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Papers in Innovation Studies no. 2023/03

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Abstract: This paper analyses how the presence of foreign-owned multinational enterprises (MNEs) affects the performance of start-ups in the same region. Focusing on the population of Swedish start-ups and MNEs between 2007 and 2015, we investigate the relationship between start-up productivity and regional share of MNE employment. We find effects that differ by sectoral belonging of start-ups and MNEs. Notably, while the effects of the local presence of foreign-owned MNEs are negative when start-ups and local MNEs belong to the same sector, they are positive for the local presence of MNEs in related and (to some weaker extent) unrelated sectors. Moreover, we find that as start-ups mature the effect of the local presence of foreign-owned MNEs on start-up productivity increases, irrespective of their sectoral belonging. We interpret this as evidence of age-dependent processes of learning, legitimacy building, and resource accumulaton allowing start-ups to reap the benefits while mitigating negative effects of MNE proximity. Interestingly, we show that the documented effects are more pronounced for service firms, particularly in the knowledge-intensive sectors.

JEL codes: R11, M13, M16

Keywords: Productivity, start-ups, MNE

1 Introduction

It is well established in the literature on regional dynamics and growth that both multinational enterprises (MNEs) and start-ups are highly important for a vibrant regional innovation ecosystem (Young, Hood et al. 1994, Audretsch and Keilbach 2004, Yeung 2009, Baptista and Preto 2011). However, much less is known about to what extent the presence of MNEs affects local start-up performance. Investigating this interdependency is important in order to understand the dynamics in regional innovation ecosystems and to provide insights about how to promote positive aspects of such an interrelation while dampening negative ones.

MNEs engage in operations abroad for two main reasons: market-seeking and asset-seeking (Makino, Lau et al. 2002, Meyer 2015). As regards the latter, the "two most important location-specific factors today are socially created, rather than occurring in nature: access to knowledge; and access to labour" (Dicken 2015, 121). To access knowledge and labor, MNEs interact with local environments and thereby create both positive and negative effects for co-located companies. Furthermore, access to labor and knowledge is important not only for MNEs (re-)location decisions but also for local firms and in particular new start-ups, which struggle with access to knowledge and labor due to liabilities of newness and smallness (Stinchcombe 1965, Freeman, Carroll et al. 1983, Aldrich and Auster 1986, Carayannopoulos 2009, Gimenez-Fernandez, Sandulli et al. 2020, Guerrazzi, Serra et al. 2022). The effects of being co-located have been captured with the term knowledge-based agglomeration externalities and can be differentiated in local knowledge spillovers and local labor market dynamics (Duranton and Puga 2004, Grillitsch and Nilsson 2019).

We conceptualize the relationship between MNEs and local start-up performance with two types of effects: i) negative competition effects (e.g. labour market competition for qualified labor), and ii) positive learning, resource accumulation and legitimacy effects (e.g., when MNEs act as sophisticated customers). Importantly, we argue that positive learning and legitimacy effects tend to increase incrementally over time while competition effects kick-in already for very young start-ups. For this reason, we expect the effect of MNEs on start-up performance to be negative for very young start-ups but positively moderated by start-ups' age. Furthermore, we develop arguments about how internal characteristics of start-ups as well as relatedness between start-ups and MNEs moderate the relationship between MNEs and start-up performance over time. We argue that start-up's skill-sets and resource endowments should enhance the learning and legitimacy effects, and thus amplify the moderation effect of age. We also discuss why the presence of MNEs in related sectors should tend to be more beneficial for start-up performance than the presence of MNEs in the same sector or unrelated sectors.

The main objective of this paper is thus to investigate to what extent MNEs affect local start-up performance in a context where seeking knowledge-related assets is the prime motivator for MNEs presence. We do this by selecting Sweden, which constitutes a small market but shows both high rates of foreign direct investment and MNE activity as well as high start-up rates. The empirical study

includes the population of Swedish start-ups from 2007 to 2015 as well as the population of foreign-owned MNEs operating in Sweden in this period. We investigate the relationship between start-up productivity and regional MNE-intensity, measured as the share of MNE employees in the regional workforce. We find effects that differ by sectoral belonging of start-ups and MNEs. While the effects are negative when start-ups and local MNEs belong to the same sector, they are positive for MNEs in related and (to some extent) unrelated sectors. We find a robust positive moderating effect of start-up age, corroborating our argument that co-location with MNEs creates a potential for learning and legitimacy-building processes, which unfold over time. We also find that the positive age-moderating effect is amplified by educational diversity and capital intensity of start-ups. It's important to note that most effects are more pronounced for start-ups in the service-sector.

2 Literature review and hypotheses

2.1 Start-up performance in the local presence of MNEs

The survival and growth of start-ups has long been studied in terms of liabilities of newness and smallness (Stinchcombe 1965, Freeman, Carroll et al. 1983, Aldrich and Auster 1986). Such liabilities come in the form of limited availability of internal skills and competencies leading to difficulties in absorbing external knowledge; limited financial and human capital; fewer (and more specialized) network ties; lack of a customer base; underdeveloped organizational routines; limited experience and expertise in management; and lacking legitimacy and track-record (Delmar and Shane 2004, Gimenez-Fernandez, Sandulli et al. 2020, Soto-Simeone, Sirén et al. 2020). These liabilities are not only shaped by internal conditions of start-ups but also impacted by environmental circumstances and regional conditions (Brüderl, Preisendörfer et al. 1992, Lööf and Nabavi 2014, Soto-Simeone, Sirén et al. 2020). The local presence of MNEs is one such regional condition that may either alleviate or exacerbate liabilities of newness and smallness, affecting start-ups' growth in positive or negative ways (Pe'er and Keil 2013).

On the one hand, the local presence of MNEs may have *competition effects* on start-ups' performance by exacerbating liabilities of newness and smallness. Small and young firms face substantial disadvantages when it comes to competing with MNEs for human capital, i.e. suffer disproportionally from negative labor market externalities. MNEs have internal labor markets, perceived long-term stability and security of employment, as well as greater opportunities for career development as compared to start-ups (Aldrich and Auster 1986, Morgan 2009, Butler and Hammer 2020). Start-ups lack a history and track record that demonstrate their ability to meet expectations of stakeholders, making them disproportionally vulnerable to obstacles when it comes to acquiring human, financial and other resources to survive and grow (de Kok and Uhlaner 2001, Tumasjan, Strobel et al. 2011, Moser, Tumasjan et al. 2015, Nicolò 2015). Pe'er and Keil (2013) argue that competition for resources between start-ups and MNEs is more detrimental to start-up performance than competition with other start-ups.

