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# An anatomy of the geographical concentration of Canadian manufacturing industries

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ABSTRACT

We use detailed micro-geographic data to document the location patterns of Canadian manufacturing industries and changes in those patterns during the first decade of 2000. Depending on industry classifications and years, 40 to 60% of industries are geographically localized, i.e., are spatially clustered relative to overall manufacturing. Although some industries are increasingly clustered, localization has generally decreased in Canada according to our measures. We further document the locational trends of small plants, young plants, and exporters. Their location patterns do not differ significantly from that of the other plants in their industries.



## 1. Introduction

One of the most salient features of the economic landscape is the strong geographical concentration of economic activity. That concentration is observed in most countries and at various spatial scales. Famous examples of 'clusters' include the high-technology concentrations of Silicon Valley, Boston's Route 128, the North Carolina research triangle, as well as concentrations of more mature industries like the automotive cluster in the Detroit-Winsor corridor or the Italian manufacturing 'districts'. In Canada, economic activity – measured by either GDP or employment – is strongly concentrated *across and within* provinces. Ontario and Quebec, for example, host about 60% of Canadian GDP and 75% of manufacturing employment. Within those two provinces, the Toronto metropolitan area, about 0.06% of Ontario's surface, generates 45% of Ontario's GDP; whereas the Montréal metropolitan area generates almost 35% of Quebec's GDP on about 0.04% of Quebec's surface.[1]

The resurgence of spatial analysis in economics has led to a renewed interest in empirically analyzing and theoretically explaining the strong geographical concentration of industries. Clusters and regional development have also often been – and are becoming increasingly more – a matter of concern for policy makers around the world. Quebec's government, for example, has recently launched the 'Plan Nord', with the aim to invest around $80 billion over the next 25 years to create 20,000 jobs, generate $14 billion in government revenue, and $162 billion for Quebec's GDP. Such huge investment plans – which have a clear regional development component – are unlikely to leave the geography of economic activity unchanged. It is, therefore, important to understand which industries tend to cluster, what location patterns we observe for specific types of plants that are important targets for economic development (e.g., young plants, small plants, and exporters), and what the broad trends of geographical concentration have been over the last decade. This is the focus of the present paper.

There is a substantial literature dealing with the measurement of *industrial localization*, i.e., the geographical concentration of industries in excess of the concentration of economic activity in general. Ellison and Glaeser (1997; henceforth EG) have developed an index that has been widely applied to that issue. Despite its numerous advantages and appealing theoretical properties, that index has no strong spatial flavor as it does not take into account the relative positions of the geographical units. We address that issue using two alternative strategies. First, we exploit the micro-geographic nature of our data to compute point pattern based continuous measures following Ripley

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[1] These figures for 2013 are from Statistics Canada and the Institut de Statistiques du Québec.

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(1976, 1977), Duranton and Overman (2005, 2008; henceforth DO), and Marcon and Puech (2003, 2010). Using continuous measures allows us to sidestep the need for pre-defined administrative units, which give rise to the well-known *modifiable areal unit problem* (henceforth MAUP; Openshaw and Taylor, 1979; Openshaw, 1983). Second, we analyze the geographical concentration in Canada by explicitly integrating 'neighborhood effects' into the EG index, following recent work by Guimarães et al. (2011).

To the best of our knowledge, continuous localization measures have until now neither been applied to Canadian data in particular, nor to North American data in general (see Holmes and Stevens, 2004).[2] The empirical literature on localization using micro-geographic data, though growing, is still relatively limited. Using the EG and DO indices, we identify the most and the least localized manufacturing industries in Canada. Consistent with previous findings for the UK, France, and Japan, industries related to textiles and to the extraction of natural resources rank among the most localized industries. We also provide a broad picture of the main trends for the first decade of 2000. Our key findings can be summarized as follows. First, depending on industry definitions and years, 40 to 60% of manufacturing industries are clustered, mainly at distances of less than 150 kilometers, and at distances of about 500 kilometers. These figures suggest that there is less industrial localization in Canada as compared to other developed countries like France or the UK. Second, since, our dataset spans a ten year period, we can look at the 'dynamics' of localization. We are not aware of any other study looking at the changes in localization over time using large micro-geographic plant-level datasets. We find that localization is decreasing, i.e., manufacturing industries have become less geographically concentrated in Canada. Yet, there is a lot of heterogeneity across industries, and some of the most strongly localized industries are becoming even more localized. The changes in spatial concentration through time are negatively correlated with changes in industrial concentration.

Two advantages of our dataset is that it contains a large number of small and young plants, and that it reports plant-level information on export status. This allows us to document in detail the location trends for those subgroups, and in particular to look at trends specific to exporter plants involved in international business. Understanding those trends is relevant from a policy perspective, since these groups of plants are perceived as being vital for employment growth and local regional development, thus making them prime targets for cluster policy. Our findings suggest that they are, in general, not more strongly concentrated than all plants in their respective industries. The only exception is for exporters, but their 'excess concentration' tends to significantly decrease over the first decade of 2000.

