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Are all startups affected similarly by clusters? Agglomeration, competition, firm heterogeneity, and survival

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ABSTRACT

Are all startups similarly affected by the survival benefits and drawbacks of locating in geographic clusters? In this paper, we argue that prior theorizing may have missed important contingencies that affect whether a startup experiences the benefits and costs of locating in a cluster. In particular, while the local levels of skilled labor, suppliers, and purchasers have a beneficial influence and local competition has a detrimental influence on startup survival, these relationships are moderated by heterogeneity in firms' resources and capabilities. We find support for these arguments using a dataset covering the early life of all independent startups in the Canadian manufacturing sector from 1984 to 1998.

1. Executive summary

Economic activity tends to be concentrated in specific geographic locations often referred to as clusters. These clusters also attract the majority of new startups. At the same time, startups in clusters experience the highest failure rates. Prior research has explained this surprising pattern by arguing that clusters provide distinct benefits and drawbacks for startups. We know relatively little, however, about whether startups in clusters are all equally likely to experience these effects. To address this gap in our knowledge, we develop arguments on the mechanisms that provide survival benefits and drawbacks and show how these effects are contingent upon a startup's early resources and capabilities. Then we test our arguments using a dataset that covers all independent startups with at least one employee in the Canadian manufacturing sector from 1984 to 1998.

Our research suggests that clusters can enhance the survival of startups through three distinct mechanisms:

1. Startups may find recruiting easier because clusters attract a higher number of skilled employees.
2. Startups may find a larger number of specialized suppliers to work with, allowing them to focus their own activities.
3. A larger number of customers may be attracted to clusters, thereby enabling a startup to form initial customer relationships more easily.

However, clusters may also have detrimental effects on survival, in particular when a large number of relatively small competitors may create a high level of rivalry, thereby offsetting the advantages of agglomeration.

Our central finding in this paper is that these benefits and drawbacks do not affect all startups equally. Rather, startups that possess below-average resources compared to their competitors benefit more from clusters. Improved access to labor, suppliers,

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and purchasers may allow these less endowed startups to compensate for the lack of internal resources. Contrary to our expectations, firms with below-average resources also suffer less from high local levels of competition. This result suggests that resource endowments may not only provide advantages but can also create constraints for startups; for instance, hampering their ability to adapt and learn. For capabilities, a different pattern emerges. Firms with an above-average quality of human capital benefit more from the advantages of clusters. High-quality human capital allows them to leverage the availability of employees, suppliers, and purchasers to their advantage. These firms also suffer less from local competition because the quality of human capital is central to building other capabilities and developing the ability to withstand competition.

Our results have important implications for the theory and practice of entrepreneurship. For scholars of entrepreneurship, our results suggest the need to further integrate the resource-based view of strategic management with the literature on economic agglomeration. Empirical evidence on the performance implications of locating in densely populated clusters has been mixed at best. Our findings suggest that firm-level differences in resources and capabilities may explain some of these mixed findings. For entrepreneurs, our results point to choice of location as one of the most important strategic decisions in the early life of a new venture. Entrepreneurs need to know how to match the opportunities and challenges of a specific location with the resources and capabilities of a young firm. They are further advised to focus on building resources and capabilities that allow them to leverage the benefits provided by their specific location and to shield them from its drawbacks.

2. Introduction

Most economic activity is concentrated in space. In many industries, the majority of production is concentrated in a few geographic clusters that also attract the majority of new entry by independent ventures (Dumais et al., 2002; Rosenthal and Strange, 2003; Stuart and Sorenson, 2003). Well-known examples of agglomeration include the high-tech clusters in the Silicon Valley and around Route 128 in the US (e.g., Saxenian, 1994), the textile cluster in the Emilia-Romagna region in Italy (e.g., Dunford, 2006), and the machinery and automotive cluster in Baden–Württemberg in Germany (Cooke and Morgan, 1994). But are all startups in such regions equally likely to experience the benefits and drawbacks of locating in such geographic clusters?

Prior research does not provide a conclusive answer to this question. On the one hand, the early literature on agglomeration has emphasized important benefits of locating in clusters, such as sharing inputs whose production is more efficient due to increases in scale (Carlton, 1983; Krugman, 1991), labor market pooling and a better match between an employee's specialized skills and an employer's needs (Helsley and Strange, 1991), and spillovers of technology and knowledge (Porter, 1998; Saxenian, 1994; Zucker et al., 1998). On the other hand, empirical evidence on the performance implications of locating in densely populated clusters is mixed at best, as a recent review by McCann and Folta (2008) underlines. While a number of studies in industries such as hotels, manufacturing, and high-tech find that agglomeration has a beneficial effect on firm performance (e.g., Baptista and Swann, 1998; Chung and Kalnins, 2001; DeCarolis and Deeds, 1999; Folta et al., 2006; Visser, 1999), other studies point to detrimental effects, and in particular to lower survival rates among new entrants in clusters (e.g., Shaver and Flyer, 2000; Sorenson and Audia, 2000; Sorensen and Sorenson, 2003; Stuart and Sorenson, 2003). More importantly, some studies have suggested that performance effects may vary with characteristics of the entrant (Canina et al., 2005; McCann and Folta, 2011; Shaver and Flyer, 2000). This suggests that prior theorizing may be missing important contingencies that affect whether a startup experiences the benefits and drawbacks of locating in a cluster.

In this paper, we address this gap in the literature by developing and testing theoretical arguments on how firm heterogeneity influences the effects of location in clusters on the survival of startups. Our base argument is that the level of local skilled labor, the level of specialized suppliers, and the level of local purchasers have beneficial effects on the survival of startups, while the level of local competition has detrimental effects. We then argue that the level of resources and capabilities held by a startup affects whether the firm is likely to gain from the beneficial effects and suffer from the detrimental effects of agglomeration. In particular, we argue that a startup's level of total assets compared to competitors (a financial proxy for the firm's endowment with tangible and intangible resources; see Villalonga, 2004; Alcacer and Chung, 2007) weakens the benefit from the local levels of skilled labor, specialized suppliers, and purchasers and also weakens the detrimental effects of local competition. We further expect that the quality of human capital of a firm relative to its competitors (a proxy for a startup's competencies) strengthens the beneficial effects of local levels of suppliers and purchasers and reduces the detrimental effects of competition. To examine the above issues, we employ a novel dataset that covers all independent startups with at least one employee in the Canadian manufacturing sector from 1984 to 1998 and find broad support for most of our predictions.

Our study makes several contributions to the literature. First, we make a theoretical contribution to the agglomeration literature by showing that the survival effects of locating in a cluster are contingent upon endowment with resources and capabilities. Second, we make an empirical contribution by unpacking the mechanisms underlying agglomeration and showing their distinct effects on survival at the firm level. Third, our unique dataset also allows us to address a number of the methodological shortcomings of prior agglomeration studies (McCann and Folta, 2008). Finally, our study adds to the broader literature on new market entry, which has frequently focused on diversifying entrants by developing and testing arguments specifically focusing on startups.

3. Theoretical framework and hypotheses

Our overarching argument, depicted below in Fig. 1, is that agglomeration provides both benefits and drawbacks to startups that locate in a cluster but that the impact of these effects on survival is moderated by firm-level endowment with resources and

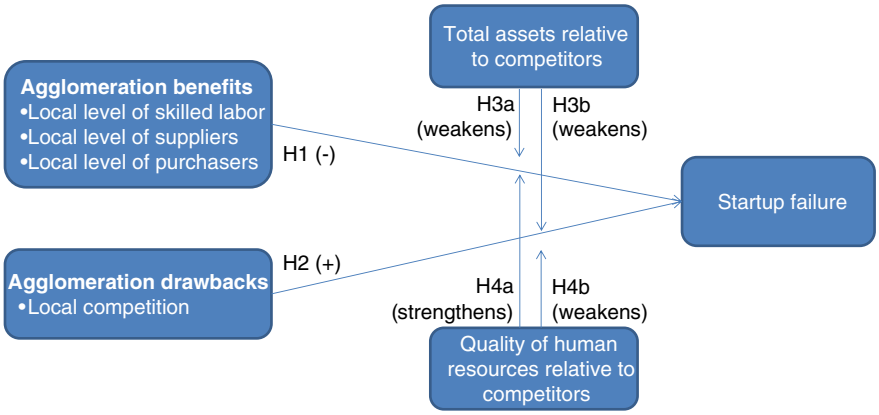

Fig. 1. Conceptual model.

capabilities. Following the established literature on agglomeration (McCann and Folta, 2008; Rosenthal and Strange, 2006) but opening up the distinct theoretical mechanisms, we next develop hypotheses for the beneficial effects of (1) the level of local skilled labor, defined here as the number of employees within an economic area and focal industry relative to the nationwide number of employees in that industry; (2) the level of specialized suppliers, defined here as the number of suppliers to a focal industry within an economic area, weighted by the importance of the focal industry to these suppliers; and (3) the level of purchasers, defined as the number of customers of a focal industry located in the same economic area, weighted by the importance of the focal industry to these customers. Next we examine the detrimental effects of the local level of competition, which we define in line with prior studies of agglomeration in an inverse employment-based Herfindahl–Hirschman Index (e.g., Pe'er et al., 2008). We then introduce the moderating effects of total assets and the firm's quality of human capital compared to competitors.

3.1. Local level of skilled labor, specialized suppliers, and purchasers and their effects on failure

3.1.1. Local level of skilled labor

As early as 1920, Marshall identified the availability of skilled labor as one of the benefits of agglomeration. Clusters may create a pooled labor market for employees with specialized skills that provides a variety of benefits for both the employees and the firms that hire them. In a cluster, both employees and hiring firms face lower search costs. For instance, in the Silicon Valley, the proximity of numerous IT firms and a large pool of highly qualified programmers make it easy for a firm to find qualified employees, but also for an employee to find employment in the industry. This availability of multiple options for employer and employee should also increase the quality of the match between them (Helsley and Strange, 1991). The multiplicity of employment opportunities in clusters should further decrease the employment risk for employees, as alternative opportunities exist, compared to a location with a low number of firms in the industry, where a hiring firm may have to pay a risk premium (David and Rosenbloom, 1990).

