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Lower St. Lawrence region, 2006-2011

Cédric Brunelle and Jean Dubé

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# **Does Proximity Increase the Survival of Firms in Remote Areas?**

## **An analysis of plant closures in Quebec's Lower St. Lawrence region, 2006-2011**

*Working Paper for the Swedish Entrepreneurship Forum*

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## Abstract

This paper presents an empirical study of the factors surrounding the survival of plants in Quebec's Lower St. Lawrence region between 2006 and 2011—a period covering one of the most important economic recessions of recent history. The region is characterized by its remoteness from large metropolitan areas, low firm turnover, and a high number of Small and Medium Size Enterprises (SMEs). Based on a micro-spatial dataset of about ten thousand establishments, we build local spatial indices to account for the effect of different types of proximities on firm survival. The research emphasizes the potential role of agglomeration economies, relatedness, and local value-chain linkages in lowering the risks of plant closure, while controlling for other factors such as firm size, labour market characteristics, regions, and industries. Using logistic regression, we find that local specialization, scale economies and the proximity to a variety of related industries favour the survival of plants, while the strongest positive effects are triggered by the proximity of local suppliers, as derived from a forward linkages index based on the Input-Output (IO) matrix. However, the effects are not the same across space, which suggest that different types of proximities may be intrinsically linked to geography.

**KEYWORDS:** Agglomeration externalities, firm survival; regional development; Related industries, Logistic regression

**JEL classification:** R12, R58, L29, O18

# 1. Introduction

From Marshall (1890) to Porter (1990), the proximity of economic activities has been acknowledged as one of the main explanations for the competitive advantage of firms, regions and nations. The clustering of similar industrial activities may be beneficial in several ways, facilitating the sharing of intermediate inputs, labour market pooling as well as the exchange of critical information for the competitiveness of firms. These advantages are now widely recognized as economies of localization—a set of positive economic externalities resulting from the spatial proximity of firms in the same industry.

But other perspectives on the effects generated by proximity have since emerged. Jane Jacobs (1969) was one of the first to raise the role that the clustering of a diversity of activities may play in generating growth for cities. Jacobs's externalities—economies gained from the proximity of a diversity of activities—have been described as key determinants of economic growth and competitiveness, promoting innovation through the exchange of information between industries.

Because of their importance for local policies, many studies have sought to understand how these two types of externalities may impact the performance of firms in terms of productivity and employment growth. A rising body of literature is developing on this topic, making huge progresses in overcoming several of the theoretical shortages between proximity of either similar or diverse activities. Concepts of *related variety* (Boschma and Iammarino 2009; Frenken, Van Oort, and Verburg 2007) and *localized mobility clusters* (Bienkowska, Lundmark, and Malmberg 2011; Boschma, Eriksson, and Lindgren 2009; Eriksson and Lindgren 2009) have been proposed to highlight the existence of external economies derived from the juxtaposition

of different, but closely related industries. Although related variety and localized mobility clusters have been described as key determinants of the performance of firms in a wide range of contexts (Boschma, Eriksson, and Lindgren 2009; De Vaan, Boschma, and Frenken 2012; Eriksson and Lindgren 2009; Timmermans and Boschma 2013), less has been said on the potential of relatedness and proximity in promoting firm survival, though a recent study by Neffke et al. (2012) suggests positive impacts on the survival rates of plants in Sweden between 1970 and 2004.

Yet, the question of the impact of proximity on firm's performance has only been asked in a limited number of geographical contexts, mainly in European countries. We think this question deserves reconsideration for sparsely populated and remote regions in other parts of the world. In distant places characterised by high unemployment rates, low firm turnover, frequent plant relocations, and a high number of small and medium sized enterprises (SMEs), keeping a business alive is of crucial importance. In this context, the question of firms' performance—i.e. labour growth, productivity, exports or value-added—seems somewhat secondary to the question of their resistance to economic shocks over time. Whereas survival may be seen as a measure of performance (De Vaan, Boschma, and Frenken 2012; Neffke, Henning, and Boschma 2012), it may also be considered as an indicator of economic resilience, which appears as a pertinent concept to account for fragile economies, more so in the setting of economic recessions. The 2008 financial crisis has had numerous consequences on local economies, many of which have made firms and regions more vulnerable to strong and rapid external shocks. The concept of resilience has thus accordingly attracted increased attention over the past five year—i.e. studies by Briguglio et al. (2008) or Martin (2012)—contributing to making it a central idea in economic geography and regional sciences.

Besides these questions, the notion of proximity raises in itself some serious theoretical and empirical issues which may have been partly neglected from previous works on plant performance. An important paper by Boschma (2005) underlines five dimensions to proximity—*social, institutional, cognitive, organisational* and *geographic*—which are central to the interactions between economic agents. Despite that some dimensions of proximity may still raise challenges—i.e. social or institutional proximities—the role of other types of proximities—i.e. cognitive or organizational—on firms' performance and survival has to some extent been established (Boschma, Eriksson, and Lindgren 2009; De Vaan, Boschma, and Frenken 2012; Eriksson and Lindgren 2009; Neffke, Henning, and Boschma 2012; Timmermans and Boschma 2013; Eriksson 2011). Yet, these studies have generally treated geography in a limited way, partly reflecting empirical problems linked to the levels of spatial disaggregation of available databases or other theoretical considerations on the capacity to distinguish between conceptualizations of spatial and relational proximities (Crevoisier 2011). More efforts would be required to properly grasp the relation of geographic proximity relative to other types of non-geographic proximities, especially in assessing the survival of firms. We strongly feel that geography should be taken more directly into account in such studies: the fast development of GIS techniques and spatial analysis creating many opportunities.

This paper presents an empirical study of the factors surrounding the survival of establishments, mainly small and medium-sized enterprises (SMEs), in Quebec's Lower Saint-Lawrence region between 2006 and 2011. Located at the eastern periphery of Quebec province in Canada, the Lower Saint-Lawrence (LSL) region is characterized by its remoteness from large metropolitan areas, high unemployment rates, frequent plant relocations, low firm turnover, and a high number of small firms. Our study relies on a micro-spatial dataset of about ten thousand establishments between 2006 and 2011. The research emphasizes the potential role

of agglomeration economies, relatedness, and local value-chain linkages in lowering the risks of plant closure, while considering other factors such as socioeconomic characteristics, sectors or firm size. Consisting of the whole population of firms in the LSL, the database is rich in terms of its spatial and industrial disaggregation—establishments being geocoded at the specific address, while industries are defined at the six digits of the North American Industrial Classification System (NAICS).

Our model is based on the use of logistic regressions, where we estimate factors enhancing the probability of firm survival between 2006 and 2011. Survival may be affected by external shocks—the period of our study being at the heart of one of the largest economic crisis in history. How do different types of proximities affect the survival of firms in such a context? Our measures of proximity are based on spatial analysis, where space is treated as continuous, and neighbouring firms are used as proxies for the construction of different types of proximity indices. Spatial economies as well as proximities are calculated in “local zones” defined at specific distance thresholds. We include variables that account for the different types of agglomeration economies—scale, localization, urbanization, and Jacobs’ externalities—as well as the effect of specialization, related variety and indexes of local input-output relations. Our control variables include socioeconomic characteristics of local labour markets, as well as firm size, regions and sectors.

## **2. Theoretical background**

### **2.1 Proximity and agglomeration**

There is plenty of evidence that the proximity of economic activities plays a central role in the competitive advantage of firms, regions and nations. Over the past two decades, the

concept has been strongly associated with *agglomeration economies*, broadly referred to as the benefits arising from the co-location of firms and individuals. But the relative effects of locating near other economic activities soon becomes complex when specific types of proximities are explored. Researchers are usually split between four types of externalities—*economies of scale*, *localization economies*, *Jacobs's externalities*, and *urbanization economies*—when considering the benefits gained from proximity (Rosenthal and Strange 2004; Glaeser et al. 1992; Frenken, Van Oort, and Verburg 2007).

