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Acquisitions of Start-ups by Incumbent Businesses

A market selection process of "high-quality" entrants?

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JEL codes: O33, G34, L22, O32, L26

Keywords: acquisitions, post-entry performance, market selection, start-ups, new technology-based firms (NTBFs), innovation, competing-risk model, Sweden

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1. INTRODUCTION

New firms are vastly heterogeneous, and much research focuses on the question of what makes a successful start-up in terms of post-entry performance. Start-ups are subject to a market selection process, and analyses of their post-entry dynamics reveal which types of firms manage to get established in the market. In a summary introduction to a special issue on the post-entry performance of start-ups, Audretsch and Mata (1995) indeed maintain that "what emerges from the studies of the entry process is that it is what happens to firms subsequent to their entry that is at least as important as the entry process itself" (p. 415).

We focus in this paper on a particular aspect of post-entry dynamics that so far has received rather little attention in the empirical literature on start-ups, namely the frequency and nature by which established corporations acquire recent start-ups. Based on a full population micro-level dataset for Sweden, we identify different types of new firms, which we follow up to 18 years after entry. We estimate competing risks models and test a number of hypotheses with regard to which types of entrants are acquired and by which types of acquiring firms. Our analyses provide new empirical insights into the interplay between recent start-ups and established businesses as evidenced by acquisitions.

Acquisitions reflect a specific form of market selection process, where established firms purposefully select particular entrants as acquisition targets. They constitute an interesting post-entry phenomenon to study in the context of start-ups for many reasons. From the perspective of new firms, selling the business to an incumbent firm and earning returns through the "market for ideas" has been advanced as a warranted commercialization strategy for start-ups (Gans & Stern, 2003). Many start-ups face difficulties in, for example, securing financing for their operations. Being acquired by a financially strong incumbent may be one means to ensure financing as well as continued development of the technology or idea the start-up is based on (Utterback, Meyer, Roberts, & Reitberger, 1988; Graebner & Eisenhardt, 2004). From the perspective of incumbent firms, acquiring new, innovative entrants is a way to complement in-house R&D and to strengthen and diversify technological capabilities (Granstrand & Sjölander, 1990; Ruckman, 2005; Desyllas & Hughes, 2008). Lindholm-Dahlstrand (1996b) holds that the growth of new technology-based firms (NTBFs) creates a market for technology that complements other types of technology markets. Many firms also report that acquisitions of small entrepreneurial entrants are an important part of their corporate strategy.[3]

[3]In the late 1990s, for instance, Ericsson reported that it employed a strategy sometimes referred to as "the string of pearls strategy" to enter the internet protocol (IP) market (Glimstedt, Zander, & Kilefors, 2007). This strategy focused on acquiring small and young innovative companies with advanced knowledge and competence in IP.

The motives of the acquiring firms and the potential consequences for the acquired start-ups show that acquisitions could be a "win-win" post-entry event, reflecting a technology transfer process (Granstrand & Sjölander, 1990; Bonardo, Paleari, & Vismara, 2010). In fact, one could argue that acquisition of start-ups by incumbents is one means by which the potential economy-wide effects of novelties developed by innovative entrants are realized. The literature on "entrepreneurship systems" (Lindholm, 1996a; Lindholm-Dahlstrand, 1997), as well as Baumol's (2002) argument of a "David-Goliath symbiosis," holds that innovative small firms and established businesses complement each other. A main idea in both Lindholm-Dahlstrand's and Baumol's frameworks is that the classic Schumpeterian discussion of "small versus large" in innovation is misleading. Instead, new entrepreneurial firms and incumbents have their respective advantages at different stages of the innovation process. New entrants bring in new technologies and innovations but may lack complementary resources to scale up, refine, and extend them. Larger established firms with global sales networks and resources can enhance or embed the novelties developed by the small entrants into existing products and production processes and bring them to a global scale. Acquisition of innovative entrants is one way in which this can happen. This type of interaction between entrants and established firms might naturally be conducive to the overall innovativeness and growth of the economy (Lindholm-Dahlstrand, 1997; Falck, 2009).[4]

Despite the role that interaction between new entrants and established businesses through acquisitions may play, there is a dearth of systematic studies that focus directly on assessing acquisition as a post-entry trajectory of start-ups. Most studies of the post-entry dynamics of recent entrants direct their attention to survival and growth in sales or employment (Santarelli & Vivarelli, 2007). Likewise, existing literature on acquisitions (including mergers) typically focuses on larger and more established companies that are publicly traded (Veugelers, 2006; Hussinger, 2010). Our knowledge of the extent and characteristics of acquisition of recent entrants by incumbents is therefore limited.

There are still increasing calls for empirical analyses of the interplay between established firms and new entrants. Haltiwanger, Jarmin, and Miranda (2013), for example, analyze the role of "small versus young versus large" firms in creating jobs in the United States. One of their conclusions is that "we need to develop the data and associated analyses that will permit investigating the complex relationships between young and mature businesses" (p. 361). Similar to the arguments above, they further state, "It may be, for example, that the volatility and apparent experimentation of young businesses that we have identified is critical for the development of new products and processes that are in turn used by (and perhaps acquired by) the large and mature businesses that account for most economic activity" (p. 361).

[4] Delmar, Wennberg, and Hellerstedt (2011) find that new technology-intensive firms started by entrepreneurs with a degree in science and engineering have positive effects on the growth of industries for which technology is important. Their result could potentially be explained by the described "symbiosis" between new technology-intensive entrants and incumbent businesses through acquisitions in high-tech sectors, driving the industry's overall growth.

We contribute in this regard with a systematic analysis of the frequency and nature of acquisitions of recent start-ups, which constitutes one type of interplay between start-ups and incumbent businesses related to transfer of technology and innovation. While the paper does not directly test for the "symbiosis" or "win-win" effect of acquisitions discussed above, we derive hypotheses concerning the characteristics of acquired start-ups and acquiring firms from this strand of literature, particularly research on "entrepreneurship systems" and on commercialization strategies of start-ups. We thus assess whether the patterns of acquisitions of start-ups are consistent with the conjectures in this literature. To this end, we focus on the influence that the technology profile, market context, and financial position of start-ups has on the probability of being acquired.

We identify the full population of independent start-ups in Sweden entering during the period 1991–2002 and follow them up to 18 years after entry (until 2009). Yearly information on the ownership structure of each entrant allows us to track whether and when a start-up is acquired by an established corporation. We distinguish between three different types of acquiring firms (foreign multinational enterprises [MNEs], Swedish MNEs, and domestic corporations), and also use established techniques to separate between different types of start-ups, namely spin-offs (pushed and pulled) and other types of new firms. This allow us to assess how acquisition probabilities vary across different types of start-ups.

Our analyses provide a number of main stylized facts and results: First, acquisitions of recent start-ups are rare. The uncontrolled general probability of acquisition is around 5% up to 5 years after entry, while the probability of exit is about 60%. Second, acquisition targets are a small group of firms with defining characteristics. They are much more likely to be spin-offs with strong technological competence and weak internal financial resources operating in high-tech sectors. MNEs also appear to be more prone to target NTBFs. Third, compared to foreign MNEs, Swedish MNEs show a higher propensity to target NTBFs. This may be an indication that domestic MNEs, with supposedly better knowledge of and networks in the home country than their foreign counterparts, are in a better position to identify innovative domestic start-ups.

The econometric analyses support the idea that acquisitions constitute an important mechanism of market selection pertaining to "good" high-tech start-ups. In fact, our findings suggest a kind of "hierarchy" in market selection in terms of the technology profile of start-ups: highly technology-intensive start-ups are acquired by (or sold to) MNEs, medium technology-intensive firms are acquired by domestic corporations, and others remain independent or exit. These characteristics of the acquisitions process are consistent with the literature on "entrepreneurship systems" of NTBFs (Lindholm, 1996a; Lindholm-Dahlstrand, 1997) and the literature on how commercialization strategies of NTBFs depend on market conditions (Norbäck & Persson, 2014; Gans & Stern, 2003). In essence we

find that acquisitions primarily occur in high-technology contexts where entry costs are large, access to finance is important and incumbents have high market power.

The rest of the paper is organized as follows: Section 2 discusses motives for acquisitions and presents hypotheses. Section 3 describes the data and defines variables. Section 4 introduces our estimation strategy, focusing on the estimation of the competing risks hazard model. An initial description of the main patterns regarding acquisitions of start-ups is presented in section 5. Section 6 presents results of the estimation of how a set of key characteristics of entrants influences the probability of being acquired, while section 7 concludes.

