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The resilience of the Canadian textile industries and clusters to shocks, 2001-2013*

Report prepared for Innovation, Science and Economic Development Canada

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Sommaire/summary

Understanding and assessing the role played by geographical clusters in the resilience of industries' and firms' to adverse economic shocks is important to inform policy and to devise regional development strategies. Yet, surprisingly little is known about that topic. This report aims to fill this gap. To this end, we first use recent microgeographic techniques to measure the degree of clustering in the Canadian textile and clothing (T&C) industry, and to detect geographical clusters of plants. We then dissect the changes in that industry (exit of plants, employment changes, productivity, industry switching, and geographical relocation) between 2001 and 2013. The T&C industry is geographically strongly clustered and subject to large industry-specific shocks (the end of the Multi Fibre Arrangement; MFA) during our study period, thus providing an ideal laboratory to examine the role of geographical clusters for resilience. We find a very limited impact of the initial level of clustering on subsequent changes in either industry-level employment, productivity, or revenue. Using detailed geocoded plant-level data, we further find that plants in clusters were more likely to exit than plants that were not part of a cluster and they downsized their employment more than non-clustered plants. These results suggest that clusters need not make industries or plants more resilient to adverse economic shocks. Furthermore, there is a composition effect of clusters. In the T&C industry, clusters contain larger plants that react to shocks by exiting or downsizing. In this respect, clusters were actually less resilient to shocks in the sense of providing local employment stability, which is usually the key concern for local policy makers. Plants in clusters were, however, more likely to switch into different industries following the end of the MFA. This suggests that being part of a cluster may help surviving plants to adapt in the event of a negative shock.

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Executive summary of key results

- Textile and clothing (T&C) industries were among the most strongly localized industries in Canada in 2001, and they were still substantially localized in 2013.
- The degree of manufacturing localization has generally decreased between 2001 and 2013, especially for T&C industries. Many T&C clusters have disappeared. Clusters near big cities have downsized but remain key places for the T&C industry in Canada.
- The effect of increasing competition has been quite heterogeneous across sectors: downstream sectors and more geographically concentrated sectors have suffered more.
- The T&C industry has been severely hit by low-income countries' competition – in particular China. This has led to a decrease in the number of plants and jobs in this sector. In the meantime, productivity in that sector has increased.
- At the industry level, we find a very small impact of the initial level of clustering in T&C industries on subsequent changes in either employment, productivity, or revenue.
- Increasing competition from low-income countries has increased the probability of plant exit in the T&C sector. The probability of exit has increased more strongly for plants located in economic clusters, therefore suggesting that clusters do not make plants 'more resilient' to adverse economic shocks.
- Hundreds of T&C plants have changed their main activity and (partly) switched out of the T&C sector. Plants not located in T&C clusters were more likely to switch. However, plants that were directly hit by the end of the MFA have been more likely to change their core activity if they were located in a cluster. This suggests that, in the event of an adverse shock, being in a cluster may help plants to switch industry which provides an alternative route to escape from competition.

1 Introduction

Recent years have forcefully shown that regions within a country are unequally affected by economic shocks. Ontario, for example, suffered from its relative specialization in finance and the automotive industry during the 2007–2008 crisis, while Alberta "faces a significant budget shortfall as oil prices continue to collapse" from more than $100 per barrel in June 2014, to less than $35 in March 2016.[1] The planned free-trade agreement with the European Union (CETA) that looms on the horizon is unlikely to affect the eastern and western Canadian provinces in the same way. So is the Trans-Pacific Partnership (TPP) which includes many provisions concerning automobiles and automobile parts manufacturing.[2] Clearly, which regions suffer and which regions weather more easily the storms triggered by the changing international environment depends on their specialization and, potentially, on the geographical concentration – the 'clustering' – of their economic activity.

There is a consensus in the academic literature that the geographical concentration of economic activity gives rise to small productivity gains, the so-called *agglomeration economies*. Productivity or wage-elasticity estimates with respect to the level or density of local economic activity traditionally fall in the 2%–5% range (see Rosenthal & Strange 2004, Melo et al. 2009, and Combes & Gobillon 2014, for surveys). There is less consensus on the channels through which these agglomeration economies percolate. Some mix of better access to intermediate inputs or final demand, improved firm-worker matching in thicker labor markets, sorting along skill or productivity, tougher competition, faster learning, knowledge sharing, and other spillovers have been traditionally put forward as potential explanations (see Duranton & Puga 2004, and Behrens & Robert-Nicoud 2014, for surveys).

The prospect of productivity, wage, and employment gains due to the clustering of economic activity – coupled with the existence of some highly successful clusters like the Silicon Valley, Boston's Route 128, or the North Carolina Research Triangle – have captured the attention of policy makers and regional development agencies alike. Countless cluster policies and initiatives have been implemented or called for to harness the potential power of clusters and to deliver their promise of prosperity. Yet, academic research has shown that the agglomeration or coagglomeration of economic activity may be inefficient (see Helsley & Strange 2014), and that the case for cluster policies is "theoretically ambiguous and empirically very weak." (Duranton 2011, p.3). The literature is also largely inconclusive on whether clusters policies: (i) can substantially influence the spatial structure of the economy; (ii) deliver economic benefits that would justify their costs; and (iii) have positive outcomes beyond small productivity gains to regions and firms, and – if yes – what forms those positive outcomes may eventually take. On top of the foregoing fundamental

[1] Online source: http://www.alberta.ca/release.cfm?xID=40271D113AEED-F73F-7D80-07C5CD8E5F479F0E (last accessed on March 4, 2016).