*Economies of scale* are cost advantages that firms may gain in relation to the size of serving a particular market. Cost per unit of output decrease with increasing scale as fixed costs are spread out over more units of output. Another set of externalities arise from specific types of economies of scale linked to the concentration of activities within a particular industry. Known as Marshall-Arrow-Romer (MAR) externalities in honor of the seminal works by Marshall (1890), Arrow (1962), and Romer (1986), *economies of localization* describe a set of positive economic externalities resulting from the concentration of activities belonging to the same industry. Concentration of similar activities is beneficial in several ways, generating economies in the sharing of intermediate inputs, the pooling of labor markets, as well as the exchange of crucial information to the competitiveness of enterprises. The third type of economies point in the opposite direction. *Jacobs's externalities* do not arise from specialization, but from advantages gained by the clustering of a variety of sectors and economic activities. As opposed to localization economies, Jacobs's externalities suggest that local competitiveness and innovation may be fostered through the exchange of information or knowledge spillovers between different sectors (Glaeser et al. 1992; Quigley 1998; Jacobs 1969). Because diversity is generally found in larger cities, Jacobs's externalities have often been confused with a fourth type of externalities—*urbanization economies*—which are arising from urban size and density.

Rather than spatial externalities generated through the local presence of a diversity of sectors, urbanization economies arise from the sharing of infrastructures, institutions or other benefits associated with being located in a larger city.

While the role played by these economic forces is now widely recognized, a growing body of literature has recently put this quartet in question; suggesting that other types of spatial juxtapositions may also have significant effects on the behavior of firms. At least since the important contributions of Boschma (2005) and Bathelt and Glückler (2003), there has been an increased awareness that relational proximities between economic agents—i.e. social, cognitive, institutional, or organisational—may be distinct from geographic proximity alone. In these emerging perspectives, an important point of focus has been the exploration the mechanisms of the process of knowledge spillovers, notably through the analysis of the cognitive dimension of proximity. One of the main contributions to these studies is to recognize that knowledge is more likely to be transmitted between economic agents if their cognitive distances is neither too large, to ensure effective learning, nor too small, to allow different types of knowledge to be learned (Boschma and Frenken 2011). This process has been especially well captured by the notion of relatedness, which has been extensively used to capture different types of spillover effects. Concepts of *related variety* (Boschma and Iammarino 2009; Cainelli and Iacobucci 2012; Frenken, Van Oort, and Verburg 2007), *skills relatedness or portfolio* (Neffke and Henning 2013; Boschma, Eriksson, and Lindgren 2009); *labour mobility* and *localized mobility clusters* (Eriksson and Lindgren 2009) or *related labour inflows* (Timmermans and Boschma 2013) have been proposed to pin-point specific ways by which knowledge spillover effects may occur across seemingly diverse activities, but which are strongly related in terms of their knowledge bases or behavior. Relatedness emphasize that not all types of diversities may promote economic growth

(or survival), but that certain types of varieties—some functions, cognitive sets or relations found within a range of industries—could have such effects.

There is much to learn from this more complex vision of proximity and agglomeration externalities; yet we feel that some dimensions should be explored more thoroughly. Particularly, there seems to be potential limitations with the treatment of geography proposed in many of these approaches, where proximities may be entirely split between space and types of non-spatial relations between actors. While we recognize the existence of other dimensions to proximity, we think that, in most cases, the two can hardly be separated—a position also shared by Crevoisier (2011). This highlights the need to properly empirically assess potential spatial variations of the effects of different proximities. The inherent complexity of these new concepts should lead to finer analyses that ultimately require much more detailed and disaggregated data. While several sources are not available at finer scales, regional entities below the local level superimposes the theoretical novelties of these approaches to traditional issues of aggregation that are the ecological problem (Robinson, 1950) and the Modifiable Areal Unit Problem (MAUP) (Openshaw and Taylor 1979). We think that there is still much to be done to develop an empirical framework that can provide the richness and reliability of observations required to address the analysis under these new theoretical perspectives. In a context of mobility, these issues also overlap with the importance of understanding these dynamics in a spatial context (Tobler 1970) facing time constraints (Hägerstrand 1970).

## **2.2. Determinants of firms' survival**

The literature on firm survival is quite extensive; though the role of spatial externalities on firm exits has not attracted as much attention as it has in the literature on firm performance. As outlined by Neffke, Henning, and Boschma (2012), determinants of plant closings have generally

been studied in the fields of industrial dynamics and business studies, which have highlighted the effects of firm characteristics, including the size and age of establishments (Dunne, Roberts, and Samuelson 1989; Mata, Portugal, and Guimarães 1995); firms' pre-entry experience (Bayus and Agarwal 2007; Dencker, Gruber, and Shah 2009); types of technologies and innovations (Cefis and Marsili 2005; Audretsch 1991); the product life-cycle and the maturity of the industry (Agarwal and Audretsch 2001; Agarwal and Gort 2002). In spite of the inherent heterogeneity of firms' characteristics—the exact portfolio of individual firms being extremely diversified—a thorough finding in this literature is that firm size and age are very important predictors of firm survival.

Industrial and business studies have also stressed the role of macroeconomic trade environments on firm survival. Being an exporter or an importer usually has a positive effect on firm survival (Pérez, Llopis, and Llopis 2004; Wagner 2013), although it may have diverging effects, depending on trade conditions. In the Canadian context, studies show that changes in exchange rates and trade tariffs play a significant and positive role on the probability of business exits (Baggs, Beaulieu, and Fung 2009; Baldwin and Yan 2011). Given the context of increasing trade liberalization following the North American Free Trade Agreement (NAFTA), these studies demonstrate that Canadian exporters are more sensitive than non-exporters to the appreciation of the Canadian currency relative to the US dollar, controlling for other firm characteristics.

This is an important point to keep in mind for the period of our study, as there are good reasons to believe that the 2008 financial crisis may have amplified these effects, with a radical decrease of the US currency paralleled by the rise of the Canadian dollar. In this context, one could certainly wonder about the potential impacts of local linkages between buyers and suppliers on firm survival, as these are likely to play a substituting role in the case of a direct exposure to large external macroeconomic shocks. It is then surprising that the levels of local

forward or backward linkages have so far been ignored from studies from this line of literature, so have other types of local characteristics.

Notwithstanding their contribution, few studies in this previous literature have considered how regional characteristics and agglomeration externalities may particularly impact firm survival—a topic yet well developed in the literature on firm performance. Among the firsts to highlight the role of regional environments of firms' survival were the papers by Falck (2007) and Fritsch, Brixey, and Falck (2006). Their studies show that new firms in Germany are less likely to exit if there are other new businesses in the same region and industry, emphasizing the existence of spatial autocorrelation and neighbourhood effects in predicting firm survival. Wennberg and Lindqvist (2010) get similar results for services' firms in Sweden, where they find that industry clusters have a positive impact on firm survival. However, their research stresses that the strengths of the effects vary depending on the chosen geographical aggregation level for the agglomeration measure, which is also consistent with these previous findings.

As noted earlier, the emerging literature on firm performance, with the notion of relatedness at its core, has put a renewed vision of the role of agglomeration externalities on firm performance. Yet, this perspective is still limited in studies on firm survival. To our knowledge, only two articles have so far made an empirical assessment of the impact of related variety on firm survival. Considering the evolution of the car industry in Britain between 1895 and 1968, Boschma and Wenting (2007) show that the presence of previous related industries—i.e. bicycle or coach making industries—have had a positive impact on the survival of automobile firms, but localization economies have a negative impact on survival of new entrants. They also find that urbanization economies do not have significant impacts. More recently, Neffke, Henning, and Boschma (2012) have assessed the effect of agglomeration economies and the role of related variety on the survival of Swedish firms between 1970 and 2004. They find that

agglomeration externalities affect the survival of plants, with Jacobs's externalities having a positive effect for young plants. Controlling between affiliated and non-affiliated firms, they also find that urbanization externalities are found to be hurting businesses at all ages, while localization economies have no significant effect over the period. Technological relatedness is found to have an important positive role on firm survival.

Other studies suggest that these effects may also be strongly dependent on the particular long term development trajectories of regions as well as macroeconomic recessionary shocks. For the US, Acs, Armington, and Zhang (2007) find that regional levels of human capital, city size and diversity have a positive effect on firm survival, although the concentration of firms in the services sector tended to increase the probabilities of exit. More important is that their study shows that these results may be strongly affected by the setting of an economic crisis, with weaker effects during the 1990-92 recession period, and stronger effects after. Besides, study by Staber (2001) provides strong evidence of the influence of regional development trajectories on firm survival. Based on the case of the knitwear firms in Baden-Württemberg, Germany, between 1960 and 1998—an economically declining regional industry—they investigate the effects of geographic proximity on firm survival. They find that location in clusters of firms in the same industry increased business failure rates, and location in diversified clusters of firms operating in complementary industries reduced failure rates.

