their existing investments' payback and profitability through supporting the innovation and commercialization of new, less profitable production sources, or ii) reinforcing and protecting the status quo, current investments and their dominant position.

The above lends support to the argument that strong incentives exist for incumbents to retain the status quo and industry structure and reinforce the use of existing technologies. As argued earlier, such reinforcing effects are achieved through the complementarity of incremental innovations, whereas radical innovations will often have destructive effects (Geels, 2004; Henderson and Clark, 1990; Tushman and Anderson, 1986). This leads to the second hypothesis of this paper, which seeks to tests whether radicalness of the innovation has a moderating effect on the incumbent suppression of SMEs:

H2: Incumbent suppressive effect on future performance of SMEs increases with radicalness of innovations

As will be explained in detail, the paper defines radicalness in relation to the existing knowledge base and competences of the individual incumbent, thereby creating the most accurate measure of its incentive to suppress innovation related to the radicalness of a given innovation. Thereby radicalness to a given incumbent is understood as innovations that are far from their existing knowledge base and competences.

2.4. Mature vs. Immature

In addition to the above, the author argues that a moderating effect on the degree of incumbent suppression of the SME is based in the maturity of the technology in question (Suárez and Utterback, 1995). The intuition of the

¹ Eurostat: <http://goo.gl/0BPPnu>

argument is that the more mature a technology is, the more comfortable the incumbents will feel with regards to its application and use, the potential threats it poses towards their current position, and they will more likely have already had experience with it or made investments related to it and thereby gained a secure position in relation to it. Utterback and Abernathy argue that in mature technologies the incumbents have obtained capabilities and have made investments into assets, thereby establishing a position for themselves (Utterback and Abernathy, 1975). Along with Afuah, Utterback elaborates on this with findings showing that incumbents with sunk costs dedicated to a given technology or regime are more likely to fight discontinuity (Afuah and Utterback, 1997). From this we build the understanding that in mature technologies the incumbents have made investments and with such investments made, these incumbents are more inclined to resist changes.

In the context of the empirical setting of this paper, a company with large sunk costs in energy production from a mature technology such as coal would be expected to provide little resistance to innovations within this technology as it would offer little threat and rather reinforce the incumbent's position. On the other hand, the same actor would be expected to be highly resistant of innovation within an immature technology such as wave energy, which would potentially lead to a destructive discontinuity related to their current technological area. Based on this, the final hypothesis of this paper seeks to test the moderating effect of technological maturity on the incumbent's suppressive effect on the SME:

H3: Incumbent suppressive effect on future performance of SMEs decreases with maturity of technology

The paper introduces the definition of maturity below, relating it to the specific incumbent and how mature the technology in question is to it, thus providing the most relevant measure of its argued resistance to the technology subsequently tested in the hypothesis above. As such, maturity is relative to each incumbent and measured in relation to their existing use of a given technology. The following explains the empirical setting chosen to test the above hypotheses, before the data from this setting is introduced and the method explained.

3. Empirical Setting

The breakdown of our climate due to unsustainable energy systems will have incomprehensible and unmanageable consequences for our planet and millions if not billions of its inhabitants. A radical transition from the worldwide dependency of fossil fuels is critical for a sustainable future without destruction of our environment. To varying but increasing degree, all but a few countries are seeking to reduce their contribution to this problem through implementation of energy saving initiatives, green energy production capacity and similar. Countries and their politicians use various approaches to realize these changes in their respective energy systems, but in all cases new energy related technologies are at the core of such efforts. This has made green energy technology a lucrative sector, and one that is sure to become increasingly attractive in the future, as more must be done to stop and reverse the negative developments of past and current. As innovation of green energy technology becomes a worldwide sector with surging demand, countries are keen to benefit from this potential for growth and job creation. At the same time these countries are also eager to see new technologies developed and implemented in order to realize transition to a more sustainable energy system able to meet goals of or demands for reductions in CO₂ emissions. This creates increasing focus on and rewards from innovation for green energy. In the quest for meeting CO₂ reduction requirements and harvesting financial rewards from innovations in this area, and in recognition of the benefits from open innovation, several countries promote collaborative efforts through only providing R&D funding for such open innovation. One example of this is the