In addition to facilitating the formation of employment relationships, agglomeration may also have a beneficial effect on the productivity of employees. For instance, in clusters such as Silicon Valley or Route 128, engineers may learn the tricks of the trade from informal interactions with other engineers in the same location. In addition to productivity benefits from informal spillovers of knowledge, in clusters employees may also be more willing to invest in industry-specific human capital because they may have a greater ability to appropriate the benefits, but also because they may face competition from other qualified employees (Rotemberg and Saloner, 2000), which further enhances their value to recruiting firms. We hypothesize:

Hypothesis 1a. The local level of skilled labor is negatively related to the likelihood of the failure of startups.

3.1.2. Local level of specialized suppliers

In addition to employee pools, agglomeration may also create a pool of specialized suppliers that make it easier for startups to secure the necessary inputs (Marshall, 1920). In a cluster with a large number of suppliers, at least some suppliers will specialize, thereby further increasing the likelihood of finding the inputs that might be necessary for startups that follow a niche strategy. For instance, Folta et al. (2006) described a wide range of specialized inputs — including universities, distributors, specialized consulting, market research, testing services, and even specialized angel investors or venture capitalists — that are germane in high-technology clusters. A high level of local suppliers and services may create opportunities for outsourcing and subcontracting. Local subcontracting provides the means for achieving flexible and lean production that avoids the rigidities of vertically integrated production (Glaeser et al., 2010). For example, it reduces transportation costs, which allows firms to adopt a variety of logistical improvements, such as “just-in-time” production policies. Local subcontracting also permits startups to specialize while

benefiting from economies of scale with lower expansion of production capacity. The thicker local market for inputs in dense clusters of suppliers therefore improves matching opportunities between specialized suppliers and buyers of intermediate inputs. In addition, local subcontracting often allows higher-wage firms to cut labor costs by contracting out some of their activities to lower-wage producers (mainly for unskilled, labor-intensive tasks). Piore and Sabel (1984), for example, described a system of specialization among firms in clusters that is based on value-added chains and vertical contacts where each firm provides a specialized activity for a single stage of production. High levels of local suppliers reduce the search, transaction, transportation, coordination, and monitoring costs of subcontracting, resulting in improved performance. Startups operating in clusters of suppliers are provided with a variety of strategic options to substitute for internal growth by relying on external resources and capabilities, including outsourcing and collaboration. The extent to which suppliers are considered direct competitors can further reduce the costs of factor inputs and outsourcing. An abundance of local suppliers also facilitates collaborations, partnerships, and spillovers, since transfer of (tacit) knowledge is improved by immediate physical adjacency and frequent social interactions between parties (Aharonson et al., 2007; Audretsch and Feldman, 1996; Rosenthal and Strange, 2003). Finally, a higher density of suppliers increases the opportunities to specialize and outsource parts of operations that might be beyond the expertise of the startup. We hypothesize:

Hypothesis 1b. The local level of specialized suppliers is negatively related to the likelihood of the failure of startups.

3.1.3. Local level of purchasers

In addition to a high level of specialized suppliers, a geographic location exhibiting agglomeration may also be characterized by a high local level of purchasers. In fact, a high level of purchasers may in many circumstances be the initial factor that attracts firms in a focal industry to a specific location. For instance, the concentration of machinery companies in Baden–Württemberg has attracted the formation of startups that supply these companies.

A high density of customers in the same location provides several advantages to a startup. The higher the density of customers, the more likely it is that startups will be able to secure the first customers that are central to a firm's survival. Locating in a dense cluster of purchasers increases the opportunities for a startup to utilize social and professional ties to increase its visibility and legitimacy and thus reduce the liabilities of smallness and newness (e.g., Audia et al., 2006; Delmar and Shane, 2004). A higher density also increases the likelihood of differentiated customer needs and will therefore make niche strategies more feasible. Customers are frequently an important source of knowledge for startups (Yli-Renko et al., 2001). Yet access to this knowledge frequently requires intense interaction, which is facilitated by geographic proximity. In addition, in many sectors, proximity allows for partnerships with customers (e.g., collaboration between the design teams of clients and suppliers), as well as customization. Partnering with purchasers may provide access to their complementary tangible and intangible assets, including financial assets, marketing efforts, human capital, R&D investments, and reputation. High geographic concentration of customers plays an even more important role in industries where purchasers are less willing (or able) to travel (Baum and Haveman, 1997; Kalnins and Chung, 2004) or products have a high degree of heterogeneity (Fischer and Harrington, 1996), as well as in industries sensitive to transportation costs (e.g., perishable output). Taken together, we hypothesize:

Hypothesis 1c. The local level of purchasers is negatively related to the likelihood of the failure of startups.

3.2. Effects of local competition on failure

Most literature on agglomeration has focused on the benefits of locating in clusters, often ignoring the potentially substantial cost and risks for a startup of being located in proximity to direct competitors (Baum and Mezias, 1992; Folta et al., 2006; Shaver and Flyer, 2000; Sorenson and Audia, 2000). Although the co-location of firms in the same sector might attract customers, skilled employees, and specialized suppliers to a geographic location, co-located firms in the same industry may also directly compete with a focal firm for those very customers, skilled employees, and specialized suppliers that their presence attracts.

In fact, research in traditional economics (e.g., Hotelling, 1929; Porter, 1980; Schmalensee, 1978) and organization ecology (e.g., Baum and Mezias, 1992; Carroll and Hannan, 2000; Greve, 2000; Sorenson and Audia, 2000) has suggested that localized competition may reduce the performance of a focal firm. For instance, economic theory of pricing (e.g., Schmalensee, 1978) suggests that even when competition is not locally constrained, as is typical in manufacturing industries, firms located in proximity compete more strongly on price than do firms that are located at a distance, given, for instance, the higher visibility of competitors' actions. While competitive effects on prices may over time spread across the whole industry, they are felt most strongly in the close proximity of a focal firm. Organizational ecology has extended this argument, suggesting that high levels of local density may negatively affect the survival prospects of a focal firm. Firms in near proximity will compete for employees and specialized suppliers and in the output market, and according to Carroll and Hannan (2000), "intense competition causes supply of potential organizers, members, patrons, and resources to become exhausted" (p. 226).

Central to this argument is the *ceteribus paribus* assumption. Most research on agglomeration analyzes the aggregate effect of agglomeration where a larger number of competitors may over time attract additional employees, suppliers, or customers. Here, however, we hypothesize the effect of *differences* in the number of same-sector firms in a region, holding constant the effects of other factors we hypothesize separately. Therefore, with a given number of purchasers in a firm's proximity, a larger number of competitors may allow these customers to conveniently compare the offerings of the focal sector firms and leverage them against

one another in negotiations. A startup that faces a large number of local competitors may find it harder to enter into close relationships with purchasers in the vicinity. Such effects should be particularly pronounced when product markets are geographically constrained (Baum and Mezias, 1992), when there are significant transportation costs (Henderson, 2003), or when goods are perishable (Rosenthal and Strange, 2003).

Similarly, if we hold the number of suppliers and employees constant on the input side, specialized suppliers and employees may find a higher geographical density of same-sector firms an advantage because it reduces their dependence on any one of them and improves their bargaining position vis-à-vis the firms in the cluster (Porter, 1980). In addition, workers and suppliers are incentivized to invest in acquiring valuable skills because, with a larger number of focal sector firms, the likelihood of finding a match for a specific skill (i.e., a focal firm willing to purchase or employ) increases. In other words, with the same number of skilled employees or specialized suppliers, a cluster with 50 firms provides a higher probability for a match between the unique skills of employees or suppliers and the exact needs of a firm than does a cluster with 20 firms. Understanding the value they create in a good match, skilled employees and suppliers are in a better position to negotiate a larger share of the surplus.

In the presence of a large number of relatively smaller firms, employees may find it easier to increase salaries by changing jobs frequently (Glaeser et al., 1992). In clusters like Silicon Valley, engineers have been reported to hop from job to job in a matter of months. Further corroborating this argument, average salaries have been found to be significantly higher in centers of economic activity (Glaeser and Mare, 2001). Moreover, firms in clusters provide less training than their more isolated counterparts (Almazan et al., 2007). This may explain the numerous instances of successful firms sometimes strategically locating away from industrial clusters. Microsoft located in Seattle, which was not a cluster for the software industry, while Bank of America and Wachovia have their headquarters in North Carolina, Dell in Texas, and Gateway in San Diego. Anticipating that workers and specialized suppliers can sell their skills for a premium in a competitive market, firms may choose isolation. Manes and Andrews (1994) describe the central role that labor markets played in Microsoft's location decision: “Paul Allen increasingly argued for a move back to familiar Seattle turf. Hiring might be simpler in Silicon Valley, but keeping employees would clearly be harder, a major consideration in a business where the primary assets walk out of the door every night” (p. 120).

The high level of employee mobility in clusters, and the relatively strong bargaining position of specialized suppliers, may make it more difficult for any firm to maintain advantages from innovations, improvements, and knowledge, as these may involuntarily disseminate to other local firms through imitation, spying, and inter-firm mobility of skilled employees (Shaver and Flyer, 2000). Co-location with a larger number of relatively similar competitors may over time further lead to strategic and technological convergence, as knowledge from competitors more easily spills over through the recruitment of employees from the same managerial and technical pool or through informal interactions (Stuart and Sorenson, 2003). Furthermore, the moves of local competitors are typically more visible than the moves of distant competitors, leading to a more intense competitive dynamic among local competitors.