### **2.3 Firm survival and the economic resilience of remote regions**

So far, the impact of proximity on firm's performance has only been assessed in a limited number of geographical contexts, mainly in European countries. We think this question deserves reconsideration for sparsely populated and remote regions in other parts of the world. In regions facing high unemployment, out-migrations and low firm turnover, the Schumpeterian

idea of a “creative destruction” may not be as straightforward as in highly dynamic regions—the death of firms rather suggesting “permanent destructions”, if not potential long term shifts of regional development trajectories. It then follows that the question of firms’ performance—i.e. labour growth, productivity, exports or value-added—may be less crucial for these regions than the more dramatic question the capacity of firms to survive through strong recessionary shocks over time. Adding to unfavourable local conditions, the 2008 financial crisis has had numerous consequences on local and national economies, many of which have made firms and regions more vulnerable to strong and rapid external shocks.

In this context, resilience appears as a pertinent concept to account for the specificities of fragile economies. In his paper, Martin (2012) presents four dimensions to resilience—*resistance, recovery, re-orientation* and *renewal*—defining resistance as “*the vulnerability or sensitivity of a regional economy to disturbances and disruptions, such as recessions*” (p.11). Considering the cumulative processes and path dependency effects that may be generated by the closing a single firm, the question of its survival soon becomes that of the resilience of industries and regions. Understanding the characteristics that shape the resistance of businesses to macroeconomic shocks thus also allows understanding how, in aggregate; it may affect the dynamics of industries and regions. The long-term positive impact of business creation and performance on regional development has long been recognize (Fritsch and Mueller 2004). As such, we may make the assumption that the resistance of firms to external economic shocks could, on the long run, favour more resilient development paths for such types of remote and declining regions.

## 2.4 Hypotheses

Considering the previous discussions, we think that firms' survival may be strongly affected by local conditions, notably through the effects of agglomeration economies and cognitive proximity (*i.e. relatedness*). The particular setting of our study, which is that of a declining region during time of a major an economic crisis, may bring considerable differences with previous similar studies. External macroeconomic shocks are expected to be important drivers of firms' exits over the period. As such, we also want to account for the role of proximity in terms of local forward and backward linkages—proximity of potential suppliers and buyers—which may act as protective barriers to those external shocks. Based on the findings by Neffke, Henning, and Boschma (2012), we posit the following hypotheses:

*H1: Scale, localization, urbanization and Jacobs' economies positively increase the probability of firms' survival.*

There are good reasons to believe that all types of agglomeration economies would favour the survival of firms, despite some contradictory results in the literature. While the clustering of similar industries in declining regions has been reported to act negatively on survival, we believe that positive effects could be found once controlling for different industries.

*H2: Related variety positively increases the probability of firms' survival.*

All previous studies that have assessed the role of cognitive or technological types of proximities on firm survival have found positive effects from the clustering of a variety of related industries.

*H3: The strong presence of local forward and backward linkages has a positive impact of the survival of firms.*

Although no study has yet assessed this hypothesis, we think that the particular setting of the 2008 economic crisis in the Canadian context will favour firms that are more integrated in local value-chains through networks of local buyers and sellers which are protected from

external recessionary shocks. These may also have broader effects in terms of knowledge transfer as well as structuring effects on local organizational and institutional routines.

*H4: The effects of the different types of proximities on firm survival vary with distance.*

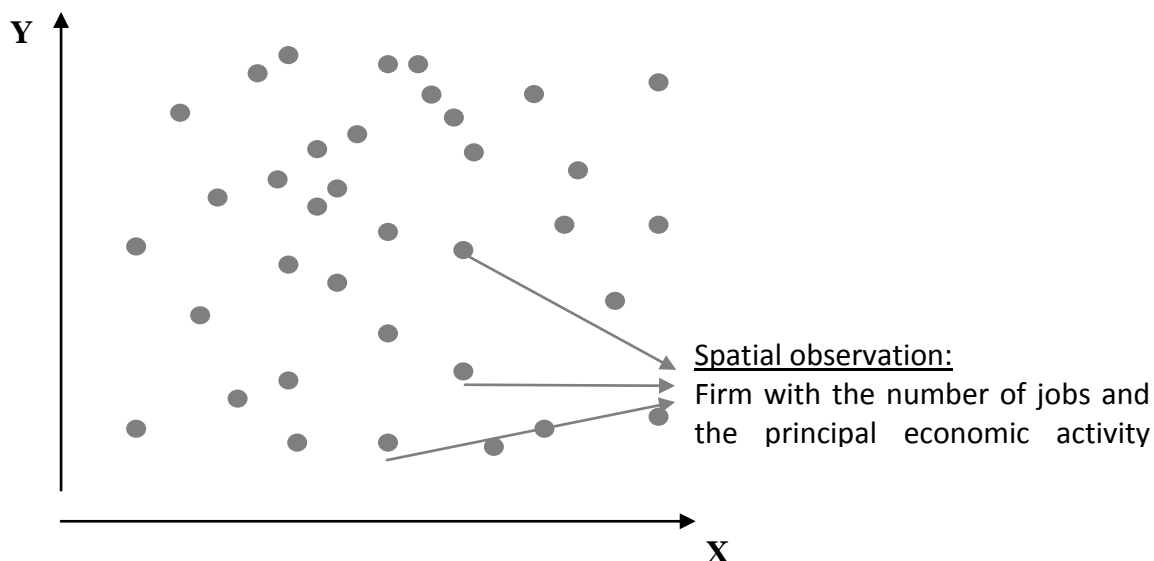
There are good reasons to believe that the previous measures of proximities may vary over distance. One novel aspect of this paper is to test whether the relationships between survival and proximities vary at different distance thresholds, based on the construction of local spatial indices characterizing the unique environment of each firm.

### 3. Analytical framework

#### 3.1. Building local spatial indices

Using micro-data, this paper builds on a conception of space as a continuum, where indicators of proximity and agglomeration effects are calculated locally at varying scales (Figure 1). One of the main challenges related to the use of individual spatial units (firms) is building indices that express diversity or specialization in local areas. If these indices are trivial to calculate with observations expressing aggregate spatial data, the transposition of the methodology with micro-data is not direct because observations are independent from another. We then need to express these relationships based on distance. The individual firms are spatially located based on a two dimension representation: the  $Y$  (north-south) coordinates and the  $X$  (east-west) coordinates (Figure 1).

**Figure 1– Location of observations (firms)**



This representation allows to build a general distance matrix, **D** (equation 1) of dimension  $(N \times N)$ , based on the usual Euclidian distance<sup>1</sup> separating firm  $i$  from firm  $j$ , (equation 2).

$$\mathbf{D} = \begin{bmatrix} 0 & d_{12} & \cdots & d_{1j} & \cdots & d_{1N} \\ d_{21} & 0 & \cdots & d_{2j} & \cdots & d_{2N} \\ \vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\ d_{i1} & d_{i2} & \cdots & d_{ij} & \cdots & d_{iN} \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ d_{N1} & d_{N2} & \cdots & d_{Nj} & \cdots & 0 \end{bmatrix} \quad (1)$$

$$d_{ij} = \sqrt{(X_i - X_j)^2 + (Y_i - Y_j)^2} \quad \forall i, j = 1, 2, \dots, N \quad (2)$$

Where  $N$  is the total number of firms.

Using the general distance matrix, it is possible to build a specific connectivity matrix, **C**, that express a constraint version of the distance matrix based on a threshold distance, noted  $\bar{d}$  (equation 3).

$$c_{ij} = \begin{cases} \kappa & \text{if } d_{ij} \leq \bar{d} \\ 0 & \text{if } d_{ij} > \bar{d} \end{cases} \quad (3)$$

Where  $\kappa$  is a general notation that can be replaced by one (1) if the interest is to calculate the number of firms within a given radius of influence, or by  $e$  if ones is interested in calculating the total number of employ located within a given distance, where  $e$  represent the total number of employment of the firm.

