Papers in Innovation Studies

Paper no. 2014/24

Ownership Change, Multinationals, and Growth of New Technology-Based Firms

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This is a pre-print version of a paper that has been submitted for publication to a journal.

This version: November 2014

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WP 2014/24

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JEL codes: L22, G34, F23, O33

Keywords: acquisition, firm growth, new technology-based firms, multinational enterprises, longitudinal data, fixed effects models, inverse-probability-of-treatment weights, Sweden

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New technology-based firms (NTBFs) are usually restricted by limited ownership and management structures. This paper explores whether acquisition, particularly that by multinational enterprises (MNEs), promotes the growth of NTBFs. Based on micro-level longitudinal data, we construct a large sample of Swedish NTBFs entering from 1997 to 2002 and follow them until 2009. This paper uses fixed effects models combined with inverse-probability-of-treatment weights (IPTW) to account for endogeneity of acquisition arising from both time-invariant and time-variant heterogeneity across firms. The findings show that acquisition by Swedish MNEs significantly improves the growth of NTBFs, but only when it comes to the growth in employees. In contrast, acquisition by both foreign MNEs and Swedish domestic enterprises are not found to have any significant effects on the growth in either employees or sales of NTBFs.

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1. Introduction

Over the recent decades, the economic slowdown of the main developed economies in Europe has directed both academic and political concerns toward entrepreneurship in general and new technology-based firms (NTBFs) in particular with respect to their potential impact on employment growth, technology transfer, and industry renewal (Licht & Nerlinger, 1998; Almus & Nerlinger, 1999; Rickne & Jacobsson, 1999). However, the direct growth effects of NTBFs on employment or wealth in European countries have been lower than expected not only owing to a relatively small number of NTBFs (Storey & Tether, 1998) but also because most NTBFs are found to be low growth oriented (Autio, 1994). One explanation is that the growth of NTBFs may be restricted by their ownership and management structures (Bonardo et al., 2010). If this argument holds, ownership changes, such as mergers and acquisitions (M&As), may be a solution to release the growth constraint faced by NTBFs.

The main purpose of this paper is to examine whether acquisition promotes growth of NTBFs. This paper specifically explores whether acquisition by multinational enterprises (MNEs) are more likely than that by domestic enterprises to promote the growth of NTBFs, given that MNEs are widely recognized as having not only high levels of ownership advantages and management skills but also international networks and linkages of knowledge, which may generate knowledge spillovers in their host countries. In addition, numerous empirical studies have shown that foreign affiliates have superior performance in, e.g., productivity, survival, and wages (see Gelübcke, 2013, for a review). But is the superior performance of foreign affiliates due to an acquisition effect or a selection effect? In other words, do acquired firms benefit from resources and capabilities transferred from acquiring firms, or are firms with better performance more likely to be acquired? This paper addresses this issue as well and casts light on the causal effect from acquisition on the growth of NTBFs by distinguishing the selection effect from the acquisition effect.

The relationship between acquisition and growth of NTBFs is neglected in the current literature on both entrepreneurship and M&As. Studies on NTBFs either emphasize the supply side of NTBFs, e.g., founders' characteristics or factors related to their creation, or the determinants of post-entry performance of NTBFs (see Storey & Tether, 1998, for a review). On the other hand,

the M&As literature still centers on large publicly traded firms (see e.g., Veugelers, 2006), usually from the perspective of acquiring firms, e.g., acquirers' motives or their post-acquisition performance, but rarely focuses on what acquisition could bring to acquired firms. To the author's knowledge, no previous study has specifically distinguished acquisition effects by different types of acquirers on the growth of NTBFs. This study not only fills this research gap but is also policy relevant. Compared to the United States, Europe has a relatively weak market for venture capital (Bottazzi & Da Rin, 2002). If acquisition is found to boost the growth of NTBFs, acquisition by large established firms could function as an alternative to the venture capital market and foster innovative activities and entrepreneurship. This may have especially important implications for the economic dynamism of some European countries with relative weak markets of venture capital.

Few empirical studies have explicitly examined the relationship between acquisition and growth of NTBFs. Granstrand and Sjölander (1990) find a positive effect of acquisition on the growth of NTBFs in their analysis based on survey data on about 100 Swedish NTBFs operating during 1945–1988. They suggest that the transfer of technological and managerial resources from acquiring firms contributes to higher post-acquisition growth for NTBFs. But they do not find a selection effect by which NTBFs exhibit a higher pre-acquisition growth than non-acquired firms. Based on the same data but with more variables associated with growth, Lindholm (1996) also finds a positive effect of acquisition on the growth of NTBFs, but she also finds the selection effect, given the higher growth of acquired NTBFs relative to non-acquired NTBFs before acquisition. Lindholm (1996) argues that the post-acquisition growth of NTBFs is promoted by the realization of technological synergies, which crucially depends on the motives of acquisition partners. One limitation for the two above-mentioned studies is that their findings are difficult to generalize in a broader context due to their relatively small number of observations. Moreover, the two studies are silent on whether different types of acquirers affect the post-acquisition growth of NTBFs differently.

The data in this paper come from the entire population of NTBFs in Sweden entering from 1997 to 2002 in high-technology manufacturing and knowledge-intensive business services (KIBS) sectors. Firms are followed from entry until 2009 (if they have not exited) in order to discern

their post-acquisition annual growth rates in terms of employees and sales. One methodological challenge is that acquisition may be endogenous to firm growth, which obscures the causality between acquisition and growth of NTBFs. We exploit the longitudinal nature of data by combining the fixed effects models with the method of inverse-probability-of-treatment weights (IPTW) to account for endogeneity of acquisition arising from both time-invariant and time-variant heterogeneity across firms. In addition, the data allow us to divide acquirers into foreign MNEs, Swedish MNEs and Swedish domestic enterprises. Therefore, different acquisition effects can be distinguished by different acquirers on the growth of NTBFs.