Central to theorizing and measuring the drawbacks of agglomeration is the distinction between agglomeration and the structure of competition (Ellison and Glaeser, 1997). Traditional measures of agglomeration (e.g., the level of employment in a given industry and location or the number of firms in an industry and location) often do not accurately reflect the underlying structure of competition among firms. For instance, a given level of industry employment in a location may be split among a small number of large competitors or among a large number of small firms. Traditional industrial organization economics suggests that competition is the highest in the presence of a larger number of similar-sized firms and that under such circumstances there will be fierce competition for inputs and outputs (Porter, 1980). Taken together, the structure of local competition, rather than concentration of economic activity per se, leads to a firm's not being fully able to restrict and internalize the resources and capabilities it controls and generates from being accessed and appropriated by local competitors without compensation (Marshall, 1920; Ciccone and Hall, 1996). We hypothesize:

Hypothesis 2. The local level of competition is positively related to the likelihood of the failure of startups.

3.3. Moderating effects of resources and capabilities

Most prior research on the performance effects of different geographical locations has assumed few differences in the resources and capabilities of the firms under study. Other studies have tried to account for such heterogeneity among firms with the help of different forms of fixed-effect models that control for unobservable factors related to cross-sectional structures yet do not provide an insight into the roles that this heterogeneity plays in determining firms' performance (Lomi, 1995; Pe'er et al., 2008). Research in the resource-based view of strategic management (Barney, 1991; Helfat and Lieberman, 2002; Peteraf, 1993; Sapienza et al., 2006; Sharma and Kesner, 1996), and on strategic entrepreneurship in particular (Hitt et al., 2001; Ireland et al., 2003), however, suggest that firms' heterogeneity is central to understanding the behavior of new ventures, as well as the effects of this behavior on survival. The resource-based view of strategic management and the literature on strategic entrepreneurship suggest that firms can be understood as heterogeneous bundles of resources and capabilities. The characteristics of these resources and capabilities will determine the firm's ability to compete and gain advantages vis-à-vis other firms (Barney, 1991; Peteraf, 1993).

In the context of the present study, we argue that differences in the resources and capabilities of a firm affect how that firm benefits from the advantages of a local pooled labor force, specialized suppliers, and purchasers, and also how strongly these firms suffer from local competition (DeCarolis et al., 2009). Furthermore, these effects are different for resources and capabilities. In our

argumentation, we focus on the total assets a firms holds relative to competitors as a proxy for a firm's tangible and intangible resources (e.g. Villalonga, 2004; Alcacer and Chung, 2007). We further focus on the quality of a firm's human capital relative to competitors, which reflects a startup's initial level of capabilities.

3.3.1. Level of total assets relative to competitors

We argue that agglomeration benefits will be stronger for firms that have fewer total assets compared to competitors. On a firm's balance sheet, total assets reflect the book value of all tangible and intangible resources the firm owns or controls to produce value. Total assets reflect a broad range of categories including tangible assets, such as buildings and equipment; intangible assets, such as copyrights, trademarks, and patents; and financial assets, such as cash, accounts receivable, bonds, and stocks (Downes and Goodman, 2003). The fewer assets a firm possesses early on in its life, the more difficult it might be to attract qualified employees. Such a firm may therefore particularly benefit from the broader employee pool in a cluster. Similarly, less well-endowed firms may benefit particularly from the advantages of specialized suppliers and outsourcing because such firms are less likely to be able to provide the necessary specialized supplies internally. In contrast, firms with an above-average level of total assets may have enough tangible resources, such as machinery, to choose to produce specialized supplies internally.

Firms with below-average levels of total assets may also particularly benefit when a high level of local purchasers provides opportunities for niche players. Being close to purchasers may allow such firms to build legitimacy through frequent interactions with the purchasers. For instance, a startup with limited total assets may be able to negotiate a financing deal with a local customer that may allow it to overcome the limitations arising from holding fewer resources than competitors (Venkataraman et al., 1990). In contrast, better-endowed firms may rely less on purchasers to overcome their resource constraints. We hypothesize:

Hypothesis 3a. The negative relationship between the local levels of skilled labor, specialized suppliers, and purchasers and the likelihood of failure is weaker for startups with a higher level of total assets relative to competitors.

Firms that hold a higher level of total assets relative to competitors not only need to rely less on the benefits of agglomeration, but may also be shielded from some of the effects of competition. All startups suffer from the liabilities of newness and smallness (Dunne et al., 1988; Stinchcombe, 1965), which indicate a limited chance of surviving adversities such as economic shocks, competition, or strategic reactions from incumbents attempting to deter their entry. However, the initial level of total assets a firm possesses provides for what Fichman and Levinthal (1991) termed a "honeymoon" or "adolescence" period during which a startup may not cease operations despite negative performance. The length of this period depends on the magnitude of these initial assets. For instance, a firm that holds a higher level of cash may be able to withstand a longer period until the first sale to a customer, compared to a firm with a lower level of cash. Firms with a higher level of total assets compared to their competitors may also be able to withstand intense price competition with these competitors for a longer period. Following this logic, we expect firms with a larger asset base to be less effected by local competition. We hypothesize:

Hypothesis 3b. The positive relationship between the local level of competition and the likelihood of failure is weaker for startups with a larger relative asset endowment.

3.3.2. Quality of human resources relative to competitors

While we expect the level of total assets relative to competitors to weaken the beneficial and detrimental effects of agglomeration, we expect the firm's capabilities will strengthen the beneficial effects and weaken the detrimental effects. Given our focus on the early life of startups, we focus here on the quality of the firm's human resources as a proxy for its initial level of capabilities. Employees are an organization's repository of skills (Becker, 1964; Grant, 1996), operational and first-order routines (Cyert and March, 1963; Cohen and Levinthal, 1994), and related social capital (Burt, 1997; Nahapiet and Ghoshal, 1998). Especially early on in the life of a startup, the quality of the employee base is critical for a firm's ability to benefit from clusters but also to shield the firm from the negative effects of competition. In particular, the higher the quality of human capital, the more likely the firm will be able to take advantage of specialized suppliers. A firm with a higher-quality employee base will be better able to adjust its internal operations to take advantage of advanced suppliers and may be better able to absorb knowledge from these suppliers. High-quality human capital also plays a critical role in building legitimacy with purchasers. In the absence of a long organizational track record and strong underlying resources, the quality of the employees may be central in convincing purchasers to enter into transactions (Venkataraman et al., 1990). High-quality human capital is also critical to capture the potential learning benefits that customer interactions provide and that are critical for the survival of new ventures (Yli-Renko et al., 2001). We hypothesize:

Hypothesis 4a. The negative relationship between the likelihood of failure and the local level of specialized suppliers and purchasers is stronger for startups with a higher quality of human capital relative to competitors.

A higher quality of human capital may also protect the firm from the downsides of competition. We argue that the quality of human resources is one factor that determines whether the firm develops the long-term ability to withstand competition because it is a critical determinant of the startup's ability to develop new routines and capabilities. Research on employee flows has shown that employees play a central role in developing new firms' capabilities (Phillips, 2002; Rao and Drazin, 2002) and employee flows may often form the seed of new capabilities. Higher-quality human capital may provide the startup with learning advantages in this process of building capability. Startups that possess a higher-quality human capital may have advantages in

spotting relevant information from successful and failing firms and integrating this information into their processes and routines. Finally, aside from being an important element in capability building, the quality of human capital may be an important source of competitive advantage in its own right for a startup, as effective human assets are difficult to build (Coff, 1997). We hypothesize:

Hypothesis 4b. The positive relationship between the likelihood of failure and the local level of competition is weaker for startups with a higher quality of human capital relative to competitors.

4. Data and methods

4.1. Data

To test our predictions, we employ the T2-LEAP database, a unique Canadian dataset that allows us to analyze the survival of *all* independent startups that entered the Canadian manufacturing sectors between 1984 and 1998. "Independent startups" refers to ventures that are started by a founder or team of founders and are not owned by an existing corporation (Helfat and Lieberman, 2002; Klepper, 2002). T2-LEAP has several advantages for our study. First, the database covers all Canadian manufacturing sectors, thereby allowing for a degree of generalizability lacking in single-industry studies.[2] In addition to entries and exits, the T2-LEAP data contain operating data on all manufacturing firms operating in Canada in the base year 1984, thereby allowing us to create variables that should not suffer from left-censoring issues. In other words, T2-LEAP includes the complete universe of all employers in Canada regardless of size, survival or failure, or private or public status.

T2-LEAP was created by merging two Canadian databases. The Longitudinal Employment Analysis Program (LEAP) is used to identify startup entry and exit, their industry sector at the three-digit SIC code, the number of their employees, and their location coordinates. The database tracks the employment and payroll characteristics of individual firms from their year of entry to their year of exit. The employment record of each business is derived from administrative taxation records that each Canadian employer must file. The payroll data are associated with a Revenue Canada employer identification number. The second database is the Corporate Tax Statistical Universe File (T2SUF). This database is used to assess firm-specific annual financial variables such as equity, assets, sales, and closing inventories, converted to constant Canadian dollars using a 1985 price index. The data are objective and recorded at the time of occurrence.

The longitudinal nature of LEAP allows entry and exit times to be measured with precision. For our analyses, firms enter the database in the year they first hire employees and record their last entry in the database in the last year they have employees or stop filing a tax return.[3] A special labor-tracking mechanism allows us to exclude mergers, changes in control, changes in sector of operation, and changes of name or location as (false) exits and subsequent (false) entries. The financial and employment information is then organized longitudinally; each observation in the database corresponds to a particular firm whose financial, employment, payroll, and industry characteristics are recorded annually.

In our empirical estimation, we include only independent new ventures; we do not include the births of diversifying entrants or parent-company ventures (Helfat and Lieberman, 2002). Similarly, failures (exits) in any given year are identified by the absence of current payroll data where such data had existed in the previous year. To ensure that an exit was an indication of poor performance, we checked the conditions of equity, assets, and sales reported at the T2SUF database.