The remainder of the paper is organized as follows. Section 2 provides a snapshot of manufacturing in Canada. Section 3 presents our empirical results using continuous measures of localization. Section 4 summarizes our empirical results using discrete measures as a robustness check, controlling for the relative position of the spatial units. Finally, Section 5 concludes and places our results into the policy debate about industry clusters and regional development. We relegate all technicalities, the description of our datasets, and additional results to an extensive set of appendices.

## 2. A snapshot of Canadian manufacturing, 2001–2009

To set the stage, we first provide a quick overview of the sectoral and geographical structure of manufacturing in Canada from 2001 to 2009. Total salaried employment in Canada in 2001 was 12,978,258 jobs, of which 1,974,636 – or 15.21% – were in manufacturing. In 2005, the corresponding numbers were 13,931,343 and 1,837,828 jobs – or 13.19% – respectively; whereas they were 14,570,025 and 1,473,472 jobs – or 10.11% – in 2009.[3] The downwards trend in manufacturing can also be seen from Table 1, which shows that the number of plants in our data has fallen from 54,379 in 2001 to 46,391 in 2009. This 'de-industrialization' is not specific to Canada and affects most developed countries in a similar way (see, e.g., Duranton et al., 2011, for the French case). As can be seen from Table 1, the decrease in the number of plants went hand-in-hand with an increase in average plant size – as measured by employment – except for the Atlantic provinces (see Appendix A for details on the data).

**Table 1**
Descriptive statistics by province.

| Province | 2001 | | 2005 | | 2009 | |
|---|---|---|---|---|---|---|
| | # of plants | Avg. empl. | # of plants | Avg. empl. | # of plants | Avg. empl. |
| Alberta | 3933 | 36.100 | 3455 | 44.430 | 3581 | 52.780 |
| British Columbia | 6219 | 31.930 | 5371 | 33.730 | 4991 | 34.370 |
| Manitoba | 1654 | 43.330 | 1481 | 55.230 | 1263 | 57.790 |
| New Brunswick | 1395 | 35.660 | 1258 | 40.080 | 1175 | 36.940 |
| Newfoundland and Labrador | 576 | 43.830 | 540 | 44.830 | 472 | 42.500 |
| Nova Scotia | 1676 | 29.930 | 1495 | 37.140 | 1296 | 35.020 |
| Ontario | 21,306 | 45.010 | 20,966 | 46.080 | 19,637 | 46.760 |
| Prince Edward Island | 328 | 25.350 | 327 | 24.410 | 280 | 25.430 |
| Quebec | 15,939 | 41.640 | 14,166 | 45.690 | 12,560 | 49.550 |
| Saskatchewan | 1353 | 27.360 | 1305 | 32.520 | 1091 | 36.230 |
| Territories | – | – | 40 | 5.940 | 45 | 10.140 |
| **Total** | **54,379** | **36.01** | **50,404** | **37.28** | **46,391** | **38.86** |

*Source*: Authors' computations using Scott's National All Business Directories.

Table 2 summarizes industry-level details of our data, including the average plant size by industry and the number of exporting plants. There is clearly substantial cross-industry variation, as extensively documented by previous studies (e.g., Bernard and Bradford Jensen, 1995). Observe that, although the number of plants has decreased substantially, the share of exporting plants has increased from 42.3% in 2001 to 45.1% in 2009 in the wake of increasing globalization.

Turning to the spatial dimension, population is strongly concentrated geographically in Canada. Indeed, because of historical settlement patterns, the climatic conditions in the north, and access to the large US market to the south, about 90% of the Canadian population lives less than 100 miles from the US border. Quite naturally, the overall distribution of manufacturing is thus also strongly concentrated geographically in Canada – namely in Ontario and Quebec and, more generally, along the Canada–US border – as can be seen from Fig. 7 in Appendix E. We show in Appendix D that the overall 'shape' of the distribution of bilateral distances between manufacturing plants in Canada has remained – in the aggregate – fairly stable between 2001 and 2009. This suggests that the localization measures we compute in what follows for individual industries are comparable between the years of our analysis.

Since manufacturing is strongly concentrated geographically in Canada, we will use its overall distribution as the benchmark against which we assess localization in a given sector. This avoids picking up localization patterns that are solely driven by the overall concentration of industries in large metropolitan areas (Combes et al., 2008) or, in the case of Canada, in the traditional manufacturing corridor running from Quebec City to Windsor via Montréal and Toronto (see Fig. 7 in Appendix E). We will compute both discrete and continuous measures of localization – for industries in general, but also for certain types of plants like small plants, young plants, and exporters – and analyze their trends over time. When looking at specific types of plants, we

[2] Ellison et al. (2010) use a 'lumpy approximation' of the DO index for the US. Riedel and Hyun-Ju (2014) do the same for Germany. It is unclear whether using a discrete approximation of a continuous measure helps in solving the fundamental spatial aggregation problems.

[3] Source: Statistics Canada, cansim.