The findings show that both the selection and acquisition effects exist in the relationship between acquisition and the growth of NTBFs. The pre-acquisition growth rates of both employees and sales are higher for acquired NTBFs, especially for firms acquired by MNEs, than for non-acquired firms. In terms of the acquisition effect, only acquisition by Swedish MNEs significantly improves the growth in employees for NTBFs. In contrast, neither acquisition by foreign MNEs nor that by domestic enterprises is found to have any significant effects on the growth in either employees or sales for NTBFs. The rest of this paper is organized as follows: in section 2, we review the literature and propose the hypotheses; in section 3, we introduce the data, sample, variables, and descriptive statistics; in section 4, we explain methods and results; and in section 5, we discuss the results and conclude the paper.

2. Literature review and hypotheses

2.1. The selection effect

Previous research has shown that the growth of NTBFs is restricted for at least two reasons. First, NTBFs are often initiated by entrepreneurs who possess a strong technological background but usually lack sufficient management competencies or even a strong desire to grow their companies (Autio, 1994; Bonardo et al., 2010). Second, successful commercialization of new products or services not only hinges on good innovation but also requires support from complementary assets and capabilities (Teece, 1986), which are usually in the hands of established firms. In this context, a division of labor suggests that acquisition by established firms may provide entrepreneurs of NTBFs an exit opportunity where they can thereby focus on their expertise (Bonardo et al., 2010).

Moreover, a "David-Goliath" (Baumol, 2002) symbiosis between small and large firms in the innovation process can be realized through the market of corporate control where large firms use their complementary assets and capabilities to extend and develop innovation introduced by small firms. However, acquisitions suffer from problems of information asymmetries (Lichtenberg et al., 1987), which are especially severe when targets are small, young and private firms and/or when the value of a target mainly resides in high-tech intangible assets (Shen & Reuer, 2005). In this vein, acquirers have to depend on some observed indicators for due diligence, such as firm growth, to evaluate the value of a potential target firm. Moreover, it is reasonable to assume that fast-growing NTBFs or those facing growth opportunities more urgently need external support in terms of resources and management capabilities than slow-growing NTBFs or those without growth prospects. Hence, the first hypothesis is proposed as follows.

H1: Acquired NTBFs exhibit a higher pre-acquisition growth than non-acquired NTBFs.

The literature on international economics reveals that MNEs are characterized as being more productive, being more R&D and knowledge intensive, focusing more on technologically cutting-edge products, getting more involved in product differentiation strategies, having more intangible assets, and so on (see e.g., Markusen, 1998). These advantages allow them to cover transaction costs arising from the process of internationalization, particularly when they are engaged in FDI (Foreign Direct Investment; see e.g., Markusen, 1998; Helpman et al., 2004). In this vein, MNEs should have even stronger ownership advantages and management capabilities than purely domestic enterprises. With their superior knowledge and managerial capabilities, MNEs may have better ability to select target firms. Furthermore, entrepreneurs in high-growth NTBFs are enticed to sell their companies to MNEs in order to obtain a higher reward or initiate an internationalization strategy (Norbäck & Persson, 2014), given MNEs' strengths in resources, management, and international networks. The second hypothesis is then proposed as follows.

H2: NTBFs acquired by MNEs exhibit a higher pre-acquisition growth rate than NTBFs acquired by domestic enterprises.

2.2. The acquisition effect

The positive effect

Acquiring firms can transfer both resources and management capabilities to acquired firms after acquisition. For example, the imperfection of external capital markets is recognized to be the most important factor that hinders growth of small and young firms (Brito & Mello, 1995). By contrast, an internal capital market is thought to be more effective for acquired firms for at least three reasons. First, corporate headquarters have more precise "company-specific information" about their subsidiaries than outside investors do (Hubbard & Palia, 1998). Second, internal capital markets can eliminate extra transaction costs associated with external financing (Matsusaka & Nanda, 2002). Third, corporate headquarters are more flexible in shifting resources to the most efficient subsidiaries within corporations in order to maximize expected profits (Stein, 1997). The "winner-picking" strategy (Stein, 1997) suggests that acquired firms with high prospects not only benefit from regular investments from headquarters but are also able to obtain extra financing that could have been distributed to other competing subsidiaries. These advantages relax the constraints in financial resources faced by NTBFs and are thought to promote the post-acquisition growth of NTBFs. In addition, according to the matching theory of ownership change (Lichtenberg et al., 1987), acquisition provides a new matching opportunity for firms that suffer from the incompatibility between their potentials and management competencies to correct their efficiency lapses. NTBFs are usually initiated by a group of experts in a specific field who lack skills in management (Bonardo et al., 2010). Established firms could replace inefficient management teams of NTBFs through acquisition in the market of corporate control and then boost the growth of NTBFs.

Moreover, the resource-based view (RBV) treats firms as a bundle of resources, including tangible resources (such as financial and physical assets) and intangible resources (such as know-how, patents, and organizational routines) (Wernerfelt, 1984; Barney, 1991). The competitive advantage for a firm rests in a specific configuration of existing resources. Drawing on RBV, firm growth is described as a process of discovery of new productive opportunities (Penrose, 2009). New productive opportunities can emerge when managers find new ways of using slack resources or new combinations of existing resources (Lockett et al., 2011). In line with this argument, acquisition may increase the scope of economies and decrease path dependence arising from the process of resource accumulation (Lockett et al., 2011), enabling firms to have better chances at discovering new productive opportunities and thus higher growth opportunities.