empirical data of this paper, which is gathered from EU funding given exclusively to projects with multiple participants. Based on the highly systemic and interconnected nature of the energy sector, the promotion of open innovation and collaborative efforts is reasonable. Furthermore, as argued by Hall and Vredenburg, the task of developing and introducing radical innovations are generally a difficult task and particularly so when influencing multiple stakeholders, as is the case with energy technologies. Radical innovation in the energy sector face more complex pressure and influence than do the traditional market-driven radical innovations, due in large part to pressure from both primary and secondary stakeholders (Hall and Vredenburg, 2012). As such, it is fitting to examine open innovation in the energy sector. Importantly in connection to the role of incumbents explore in this paper, the complexity of the sector is a suspected driver of the hypothesized suppressive effect of the incumbents. In the sector, the incumbent actors have a strong, central position, which makes collaboration with them common, if not a potential necessity for developing and commercializing innovations. Therefore, the energy sector and green technologies provide a good empirical setting to explore the potential negative effects of incumbent collaboration.

Furthermore, this is a sector in which the hypothesized strategy of incumbents is likely to be present, as it is characterized by very high sunk costs related to investments in both production facilities and distribution. At the same time the production facilities are incompatible with other technologies and radical innovations are thus highly destructive for the owners of these. For example a coal fired power plant would be replaced by a wind farm or solar plant, thus leading to a loss of the investments made into such a plant if the alternatives were to be preferred. Furthermore, the incumbents in this sector has been enjoying monopoly power for years, and effectively continue to do so to a large extend, even after liberalization measures across most countries (Joskow, 2008). As such, these incumbents are both in a good position to protect themselves from destructive events via radical innovations, and stand to gain significantly from doing so. The central position of these incumbents also creates an increased incentive, if not necessity, for SMEs to collaborate with them, which enables the analysis of the hypothesized effects. Studying the energy sector has further relevance as it is one of the key sectors, if not the key sector for a sustainable future, and one which is facing a high pressure for transition through radical innovations from multiple stakeholders. Since the majority of firms in the sector indicate that they collaborate with incumbents to innovate (EIS, 2012), the understanding of potential incumbent suppression of innovations leading to sustainable energy systems in all the more important to understand.

4. Data & Method

The unit of analysis in this paper is the SME, which seeks to innovate through collaborative efforts, either with or without incumbent participation. The main hypothesis is that such collaboration may function as a mechanism, which negatively influences the future performance of SMEs due to the intentional or unintentional suppression of the incumbent. For the purpose of testing this and the related moderators, the author has constructed a unique dataset. Firstly, author makes use of EU data on more than 1.200 applications funding of R&D projects in the energy sector, of which 333 were granted funding. The data enables identification of each participant, their role in the project, their NACE code and whether they are an SME and not a subsidiary. Furthermore the data contains information on the technology, which is the focus of the project, and start and end dates. Register data from the Orbis database is merged for all commercial actors, thereby excluding such data on NGOs, public institutions and universities. This provides a range of control variables as well as measures of post-project performance of the actors. To determine the destructive potential of the innovation on the

incumbent, the author measures each incumbent's existing knowledge base related to the project's technology by including patent applications from the Derwent database and a media search through Factiva on previous R&D projects or collaborations related to the technology. Finally, to test the moderating effect of technological maturity, the penetration of the relevant technology on the incumbent actor's home market is represented by a percentage measure of this technology's production capacity from the total production in that market, taken from the EU Energy Statistics data.

4.1 Defining and Identifying the Incumbent Actors²:

In the context of this paper we define the incumbent actors as those with a strong incentive to retain the status quo in the energy sector. These are the actors facing the largest threats and negative effects from the destructive impacts of innovations, particularly those of a radical nature. The actors are mainly involved in mature, established and proven technologies, which have proven reliable for decades and in which these actors have invested significant amounts of capital with a long term perspective. As such, the incumbent actors in this paper are those with competences and investments within the traditional energy production technologies, i.e. fossil fuel based technologies as opposed to green energy technologies. These actors can be expected to deploy strategic behavior aimed at protecting their position, investments and capabilities (Geels, 2010; Meadowcroft, 2009; Smink et al., 2013) and thereby, as this paper hypothesizes, suppress the performance of the partners which collaborate with them.