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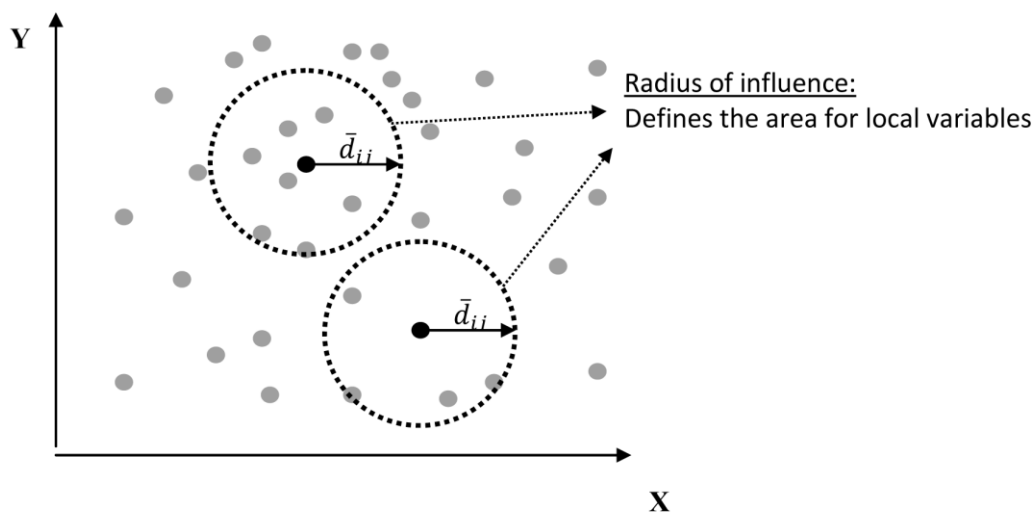
<sup>1</sup> Of course, any distance could be used in this specification. However, the Euclidian distance and the Mannathan distances are quite easy to compute because only the geographical coordinates are needed.

With this representation, it is possible to calculate, for a particular line  $i$ , the total number of firms or employment ( $n_i$ ) in the other firms  $j$  located within the threshold distance  $\bar{d}$  from a given firm  $i$ . Thus, summing the elements appearing on a line gives the total number of firms ( $\kappa = 1$ ) or employment ( $\kappa = e$ ) located within a critical distance (equation 4).

$$n_i = \sum_{j=1}^N c_{ij} \quad (4)$$

This mathematical expression is simply a compact way of expressing what is usually done in geographical information system (GIS) using buffer specification (Figure 2) with the difference that this approach can be operationalized through matrix calculation<sup>2</sup>, which makes the computation faster.

**Figure 2- Construction of multiple local indices**



<sup>2</sup> The matrix of total number of firms or employment located among the critical distance  $\bar{d}$ , is given by a simple matrix multiplication operation:  $\mathbf{N} = \mathbf{C} \cdot \mathbf{1}$ , where  $\mathbf{1}$  is a vector of 1 of dimension  $N$ .

This simple decomposition can be generalized to calculate the total number of firms for a given economic sector  $s = \bar{s}$ . In this case, there is a total  $S$  connectivity matrices, each expresses a more complex restrictive expression (equation 5).

$$c_{ij} = \begin{cases} \kappa & \text{if } d_{ij} \leq \bar{d} \text{ and } s = \bar{s} \\ 0 & \text{if } d_{ij} > \bar{d} \end{cases} \quad (5)$$

The total number of firms ( $\kappa = 1$ ) or employment ( $\kappa = e_s$ ) in a given economic sector ( $n_{is}$ ) in a given vicinity is then obtain by the addition of the connectivity term on a line of the matrix (equation 6). This operation can be generalized to all connectivity matrices representing each economic sector.

$$n_{is} = \sum_{j=1}^N c_{ij} \quad (6)$$

The sum of the total number of firms or employment in each economic sector returns the total number of firm or employment for all economic sectors (equation 7). Thus, the equations (4) and (7) are equivalent.

$$n_i = \sum_{s=1}^S n_{is} \quad (7)$$

However, the decomposition in (6) and (7) allows to compute the percent of firm, in a given radius of influence, in the economic sector  $s$  (equation 8) and the usual indices (Herfindhal, Entropy) can be calculated, for each firm, on an individual basis instead of an aggregated basis.

$$p_{is} = f_{is} / f_i \quad (8)$$

An interesting feature is that varying the threshold distance parameter  $\bar{d}$  allows to define different local spatial indices. Models can therefore be estimated using different values for each individual. In this sense, this general methodology to build the local indices allows to test for the possible radius of influence that significantly affects the phenomena under study. Variance of local indices varies according to the critical distance parameter used. This suggests that the MAUP problem may not be a limit when application is based on individual spatial units instead of the usual regional aggregates.

### 3.2. Agglomeration economies

We measure localization economies in a similar way to the index developed by Neffke, Henning, and Boschma (2012), which proposes a proxy for economies arising from labour market pooling in a given industry. For a given plant  $o$ , the indicator used is the difference between employment potential in industry  $i$  in local area  $j$ , minus the firm's own employment:

$$LocEcon_i = E_{ij} - E_{oij} \quad (9)$$

Scale effects are measured in a straightforward way by simply taking the average number of workers per firm in the area  $j$ , minus the firm's own employment:

$$Scale_j = (E_{..j} - E_{oij}) / F_j, \quad (10)$$

Where  $F_j$  is the number of firms in area  $j$ .

Relative specialization corresponds to the size of the firm relative to same-industry employment in the local zone  $j$ . This measures the level of the firm's uniqueness in the given local area. The index is measured similarly to a location quotient:

$$Specialization_j = (E_{oij}/E_{.ij}) / (E_{.i}/E_{...}) \quad (11)$$

Urbanization economies simply measured by taking the population logarithm of the municipality in which each firm falls.

### 3.3. Related Variety

We measure indices of related and unrelated variety based on the now widely used index developed by Frenken, Van Oort, and Verburg (2007). As an indicator of Jacobs's economies, unrelated variety per region is specified by the entropy of the two-digit distribution of employment in the local area. Related variety is indicated by the weighted sum of the entropy at the three-digit level<sup>3</sup> within each two-digit class. Formally, let all the three digits industries  $i$  fall exclusively under a two-digit sector  $S_g$ , where  $g=1,...,G$ . One can derive the two digit shares,  $P_g$ , by summing the three-digits shares  $p_i$ :

$$P_g = \sum_{i \in S_g} p_i \quad (12)$$

The entropy as the two-digit level, or unrelated variety, is given by:

$$UNRELVAR_j = \sum_{g=1}^G P_g \log_2 \left( \frac{1}{P_g} \right) \quad (13)$$

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<sup>3</sup> We preferred using a three digit rather than industrial disaggregation at the five or six digits since local areas, with radius ranging between 500 meters and 10 kilometers, did often not allow enough firms to account for the extra variability provided at that level.

Related variety, which is the weighted sum of entropy within each two-digit sector, is given by:

$$RELVAR = \sum_{g=1}^G P_g H_g \quad (14)$$

Where:

$$H_g = \sum_{i \in S_g} \frac{P_i}{P_g} \log_2 \left( \frac{1}{P_i/P_g} \right) \quad (15)$$

### 3.4. Local Value-Chains Linkages

In order to account for the effects of proximity of value chains linkages—both forward and backward—we created specific indexes for local areas, based on Input-Output matrix. The measure of local value-chains proximity for forward linkages (FWDLINK) was measured as follows. We created a weight component for each industry  $i$ , based on the total basic price valuation of provincial spending used as inputs from that industry to the given firm's sector, as derived from the Quebec provincial average Input-Output (IO) matrix.  $IN_i$  is then the total inputs in dollars that industry  $i$  provides to the sector of the given firm at the provincial level.  $IS_i$  is simply the share of inputs that industry  $i$  provides relative to the total provincial inputs of the firm's sector:

$$IS_i = \frac{IN_i}{IN}, \quad (16)$$

Within the specific local area  $j$ , employment share  $ES$  that each industry  $i$  represents relative to the area's total employment  $E \cdot j$  is given by:

$$ES_{ij} = \frac{E_{ij}}{E \cdot j}, \quad (17)$$

FWDLINK is then defined as the weighted sum of employment shares of each industry relative to the proportion of inputs of that industry to the firm's sector in local area  $j$ :

$$FWDLINK = \sum_i Is_i * Es_{ij}, \quad (18)$$

The variable backward linkages (BCKLINK) is calculated essentially in the same way as FWDLINK, but by changing the weight component  $Is_i$  for  $Os_i$ , which is based on basic price valuation of provincial output spending from each industry  $i$  to the given firm's sector, as derived from the Quebec provincial average Input-Output (IO) matrix:

$$Os_i = \frac{OU_i}{OU}, \quad (19)$$

$$BCKLINK = \sum_i Os_i * Es_{ij}, \quad (20)$$

## **4. Empirical Analysis: Plant Closures in the Lower St. Lawrence**

### **Region**

#### **4.1 Data**

Our database relies on the List of Industries and Trade (LIT) from the Quebec Ministry of Employment and Social Security. This source offers data compiled at the plant level for the entire population of firms in the Lower St. Lawrence region between 2006 and 2011. Information is gathered through local partners, where collection methods may be comparable to that of an annual census where partners try to contact all legal firms listed on their territory during the year.