2. THEORY AND HYPOTHESES

2.1. The "why" and "who" of acquisitions of start-ups

Why do some firms acquire other firms? Economic theory identifies various motives, such as achieving market power (Stigler, 1950), technology sourcing (Granstrand & Sjölander, 1990), creating synergy gains (Hall, 1987), lowering transaction costs (Williamson, 1975), and corporate control (Lichtenberg, Siegel, Jorgenson, & Mansfield, 1987). Evidence accumulated over recent decades suggests that more and more incumbent firms are motivated to source or diversify technological capabilities through acquiring high-technology start-ups (Granstrand & Sjölander, 1990; Chakrabarti, Hauschildt, & Süverkrüp, 1994; Desyllas & Hughes, 2008). Intel and Cisco are examples of incumbent firms that have successfully used acquisitions of high-technology start-ups as a persistent corporate strategy to source new technology (Kale & Puranam, 2004). Such strategies can be motivated within established theories of firms' competitive advantages.

The resource-based view of the firm suggests that the competitive advantage of a firm depends on its specific configuration of existing resources (Wernerfelt, 1984; Barney, 1991). Technological knowledge has been advanced as one of the most crucial resources to build an organization's distinct competitiveness (Kogut & Zander, 1992). A firm's capabilities to sustain its competitiveness in a dynamic environment with rapid technology change (dynamic capabilities) are consequently linked to its ability to create, modify, and extend its technological resources (Teece, Pisano, & Shuen, 1997; Winter, 2003). In this context, acquisitions of NTBFs can be understood as a quick and less risky way to gain access to new technology or solve the problem of technology exhaustion (Chakrabarti et al., 1994; Danzon, Epstein, & Nicholson, 2007).

One strand in the literature on innovation and industrial dynamics also holds that small new firms and large incumbent firms have their respective advantages in different stages of the innovation process. Small new firms are successful in introducing breakthrough innovations while large incumbent firms have advantages in producing incremental innovations (Henderson, 1993; Sørensen & Stuart, 2000; Baumol, 2002). Incumbent firms thus tend to target NTBFs that have technological competencies or product ideas that complement and/or expand their own in-house R&D and technologies (Granstrand & Sjölander, 1990; Desyllas & Hughes, 2008).[5] Furthermore, incumbent firms may use acquisitions of start-ups as an important strategy for corporate control by replacing inefficient management teams of start-ups (Lichtenberg et al., 1987). In this case, acquisitions can be regarded as a mechanism to reallocate technological resources to firms with higher levels of management capability.[6] Based on the discussion above, we formulate our first hypothesis regarding the type of new entrant that is acquired:

H1: *NTBFs, as defined by technological capabilities and high-tech sectors, are more likely to be acquired.*

Extensive literature suggests that there are distinct differences between types of new firms. In a series of studies, spin-offs have been shown to have superior post-entry performance in terms of both survival and employment growth (Eriksson & Kuhn, 2006; Andersson & Klepper, 2013). This pattern is explained by spin-offs inheriting capabilities and routines from their parent organization, which gives them an advantage (Klepper, 2001; Agarwal, Echambadi, Franco, & Sarkar, 2004). Acquisitions of spin-offs also play an important role in Lindholm-Dahlstrand's (1996a) idea of an "entrepreneurship system". The argument is that new firms spin off from established corporations and inherit capabilities and technology from their parents. Since incumbents tend to target new firms with strong technological capabilities, spin-offs are likely to be acquired by other established firms through the market for corporate control. This type of market complements other types of technology markets, and constitute a means by which technology diffuses and transfers between established businesses (Granstrand & Sjölander, 1990). In view of this, we expect that spin-offs are more likely to be acquired, even after controlling for their observable technological competences and the characteristics of the industry in which they operate:

H2: *Spin-offs are more likely to be acquired than other types of new firms.*

[5]Granstrand (1998) also argue that technological diversification is a key strategy for technology-based firms. Acquisitions of high-tech entrants with strong technological capabilities are certainly a means to accomplish such a strategy.

[6] However, incumbent firms may also have a hostile motive to acquire start-ups in technology markets in order to pre-empt potential competitors (Reinganum, 1983; Grimpe & Hussinger, 2008).

From the perspective of start-ups, new entreprenurs in high-tech sectors may be prone to favor a commercialization strategy that involves selling the business to an incumbent (Gans & Stern, 2003). The literature argues that difficulties in gaining access to external financing is a main factor preventing small new firms, especially NTBFs, from surviving and growing (Carpenter & Petersen, 2002a, 2002b; Colombo & Grilli, 2005a; 2007). Financing innovation activity is associated with issues of asymmetric information between the firm and potential financiers (Hall, 2002), and small firms often have more-limited access to capital markets (Himmelberg & Petersen, 1994). In fact, if venture capital markets are weak and an initial public offering (IPO) unfeasible, then being acquired is one of the few available options to secure financing and continue developing the technology or product idea the start-up is based on.[7] Based on survey data covering about 100 Swedish NTBFs operating during 1945–1988, Lindholm (1996b) finds that lack of capital is the major motive for entrepreneurs to sell their businesses.

We then expect that new firms with *low* internal financial resources are more likely to be acquired. As stated above, being acquired is one option to secure financing and continue developing the technology or product idea the start-up is based on. This is clearly a more relevant option for entrants with weak internal financial resources, which are in general a more pressing issue for small, young innovative firms. We thus formulate our third hypothesis as follows:

H3: *Acquisition probabilities are higher for new firms with weaker internal financial resources.*

Acquisitions may entail high transaction costs due to problems of information asymmetries as acquiring firms might not know the true quality of target firms until the transaction of acquisition has been completed (Lichtenberg et al., 1987). Information asymmetries may become more problematic when acquisitions involve high-tech intangible assets and/or when targets are small, young, and private firms (Shen & Reuer, 2005). Acquiring firms can use labor productivity as one of the main indicators of target firms' quality for due diligence before acquisitions. We then expect that entrants with higher productivity are more attractive targets for acquiring firms.

H4: *New firms with higher labor productivity are more likely to be acquired.*

2.2. Who acquires?

If a main motive for acquisition is technology, then we would expect incumbent businesses for which technology and technological competence are important to be more likely to acquire start-ups. We conjecture in this regard that MNEs are particularly prone to acquire NTBFs. The main reason for this

[7] Raising capital through issuance of additional shares has also been found to be unattractive for owners of entrepreneurial firms because of financial dilution (Graebner & Eisenhardt, 2004).

is that MNEs typically operate in highly dynamic and competitive industries and market contexts in which technology is central to their competitiveness and acquisitions are part of corporate strategy to obtain technological resources and capabilities. Markusen (1995, p. 172), for example, states that MNEs have four main characteristics: high R&D relative to sales, a large share of professional and technical workers, products that are new and/or technically complex, and high levels of product differentiation and advertising. These characteristics entail a higher level of knowledge-based, firm-specific assets owned by MNEs (Markusen, 1995). An abundance of resources and firm-specific assets may give MNEs a high potential for synergy gains during the matching process where acquirers match their assets with assets of possible target firms (Hall, 1987; Blonigen & Taylor, 2000). MNEs may also have knowledge of technologies that makes them more alert to the opportunities for synergy creation arising from acquisitions. Cohen and Levinthal (1989) argues that R&D have two functions. One is to generate new knowledge. The other one is to increase firms' knowledge stock and thus "absorptive capacity," which allows firms to recognize, assimilate, and exploit knowledge from the environment (Cohen & Levinthal, 1990). For example, empirical evidence shows that firms' knowledge stock is positively related to their propensity to acquire small private firms and former subsidiaries (Desyllas & Hughes, 2008).