The negative effect

But at the same time, acquisition may also exert a negative effect on the growth of NTBFs. For example, the RBV also suggests that the process of discovering new productive opportunities always generates associated adjustment costs (Lockett et al., 2011). These costs come from firm growth but have a negative effect on the future growth of the firm. In the context of acquisition, the main adjustment costs arise from the post-integration process. Previous studies reveals that unsuccessful post-acquisition integration is the main reason that most M&As fail (see e.g., Shrivastava, 1986). The issues arising from post-acquisition integration, such as disruption in organizational routines, agency problems, increased management control, and conflicts in culture and bureaucracy (Hitt et al., 1990; Hitt et al., 1996; Ahuja & Katila, 2001), are detrimental to growth of NTBFs after acquisition.

2.3. Multinational enterprises

Acquisition may have both positive and negative effects on acquired NTBFs, but these effects may offset each other in the post-acquisition process. In this case, it would be difficult to draw an ex ante hypothesis about acquisition effects on the growth of NTBFs based on theories and previous studies. A better solution may be to distinguish the different acquisition effects of different acquirers. First, we could assume that acquisition by Swedish MNEs and Swedish domestic enterprises would impose a similarly negative effect on NTBFs in the post-acquisition process. However, as discussed above, MNEs should have stronger ownership advantages and management capabilities than purely domestic enterprises. NTBFs acquired by MNEs are thought to have better access to complementary assets and capabilities than their counterparts acquired by Swedish domestic enterprises. Moreover, MNEs have international networks and linkages, which enable NTBFs to access to global stocks of knowledge and resources (Andersson & Lööf, 2012) that may be more complementary to the knowledge base of NTBFs. Thus, compared to firms acquired by Swedish domestic enterprises, firms acquired by Swedish MNEs are more likely to improve their chances of discovering new productive opportunities after acquisition. The third hypothesis is proposed as follows.

H3: Compared to Swedish domestic enterprises, Swedish MNEs are more likely to promote the post-acquisition growth of NTBFs.

Second, we could assume that acquisition by foreign MNEs and Swedish MNEs have a similarly positive effect on NTBFs in the post-acquisition process. But foreign MNEs may face more transaction costs abroad due to economic, institutional, and cultural differences (Zaheer, 1995; Barkema et al., 1996; Shimizu et al., 2004). Due to the liability of foreignness, foreign MNEs are assumed to have a stronger negative effect than Swedish MNEs on the post-acquisition growth of NTBFs. For example, the liability of foreignness may lead to more errors in the pre-acquisition process when acquirers select target firms. Moreover, the liability of foreignness may also create more challenges in the post-acquisition integration process. The fourth hypothesis is then proposed as follows.

H4: Compared to Swedish MNEs, foreign MNEs are less likely to promote the post-acquisition growth of NTBFs.

3. Data, sample, variables, and descriptive statistics

3.1. Data

The dataset used in this paper is constructed by merging several databases from Statistics Sweden (SCB), including data on matched employer-employee, business group, business statistics[2] and population register. Following Eriksson and Kuhn (2006) and Andersson and Klepper (2013), we employ the dynamic information from matched employer-employee data and the method of tracing the yearly flows of employees among workplaces to identify new independent entrants with 1-10 employees. The dataset also contains information whether the initial employees of new entrants has been listed as inventors[3] of patents at the European Patent Office (EPO). We use the presence of inventor(s) in the initial employees as one indicator of technical capital of new firms (Ejermo & Xiao, 2014).

3.2. Sample

Based on the dataset mentioned above, NTBFs are defined as entrepreneurial firms entering in high-technology manufacturing or knowledge-intensive business services (KIBS) sectors. In this

[2] Business statistics have been deflated by consumer price index (CPI) derived from SCB. Base year=1980.
[3] Details of inventor data can be found in Jung & Ejermo (2014).

paper, "high technology" includes high-tech and medium high-tech manufacturing sectors. The definition of these sectors is based on the industry classification of OECD (Hatzichronoglou 1997; Eurostat 2011). KIBS includes "Post and telecommunications" (NACE[4] code 64), "Computer and related activities" (NACE code 72), "Research and development" (NACE code 73), and "Other business activities" (NACE code 74[5]), according to the definition by Miles (2005).[6] The paper considers two more aspects when constructing the sample of firms. First, the sample selects firms entering from 1997 to 2002. The reason is that business statistics are only available for the whole population of firms since 1997. Second, about 26% of NTBFs are dropped if their value of the ratio of cash to sales is below the 1st or above the 99th percentile or if their value of labor productivity is missing. The final sample contains 43,688 unique firms entering from 1997 to 2002 and follows them until 2009 (if they not exited), for a total of 122,049 observations.

3.3. Variables

We measure firm growth as relative change in firm size between two consecutive years. The annual growth rate is calculated by taking log-differences of size (Coad, 2007), see Equation (1).[7] Firm size is indicated by employees or sales, which are the two most widely used growth indicators in the previous studies on firm growth (Delmar, 1997; Delmar et al., 2003).

$$growth_{it} = \ln(X_{it}) - \ln(X_{it-1}) \quad (1)$$

The independent variables consist of a large set of founder-specific, firm-specific, and industry-specific characteristics, which will be discussed separately at follows.