On the other hand, however, the presence of MNEs may benefit local start-ups (Jacobs, Koster et al. 2013, Jacobs, van Rietbergen et al. 2016) and mitigate liabilities of newness and smallness throuh *learning and legitimacy effects* that manifest in two ways. Firstly, MNEs may provide start-up firms with access to local and global markets. MNEs themselves may serve early customers to local start-ups. Potential benefits of this are twofold. MNEs are demanding customers and serving them provides a learning opportunity for start-ups, making them better equipped to expand their market coverage. Also, MNEs are gateways, or boundary spanners, to global markets since they have well-developed linkages to international markets. Secondly, MNEs may also serve as a reference customer, providing legitimacy to a start-up firm. Lack of legitimacy and track record is a unique problem for start-up firms, the one that Delmar and Shane (2004) argue should be addressed first because it is a necessary precondition for initiating social ties with stakeholders and obtaining resources. MNEs thus provide benefits both as potential early customers and sources for learning, and important conduits for legitimacy-creating activities for start-ups. In fact, learning and legitimacy building go hand in hand when start-ups gain access to MNEs.

Hence, there are strong theoretical reasons and empirical evidence that co-location with MNEs triggers (negative) competition effects and (positive) learning and legitimacy effects on start-ups. The interesting question then is which conditions moderate these effects so that the balance between negative and positive effects shifts, this is to say the aggregate effect of the two counteracting tendencies. We argue below that there are at least two important moderators relating to relatedness between local MNEs and start-ups and start-up characteristics, in particular age and accumulated internal skills and resources.

First, the extent to which start-ups will suffer from competition effects or benefit from learning and legitimacy effects is expected to be dependent on sectoral belonging of local MNEs. Fundamentally, this argument builds on the discussion about benefits that firms derive from co-location with other firms, also referred to as agglomeration externalities. Traditionally, this discussion has focused on two extremes: highly specialised and highly diversified regional environments. On the one hand, Marshall (1890) suggested that specialised regional industry structures facilitate knowledge spillovers between local firms through a variety of mechanisms such as developing specialised labour force, specialised supplier base and learning through monitoring of and interacting with peers. On the other hand, Jacobs (1969) argued that regional industrial diversity is conducive to new knowledge generation as the latter is a recombinant process that builds on pre-existing knowledge variety. A vast amount of empirical research, following the seminal study by Glaeser, Kallal et al. (1992), has attempted to compare the benefits of specialization vis-à-vis diversity without coming to conclusive evidence neither in general (see de Groot, Poot et al. 2016 for a literature review), nor with respect to start-up performance (Ebert, Brenner et al. 2019, Power, Doran et al. 2019). It has been suggested that traditional conceptualisations of specialization and diversity are thus too simplistic to capture the relationship between regional environment and firm performance (Content and Frenken 2016).

In an attempt to resolve this controversy, Frenken, Van Oort et al. (2007) suggested that neither specialisation nor diversity are enough for fruitful knowledge exchange because not all knowledge

can be meaningfully exchanged and (re)combined. "[A] not too great cognitive distance between firms … enables effective communication and thus learning, while a not too small cognitive distance avoids lock-in" (Boschma 2005, p. 64). Yet, "at a certain point cognitive distance becomes so large as to preclude sufficient mutual understanding" (Noteboom, Van Haverbeke et al. 2007, p. 1017). Thus, it is the optimal level of cognitive proximity that enhances knowledge spillovers between firms (Noteboom 2000). To capture the concept of cognitive distance between the extremes of specialisation and diversity, Frenken, Van Oort et al. (2007) introduced the notion of related variety. The literature has shown that related variety enhances the rate of regional entrepreneurship (Content, Frenken et al. 2019) as well as performance of firms (Antonietti and Cainelli 2011, Aarstad, Kvitastein et al. 2016, Stavropoulos, van Oort et al. 2020). The effect of unrelated variety is less clear (Cheng, Yuan et al. 2023).

The studies above, however, focus on the overall degree of (un)related variety, ignoring the types of actors present in a region. Provided our particular interest in the relationship between the local presence of MNEs and start-up performance, we focus our attention specifically on the degree of relatedness between start-ups and MNEs. In relation to each start-up, we distinguish between MNE-intensity in (a) the same sector, (b) related sectors and (c) unrelated sectors. The degree of relatedness between start-ups and MNEs is expected to moderate the relationship between MNE-intensity and start-up performance via the two effects introduced above: competition effects and learning and legitimacy effects.

Having a high intensity of MNEs in the same sector may expose start-ups to high competition for resources, which would arguably have a negative impact on start-up performance. At the same time, having MNEs in the same sector may benefit start-ups by facilitating local knowledge exchange. The exact outcome for start-ups would then depend on the technological intensity of the sector. In particular, the literature suggests that co-location with firms in the same sector is important for start-ups in non-high-tech environments and for less innovative companies (Ebert, Brenner et al. 2019). However, when start-ups and MNEs are in the same sector and thus potential competitors on product markets, MNEs may be careful in sharing knowledge and engaging in learning relationships. Furthermore, it is less evident that the MNEs would need a start-up from the same sector as a supplier. Hence, we expect that the potential of benefiting from learning and legitimacy effects is relatively small.

H1a: The relationship between start-up performance and MNE-intensity in the same sector is negative.

In contrast, having a high intensity of MNE in related sectors should, in principle, improve the situation for start-ups in comparison to same-sector MNE-intense regional environments. The competition is potentially lower, while the potential for knowledge spillovers is higher as related sectors are expected to have the optimal degree of knowledge proximity (neither too similar nor too distant).

H1b: The relationship between start-up performance and MNE-intensity in related sectors is positive.

As regards the MNE-intensity in unrelated sectors, start-up performance is expected to be mainly shaped by the learning effects due to absence of the competition effects. Here, on the one hand, the increased cognitive distance between sectors may make it less likely that the MNEs and start-ups engage in some form of joint learning activity, and if they do, this will involve higher investment risks and uncertainty (Janssen and Frenken 2019, Fagerberg and Srholec 2022). On the other hand, unrelated variety is more likely to lead to breakthrough innovations that may have a positive impact on start-up productivity (Barbieri, Perruchas et al. 2020, Martynovich and Taalbi 2022). This means that theory cannot provide us with a hypothesis on the baseline effect as it depends on the rare event of breakthrough innovations.