The approach to identifying the incumbents in the dataset begins with looking at firm size. The energy incumbents are large organizations, which do not fall into the SME categorization of in the data, which considers the number of employees, turnover and balance sheet criteria, as well as independence from a parent company. After disregarding SMEs through this screening, we are left with X actors. Y of these are universities, NGOs, public bodies and non-profits, and are therefore disregarded. The remaining X actors are firms, which are considered potential incumbents in the context of this paper as described above. Through studying the NACE codes of these actors, we are able to retain those engaged in energy production or distribution, leaving us with X. The annual reports of these firms were studied to avoid defining actors as incumbents if they produce green electricity only, as this would not sufficiently fit the description of seeking to retain the industry status quo through suppression of SMEs. As no such cases are identified in the sample, a total number of X incumbent actors are identified in the data, a list of which can be found as appendix A. The variable **incumbent** is added to the data and takes the value 1 for actors defined as incumbents and 0 for those not. Similarly, the variable **SME** is added to identify the actors outside the incumbent definition, which are not universities, NGOs etc., but commercial firms.

4.2. Explanatory Variables

As the unit of analysis in this paper is the individual SME the author adds the dummy variable **Incmb_Collab** for each SME in the data. This variable takes the value 1 if the SME has collaborated with an incumbent and 0 if not. This is used to split the sample into a treated group exposed to incumbent collaboration, and an untreated group without such exposure, which is used to test the main hypothesis of a negative impact on SMEs from incumbents.

² As the dataset is not yet made available by the European Union the exact numbers will be added at a later stage

The data provides information on the technology area of the specific project, and thus the individual SME. This is included in the analysis to test hypotheses H2 and H3 regarding radicalness and technological maturity as moderating effects of incumbent suppression. As the relevance lies in the motive of the individual incumbent to suppress innovation, and the effects thereof, the paper develops measures to reflect radicalness and maturity at an individual level for each incumbent. As a lack of competencies within a radical innovation is a large contributor to this innovation's destructive effect on incumbents, the paper seeks to determine the incumbent's existing competences within the technology in question. The variable **Increment** is created, which is a count of patent applications by the incumbent and the number of previous innovation projects or R&D activities carried out by the incumbent within the technology in question. This variable is added to each SME in the data, which lets a higher number reflect that the innovation is within the existing competences of the incumbent the SME has collaborated with, and thus less radical. The hypothesized effect will be less suppression of SME performance as this count increases.

As argued by Utterback and Abernathy, a mature technology can be identified by higher use in the industry (Utterback and Abernathy, 1975). To obtain the most precise estimation of the incumbent's motivation to suppress innovation and thus suppress the future SME performance, we focus on each incumbent's individual use of the technology related to the specific SME collaboration. The continuous variable **Maturity** measures the installed electricity generation capacity of the incumbent with the technology. As above, this variable is added to each SME to capture the degree to which the technology is mature to the incumbent this SME collaborates with. A higher value reflects a more mature technology in the context of this incumbent, which is hypothesized to reduce the suppressive effect on the SME's future performance.

4.3. Dependent Variable

The dataset does not include direct performance measures for the collaborations, since no formal post-evaluations are conducted by the EU. Therefore the author merges the EU databases with register data from Orbis to develop performance measures and evaluate the hypothesized effects on SMEs of incumbent collaboration. As argued, SMEs often face resource constraints and are likely to lack opportunities for funding of R&D activities (Spithoven et al., 2013), and can reasonably be expected to mostly participate in collaborations related to their core technology as diversifying into multiple technologies requires too many resources for SMEs. Therefore, the collaborations analyzed are highly significant opportunities for and determinants of the future performance of the SMEs, and thus this paper argues that the future of the firm is directly linked to the potential suppressive effect of incumbents in this collaboration.

The paper measures each SME's future survival and growth in both turnover and number of employees to test the effect of incumbent collaboration, while controlling for a number of factors. A likelihood estimation of the survival of the SMEs in the three years following the conclusion of the project is developed, and complimented by analyses of turnover and growth in the number of employees. These are compared to the SMEs in the sample without exposure to incumbent collaboration.