An interesting feature of the database is its level of disaggregation. Firms are provided with their exact address, which allows geocoding at a very fine scale. Besides, the coding of the primary industry is carried out by using the North American Industrial Classification System (NAICS) at the six digits level. The number of jobs provided for each firm corresponds to the most active period of the company during the past year. Despite that the frequency and methods for updating the database vary between different local partners, the organization estimates that nearly thirty percent (30%) of establishments in the list are in fact continuously updated on a day to day basis, while the remainder is updated once a year.

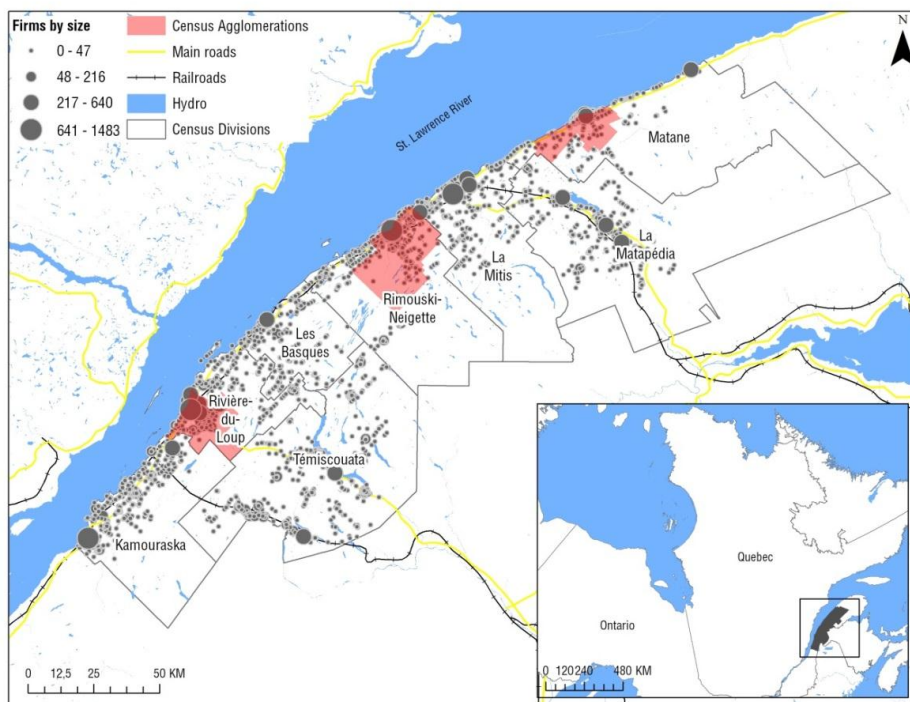
The data used comprises a total of 9839 establishments (firms), of which 1184 are closing between 2006 and 2011. Given that the focus of this article is on plant survival, a central element that should be made explicit is that of the exact procedure defining what makes a firm exit in our database. The LIT provides each establishment (firms) with an individual ID number, uniquely identifying the establishment as a physical entity. If a firm is relocated within the

region, it retains its ID and is thus not counted as a firm exit. The data is also not affected if the entire plant is acquired by another firm. If a new plant is set on the address of an old plant, it will be assigned a new ID. To control for cases of potential merging, we thus executed a spatial match between the exiting firm and the possible merging firm, thus eliminating any counted exit that would be caused by the acquisition of the establishment by another firm.

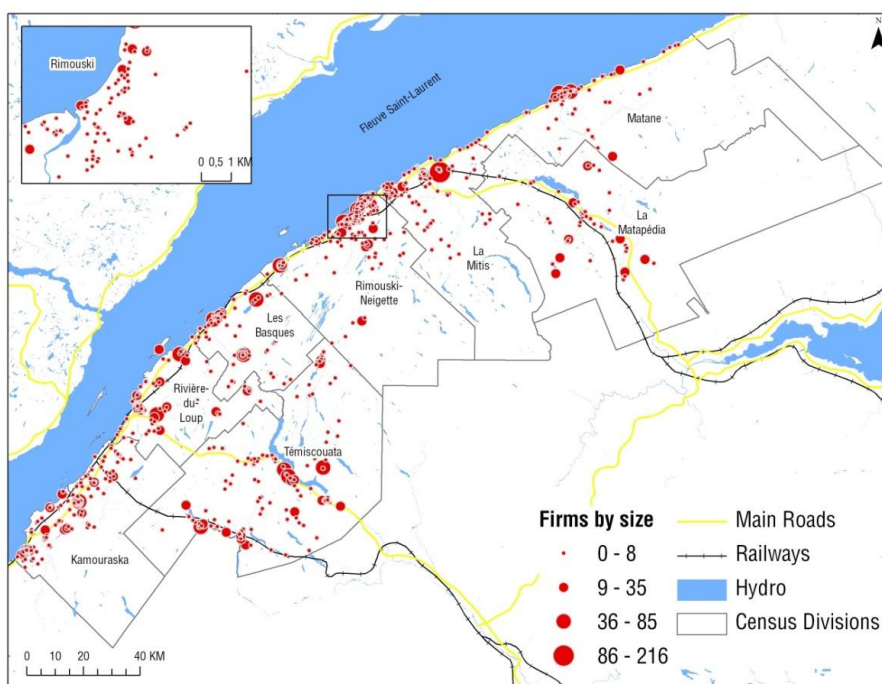
The database covers the entire population of firms in Lower St. Lawrence (LSL) between 2006 and 2011. The region is characterized by its remoteness from large metropolitan areas—the closest being Quebec City, located a three hour drive from the region’s core (Figure 3). The three main urban centres in the LSL are identified by light red shading on Figure 3: respectively, Rimouski, Rivière-du-Loup and Matane, with populations of fifty, twenty and fifteen thousand habitants. This contrasts with the region’s size, which extends across twenty-two square kilometers, making population densities relatively low. A consequence is the wide dispersion of firms and activities across space (Figure 3), although clustering may be seen in urban centres and along major roads leading to other centers outside the LSL. The region faces numerous challenges: population decline and aging, low firm turnover, as well as a high number of very small firms, although local champions have emerged in the peat moss and transport industries. This precarious regional setting has made firms particularly prone to closing and relocation. The recent decision of Bombardier’s transport division to relocate its engineers to its Montreal branch provides a good example. Following the 2008 recession, the region faced several plant closures, depicted on Figure 4. Although the whole region was affected, the map also suggests that there may be spatial patterns associated with the closings. Descriptive statistics of variables in the database are provided in Tables 2 and 3 in Appendix, with t-tests showing significant differences between the local indices for firm that survived and ones that closed over the

period–local areas being defined for a five kilometer threshold. Table 3 offers cross-correlations of the variables for the same dataset.

**Figure 3 - The distribution of firms in the Lower St-Lawrence region, Canada, 2006**



**Figure 4 – Firms' closures between 2006 and 2011, Lower St. Lawrence, Canada**



## 4.2 – The model

We model plant survival through logistic regressions, where we estimate factors enhancing (or lowering) the probability of firm survival between 2006 and 2011. Because our database lacked important temporal variables such as the age of the firms, survival analysis could not be used to assess time to failure and event rates, as proposed in studies such as the one from Neffke, Henning, and Boschma (2012). Several studies of firm survival have relied on the use of Logit or Probit models to assess the survival of firms, such as studies by Audretsch, Houweling, and Thurik (2000); Baldwin and Yan (2011); Greenaway (2009); Timmermans (2009)<sup>4</sup>. In our model, measures of proximity presented earlier are based on the definition of unique environments for each firm, where space is treated as continuous, and neighbouring firms are used to calculate indices for different types of proximities. Agglomeration economies, indices of relatedness, as well as local value-chain linkages are calculated in “local zones” defined at specific distance thresholds, as previously presented. Our control variables include socioeconomic characteristics of local labour markets, as well as firm size, regions and sectors. The model tests the probability that a firm  $i$  survives in period  $t$ . In its general form, the model is given by:

$$Pr(Y_{ij,t} = 1) = f(\beta' P_{ij,t0}, \lambda' F_{ij,t0}, \gamma' R_{j,t0} + J + IS + \mu) \quad (21)$$

*Proximity  
Indices*

*Firm  
Attributes*

*Regional  
Characteristics*

*Control  
Variables*

where  $Y_t$  is a binary indicator taking the value of 1 if firm  $i$  in period  $t$  (2006-2011) survives, and 0 otherwise. There are four groups of variables assumed to influence the

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<sup>4</sup> After testing for potential differences, we find that our results are robust and highly similar using both Probit of Logit models.

probability that a firm  $i$  survives in period  $t$  ( $Y_{ij,t} = 1$ ); (i) proximity indices (**P**); (ii) firm attributes (**F**); (iii) regional characteristics (**R**); and (iv) other control variables (**J**; **I**). The  $t_0$  subscript indicates that all explanatory variables are taken for the initial year of the period (2006). Since this study focus on the effect of proximity on firm survival, we consider proximity indices (**P**) as the main interest group of variables. The estimated parameters in  $\beta$  associated with the variables in **P** can be classified in three groups: i) agglomeration economies (scale, localization, urbanization, specialization); ii) relatedness (related variety; unrelated variety); iii) value-chain linkages (forward; backward). These results will be conditional of firm **F** and regional **R** attributes, which together make up our base model. Other variables are -added to allow for a greater number of controls. **J** provides regional fixed effects, which corresponds to dummy variables for each of the eight Census Divisions (see Figure 3), minus Rimouski, which is used as the reference group. **IS** provides industrial fixed effects, which correspond to a dummy variable for each industry at the two-digit level, minus SCIAN-81 (other services), used as the reference group.