From the perspective of NTBFs, MNEs also constitute attractive incumbents to sell the business to. Norbäck and Persson (2014) maintain that an entrant building its business on a new technology (invention) has two options: (i) entering the world market or (ii) selling its business to incumbents. They show that the second option is more favorable when incumbents have high market power and when entrants' costs of going global independently are high. These features particularly apply to high-tech sectors dominated by MNEs with built-up global sales networks and an abundance of resources (Markusen, 1995). This fits nicely with Teece's (1986) argument that successful commercialization requires associated support from complementary assets and capabilities, such as complementary technologies, marketing, manufacturing, and distribution. Large MNEs typically have an abundance of these types of resources. Lindholm (1996b) also finds that the ambition to expand or internationalize their businesses was the second most important reason for owners of NTBFs to sell.[8]

On these grounds, we formulate our fifth hypothesis as follows:

H5: *NTBFs, as defined by technological capabilities and high-tech sectors, are particularly likely to be acquired by MNEs.*

[8] It is also the case that NTBFs may face more growth opportunities globally than other entrants. MNEs that operate globally may be more willing to pay for NTBFs than other potential acquirers. Entrepreneurs in NTBFs could therefore purposefully strive to sell their business to MNEs because it is a more rewarding exit strategy for compensating their entrepreneurial activities and expertise (Bonardo et al., 2010; Meoli, Paleari, & Vismara, 2013).

3. DATA AND VARIABLES

3.1. Data

The analyses builds on register matched employer-employee dataset for Sweden audited by Statistics Sweden (SCB). The dataset contains detailed information on employees, establishments, and firms. It also includes information indicating whether individuals have been involved in developing new technology, as evidenced by being listed as an inventor on patents at the European Patent Office (EPO).[9] We use these data as a complementary measure of the technological capabilities of new entrants (Ejermo & Xiao, 2014).

Building on methods employed by Erikson and Kuhn (2006) and Andersson and Klepper (2013), we label firms as surviving, new, or exit in each specific year by tracing the flows of employees among workplaces from the preceding year. A key issue concerns how we measure acquisitions. We code a firm as acquired when its ownership status changes from being independent to being controlled by a corporation, either a domestic corporation, a Swedish MNE, or a foreign MNE. This occurs when a corporation acquires a controlling position in a new firm, i.e., possessing more than 50% of the voting rights.[10]

For each year during of the period 1991–2002, we identify new firms with 2–10 initial employees. This means that we exclude self-employed as well as large entrants that reflect divestitures rather than new independent firms.[11] The identification of a new firm is based on a combination of the appearance of new firm ID codes (organization numbers) and information on employee flows at the level of establishments between each pair of years. All new firms are independent at the time of entry in the sense that they have no affiliation to any corporation.

Like Andersson and Klepper (2013), we make use of the so-called FAD (Företagens och Arbetsställens Dynamik) coding scheme for establishments to distinguish various types of new firms based on worker flows: pulled spin-offs, pushed spin-offs, other new firms, and unemployed firms. Spin-offs are new firms with over 50% of employees coming from the same parent firm. A pushed spin-off refers to a spin-off if its parent firm exits the same year when it enters; otherwise it is defined as a pulled spin-off. The latter is assumed to reflect opportunity-based new firms whereas the former is likely to start out of

[9] Details on the construction and characteristics of these data are found in Jung and Ejermo (2014).
[10] Similar definitions of acquisitions have been used in analyses of Swedish data. For example, Karpaty (2007) and Bandick and Görg (2010) analyze consequences for incumbent plants of being acquired by foreign MNEs. They define acquisitions in the same way as in this paper, though they focus on acquisitions by foreign MNEs.
[11] The strategy of excluding divestitures is the same as Andersson and Klepper (2013) and Erikson and Kuhn (2006) employ.

necessity. Other new firms are those new firms with no single previous firm dominating the source of employees. Unemployed firms refers to firms whose initial employees are all unemployed in the preceding year. We focus on new private firms in manufacturing and service sectors.[12] Though the latest cohort is restricted to firms established in 2002, the data span until 2009. In this way, we can observe firms for at least 7 years after entry. All firms are followed separately from their year of entry until they exit or are acquired. Firms that survive or are not acquired until 2009 are censored.

Our final dataset is a panel with 80,007 new firms, with 299,053 firm-year observations in total. Financial and balance-sheet data on the whole population of firms are only available from 1997. To test the influence of the financial resources of new entrants on the probability of being acquired, we also undertake analyses on a subsample that consists of firms entering from 1997 to 2002. This subsample contains totally 31,983 new firms and 112,507 firm-year observations.[13] All accounting data are deflated using the CPI index obtained from SCB.[14]

3.2. Variables

The main variables included in the analysis and their descriptions are displayed in Table 1, and descriptive statistics for each variable are presented in Table A1 in the Appendix. To test the hypothesis that NTBFs are more likely to be acquired, we employ variables intended to reflect the technology intensity (or technological capabilities) of entrants. These include dummy variables for the type of industry in which they operate. Six industry categories are defined based the industry classification developed by OECD (Hatzichronoglou, 1997; Eurostat, 2011): (i) high-technology manufacturing, (ii) medium-high-technology manufacturing, (iii) medium-low-technology manufacturing, (iv) low-technology manufacturing, (v) knowledge-based services, and (vi) ordinary services sectors.

We also construct measures of the education level of the employees in entrants, namely the fraction of employees with a long university education ($\geq$ 3 years) and the fraction of employees with a long university education in science and engineering (SE). Finally, we include a dummy of 1 for entrants that employ people with experience in developing technology (i.e., inventors). Measuring technological capabilities or knowledge resources by assessing the qualifications and experiences of employees is consistent with the so-called competence-based view of new firms (Colombo & Grilli, 2005b). This

[12] Recycling and public sectors are excluded.
[13] In the data on this subset of entrants from 1997 and onward, we drop the observations where the value of the ratio of cash to sales at entry year is below the 1st percentile or above the 99th percentile. We also drop the observations where the variable of labor productivity is missing at entry year. In total, 6,091 unique firms are dropped.
[14] Base year=1980.

view holds that new firms' capabilities ultimately reside in the knowledge, experiences, and skills of the founding team, i.e., the individuals in the firm.[15]

To test whether spin-offs are more likely to be acquired than other types of new firms, we include dummy variables indicating the type of new firm. Four types of new firms are distinguished: (i) pulled spin-offs, (ii) pushed spin-offs, (iii) other new firms, and (iv) new firms started by previously unemployed. The distinction between these different types of new firms follows Andersson and Klepper (2013). Testing H3 and H4 requires balance-sheet information for each new entrant. Such information is available for a subsample of new firms in the period 1997–2002. We use this subsample to calculate measures of internal financial resources and labor productivity. The former is defined as the ratio of equity to sales (Andersson & Lööf, 2012) whereas the latter is defined as the logarithm of value-added per employee. We also differentiate between three types of acquiring firms, i.e. domestic corporations, and Swedish and foreign MNEs, which allows us to test whether MNEs are more likely to acquire NTBFs (H5).

In addition to the main explanatory variables discussed above, we also include dummy variables for the location of entrants in Sweden (Stockholm, Gothenburg, Malmo, and rest of Sweden), their entry size measured as the logarithm of the initial number of employees as well as the adjusted overall entry rate and employment growth of the sector in which an entrant operates. These variables serve as general control variables. Entry size is often claimed to reflect the level of resources possessed by new firms. Smaller start-ups are subject to the so-called "liability of smallness", which is manifested in lower survival probabilities. The explanations include that smaller firms face more difficulties in access to external finance (Brito & Mello, 1995; Carreira & Silva, 2010), have cost disadvantages (Audretsch & Mahmood 1994) and have lower possibilities to spread risks (Geroski et al., 2010). We thus expect that entry size has a positive impact on the likelihood of both being acquired and to survive. The adjusted overall entry rate and industry growth account for the industry-specific effects of entry barriers and industry life cycles on the likelihood of acquisitions and survival (Geroski 1995; Utterback & Suárez, 1993; Jovanovic & MacDonald, 1994). The location dummies distinguishes the metropolitan regions from the rest of Sweden, and are intended to capture effects pertaining to the local context of start-ups. Metropolitan regions are in general more knowledge intensive and often host a disproportionate fraction of non-routine activities, such as R&D, from which knowledge-based start-ups could emerge (Audretsch and Lehmann 2005). Such regions could thus be argued to be more likely to generate knowledge-based 'high-quality' start-ups that are attractive targets for incumbent firms.

[15]For example, Cooper and Bruno (1977, p. 21) state that "for a new, high-technology firm, the primary assets are the knowledge and skills of the founders. Any competitive advantage the new firm achieves is likely to be based upon what the founders can do better than others."

