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Abstract: This paper analyzes various innovation strategies of firms. Using five waves of the Community Innovation Survey in Sweden, we have traced the innovative behaviour of firms over a ten-year period, i.e. between 2002 and 2012. We distinguish between sixteen innovation strategies, which compose of Schumpeterian 4 types of innovations (process, product, marketing, and organizational) plus various combinations of these four types. First, we find that firms are not homogenous in choosing innovation strategies; instead, they have a wide range of preferences when it comes to innovation strategy. Second, using Transition Probability Matrix, we found that firms also persist to have such a diverse innovation strategy preferences. Finally, using Multinomial Logit model, we explained the determinant of each innovation strategies, while we gave special attention to the commonly used innovation strategies among firms.

Keywords: innovation strategy, product innovations, process innovations, market innovations, organizational innovations, innovation strategies, heterogeneity, firms, persistence, Community Innovation Survey, Sweden

JEL Codes: D22, L20, O31, O32

1. Introduction

Innovation decisions are the most fundamental strategic decisions for every firm, since innovation today is the most fundamental instrument of firms to enter new markets, to increase current market shares, and to strengthen the competitive edge (Gunday et al., 2011). This strong focus on innovation is motivated by the increasing competition in both domestic and global markets, generated by rapidly changing technologies and competition strategies, which in turn may swiftly erode the valuation in the market place of current products and associated services. This implies that innovation, which can be conceived as the transformation of ideas, information and knowledge to increased competitiveness and sustained competitive advantage, overall constitutes an indispensable component of firm strategies. There are several reasons for this, such as the need to offer improved or even new products, to apply more efficient production, and organization methods, to perform better in the critical markets, and to increase the perception among the customers of the firm's products. At the same time, we must remember that firms have different levels of innovative resources and capabilities.

In order to guide their decisions on how the limited innovation resources should be used to reach their objectives, firms apply different innovation strategies. Should a firm focus on only one type of innovation or combine various types of innovation at the same time? In either case, how to choose between product, process, market and organizational innovations and possible combinations of these four basic types of innovation, given limited resources for innovation? What are the determinants of these choices? Today there exist a very large body of research on the determinants of innovation as well as the effects of innovation for firms, industries, regions and nations. However, surprisingly little is known theoretically and empirically about the determinants of different innovation strategies. We even barely know much about which innovation strategy is commonly used by firms. The few studies by economists that exist have almost exclusively focused on the determinants of product and process innovations and combinations of product and process innovations (Cabagnols & Le Bas, 2002; Du, Love & Roper, 2007). Market and organizational innovations are seldom included in these studies. This is despite the fact that already Schumpeter have clearly distinguished between at least four types of innovation[1].

[1] A rapid review of the literature in the field highlights a few different approaches. In the microeconomics of innovation, it is often assumed that firms concentrate wholly on product innovation (Du, Love & Roper, 2007). In the industrial economics literature, there has been a focus on the relationship between product and process innovation, and how firms distribute their innovation resources between these two types of innovation depending

Against this background, the purpose of this paper is to analyze theoretically and empirically not only the various choices of innovation strategies that firm actually choose, but also the microeconomic determinants of firms' innovation strategies. Our ambition is to increase our understanding of firms' choice between sixteen different innovation strategies of which, one is deciding to not innovate at all, four are pure innovation strategies, i.e. product, process, market or organizational innovation, and eleven are mixed innovation strategies containing two or more of the four innovation types. These sixteen innovations strategies are collectively exhaustive and mutually exclusive choices.

The rest of the paper is organized as follows: Section 2 provide a theoretical background for analyzing innovation strategies, and why and how firms choose between a wide range of innovation strategies. Section 3 describes the data. Section 4 illustrates and discusses the frequency of various types of innovation strategies in our sample. Section 5 shows that not only firms have heterogeneous innovation strategies, but also they persist to do so. Section 6 analyzes the determinant of each innovation strategies. Section 7 concludes and provides suggestions for future research.

2. Literature Review on Innovation Strategies

One of the most fundamental choices firms face concerns whether to innovate or not. If the firm decide to innovate (and there are good reasons to do so, as discussed briefly in introduction), then the firm faces several choices on what type and/or what combination of types of innovation should introduce? This choice constitutes the choice of firm innovation strategy. Rooted in Schumpeter's classification of innovation types, OECD (2005) distinguishes between four basic types of innovation, i.e. product, process, marketing (market), and organizational innovation, which represents four pure innovation strategies but they can be combined in different ways generating 11 more types of innovation strategies. Here is the description of these four basic types:

First, a *product innovation* is defined as the introduction of a good or a service that is new or significantly improved regarding its characteristics or intended uses, including significant improvements in technological specifications, components and materials, incorporated software, user friendliness or other functional characteristics. It can utilize new knowledge or

among other things on the development phase of the actual technology (Utterback & Abernathy, 1975; Abernathy & Utterback, 1982). A number of authors (Klepper, 1996; Yin & Zuscovitch, 1998; Rosencranz, 2003) have later analyzed the mix between product and process innovation theoretically, yet the empirical work is rare.

technologies, or it can be based on new uses or combinations of existing knowledge or technologies. Product innovation is the result of a difficult process driven by advancing technologies, changing customer demand, shortening product cycles and increasing national and international competition. It is normally assumed that successful product innovation demands a strong intra-firm interaction as well as between the firm and its customers and suppliers.

Second, a *process innovation* is the implementation of a new or significantly improved production or delivery method. It includes significant changes it techniques, equipment and /or software. They can be designed to decrease unit costs of production or delivery, to increase/improve product and delivery quality.

Third, a *market innovation* is defined as the implementation of a new marketing method involving significant changes in product design or packaging, product placement or pricing strategy. Its target is to better meet customer' needs, to open up new markets, or to give the firm's products a new position in the market with the intention to increase sales incomes. They are strongly related to pricing strategies, product offers, design properties, product placements and/or promotion activities.

Finally, an *organizational innovation* is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations. Such innovations have a tendency to increase the performance of firms by reducing administrative and transaction costs, improving workplace satisfaction, increase labour productivity and get access to non-tradable assets, such as external tacit knowledge, and/or reduce the costs of external supplies. They may include practices for codifying knowledge by establishing databases of best practices, lessons learnt and other tacit knowledge, the introduction of training programs for developing the skills of the employees or the initiation of supplier or customer development programs. This implies that organizational innovations are strongly related to all administrative efforts of renewing the organizational routines, procedures, mechanisms, systems, etc. to promote teamwork, information sharing, coordination, collaboration, learning and innovativeness.

The literature in the field illustrates that there are substantial differences in terms of innovation strategies between firms even within individual industries as well as over time (Andersson, et al., 2012). Some firms are persistent innovators; some firms innovate intermittently,

while others are non-innovators.[2] We can easily find reasons to why some firms never innovate, such as a strong position in the market, the control of a unique resource, lack of skills or resources, bad management, and pure inertia. However, our focus here is not the non-innovators, but on the innovators and the factors that determine their innovation strategies.