Acquisition

Acquisition is the main variable of interest. An acquisition is identified when a NTBFs joins a business group. This means that the business group obtains a controlling position in the NTBF by

[4] NACE Version 1.1.
[5] Some subsectors under NACE division 74 are excluded, according to the definition by Miles (2005).
[6] In his study, Miles (2005) mentioned that KIBS may also exist in other sectors, such as telecommunications, but did not explicitly include "Post and telecommunications" (NACE code 64) in his definition of major KIBS sectors. This paper, however, includes "Post and telecommunications" in KIBS sectors.
[7] We calculate the annual growth rates by measuring a relative change. Literature on firm growth notes that the relative measure favors growth of small firms compared to large firms (Delmar, 1997). We do not think this is a problem in our analysis. First, our sample contains only small firms. Second, we control for the size of firms in the previous year in our analysis.

possessing over 50% of the voting rights. Acquisition is further divided into acquisition by foreign MNEs, Swedish MNEs, and Swedish domestic enterprises.

Growth in the previous year

The previous evidence shows that the annual growth rates of small firms are subject to a negative serial correlation (Coad, 2007). In this study, we account for the serial correlation of annual growth rates by including the growth rates in the previous year as a control variable.

Age and size

Substantive literature reveals that firm size and age are negatively related to the growth of new firms (see e.g., Jovanovic, 1982; Evans, 1987). We control for firm size measured by the logarithm of number of employees and age by including dummies for each age.

Human capital and technical capital

Human capital and technical capital are important founder-specific characteristics and are found to have a positive impact on the growth of NTBFs (Storey & Tether, 1998; Almus & Nerlinger, 1999). This study uses the share of employees with tertiary education or above to indicate human capital and the share of scientists and engineers and the presence of inventor(s) in the initial employees to indicate technical capital of a firm.

Firm types

Founders' ex ante experience, particularly working experience, is found to be closely related to post-entry growth of new firms (Colombo & Grilli, 2005; Santarelli & Vivarelli, 2007). For example, spin-offs are considered to have higher growth than other types of new firms as spin-offs can inherit knowledge and routines from their parent companies (Nelson & Winter, 1982; Klepper & Sleeper, 2005; Eriksson & Kuhn, 2006; Andersson & Klepper, 2013). By contrast, the founders' unemployment status in the pre-entry stage is found to have a negative impact on post-entry growth as unemployed individuals are likely to start a new firm as a way of escaping unemployment (Santarelli & Vivarelli, 2007). This study controls for founders' working experience by including variables of firm types. Following Andersson and Klepper (2013),

NTBFs are divided into five types: pulled spin-offs, pushed spin-offs, other new firms, unemployment firms, and self-employment firms.

Internal financial resources

As discussed above, because of imperfections of external financial markets, internal finances may be the main financial resources of new firms (Carpenter & Petersen, 2002) and are thus expected to have a positive impact on the growth of NTBFs. Following Andersson and Lööf (2012), the ratio of cash flow to sales is used as a proxy for internal financial resources and is controlled for in this study.

Labor productivity

We control for labor productivity which is served as one quality indicator of new firms. Labor productivity is measured by the logarithm of ratio of value added to the number of employees.

Industry controls

Industry dummies (defined at as two-digit NACE code) are included to accommodate industry-specific effects on firm growth.

Location controls

This study controls for regional effects by including regional dummies to indicate whether firms are located in the three main metropolitan regions (Stockholm, Gothenburg, and Malmo) or in the remaining regions in Sweden.

3.4. Descriptive statistics

Table 1 displays the description of main variables and reports mean values for all firms, firms acquired by foreign MNEs, Swedish MNEs, and Swedish domestic enterprises, and non-acquired firms.[8] In the total sample, about 3.6% of NTBFs had been acquired by business groups by 2009. Among others, about 0.4% of NTBFs were acquired by foreign MNEs and 0.2% by Swedish MNEs. Although acquired firms only represent a small share of all firms in the sample, they display characteristics distinctive from non-acquired firms. Table 1 also shows *t* tests on the

[8] Firms defined as acquired firms if they are acquired within the observation period, otherwise as non-acquired firms.

equality of means by comparing firms acquired by different types of acquirers and non-acquired firms. Compared to non-acquired firms, acquired firms, particularly firms acquired by MNEs, are significantly larger and more productive; they have significantly higher growth rates in employees, sales, and technical capital but fewer internal financial resources on average. In terms of firm types, acquired firms are significantly more likely to be spin-offs and other new firms and are less likely to be self-employment firms compared to non-acquired firms.

Figure 1 displays the distribution of the growth rates of acquired and non-acquired firms over the period 1998–2009.[9] The upper graph shows that the growth rates in employees are highly skewed to zero, especially in the sample of non-acquired firms. By contrast, the lower graph shows that the distribution of growth rates in sales is comparatively flatter and closer to a normal distribution.[10]

[9] The growth rates are missing at entry year, and thus the growth rates are observed from 1998 to 2009.
[10] Please note that the scales of the y-axis are different between the upper and lower graphs in Fig. 1.