Table 1. Definition of Variables in the Empirical Analysis

Variable	Definition
Foreign MNEs	Indicator of being acquired in year *t* by a foreign MNE
Swedish MNEs	Indicator of being acquired in year *t* by a Swedish MNE
Domestic enterprises	Indicator of being acquired in year *t* by a domestic enterprise
Share of tertiary education	Fraction of employees with a long university education ($\geq$ 3 years)
Share of S&E	Fraction of employees with a long university education in science and engineering disciplines
Inventor	Dummy of 1 for firms where at least one of the employees has been involved in developing new technology as evidenced by being listed as an inventor of an EPO patent, 0 otherwise
Entry size	Logarithm of number of employees at the year of entry
Pulled spin-offs	Dummy variable for pulled spin-offs
Pushed spin-offs	Dummy variable for pushed spin-offs
Other new firms	Dummy variable for other new firms
Unemployed firms	Dummy variable for unemployed firms (reference group)
High-tech manufacturing	Dummy variable for firms in high-technology manufacturing sectors
Medium-high-tech manufacturing	Dummy variable for firms in medium-high-technology manufacturing sectors
Medium-low-tech manufacturing	Dummy variable for firms in medium-low-technology manufacturing sectors
Low-tech manufacturing	Dummy variable for firms in low-technology manufacturing sectors (reference group)
Knowledge-based services	Dummy variable for firms in knowledge-based service sectors
Ordinary services	Dummy variable for firms in ordinary service sectors
Stockholm	Dummy variable of firms located in Stockholm region
Gothenburg	Dummy variable of firms located in Gothenburg region
Malmo	Dummy variable of firms located in Malmo region
Rest of Sweden	Dummy variable of firms located in other regions (reference group)
Internal financial resources*	Ratio of equity to sales
Labor productivity*	Logarithm of ratio of value added to the number of employees
Entry rate	The number of star-ups in each 2-digit NACE sector divided by the total number of start-ups each year
Industry growth	Industry employment growth in 2 consecutive years

Note: * denotes that the variable is defined only for the subsample covering the period 1997–2002. See section 2.1.

4. EMPIRICAL STRATEGY

To test our hypotheses concerning characteristics of entrants that have a positive influence on the probability of being acquired and which types of incumbent businesses acquire new firms, we employ competing risks models. In our baseline model, every firm is subject to three events in each period: survival, acquired or exit. We briefly present the estimation methodology in the following two subsections.

4.1. Competing risks models

In our empirical context of new firms, acquisition is not the only possible transition event. New firms feature high exit rates during their adolescence (Dunne, Roberts, & Samuelson, 1988; Geroski, 1995). Exit is thus a non-negligible competing cause of transitions out of the current state (i.e., survival). Competing risks models allow us to distinguish different causal processes between these two different transition events. It also allows us to split up the transition event of acquisition in different parts, namely acquisition by foreign MNEs, by Swedish MNEs, and by domestic corporations. We use competing risks models to discern different causal processes among the three different types of acquisitions.

Competing risks models have two additional advantages in the current context. First, they are able to consider incomplete information of occurrences of transitions (Singer & Willett, 1993). In our study, we observe firms only until 2009. Up to this year, not all firms have experienced a transition to acquisition or exit. The firms that have not experienced any transitions by the end of observation are right-censored subjects. Second, we can account for the duration dependence of transitions. The evolution of new firms after entry is a market selection process. The classic "passive learning" model by Jovanovic (1982) suggests that only firms that can adapt to the external environment remain as they age. In this sense, age can be regarded as a quality indicator for new firms particularly in their early years, which may affect the transition either to acquisition or to exit.

As our data are constructed in discrete time units (years), we employ the discrete-time competing risks model. Suppose there are *k* mutually exclusive transition events. The cause-specific hazard function can then be expressed as:

$$(1) \qquad h_j(\mathrm{t}) = \Pr[T_j = \mathrm{t} | T_j \geq \mathrm{t}]$$

where $j = 1,\ldots, k$, $T_j = T_1,\ldots, T_k$. T_j is a latent duration variable, which indicates the duration of time before the occurrence of transition from *j*. We can observe only the shortest T_j for each subject; i.e., the

occurrence of one specific transition will remove the subject from the risk set of transition from the other causes. The cause-specific hazard for cause *j* at time *t* is the probability that a subject will experience an event of transition from cause *j* in a given time interval, conditional on being at risk at the beginning of that interval. The overall hazard rate at time *t* is the sum of all cause-specific hazards at time *t*:

$$(2) \qquad h(t) = \sum_{j=1}^{k} h_j(t)$$

A main assumption in competing risks models is independence among the latent variables $T_1, \ldots, T_k$, which means that the occurrence of one event should not be informative about the occurrence of other competing events (Singer & Willett, 2003). Of course, we cannot say that the occurrence of acquisition is non-informative about exit and vice versa. Neither can we say that the occurrence of acquisition by foreign MNEs is non-informative about acquisition by Swedish MNEs or domestic enterprises. But as suggested by Singer and Willett (2003), we can assume that these competing risks are non-informative conditional on the variety of covariates that we control for in the analysis.

The cumulative incidence function, rather than the survivor function, is appropriate to accommodate the competing risks model (Cleves, Gutierrez, Gould, & Marchenko, 2010). The reason is that the incidence function can be easily generalized to consider all cause-specific hazards, while the survivor function fails to do so. The cumulative incidence function is given by:

$$(3) \qquad CIF(t) = P(T_j \leq t)$$

The cumulative incidence function from cause *j* at time *t* is thus the probability of the occurrence of transition from cause *j* up to time *t*.

4.2. The multinomial logit model

We follow Singer and Willett (2003) and employ the logit (proportional hazard odds) model for estimation by imposing a proportional hazard odds assumption. The model can be easily modified to a multinomial logit (ML) model, which can accommodate multiple transition events (Allison, 1982; Jenkins, 2004). Equation (4) shows the specification of the ML model and includes duration dummies to let the baseline hazard (i.e., the hazard only varying with time, when all the covariates equal 0) vary across time intervals:

(4) $$P_j = \frac{e^{\alpha_i' D_i + \beta' X_{jt}}}{1 + \sum_{l=1}^{k} e^{\alpha_i' D_i + \beta' X_{jt}}}$$

where $j = 1,\ldots, k$ represents the possible events; D_i refers to a vector of dummies for duration time (age in our study), and α_i is a vector of estimated parameters of the baseline logit hazard function at each age. *X* represents our independent variables. Equation (4) can be rewritten in the form of relative-risk ratio to facilitate interpretation:

(5) $$\frac{P_j}{P_1} = e^{\alpha_i' D_i + \beta' X_{jt}}$$

where P_1 refers to the probability of transition from cause 1 (the base category). The specification is estimated by maximum likelihood method.

5. ACQUISITIONS OF START-UPS: an initial description

5.1. The frequency of acquisitions

Acquisitions of new entrants are a rare event. Figure 1 compares acquisition and exit and plots the cumulative incidence functions for each event. Overall, the cumulative incidence rate is much lower for acquisition than for exit.[16] The probability of acquisition is around 5% up to 5 years after entry while the probability of exit during the same time frame is about 60%. Compared to exit, acquisition is quite a rare event for start-ups.

Next, we divide acquisitions into three types according to different acquirers: foreign MNEs, Swedish MNEs, and domestic corporations. Acquisition by different acquirers and exit are regarded as a sequential process of the event occurrence instead of a competing-risk process, which means (i) acquisition and exit compete for the event occurrence and (ii) among acquisition events, three different acquirers compete for the event occurrence of acquisition. Following the common approach for the competing risks model (Singer & Willett, 2003), we take the events of exit as censoring observations when focusing on the competing process among three different acquirers. Cumulative incidence estimates among three acquirers are displayed in Figure 2.

[16] Note that the scale is different for each event.