4.2. Dependent variables

4.2.1. Startup failure

For each firm-year observation, *startup failure* was coded as 1 if the startup failed in a given year and as 0 otherwise. Survival is a universal measure of performance and the prerequisite of other such measures. New entrants, depending on their sector and age, may have different performance goals—such as first sales, positive profits, acquiring and retaining customers, developing intellectual property, and organizational growth—and comparing firms using these measures may require implicit assumptions as to the time horizon during which these should be achieved (Delmar and Shane, 2004, 2007). Survival, on the other hand, is the unequivocal goal of all new ventures independent of these alternative goals.

4.3. Independent variables

Conscious that the forces underlying our theory are localized, the geographic units used in the analysis are economic regions (ERs). Statistics Canada defines an ER as a standard geographic unit based on regional economic activity, population density, and

[2] Each establishment in the LEAP database is given a unique, time-invariant identifier that can be longitudinally tracked. The database also assigns an identifier to each establishment that facilitates a linkage to other establishments within the same firm. We excluded the subsample startups that operate with more than one establishment, since our data do not report resources or capabilities at the establishment level. The excluded subsample represents, however, less than 5% of the population of new entrants into the manufacturing sectors. This hierarchy of firms also allows us to separate startups from existing firms' expansions of facilities.

[3] The self-employed accounted for 11% of total employment in Canada in 1997. However, a substantial proportion of the self-employed are not creating production entities of any substance — either in sales, employment, or capital formation. Indeed, Statistics Canada (2002) argues that the LEAP data cover about 98% of the economic activity in the Canadian economy. Because of difficulties in measuring self-employment and the conceptual problems in equating it to the creation of new enterprises (Glaeser, 2007), we follow previous research and capture a new firm when it first hires employees.

commuting patterns (Statistics Canada, 2002). Each ER consists of at least one metropolitan or densely populated area that serves as a center of economic activity. Canada as a whole is divided into 76 ERs. The economically important provinces of Ontario and Quebec are comprised of 11 ERs and 17 ERs respectively. All the covariates are updated annually and are based on aggregating firm-level data.

4.3.1. Local level of skilled labor

Our first measure of agglomeration is the local level of skilled labor, which we measure as the number of employees within an economic area and focal three-digit SIC industry divided by the total number of employees in that three-digit industry nationally. This measure has been widely used in work on the geographic concentration of manufacturing industries (e.g., Alcacer and Chung, 2007; Porter, 2000; Rosenthal and Strange, 2003; Shaver and Flyer, 2000). An ER with a higher portion of focal-industry employment provides an entrant with a larger pool of potential employees by recruiting from either existing or exiting firms. We aggregate employment per industry-year from all firms, incumbents and new entrants, operating in the economic region.

4.3.2. Local level of specialized suppliers

To measure the local level of specialized suppliers, we use input/output (I/O) tables from the Annual Survey of Manufactures (ASM). I/O tables report the types and quantities of inputs made and used by all industries. Using these data, we calculate the fraction of inputs from all other three-digit industries consumed by each focal three-digit industry. Following Dumais et al. (2002), we calculate

$$\mathrm{SC} = \sum_{s} \left(\frac{VI_s}{VS_s} \right) * d_s \tag{1}$$

where s indexes all three-digit SIC sectors, VI_s is the dollar value of inputs that the focal sector acquires from sector s, VS_s is the dollar value of sales made by sector s to all other sectors, and d_s is the count of firms in sector s in the ER. While the focal sector can potentially be one of the input providers, we exclude the focal sector as we explicitly capture this agglomerative effect in "local level of skilled labor." As the share of inputs that sector s sells to the focal sector increases, and as the number of firms from sector s in the ER of the focal firm increases, the local level of specialized suppliers increases.

4.3.3. Local level of purchasers

We define purchasers' concentration (PC) similarly to the measure of supplier concentration, so

$$\mathrm{PC} = \sum_{S} \left(\frac{VO_s}{VP_s} \right) * d_s \tag{2}$$

where the only differences are that VO_s is the dollar value of sales (outputs) from the focal sector to sector s and VP_s is the dollar value of purchases made by sector s from all other sectors. As the share of outputs that the focal sector sells to sector s increases, and as the density of purchasers from sector s in the ER of the focal firm increases, purchaser concentration increases.

4.3.4. Local competition

As an indicator of the structure of local competition, we used an inverse Herfindahl–Hirschman Index (HHI). We calculate the measure based on employees; that is, we calculate HHI as the sum of squared shares of employees by firms in a three-digit SIC industry within the ER. Since the measure is inverse, higher values correspond to less concentrated (more competitive) areas. We ran robustness analyses with an alternative specification where we calculated the HHI measure based on sales. Results were highly similar with the results reported here.

The intuition behind this measure is that in less concentrated ERs, competition consists of an increasing number of increasingly smaller competitors. According to standard theories of industrial organization (e.g., Porter, 1980), a larger number of smaller firms should exhibit increasing competition for employees, suppliers, and customers. While this effect should be particularly pronounced in industries that produce perishable goods or where transportation costs matter, competition for supplies and employees makes us expect such effects across all industries, as discussed above.

4.4. Moderating variables

Resource-based theory informs us that an entrant's resources influence its chance of survival. Measuring these resources over an extended period and over a large number of firms poses a formidable challenge for an empirical design. To address this challenge, we chose proxies available in our data. Specifically, we measure two of the most important resources available to a startup: its endowment with assets relative to competitors and the quality of its employee base. Our main focus here is on how the focal firm deals with moderate local competition and learning opportunities. Consistent with our theoretical development and the population, we compare the annual levels of resources an entrant has to its peers in the same three-digit industrial sector and cohort.[4]

[4] Our results are not sensitive to scaling the moderators by the sector averages of all firms.

4.4.1. Total assets relative to competitors

To measure the entrant's time-varying endowment with assets relative to competitors, we measure its total assets divided by the sector average assets of all other *independent new ventures* in the same cohort. Total assets are the sum of: fixed assets—capital equipment and property (less depreciation), cash, accounts receivable, inventory, and supplies—and intangible assets, such as copyrights, trademarks, and patents. Although an imperfect proxy for the overall resource base, total assets reflect at least the tangible and intangible resources a startup holds (see Villalonga, 2004; Alcacer and Chung, 2007). During the early life of a startup, such tangible resources may be particularly important to shield the incumbent from competitive pressures that otherwise may force the firm to exit.

4.4.2. Quality of human capital relative to competitors

As we have argued above, the quality of a startup's employee base provides an indicator of its capabilities; for instance, its ability to acquire new knowledge and resources, to build capabilities, or more generally to adapt to the competitive environment. As an indirect measure of the quality of human capital available to a firm, we define it as the average wage paid by the firm divided by the sector's average wages within the economic region at the time (*t-1*). Higher wages tend to reflect a greater investment in certain labor-related enhancements, such as training and firm-specific human capital (Mincer, 1958). The literature on wage efficiency further shows that firms tend to pay a wage rate above the market's clearing wage to attract and retain high-quality labor and to provide incentives for workers to exert more effort (Lemieux, 2005). A ratio of 1 or higher suggests that the quality of human capital that the firm employs is on par or better than its local competitors'. As wages are affected by various factors besides the quality of employees—such as local markets, relative scarcity of people with a particular specialty in a given location, and government regulations—the advantage of our operationalization is that it compares the average wage paid by the focal firm to the average in its sector and ER in the same time period, thereby separating out the potential effect of higher wages being paid in areas with high agglomeration.

4.5. Control variables

4.5.1. Firm-level controls

4.5.1.1. Lagged sales. The *sales* of a firm are calculated as the natural logarithm of the value of lagged sales, corrected for inflation. The reason for including this variable as a control is the possibility that some of the observed firm-level moderators could be the spurious consequences of the confounding effects of any unobserved strategic, business model, or operational choices that systematically differ across firms. Including a lagged measure of sales improves our ability to rule out this issue (Hamilton and Nickerson, 2003).

4.5.2. Local environment characteristics

4.5.2.1. ER failure rate. As an indicator for hazards facing new ventures in a given locale (ER), we calculate the failure rate, defined as the sum of the number of exits in the ER over a lagged three years prior in the focal three-digit industry (including both de novo and de alio short-lived firms that have entered and exited during this interval), divided by the base population at risk (i.e., ER incumbents in the sector at time *t-4*) (Caves, 1998). Local failure may lead to lower competition as resources (e.g., employees, equipment) are released back to the environment. High average local failure rates, however, capture the overall risks associated with entering a specific area.

The attractiveness of an economic region should be capitalized in both land rents and wages. For example, if households prefer a certain ER because of amenities or weather, this will work to raise land rents and reduce wages. If firms find the workers in a certain ER more productive, this will work to raise wages and rents. The empirical relevance of this point depends on the correlation between the underlying benefits for households and firms.

4.5.2.2. ER land rents. To account for differences in demand for land and therefore land prices, we calculate land rents as the natural logarithm of ER land rents adjusted for inflation. The levels of land rents were obtained from the Canadian Census and were interpolated between census years.

4.5.2.3. ER average wage. Average wage is defined as the natural logarithm of the average employee wage paid by firms operating in a given sector and economic region at a given time (*t-1*). As the boundaries of ERs are chosen to reflect commuting patterns, they represent the pool of employment from which local companies competitively draw. Higher wages tend to reflect a higher quality of human capital available in the area and thus enhanced survival (Dumais et al., 2002; Glaeser, 2007).

4.5.2.4. Lagged ER industry sales growth. This variable represents growing sales in a specific industry in the same ER. Growing demand is expected to decrease competitive pressure and permit higher profit margins, allowing less productive firms to survive (Eisenhardt and Schoonhoven, 1990).