To our knowledge, few studies analyze explicitly the determinants of different innovation strategies including product, process, market and organizational innovations and various combinations of these four types of innovation.[3] It seems quite unusual to consider simultaneously these different innovation strategies. Nevertheless, we think it is of great interest to distinguish between these different possible innovation strategies since the competitiveness of firms increasingly seems to depend also on market and organizational innovations. Our intuition for this is that different innovation strategies have different economic effects for firms in terms of costs, market shares, growth, profitability, and competiveness. A better understanding of the determinants of different innovation strategies would help to understand better the market and economic dynamics induced by the innovation behaviour of firms.

Generally, most innovation studies focus on the role of R&D as the determinant of innovation (Hirsch-Kreinsen et al., 2005). However, many innovation activities are not R&D-based, since innovation is "the search for, and the discovery, experimentation, development, imitation and adoption of new products, new production processes and new organizational set-ups" (Dosi, 1988, p. 222), which is based primarily on new combinations of resources, people, ideas, knowledge and/or technologies. This suggests that the innovation strategies and innovation performance of firms are influenced by numerous factors and activities both within and outside them.[4]

Today there is a lack of convincing models explaining firms' choices of innovation strategies. However, a large number of theoretical and empirical studies have highlighted the influence of specific factors on the innovation behaviour of firms since the 1950s.[5] Unfortunately, few economics studies have gone beyond the influence on product and process innovations.

[2] We must remember that this classification comes from innovation surveys and it is of course possible and even probable that non-innovators also perform some minor types of improvements that could be considered as innovations even if they not are innovations according to the survey criteria. It is probably difficult for firms to survive in the market in the long run without performing some innovation.
[3] One exception is Polder, et al., (2010).
[4] Even in the case of product innovations, R&D accounts for barely a quarter of the total expenses necessary to generate an innovation (Kleinknecht, von Montfort & Brouwer, 2002).
[5] See, e.g., Carter & Williams (1957), Mansfield (1968), Mansfield, et al. (1971), Pavitt (1984), Scherer (1986), Dosi (1988), Cohen & Klepper (1996), Lööf & Heshmati (2002) and Andersson, et al. (2012).

We imagine innovation processes as interactive processes in which firms interact both with customers and suppliers and with knowledge institutions (Vinding, 2002). They are firm-specific dynamic processes governed by the firms' innovation strategies and imply that firms source, transform and exploit new as well as existing information and knowledge using their innovation routines and the skills and knowledge of their employees. Thus, the innovation output of each individual firm will be a function of its innovation strategy and its internal routines and resources in line with the resource-based view of the firm (Foss, 2004). The innovation processes can be seen as broader evolutionary processes where firms steadily refine and occasionally transform their products, processes, organization and market approach individually or in different combinations in an ongoing learning process (Nelson & Winter, 1982).

To understand the innovation behaviour of firms it is essential to place emphasis on the different information and knowledge sources for innovation and the complementarities as well as substitutabilities between them (Roper, Du & Love, 2008). It is also important to acknowledge the influence of firms' prior information and knowledge resources, external networks and information and knowledge utilization capabilities on the different information and knowledge sourcing activities. This opens up for path-dependency and the possibility that different firms will follow different innovation paths even if they belong to the same industry.

Innovations are the result of new combinations of innovation inputs in the form of resources, ideas, information, knowledge and/or technologies, which to a varying degree are generated in-house in firms using in-house capabilities and often in-house R&D. Due to an increasing competition; innovations increasingly are dependent upon a diverse set of specialized innovation inputs and capabilities. This implies that we shall expect that firms in general no longer can perform all parts of the innovation process in-house relying only on in-house innovation capabilities and inputs (Iansiti, 1997). Even the largest innovative firms cannot rely solely on internal innovation inputs for the innovation process, and thus need external innovation inputs in the form of ideas, information, knowledge and/or technologies to develop innovations (Chesbrough & Crowther, 2006).

Furthermore, in addition to performing in-house R&D, firms typically use external sources for new ideas, information, knowledge and technologies including different kinds of consultants, outsourcing of R&D to universities and specialized R&D firms, co-operative agreements with suppliers, customers and/or competitors (Veuglers & Cassiman, 1999). There are obviously important benefits to be gained by opening up the innovation process to external sources of

new ideas, information, knowledge and technologies and to combine internal and external sources (Rigby & Zook, 2002), which might increase the productivity of the in-house innovation activities (Cassiman & Veuglers, 2006). However, the ability to gain from external sources is probably dependent upon that in-house R&D is performed continuously and that the internal absorptive capacity is high enough. Larger firms generally have a larger internal pool of innovation inputs, more links to external sources, larger financial resources, opportunities to pool the risks between different innovation projects, which imply that we shall expect that larger firms to be more inclined to innovate than smaller firms. Moreover, we assume, building upon the general arguments in the literature on the resource-based view of the firm, that the stronger a firm's in-house R&D and knowledge stocks, the lower its need to engage external knowledge sourcing (Schmidt, 2005).

An important issue is that innovating firms must decide on how to distribute their limited innovation resources on product, process, organizational and market innovations including different combinations of these basic types of innovation, and how to adjust this distribution over time as internal and external conditions change. What decisions that are taken are influenced by the internal characteristics of firms as well as by the characteristics of the external context within which they operate. While firms over time partly can change their internal characteristics, they have to accept that the external context is shaped by factors that they cannot influence. The general conclusion we can draw is that to analyze the determinants of innovation behaviour of firms we in principle need a theoretical framework able to grasp the complexity, multidimensionality and interaction of the factors governing decisions to innovate or not to innovate as well as the choice of innovation strategy. Naturally, different explanatory variables have different impacts on the various innovation strategies and might interact in different ways. Unfortunately, no such theoretical framework exists as far as we know. Instead, we have to fall back on explanatory variables found significant for product and process innovation in earlier research, such as size of firms, firm strategies, technological opportunities, technological learning, sources of technology, appropriability conditions and market structures and complement them with variables that can be assumed to influence market and organizational innovation.