## 5. Results

Table 1 presents the outputs for three groups of models: one in which local areas is defined at a 500 meter threshold, a second defined at a 5 kilometer threshold, and a third at 10 kilometers. At each distance, a base model presents the coefficients for the variables of interest; with model A proposing extra sets of controls (region and industry fixed-effects). A first observation is that for all models, McFadden pseudo  $R^2$  more than double when adding industry and region fixed-effects, which provides an indication that model A accounts for a larger share of variability than the base model. Besides, comparing the three models shows that more variance is being explained at the 5 kilometers threshold, with an R square nearly 15% superior to models specified at the two other distances. For that reason, we focus on this specific model before considering others or potential further cross comparisons.

At the 5 kilometer threshold, both base and model A provide evidence that proximity plays a positive role on firm survival. Given that coefficients are the normal coefficients and not the odds-ratio, we find that agglomeration effect variables are all positive, which means that they increase the probability of firm survival. Yet, within agglomeration economies, both localization and urbanization externality measures are not significant. The result is surprising, as we would normally expect urbanization and localization economies to lower the chances of exits. However, for firm survival, these findings are not totally different from those of Boschma and Wenting (2007) and Neffke et al. (2011) when other relations are explored (see below). Within these correlates, the strongest positive effects are found for scale economies (0,03), followed by relative specialization (0,01). Firms benefiting from the concentration of firms with large number of employees are, it appears, best positioned to resist strong economic shocks. But these effects may not be true in all cases. Specialization effects show that having less firms

falling within the same industry of a given business in the immediate local area has a positive influence on survival. Despite the fact that the two variables are not strongly cross-correlated (see Table 3, Appendix), this may in fact also explain why localization economies are not significant, as specialization may well act as a barrier to other local firms, which may be thought of as potential competitors on local markets. The negative effect of spatial competition on firm survival has been outlined by Staber (2001) as well as Boschma and Wenting (2007).

Notwithstanding their positive influence, the model shows that agglomeration economies are not the strongest predictors of firm survival. Relatedness appears to be an important dimension enhancing the probability of keeping a business alive. The model shows that related variety has a significant and positive impact on firm survival. Overall, the variable stands as the second most robust positive relation (0,67) in the model—in line with expectations as well as findings by Boschma and Wenting (2007) and Neffke et al. (2011). As a corollary, unrelated variety is found to have no significant effect on the resistance of firms to recessionary shocks. Given that the model controls for other types of proximities (agglomeration economies; value-chain linkages), we feel that this finding offers further evidence of the importance of cognitive types of proximities for firms' survival. As previously described, the proximity of closely tied (related) firms is expected to allow potentially greater absorptive knowledge capacities, since cognitive distances between economic agents are neither too large nor too low. Unrelated variety would not have such effects, for the distances would be too important. In the context of an economic downturn, the results offers an indication that firm benefitting from cognitive proximity and a pool of related skilled workers may be better positioned to face increased market uncertainty. The finding suggests that the proximity of a diversity of strongly related activities plays a protective role for firms that benefit from such types of business environments.

Nonetheless, the strongest effect is by far attributable to local value-chain linkages, with forward linkages having the highest positive impact on survival (8,12) and backward linkages not being significant. We see two potential explanations for this finding. The first links to our previous discussion about potential substituting effects of local suppliers and buyers acting as protective barriers to external recessionary shocks. Firms that rely too much on external suppliers for their activities may face greater risks of not getting proper inputs on time or at a specific price, thus making firms with proximity to suppliers better adapted to suit changing demands and needs in times of increased uncertainty. Yet, it is surprising to find that not local outputs, but rather the levels of linkages for local inputs have such effects. We think that it is a sign that firms can better adapt to changes in external customer than supplier markets, thus making local backward value-chain linkages not a significant determinant of their survival. In an economic downturn, firms need to find new markets and adapt rapidly to changing demand, which requires the ability to find reliable and specialized inputs in a short time period.

**Table 1 - Logistic regression models: Determinants of plant survival in Lower St. Lawrence (Canada) between 2006 and 2011**

	Local Area Threshold: 500m				Local Area Threshold: 5km				Local Area Threshold: 10km			
	Base Model		Model A		Base Model		Model A		Base Model		Model A	
	Coef.	P > t	Coef.	P > t	Coef.	P > t	Coef.	P > t	Coef.	P > t	Coef.	P > t
<i>Agglomeration Effects</i>												
Localization eco.	0,016	0.002	0,014	0.009	0,108	0.028	0,034	0.537	0,160	0.012	0,015	0.853
Scale eco.	0,006	0.272	0,008	0.220	0,007	0.511	0,028	0.022	0,011	0.459	0,029	0.075
Relative spec.	0,000	0.909	0,002	0.585	0,003	0.049	0,007	0.003	0,005	0.021	0,008	0.012
Urb. Eco.	0,053	0.451	-0,064	0.466	0,045	0.513	-0,072	0.388	0,015	0.835	-0,085	0.319
<i>Relatedness</i>												
Unrel. Variety	0,100	0.070	0,119	0.061	-0,048	0.673	0,143	0.269	0,155	0.398	0,304	0.136
Rel. Variety	0,108	0.024	0,108	0.040	0,611	0.005	0,665	0.002	0,583	0.034	0,555	0.052
<i>Local Value-Chain Linkages</i>												
Forward Linkages (I-O)	2,669	0.000	4,250	0.003	2,184	0.016	8,119	0.002	1,688	0.075	10,158	0.012
Backward Linkages (I-O)	0,215	0.792	0,424	0.810	-1,396	0.109	-1,269	0.661	-1,526	0.092	-6,976	0.101
<i>Firm Characteristics</i>												
Number of Employees	0,433	0.000	0,557	0.000	0,429	0.000	0,542	0.000	0,426	0.000	0,547	0.000
Very Small	-13,279	0.000	-13,035	0.000	-12,261	0.000	-11,334	0.000	-12,140	0.000	-11,193	0.000
Small (ref.= Large)	-13,522	0.000	-13,374	0.000	-12,559	0.000	-11,735	0.000	-12,433	0.000	-11,587	0.000
Medium (ref.= Large)	-14,005	0.000	-14,015	0.000	-13,016	0.000	-12,342	0.000	-12,931	0.000	-12,231	0.000
Nonprofit Org. (ref.= Business)	2,824	0.005	2,552	0.011	2,146	0.003	1,834	0.011	2,160	0.003	1,861	0.010
<i>Regional Workforce Characteristics</i>												
Univ. Degree (%)	-0,013	0.355	0,012	0.420	-0,015	0.224	0,007	0.628	-0,019	0.108	0,003	0.832
Mobility last five years (%)	0,010	0.160	0,000	0.962	0,008	0.217	0,000	0.975	0,008	0.211	0,000	0.966
Median Income (\$)	0,000	0.822	0,000	0.589	0,000	0.487	0,000	0.854	0,000	0.537	0,000	0.875
Unemployment (%)	-0,005	0.439	-0,015	0.083	-0,003	0.672	-0,011	0.137	0,002	0.796	-0,009	0.266
Work within CSD (%)	0,004	0.156	0,006	0.041	0,003	0.192	0,004	0.124	0,005	0.022	0,007	0.007
<i>Region (ref.=Rimouski)</i>												
La Matapedia			0,525	0.006			0,582	0.001			0,610	0.001
Matane			-0,172	0.243			-0,121	0.387			-0,100	0.475
La Mitis			-0,442	0.003			-0,372	0.009			-0,315	0.024
Les Basques			-0,724	0.000			-0,652	0.000			-0,607	0.000
Rivière-du-Loup			0,557	0.000			0,545	0.000			0,534	0.000
Témiscouata			-0,180	0.267			-0,113	0.448			-0,085	0.565