[2] Online source: http://www.international.gc.ca/trade-agreements-accords-commerciaux/agr-acc/tpp-ptp/benefits-avantages/sectors-secteurs/05-IndustrialSector.aspx?lang=eng (last accessed on March 26, 2016).

problems, there are also several operational problems. A quick look at the literature reveals, for example, that there is little to no consensus on how to define and to identify 'clusters' or geographical groupings of related economic activities that are relevant for regional performance (see Delgado et al. 2015, for a recent review and methodology to define clusters). And even if there were a consensus on this, it is unclear from the literature how 'clusters' could be used to inform our understanding about the effects of the geographical concentration of related industries on regional and firm-level outcomes.

The aim of this report is twofold. First, we investigate a specific dimension of the geographical concentration of economic activity that looms large in policy debates – often explicitly, and always implicitly – but has to date received next to no empirical scrutiny: *the effects of clustering on the resilience of firms and employment to adverse economic shocks*. If the geographical concentration of industries may drive local prosperity, it is also associated with more local risk due to exposure to shocks. In a nutshell, regions become more vulnerable as adverse shocks propagate more easily when they are geographically specialized in closely related industries. It is, however, unclear whether the negative consequences of the shocks are more severe or less severe for firms in clusters compared to firms outside clusters. For example, a region that is strongly specialized in T&C manufacturing will surely suffer from the increase in import competition from China and other low-wage countries, just because of its specialization. Yet, the true question is *how the firms of that region would have fared if they had not been clustered together*. Another question is *through which channels* firms react to shocks, and whether those channels are different in clusters. Do plants exit, or downsize, or switch into different industries, and does the type of reaction depend on the geographical clustering? Are clusters more resilient because firms can more easily 'reinvent themselves'? Despite its importance for regional and national development policies, surprisingly little is known in general about whether or not clusters make industries and firms more resilient to adverse economic conditions (see Martin et al. (2013) and Delgado et al. (2016) for some analysis). Even less is known on the channels through which firms adapt to shocks, and on their spatial dimension. We intend to partly fill this gap. Our two key questions are the following:

- Do changes in import and export values – especially with low-cost trading partners – significantly affect industry-level variables such as employment, productivity or revenue, and do more clustered industries fare better than more dispersed sectors?

- Do plants and firms in 'clusters' survive more easily the adverse economic shocks, and how do employment and plant counts in clusters change relative to those same measures outside of clusters?

- What are the channels through which plants react to increased international competition (exit; relocation; industry switching)? Do those channels differ systematically across different types of firms (large or small; exporters or domestic firms; standalone or multiunit) and depending on whether or not firms belong to clusters?

To answer those questions, we dissect the changes in the Canadian textile and clothing (T&C) industry between 2001 and 2013. This choice is motivated by three basic considerations. Firstly, as shown in this report, T&C industries can be naturally grouped into coherent industry clusters using a variety of different criteria to delineate these 'clusters of closely related activities'. Furthermore, T&C clusters do not rely on many specialized service sectors (see Delgado et al. 2015), which is important since our geocoded plant-level data does not cover extensively the service sectors. Secondly, the T&C industries were among the most geographically concentrated industries in Canada. This provides substantial variation in clustering that allows for better identification of the effects of shocks on these industries. Finally, our study period features large shocks in trade in the T&C industries. Having conceptually well delineated clusters of geographically strongly concentrated industries that were subject to large industry-specific shocks (the end of the Multifibre Arrangement, MFA, on January 1, 2005) thus provides an ideal laboratory to examine the role of geographical clusters for resilience.[3]

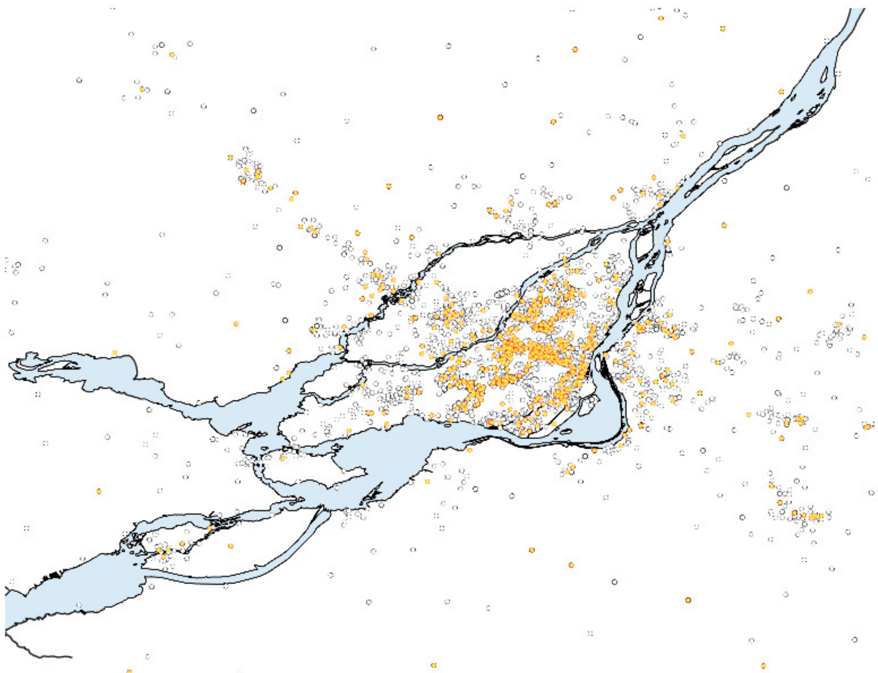
Second, we provide an up-to-date and extensive overview of broad changes in international trade patterns and the geographical concentration of manufacturing industries in Canada from 2001 to 2013. In doing so, we make use of a large (more than 320,000 year-plant observations) and geographically very fine-grained (geocoded) manufacturing plant-level dataset. These data allow us to push beyond existing studies by: (i) constructing cutting-edge measures of geographical concentration of industries and clusters that allow for statistical inference; (ii) mapping the geographical location and evolution of manufacturing clusters in general, and T&C clusters in particular (see Figures 1 and 2 for an illustration of our data in the Greater Montreal and Toronto regions in 2001 and 2013, respectively), over a fairly long time horizon; and (iii) allowing us to better gauge the resilience of the T&C industry and individual T&C plants to international trade shocks depending on their geographical environment.