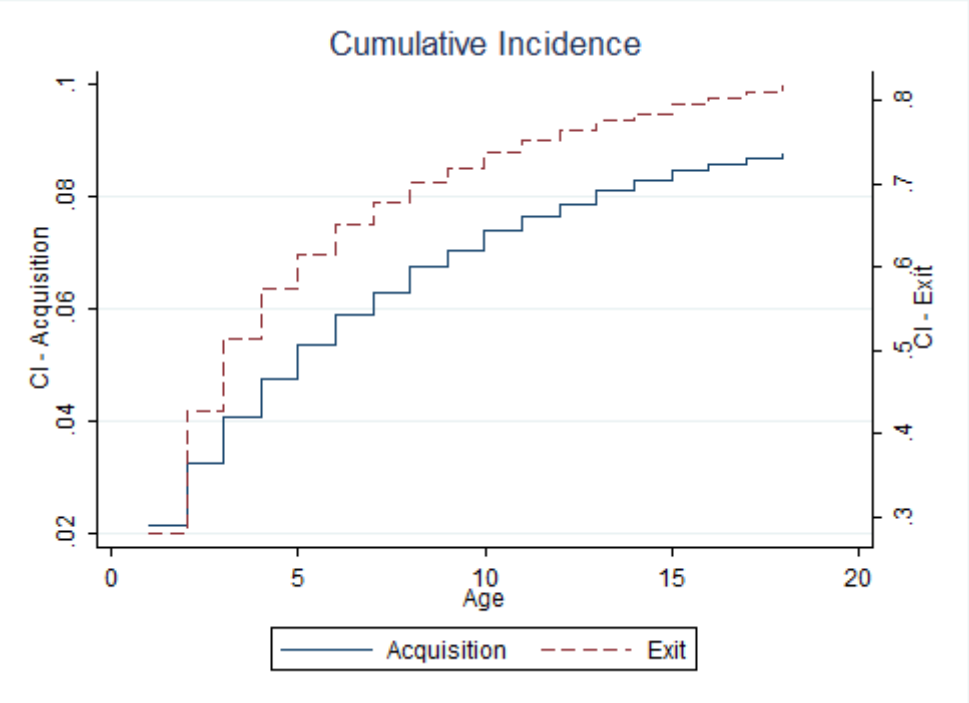

Figure 1. Cumulative incidence estimates: acquisition vs. exit.

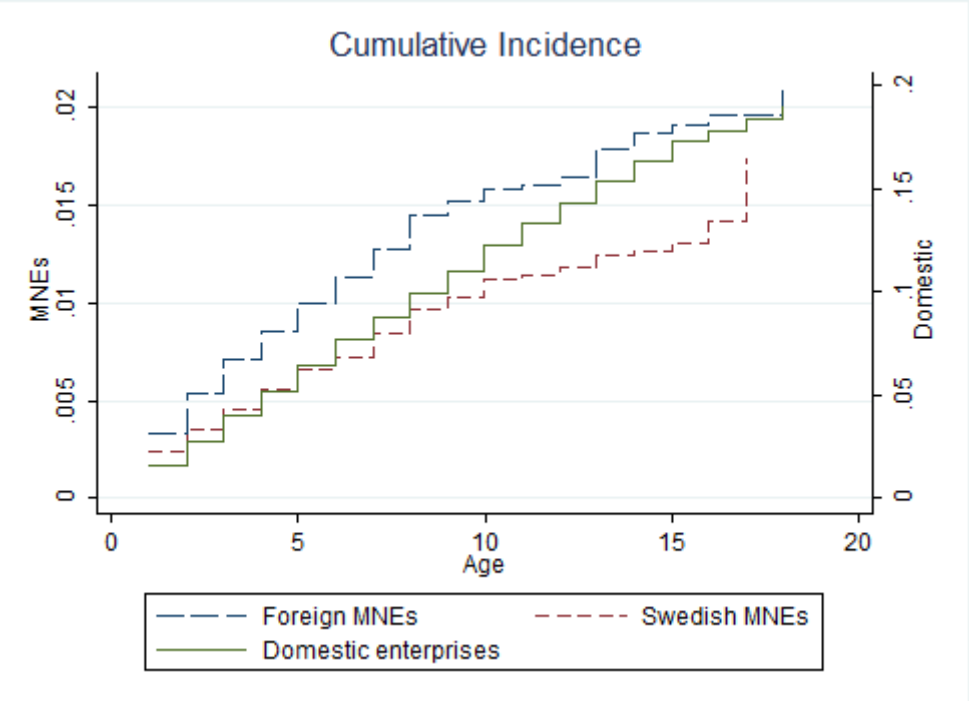

Figure 2. Cumulative incidence estimates: by acquisition type.

Overall, the cumulative incidence rate for acquisition by MNEs is lower than that for domestic enterprises.[17] The probability of acquisition by domestic enterprises is about 6% up to 5 years after entry. However, the probability of acquisition by foreign MNEs is around 1% up to 5 years after entry, and the probability of acquisition by Swedish MNEs is even lower – about 0.6% up to 5 years after entry. These patterns are also evident from Table A1 in the Appendix. For the whole period 1991–2002, we see that only about 6.3% of start-ups have been acquired by incumbent businesses by 2009, with about 5% acquired by domestic enterprises, 0.8% acquired by foreign MNEs, and 0.5% acquired by Swedish MNEs. Being acquired by MNEs, with supposedly rich resources and global networks, is much more uncommon than being acquired by a domestic corporation.

5.2. When are new firms acquired?

In order to explore which firm age is most hazardous for the event of acquisition, we depend on a more intuitive statistic – the cause-specific hazard, as defined in Equation (1). There are usually a small number of firms remaining at risk sets from the 16th year after entry. A small variation of number of events will thus cause large differences in the cause-specific hazard probability; therefore we only show the cause-specific hazard probability for all start-ups by comparing among different types of acquisition until age 15. Figure 3 presents the results.

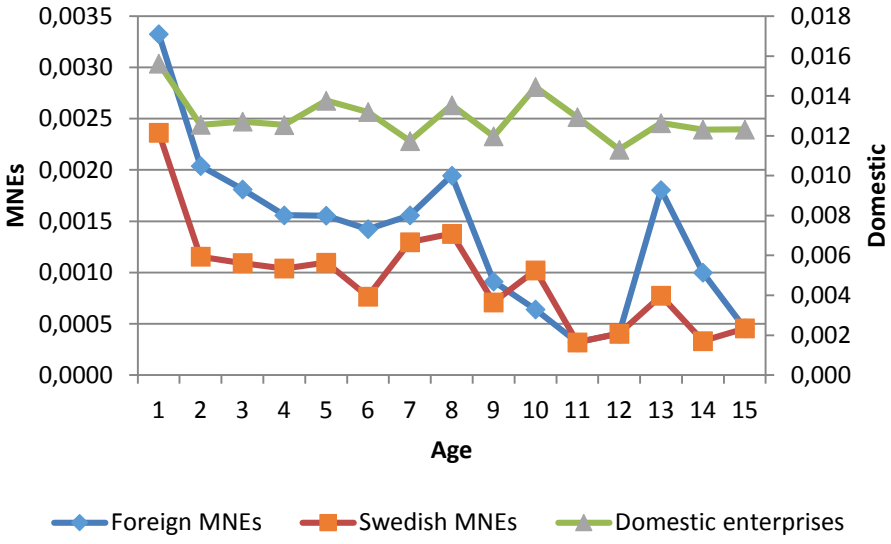

Figure 3. Cause-specific hazard probability: by acquisition type.

[17] Again, note the different scales on the respective axes.

In terms of domestic acquisitions, the hazard probability is highest at the first year after entry and then shows a flat pattern despite some minor cyclical variations over age. Comparatively, the patterns of hazard probability for acquisitions by foreign MNEs and Swedish MNEs are more similar, displaying a faster decreasing rate both at the first year after entry and in the long term than do acquisitions by domestic enterprises.

5.3. Which new firms are acquired?

Table 2 breaks down firm characteristics at entry year by transition events. Pane1 A shows the mean values of the variables. First, we compare acquired firms and exiting firms with surviving firms as the reference group. Overall, the main patterns are in line with our hypotheses. Compared to surviving firms, acquired firms have better technological capabilities, as evidenced by a higher share of highly educated employees, a higher share of scientists and engineers, and a higher likelihood of having inventors. But they seem to have less internal financial resources on average than surviving firms. Exiting firms, by contrast, are on the other side of extreme. Compared to surviving firms, they have a lower level of highly educated employees, a lower share of scientists and engineers, and a lower likelihood of having inventors. However, they have more internal financial resources than surviving firms.

Second, when focusing on the heterogeneity within acquired firms, we use firms acquired by domestic enterprises as the reference group. Compared to domestic enterprises, MNEs, especially Swedish MNEs, seem to be more likely to target firms with a higher level of technological capabilities.

The table also reports the distribution of firms over occurrences by firm types (Panel B). Compared to the transition rates of all start-ups, spin-offs (in particular pulled spin-offs) are more likely to be acquired by any type of acquirer and less likely to exit. However, unemployed firms appear to be less likely to be acquired by any type of acquirer but show a higher likelihood of exiting. Other new firms represent a roughly average level in terms of the transition frequency compared to all start-ups.