Kamouraska			-0,420	0.012			-0,325	0.038			-0,317	0.039
<i>Industry (ref.= Other Services - 81)</i>												
Agri., forest., & fishing (11)			-0,355	0.038			-0,417	0.009			-0,390	0.028
Mining, oil & gas extr. (21)			-0,582	0.497			-1,235	0.062			-1,278	0.050
Construction (23)			-1,005	0.000			-1,021	0.000			-0,927	0.000
Low-tech manuf. (31)			-1,805	0.000			-2,279	0.000			-1,836	0.000
Mid-tech manuf. (32)			-1,897	0.000			-2,273	0.000			-1,838	0.000
Mid/high-tech manuf. (33)			-1,028	0.003			-1,402	0.000			-0,958	0.059
Wholesale trade (41)			-0,928	0.000			-0,903	0.000			-0,843	0.000
Retail trade - General (44)			-0,673	0.000			-0,697	0.000			-0,628	0.000
Retail trade - Dpt. stores (45)			-0,885	0.000			-0,987	0.000			-0,922	0.000
Transportation (48)			-0,642	0.003			-0,639	0.002			-0,490	0.030
Warehousing (49)			-0,793	0.351			-1,635	0.003			-1,048	0.038
Inf. & cult. Indust. (51)			-0,169	0.659			-0,378	0.291			-0,321	0.373
Finance & Insurance (52)			-0,484	0.136			-0,763	0.030			-0,691	0.120
Real Est. & Leasing (53)			-0,265	0.571			-0,758	0.121			-0,595	0.297
Prof. Sci. & Tech. Serv. (54)			-0,776	0.000			-0,979	0.000			-0,958	0.000
Mgmt. of Comp. (55)			-1,060	0.345			-1,254	0.270			-1,245	0.275
Adm. Supp. & Wste Serv. (56)			-1,084	0.000			-1,374	0.000			-1,389	0.000
Education Services (61)			0,530	0.163			0,658	0.086			0,614	0.112
Health & Social Ass. (62)			-0,351	0.037			-0,332	0.057			-0,312	0.091
Arts, Entert. & Rec. (71)			-0,611	0.022			-0,472	0.060			-0,332	0.195
Accom. & Food Serv. (72)			-1,120	0.000			-1,109	0.000			-1,069	0.000
Public Adm. (91)			0,224	0.545			0,346	0.453			1,133	0.083
Intercept	14,850	0.000	14,851	0.000	12,903	0.000	12,767	0.000	12,250	0.000	1,133	0.083
Pseudo $r^2$	0,041		0,083		0,041		0,095		0,041		0,083	
Prob > $\chi^2$	0.000		0.000		0.000		0.000		0.000		0.000	
N	9089		9089		9787		9091		9787		9790	

As an extension of the first, our second explanation points more specifically to the potential implicit dimensions of local value-chains. Whereas our indicator of forward linkages can be interpreted as a proxy for traditional local input-output trade relations, it may also be interpreted as an indirect indicator of the institutional or organizational environment of a firm. In time of uncertainty, trust, adaptability and the capacity to exchange information are critical factors that may have important implications for the capacity of firms to resist external shocks. Through trust, proximity to local suppliers allows firm to benefit from crucial information inflows from their clients. It may also facilitate the creation of new local organizational routines between firms, which would enhance the capacity of forward firms to adapt to rapid changing external environments.

Firm characteristics are also important predictors, with the number of employees and firm types having strong effects on plant survival—smaller firms' groups having more risks to exit relative to large firms. This is largely consistent with previous findings in the literature. Besides, being a business or non for profit organization—*i.e. cooperatives*—has a significant effect on firm survival, with non for profit firms being more likely to survive than private businesses. Although the finding is fairly self-evident, with private firms having more risks of closures, it may have important implications for local development strategies in remote regions during recessionary periods. Enterprises where customers are stakeholders (cooperatives) are more likely to resist external shocks, which suggests that these should be considered when targeting policies of economic resilience.

We did not find significant effects for regional characteristics of the workforce, which is somewhat surprising. The percentage of university degree holders, the mobility of workers over

the last five years, the median incomes and unemployment rates within the municipality are all not significant. The finding may partly reflect the fact that local effects are being controlled through our other variables and proximity measures. Being located within a specific region either increases (i.e. Rivière-du-Loup) or lowers (i.e. Les Basques) the survival probability of firms, while industry also have significant effects—manufacturing (low, mid and high); warehousing; food and accommodation, as well as administrative services industries having the less probability of survival compared to other services, while public administration provides the best probability of survival.

An important finding of our study is that these relationships change with distance. Looking at results for the 500 meters and 10 kilometers threshold, we find that agglomeration economies are not robust for all distances, with significant effects at a distance but not at another. Localization economies are only present at 500 meters, while scale economies are present at 5 kilometers, then only significant at a 10% confidence level at the 10 kilometer threshold. Relative specialization is significant for both larger distances. Yet, while there is variability, we find evidence that both relatedness (related variety) and local value-chain linkages (forward linkages) are significant for all three distances, although the strength of the coefficients vary with distance.

**Figure 5 - Correlates of firms' survival as a function of local areas' distance thresholds (95% confidence interval in grey)**