Apart from the characteristics of the regional environment, we expect the relative importance of competition as well as learning and legitimacy effects to be related to start-up age and its internal skills and resources. The former plays a role because learning and legitimacy effects unfold over time. For example, it is particularly important during the initial phase after new firm formation to recruit complementary resources and increase the professionalization of new ventures (Boeker and Karichalil 2002, Hellmann and Puri 2002, Grillitsch and Schubert 2021). While employees from MNEs tend to move to other MNEs, recent research from Sweden suggests that there is also significant employment mobility of high-wage workers and managers between MNEs and start-ups (Andersson, Castellani et al. 2022), which is an essential source of learning and legitimacy building as a consequence of the start-up's co-location with MNEs. Indirectly, such moves also enhance networking between start-ups and MNEs and thereby the potential to gain MNEs as sophisticated customers, gatekeepers to international markets, or collaboration partners. However, recruiting, building relations, learning, and building legitimacy takes time, and thus we expect the beneficial effects from such processes to increase with start-up age. In contrast, we argue that the competition effects, in particular the competition for high-skilled workers, begin from the very start of an entrepreneurial venture. Hence, we derive the following hypotheses:

H2a: The effects of co-location with MNEs on start-up performance are negative for very young start-ups.

H2b: The effects of co-location with MNEs on start-up performance are positively moderated by firm age.

Finally, MNEs comprise pools of knowledge and competencies. While start-ups may possess a sophisticated knowledge base within a narrow and highly specialized field, they lack the ability to build up a broader skill and knowledge base in-house (Shane and Khurana 2003, Kor and Misangyi 2008, Politis 2008, Cafferata, Abatecola et al. 2009). Start-ups located close to MNEs have an opportunity to build ties to these firms and thereby get access to knowledge, skills and human capital not equally available to firms in less MNE-intense environments, i.e., benefit from local knowledge spillovers and labor market externalities (Duranton and Puga 2004, Grillitsch and Nilsson 2019). Not

all start-ups are however equally well-equipped to benefit from those. Pe'er and Keil (2013) find that start-ups with lower levels of total assets (resources) and an above-average quality of human capital benefit more from clusters co-location with other firms and suffer less from local competition. This points to an ability for resource-weak firms to compensate for lacking internal resources through higher absorptive capacity to internalize external knowledge. Extending this argument to the discussion above, we expect that in-house capabilities and resources of start-ups will moderate the the learning and legitimacy effects, but notthe competition effects on the start-up productivity. More specifically, we expect that start-ups will benefit more from learning and legitimacy effects from local MNE presence if they have stronger in-house capabilities and resources since MNEs tend to select collaboration partners and suppliers with strong in-house skills and resources. Thus, we arrive to our final hypothesis.

H3: The moderating effect of age is amplified by the accumulation of firm internal skill levels and capital endowments.

3 Data and identification

3.1 Data sources

We base our empirical analysis on a linked employer-employee dataset on the population of Swedish start-ups observed under period from 2007 to 2015. The data are regularly collected and provided for research purposes by Sweden's statistical office, Statistics Sweden (SCB). SCB provides various types of firm and individual-level information in different databases, which can be flexibly merged using common firm and individual identifiers. In this paper, we employ a dataset that combines data from the Register of Firms and Establishments Dynamics (FAD) that allows identification of new firms, the Database of Structural Business Statistics (FEK) and Business Register (FDB) that provide firm- and establishment-level information on profitability, growth, development, financing and production, as well Longitudinal Integrated Database for Health Insurance and Labour Market Studies (LISA) that allows constructing employment profiles of firms and establishments. Foreign-owned firms are identified using the Foreign Controlled Enterprises Register maintained by the Swedish Agency for Growth Policy Analysis (Tillväxtverket).

3.2 Identifying new firms

The identification of new firm poses an empirical challenge for researchers since not all new legal entities can be meaningfully considered new businesses (Davidsson and Wiklund 2006). The new firm identifiers in datasets may be a result of purely legal events, such as firm name changes, legal form changes, mergers and acquisitions, reorganizations in larger corporations, etc. To avoid this, we adopt an economic rather than legal interpretation of start-ups, i.e. we define new start-ups as new firms that are independent of previous organizational contexts and not part of a corporate group.

In our case, the FAD register provides information on the circumstances under which a new firm was founded, thus, allowing new firms to be identified without defining newness solely on the basis of new legal identifiers. Specifically, the FAD register identifies new firms by combining information about employment flows and the appearance of firm identification numbers over a period of two years. In line with Andersson and Klepper (2013) and Grillitsch and Schubert (2021), we identify a firm as new if all of the following conditions are met:

- The firm is identified as new according to the FAD database (except for new firms resulting from a merger).
- The firm's legal organization number did not exist in the previous year.
- The firm has only one establishment (site).
- The firm is not part of a corporate group.

3.3 Focal variables

Our dependent variable is the productivity level of a start-up, which we define as value-added per employee. The key explanatory variable is the intensity of foreign-owned MNEs in the regional employment mix[1]. To calculate this measure, we (1) identify foreign-owned firms using Foreign Controlled Enterprises Register, (2) calculate the number of employees in those firms in each region, and (3) calculate the share of employees in foreign-owned MNEs out of the total regional employment derived from the LISA database.

Further, we decompose the total MNE-intensity into three components: MNE-intensity in the same sector, in related sectors and in unrelated sectors. Sectoral belonging of start-ups and MNEs is based on the Swedish Standard Industrial Classification 2007 (SNI2007), which is the Swedish national implementation of the Statistical Classification of Economic Activities in the European Community (NACE) Rev. 2. We employ a four-digit industry level.

Following Neffke and Henning (2013), we define related industries empirically by analysing inter-industry labour flows. The departure point is that since human capital is specific, workers tend to switch to jobs where they incur fewer shortages (skills to be acquired) and smaller redundancies (skills not needed anymore) in their human capital (Neffke, Otto et al. 2017). Thus, labour flows should be larger between industries with bigger skill overlaps – or, skill-related industries. Flipping this argument, the existence of extensive labour flows between two industries signals that these industries are related.

Let F_{ijt} be an observed worker flow between industries *i* and *j* at time *t* and $\widehat{F_{ijt}}$ – an expected worker flow between them. Then the ratio values

$$s_{ijt} = \frac{F_{ijt}}{\widehat{F_{ijt}}},$$

[1] We define regions as municipalities (kommuner), which corresponds to level LAU2 in the NUTS classification.

that are significantly larger than 1 indicate that industries *i* and *j* are related[2]. This indicator has been shown to better capture industry-relatedness structures than more conventional classification-based relatedness measures (Martynovich and Taalbi 2022).

After calculating relatedness between industries, we derive regional MNE-intensities separately for a subset of MNEs belonging to the same sector as a start-up in question, within related sectors, and within unrelated sectors.