In terms of industries (Panel C), we see, as expected, that firms in high-tech manufacturing, medium-high-tech manufacturing, and knowledge-intensive service sectors are more likely to be acquired by any type of acquirer. In addition, Swedish MNEs and domestic enterprises seem to be interested in targeting medium-low-tech manufacturing firms also. Comparatively, firms in service sectors seem to be more likely to exit than firms in manufacturing sectors.

Table 2. Entry Characteristics by Transition Event (Until 2009)

A: Mean values of human capital, technical capital, and internal financial resources

	Share of tertiary education or above	Share of S&E	Inventor	Ratio of equity to sales
Acquired by foreign MNEs	0.210	0.067	0.020	0.062
Acquired by Swedish MNEs	0.230	0.097	0.038	0.051
Acquired by domestic enterprises	0.135	0.045	0.012	0.114
Survive	0.089	0.027	0.006	0.135
Exit by closing down	0.073	0.018	0.003	0.136

B: Transition (%) by firm type

	All	Pulled spin-offs	Pushed spin-offs	Other new firms	Unemployed firms
Acquired by foreign MNEs	0.76	3.20	1.26	0.75	0.31
Acquired by Swedish MNEs	0.52	1.54	1.05	0.51	0.26
Acquired by domestic enterprises	5.04	12.64	10.78	4.99	2.59
Survive	28.81	57.37	49.77	29.44	16.85
Exit by closing down	64.87	25.24	37.14	64.30	80.00

C: Transition (%) by industry

	High-tech man.	Medium-high-tech man.	Medium-low-tech man.	Low-tech man.	Knowledge-based services	Ordinary services
Acquired by foreign MNEs	2.16	1.25	0.49	0.59	0.95	0.65
Acquired by Swedish MNEs	1.62	1.32	0.63	0.25	0.78	0.34
Acquired by domestic enterprises	8.63	8.09	6.04	5.25	6.77	3.79
Survive	36.33	40.16	38.90	32.78	28.61	27.51
Exit by closing down	51.26	49.18	53.94	61.12	62.89	67.70

Note: Mean values of the ratio of cash flows to sales are calculated from the subsample covering the period 1997–2002.

While these preliminary patterns provide an overall picture that is consistent with our hypotheses, they provide only partial answers. For instance, the fact that firms with a higher share of educated workers and in high-tech sectors appear to be more likely to be acquired could be an artifact of many firms with these characteristics being spin-offs. Consequently, it could be that they are spin-offs with certain tacit (unobserved) resources or capabilities that drive the patterns. To deal with this issue, and thus to better isolate the independent effect of the characteristics of new firms on the probability of being acquired, we estimate a ML model as described above. The results of this undertaking are presented in the next section.

6. THE IMPACT OF CHARACTERISTICS OF START-UPS ON ACQUISITION PROBABILITY

In this section we test the hypotheses derived in section 2 in a joint framework allowing all variables to jointly affect the likelihood of the transition events. We report estimated relative-risk ratios estimated with an ML model, with surviving firms as the base category. Relative-risk ratios are analogous to odds ratios in binary logit models. A relative-risk ratio higher than 1 implies a positive effect from the covariate on the cause-specific hazard probability. A relative-risk ratio lower than 1 implies a negative effect from the covariate on the cause-specific hazard probability.

6.1. Results for the whole population 1991–2002

Competing risks: Acquisition vs. exit

The results from the whole population of firms are reported in Table 3. The left panel of the table displays the results when we focus on competing risks between acquisition and exit. We find support for both H1 and H2 derived in section 2.

Firms with a higher share of highly educated employees and firms with presence of inventor(s) have a higher probability of being acquired relative to survival. Notably, the relative-risk ratio of being acquired relative to survival is almost twice as high for firms with inventor(s) than without inventor(s). The share of scientists and engineers is also found to have positive effect on the probability of being acquired, but it is not statistically significant. In terms of firm type, compared to the reference group, unemployed firms, we find that spin-offs, particularly pulled spin-offs, have the highest probability of being acquired.

Table 3. The Influence of Characteristics of New Firms on Acquisition Probability. Estimates from a Multinomial Logit Model (Whole Population of Start-ups 1991–2002)

	Acquisition	**Exit**	**Foreign MNEs**	**Swedish MNEs**	**Domestic**
Share of tertiary education or above	1.791***	0.758***	3.820***	3.278***	1.551***
	(0.118)	(0.0217)	(0.638)	(0.668)	(0.118)
Share of scientists and engineers	1.178	0.804***	0.745	1.934**	1.194
	(0.129)	(0.0456)	(0.209)	(0.565)	(0.153)
Inventor	1.735***	0.791***	1.808*	2.876***	1.588***
	(0.217)	(0.0680)	(0.575)	(0.803)	(0.240)
Entry size	2.059***	1.230***	2.460***	2.788***	1.826***
	(0.0746)	(0.0179)	(0.237)	(0.317)	(0.0750)
Pulled spin-offs	2.355***	0.235***	4.435***	2.141***	2.783***
	(0.173)	(0.0107)	(0.888)	(0.525)	(0.231)
Pushed spin-offs	2.208***	0.361***	2.218***	1.927***	2.789***
	(0.148)	(0.0109)	(0.467)	(0.443)	(0.206)
Other new firms	1.590***	0.722***	1.884***	1.479**	1.697***
	(0.0774)	(0.00876)	(0.289)	(0.249)	(0.0910)
Entry rate (L1)	0.0536***	1.607***	0.00329***	0.0423***	0.0814***
	(0.0130)	(0.154)	(0.00229)	(0.0338)	(0.0221)
Industry growth (L1)	1.202***	0.924***	1.571***	1.436***	1.154***
	(0.0204)	(0.00540)	(0.0798)	(0.0913)	(0.0215)
High-tech manufacturing	2.246***	0.669***	6.060***	8.397***	1.797***
	(0.328)	(0.0465)	(2.340)	(4.121)	(0.302)
Medium-high-tech manufacturing	1.688***	0.681***	3.079***	6.305***	1.459***
	(0.187)	(0.0332)	(1.022)	(2.573)	(0.180)
Medium-low-tech manufacturing	1.301***	0.740***	1.578	3.957***	1.210*
	(0.129)	(0.0269)	(0.551)	(1.622)	(0.129)
Knowledge-based services	1.912***	1.113***	2.020***	3.400***	1.767***
	(0.147)	(0.0305)	(0.480)	(1.183)	(0.147)
Ordinary services	1.518***	1.012	3.747***	3.614***	1.226**
	(0.120)	(0.0274)	(0.913)	(1.303)	(0.105)
Stockholm	1.190***	1.119***	3.382***	1.743***	0.971
	(0.0407)	(0.0132)	(0.370)	(0.217)	(0.0372)
Gothenburg	1.271***	1.071***		1.956***	1.148***
	(0.0579)	(0.0177)	(0.323)	(0.304)	(0.0576)
Malmo	1.068	1.027	2.535***	1.834***	0.913
	(0.0538)	(0.0174)	(0.375)	(0.304)	(0.0520)
Constant	0.00406***	0.448***	5.92e-05***	3.80e-05***	0.00317***
	(0.000648)	(0.0254)	(3.38e-05)	(2.49e-05)	(0.000545)
Baseline hazard	Survival			Survival	
Year dummies	Yes			Yes	
Obs.	299,053			299,053	
Log-likelihood	−153110.85			−26953.171	
LR χ^2	19117.86			3851.02	
Prob > χ^2	0.0000			0.0000	

Notes: The table reports relative-risk ratios (RRR) obtained from a multinomial logit model. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated baseline hazard and year dummies are not reported due to space limitation. L1 refers to 1-year lag.

For the industry categories, the reference industry is low-tech manufacturing. Firms in all the other industries exhibit a higher probability of being acquired. In particular, the relative-risk ratio for firms in high-tech manufacturing and knowledge-intensive service sectors is around twice as high as that of firms in low-tech manufacturing sectors. When comparing the magnitude of relative-risk ratios among firms with different

industry affiliations, we find that firms in high-tech manufacturing sectors have the highest probability of being acquired. As expected, larger entrants as well as entrants in industries that grow in employment also show a higher probability of being acquired. Entry rate shows a significantly negative effect on probability of being acquired. With the exception of entry size, the dummy variables of knowledge-intensive service and ordinary service sectors, and location dummies, all the other covariates exhibit an opposite effect on the probability of exit than acquisition, relative to survival.[18]

Competing risks: By acquisition type

The right panel of Table 3 shows the results when we distinguish competing risks among the types of acquiring firms. These results provide support for H5; i.e., NTBFs are more likely to be acquired by MNEs.