4.5.2.5. Fixed effects. Unobserved permanent and time-varying factors such as location and industry likely affect firm survival. If these unobserved heterogeneities are correlated with the determinants of survival, the resulting coefficients may be biased. To

partially eliminate this potential bias, and since some of our covariates were calculated at the ER level, we use the coarser metropolitan statistical area (MSA) and two-digit industry fixed effects in our estimation (Greene, 2002). For the MSA effects term d_{MSA_i}we collapse the 76 ERs to 33 MSAs. This term captures all other permanent factors common to every ER within an MSA that are not observed by the econometrician. The industry term d_k absorbs permanent industry characteristics. Macro-economic conditions reflecting the impacts of business cycles, movements in exchange rates, policy changes, and free trade agreements have long been indicated as an important force affecting the survival of firms (Geroski and Mazzucato, 2002). Adverse conditions such as increases in interest rates or a drop in income may affect costs, demand, and other critical determinants of firm survival. Startups are more vulnerable than incumbents to these influences. Indeed, studies suggest that entry rates decline during recessions, reducing the pressures on incumbents (Caballero and Hammour, 1994). Conversely, all firms, including entrants, may reap the benefits of a robust economy. Empirically, Keasy and Watson (1991) showed a positive relationship between the survival of new small firms and national economic growth. Those factors are captured by time dummies d_t and interactions between the fixed effects.[5]

4.6. Empirical model

To test our hypotheses, we employ a piecewise exponential model that splits time into pieces according to the age of the firm, with standard errors clustered by firm. The model assumes that the transition rate is constant within these intervals but can change between them (Blossfeld and Rohwer, 1995). Our model is a non-parametric estimation—it does not assume a particular distributional form for the time dependence of the process (Fichman and Levinthal, 1991). This method of estimation has been widely used in the literature on firm survival (e.g., Sorenson and Audia, 2000; Delmar and Shane, 2004).

Our model estimates the hazard $h(t)$—the probability that startup i operating in sector j at location ER l exits at time t, conditional on the fact that it survived to period $t-1$:

$$\begin{aligned}\log\left[h_{i,j,l}(t)\right] &= \Pr(\text{startup } i \text{ exits at } t \mid \text{startup } i \text{ survived to } t-1) = \Pr(T = t \mid T \geq t) \\ &= \beta_1 \vec{C}_{j,l,t-1} + \beta_2 \vec{L}_{j,l,t-1} + \chi_1 \vec{C}_{j,l,t-1} \cdot \vec{F}_{i,t-1} + \chi_2 \vec{L}_{j,l,t-1} \cdot \vec{F}_{i,t-1} + \delta \vec{X}_{i,j,l,t-1} + \nu_{i,j,l,t}\end{aligned} \tag{3}$$

where $\vec{C}_{j,l,t-1}$ represents the local competition in ER l within sector j, $L_{j,l,t-1}$ represents the agglomeration forces (i.e., local level of skilled labor, local level of specialized suppliers) at ER l within sector j, $\vec{F}_{i,t-1}$ represents firm-specific characteristics (relative assets, productivity, and quality of human capital), $\vec{X}_{i,j,l,t-1}$ is a vector of location, industry, and firm-specific controls, including the simple effects of firm specific characteristics $\vec{F}_{i,t-1}$. The term $\nu_{i,j,l,t}$ captures the effects of unobserved factors representing firm-specific heterogeneity that is assumed to be uncorrelated with the explanatory variables.

5. Results

Table 1 presents the descriptive statistics and correlations for the variables used in the analyses. Independent startups account for 85% to 94% of all newly created manufacturing establishments, depending on the sector. The population of startups in Canada consists of predominantly small enterprises (59% of all new entrants have less than 10 employees, while only 3% have more than 100 employees). Our data cover 46,879 entries and 11,052 exits of startups between 1984 and 1998. About 64% of the exits occur during the first four years after entry.

Table 2 reports maximum-likelihood estimates from the piecewise model of new ventures' hazard. We use a hierarchical approach in introducing the independent variables and moderators in subsequent models. Column 1 includes firm-level and local-sector controls. Columns 2 through 8 add the main effects and interaction terms. Consistent with prior studies, column 1 reports the hazard-reducing impacts of a firm's lagged size (measured in terms of lagged sales). Firms who had lagged sales that are one standard deviation above the sample's mean experienced −71% lower hazard. The economic impact of this coefficient suggests that, as expected, it captures a large portion of the underlying firm-level heterogeneity. Other controls that reduce the hazard facing startups are the costs of local resources: land rents, average wage, and industry sales growth (see Romanelli, 1989; Mata and Portugal, 1994, 2002; Baum and Mezias, 1992). Column 1 also suggests an increased hazard for the focal firm as an outcome of the overall local sectoral challenges as captured by the three-year average failure rates. The likelihood ratio test statistics presented at the bottom of the table soundly reject the hypothesis that the MSA, industry, and time fixed effects are jointly equal to zero.[6]

Consistent with Hypotheses 1a, 1b, and 1c, Model 2 reports a negative (failure-hazard-reducing) and significant coefficient on the main effects of the local level of skilled labor (−0.497, $P<0.01$), local level of specialized suppliers (−0.0302, $P<0.05$), and local level of purchasers (−0.0083, $P<0.05$). The economic impact of the agglomeration benefits varies. An increase of 1 standard deviation in the local level of skilled labor over the average in the samples results in an 8% decrease in failure, while an increase of 1 standard deviation in the local level of specialized suppliers and local level of purchasers results in a 1% and 0.3% decrease in

[5] Specifically, in auxiliary analyses we also included interaction terms between time dummies and MSAs ($d_t \cdot d_{MSA_i}$), and time dummies and industry ($d_t \cdot d_k$). While many of the additional interactions were significant, our reported effect remained significant and consistent with those reported.

[6] The test statistics are given by twice the difference in the log likelihood for the unrestricted model less the restricted model that omits the fixed effects. While many of the fixed MSA and industry fixed effects are significant, the sizes of their coefficients suggest that their impacts on the survival of new ventures are smaller than that of the key covariates included in our models. This confirms the importance of *within* MSA and industry variation in our data.

Table 1
Descriptive statistics and pairwise correlations.

	Covariate	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Startup failure	0.461	0.302														
2	Local competition	17.082	12.672	0.30													
3	Local level of skilled labor	0.607	1.724	-0.16	0.24												
4	Local level of specialized suppliers	0.507	0.311	-0.19	0.15	0.28											
5	Local level of purchasers	0.394	0.278	-0.14	0.22	0.17	0.12										
6	Relative assets	0.954	2.451	-0.25	0.18	0.09	0.03	0.14									
7	Relative quality of human capital	0.819	0.562	-0.22	0.15	0.13	0.06	0.04	0.23								
8	ln (Sales)	12.701	19.004	-0.31	0.13	0.07	0.16	0.23	0.13	0.20							
9	ER Failure rate	0.192	0.117	0.18	0.32	-0.09	-0.14	0.03	-0.05	-0.07	-0.09						
10	ln (ER land rents)	4.374	4.108	-0.05	0.19	0.16	-0.01	0.15	0.18	0.24	0.16	-0.04					
11	ln (Lagged ER average wage)	11.473	3.067	0.06	0.23	0.15	0.12	0.04	0.08	0.24	0.16	-0.10	0.23				
12	Lagged ER industry sales growth	0.142	0.169	-0.07	0.11	0.12	0.08	0.07	0.12	0.17	0.08	-0.23	0.09	0.02			
13	ln (Initial Employees)	1.415	2.806	-0.10	0.19	0.02	0.03	0.08	0.11	0.16	0.30	0.05	-0.09	0.06	0.04		
14	ln (initial assets)	12.007	12.816	-0.13	0.25	-0.05	-0.10	0.15	0.27	0.23	0.38	0.07	-0.14	0.07	0.12	0.53	
15	ln (initial sales)	12.274	12.798	-0.20	0.08	0.16	0.20	0.13	0.12	0.31	0.47	0.03	0.06	-0.04	0.19	0.34	0.36

failure, respectively. Our findings on the different economic impacts of agglomeration benefits are consistent with Rosenthal and Strange (2003), who studied the determinants of the level of births of new ventures in a location. Note that, as theorized, the three agglomeration forces are jointly significant, suggesting that they capture unique underlying survival-enhancing mechanisms, albeit for the average startup the levels of suppliers and purchasers have lower impacts.

Model 3 reports a positive (failure-hazard-increasing) and significant effect of local competition (0.2026, $P<0.01$). Model 4 jointly includes the effects of local agglomeration and competition (0.1787, $P<0.01$), thus supporting Hypothesis 2. An increase of 1 standard deviation in local competition results in about a 6% increase in failure. Note that the covariates for local level of skilled labor, local level of specialized suppliers, local level of purchasers, and local competition are jointly significant and opposite in their effect on the hazard facing de novo firms, as we theorized. In an unreported analysis, we included a dummy variable interacting with local competition for sectors whose products are highly perishable and where transportation costs dominate (such as food and kindred products, meat packing, newspapers, milk and cream, and concrete products). Results suggest that the effect of local competition on failure is much stronger for those sectors.

Model 5 adds the main effect of our covariates for firm resources—total assets relative to competitors—and interaction terms to examine the hypothesized relationship between agglomeration benefits and the likelihood of survival for better-endowed firms. In line with prior literature on the resource base of the firm, the negative and significant coefficient for total assets relative to competitors (-0.0384, $P<0.01$) indicates that firms with a larger resource endowment have better survival prospects. Hypothesis 3a, however, is only partially supported. Consistent with our expectation, the positive interaction terms "local level of skilled labor × relative assets" (0.0106, $P<0.05$) and "local level of specialized suppliers × total assets relative to competitors" (0.0138, $P<0.1$) indicate that less well-endowed startups benefit more from local concentrations of labor and suppliers. The interaction term "local level of purchasers × relative assets" is positive, albeit not significant. To ensure that multicollinearity does not cause imprecise parameter estimates, we follow Kmenta's (1986) recommendation and conduct a variance inflation factor (VIF) test, adding one interaction term at a time and checking for changes in the coefficients and standard errors. No significant variance in the estimates of the coefficients emerges and the average VIF test is 5.04. However, conservatively, due to the multiple occurrences of the main effects, we rely on the partial models for testing our hypotheses.