Table 1 Description and Descriptive Statistics of Main Variables

Variable	Description	Mean					*t* test		
		Total Sample	Acquisition by foreign MNEs	Acquisition by Swedish MNEs	Acquisition by domestic enterprises	Non-acquired Firms	Acquisition by foreign MNEs	Acquisition by Swedish MNEs	Acquisition by domestic enterprises
g_employment	Annual growth of employees	0.020	0.071	0.129	0.064	0.017	0.0000	0.0000	0.0000
g_sale	Annual growth of net sales	0.048	0.169	0.238	0.125	0.042	0.0000	0.0000	0.0000
Foreign MNEs	Dummy variable for acquisition by foreign MNEs	0.004	-	-	-	-	-	-	-
Swedish MNES	Dummy variable for acquisition by Swedish MNEs	0.002	-	-	-	-	-	-	-
Domestic	Dummy variable for acquisition by domestic enterprises	0.031	-	-	-	-	-	-	-
Size	Logarithm of number of employees	0.279	1.015	1.547	0.826	0.237	0.0000	0.0000	0.0000
Share of tertiary education or above	Share of employees with tertiary or above education	0.311	0.332	0.325	0.354	0.308	0.1703	0.4282	0.0000
Share of S&E	Share of employees with tertiary or above education in the field of science and engineering	0.092	0.131	0.154	0.127	0.089	0.0001	0.0000	0.0000
Inventor	Dummy variable for firms with inventors	0.007	0.000	0.040	0.011	0.006	0.0436	0.0000	0.0000
Pulled spin-offs	Dummy variable for pulled spin-offs	0.014	0.084	0.067	0.054	0.010	0.0000	0.0000	0.0000
Pushed spin-offs	Dummy variable for pushed spin-offs	0.015	0.107	0.109	0.065	0.011	0.0000	0.0000	0.0000
Other new firms	Dummy variable for other new firms	0.137	0.358	0.492	0.290	0.125	0.0000	0.0000	0.0000
Unemployment firms	Dummy variable for firms started by unemployed individuals	0.020	0.025	0.017	0.027	0.020	0.3613	0.6454	0.0000
Self-employment firms	Dummy variable for firms started by only one individual (reference group)	0.815	0.427	0.316	0.563	0.834	0.0000	0.0000	0.0000
Ratio of cash flow to sales	Ratio of cash flows to sales	0.344	0.092	0.101	0.146	0.358	0.0000	0.0000	0.0000
Labor productivity	Logarithm of ratio of value added to the number of employees	12.379	13.094	12.876	12.949	12.339	0.0000	0.0000	0.0000
High-tech	Dummy variable for firms in high-tech manufacturing sectors	0.016	0.048	0.024	0.014	0.015	0.0000	0.1644	0.4064
Medium high-tech	Dummy variable for firms in medium high-tech manufacturing sectors	0.041	0.046	0.145	0.050	0.040	0.3704	0.0000	0.0000
KIBS	Dummy variable for firms in knowledge-intensive business service sectors	0.896	0.810	0.793	0.876	0.898	0.0000	0.0000	0.0000
Stockholm	Dummy variable for firms located in Stockholm region	0.434	0.690	0.437	0.435	0.433	0.0000	0.8584	0.6785
Gothenburg	Dummy variable for firms located in Gothenburg region	0.125	0.093	0.154	0.139	0.124	0.0154	0.0630	0.0004
Malmo	Dummy variable for firms located in Malmo region	0.112	0.087	0.128	0.081	0.114	0.0307	0.3491	0.0000
Other regions	Dummy variable for firms located in other regions (reference group)	0.329	0.130	0.280	0.345	0.329	0.0000	0.0334	0.0074

Note: Descriptive statistics are based on all firm-year observations. The annual growth rates of employees and net sales are missing at entry year. Sector dummies (based on two-digit NACE code) are reported as grouped into high-tech manufacturing, medium high-tech manufacturing, and KIBS. There are some missing values in sector dummies as some firms changed their sectors after entry to sectors that do not belong to high-tech manufacturing, medium high-tech manufacturing, or KIBS.

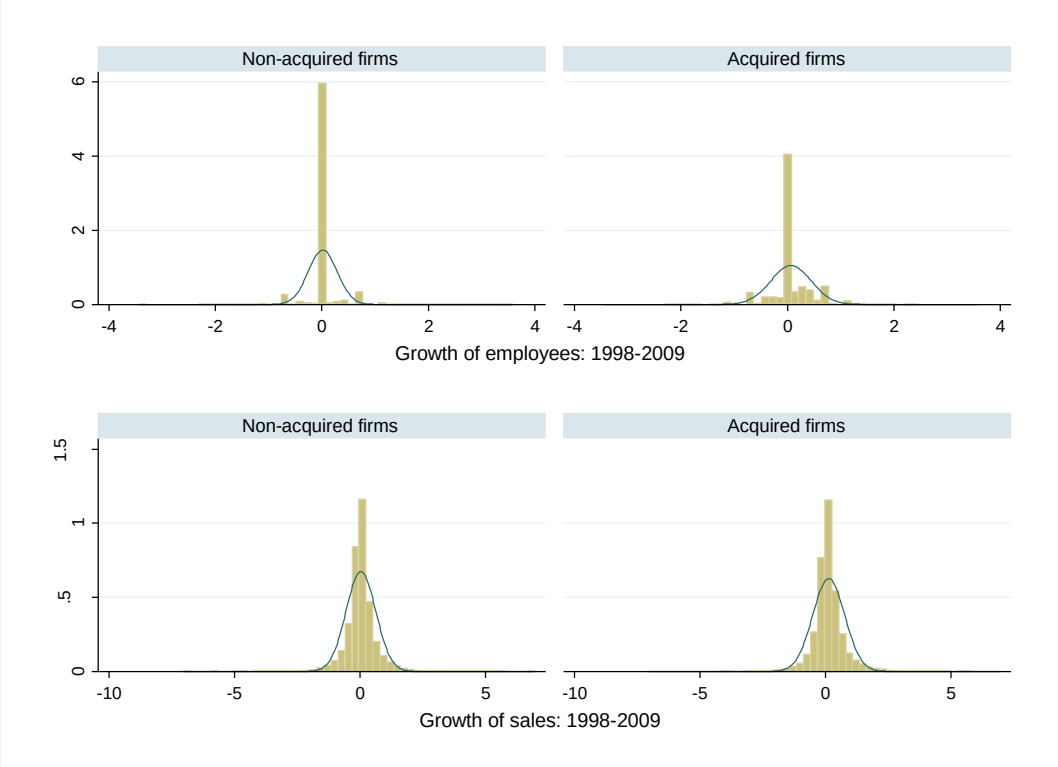

Fig. 1 Histogram of the annual growth rates in employees and sales

Table 2 shows the correlation matrix of current growth rates and growth rates in the previous year. The current growth rates in employees and sales show significantly negative correlations with their respective growth rates in the previous year. This is consistent with the findings of Coad (2007) that small firms have a negative serial correlation in terms of annual growth rates.