In order to analyse the moderating impact of age on the relationship between start-up productivity and regional MNE intensity, we calculate firm age in full years since the firm entry.

3.4 Control variables

We include firm-level, regional and time controls. As basic firm-level control variables x_{it} , we chose capital (physical assets per employee) and investment intensity (asset investments as a share of turnover) as a measure of capital use because productivity varies considerably with capital intensity (Mason and Osborne 2007). In addition, because capital intensity will depend on industry structure potentially determined by larger foreign-owned firms, capital intensity can easily become a confounder. We also control for the size of the firm in terms of the number of employees following ample evidence that size and productivity are systematically related (Dhawan 2001, Huergo and Jaumandreu 2004, Brouwer, De Kok et al. 2005). In addition to basic firm-level characteristics, we also include variables accounting for differences in the skill base. Notably, we use the share tertiary-educated employees and the educational diversity in the employee base, which both can be important to explain firm-level productivity (Distel, Källström et al. 2021). We also include regular year-dummies to account for remaining common time shocks. Finally, we include generic sector and region dummies, which are both necessary even using fixed-effects regression because some firms switch location or their sectoral belonging.

3.5 Identification strategy

The baseline model to test the productivity effects of regional anchors can be schematically represented by the following semi-logarithmic equation with subscripts i indicating firms, t indicating time and r indicating regions:

$$\log productivity_{itr} = \mathrm{reg\_MNE_{tr}}\gamma + x_{it}\beta + z_{tr}\theta + d_t\vartheta + u_i + e_{it} \qquad (1)$$

Here, $productivity_{itr}$ is firm-level labour productivity, $\mathrm{reg\_MNE_{tr}}$ refers to the regional MNE-intensity , x_{it} is a vector of firm-level control variables, z_{tr} a vector of regional controls, d_t is a vector of year dummies, u_i is a firm-specific fixed effect covering remaining time-invariant unobserved heterogeneity and e_{it} is a random idiosyncratic error term. This model can be consistently estimated

[2] Technical details of calculating $\widehat{F_{ijt}}$ and determining significance of s_{ijt} are presented in A1 in the online supplement.

from a random sample using a fixed effects panel data estimator, where the main interest is in the identification of the parameter γ.

To identify H1a/b, we estimate the structural model defined by Eq. (1) with variants of the regional MNE-intensity specifically differentiating between overall MNE intensity, MNE-intensity in the same sector, in related sectors, and in unrelated sectors.

To identify H2a/b we specifically, include an age moderation as follows:

$$\log productivity_{itr} = \text{reg\_MNE}_{\text{tr}}\gamma_{1age} + \text{reg\_MNE}_{\text{tr}} \cdot age_{it}\gamma_{2age} + \text{age}_{\text{it}}\gamma_{3age} + x_{it}\beta + z_{tr}\theta + d_t\vartheta + u_i + e_{it} \quad (2)$$

where the interest is now on γ_{2age}. As before, we will in Eq. (2) be differentiating between overall MNE-intensity, MNE-intensity in the same sector, in related sectors, and in unrelated sectors.

Finally, to test H3, we enrich Eq. (2) by tripple interactions using capital intensity, educational diversity in the employee base and share of tertiary educated employees as variables moderating the interaction between age and MNE-intensity. Specifically, we derive the following testable equations, where the interest is the parameter γ_{4age}.

$$\log productivity_{itr} = \text{reg\_MNE}_{\text{tr}}\gamma_{1age} + \text{reg\_MNE}_{\text{tr}} \cdot age_{it}\gamma_{2age} + \text{age}_{\text{it}}\gamma_{3age} + \text{reg\_MNE}_{\text{tr}} \cdot age_{it}\gamma_{2age} \cdot capint_{it}\gamma_{4age} + \text{capint}_{\text{it}}\gamma_{5ag} + x_{it}\beta + z_{tr}\theta + d_t\vartheta + u_i + e_{it} \quad (3a)$$

$$\log productivity_{itr} = \text{reg\_MNE}_{\text{tr}}\gamma_{1age} + \text{reg\_MNE}_{\text{tr}} \cdot age_{it}\gamma_{2age} + \text{age}_{\text{it}}\gamma_{3age} + \text{reg\_MNE}_{\text{tr}} \cdot age_{it}\gamma_{2age} \cdot eddiv_{it}\gamma_{4age} + \text{eddiv}_{\text{it}}\gamma_{5age} + x_{it}\beta + z_{tr}\theta + d_t\vartheta + u_i + e_{it} \quad (3b)$$

$$\log productivity_{itr} = \text{reg\_MNE}_{\text{tr}}\gamma_{1age} + \text{reg\_MNE}_{\text{tr}} \cdot age_{it}\gamma_{2age} + \text{age}_{\text{it}}\gamma_{3age} + \text{reg\_MNE}_{\text{tr}} \cdot age_{it}\gamma_{2age} \cdot terted_{it}\gamma_{4age} + \text{terted}_{\text{it}}\gamma_{5age} + x_{it}\beta + z_{tr}\theta + d_t\vartheta + u_i + e_{it} \quad (3c)$$

3.6 Robustness checks

The literature suggests that the presence of related economic activities in a region may impact service and manufacturing activities differently. Mameli, Iammarino et al. (2012) find that regional variety positively affects regional employment in services, but not in manufacturing. Firgo and Mayerhofer (2017) however arrive at the opposite conclusion. Bosma, Stam et al. (2011) find that related variety had a positive effect on productivity growth in manufacturing, but a slightly negative effect on productivity growth in services. Basile, Pittiglio et al. (2017) provide empirical support for a positive relationship between related variety and firm survival in manufacturing sectors, but no significant relationship in service sectors. Given previous research has presented different and even contradictory results as to the effect of regional presence of related economic activities on regional and firm-level outcomes, as a robustness check, we re-estimate the models specified in Section 3.5 separately for manufacturing and service start-ups.

Furthermore, we conduct a robustness check aimed to addresses the issue of endogenous panel attrition that makes the fixed effects estimator not robust. For this robustness check, when assuming

attrition depends on observables that change over time, it is possible to derive an attrition-consistent estimator based on the Mundlak-Chamberlain device (Wooldridge 2002, Ch. 17). This works by estimating Heckman-type of selection equations in each year to determine the probability that a firm will drop out in the next year based on observable characteristics. The Inverse-Mills-Ratio for each year alongside Mundlak-Chamberlain-correction terms are then included in pooled OLS-model with cluster-robust variances, where the whole model is estimated only on the set of firms not dropping out. Also, with this robustness check, our findings hold.