We believe that our findings are useful to inform policy on the potential benefits of clusters. We also think that our methodology is useful since it can be extended to cope with clusters other than those in the T&C industry (e.g., the Canadian automotive clusters, and how they are likely to be affected by the TPP) to investigate the resilience of different types of clusters. Our methodology can also be readily extended along many lines to investigate other outcomes (e.g., how does the composition of clusters change? does the composition matter for the adjustment to shocks?) and channels (e.g., how do firms change their product lines or move along the quality ladder?) in response to shocks. The latter question will be the focus of follow-up research to this report. Our dataset features detailed product-level information for plants and is, therefore, well-suited to investigate that question. Taking into account the geographical dimension and the composition of

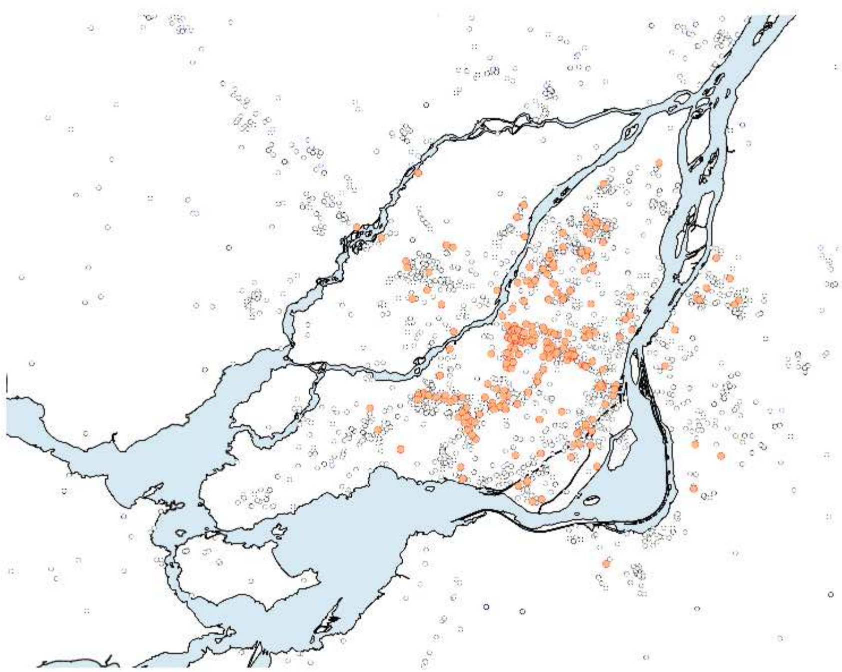
[3] The geographical concentration of the T&C industry fell significantly between 2001 and 2013. Understanding whether or not changes in the international trading environment influenced this 'unweaving' of T&C clusters is not the key objective of this study. See Behrens et al. (2015) for a detailed analysis of the impacts of trade and transportation on industry location more broadly.

Figure 1: T&C and other manufacturing plants in the Greater Montreal Area.