Table 2 Correlations of Current Growth and the Growth in the Previous Year

Variables	g_employment	g_employment_L1	g_sales	g_sales_L1
g_employment	1			
g_employment_L1	−0.2542***	1		
g_sales	0.1409***	0.0578***	1	
g_sales_L1	0.0283***	0.1279***	−0.2295***	1

Notes. *** p<0.01. L1 refers to a one-year lag.

4. Methods and results

4.1. The selection effect

The main aim of this paper is to examine the acquisition effect on the growth of NTBFs. One methodological challenge is that acquisition may be endogenous to firm growth, which means firm growth may predict acquisition (the selection effect). In order to detect whether the selection effect exists in the relationship between acquisition and firm growth, we first explore differences in growth before acquisition between acquired and non-acquired firms through a multivariate regression model.[11] See Equation (2a).

$$growth_{it} = \alpha + \beta_1 For_i + \beta_2 Swe_i + \beta_3 Dom_i + \gamma C_{it-1} + \varepsilon_{it} \quad (2a)$$

$$growth_{it} = \alpha + \beta_1 For_i + \beta_2 Swe_i + \gamma C_{it-1} + \varepsilon_{it} \quad (2b)$$

where *i* refers to the *i*th firm; *t* refers to year *t*; For_i refers to firms acquried by foreign MNEs; Swe_i refers to firms acquired by Swedish MNEs; Dom_i refers to firms acquired by Swedish domestic enterprises; C_{it-1} is a vector of control variables in the previous year.[12] In addition, an alternative model is employed to compare the pre-acquisition growth differences for acquired firms only; see Equation (2b). In this model, firms acquired by Swedish domestic enterprises serve as the control group. The models are estimated by pooled OLS and results are reported in Table 3.

[11] Alternatively, a logit model can be employed to explore whether growth rates in the previous year predict an event of acquisition in the current year. But in our sample, over 30% of acquired firms are acquired in the first year after entry, which means their growth rates in the year before they are acquired are missing. Thus, the logit model is not chosen here.

[12] The reason that this model uses control variables in the previous year is to avoid for the possible problem of simultaneity. In addition to control variables discussed in Section 3.3, year dummies are also included.

Table 3 Pooled OLS Estimation: The Growth Premium of Acquired NTBFs Before Acquisition

	(2a)		(2b)	
Variables	**g_employment**	**g_sale**	**g_employment**	**g_sale**
Foreign MNEs	0.112***	0.124***	0.0103	−0.0447
	(0.0327)	(0.0356)	(0.0307)	(0.0383)
Swedish MNEs	0.223***	0.225***	0.0912***	0.0832*
	(0.0350)	(0.0380)	(0.0341)	(0.0435)
Domestic	0.0857***	0.149***	–	–
	(0.00861)	(0.0101)	–	–
Control variables	Yes	Yes	Yes	Yes
Constant	−0.337***	1.604***	−0.0238	2.386***
	(0.0144)	(0.0407)	(0.150)	(0.327)
Obs	90,918	90,918	2,468	2,468
R-squared	0.104	0.108	0.082	0.162

Notes. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated coefficients of control variables are not reported.

From the results of Model (2a) in Table 3, it is noteworthy that acquired firms have significantly higher growth rates than non-acquired firms in both employees and sales before acquisition. Compared to non-acquired firms, the pre-acquisition growth for firms acquired by foreign MNEs is about 11% and 12% higher in employees and sales; about 22% and 23% higher, respectively, for firms acquired by Swedish MNEs; and about 9% and 15% higher, respectively, for firms acquired by Swedish domestic enterprises.

Model (2b) in Table 3 displays the results of comparing the growth differences for acquired firms before acquisition. Compared to firms acquired by Swedish domestic enterprises, the higher pre-acquisition growth in both employees and sales is only significant for firms acquired by Swedish MNEs – about 9% higher in employees and 8% higher in sales.

The results in Table 3 support H1: acquired firms exhibit a significantly higher pre-acquisition growth than non-acquired firms. However, H2 is only partially supported. Compared to firms acquired by Swedish domestic enterprises, firms acquired by Swedish MNEs are found to have a significantly higher pre-acquisition growth in both employees and sales while firms acquired by foreign MNEs are not.

4.2. The acquisition effects

The results in the last section show that the selection effect exists in the relationship between acquisition and the growth of NTBFs. Previous studies have usually employed the propensity score–matching method to account for the endogeneity of acquisition (see e.g., Bandick & Görg, 2010). The rationale of propensity score matching is to construct an artificial control group based on the observed characteristics across firms before treatment in order make the treatment as random as possible between the treatment and control group. However, we do not think propensity score matching is an appropriate method in the current context. First, propensity score matching does not control for unobserved firm-level heterogeneity unless it can combine with the difference-in-difference approach (Arnold & Javorcik, 2009). Second, the observed heterogeneity may change over time and with the status of acquisition, which will be explained in details later.