3.7 Description of the dataset

The final dataset includes 1,254,095 firm-year observations referring to a total of 496,264 firms over 2007-2015 (see Table 1). The average productivity is 367,000 SEK per employee. The average MNE-intensity is 11%, indicating that on average 11% of the regional labour force is employed by MNEs, of which 8% is employed in MNEs in unrelated sectors, 2% - in related sectors, and 1% in the same sector. Interestingly, the correlation between start-up productivity and MNE-intensity is strongest for MNEs in related sectors, while it's much weaker for MNEs in the same and unrelated sectors. Of course, this should not be interpreted as a causal effect.

Overall, an average start-up has 1.5 employees. Though, there is considerable variation, with some outliers becoming quite large over the observation period. The biggest firm in the sample has 681 employees. The firms in the sample are on average 1.6 years old, with a maximum of 8 years, when a firm was founded in 2007 and survived throughout the whole time period.

Overall, the correlations between the variables are quite low, which limits the risks of multicollinearity. This holds with the exception of the four MNE-intensity variables, which display substantially larger degrees or association. This indeed gives a strong reason not to include them simultaneously in the same regression.

Table 1: Descriptive statistics

	Variable	N	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12
1	Productivity	1254095	367000	602000	1.00	144000000	1.00											
2	Regional MNE-intensity	1254095	0.11	0.12	0.00	0.50	0.02	1.00										
3	Regional MNE-intensity (related sectors)	1254095	0.02	0.04	0.00	0.46	0.07	0.60	1.00									
4	Regional MNE-intensity (same sector)	1254095	0.01	0.04	0.00	0.39	0.00	0.39	0.05	1.00								
5	Regional MNE-intensity (unrelated sectors)	1254095	0.08	0.09	0.00	0.50	0.00	0.89	0.36	0.04	1.00							
6	Firm age	1254095	1.66	1.89	0.00	8.00	0.06	-0.04	-0.01	-0.08	-0.01	1.00						
7	Share tertiary educated employees	1254095	0.35	0.46	0.00	1.00	0.04	0.17	0.17	0.04	0.13	-0.03	1.00					
8	Educational diversity (Teachman)	1254095	0.14	0.33	0.00	2.15	0.01	0.01	0.01	0.01	0.01	0.05	-0.08	1.00				
9	Region size	1254095	156000	249000	1073.00	769000	0.03	0.83	0.58	0.23	0.75	-0.02	0.18	0.01	1.00			
10	Employees	1254095	1.50	2.32	1.00	681	0.01	0.02	0.01	0.01	0.01	0.04	-0.04	0.48	0.02	1.00		
11	Capital intensity	1254095	106000	1040000	1710000.00	556000000	0.26	-0.03	-0.03	-0.01	-0.03	0.01	-0.03	0.00	-0.03	0.00	1.00	
12	Investment intensity	1254095	0.73	2714.49	930000.00	1800000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

4 Results

4.1 Baseline models

The baseline results are presented in Table 2, where we find that without sectoral differentiation, the presence of regional MNEs does not significantly affect start-up productivity. However, this non-significance appears to be driven by divergent effects between the sectors cancelling out each other. Notably, a higher regional MNE-intensity in the same sector affects start-up productivity negatively, while it has positive effects when referring to related sectors. There is no significant effect of the MNE-intensity in unrelated sectors. These contrasting findings are in line with our reasoning that the local MNE presence may cause both negative and positive effects depending on the relative weight of competition effects on one side and learning and legitimacy effects on the other. In line with H1a, the negative effects outweigh the positive ones for start-ups in the same sector as the MNE, while the opposite holds true if the MNEs are in related sectors (confirming H1b).

Table 2: The effects of MNE-intensity of productivity (fixed effects)

	(1) Log productivity	(2) Log productivity	(3) Log productivity	(4) Log productivity
Regional MNE-intensity	-0.0169			
	(0.0281)			
Regional MNE-intensity (same sector)		-0.2363***		
		(0.0383)		
Regional MNE-intensity (related sectors)			0.3697***	
			(0.0669)	
Regional MNE-intensity (unrelated sectors)				0.0459
				(0.0284)
Firm age	0.0536***	0.0512***	0.0529***	0.0533***
	(0.0007)	(0.0008)	(0.0007)	(0.0007)
Share tertiary educated employees	0.0531***	0.0530***	0.0530***	0.0531***
	(0.0081)	(0.0081)	(0.0081)	(0.0081)
Educational diversity (Teachman)	-0.3821***	-0.3820***	-0.3821***	-0.3821***
	(0.0051)	(0.0051)	(0.0051)	(0.0051)
Employees	-0.0336***	-0.0336***	-0.0336***	-0.0336***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
Capital intensity	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Investment intensity	-0.0000	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Log region size	0.0177***	0.0184***	0.0126***	0.0150***
	(0.0026)	(0.0020)	(0.0021)	(0.0023)
Constant	11.8833***	11.8890***	11.9354***	11.9078***
	(0.0316)	(0.0285)	(0.0296)	(0.0302)
Year dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	1254095	1254095	1254095	1254095
Number of firms	496264.0000	496264.0000	496264.0000	496264.0000
R2	0.0291	0.0291	0.0291	0.0291
Share of firm-level unobserved heterogeneity	0.7752	0.7751	0.7750	0.7752

Standard errors in parentheses Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2 Moderation effects

Concerning the moderation effects in H2a/b, we argued that the negative effects are likely to have a greater effect on younger start-ups as compared to relatively more mature and established firms, even within the

cohort of start-up firms investigated here. We test this by including an interaction term for start-up age. The are found in Table 3. For the model without sectoral differentiation (column 1), we confirm both hypothesis H2a – since the coefficient for regional MNE-intensity at age 0 is negative and significant – and H2b – since the interaction effect is positive and significant. The result also holds for MNEs in the same and unrelated sectors. Interestingly, this means that when including an age interaction effect, the overall regional MNE-intensity and MNE-intensity in unrelated sectors become significant variables. In fact, the interaction effect has approximately the same size for regional MNE-intensity in the same sector (column 2) and regional MNE-intensity in unrelated sectors (column 4). The difference lies in the magnitude of the negative effect of regional MNE-intensity at age 0, which is about double for regional MNE-intensity in the same sector, which could be explained by a higher competition effect in the same sector. Somewhat surprisingly the interaction effect is negative but not significant for the regional MNE-intensity in related sectors. At age 0, the effect of regional MNE-intensity is positive for productivity of start-ups in related sectors, which is in line with H1b. However, the results suggest that the balance between competition and learning effects is not changing over time.