(a) 2001



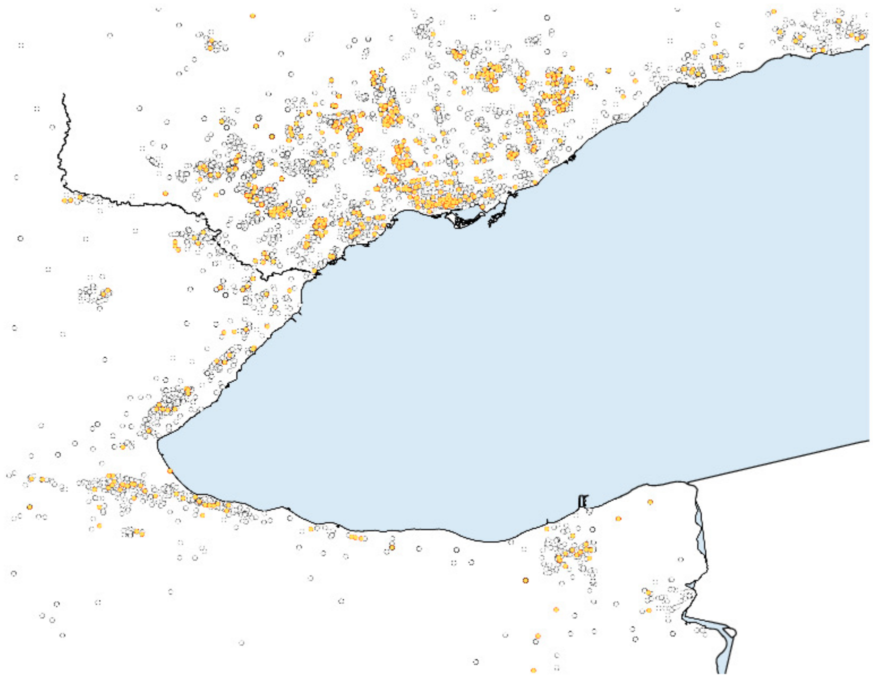
(b) 2013



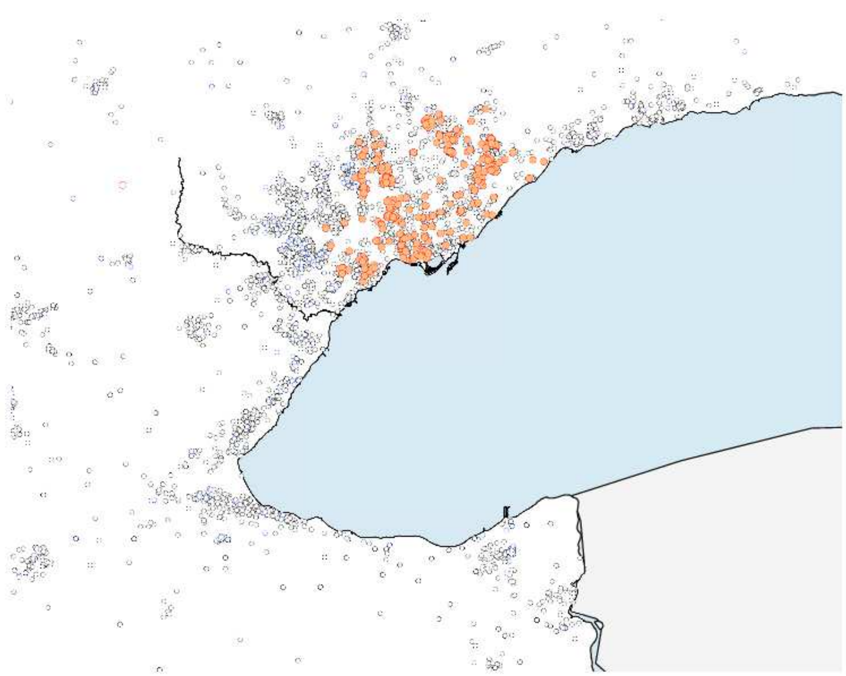
Notes: The orange filled dots depict the 'main cluster' plants in the T&C industry (see Section 3 for details). Non-cluster T&C plants are represented by blue circles, whereas all other manufacturing plants are represented by black circles. All plants are geocoded at their postal code centroid.

Figure 2: T&C and other manufacturing plants in the Greater Toronto Area.

(a) 2001



(b) 2013



Notes: The orange filled dots depict the 'main cluster' plants in the T&C industry (see Section 3 for details). Non-cluster T&C plants are represented by blue circles, whereas all other manufacturing plants are represented by black circles. All plants are geocoded at their postal code centroid.

clusters is important, because firms are likely to change their activity and product mix by learning from close-by plants in the clusters. There is little hard evidence of 'learning in clusters' to date, and shedding more light on this issue important to better understand the hitherto rather elusive knowledge spillovers in clusters.

The remainder of this report is organized as follows. Section 2 briefly surveys the related literature on the effects of the end of the MFA, what is known about firms' responses to international competition and its spatial effects, the resilience to economic shocks, and geographical clusters. Section 3 describes our data and explains how we delimit the T&C industry. Section 4 presents aggregate trends in the data for the T&C industry and its international trading environment. Section 5 assesses the geographical concentration of the T&C industry and analyzes changes therein between 2001 and 2013. We show how T&C clusters have been progressively 'unweaving' over our study period. Section 6 provides a detailed econometric analysis of the resilience of T&C clusters in Canada. We first run aggregate regressions at the industry level to paint the big picture, and then run detailed plant-level regressions to better understand the adjustment channels and to control for compositional effects. Section 7 draws some policy lessons from our analysis. Last, Section 8 concludes and discusses future research directions.

2 Related literature

Since our work deals with T&C industries' and firms' resilience and responses to industry-specific shocks, and on how the responses and resilience differ depending on the clusters within which firms operate, we now briefly (and selectively) survey four strands of related literature. First, we document the effects of the end of the MFA on T&C industries and firms. Second, we review the ways in which firms respond to shocks, especially those originating from the international trading environment. Third, we review the economic literature on countries', industries', and firms' resilience to shocks. Last, we briefly survey the geographical clustering of firms and its impact on various economic outcomes.

2.1 Effects of the end of the Multi Fibre Arrangement

On January 1st, 2005, the Multi Fibre Arrangement (MFA) that strongly regulated world trade in T&C for more than 30 years was abandoned. The MFA was first imposed by the US in 1955 to limit Japanese T&C exports. The US were then followed by other European countries and Canada and import restrictions were extended to many developing countries including India, Pakistan, China, and other Asian countries. The MFA regulated – via a quota system – how much textile and clothing developing economies could export to developed countries. In 1994, developed countries accepted to remove all quotas on textiles and clothing exports from developing countries under the World Trade Organization (WTO)'s Agreement on Textiles and Clothing (ATC). The ATC was considered as a 10-year transition process at the end of which developed countries committed to have removed all quotas imposed to *other* WTO *members*. Meanwhile, China entered the WTO in 2001. Following its accession, developed countries progressively removed a number of pre-existing quotas imposed on Chinese T&C exports under the ATC. On January 1st, 2005, all Chinese exports to the US, Canada, and the EU in the T&C industry were also free of quotas: the floodgates had been opened.