In this study, we employ fixed effects models to account for the selection effect arising from time-invariant firm-level heterogeneity, both observed and unobserved. The benchmark model is shown in Equation (3a).

$$growth_{it} = \alpha + \beta_1 Ac_{it} + \gamma C_{it-1} + v_i + u_{it} \quad (3a)$$

$$growth_{it} = \alpha + \beta_1 For_{it} + \beta_2 Swe_{it} + \beta_3 Dom_{it} + \gamma C_{it-1} + v_i + u_{it} \quad (3b)$$

where Ac_{it} refers to the status of being acquired; v_i refers to fixed firm-level effects; C_{it-1} are control variables in the previous year.[13] We also include an alternative model to distinguish acquisition effects from different types of acquirers; see Equation (3b).

However, the selection effect may also arise from time-variant heterogeneity across firms. For example, the propensity of acquisition may vary with these time-varying variables. Moreover, acquisitions in the previous period may impact on covariates in the current period, which in turn affect growth in the future. Thus, standard fixed-effects models will give a biased estimate of the acquisition effect without considering time-varying confounders. A new estimator, inverse-probability-of-treatment weights (IPTW), developed originally in biostatistics (Robins et al.,

[13] Time-invariant control variables, such as the presence of inventor(s) and firm types, are not included in the estimation. However, year dummies are included.

2000), was recently introduced by economists to account for time-varying confounders (Azoulay et al., 2009). The rationale of the IPTW estimator is to make a treatment as random as possible by accounting time-varying confounders. Following the procedures of Fewell et al. (2004), IPTW are constructed as shown in Equation (4).

$$w_{ij} = \prod_{t=1}^{j} \frac{1}{Prob(A_{it}|\bar{A}_{i,t-1},\bar{X}_{it})} \quad (4)$$

The denominator of Equation (4) estimates a firm's probability of receiving the treatment of acquisition for each firm-year observation conditional on its previous history of acquisitions and covariates.[14] By inversing the estimated probability, firms with higher probabilities of acquisition receive lower weights, while firms with lower probabilities of acquisition receive higher weights. We follow Fewell et al. (2004) and employ a stabilized version, see Equation (5), to correct the skewed distribution and high variance of w_{ij}.

$$sw_{ij} = \prod_{t=1}^{j} \frac{Prob(A_{it}|\bar{A}_{i,t-1},\bar{X}_{i0})}{Prob(A_{it}|\bar{A}_{i,t-1},\bar{X}_{it})} \quad (5)$$

The numerator calculates a firm's probability of receiving the treatment of acquisition for each firm-year observation conditional on its previous history of acquisitions and the baseline values of covariates (the values at entry year).

Another advantage of the IPTW estimator is that it could also account for a potential survivor selection bias that arises from time-variant heterogeneity across firms. The conventional growth model is often criticized for its potential survivor selection bias because we can only observe surviving firms in the data instead of the whole population of firms. The growth patterns of surviving firms could be systematically different from firms that do not survive. Moreover, the selection bias could be even worse in the sample of small and new firms, which usually experience a high exit rate. Thus, we need to control for survivor selection bias when exploring the acquisition effect on the growth of NTBFs. The weights that will account for this bias are derived through a similar way as the one described in Equations (4) and (5), where exits are substituted for acquisitions as the treatment. The final IPTW estimator used in the estimation is the product of the weights that account for the selectivity problem from both acquisitions and exits.

[14] In this study, we focus only on the first acquisition of NTBFs and drop observations once acquired firms are observed to be divested from their acquiring firms.

Table 4 reports the results estimated by the fixed effects method. The first two columns in Table 4 display the estimates for the general acquisition effect on the growth of NTBFs based on Model (3a). In the first column, acquisition is found to significantly improve the growth in employees for NTBFs by 5% after controlling for time-invariant heterogeneity across firms. However, in the second column, the acquisition effect on the growth in sales is not statistically significant. The third and fourth columns display the estimated acquisition effects of different types of acquirers based on Model (3b). In the third column, both Swedish MNEs and domestic enterprises are found to have a significantly positive effect on the post-acquisition growth in employees for NTBFs. However, in the fourth column, only foreign MNEs are found to have a significantly positive acquisition effect, promoting the post-acquisition growth in sales for NTBFs.

Table 4 Fixed Effects Estimation: Acquisition Effects on the Growth on NTBFs

	(3a)		(3b)		(3a)		(3b)	
	Standard		Standard		IPTW		IPTW	
Variables	**g_employment**	**g_sale**	**g_employment**	**g_sale**	**g_employment**	**g_sale**	**g_employment**	**g_sale**
Acquisition	0.0537***	0.00782			0.0205	−0.0249		
	(0.00742)	(0.0147)			(0.0158)	(0.0273)		
Foreign MNEs			0.00305	0.215***			−0.0683	0.0673
			(0.0350)	(0.0696)			(0.0870)	(0.0781)
Swedish MNEs			0.212***	0.0660			0.149***	−0.0659
			(0.0308)	(0.0613)			(0.0387)	(0.105)
Domestic			0.0464***	−0.00566			0.0177	−0.0270
			(0.00779)	(0.0155)			(0.0167)	(0.0292)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.380	6.001***	−0.378	6.002***	−0.157***	5.594***	−0.156***	5.594***
	(0.248)	(0.493)	(0.248)	(0.493)	(0.0581)	(0.296)	(0.0581)	(0.296)
Obs	94,877	94,877	94,877	94,877	93,552	93,552	93,552	93,552
R-squared	0.347	0.282	0.348	0.282	0.466	0.468	0.466	0.468

Notes. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated coefficients of control variables are not reported. For models weighted by IPTW, robust standard errors are reported in parentheses. One-sided *t* tests on coefficients after estimation in the seventh column: (1) H0: Swedish MNEs<=Domestic: Prob>F=0.0004; (2) H0: Foreign MNEs<=Domestic: Prob>F=0.4989; (3) H0: Swedish MNEs<=Foreign MNEs: Prob>F=0.0000.