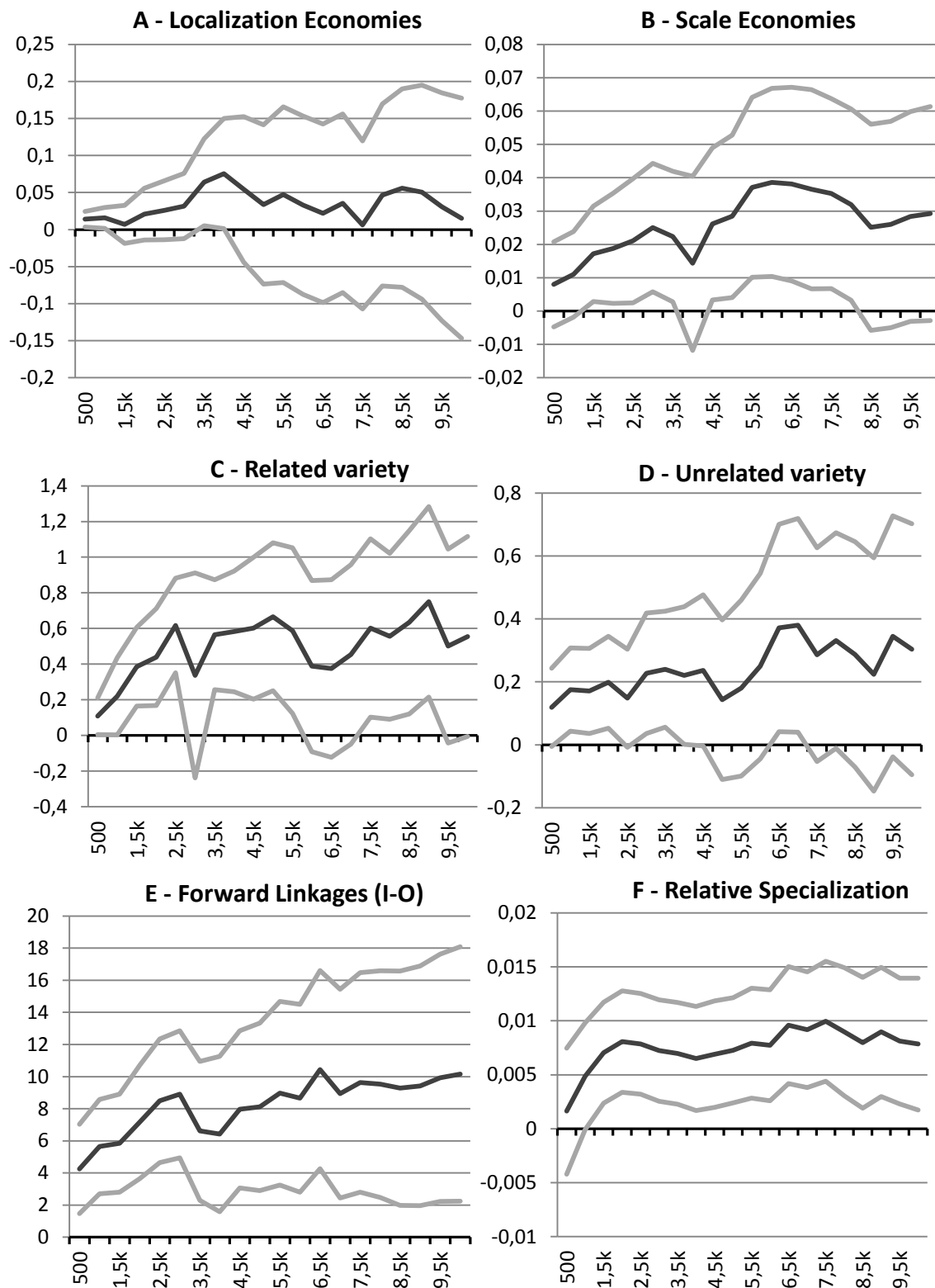


Figure 5 further explores this last finding by exposing correlates of firms' survival as a function of local areas' distance thresholds. The coefficients (in black) of variables are calculated in different regressions where all local characteristics are rescaled at the given threshold, with 95% confidence interval (in grey). Looking at spatial heterogeneity for localization economies (A), we find that the effects are significant only at a very short distance (500 meters), and not after, which is indicative that these types of effects may be highly sensible to the effects of distance. For scale economies (B), we find that the coefficients are greater at larger distances, although the relationship fades passed 8 kilometers, which suggests that the geographic scope of the benefits to locate near large firms occurs at mid-range, with a maximal effect occurring near 6 kilometer.

Related variety (C) offers a different picture, where positive effects associated with the proximity of a diversity of related industries increase rapidly with distance, but stabilize around 2.5 kilometers, before reaching a new peak at 8,5 kilometers; although the relationship decreases beyond the limit of 9 kilometers. Unrelated variety (D) does also have a positive effect on firm survival, but this effect is contained between 1 and 4.5 kilometers. These findings suggest that close proximity may be more useful when cognitive distances are more important, but that longer distances may be more beneficial when spillovers are for similar types of knowledge. Similar to related variety, value-chain proximity in forward linkages (E) increases sharply with distances until 2,5 kilometers, then steadily before stabilizing around 7 kilometers. This provides further evidence that proximity to forward linkages not simply is an indicator of input and output flows of goods—the effects of distance would not change so much if it only represented the delivery of goods between firms—but rather an indicator of potential inter-firms

linkages representing the effect of close proximity in terms of trust, knowledge exchange and the development of new local inter organizational routines. Finally, relative specialization also increases with distance, but stabilize around 1,5 kilometer, which is in line with our previous interpretation of specialization as protective barrier to local competition. Finally, the results are consistent with expectations that the effects of different types of proximities change over distance.

## 6. Conclusion

This paper presented an empirical study of the factors surrounding the survival of establishments in Quebec's Lower Saint-Lawrence region between 2006 and 2006—a period covering one of the most important economic crises of recent history. Four hypotheses have been tested, based on the development of the literature. Our first *H1* posits that scale, localization, urbanization and Jacobs' economies positively increase the probability of firms' survival. We find that only scale and, at a certain distance, Jacobs' externality have such effects, while localization and urbanization economies are not significant. Given our other results, these findings are not totally aside those of Boschma and Wenting (2007) and Neffke et al. (2011), who both find contradictory effects for urbanization and localization economies. On the other hand, our measure of specialization appears to have a significant effect on survival, which is indicative that having less firms falling within the same industry of a given business in the immediate local area has a positive influence on survival—negative effect of spatial competition on firm survival being found in other studies (Staber, 2001; Boschma and Wenting, 2007).

Our results confirm our second hypothesis, *H2*, which suggested that related variety would positively increase the probability of firms' survival. We find that related variety act as the second strongest predictor of survival in our model, whereas unrelated variety has no significant effect on the resistance of firms to recessionary shocks—results directly in line with previous findings from Boschma and Wenting (2007) and Neffke et al. (2011). As such, our study provides further evidence of the importance of relatedness as an indicator of the effect of cognitive proximity on firms' survival. Such proximity is possible through the portfolio of shared skills in the local labour market, which better position firms to face increased market uncertainty. The

finding suggests that the proximity of a diversity of strongly related activities plays a protective role for firms that benefit from such types of business environments.

The third hypothesis suggested that the high presence of local forward and backward linkages (local value-chains) could have a positive impact of the survival of firms. Our results provide strong evidence of such effects for forward linkages but not for backward ties. Indeed, the strongest predictor of our model is attributable to local concentrations of forward linkages. No previous study has to our knowledge used such an indicator, although a study by Renski, Koo, and Feser (2007) provides empirical evidence of the difference between labour and value-chain industry clusters. We provide two interlinked explanation for this finding. The first stresses the particular context of our study, which is that of a declining region during a recessionary shock,. We posit that in times of crisis, firms need to secure new markets and adapt rapidly to changing demand, which requires the ability to find reliable and specialized inputs in a short time period. Firms that rely too much on external suppliers for their activities may face greater risks of not getting proper inputs on time or at a specific price, thus making firms with proximity to suppliers better adapted to changing demand and needs in times of uncertainty. In time of uncertainty, trust, adaptability and the capacity to exchange information are critical factors that may have important implications for the capacity of firms to resist external shocks. Proximity to local suppliers within the same value-chain may enhance the capacity of firms to facilitate the exchange of decisive type of knowledge, but also favour the creation and of local organizational routines between firms, thus enhancing the capacity of forward firms to adapt to rapid changing external environments.

Our last hypothesis *H4* advanced that the effects of the different types of proximities on firm survival vary with distance. We find that the effects of our different indices are not the same across space, with relationships increasing or decreasing with distance. As such, our

results suggest that different types of proximities may be intrinsically linked to geography, calling for a consideration of the embeddedness of spatial as well as relational types of proximities. With regard to relatedness, our results support that close proximity may be more useful when cognitive distances are more important, but that longer distances may be more beneficial when spillovers are for similar types of knowledge. In this context, the methodology used in this study, where we considered space as continuous and used characteristics of neighbours to construct local indices, has revealed to be very useful to account for known aggregation issues..

, Our findings provide empirical evidence that proximity and specific characteristics of establishments—i.e. being a private business or a cooperative—may increase the probability of businesses to resist strong macroeconomic shocks. We feel that future research should more specifically target the determinants of micro regional behaviors which, we believe, act as sources of new development trajectories that may, on the whole, evolve towards more resilient local economic dynamics. The results presented in this study opens up many new research opportunities in this regard.

## Appendix

**Table 2 – Descriptive statistics per outcome with T-tests (5km threshold)**

Variable	Survival			Death			T test	
	Obs	Mean	Std, Dev,	Obs	Mean	Std, Dev,	T Difference	P value
Localization Eco.	8645	0,59	0,85	1 182	0,49	0,81	3,88	0.000
Scale Eco.	8652	9,30	3,78	1 183	8,29	3,89	8,59	0.000
Relative Spec.	8647	5,90	22,62	1 184	6,26	19,09	-0,51	0.607
Urb. Eco.	8638	8,60	1,55	1 179	8,04	1,49	11,63	0.000
Unrel. Variety	8652	2,41	0,00	1 183	2,29	0,45	8,66	0.000
Rel. Variety	8652	0,67	0,28	1 183	0,56	0,31	11,90	0.000
Forward Linkages (I-O)	8652	0,33	0,04	1 183	0,03	0,04	0,54	0.587
Backward Linkages (I-O)	8652	0,34	0,04	1 183	0,03	0,03	0,09	0.359
Plant Size	8647	1,27	1,12	1 184	0,88	0,93	11,55	0.000

**Table 3 - Cross-correlations between covariates (5km threshold)**

	Loc. Eco.	Scale Eco.	Relative Spec.	Urb. Eco.	Unrel. Variety	Rel. Variety	Fwd. Link.	Bck. Link.	Plant Size
Localization Eco.	1,00								
Scale Eco.	0,26	1,00							
Relative Spec.	-0,21	-0,17	1,00						
Urb. Eco.	0,21	0,62	-0,20	1,00					
Unrel. Variety	0,09	0,33	-0,17	0,70	1,00				
Rel. Variety	0,19	0,48	-0,21	0,80	0,78	1,00			
Forward Linkages (I-O)	-0,07	-0,12	0,04	-0,09	-0,19	-0,10	1,00		
Backward Linkages (I-O)	-0,10	-0,03	0,05	-0,02	-0,07	-0,02	0,53	1,00	
Plant Size	-0,06	0,15	0,03	0,19	0,16	0,18	0,02	0,16	1,00

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