Which internal characteristics of firms can then be expected to influence their innovative activities? A review of earlier research in the field indicates that the following characteristics are of special importance:

1. Internal capacity to generate new knowledge, which is a function of the volume and efficiency of in-house R&D as well as its organizational structure (Shelanski & Klein, 1995; Argyres & Silverman, 2004). Firms that are part of a multi-firm group might of course also benefit from R&D within other group firms (Love & Roper, 2001).
2. Links to external information and knowledge sources, which includes links to suppliers and consultancy firms, i.e. upstream sources (Kleinknecht & Reijnen, 1992; Cabagnols & Le Bas, 2002; Horn, 2005), customers, i.e. downstream sources (Von Hippel, 1988; Lundvall, 1988; Joshi & Sharma, 2004), competitors including strategic R&D alliances (Mansfield, 1985; Arora, Fosfuri & Gambardella, 2001; Link, Paton & Siegel, 2005), providers of technological services (Klepper, 1996) and R&D performers and providers of scientific and technological knowledge (Levin, et al., 1987), such as R&D universities (Bercovitz & Feldman, 2005), R&D institutes and specialized R&D firms (Roper, Hewitt-Dundas & Love, 2004).[6]
3. The absorptive capacity (Cohen & Levinthal, 1990), which reflects the training, quality, skills, capability and competence of a firm's employees (Leiponen, 1997; Freel, 2005), and the characteristics of its innovation routines (Finegold & Wagner, 1998).
4. The firm's history and resource base, which is reflected by its size (Xiangkang & Zuscovitch, 1998), its financial resources, its profitability, its degree of diversification (Lunn, 1987), which indicates its potential in terms cumulative accumulated knowledge capital (Klette & Johansen, 1998) and firm life-cycle effects (Atkeson & Kehoe, 2005), and its organization of work, production and innovation (Michie & Sheehan, 2003; Love, Roper & Mangiarotti, 2006).
5. Current product, process, market and organizational technology and design.
6. The firm's demand conditions including market size, market share, price elasticity, diversity, variability, volatility, uncertainty, degree and intensity of competition (Bonanno & Haworth, 1998), and market evolution (Spence, 1975; Freeman, 1982; Pavitt, 1984; Lunn, 1986; Gomulka, 1990; Klepper, 1996).
7. The characteristics of its management, including its competence, capability, incentives, strategy, values and norms (Kok & Biemans, 2009).
8. The firm's external links locally, regionally, nationally and internationally (Karlsson, Johansson & Stough, 2005). Especially concerning international linkages, both import and export acts as the conduit for inflow of knowledge to the firm.

[6] External knowledge sources can be either a complement (Cassiman & Veuglers, 2002) or a substitute (Schmidt, 2005) for internal knowledge sources (Pittaway, et al., 2004).

9. Firm innovation strategies (Dodgson, Gann & Salter, 2008; Strecker, 2009) for the short-term, medium-term and long-term in terms of exploration versus exploitation (Tushman & O'Reilly, 1996) as well as in terms of product competition, market orientation (Kok & Biemans, 2009), cost competition, flexibility, quality, and market shares (Cabagnols & Le Bas, 2002).
10. Its industry, which indicates the main type of products produced by the firm.

However, these factors tell us very little about which types of innovative activities that firms will perform. Will they concentrate on product, process, organizational or market innovations or will they pursue combinations of these different types of innovation? Interestingly, the literature gives us rather little guidance concerning how to answer this question theoretically. In most of the literature, the authors have concentrated their efforts on analyzing the choice between product and process innovations including varying combinations of the two, with the general conclusion that complete specialization in one type of innovation is rare (Rosencrantz, 2003).

The choices between different types of innovation have mainly been analyzed within the literature on product and industry life cycles (Vernon, 1966; Hirsch, 1967; Utterback & Abernathy, 1975; Abernathy & Utterback, 1978; Klepper, 1996) and then mainly limited to the choice between product and process innovations. The literature on product life cycles sometimes hints that firms may turn to market and/or organizational innovations during the maturity and obsolescence stages. Klepper (1996) questions the approach in the earlier contributions and claims that product and process innovations may appear more or less simultaneously. He does not consider market and organizational innovations but one might assume that in several cases there might be a need also for more or less simultaneous market and/or organizational innovations. The literature on "born global firms" indicates that this might be the case.

It seems natural to assume that innovative activities need to focus many aspects related to new products, new production processes, and new market and organizational practices simultaneously (Azedegan & Wagner, 2011). Furthermore, it might be the case that a simultaneous introduction of more than one type of innovation might be more effective in preserving or improving a firm's competitive position than implementing one type of innovation alone (Damanpour & Evan, 1984). Unfortunately, the literature on innovation strategies gives very little

help to understand theoretically the factors that determine firms' choice of innovation strategies.

What does the information and knowledge transformation process to innovation look like? We may think in terms of an innovation production function (Harris & Trainor, 1995), which illustrates the efficiency with which the firm's characteristics and resource-base can generate innovations and where this efficiency is a function of the firm's managerial, organizational and R&D capabilities (Love & Roper, 1999). In terms of innovation outputs, we stress the importance of examining product, process, organizational and market innovations as well as combinations of these. This forms the notion of innovation strategies. We assume that different information and knowledge sources vary in their importance for the different innovation strategies. Given that we have to deal with quite many innovation strategies, we do not present any hypotheses about the importance of different information and knowledge sources, and firm resources and capabilities for the different innovation strategies. However, we assume that there exist different routes through which information and knowledge of different types influence the different innovation strategies of firms, which might generate differences in innovation success.

3. Data

The innovation related data in this study comes from five waves of the Swedish Community Innovation Survey (CIS) in 2004, 2006, 2008, 2010, and 2012. The CIS 2004 covers the period 2002-2004 and CIS 2006 covers the period 2004-2006 and so on, hence using the five ways, provide us with information about innovation activities of firms over a ten years period, i.e. from 2002 to 2012. In all five waves, there is information concerning product and process innovations as well as to innovation inputs (e.g. R&D investments). In the last three waves, there is also information concerning the marketing and organizational innovations. The survey consists of a representative sample of firms in industry and service sectors with 10 and more employees. Among them, the stratum with 10-249 employees has a stratified random sampling with optimal allocations and the stratum with 250 and more employees is fully covered. The response rates in the five waves vary between 63% and 86%, in which the later CIS waves having higher response rates compared with the earlier ones.

There are 21,104 observations in total, after appending all five waves of CIS[7]. Then we construct two panel datasets: (i) A balanced dataset consists of 2,870 observations, corresponding to 574 firms who participated in all five waves of CIS, and (ii) an unbalanced dataset consists of 16,166 observations, corresponding to 4,958 firms participated in at least two consecutive waves (2,488 firms participated in two waves, 1,534 firms in three waves, and 936 firms in four waves). Finally, we merged the innovation-related data with other firm-characteristics data (e.g. export, import, ownership structure) coming from registered firm-level data maintained by Statistic Sweden (SCB). We use both balanced and unbalance panel datasets in investigating the various choices of innovation strategies that firms made (Section 4), while we only report unbalanced panel dataset in analyzing the determinants of the various choices, since we gain more observations (Section 5). The variable description is presented in the Appendix. The Vector Inflation Factor (VIF) among regressors has the mean value of 2.21 and each variable get a VIF score of below 3.4. This implies that multicollinearity is rather mild and may not bias the subsequent regression analyses results in Section 5.

4. Variety of innovation strategies

There are four types of innovation and a firms in a given point in time can choose to have any of these four types, any combination of these four types, or non them at all. Therefore, a firm can have sixteen possible innovation strategies at a given point in time. Table 1 reports the frequency and percentage of each innovation strategies using balanced and unbalanced panel dataset.