To determine the treatment effect of incumbent participation, the paper estimates the likelihood of failure of the SME in the three following years. This is done by creating the variable **Fail**, which can take values from 1 to 4, indicating if the firm has failed in year one, two or three after completion of the project, or if the firm is still alive at the end of the data availability, the value 4. The analysis of growth in the number of employees is captured by the variables **Emp_Growth_1**, **Emp_Growth_2** and **Emp_Growth_3**, which contain a percentage

change in the number of employees in the firm in each year following the project compared to the year of initiating the project. Similarly the performance is also measured by comparing turnover in the subsequent three years to the turnover in the year of initiating the project. This is captured by the variables **Turno_1**, **Turno_2** and **Turno_3**.

4.4. Controls

The paper utilizes the above performance analysis of SMEs in both approved and non-approved projects. This creates a control group for the main group of SMEs, which contains the treated and untreated observations. The effects of this treatment is measured in post-project performance of the treated and non-treated SMEs, with SMEs from non-approved applications functioning as a control group with closely related characteristics in terms of size, sector, R&D focus and similar.

Based on third party experts' evaluations the applications are rated on five different criteria, which determines approval or rejection. These criteria and the projects' individual scores are provided in the data, and serve as a control for a selection bias, in which incumbents choose the best projects, or the best projects de-select incumbents. The analysis controls for whether this selection bias drives the findings through the creation and inclusion of the variable **Rating**, which consists of the total score of these five criteria.

The method and model used in this paper seeks to isolate incumbent participation as the mechanism influencing the future performance of SMEs, with two hypothesized moderators. For this purpose we control for a number of factors, which may otherwise influence the outcome. **Both** is a dummy variable, which takes the value 1 if the SME has participated both in projects with and without incumbents, and **Projects** is a count variable, which counts the number of projects in the database that the actor has participated in. A number of controls are included from the register data. The continuous variables **Size** and **Turnover** measure the number of employees and the turnover respectively in the year prior entering the collaboration. **Subsidiary** is a dummy with the value 1 if the firm is a subsidiary of another firm. Furthermore, as the data covers a period of time in which the effects of the financial crisis has varied. The author controls for potential influences of this on the failure, growth and turnover of SMEs through cohort dummies to reflect both the time of applying for funding and time of ending the R&D projects. To control for potentially increased motivation to engage in publicly funded R&D due to economic turbulence being more significant in one year than other, the variables **apply_07**, **apply_08**, and so forth are created to represent the year of application. Similarly, variables **end_07** and so forth represent the year a given project ends. These dummies take the value 1 if the project is started or ended in a year, and 0 if not.

4.5. Model

For the likelihood estimation of SME survival the author employs a proportional hazards model in order to determine the influence of incumbent collaboration of the time that passes before the SME is no longer observed in the data. The hypothesized effect is that incumbent collaboration increases the likelihood of no longer being observed in the data, compared to the SMEs without incumbent collaboration.

For the part of the analysis using growth in turnover and number of employees as the dependent variable, the author employs an OLS regression. The hypothesized effect is that the exposure to incumbent collaboration will lead to lower growth on both measures when compared to the growth of the SMEs not exposed to this type of collaboration.

5. Limitations and Future Research

The choice of collaborating is a conscience choice made by the SME, which may potentially lead to some endogeneity. With the SME electing to collaborate with the incumbent, they may be well aware of and prepare for the potential suppressive effect that this paper is seeking to identify. However, should this be the case, any findings of a suppressive effect can be argued to be all the more significant, since such endogeneity would reduce this effect rather than increase it. Hence, the author does not consider this a cause for disregarding any findings presented here. It would however be interesting and relevant for future research to explore to which extent SMEs might be conscience about this danger of suppression and whether they employ strategies to reduce this effect.

Naturally a number of factors may influence the performance of any firm. In the attempt to determine the particular effect of collaborating with incumbents, the author attempts to control for as many of these factors as possible. Obviously not all such factors are subject to control in statistical analysis, and unobserved factors may remain.

6. Future Directions of the Paper

At the moment the author is waiting for approval by the European Union in order to access the data. This is expected before the Druid Academy and will hopefully enable the presentation of descriptive statistics along with some preliminary findings at the conference.

Based on the data and actor characteristics, the author hopes to focus the paper more along new entrants/entrepreneurs rather than SMEs. This will firstly make the theoretical argumentation clearer related to resource constraints, the necessity to collaborate with incumbents and the effects of this collaboration on future performance. The author expects that this refocus will also make findings more significant. Once data is supplied both an SME and new entrant analysis will be run.

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