Table 3: The effects of MNE-intensity of productivity with firm-age moderations (fixed effects)

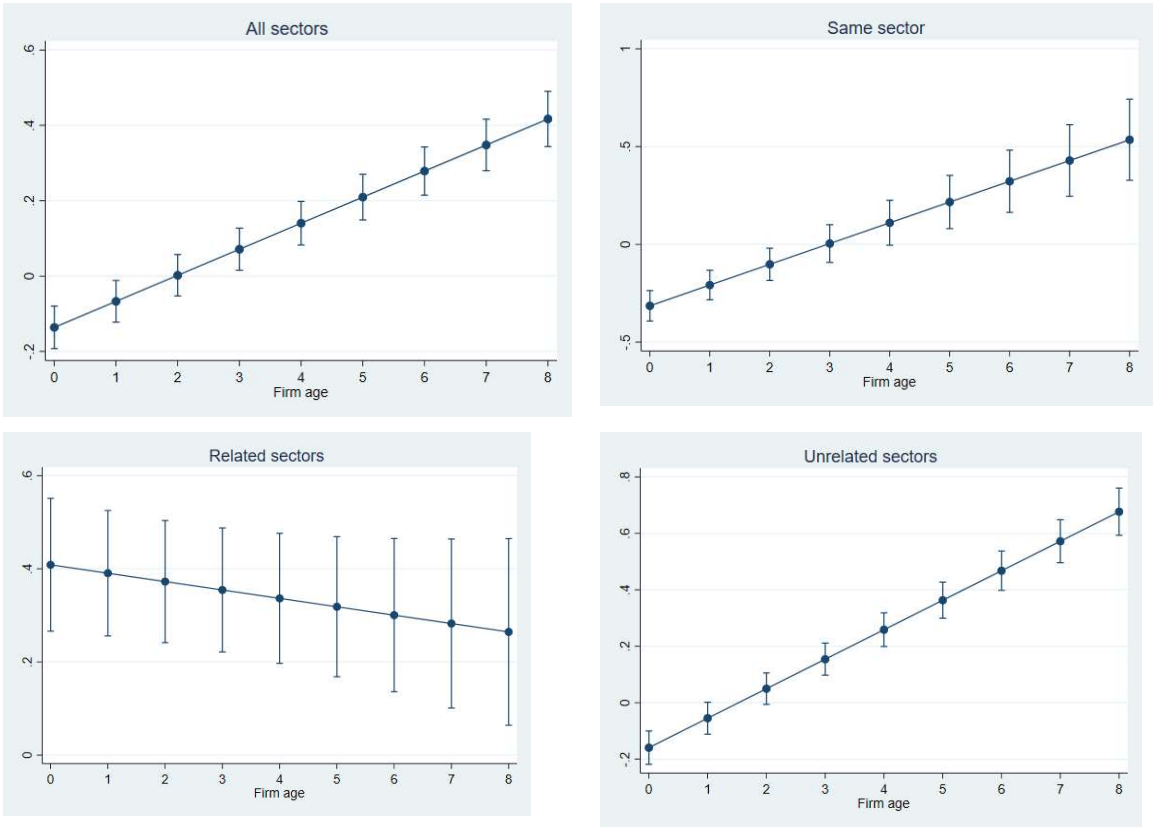
	(1) Log productivity	(2) Log productivity	(3) Log productivity	(4) Log productivity
Regional MNE-intensity	-0.1362***			
	(0.0289)			
Regional MNE-intensity # Firm age	0.0692***			
	(0.0039)			
Regional MNE-intensity (same sector)		-0.3142***		
		(0.0396)		
Regional MNE-intensity (same sector) # Firm age		0.1061***		
		(0.0136)		
Regional MNE-intensity (related sectors)			0.4086***	
			(0.0727)	
Regional MNE-intensity (related sectors) # Firm age			-0.0180	
			(0.0132)	
Regional MNE-intensity (unrelated sectors)				-0.1592***
				(0.0302)
Regional MNE-intensity (unrelated sectors) # Firm age				0.1045***
				(0.0052)
Firm age	0.0462***	0.0493***	0.0531***	0.0467***
	(0.0008)	(0.0008)	(0.0007)	(0.0008)
Share tertiary educated employees	0.0516***	0.0529***	0.0531***	0.0512***
	(0.0081)	(0.0081)	(0.0081)	(0.0081)
Educational diversity (Teachman)	-0.3817***	-0.3818***	-0.3821***	-0.3819***
	(0.0051)	(0.0051)	(0.0051)	(0.0051)
Employees	-0.0338***	-0.0337***	-0.0336***	-0.0337***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
Capital intensity	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Investment intensity	-0.0000	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Log region size	0.0157***	0.0176***	0.0126***	0.0137***
	(0.0026)	(0.0020)	(0.0021)	(0.0023)
Constant	11.9173***	11.9010***	11.9346***	11.9297***
	(0.0316)	(0.0285)	(0.0296)	(0.0303)
Year dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	1254095	1254095	1254095	1254095
Number of firms	496264.0000	496264.0000	496264.0000	496264.0000
R2	0.0295	0.0292	0.0291	0.0296

Share of firm-level unobserved heterogeneity	0.7752	0.7751	0.7750	0.7752

Standard errors in parentheses, $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

The effects of regional MNE-intensity on firm performance at different values of firm age are most easily seen in the visualization of the moderation effect in Figure 1. Indeed, the baseline effect at age zero is lowest for MNE intensity in the same sector, followed by unrelated sectors. For the same sector, the aggregate effects turn positive at an age of about 3 years. For unrelated sectors it takes about 1.5 years for the aggregate effects to turn positive. For related sectors the effects are always positive. Thus, in summary, we can corroborate H2, for the same sector as well as related sectors.