[Table 1 about here]

Table 1 show that firms choose between a wide variety of innovation strategies. Some firms choose to be a solo-innovator (innovating in only one type of innovation), while others choose to be a complex innovator by combining various types of innovation at the same time. Overall, it is evident that firms choose from all "possible" sixteen strategies and they do not exclude even one possible innovation strategies. There are several worthy points to highlight. First, the balanced and unbalanced panel provide similar patterns and hence for the sake of brevity we choose to discuss only one of them. We will discuss (and further analyze in Section 5) the unbalanced panel, since it provides substantially higher observations. Second, more than half of the innovators (58%) in our sample introduce more than one type of innovation at

[7] This is obtained after the usual data cleaning, i.e. dropping observations with zero turnover or zero employees.

a given point in time, i.e. complex innovators. This is striking as previous empirical studies rarely investigated the complex innovators. Third, looking at the frequency of all types of innovation strategies, it is clear that they are not equally popular among firms. The most popular ones are: (i) only product, (ii) only process, (iii) only marketing, (iv) only organizational, (v) both product and process, and finally (vi) all four types of innovation. These six most popular innovation strategies account for 65% of all choosing innovation strategies (it is even higher in balanced panel: 71%). While we are interested in determining the factors that drive the all the diverse choices of firms concerning innovation strategies, we will also give extra attention on the most popular (commonly used) innovation strategies in the subsequent sections.

5. Persistency of firms to have variety of innovation strategies

Previous section made it evident that firms choose between a large variety of innovation strategies. An interesting point is whether firms even "persist" to choose the specific innovation strategies that they already chose. In order to investigate such persistency pattern, we used Transition Probabilities Matrix (TPM). TPM reveals the information about the probability of transitioning from one state to another. In our case, "state" is the innovation strategies of firms in each period of time, i.e. any of sixteen possible innovation strategies. In particular, let a sequence of random variables $\{Y_1, Y_2, \dots, Y_n\}$ be a Markov chain. Then the TPM is formulated as follows:

$$\boldsymbol{TPM} = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1d} \\ p_{21} & p_{22} & \dots & p_{2d} \\ \vdots & \dots & \dots & \vdots \\ p_{d1} & p_{d2} & \cdots & p_{dd} \end{bmatrix} \quad (1)$$

Where,

$$p_{ij} = P(Y_t = j \,|Y_{t-1} = i) \quad (2)$$

Where ***TPM*** is a 16x16 matrix in our case and p_{ij} measure the probability of moving from innovation strategy *i* to innovation strategy *j* from *t-1* to *t*. The parameters p_{ij} are unknown; nevertheless, they can be estimated by Maximum Likelihood. It can be shown that the estimated parameters of p_{ij} equals to $\widehat{p_{ij}} = \frac{n_{ij}}{ni}$, where n_{ij} is the number of observed consecutive transitions from innovation strategy *i* to innovation strategy *j* and n_i is the total number of innovation strategy *i*. In the context of innovation persistence, it is shown that persistency can exist in two forms of weak or strong (Cefis and Orsenigo, 2001; Roper and Hewitt-Dundas,

2008). First, there is a weak innovation persistency if sum of diagonal elements of the matrix ***TPM*** ($p_{ij}, \text{if } i = j$) is equal or bigger than 100% probability *but* not all elements of the diagonal of the matrix are equal to or higher than 50%. Second, there is a strong innovation persistency if sum of diagonal elements of the matrix ***TPM*** ($p_{ij}, \text{if } i = j$) is equal or bigger than 100% probability *and* all elements of the diagonal of the matrix ***TPM*** equal to or higher than 50%. The matrix ***TPM*** is reported in Table 2.

[Table 2 about here]

Based on result in Table 2 several findings can be highlighted. First, 60% of non-innovators stay non-innovators in the subsequent period. Although none of the other individual element of the diagonal exceeds 50%, nevertheless the sum of the diagonal elements is clearly above 100%. This shows simply shows that not only firms choose very diverse variety of innovation strategies, but also they "persist" on pursuing such diverse innovation strategies in the next period. Although the observed persistency can be considered as "weak" rather than "strong" persistency, nevertheless, it is interesting to observe the persistency pattern even after breaking down the conventional dichotomous state of being innovative/non-innovative into sixteen different combinations of types of innovation. Second, the solo-innovators (only engaging in only one types of innovation) tend to keep the same innovation strategy with the same of type of innovation in the subsequent period. An exception is product innovators, which also tend to combine product innovation with process innovations in the subsequent period (15% of transitions). Third, those firms who combine two or three types of innovation in year *t-1* persist on keeping exactly the same two types of innovations in the subsequent period *t*. For instance, product and process innovators are also exactly product and process innovators in 31% of transitions (which is the highest among all other possible transitions). Apart from this, these firms, also show a tendency to transit to an innovation strategy, which at least one type of innovation, is the same as the previous period. For instance, product and process innovators shift to become product-process-marketing-organization innovators (all type innovators) in the subsequent period (14% of transitions). Fourth, looking at the first column of Table 2, the more firms simultaneously engage in various types of innovation, the less likely they transit to be non-innovative. This is in contrast to the firms who do only one types of innovation, to whom the probability of being non-innovative in the next period is considerably higher (41% for solo-marketing innovator and 44% for solo-organizational innovators higher. Finally, the

all-types innovators mostly persist to stay all-types innovators in the subsequent period (28% of transitions).

6. Determinants of various innovation strategies

6.1. Empirical strategy

In previous sections, we have seen that firms choose various types of innovation strategies as a preferred choice and they even persist to have their choice. However, what determines these choices? We employed Multinomial Logit model in order to investigate the determinants of various innovation strategies that firms choose[8]. The probability that firm *i* chooses innovation strategy *j* is given by:

$$P_{ij} = Prob(Y_i = j \,|\boldsymbol{X}_i) = \frac{\exp(\boldsymbol{X}_i'\beta_j)}{1 + \sum_{k=1}^{J} \exp(\boldsymbol{X}_i'\beta_k)} \qquad j = 0, 1, 2, \dots, 15 \qquad (1)$$

Where $\boldsymbol{X}_i$ is the vector of explanatory variables which are alternative-invariant regressors, β_j are a set of fifteen parameters per each explanatory variable, capturing the effect of each explanatory variables on the probabilities of choosing each choices (innovation strategies), and *j* is innovation strategies: *j*=0 is when firms choose not to innovate at all and considered as based model, *j*=1 when firm chooses to introduce only product innovation, *j*=2 when firm chooses to introduce only process innovation and so on. Multinomial Logit model is valid if the assumption of Independence for Irrelevant Alternatives (IIA) is not violated[9].

Since multinomial logit is in the class of non-linear models, interpreting the estimated parameters in terms of coefficient may not be intuitive. One common way is to express the estimated parameters obtained from Equation (1) as Relative Risk Ratio (RRR) instead. Given

[8] We have a situation where firm *i* can choose between any of sixteen various innovation strategies *j*, which are collectively exhaustive and mutually exclusive choices ($\sum_{j=0}^{J} P_{ij} = 1$). We only have alternative-invariant (2) specific) regressors and we do not have any alternative-specific regressors. In this situation, a good model to employ is Multinomial Logit.