While part of the effects of removing the MFA quotas likely materialized earlier than 2005 due to firms' anticipations, it is fair to say that the bulk of the impacts was felt in the developed world from 2005 on. Indeed, while developing countries like China massively invested in the T&C industries in anticipation of the end of the MFA, developed countries very slowly faded out quotas before the 'T&C D-Day' (see Harrigan & Barrows 2009, for additional details). Having not fully anticipated the surge in imports after the end of the MFA, the US and the EU implemented safeguard measures to limit the growth of T&C imports from China to 7.5% per year until the middle of 2008. Canada, however, "did not respond with the imposition of temporary safeguard measures against Chinese imports." (Audet 2007, p.270). This latter point is important since we will use the end of the MFA as a 'natural' experiment that is not plagued by the same problems than many other episodes of trade liberalization. In the words of Harrigan & Barrows (2009, p.282), the end of the MFA was a "[...] large, sudden, fully anticipated, easily measured, and statistically exogenous change in trade policy." In the Canadian case, it was not impeded by subsequent restrictions that may mask the effect of the policy change.

Turning to the effects of the end of the MFA, Brambilla et al. (2010) analyze Chinese T&C exports to the US. They show that China was more constrained than other countries before the quota removal and that its exports to the US skyrocketed after 2005. For instance, Chinese exports to the US of products in which quotas were removed at the end of 2004 increased by 270%. These authors further document that the increase in imports from China adversely affected both US domestic producers and other US trading partners.[4] The end of the MFA is also shown to have a deep impact on the *structure and composition* of the T&C industry in developed countries. Using Danish firm-level data, Utar (2012) shows that increasing competition from China following the quota removal led to a change in the workforce composition of Danish firms. Sales, value-added, intangible assets, and employment dropped in firms subject to this new source of competition. Interestingly, all workers were not equally hit by this shock. Low-educated workers were the most affected, while college-educated workers managed to keep their jobs. Some college educated, as well as professional and technical employees, even experienced a rise in their salaries. However, this rise was limited to employees working in firms that were outsourcing part of their production to China. Finally, Martin & Mejean (2014) show that the quota removal on Chinese T&C exports led to a

[4] Harrigan & Barrows (2009) find that the surge in Chinese exports following quota removal has led to a decrease in the quality of Chinese exports in the sectors. Khandelwal et al. (2013) show that the removal of quotas led to the entry of more productive Chinese exporters.

reallocation of activities in France from low- to high-quality firms.[5]

As should be clear from the foregoing, the end of the MFA led to profound changes in the trading environment in the T&C industry. It is thus likely to also have had a lasting impact on location patters in T&C industries and on the workings of T&C clusters.

2.2 Responses to international competition

Changes in the international environment create economic shocks. Industries and firms respond to these shocks. In doing so, they adjust their structure and operations along several margins: they can exit (extensive margin), adjust their size (intensive margin), or alter their product mix and product quality. Their location and the geographical structure of the industry is another, less studied, margin.

2.2.1 Firms' responses to international competition

How do firms usually respond to shocks?

Exit and size: The end of the MFA is tightly connected to the drop in manufacturing employment in most advanced countries. A vast literature has investigated the economic effects of free trade agreements or quota and tariff removals on industries and firms. Trefler (2004) documents in detail the effects of the Canada-US free trade agreement on the Canadian manufacturing industries. As expected, the free trade agreement led to substantial exit of less productive plants, and labor reallocations towards more productive plants. Productivity in the most exposed manufacturing industries increased, although manufacturing employment shrank by a sizable margin in Canada as a whole. Looking more specifically at China after the end of the MFA, Pierce & Schott (2014) show in a recent paper that the drop in manufacturing employment is partly explained by the US trade policy vis-à-vis China, and that American firms responded to this change in policy by reallocating part of their production to China. From a local policy maker's perspective, this adjustment margin of overseas reallocations is not very different from 'exit' in its more conventional form.

The substantial decline in manufacturing employment in developed countries, due to exit and downsizing of manufacturing firms, probably exaggerates the net effect of trade agreements on the labor market. Indeed, using Danish firm-level data, Bernard et al. (2014) decompose the drop of manufacturing employment in Denmark. They show that this decline is mostly due to firms' exit and downsizing. However, a sizable portion of this decline has also been driven by firms switching from manufacturing to service industries. This 'switching margin', which we discuss in more detail in this report, has been less investigated than the more obvious 'exit and size' margins. It is,

[5] The consequences of the removal of quotas on Chinese exports have not been limited to developed countries. Iacovone et al. (2010) show that the surge in Chinese exports at the beginning of the 2000's caused a strong exit of small Mexican plants and a reallocation of activities from small to large plants.

however, an important one. We will show that it is one of the margins that smaller firms use to adapt to the changing international environment, whereas larger firms – and multiunit plants – adjust more via the exit and size margins.

Industry switching, process innovation, and product upgrading: Bernard & Fort (2015) show that part of the drop in manufacturing in the US is an artefact due to changes in the nomenclature of activities of some firms. More specifically, they point to the increasing importance of so-called factory-less producers. These firms have no manufacturing plants in the US, are classified as operating in the wholesale sector, but are heavily involved in the production process of tangible goods. The prevalence of these firms in the US has grown at the same pace as the decline in manufacturing firms. Factory-less producers have also grown in numbers in the Canadian T&C industries, with design being done in the remaining Canadian T&C clusters, but production being outsourced overseas.