To visually depict the interactive effect—how the effect of agglomeration benefits on hazard changes with the level of firm endowments—we used the coefficients in Model 5. Fig. 2 presents this illustration. In this graph, probability of failure (the vertical axis) in relation to the local level of skilled labor (the horizontal axis) is represented in standard deviation units. Firm endowment is measured as a categorical variable—*highly endowed* startups are firms whose total assets relative to competitors are above the top quartile and *less-endowed* startups are firms whose total assets relative to competitors are less than the top quartile. All remaining variables are held at their mean levels. We created a similar graph with the local level of suppliers as the horizontal axis. The graph was almost identical to the graph represented here and is therefore omitted for space reasons. The illustration shows that failure rates decrease with an increase in the local level of skilled labor (or local level of specialized suppliers), as indicated by the downward-sloping curves. In line with Hypothesis 3a, the survival prospects of better-endowed firms depend less on the proximity to clusters of skilled employees and suppliers. Stated differently, less-endowed firms rely more heavily and extract more benefits from access to existing pools of skilled employees and suppliers.

Contradicting our Hypothesis 3b, Model 6 reports a positive (failure-hazard-increasing) and significant interaction term, "local competition × total assets relative to competitors" (0.0281 $P<0.01$); that is, a positive value is added to the positive (failure-hazard-increasing) main effect, yielding a larger hazard. This finding suggests a decrease in the failure of less-endowed startups (i.e., those with less than average assets) when located in a competitive industrial environment. The illustration in Fig. 3 captures the downward-sloping curve for less-endowed startups, indicating that a more competitive local market results in reduced hazard for those firms, and a upward-sloping curve for highly endowed startups, indicating an increased hazard due to intensified local competition for this subgroup of firms.

Table 2
The effects of agglomeration benefits and drawbacks on failure of startups with different resources and capabilities: piecewise exponential hazard model.

	1	2	3	4	5	6	7	8	9
Local Level of Skilled Labor		−0.0497***		−0.0504***	−0.0316***	−0.0506***	−0.0426***	−0.0496***	−0.0486***
		(2.87)		(2.84)	(2.80)	(2.83)	(2.83)	(2.86)	(2.82)
Local Level of Specialized Suppliers		−0.0302**		−0.0304**	−0.0386**	−0.0285**	−0.0369*	−0.0285**	−0.0384*
		(2.11)		(2.10)	(2.11)	(2.13)	(2.08)	(2.14)	(2.08)
Local Level of Purchasers		−0.0083**		−0.0088**	−0.0102*	−0.0086**	−0.0106*	−0.0089**	−0.0121**
		(2.13)		(2.14)	(2.09)	(2.15)	(2.08)	(2.15)	(2.17)
Local Competition			0.2026***	0.1787***	0.1776***	0.2281***	0.1794***	0.2104***	0.2103***
			(3.33)	(3.35)	(3.38)	(3.32)	(3.32)	(3.21)	(3.33)
Relative Assets					−0.0384***	−0.0413***	−0.0350***	−0.0357***	−0.0381***
					(2.57)	(2.52)	(2.55)	(2.55)	2.56)
Local Level of Skilled Labor x Relative Assets					0.0106**				0.0105**
					(2.16)				(2.14)
Local Level of Specialized Suppliers x Relative Assets					0.0138*				0.0133*
					(2.09)				(2.11)
Local Level of Purchasers x Relative Assets					0.0077				0.0080
					(1.75)				(1.77)
Local Competition x Relative Assets						0.0281***			0.0273***
						(3.11)			(3.06)
Relative Quality of Human Capital							−0.0340***	−0.0365***	−0.0352***
							(2.27)	(2.37)	(2.34)
Local Level of Specialized Suppliers x Relative Quality of Human Capital							−0.0067***		−0.0064***
							(2.69)		(2.66)
Local Level of Purchasers x Relative Quality of Human Capital							−0.0024***		−0.0025***
							(2.36)		(2.38)
Local Competition x Relative Quality of Human Capital								−0.0112**	−0.0118**
								(2.23)	(2.19)
Control variables									
ln (lagged Sales)	−0.0651***	−0.0646***	−0.0650***	−0.0645***	−0.0603***	−0.0604***	−0.0595***	−0.0600***	−0.0601***
	(3.41)	(3.40)	(3.40)	(3.41)	(3.40)	(3.41)	(3.41)	(3.41)	(3.43)
Failure Rate	0.0486**	0.0489**	0.0488**	0.0495**	0.0492**	0.0488**	0.0495**	0.0489**	0.0493**
	(2.23)	(2.22)	(2.23)	(2.22)	(2.23)	(2.21)	(2.21)	(2.24)	(2.23)
ln(ER Land Rents)	−0.0094	−0.0105	−0.0095	−0.0105	−0.0107	−0.0106	−0.0107	−0.0106	−0.0107
	(1.78)	(1.81)	(1.79)	(1.80)	(1.82)	(1.81)	(1.81)	(1.80)	(1.81)
ln(Lagged ER Average Wage)	−0.0144*	−0.0140*	−0.0145*	−0.0142*	−0.0139*	−0.0140*	−0.0132**	−0.0140*	−0.0141*
	(2.03)	(2.06)	(2.03)	(2.07)	(2.06)	(2.05)	(2.11)	(2.07)	(2.05)
Lagged ER Industry Sales Growth	−0.0109**	−0.0110**	−0.0109**	−0.0108**	−0.0107**	−0.0109**	−0.0105**	−0.0110**	−0.0109**
	(2.18)	(2.18)	(2.19)	(2.17)	(2.17)	(2.17)	(2.19)	(2.18)	(2.17)
Treatment for selection									
ln(Initial Employees)									−0.0197**
									(2.12)
ln(Initial Assets)									−0.0186***
									(2.42)
ln(Initial Sales)									−0.0213***
									(2.48)
No. of Subjects	46,879	46,879	46,879	46,879	46,879	46,879	46,879	46,879	46,879
No. of Observations	250,524	250,524	250,524	250,524	250,524	250,524	250,524	250,524	250,524
No. of Failures	11,052	11,052	11,052	11,052	11,052	11,052	11,052	11,052	11,052
Log Likelihood	−3452.68	−3218.30	−3401.08	−3190.11	−3004.50	−3006.11	−2955.04	−2949.12	−2910.55
Improvement in Model Fit Test		vs (1)	vs(1)	vs (2)	vs (3)	vs (3)	vs (3)	vs (6)	vs (7)
Chi-square of Change LogL		0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.1870	0.000***

Comments:
Robust *z*-statistics are reported in parentheses. Standard errors have been clustered by firm.
All specifications include time, Metropolitan Statistical Area and two-digit SIC dummies.
*P<0.10, **P<0.05, ***P<0.01 based on one-tailed tests.

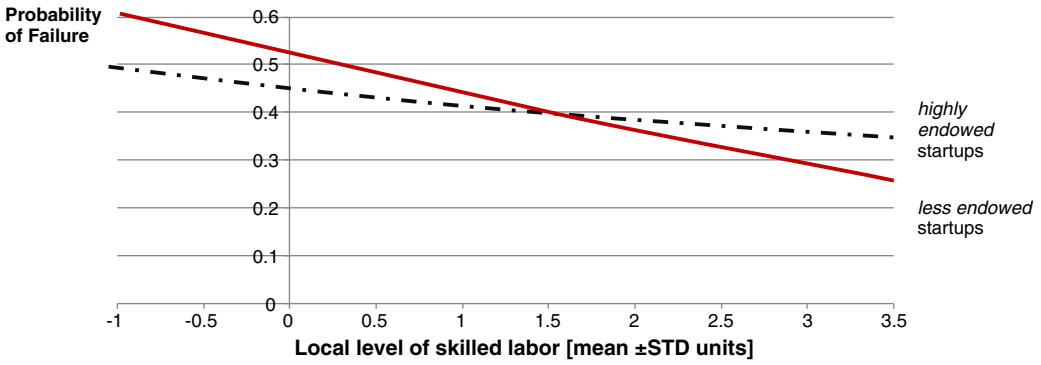

Fig. 2. Interactive effects of agglomeration benefits and resources on startup failure rates. Predicted hazard facing startups is derived from Model 5 in Table 2 and holding all other variables at their mean. Startups with high level of resources are firms whose relative assets are above the top quartile and startups with lower level of resources are firms whose relative assets are less than the top quartile.

One explanation for this unexpected effect may be that in the manufacturing sector, markets with a high concentration of small incumbents may offer better learning opportunities for less-endowed entrants that are less constrained by an early commitment to particular tangible assets. Hence, early investment in tangible assets may stifle experimentation and learning by doing, thus becoming a liability during the early life of an entrant in a competitive environment.

In Model 7, we examine the moderating effect of the quality of human capital relative to competitors on the positive relationship between survival and local concentrations of specialized suppliers and purchasers. Our results support Hypothesis 4a. The coefficients of the interaction terms "local level of specialized suppliers × quality of human capital relative to competitors" (-0.0067, $P<0.01$) and "local level of purchasers × quality of human capital relative to competitors" (-0.0024, $P<0.01$) are both negative and significant, suggesting improved survival prospects for companies with superior human resources because these companies can extract more benefits from the relationships with local specialized suppliers and customers. To visually depict the interactive effect—how the effect of agglomeration benefits on hazard changes with the level of firm endowments—we used the coefficients of Model 7. In Fig. 4, the probability of failure (the vertical axis) in relation to the local level of skilled labor, or local level of specialized suppliers, which is not shown (the horizontal axis) is represented in standard deviation units. A firm's endowment is measured as a categorical variable—*high-quality* startups are firms whose quality of human capital relative to competitors is above the top quartile and *low-quality* startups are firms whose quality of human capital relative to competitors is less than the top quartile. All remaining variables are held at their mean levels. Note the steeper downward slope for the *high-quality* startups than for the *low-quality* startups, as illustrated in Fig. 4.