[9] IIA assumption states that characteristics of one particular choice alternative do not affect the relative probabilities of choosing other alternatives. For example, if IIA is valid, how a firm *i* chooses between introducing only product innovation or only process innovation ($P_{i,j=1}/P_{i,j=2}$) is independent of any other possible choices of innovation strategy. We will test whether this assumption is met or not in our result section.

the equation (1), RRR of innovation strategy j for an explanatory variable X_i is calculated as follows:

$$RRR_j^X = \frac{Prob(Y_i = j \,|X_i + 1) \Big/ Prob(Y_i = j0 \,|X_i + 1)}{Prob(Y_i = j \,|X_i) \Big/ Prob(Y_i = j0 \,|X_i)}$$

Where $Prob(Y_i = j \,|X_i + 1)$ is the probability that firm i chooses innovation strategies j conditional in one unit increase in explanatory variable X_i, and $j0$ is the base choice (alternative), which in our case is when firm chooses not innovative (j=0). A RRR bigger than one means that increasing the X_i by one unit positively affect the probability choosing innovation strategy j against being non-innovative. Conversely, a RRR smaller than one means that increasing the X_i by one unit negatively affect the probability choosing innovation strategy j against being non-innovative.

6.2. Empirical results

The results of our empirical estimations are presented in Table 3. All innovative and non-innovative firms are used in the estimation. The base model is the particular innovation strategy that firms decide not to innovate (non-innovative). Therefore, Table 3 presents the determinants of the remaining 15 choices out of 16 possible innovation strategies. The table reports RRR of the estimated parameters and they should be interpreted in refer to the base model.

[Table 3 about here]

The results in Table 3 show some interesting patterns as well as few unexpected results. In-house R&D (*RDIN*) comes out as significantly positive for 12 of the 15 innovation strategies. For example, if a firm had in house R&D investments two years ago, then the probability that the firm chooses to be a pure product innovator (Model 1), in contrast to choose to be non-innovative, increases by 2.414 times. Such a significantly positive effect of In-house R&D for 12 of the 15 innovation strategies confirms the widely held belief that in-house R&D is critical for innovation and not only for pure product innovation. In terms of product innovation, it is interesting that there is such a clear relationship between continuous R&D (*CONT.RD*) and product innovation. If a firm wants to be a leader in product innovation, continuous innovation seems to be necessary. Outsourced R&D (*RDEX*), on the other hand, seems to have very

little significance for innovation, which is interesting since there is a rich discussion in the literature on the relationship between in-house and out-sourced R&D. It seldom seems to be a complement and never a substitute. Product innovation also shows a strong significant relationship with the human capital (*HUMCAP*) of the innovation firms. This indicates that other types of innovation are possible without a strong internal human capability. In all cases except one, a high import intensity (*IMPORT*) is strongly related to product innovation. This is most probably an indication of that product innovation today is strongly dependent upon the imports of inputs and systems of various kinds as an effect of globalization. A similar pattern is found for export intensity (*EXPORT*). Product innovation is in all cases except one strongly influenced by the export intensity of firms. This is because competing at the world market demands a continuous flow of new and improved products. Moreover, this finding is in line with the trade version of endogenous model, which predicts that export contributes to innovation and growth (Grossman and Helpman, 1991). Process innovations are, for natural reasons, strongly influenced by machinery investments (*MACH*). This is because process innovations are to high extent equal to the introduction of new machinery embodying new knowledge and technologies. Moreover, while investments in machinery does not have influence on pure product innovations, it actually shows its effect when firms decide to combine product with process (and other types of) innovation. This could be because in such innovation strategies, firms can utilize the investment machinery in the actual product development processes, e.g. prototyping. Interestingly, external acquisition of knowledge (*EXKN*) only comes out at significant in two choices. This is somewhat unexpected since one could expect that such acquisition should be important not least for product innovation. The effect of training (*TRAINING*) on innovation is very mixed. In some choices, it has a significant positive effect and in others a significant negative effect. An interesting point is that the common denominator in those choices that training has negative effect is market innovation. This could be due to the competition of scarce resources within a firm for different innovation strategies. The variable market introduction of innovation (*MARK*) in several choices has a positive effect on innovation, especially concerning product innovation, which seems natural. An interesting point is that it has a negative effect on pure process innovation, which should be again due to the scarce resources competing with each other in two very different choices of innovation strategies (pure product vs. pure process innovations). We now turn to the influence of the five co-operation variables on innovation: co-operation with suppliers (*COS*), with customers (*COCL*), with competitors (*COCOM*), with universities (*COUNIV*), and with research institutes (*COINST*). Among all cooperation variables, cooperation with suppliers seems to have

relatively strongest effect on several choices. Nevertheless, generally speaking, the effect of cooperation is not something to claim. Cooperation with competitors shows even negative effect on choosing one of the most popular innovation strategies, i.e. introducing both product and process innovations (Model 5). This is really a surprising result, since the literature repeatedly stresses the importance of such cooperation for innovation. Is earlier research wrong or are there some problems with the indicators we use? Since the results are unexpected, we certainly think that more research is needed on this matter. Size (*SIZE*) in many choices has a significant positive influence on innovation. However, we can also see that the effect on innovation strategies involving product innovation is insignificant in four choices. This is in line with what we should expect; since the literature generally stresses that smaller firms can be at least as efficient product innovators as larger firms. The impact of investments in buildings and machinery (*PHYSCAP*) is varying. In some choices, it has a significant positive influence, in some choices, it is insignificant and in some choices, it has a significant negative effect, so it is difficult to draw any conclusions here. We have three variables capturing the ownership structure of the firms by describing if a firm belongs to a group or not. Belonging to no group is a base category and if a firm belong to a group, it falls to one of the following categories: non-international (*UNINAT*), domestic multinational (*DOM MNE*) and foreign multinational (*FOR MNE*). Among these categories, being uninational enterprise seems to have positive effect in favour of some choices; nevertheless, these variables generally seem to have very little influence on innovation. Finally, if a firm belongs to the manufacturing sector, this has a significant positive influence on product innovation but a significant negative on several innovations involving market innovations.

As it is shown in Section 4, firms apparently choose some of the choices more frequently than others when it comes to innovation strategy. These innovation strategies deserve further attention. Therefore, in Table 4, we summarize the significant results for the most commonly used choices of innovation strategy.