Firms may also respond to import competition from low-wage countries by process innovation and by positioning themselves on different segments of the quality ladder. Some of the Canadian T&C production has shifted from final consumer goods to intermediate inputs such as speciality garments and high-tech fibres. Others remain on the final goods segment, yet specialize on niche products and flexible production processes that allow to respond quickly to changes in local fashion and trends (see Holmes & Stevens 2014 for the US furniture industry).[6] Using Belgian firm-level data, Mion & Zhu (2011) show that outsourcing from, and competition with, China led to skill upgrading within and between firms. In a related paper, Bloom et al. (2009) show that increasing competition from China induced an increase in innovation by European firms. Both of these papers suggest that import competition leads to quality upgrading in firms in order to relax competition.

In this report, we will look at the exit and size, as well as the industry switching margins. In all cases, we will investigate how these margins differ between firms and industries that are more or less geographically clustered. Clustered firms may behave differently in their reactions to shocks either because clusters host different types of firms (compositional effects), or because spatial proximity allows for interactions that allow to adjust to shocks (cluster effects). For example, firms may learn in clusters how to adapt to shocks by observing nearby firms. Also, industry switching may be facilitated by the local presence of complementary economic activity and knowledge. Although these issues are important to understand, we are aware of very little quantiative and systematic work on them.

[6] As Eric Wazana, co-owner of Montreal-based Second Denim put it, "Fashion changes faster and faster and our biggest edge is being able to react very quickly compared to clothes being made anywhere else in the world" (see `http://www.thestar.com/news/insight/2013/05/27/made_in_canada_how_globalization_has_hit_the_canadian_apparel_industry.html`.

2.2.2 Spatial effects of international competition

International competition induces changes at the firm level. Since location choices are one of the firms' strategic decision, changes in the trading environment may lead to profound changes in the geographical structure of industries.

There is a vast theoretical literature on 'geography and trade', i.e., the impacts of international trade on the spatial organization of an economy (see Fujita & Thisse 1999, 2002 and Combes et al. 2008 for reviews). Although a leitmotif of that literature is that *trade does matter for the spatial structure of economic activity*, the precise impacts of deeper integration on economic geography depend on the models used (e.g., Krugman & Elizondo 1996, Monfort & Nicolini 2000, Behrens et al. 2007). While theory has a lot to say on geography and trade, surprisingly little is know empirically. Only few papers have looked at the dynamics of geographical concentration or on the impacts of trade on the spatial structure of countries. In a pioneering study, Dumais et al. (1997) investigate how entry, exit, and firm growth affect the geographic distribution of manufacturing employment in the US from 1972 to 1992. They find that firm entry had a dispersive effect, whereas firm exit was agglomerative. On balance, however, these effects roughly canceled out and the spatial structure remained fairly stable. Although these results are important, the study remains silent on the role of trade. It is also carried out at an aggregate spatial level, using either states or metropolitan areas.

Turning to the impacts of trade – as proxied by 'market access' – Redding & Sturm (2008) use the division and reunification of Germany after World War II as a natural experiment. They find that West-German cities close to the East-West border shrank after the division when compared to cities further away from the border, thus showing that market access matters for the spatial structure of the economy. Brülhart et al. (2012, 2013) use the fall of the Iron Curtain in 1990 as an exogenous and unanticipated change to market access, and they look at the differential impact this change had on the Austrian municipalities located close to the hitherto relatively impenetrable eastern borders. They find that better market access triggered both price and quantity responses: better market access raises wages and attracts economic activity, as predicted by theory. While these papers all provide valuable insights, none of them answers the question of whether or not trade is agglomerative or dispersive, which sectors are affected more, and what the role of firm-level entry and exit is in determining changes in geographic concentration.

What drives changes in observed location patterns? It is likely that the impact of increased import competition depends both on the types of goods imported – final goods vs intermediates – and on the nature and origin of the goods – differentiated goods from high-income countries vs homogenous goods from low-cost countries. It also depends on what type of firms are more likely to benefit from or to be hurt by international trade, and how these firms are distributed across space. If, e.g., less productive firms are eliminated by fiercer import competition whereas more productive firms expand (see, e.g., Aw et al. 2000, Melitz 2003, Bernard et al. 2007), and if less productive firms are less strongly clustered than more productive firms, then increased import competition would tend to reinforce existing patterns of localization.

Holmes & Stevens (2014) develop and estimate a model where two types of firms co-exist: large firms producing standardized products and smaller firms producing niche products. In this model, large firms tend to agglomerate in clusters, while niche producers are spread out more evenly in the economy. In this framework, large plants producing standardized products suffer more from low-wage country competition while niche – geographically isolated – plants resist better. The authors estimate the model and show that it provides consistent predictions regarding the geography of activity and the effect of import competition. As we will see, our results for the Canadian T&C industry are consistent with their results for the US furniture industry. This suggests that more general mechanisms are at work, at least for labor-intensive low-tech industries such as textiles and furniture.

2.3 Resilience to economic shocks

The question of the resilience of local economies and firms to shocks is an old one. As emphasized by Pendall et al. (2010), Martin (2011), or Martin & Sunley (2015), *resilience* is now a buzzword in policy and academic circles. This notion encompasses different definitions: it may alternatively refer to the ability of a system to recover from, to absorb, or to adapt in response to a shock. In the economic literature, the first definition – the ability to recover – usually prevails, either explicitly or implicitly. In recent years, many studies have examined the effects of the 2008–2009 crisis on the resilience of countries, firms, and – to a smaller extent – regions.