Figure 1: Visualizations of the firm-age moderations (marginal effects)



Finally, turning to H3, we argued that the accumulation of firm internal resources is likely to be an important driver of the age moderation effects. This argument suggests the existence of a positive triple moderation between regional MNE intensity, firm age, and tangible and intangible firm internal resources. In Table 4, we present the main regression results. We find our results corroborated for capital intensity (column 1) and educational diversity of the employees (column 2). However, the effect is negative for the share of employees with tertiary education (column 3), even though at a lower level of statistical significance. A visual representation can be found in Figure 2, where we depict the marginal effects of regional MNE-intensity for different values of age and separated by values for moderators at their empirical minima, means and maxima. Because for capital intensity and educational diversity, marginal effects differ for empirical minima and maxima for all age values, we can corroborate H3 for these two variables. As regards the share of tertiary educated employees, marginal effects at minima, means, and maxima overlap, which

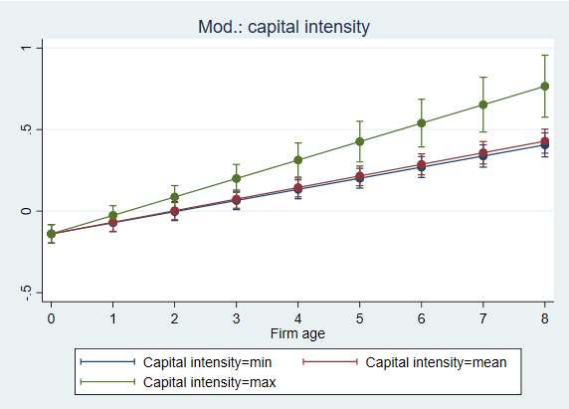
indicates that the negative effect is comparably small. Nonetheless, we cannot corroborate H3 for this variable.

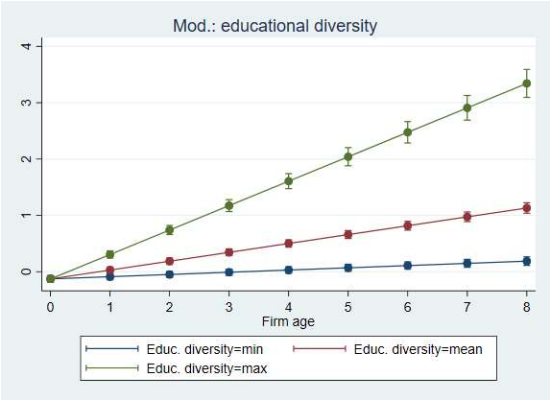
Table 4: The effects of MNE-intensity of productivity with tripple moderations (fixed effects)

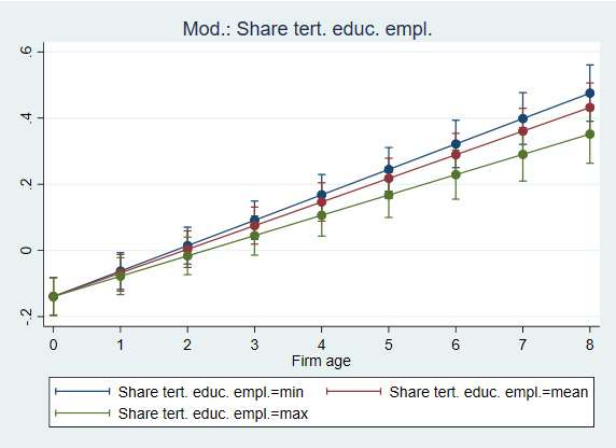
	(1) Log productivity	(2) Log productivity	(3) Log productivity
Regional MNE-intensity	-0.1392***	-0.1278***	-0.1391***
	(0.0289)	(0.0289)	(0.0289)
Regional MNE-intensity # Firm age	0.0682***	0.0394***	0.0768***
	(0.0039)	(0.0041)	(0.0049)
Regional MNE-intensity # Firm age # Capital intensity	0.0000***		
	(0.0000)		
Regional MNE-intensity # Firm age # Educational diversity (Teachman)		0.1843***	
		(0.0076)	
Regional MNE-intensity # Firm age # Share tertiary educated employees			-0.0155**
			(0.0059)
Firm age	0.0461***	0.0469***	0.0460***
	(0.0008)	(0.0008)	(0.0008)
Share tertiary educated employees	0.0517***	0.0520***	0.0553***
	(0.0081)	(0.0081)	(0.0082)
Educational diversity (Teachman)	-0.3816***	-0.4221***	-0.3818***
	(0.0051)	(0.0054)	(0.0051)
Employees	-0.0338***	-0.0378***	-0.0338***
	(0.0013)	(0.0013)	(0.0013)
Capital intensity	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)
Investment intensity	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)
Log region size	0.0159***	0.0154***	0.0158***
	(0.0026)	(0.0026)	(0.0026)
Constant	11.9160***	11.9286***	11.9151***
	(0.0317)	(0.0316)	(0.0317)
Year dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Observations	1254095	1254095	1254095
Number of firms	496264.0000	496264.0000	496264.0000
R2	0.0295	0.0302	0.0295
Share of firm-level unobserved heterogeneity	0.7753	0.7762	0.7753

Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 2: Visualizations of the triple moderations (marginal effects)







4.3 Sectoral heterogeneity

Table 5 presents the results of estimating the baseline models separately for manufacturing and service start-ups. It appears that the relationship that we observe between productivity and regional MNE-intensity is only driven by the service sector firms. For all types of regional MNE-intensity, the relationship with the productivity of manufacturing firms is insignificant. This holds both for high-tech and low-tech manufacturing[3].

When it comes to the service sector, the results replicate those that we observed for all start-ups in Table 2. This comes as no surprise given that the number of service start-ups is 16 times higher than those in the manufacturing sector. It should be mentioned, however, that within the service sector, a positive relationship between productivity and regional MNE-intensity holds for knowledge-intensive start-ups, while it disappears for less knowledge-intensive ones[4]. A plausible explanation is that the learning and legitimacy effects are relevant mainly for knowledge-intensive start-ups.

Table 5. Sectoral heterogeneity: baseline models (fixed effects)

(a) manufacturing

	(1) Log productivity	(2) Log productivity	(3) Log productivity	(4) Log productivity
Regional MNE-intensity	0.0452			
	(0.1353)			
Regional MNE-intensity (same sector)		0.2148		
		(0.1885)		
Regional MNE-intensity (related sectors)			-0.5491	
			(0.4162)	
Regional MNE-intensity (unrelated sectors)				-0.0076
				(0.1370)
Firm-level controls	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	55640	55640	55640	55640
Number of firms	21124.0000	21124.0000	21124.0000	21124.0000
R2	0.0334	0.0334	0.0335	0.0334
Share of firm-level unobserved heterogeneity	0.7996	0.7995	0.7998	0.7996

[3] See the online supplement

[4] See the online supplement

(b) services

	(1) Log productivity	(2) Log productivity	(3) Log productivity	(4) Log productivity
Regional MNE-intensity	-0.0108			
	(0.0324)			
Regional MNE-intensity (same sector)		-0.1900***		
		(0.0440)		
Regional MNE-intensity (related sectors)			0.3005***	
			(0.0720)	
Regional MNE-intensity (unrelated sectors)				0.0321
				(0.0327)
Firm-level controls	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	885769	885769	885769	885769
Number of firms	358533.0000	358533.0000	358533.0000	358533.0000
R2	0.0339	0.0339	0.0339	0.0339
Share of firm-level unobserved heterogeneity	0.7770	0.7769	0.7768	0.7770

Analyzing the interaction between regional MNE-intensity and start-up age provides additional qualification to these results (Table 6).