[Table 4 about here]

The pattern exhibited in Table 4 contains both clear similarities and differences between the most commonly used innovation strategies. Pure market and organizational innovations are determined by the explanatory variables that we have used only to a minor degree. Process innovations are strongly influenced by three explanatory variables. Things become quite different when we turn to product innovations. Seven explanatory variables have a strong posi-

tive influence on this innovation strategy. If we turn to innovation strategy No. 5 (i.e. combination of product and process innovations), we see that the pattern of determinants very much looks like a merger of the determinants of innovation strategies No.1 and 2. This seems very plausible and is what we should expect. The last innovation strategy (No. 6), which is the most complex innovation strategy, since it involves product, process, market and organizational innovations, has a pattern of determinants that looks rather similar to that of innovation strategy No. 5. However, we can here see that now also the acquisition of external knowledge (*EXKN*) and cooperation with suppliers (*COS)* have a strong positive influence. All this makes sense. The more complex innovation strategies use and need a larger variety of inputs of various kinds to function.

7. Conclusion

Already Schumpeter distinguish between four different basic types of innovation, i.e. product, process, marketing and organizational innovations. Moreover, one can imagine any possible combinations of these four basic types, which amount in total to sixteen choices. This wide range of choices constitutes the innovation strategy of firms. In each period, a given firm can pick only one of sixteen choices, since they are collectively exhaustive and mutually exclusive choices. Surprisingly we have seen neither any study that investigate the frequency of these choices among firms nor any study that analyzes the determinant of each choice in innovation strategy. In this paper, we investigated these issues in a novel way by focusing on various choices that firms make in their innovation strategies. Following Schumpeter's basic innovation types and various combinations, we consider sixteen choices in innovation strategy. Employing a long panel of Community Innovation Surveys in Sweden enabled us to trace the preferred choice of firm in term of their innovation strategy over a ten years period, i.e. 2002 to 2012. We found several interesting findings. First, firms are considerably heterogeneous in their preferences of choices when it comes to innovation strategy. Moreover, six innovation strategies account for about 70 percentages of all chosen choices. These commonly used innovation strategies are: introducing pure product, pure process, pure marketing, pure organizational, both product and process, and finally introducing all type of innovation at the same time. Second, using Transition Probability Matrix, we found that firms not only choose from a wide range of choices, but also tend to persist to choose whatever they have chosen in the previous period. Finally, using Multinomial Logit model we disentangle the determinant

of various choices of innovation strategies of firms. Focusing on the most commonly used innovation strategies, we found most significant explanatory variables for product innovation. Then it comes to process innovation, which is positively affected by internal R&D investments, machinery investments, training of employees, and size of firm. Pure market and organizational innovations are determined by the explanatory variables that we have used only to a minor degree. Generally speaking, cooperation variable have little effect on innovation of firms, no matter which innovation strategy to choose, although relatively speaking, cooperation with supplier seems to have some positive effect on most commonly used innovation strategies. A similar pattern is seen for outsourcing of R&D (external R&D activities), with no considerable effect on innovation choices, except the most complex innovation strategy, in which firm succeed to introduce all four types of innovation simultaneously. This is a striking finding considering all the rich literature emphasizing the cooperation with external partners. On the other hand, internal R&D still affects most of the innovation strategies of firms (12 out of 15). International linkages (import and export) positively affect the choice of firms to choose product innovation as well as the complex innovation.

The basic assumption in this paper was that various choices concerning innovation strategies happening simultaneously. However, one could also consider a case that some innovation strategies induce other innovation strategies later in time (i.e. subsequent manner instead of simultaneous manner). For instance, organizational innovations can facilitate other types of innovations (Demanpour, Szabat & Evan, 1989). Further investigation is needed to analyze the dynamic between various choices of innovation strategies. Another area of further research could be to analyze the effect of various choices of innovation strategies on firm performances, such as productivity.

Table 1-Innovation strategies: various combination of innovation types

		Balanced Panel			Unbalanced Panel		
#	**Innovation Strategy**	Frequency	Percentage	Percentage	Frequency	Percentage	Percentage

			(Total)	(Innovative)		(Total)	(Innovative)
1	NON-INNO	1089	38%	-	9718	46%	-
2	PROD	269	9%	15%	1512	7%	13%
3	PROC	288	10%	16%	1799	9%	16%
4	MAR	96	3%	5%	826	4%	7%
5	ORG	88	3%	5%	746	4%	7%
6	PROD PROC	369	13%	21%	1580	7%	14%
7	PROD MAR	51	2%	3%	453	2%	4%
8	PROD ORG	44	2%	2%	220	1%	2%
9	PROC MAR	39	1%	2%	305	1%	3%
10	PROC ORG	69	2%	4%	508	2%	4%
11	MAR ORG	63	2%	4%	630	3%	6%
12	PROD PROC MAR	70	2%	4%	381	2%	3%
13	PROD PROC ORG	63	2%	4%	347	2%	3%
14	PROD MAR ORG	48	2%	3%	351	2%	3%
15	PROC MAR ORG	61	2%	3%	774	4%	7%
16	PROD PROC MAR ORG	163	6%	9%	955	5%	8%
	Total	2870	100%	100%	21105	100%	100%

Notes: The table shows the 16 possible combinations of innovation strategies that firms make considering four types of innovation. NON-INNO: non-innovative, PROD: doing only product innovation in year *t*, PROC: doing only process innovation in year *t*, MAR: doing only marketing innovation in year *t*, ORG: only organizational innovation in year *t*, PROD PROC: doing product and process innovations in year *t*, PROD PROC MAR doing product, process and marketing innovations in year *t* and so on. The period is from 2002 to 2012.

Table 2-Persistancy of firms in having diverse innovation strategies (using balanced panel)

	Innovation Strategy in t+1																
Innovation Strategy in t	NON-INNO	PROD	PROC	MAR	ORG	PROD PROC	PROD MAR	PROD ORG	PROC MAR	PROC ORG	MAR ORG	PROD PROC MAR	PROD PROC ORG	PROD MAR ORG	PROC MAR ORG	PROD PROC MAR ORG	Total
NON-INNO	60%	4%	6%	4%	5%	3%	1%	1%	1%	3%	3%	2%	0%	1%	2%	3%	100%
PROD	20%	25%	4%	3%	1%	15%	6%	3%	1%	1%	2%	4%	3%	3%	0%	9%	100%
PROC	35%	3%	23%	3%	5%	8%	1%	0%	2%	5%	3%	2%	2%	2%	3%	2%	100%
MAR	41%	5%	7%	9%	3%	2%	2%	0%	5%	3%	10%	0%	0%	0%	10%	2%	100%
ORG	44%	5%	5%	13%	11%	2%	0%	3%	2%	13%	0%	0%	0%	0%	5%	0%	100%
PROD PROC	13%	14%	7%	1%	2%	31%	2%	3%	1%	0%	1%	3%	5%	1%	1%	14%	100%
PROD MAR	36%	3%	0%	0%	0%	3%	18%	3%	6%	0%	0%	9%	0%	15%	0%	6%	100%
PROD ORG	24%	18%	0%	0%	6%	0%	6%	6%	0%	3%	6%	6%	9%	6%	9%	0%	100%
PROC MAR	33%	0%	11%	7%	15%	0%	4%	0%	11%	0%	4%	0%	0%	0%	7%	7%	100%
PROC ORG	33%	0%	6%	15%	6%	6%	0%	2%	4%	10%	4%	0%	0%	4%	6%	2%	100%
MAR ORG	29%	3%	0%	13%	8%	3%	0%	3%	5%	5%	11%	0%	0%	11%	5%	5%	100%
PROD PROC MAR	19%	14%	5%	0%	5%	12%	5%	0%	2%	5%	0%	9%	2%	5%	5%	14%	100%
PROD PROC ORG	9%	9%	4%	2%	0%	6%	2%	8%	0%	4%	2%	8%	19%	0%	2%	26%	100%
PROD MAR ORG	16%	13%	3%	13%	0%	3%	3%	13%	0%	0%	0%	6%	3%	19%	3%	6%	100%
PROC MAR ORG	33%	0%	11%	8%	0%	0%	3%	0%	3%	6%	8%	0%	6%	0%	14%	8%	100%
PROD PROC MAR ORG	11%	8%	3%	3%	1%	4%	3%	2%	1%	1%	4%	13%	11%	6%	3%	28%	100%
Total	37%	8%	8%	4%	4%	9%	2%	2%	2%	3%	3%	3%	3%	2%	3%	7%	100%