In Hypothesis 4b, we suggested that entrants with higher-quality employees will have improved chances of survival in a competitive market. Supporting this hypothesis, we find in Model 8 a negative and significant coefficient for the interaction term "local competition × quality of human capital relative to competitors" (-0.0112, $P<0.05$); that is, a negative value is added to the positive (hazard-increasing) main effect of competitive markets, yielding a lower hazard and indicating that startups with better-quality employees are more likely to survive a competitive local environment. Fig. 5 illustrates the opposing slopes of startups with *high*- and *low*-quality human capital relative to competitors.

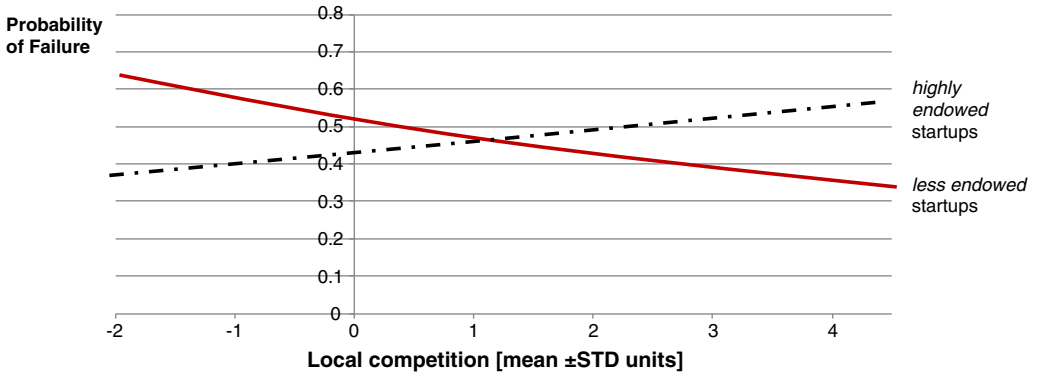

Fig. 3. Interactive effects of local competition and resources on startup failure rates. Predicted hazard facing startups is derived from Model 6 in Table 2 and holding all other variables at their mean. Startups with a high level of resources are firms whose relative assets are above the top quartile and startups with a lower level of resources are firms whose relative assets are less than the top quartile.

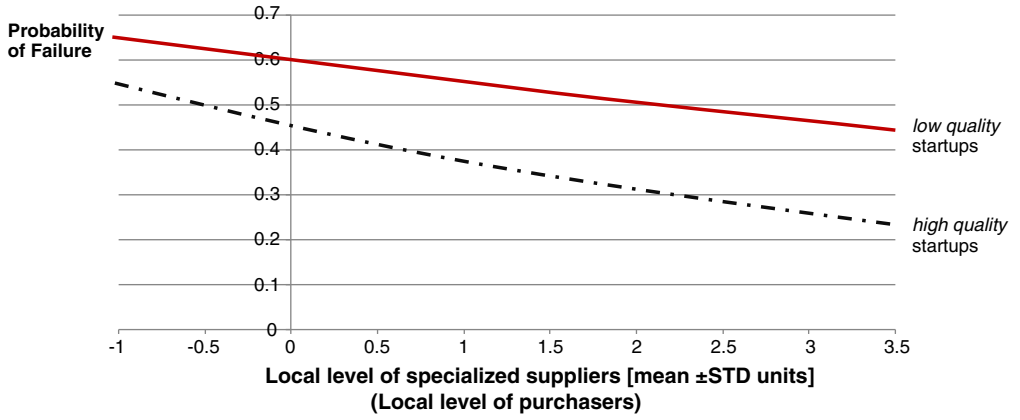

Fig. 4. Interactive effects of agglomeration benefits and capabilities on startup failure rates. Predicted hazard facing startups is derived from Model 7 in Table 2 and holding all other variables at their mean. *High-quality* startups are firms whose relative quality of human capital is above the top quartile and *low-quality* startups are firms whose relative quality of human capital is less than the top quartile.

5.1. Robustness tests

We conducted several robustness checks with alternative operationalizations of our competition measure. First, we use the ratio of firms per employee in a given three-digit industry and economic region. This measure is very common in the industrial organization literature and has been used in the agglomeration literature (Glaeser et al., 1992; Henderson, 2003; Pe'er et al., 2008; Rosenthal and Strange, 2003). Measuring local competition in the manner just described, Glaeser et al. (1992) find that an increase in competition is positively associated with the growth of surviving local companies. Rosenthal and Strange (2003) examined the impact of the above measure of competition on births of new establishments in six manufacturing industries.

Second, we define HHI as the sum of squared market shares: $HHI_{jt} = \sum_{i=1}^{N_j} s_{ijt}^2$ where s_{ijt} is the local market share of firm i in sector j (three-digit SIC codes) in year t. Market shares are computed based on the sales of firms located in the same ER as the focal entrant. The qualitative and quantitative pattern of the results was similar with these different measures.

To test the robustness of our results to model specification, we also considered alternative specifications. One frequently used model is the Cox hazard model (Greve and Rao, 2006; Mata et al., 1995; Shane and Foo, 1999). After testing for the proportional hazards assumption using Schoenfeld residuals, we reran the analyses with this specification and found qualitatively similar results.

Third, we ran multiple additional robustness analyses to address potential endogeneity issues that may be present in our data set. For a full discussion of these analyses see Appendix 1.

Finally, we run our models with a gamma mixture to deal with potential unobserved heterogeneity, as recommended by Blossfeld and Rohwer (1995). Models with a mixture distribution incorporate an "error term," based on the assumption that the unobserved constant can be represented as the realization of a random variable, identically distributed for all firms and independent of observed covariates. Mixture distribution should therefore be considered a step in a search for robust parameter estimates.

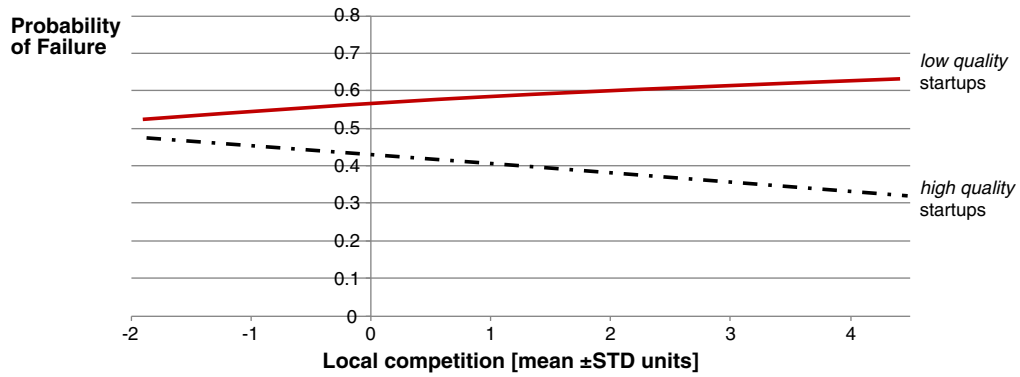

Fig. 5. Interactive effects of local competition and capabilities on startup failure rates. Predicted hazard facing startups is derived from Model 8 in Table 2 and holding all other variables at their mean. *High-quality* startups are firms whose relative quality of human capital is above the top quartile and *low-quality* startups are firms whose relative quality of human capital is less than the top quartile.

6. Discussion

In this paper, we set out to shed new light on the benefits and drawbacks of agglomeration for the survival of startups. In particular, we investigated how the local level of skilled labor, suppliers, and purchasers and the level of competition affect startups and how these effects are moderated by the level of total assets and the quality of a startup's human resources relative to competitors. Our results go beyond prior research by opening up the mechanisms through which agglomeration affects the survival of startups and by analyzing how these mechanisms are moderated by startups' resources and capabilities.

6.1. Contribution to research on agglomeration

First, our research adds to the literature on agglomeration. Prior research on the benefits and drawbacks of agglomeration has produced mixed findings (McCann and Folta, 2008). We argue that one reason for these mixed findings is that prior research has missed important contingencies that affect whether a startup experiences the survival benefits and drawbacks of locating in a cluster. The results of our study suggest that the level of resources (specifically, the level of total assets relative to competitors) and the level of firm capabilities (specifically, the quality of the startup's human capital relative to competitors) are important contingencies that affect how the startup is affected by locating in a cluster. Our study thereby adds to a small literature (e.g., Alcacer and Chung, 2007; Canina et al., 2005; McCann and Folta, 2011; Shaver and Flyer, 2000) that has brought firm-level heterogeneity back into the study of agglomeration. Within this literature, and closest to our study in terms of the theoretical development and population studied, McCann and Folta (2011) have argued that firms' combinative capabilities, measured as stocks of knowledge, experience with alliances, and age of the firms, moderate the benefits of agglomeration. Our study extends this argument in two ways. First, we show that a firm's heterogeneity moderates agglomeration benefits and drawbacks. Further, we show that resources and capabilities have differing effects on the relationship between different benefits and drawbacks and firm survival, thereby creating a more fine-grained theoretical picture of how firm heterogeneity and agglomeration interact. These arguments contribute to further integrate the resource-based view—a literature that has been central to strategic management and entrepreneurship (Alvarez and Barney, 2004; Alvarez and Busenitz, 2001)—with the literature on agglomeration that has emerged predominantly in the literature on economic geography.