Starting with countries, Abiad et al. (2015) study the resilience of emerging markets and developing countries to economic downturns. They measure resilience as the speed of recovery following economic downturns and show that the resilience of these countries has increased over the past 60 years. This improved resilience is explained both by a lower incidence of economic shocks and by a better governance. Giannone et al. (2011) define resilience as a country's ability to absorb a shock, consistent with the second definition proposed by Martin & Sunley (2015). In this study, they find that a country's liberalization of credit markets is negatively correlated with resilience during the crisis.

Turning next to firms, a full set of papers have studied the response and adaptation of firms to economic shocks – even if most of these papers however do not use the term 'resilience'. Bloom et al. (2009), for example, show that firms increase innovation in response to increasing competition from low-wage countries. Bernard et al. (2006) and Mayer et al. (2014) find that firms adjust their product-mix and Bernard et al. (2006) further show that multi-plant firms shut down most vulnerable plants in response to increasing competition. Amiti & Khandelwal (2013) show that firms adapt to import competition by upgrading the quality of their products. Looking at public hospitals in the UK, Bloom et al. (2015) show that increasing competition results in higher management quality. A large number of recent studies have explicitly looked at the resilience of exporting firms during the 2008–2009 financial crisis. The reason for that interest is that the financial crisis was accompanied by a steep fall in world trade. The general finding of the literature is that the 2008–2009 crisis operated as a large demand shock that affected most firms indiscriminately in their export and domestic markets. Using Belgian micro-data, Behrens et al. (2013) find that virtually all of the adjustments of exporting firms to the demand shock occured at the intensive margin: the product-destination mix of firms remained very stable – as did unit prices – whereas quantities traded fell enormously. Credit constraints, intermediate goods and inventories, and trade frictions due to protectionnist measures played only a small role in firms' adjustment to the shock. Using very different datasets and methodologies, Eaton et al. (2013) and Bricongne et al. (2012) reach the same conclusion: firms predominantly contracted at the intensive margin, with a limited role for the extensive margin and global supply chains, and almost no role for credit constraints or trade barriers. Chor & Manova (2012) find a larger role for credit constraints during the crisis for financially constrained countries and industries exporting to the US. Last, Bems et al. (2011) and Levchenko et al. (2010) find some role for the disruption of global value chains in explaining the fall in world trade during the crisis.

Last, turning to the spatial dimension of resilience, the impact of geographic clusters on industries' and firms' resilience is not a topic of extensive research.[7] In a very recent paper, Delgado et al. (2016) empirically assess the role of clusters in the resilience of regional industries during the Great Recession in the US. In this work, the authors delineate clusters using a publicly available dataset developed in Delgado et al. (2015). In their empirical exercise, they exploit variations in the growth rate of employment across regional industries over the period 2003-2011 and show that industries located in strong regional clusters (in terms of employment and number of plants) experienced a higher employment growth during and after the recession. This finding is interpreted as evidence of a lower vulnerability and a faster recovery of regional industries active in strong clusters. Finally, Martin et al. (2013) is the only contribution that investigates whether firms in clusters resist better to economic shocks using microlevel data. In this work, the authors define resilience as the probability of firms to stay in the export market after the 2008–2009 crisis. They show that in normal times, firms that are located near other exporters or targeted by cluster policies perform better than other firms: they have a higher probability of staying active in the export markets, and they experience a higher growth of their exports. However, these advantages vanished during the recent economic turmoil. This suggests that firms that belong to a clusters are not more resilient to aggregate economic shocks than their 'isolated' counterparts. They may even be less resilient if

[7]A recent literature uses spatial variations in specialization to investigate the impacts of trade shocks on local labor markets. Autor et al. (2013*a*,*b*), e.g., compare the geography of technology and trade shocks in the US. They show that trade shocks are spatially concentrated because of the strong spatial concentration of manufacturing industries. They examine the impact of Chinese competition on US local labor markets and show that commuting zones more exposed to Chinese competition suffered higher unemployment, lower labor-force participation, and lower wages than less exposed areas. Kovak (2013) reaches a similar conclusion by looking ar the impact of tariff cuts on local wages across Brazilian regions.

they are in a cluster in which the 'leader', i.e., the dominant firm in the cluster, performs relatively badly. This suggests that the cumulative 'benefits of clusters' can go either way: in good times, clusters boost productivity and generate cumulative benefits to firms; in bad times, clusters depress productivity and the cumulative benefits may erode quickly.

Although the 2008–2009 crisis that the literature has used to look at resilience is a priori useful – since it is a broad-based shock that affected many regions, countries, and firms at the same time, thus allowing for many observations – its broad base also makes it less suited for understanding the different channels and differential effects. In this report, we hence focus on a specific industry and a well-identified shock in order to more cleanly tease out the effects of that shock and its interaction with the geographical structure of the economy.

2.4 Geographic concentration of industries

It has been widely documented that manufacturing activity is strongly concentrated geographically. Ellison & Glaeser (1997) and Duranton & Overman (2005, 2008) develop methodologies to assess the geographic concentration of plants and employment and apply them to US and UK data, respectively. The latter authors find that about half of the UK manufacturing industries are geographically localized. Behrens & Bougna (2015) apply the Duranton and Overman (DO) methodology to Canada for the years 2001, 2005, and 2009. They document that manufacturing is less localized in Canada than in the US or in the UK, and that the trend has been decreasing over time (thus suggesting that the extent of regional specialization in specific manufacturing industries has been falling in Canada).