Notes: The table is a 16x16 matrix of ***TPM***, which reports all types of innovation and all possible combination of types of innovations. Each element of the matrix is the estimated parameters of Transition Probabilities Matrix ($\widehat{p_{ij}} = \frac{n_{ij}}{ni}$). NON-INNO: non-innovative, PROD: only product innovators, PROC: only process innovators, only MAR: marketing innovators, ORG: only organizational innovators, PROD PROC: both product and process innovators and so on. t=2004, 2006, 2008, 2010, 2012. Using unbalanced panel produced similar results to this table.

Table 3-Determinants of the various choices in innovation strategy (in year *t*)

VAR	(1) PROD	(2) PROC	(3) MAR	(4) ORG	(5) PROD PROC	(6) PROD MAR	(7) PROD ORG	(8) PROC MAR	(9) PROC ORG	(10) MAR ORG	(11) PROD PROC MAR	(12) PROD PROC ORG	(13) PROD MAR ORG	(14) PROC MAR ORG	(15) PROD PROC MAR ORG
$RDIN_{it-1}$	2.414***	1.361**	1.429**	1.096	1.841***	2.227***	2.119**	1.437	1.378*	1.632***	2.000***	2.121***	1.569*	1.228	1.780***
	(0.153)	(0.145)	(0.158)	(0.177)	(0.175)	(0.223)	(0.332)	(0.223)	(0.186)	(0.183)	(0.215)	(0.229)	(0.269)	(0.177)	(0.161)
$RDEX_{it-1}$	1.292*	0.837	1.032	1.404*	1.259	1.094	1.079	1.143	0.955	1.175	1.522**	1.301	1.487**	1.219	1.193
	(0.148)	(0.157)	(0.182)	(0.188)	(0.152)	(0.198)	(0.224)	(0.250)	(0.195)	(0.205)	(0.192)	(0.211)	(0.200)	(0.174)	(0.145)
$CONT.RD_{it-1}$	1.721***	1.033	1.177	1.104	1.930***	2.353***	2.894***	0.720	0.882	0.786	2.215***	1.554**	2.350***	1.286	1.784***
	(0.152)	(0.156)	(0.199)	(0.218)	(0.160)	(0.197)	(0.279)	(0.275)	(0.223)	(0.230)	(0.206)	(0.213)	(0.231)	(0.187)	(0.158)
$MACH_{it-1}$	0.947	1.795***	1.343**	1.192	1.913***	1.556**	1.549*	1.925***	1.635***	0.972	1.776***	2.208***	1.216	1.965***	1.375**
	(0.132)	(0.131)	(0.144)	(0.148)	(0.150)	(0.184)	(0.249)	(0.198)	(0.175)	(0.160)	(0.188)	(0.196)	(0.218)	(0.161)	(0.137)
$EXKN_{it-1}$	0.984	1.189	1.219	1.273	1.232	1.204	1.452	1.527*	1.253	1.404*	1.168	1.196	1.176	1.659***	1.527***
	(0.133)	(0.133)	(0.157)	(0.171)	(0.139)	(0.190)	(0.245)	(0.223)	(0.181)	(0.176)	(0.179)	(0.187)	(0.199)	(0.166)	(0.133)
$TRAINING_{it-1}$	1.064	1.446***	0.898	1.408**	1.420**	0.485***	0.964	0.560**	1.513**	0.990	0.701*	1.706***	0.978	1.270	1.101
	(0.139)	(0.132)	(0.172)	(0.167)	(0.148)	(0.196)	(0.254)	(0.236)	(0.172)	(0.187)	(0.185)	(0.185)	(0.209)	(0.154)	(0.135)
$MARK_{it-1}$	1.858***	0.680***	1.300	0.889	1.557***	3.058***	1.369	1.711**	0.754	1.364*	2.715***	1.366*	3.224***	1.037	2.432***
	(0.133)	(0.145)	(0.171)	(0.189)	(0.145)	(0.183)	(0.239)	(0.215)	(0.212)	(0.181)	(0.184)	(0.187)	(0.207)	(0.162)	(0.133)
COS_{it-1}	1.355*	1.350*	1.301	1.269	1.081	1.547**	1.497	1.398	1.208	1.574**	1.185	1.417*	1.611**	1.274	1.806***
	(0.159)	(0.162)	(0.199)	(0.215)	(0.164)	(0.206)	(0.263)	(0.269)	(0.252)	(0.226)	(0.208)	(0.207)	(0.221)	(0.193)	(0.153)
$COCL_{it-1}$	0.896	0.947	0.699	0.522**	1.176	0.801	1.466	0.890	1.116	0.700	1.396	1.054	1.196	1.294	0.763
	(0.172)	(0.192)	(0.244)	(0.271)	(0.189)	(0.249)	(0.297)	(0.331)	(0.257)	(0.285)	(0.236)	(0.225)	(0.271)	(0.216)	(0.179)
$COCOM_{it-1}$	0.959	1.397	1.330	1.090	0.642**	1.155	0.773	1.897**	0.957	0.974	1.175	0.771	0.862	1.182	0.845
	(0.201)	(0.204)	(0.236)	(0.263)	(0.223)	(0.261)	(0.327)	(0.289)	(0.267)	(0.278)	(0.244)	(0.272)	(0.276)	(0.216)	(0.194)
$COUNIV_{it-1}$	0.877	0.873	0.755	0.880	1.040	0.838	0.923	0.824	1.359*	0.956	0.988	1.007	1.020	0.875	1.141
	(0.124)	(0.130)	(0.182)	(0.169)	(0.123)	(0.172)	(0.210)	(0.240)	(0.167)	(0.201)	(0.152)	(0.154)	(0.155)	(0.149)	(0.117)
$COINST_{it-1}$	0.901	1.075	1.280	1.060	1.091	0.693	1.125	0.864	0.733	0.767	0.610**	1.147	0.776	0.772	0.749*
	(0.162)	(0.163)	(0.199)	(0.207)	(0.141)	(0.245)	(0.221)	(0.340)	(0.221)	(0.314)	(0.221)	(0.176)	(0.243)	(0.224)	(0.162)
$SIZE_{it-1}$	0.948	1.160***	1.110**	1.319***	1.187***	0.930	1.121	1.319***	1.530***	1.276***	1.376***	1.526***	1.049	1.541***	1.548***
	(0.049)	(0.043)	(0.048)	(0.047)	(0.054)	(0.068)	(0.073)	(0.074)	(0.054)	(0.053)	(0.063)	(0.071)	(0.075)	(0.045)	(0.047)
$PHYCAP_{it-1}$	1.026*	1.015	0.998	1.003	1.045**	0.995	1.055***	0.971**	1.021	0.976**	1.045**	1.034	1.030*	0.974***	0.997
	(0.013)	(0.013)	(0.011)	(0.011)	(0.022)	(0.017)	(0.020)	(0.015)	(0.015)	(0.011)	(0.022)	(0.029)	(0.016)	(0.010)	(0.012)
$HUMCAP_{it-1}$	4.455***	1.273	1.556	1.339	2.995***	3.889***	5.256***	1.206	2.274**	1.658	2.413*	6.948***	3.050***	2.557***	6.721***
	(0.303)	(0.290)	(0.290)	(0.321)	(0.353)	(0.387)	(0.567)	(0.457)	(0.370)	(0.332)	(0.482)	(0.499)	(0.416)	(0.305)	(0.313)
$IMPORT_{it-1}$	5.075***	1.013	0.758	1.164	2.423***	4.650***	5.632***	1.280	1.768	0.926	4.503***	3.968***	1.515	0.833	3.571***
	(0.278)	(0.342)	(0.403)	(0.385)	(0.342)	(0.350)	(0.423)	(0.628)	(0.402)	(0.471)	(0.405)	(0.369)	(0.468)	(0.541)	(0.306)
$EXPORT_{it-1}$	1.956***	1.249	1.293	1.027	1.544**	2.647***	2.218**	0.682	1.315	0.710	1.113	2.313***	2.460***	0.493*	1.976***
	(0.201)	(0.231)	(0.254)	(0.277)	(0.214)	(0.260)	(0.310)	(0.529)	(0.287)	(0.347)	(0.273)	(0.278)	(0.309)	(0.395)	(0.209)
$UNINAT_i$	1.131	1.144	1.438**	0.997	1.213	0.945	0.845	1.517**	1.314	1.760***	1.039	1.584	0.990	1.558**	1.043
	(0.146)	(0.129)	(0.142)	(0.148)	(0.169)	(0.209)	(0.360)	(0.205)	(0.189)	(0.180)	(0.225)	(0.308)	(0.271)	(0.172)	(0.177)
$DOM\ MNE_i$	1.133	1.240	1.214	1.085	1.054	1.151	1.565	1.035	1.079	1.714***	0.923	1.299	1.504	1.431*	1.233
	(0.166)	(0.154)	(0.179)	(0.185)	(0.188)	(0.226)	(0.338)	(0.277)	(0.227)	(0.209)	(0.247)	(0.308)	(0.280)	(0.195)	(0.185)
$FOR\ MNE_i$	1.313	1.124	0.950	0.918	1.032	1.027	1.579	0.734	0.825	1.202	0.785	1.016	1.364	0.824	0.830
	(0.168)	(0.160)	(0.200)	(0.194)	(0.201)	(0.236)	(0.343)	(0.302)	(0.245)	(0.229)	(0.246)	(0.327)	(0.297)	(0.215)	(0.192)
$MANUF_i$	3.203***	1.153	0.664***	0.817	4.592***	1.991***	2.249***	0.894	1.001	0.707**	2.583***	4.024***	1.478*	0.623***	2.396***
	(0.143)	(0.115)	(0.130)	(0.134)	(0.173)	(0.190)	(0.286)	(0.197)	(0.161)	(0.153)	(0.193)	(0.247)	(0.204)	(0.154)	(0.151)