The magnitude of most variables shows a stronger effect on the probability of being acquired by MNEs than by domestic enterprises, particularly in terms of the factors reflecting firms' technology profiles. For example, at each age, the relative-risk ratio of being acquired by Swedish MNEs is about 93% higher for firms with a 1-unit higher share of scientists and engineers. But at each age, the relative-risk ratio of being acquired by domestic enterprises is only about 20% higher for firms with a 1-unit higher share of scientists and engineers, although not statistically significant. The relative-risk ratio of being acquired by foreign MNEs, Swedish MNEs, and domestic enterprises is about 1.8, 2.9, and 1.6 times as high, respectively, for inventor(s) firms compared to firms without inventor(s).

Moreover, the relative-risk ratio of being acquired by foreign MNEs, Swedish MNEs, and domestic enterprises is 6, 8.4, and 1.8 times as high, respectively, for firms in high-tech manufacturing sectors than for firms in low-tech manufacturing sectors. In terms of firm type, we find that the relative-risk ratio of being acquired by foreign MNEs, Swedish MNEs, and domestic enterprises is 4.4, 2.1, and 2.8 times as high, respectively, for pulled spin-offs in comparison to unemployed firms. Foreign MNEs appear to be particularly prone to target pulled spin-offs.

[18]The fact that being located in Stockholm and Gothenburg, two of the largest metropolitan regions in Sweden, has a positive influence on both acquisition and exit could be explained by market selection. Agglomerated areas are often claimed to constitute more competitive environments, and this could imply higher hazard rates (tougher competition) as well as higher acquisition probabilities (competition and local knowledge resources produce 'better' firms).

6.2. The subsample: Testing the influence of internal financial resources and productivity

Competing risks: Acquisition vs. exit

We now repeat the procedures above for the subsample of entrants in the period 1997–2002. The purpose of using this subsample is to test the influence of internal financial resources and productivity on the probability of being acquired; i.e., it enables us to test H3 and H4.

Panel A of Table 4 reports the results when we focus on competing risks between acquisition and exit. We find that the results from the subsample display a pattern similar to that of the whole population despite some minor exceptions. First, consistent with H3, we find that a higher ratio of equity to sales decreases the probability of both acquisition and exit, relative to survival. Second, labor productivity predicts a positive effect on the likelihood to be acquired but a negative effect on exit. This also provides support for H4.

Competing risks: By acquisition type

Panel D of Table 4 reports the results when we distinguish competing risks among the types of acquisition. It is evident from the table that H3 and H4 are further confirmed. New entrants with weak internal financial resources, as evidenced by a low ratio of equity to sales, and high labor productivity are more likely to be acquired.

We also find some differences when comparing the overall results in Table 4 with the results for the whole population of new firms over the period 1991–2002 (Table 3). In order to check robustness and try to disentangle the source of these differences changes, we include two additional estimations, with the results displayed in Panels B and C of Table 4. Panel B shows the results before firms with unreliable accounting data are dropped. Panel C reports the results for the subsample but without controlling for the two additional variables. In this case, we can distinguish whether the changes are because we estimate the models for firms from different birth cohorts, we drop firms, or we control for two additional variables.

Consistent with results from Panel A, the results in Panel D show that the share of scientists and engineers has no significant effect on the probabilities of being acquired by any type of acquirer. The relative-risk ratio of being acquired by Swedish MNEs for inventor(s) firms is about four times as high compared to firms without inventor(s), stronger than the magnitude in the whole population. But the relative-risk ratio of being acquired by foreign MNEs and domestic enterprises is not significant.

Table 4. The Influence of Characteristics of New Firms on Acquisition Probability. Estimates from a Multinomial Logit Model (Subpopulation of Start-ups 1997–2002)

Variables	A		B			C			D		
	Acquisition	Exit	Foreign MNEs	Swedish MNEs	Domestic	Foreign MNEs	Swedish MNEs	Domestic	Foreign MNEs	Swedish MNEs	Domestic
Share of tertiary education or above	1.511***	0.862***	3.449***	4.619***	1.529***	2.621***	4.000***	1.478***	2.073***	3.486***	1.355***
	(0.156)	(0.0381)	(0.680)	(1.167)	(0.155)	(0.683)	(1.387)	(0.171)	(0.553)	(1.233)	(0.159)
Share of scientists and engineers	1.018	0.812**	0.605	1.080	1.063	1.153	1.140	1.054	1.086	1.061	1.017
	(0.172)	(0.0730)	(0.203)	(0.405)	(0.180)	(0.468)	(0.602)	(0.204)	(0.451)	(0.574)	(0.198)
Inventor	1.618**	0.665***	1.520	3.823***	1.726***	1.445	4.842***	1.513*	1.308	4.119***	1.450
	(0.315)	(0.0987)	(0.588)	(1.241)	(0.315)	(0.769)	(1.976)	(0.349)	(0.710)	(1.741)	(0.338)
Entry size	2.041***	1.234***	2.169***	2.730***	1.735***	2.500***	3.298***	1.843***	2.400***	3.112***	1.806***
	(0.113)	(0.0288)	(0.244)	(0.407)	(0.0968)	(0.352)	(0.614)	(0.113)	(0.342)	(0.584)	(0.113)
Pulled spin-offs	2.161***	0.223***	5.340***	2.722***	2.759***	4.485***	2.367**	2.624***	3.766***	2.161*	2.465***
	(0.245)	(0.0165)	(1.377)	(0.937)	(0.326)	(1.345)	(1.004)	(0.333)	(1.136)	(0.919)	(0.313)
Pushed spin-offs	1.926***	0.379***	2.975***	2.348**	2.608***	2.880***	2.537**	2.341***	2.445***	2.340**	2.210***
	(0.209)	(0.0187)	(0.790)	(0.794)	(0.287)	(0.870)	(1.012)	(0.281)	(0.744)	(0.936)	(0.266)
Other new firms	1.479***	0.800***	2.195***	1.663*	1.738***	1.693**	1.531	1.602***	1.541*	1.474	1.551***
	(0.120)	(0.0166)	(0.457)	(0.446)	(0.142)	(0.408)	(0.498)	(0.142)	(0.372)	(0.480)	(0.137)
Entry rate (L1)	0.0998***	3.521***	0.00377***	0.0378***	0.0662***	0.0375***	0.0744*	0.0662***	0.0820**	0.144	0.0933***
	(0.0359)	(0.562)	(0.00297)	(0.0374)	(0.0235)	(0.0371)	(0.101)	(0.0262)	(0.0820)	(0.199)	(0.0372)
Industry growth (L1)	1.198***	0.881***	1.526***	1.549***	1.118***	2.153***	1.675***	1.157***	1.937***	1.608***	1.134***
	(0.0345)	(0.00895)	(0.0940)	(0.141)	(0.0290)	(0.212)	(0.204)	(0.0356)	(0.187)	(0.196)	(0.0348)
High-tech manufacturing	2.421***	0.642***	7.740***	6.398**	1.717**	15.64***	9.613***	2.141***	9.301***	6.693**	1.949**
	(0.580)	(0.0862)	(3.735)	(4.983)	(0.430)	(9.731)	(7.852)	(0.585)	(5.771)	(5.568)	(0.534)
Medium-high-tech manufacturing	1.717***	0.696***	3.267***	8.438***	1.406*	3.070*	9.567***	1.588**	2.411	8.738***	1.470**
	(0.301)	(0.0599)	(1.433)	(4.846)	(0.255)	(1.865)	(5.678)	(0.309)	(1.463)	(5.174)	(0.286)
Medium-low-tech manufacturing	1.368**	0.801***	1.797	3.672**	1.123	3.797***	3.965**	1.271	3.142**	3.774**	1.224
	(0.209)	(0.0488)	(0.796)	(2.240)	(0.172)	(1.959)	(2.524)	(0.210)	(1.603)	(2.392)	(0.202)
Knowledge-based services	1.811***	1.024	2.461***	3.535***	1.784***	2.026*	2.061	1.939***	1.607	1.790	1.838***
	(0.215)	(0.0494)	(0.740)	(1.721)	(0.204)	(0.740)	(1.085)	(0.248)	(0.585)	(0.943)	(0.236)
Ordinary services	1.269*	0.932	3.609***	3.832***	1.038	6.138***	3.809**	1.105	4.332***	3.179**	1.020
	(0.157)	(0.0423)	(1.135)	(1.968)	(0.125)	(2.479)	(2.127)	(0.149)	(1.702)	(1.756)	(0.136)
Stockholm	1.102*	1.166***	3.547***	2.060***	0.972	3.459***	1.610**	0.937	3.166***	1.528**	0.900*
	(0.0592)	(0.0222)	(0.493)	(0.368)	(0.0520)	(0.590)	(0.343)	(0.0556)	(0.543)	(0.327)	(0.0536)
Gothenburg	1.296***	1.069**	2.104***	2.253***	1.225***	2.267***	2.373***	1.197**	2.119***	2.211***	1.166**
	(0.0902)	(0.0293)	(0.401)	(0.494)	(0.0848)	(0.512)	(0.576)	(0.0913)	(0.481)	(0.542)	(0.0891)
Malmo	1.022	1.051*	3.074***	1.997***	0.873	3.260***	1.531	0.843*	3.096***	1.504	0.834**
	(0.0816)	(0.0291)	(0.549)	(0.481)	(0.0721)	(0.696)	(0.454)	(0.0770)	(0.666)	(0.446)	(0.0763)
Ratio of equity to sales	0.234***	0.783***							0.0980***	0.140***	0.302***
	(0.0275)	(0.0359)							(0.0284)	(0.0493)	(0.0396)
Labor productivity	1.381***	0.866***							1.967***	1.500***	1.331***
	(0.0368)	(0.00783)							(0.144)	(0.144)	(0.0392)
Constant	6.57e-05***	2.045***	3.62e-05***	2.58e-05***	0.00298***	8.31e-06***	1.92e-05***	0.00242***	4.15e-09***	1.90e-07***	9.18e-05***
	(2.66e-05)	(0.291)	(3.38e-05)	(2.37e-05)	(0.000742)	(8.46e-06)	(1.90e-05)	(0.000654)	(5.50e-09)	(2.86e-07)	(4.07e-05)
Baseline hazard	Survival		Survival			Survival			Survival		
Year dummies	Yes		Yes			Yes			Yes		
Obs.	112,507		129,016			112,507			112,507		