In order to control for the possible time-varying confounders, we employ the IPTW-weighted fixed effects method to re-estimate Model (3a) and (3b). The results are reported from the fifth to eighth column in Table 4. It is noteworthy that the coefficients in the IPTW-weighted fixed effects are all lower in magnitude than those in the standard fixed effects estimations. This indicates that not controlling for the time-varying confounders may result in overestimated acquisition effects. In the fifth and sixth column, acquisition is not found to have a significant effect on the growth in either employees or sales for NTBFs after further controlling for time-varying confounders. In the seventh column, only Swedish MNEs are found to significantly improve post-acquisition growth in employees for NTBFs by about 15%. In the eighth column, none of the coefficients of the three types of acquirers are statistically significant.

In order to test H3 and H4, we need to use one-sided *t* tests to explore whether the coefficients of Swedish MNEs are significantly higher than those of either Swedish domestic enterprises or foreign MNEs based on the estimation in the seventh column. The results are reported in the notes in Table 4, showing that both H3 and H4 are supported. Compared to the findings of Lindholm (1996), this study also finds both the selection and acquisition effects in the relationship between acquisition and the growth of NTBFs. But in terms of the acquisition effect, we find that only acquisition by Swedish MNEs significantly improves the growth in employees for NTBFs.

4.3. Robustness check

Recall that about 26% of firms from the whole population of NTBFs were dropped from the data sample because of missing or unreliable values in the variables of ratio of cash to sales and labor productivity. In order to check whether the results are sensitive by dropping those firms, we employ the IPTW-weighted fixed effects method to re-estimate Model (3b) for the whole population of NTBFs. Due to the missing or unreliable values mentioned above, we can only test the acquisition effect on the growth of employees, and the variables of ratio of cash to sales and labor productivity are not included in the control variables. The results reported in Table 5 generally exhibit a similar pattern with that in the seventh column in Table 4. Swedish MNEs are still found to significantly improve the post-acquisition growth in employees of NTBFs.

Table 5 Fixed Effects Estimation: Acquisition Effects on the Growth of NTBFs – A Robustness Check Based on the Whole Population of NTBFs

	(3b)
	IPTW
Variables	**g_employment**
Foreign MNEs	0.0246
	(0.0593)
Swedish MNEs	0.125***
	(0.0360)
Domestic	0.00191
	(0.0128)
Control variables	Yes
Constant	0.177***
	(0.0444)
Obs	134,306
R-squared	0.461

Notes. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Estimated coefficients of control variables are not reported. The variables of ratio of cash to sales and labor productivity are not included in the control variables. One-sided *t* tests on coefficients: (1) H0: Swedish MNEs<=Domestic: Prob>F=0.0006; (2) H0: Foreign MNEs<=Domestic: Prob>F=0.9991; (3) H0: Swedish MNEs<=Foreign MNEs: Prob>F=0.0051.

5. Discussion and conclusion

The findings in this paper show that both the selection and acquisition effects exist in the relationship between acquisition and the growth of NTBFs. Pre-acquisition growth rates in both employees and sales are higher for acquired NTBFs, especially for firms acquired by MNEs. In terms of the acquisition effect, only acquisition by Swedish MNEs significantly improves the growth in employees for NTBFs. By contrast, acquisition by foreign MNEs or domestic enterprises is not found to exert a significant effect on the growth in either employees or sales for NTBFs. Although this study does not show any positive effects of foreign acquisition on the growth of NTBFs, we cannot rule out that acquisition by foreign acquirers is subject to a different motive than that of Swedish acquirers. For example, compared to Swedish MNEs, foreign MNEs may be more likely to have a motive for obtaining some specific resources locally through acquisition, such as intangible assets or firm-specific tacit knowledge, which are difficult to trade individually in traditional factor markets (Lockett et al., 2011). In this scenario, foreign acquirers may rely on acquisition to acquire resources or knowledge but would not intend to further promote the growth of NTBFs after acquisition.

The findings of this paper are both research and policy relevant. First, this study sheds light on how acquisition by domestic MNEs could be an effective strategy to promote the growth of NTBFs. Compared to purely domestic enterprises, domestic MNEs have a higher level of ownership advantages and managerial capabilities. Compared to foreign MNEs, domestic MNEs are less affected by information asymmetries in the market of corporate control. This may pose important implications for countries without strong markets of venture capital, when it comes to their economic dynamism. Second, the findings cannot verify a "David-Goliath" symbiosis between small and large innovators directly, but the study suggests that current innovation policies may need to pay more attention to the possible complementary instead of the substitutive relationship between different types of innovation actors in order to increase the overall efficiency of the innovation system. Third, this study finds that acquisition is endogenous to firm growth, which obscures the causality between acquisition and growth of NTBFs. The endogeneity of acquisition is not only from time-invariant but also time-variant heterogeneity across firms. IPTW provides a new approach to control for possible time-varying confounders.

Acknowledgements

An earlier version of this paper was presented at the 15th International Conference of the International Joseph Alois Schumpeter Society (ISS) in July 2014 in Jena, Germany. I am grateful to Martin Andersson at CIRCLE for his generous and overall help for this paper, particularly in defining entry and exit of new firms and mergers and acquisitions. I also would like to express my thanks to Olof Ejermo, Torben Schubert, Alex Coad, and Katrin Hussinger for their constructive comments on earlier versions of this paper. Niclas Lavesson at CIRCLE is appreciated for his generous help for the location data.

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