Notes for Table 3: The table reports Relative Risk Ratio (RRR) with clustered standard errors in parentheses. ***,** and * indicate significance on a 1%, 5% and 10% level. Multinomial Logit model is used for estimating the sixteen innovation strategies of all firms with being non-innovative as the base model (strategy). RRR is calculated as in Equation 2. RRR>1 means one unit increase in the corresponding regressor is associated with higher probability that firms chooses the corresponding innovation strategy in compare with the base model (being a non-innovative firm) by RRR times. Conversely, RRR< 1 implies a negative effect. PROD: only product innovators, PROC: only process innovators, only MAR: marketing innovators, ORG: only organizational innovators, "PROD PROC": both product and process innovators, and so on. Observations are pooled over t=2004, 2006, 2008, 2010, 2012. All time-variant explanatory variables are lagged one period in time (2 years). Both Hausman tests and suest-based Hausman tests of IIA assumption point that IIA assumption is not violated in the estimation. Time dummies are included in the regression model. The estimation is based on unbalanced panel data with 9,061 observations. Balanced panel data reveals similar results.

Table 4-Determinants of the commonly used innovation strategies

Variables	(1) PROD	(2) PROC	(3) MAR	(4) ORG	(5) PROD PROC	(6) PROD PROC MAR ORG
$RDIN_{it}$	+++	++	++	0	+++	+++
$RDEX_{it}$	+	0	0	+	0	+
$CONT.R\&D_{it}$	+++	0	0	0	+++	+++
$MACH_{it}$	0	+++	++	0	+++	++
$EXKN_{it}$	0	0	0	0	0	+++
$TRAINING_{it}$	0	+++	0	++	++	0
$MARK_{it}$	+++	---	0	0	+++	+++
COS_{it}	+	+	0	0	0	+++
$COCL_{it}$	0	0	0	++	0	0
$COCOM_{it}$	0	0	0	0	++	0
$COINST_{it}$	0	0	0	0	0	+
$SIZE_{it}$	0	+++	++	+++	++	+++
$PHYS\ CAP_{it}$	+	0	0	1	++	0
$HUMAN\ CAP_{it}$	+++	0	0	0	+++	+++
$IMPORT_{it}$	+++	0	0	0	+++	+++
$EXPORT_{it}$	+++	0	0	0	++	+++
$UNINATIONAL_i$	0	0	++	0	0	0
$MANUF_i$	+++	0	---	0	+++	+++

Notes: The table extracts the result of Table 3 in terms of significance and sign for the most commonly used innovation strategies. +++, ++, +: indicate positive significance on a 1%, 5% and 10% level, respectively. ---, --, -: indicate negative significance on a 1%, 5% and 10% level, respectively. 0 means no significant effect. Innovation strategies 1,2,3,4, 5 have the same model number as in Table 3. Innovation strategy 6 in this table is equivalent to model 15 in Table 3.

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