Table 6. Sectoral heterogeneity: regression with firm age moderations (fixed effects)

(a) manufacturing

	(1) Log productivity	(2) Log productivity	(3) Log productivity	(4) Log productivity
Regional MNE-intensity	0.0318			
	(0.1418)			
Regional MNE-intensity # Firm age	0.0066			
	(0.0206)			
regMNEsame_size		0.2193		
		(0.1978)		
regMNEsame_size # Firm age		-0.0044		
		(0.0586)		
Regional MNE-intensity (related sectors)			-0.4303	
			(0.4801)	
Regional MNE-intensity (related sectors) # Firm age			-0.0425	
			(0.0857)	
Regional MNE-intensity (unrelated sectors)				-0.0475
				(0.1461)
Regional MNE-intensity (unrelated sectors) # Firm age				0.0197
				(0.0252)
Firm age	0.0435***	0.0458***	0.0451***	0.0431***
	(0.0034)	(0.0034)	(0.0031)	(0.0033)
Firm-level controls	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	55640	55640	55640	55640
Number of firms	21124.0000	21124.0000	21124.0000	21124.0000
R2	0.0334	0.0334	0.0335	0.0334
Share of firm-level unobserved heterogeneity	0.7995	0.7995	0.7997	0.7995

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(b) services

	(1) Log productivity	(2) Log productivity	(3) Log productivity	(4) Log productivity
Regional MNE-intensity	-0.0703*			
	(0.0333)			
Regional MNE-intensity # Firm age	0.0363***			
	(0.0045)			
regMNEsame_size		-0.2228***		
		(0.0453)		
regMNEsame_size # Firm age		0.0491**		
		(0.0163)		
Regional MNE-intensity (related sectors)			0.5555***	
			(0.0779)	
Regional MNE-intensity (related sectors) # Firm age			-0.1213***	
			(0.0141)	
Regional MNE-intensity (unrelated sectors)				-0.1133**
				(0.0347)
Regional MNE-intensity (unrelated sectors) # Firm age				0.0763***
				(0.0061)
Firm age	0.0561***	0.0574***	0.0620***	0.0549***
	(0.0010)	(0.0010)	(0.0009)	(0.0009)
Firm-level controls	Yes	Yes	Yes	Yes
Regional controls	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Observations	885769	885769	885769	885769
Number of firms	358533.0000	358533.0000	358533.0000	358533.0000
R2	0.0340	0.0340	0.0341	0.0342
Share of firm-level unobserved heterogeneity	0.7770	0.7769	0.7767	0.7770

For manufacturing firms, the findings of the baseline models stand: there is no significant relationship neither with regional MNE-intensity of any kind nor with regional MNE-intensity-age interactions. So, the overall results for all start-ups are only driven by the service sector.

For the service sector, there is one additional qualification to the results: the interaction between age and related MNE intensity is now negative and strongly significant (as compared to insignificant for all firms, Table 3). The results suggest that over time the balance between negative competition effects and positive learning and legitimacy effects shifts in the case of regional MNE-intensity in related sectors, to the extent that they become negative after 5 years of start-up age. This is a rather surprising result. One interpretation could be that MNEs are increasingly poaching labor from related start-ups as they get older. That is, older firms make less use of the presence of MNEs in related sectors, which mitigates negatively the overall positive relationship between MNE presence in related sectors in service firms' productivity.

6. Conclusions

In this paper, we investigated the effects of MNEs on the performance of start-ups. MNEs and start-ups are important actors in regional innovation ecosystems, but little is known about the interdependencies between these two types of actors. We thus elaborate the argument that MNEs have both negative competition effects (e.g., for labor) and positive learning and legitimacy effects (e.g., as first/reference customer) for co-located start-ups. The overall effect of MNEs on the start-ups' performance will depend on the relative importance of the negative and positive effects, which is why the mechanisms through which this balance is moderated are of crucial importance. We argue that this depends on the age of the start-ups because learning and legitimacy effects take time to materialize while competition effects are present from the establishment of start-ups. Furthermore, we argue that the learning and legitimacy effects (and thus

the age moderation) should increase with the in-house capabilities and resources of start-ups. We also consider that the relative importance of competition and learning and legitimacy effects differ between the skill-relatedness of MENs and start-ups. Are those in the same sector, the negative competition effects should tend to be larger while the learning and legitimacy effects should tend to be smaller than if they are not in the same but related sectors.

Overall, our empirical results covering the population of Swedish start-ups and MNEs corroborate these theoretical arguments. Start-up performance tends to be negatively affected by local MNE presence, which we attribute to the competition effects, but becomes positive over time, which we relate to the gradually increasing learning and legitimacy effects. Furthermore, the effects are overall negative if the MNEs are in the same sector as the start-ups while they are positive if the MNEs are in related sectors. This indicates that the competition effects outweigh within the same sector outweigh the positive learning and legitimacy effects.

There are also some additional and more detailed observations. Firstly, the results in Sweden are solely driven by start-ups in the service sector. We do not have a convincing theoretical explanation at hand for this result. Second, we found a surprising result when differentiating the age effect by relatedness of the co-located MNEs. We found that age is positively moderating the effect of MNEs on start-up performance if they are in the same sector or unrelated sectors, while the moderating effect is negative if they are in related sectors. This is surprising as it would suggest that the competition effects are increasingly becoming more important than the learning and legitimacy effects when MNEs are in related sectors. A potential explanation for why competition for labor would intensify with the age of the start-up could be related to the increasing attractiveness of employees from related start-ups as they age (increasing labor poaching from MNEs), while related start-ups might find it difficult to recruit in a growth process.

The implications of these findings have relevance for innovation and entrepreneurship policy. It suggests that significant MNE presence may be an obstacle in the formation and initial growth phase of start-ups This is theoretically plausible because of competition effects, which include opportunity costs on the labor market where MNEs typically offer relatively more attractive jobs than new startups. In other words, entrepreneurial dynamics may be negatively affected by MNE presence Over time, however, MNE density appears to become a resource for start-ups. Against this backdrop, policy could improve the conditions and provide incentives, especially in the period of establishment and first years of start-up existence. It could directly link to the competition effects with measures that make, for instance, employment in start-ups more attractive, while also addressing the learning and legitimacy effects with incentives to MNEs to engage with local start-ups, e.g. as collaboration and innovation partner or first customer.

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