Our study makes a second, empirical contribution to the literature on agglomeration. With few exceptions (e.g., Audia et al., 2006; Dumais et al., 2002), prior studies have focused on the impact of externalities that stem from same-sector collocation and therefore have typically focused on the density of same-sector firms or the local level of same-sector employment. The implicit assumption in this research was that the spatial distribution of customers and suppliers is similar to the distribution of same-sector firms. While the theoretical argument has been made and individual mechanisms have been tested in a variety of studies (Rosenthal and Strange, 2003, 2006), our study is, to our knowledge, among the first that uses longitudinal firm-level data to empirically unpack the concept of agglomeration to reveal the unique effects of the local levels of skilled labor, specialized suppliers, purchasers, and competition on the survival of startups. Our results suggest non-trivial differences in the effects of local skilled labor, suppliers, and purchasers on survival. These findings suggest that future studies will need to measure these separately and that more fine-grained theorizing will further disentangle the effects of these mechanisms.

6.2. Contribution to research on new market entry

Our study also contributes more broadly to the study of market entry. Much of the prior literature has focused on mature firms acting as diversifying entrants or firms entering new markets through parent-company ventures such as franchises, parent spinoffs, or joint ventures (e.g., Alcacer and Chung, 2007; Chung and Alcacer, 2002; Kalnins and Chung, 2004; Klepper, 2002; Shaver and Flyer, 2000). Within this literature, the argument has been made that stronger diversifying entrants benefit less from agglomeration (Shaver and Flyer, 2000). At the core of this argument is that there is an adverse selection with respect to which diversifying entrants agglomerate. Specifically, Shaver and Flyer (2000) argue that larger entrants are less likely to agglomerate. While our study focused on independent new ventures and a direct comparison is therefore not possible, we believe the comparison of our findings with these prior findings adds insight because, in the past, arguments from literature studying diversifying entrants have often been directly extended to startups. Our results suggest that such an extension may ignore important differences between startups and diversifying entries, so theories dealing with the performance of these firms may not provide accurate predictions about the behavior of startups. Specifically, our analysis shows that for new ventures, a marginal increase in resources has the opposite effect than it does for diversifying entrants. Rather than reducing their survival rates, causing them to flee agglomerated areas (e.g., Shaver and Flyer, 2000), this increase enhances survival prospects and causes them to seek agglomerated areas out. These additional resources make areas of agglomeration more attractive, we argue, because they help the new ventures absorb and exploit the economies created by the cluster. When it comes to agglomeration drawbacks, we show that less-endowed startups are less affected by a competitive market structure, while those endowed with lower-quality employees may find it harder to withstand fierce competition.

6.3. Limitations and future research

As in any study, we need to acknowledge a number of limitations that open up avenues for future research. In our study, we were forced to make a tradeoff between the data used to operationalize our variables and the comprehensiveness of the sample

we study. We resolved this tradeoff by choosing to study all independent new ventures in the Canadian manufacturing sector from 1984 to 1998. As a result, we are bound by the limits of the data available from the T2-LEAP dataset. Although it is among the most comprehensive datasets we are aware of, this source create limitations in terms of the dependent and independent variables we can study. It has further limited us to startups with at least one employee. Future studies should build on and complement our study by following smaller cohorts of entrants and by studying these on a more fine-grained level. A second limitation stems from our focus on multiple industries. Although we went to great lengths in operationalizing our variables so they are comparable across industries, comparison across industries might be challenging. For instance, our sample forced us to use a relatively coarse measure of competition. We therefore encourage future studies to extend our study by focusing on individual industries and utilizing measures that are developed for a single industry context. A third limitation is the focus on the Canadian economy. Comprehensive data such as ours are simply unavailable in most countries, forcing us to limit ourselves to one institutional environment. Future research should replicate our study in different institutional environments, thereby testing for the generalizability of our findings across different geographies. A fourth limitation of our study stems from the lack of information on the characteristics of founders. A rich literature in entrepreneurship has examined the role of founder characteristics on the failure of startups, in particular in the early life-stages of a new venture (e.g., Baum and Bird, 2010; Baum and Locke, 2004; Beckman et al., 2007; Chandler and Jansen, 1992; Gimeno et al., 1997; Herron and Robinson, 1993; Lee and Tsang, 2001; Westhead and Wright, 1998; Westhead et al., 2001). Given that our data do not contain detailed information on the founders of the firms we studied, we were unable to control for these effects. However, we believe that the characteristics of founders are likely to be complementary to the effects we studied here. Future research could investigate the joint effects of resources and the characteristics of founders on the survival or failure of startups. Finally, our study focused on survival as the dependent variable. While we believe survival is the most fundamental prerequisite for all other outcomes of interest, future research should go beyond this variable and investigate other outcomes, such as firms' growth or profitability over time.

Our study also opens up several additional routes for future research. First, in our empirical analyses we focused on the direct effects of the local level of skilled employees, suppliers, purchasers, and competition. We might expect that these factors interact in a non-trivial way. Future research could investigate in particular how local levels of competition strengthen or weaken the benefits provided by local levels of skilled employees, suppliers, and purchasers.

Second, given the importance of heterogeneity in resources and capabilities that we found in our study, a logical follow-on question would be, what are the origins of this heterogeneity, and how do the factors described in this paper affect the development of resources and capabilities over time? While some research provides important pointers to answer these question (e.g., Dahl and Sorenson, 2007; Helfat and Lieberman, 2002; Henderson, 2003; Klepper, 2002; Pe'er et al., 2008), additional work would be needed to create a better understanding of the dynamic process of how entrepreneurs create initial resource bundles and develop them over time. Such research would further contribute to integrate the resource-based view with the literature on agglomeration, which has frequently focused on the firm's environment in its explanations of the processes taking place during the early stages of new ventures. Future studies should continue to explore how the environment and the resource base of the firm interact to shape the behavior of startups.

Finally, our study further suggests that systematic comparison between independent new ventures and diversifying new entrants would lead to a deeper understanding of the effects of agglomeration. As we have argued above, we have reason to believe that these firms face different opportunities and constraints, and we might therefore benefit from studies that extend current theory to explicitly incorporate these differences.

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Appendix 1. Endogeneity issues

We considered several endogeneity issues. It is plausible that some of our control variables are endogenous to agglomeration benefits and drawbacks. While this potential source of bias has recently been discussed in the agglomeration economic literature (e.g., Combes et al., 2010), it has been acknowledged that the nature of equilibrium in a system of locations makes the endogeneity problem especially daunting. Employees and firms are both mobile, as are their outputs. The processes underlying agglomeration economies operate at a fairly local level, so there are significant challenges in finding plausible instruments and disaggregated data that allow differencing. We ran our models excluding all control variables and received results that are consistent with the one reported in Table 2 as far as the signs and relative magnitudes of the coefficients are concerned.

The assumption regarding unobservable heterogeneity will not hold if unobserved characteristics of entrants affect the choice of locations, costs and benefits associated with competition and learning, and the likelihood of survival. For example, entrepreneurs could purposely choose (self-select) environmental traits (levels of agglomeration and competition), expecting performance enhancements on the basis of their specific characteristics (e.g., relative quality of human capital). Location in an environment characterized by high same-sector competition could be more attractive to entrepreneurs who have access to superior initial endowments and capabilities (Henderson, 2003; Pe'er et al., 2008). It is also plausible that entrants with higher-quality employees could purposely choose to enter environments with high failure levels. Such entrants could, for example,

benefit from recruiting employees whose training was provided by less productive entrants who failed. Entrants that best carry out all production activities internally (vertically integrated entrants) and have no intention to exploit locational opportunities for outsourcing could prefer more peripheral regions to benefit from lower labor and land costs. These choices, based on initial characteristics and strategic fit to an environment, may have direct effects on the probability of survival. Thus, studies that do not account for this endogenous choice may have a potential specification problem that could result in overestimation of the environmental factors.

The standard procedure to account for the selection bias is a two-stage model specification (Heckman, 1979). The first stage of these models is used to predict the likelihood that a firm will choose a specific strategy for their entry location. This stage generates a sample correction variable for self-selection, which is included as a control in the second stage—the survival model (treatment model). Several fundamental problems limit the ability to implement this procedure. First, researchers need to reduce all the economic and strategic environmental attributes underlying a choice of location to a binary version. Since locations offer a bundle of attributes across multiple dimensions (e.g., competition with different populations, supplier concentration, purchaser concentration, and potential sources of vicarious learning) that entrants match to best fit their needs (Baum and Haveman, 1997), a binary version will not accurately reflect the strategic choices made. Second, the first stage should include at least one variable that affects the choice of location but does not affect firm performance. Such a variable is hard to find in the current context, since firms ultimately attempt to enhance their survival when choosing a location (Dahl and Sorenson, 2007; Henderson, 2003). If no such variable is available, it may be difficult to correct for sampling selectivity using this method and the researcher should include the source of selection as controls in the survival model (Wooldridge, 2002). Finally, the method restricts the estimates of the correction variable so that it is the same for all entry strategies when there is no reason to believe that the effects are similar. Furthermore, this restriction makes it difficult to interpret the effect of self-selection (Shaver, 1998). Given these problems, Heckman correction is often either unavailable or results are uninformative about the basic economic decisions that produce the selectivity bias, and the researcher may be better advised to rethink these basic decisions rather than mechanistically apply the Heckman method (Maddala, 1992).

In light of these problems with the Heckman two-stage approach, we correct for self-selection by including the sources of initial firm heterogeneity identified in prior research (see Pe'er et al., 2008) as controls in our models — as Wooldridge (2002) suggests—where, for instance, identifiable sources of heterogeneity cause the self-selection. We include controls for *initial employment*, *initial assets*, and *initial sales*, operationalized as the natural logarithm of the value of employment, assets, and sales at the first year of operation. Including controls for initial firm heterogeneity is also consistent with previous theoretical and empirical research arguing that differences in resources and capabilities that existed at the time of founding have persistent impacts on the chance of survival (Dunne et al., 1988; Geroski and Mazzucato, 2002; Klepper, 2002; Shane and Delmar, 2004). Robustness analysis with these measures of initial firm heterogeneity (Model 9) produced qualitatively similar results, further supporting our results.

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