Notes: The table reports relative-risk ratios (RRR) obtained from a multinomial logit model. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated baseline hazard and year dummies are not reported due to space limitation. L1 refers to 1-year lag.

The results for pulled spin-offs show a similar pattern in the subsample as in the whole population. In terms of industry, we find that for firms in high-tech manufacturing sectors, the relative-risk ratio of being acquired by foreign MNEs is higher than for Swedish MNEs in the subsample. The new pattern emerges from the results of Panel B and continues until Panel C. This suggests that the change is primarily because we focus on firms in different birth cohorts. That is to say, foreign MNEs seem to have the most interest in acquiring firms in high-tech manufacturing sectors from 1998 and onwards. In terms of the two additional variables, we find that foreign MNEs are more prone than Swedish MNEs to target new entrants with a low level of internal financial resources but a high level of labor productivity.

7. SUMMARY AND CONCLUSIONS

Start-ups are subject to a post-entry market selection process. This paper focuses on a particular type of selection process of start-ups, namely acquisitions, whereby established firms purposefully select particular entrants as acquisition targets. Acquisitions, in principle, imply a technology and knowledge transfer process and have been claimed to, under certain circumstances, constitute a way in which a "symbiosis" between new entrants and established businesses is realized (Lindholm, 1996b; Baumol, 2002). Still, our knowledge of the frequency and nature of this type of interaction between new entrants and established businesses remains limited.

In this paper we show that acquisitions of recent start-ups are rare. The uncontrolled general probability of acquisition is around 5% up to 5 years after entry while the probability of exit is about 60%. Second, acquisition targets are small group of firms with defining characteristics. In line with our hypotheses, they are much more likely to be spin-offs with strong technological competence and weak internal financial resources, as well as high levels of labor productivity, operating in high-tech sectors. Furthermore, NTBFs are particularly prone to be acquired by MNEs, domestic as well as foreign.

Our findings support the arguments in the literature that acquisitions primarily pertain to NTBFs operating in high-technology sectors, where entry costs are large and incumbent businesses (typically MNEs) have large market power. Incumbents in such sectors often employ acquisitions as a strategy to expand their technological capabilities, and NTBFs often perceive selling the business to an incumbent as an attractive commercialization strategy. Acquisitions appear to be a particularly important mechanism of market selection pertaining to "good" high-tech start-ups. The results indeed suggest a kind of "hierarchy" in market selection in terms of the technology profile of start-ups: NTBFs are acquired by (or sold to) multinational business corporations, and medium technology-intensive firms are acquired by domestic corporations.

We argue that these results are consistent with the "entrepreneurship system" hypothesis, where entry of NTBFs creates a market for technology that complements other types of technology markets. The fact that spin-offs are particularly likely to be acquired also provide further support for the idea that acquisitions of spin-offs are a vehicle for technology transfer between established business in an "entrepreneurship system" (Lindholm 1996a); established firms generate spin-offs, which in turn are likely to be acquired by other firms through the market for corporate control. This establishes an inter-firm technology transfer process.

The results in the paper also add perspectives to, for example, the strand of research that focuses on so-called "high-impact" new (or young) firms (Acs, 2008; Henrekson & Johansson, 2010; Coad, Daunfeldt, Hölzl, Johansson, & Nightingale, 2014). This literature typically focuses on survival and employment growth to identify and analyze firms that matter for the economy in a broad sense. Still, the arguments and findings in this paper suggest that start-ups may have a very large economy-wide impact without showing strong post-entry performance in terms of either employment growth or survival because, for instance, they are acquired by established firms that refine and develop their novelties and bring them to world markets. We find that factors that are often found to stimulate survival of new firms also have a positive influence on the likelihood of being acquired.

We further find a number of results that lend themselves to discussion. For example, compared to foreign MNEs, Swedish MNEs show a higher propensity to target NTBFs. By contrast, foreign MNEs appear to be particularly prone to target spin-offs and productive entrants. This may be interpreted as an indication that home-based acquiring firms, with supposedly better knowledge of and networks in the home country than their foreign counterparts, are in a better position to identify domestic innovative start-ups. Foreign MNEs may instead focus on entrants with supposedly more easily identifiable quality indicators, such as having high levels of productivity and coming from a successful established parent firm. However, further analyses are needed to verify these results and their sources.

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APPENDIX

Table A1. Descriptive Statistics for Variables in the Empirical Analyses

	Whole population (80,007 firms)		**Subsample with accounting data (31,983 firms)**	
	Mean	*SD*	*Mean*	*SD*
Foreign MNEs	0.008	0.087	0.009	0.092
Swedish MNEs	0.005	0.072	0.005	0.068
Domestic enterprises	0.050	0.219	0.053	0.223
Share of tertiary education or above	0.083	0.209	0.093	0.220
Share of S&E	0.023	0.108	0.024	0.113
Inventor	0.005	0.069	0.005	0.068
Entry size	0.994	0.409	1.013	0.421
Pulled spin-offs	0.028	0.166	0.032	0.176
Pushed spin-offs	0.054	0.225	0.055	0.228
Other new firms	0.718	0.450	0.737	0.440
Unemployed firms	0.200	0.400	0.176	0.381
High-tech manufacturing	0.007	0.083	0.005	0.070
Medium-high-tech man.	0.016	0.126	0.014	0.116
Medium-low-tech man.	0.036	0.186	0.035	0.183
Low-tech manufacturing	0.050	0.219	0.048	0.214
Knowledge-based services	0.332	0.471	0.323	0.468
Ordinary services	0.559	0.497	0.575	0.494
Stockholm	0.317	0.465	0.336	0.472
Gothenburg	0.115	0.319	0.114	0.318
Malmo	0.105	0.307	0.105	0.306
Rest	0.463	0.499	0.445	0.497
Ratio of cash flow to sales	-	-	0.133	0.188
Labor productivity	-	-	11.779	0.958
Entry rate (L1)	0.098	0.073	0.100	0.077
Industry growth (L1)	0.739	1.268	0.765	1.293

Note: L1 refers to 1-year lag.