One surprising finding of the literature on the geographic clustering of industries is that *T&C industries are strongly spatially concentrated in most countries.* These findings hold for the UK, where textiles and clothing (SIC 17-19) and publishing (SIC 22) industries are among the most localized industries, while food and drink (SIC 15), wood (SIC 20), and petroleum (SIC 23) industries are among the least localized ones (see Duranton & Overman 2005). The pattern is also similar to that observed in Japan by Nakajima et al. (2012), where the most localized industries are related to 'textile mill products' (JSIC 11). Ellison et al. (2010) and Holmes & Stevens (2014) document similar findings for the case of the T&C and furniture industries in the US, respectively. Krugman (1991) also extensively discusses the 'carpet cluster' in the US. This strong spatial concentration of 'low-tech' industries such as textiles and clothing, carpets, and furniture runs against the received wisdom of many 'cluster proponents' who think first about high-tech, bio-tech, or other 'high-end' industries when it comes to geographical agglomeration.

Most of the literature has used measures of the geographic concentration of industries to better understand the microeconomic mechanisms giving rise to increasing returns to scale that explain the spatial concentration of related activities (see Rosenthal & Strange (2004) and Combes & Gobillon (2014) for surveys). Little consideration has been given to international trade in that literature. Behrens et al. (2015) is an exception. These authors use confidential data on a panel of Canadian manufacturing plants from 1991 to 2010 to show that increasing import competition – and changes in the costs of transporting goods across space more broadly defined – has been dispersive: "changes in trucking rates, in import exposure, and in access to intermediate inputs explain between 20% and 60% of the observed decline in spatial concentration over the 1992–2008 period." (Behrens et al. 2015, p.1). However, their analysis is at the industry level and does not investigate how firms in clusters or firms outside of clusters react to adverse economic shocks.

3 Data description

We now briefly describe our key datasets and sources. More detailed information on the data, its quality, and how it compares to the datasets of Statistics Canada, is provided in the appendix of Behrens & Bougna (2015).

3.1 Plant-level and geographical data

Our analysis is based on the *Scott's National All Business Directories Database*. This establishment-level database contains information on plants operating in Canada, with a very exhaustive coverage of the manufacturing sector. Our cleaned dataset comprises 321,683 manufacturing plants from 2001 to 2013 in two-year intervals (see Table 1 below for a breakdown by year). For every establishment, we have information on its primary 6-digit NAICS code and up to four secondary 6-digit NAICS codes; its employment; its export status; up to 10 products produced; and its 6-digit postal code. The latter allows us to effectively geocode the plants using postal code centroids. All NAICS codes are concorded to a stable classification of manufacturing industries between 2001 and 2013.[8] Our data are very similar to those of the *Annual Survey of Manufacturers* (ASM) and the *Canadian Business Patterns* (CBP) in terms of coverage and industry-level breakdown of plants and, therefore, provide a fairly accurate picture of the overall manufacturing structure in Canada over our study period.[9]

We include all manufacturing plants in our analysis and apply a 0.5% trimming from above on employment to get rid of some obvious outliers. We consider that a plant is a manufacturer if

[8]Our data span the NAICS 1997, 2002, 2007, and 2012 classifications. We concord the data to 242 stable industries over that period. We exclude two industries (NAICS 325110 'Petrochemical manufacturing', and 311830 'Tortilla manufacturing') from our analysis because they contain only a very small number of plants.

[9]The Scott's database constitutes the best alternative to Statistics Canada's proprietary *Annual Survey of Manufacturers Longitudinal Microdata File* or the manufacturing portion of the micro-level *Canadian Business Patterns*. See Behrens & Bougna (2015) for additional comparisions with these datasets. The yearly correlation of plant counts across industries in our data and the ASM ranges from 0.91 to 0.97. There is no 'sampling frame' strictly speaking in the Scott's data (though Scott's uses the Canadian Business Register – which contains the universe of entities – to contact the different establishments in a systematic way to include them into their database). There may be some selection and updating biases, since firms are contacted to sign up but are of course free to not do so, but those are unlikely to systematically affect our analysis.

Table 1: Descriptive statistics for plants by year.

				% exporters		Plant size		Multiunit	
Year	#plants	#textile	% T&C	T&C	non-T&C	T&C	non-T&C	T&C	non-T&C
2001	52,051	4,465	8.58	39.80	43.81	32.39	33.33	5.01%	9.33%
2003	51,893	4,386	8.45	41.43	45.06	31.54	33.96	4.58%	8.99%
2005	49,228	3,803	7.73	43.33	45.60	30.01	35.32	4.05%	8.57%
2007	46,272	3,170	6.85	45.55	45.95	28.13	36.21	3.82%	8.22%
2009	44,684	2,910	6.51	45.84	45.31	27.41	36.21	3.37%	7.78%
2011	42,219	2,696	6.39	45.51	45.48	25.81	35.59	2.74%	7.65%
2013	35,336	2,057	5.82	45.99	45.82	25.30	37.92	2.67%	7.18%

Source: Scott's National All database, years 2001–2013. T&C plants are in NAICS industries 3131–3169. All industries are concorded to a stable classification. Plant size is measured by total employment. Plants indicate whether or not they are engaged in export activities (dummy variable). Multiunit is based on plants having the same legal firm name.

it reports a manufacturing sector (NAICS 31–33) as its primary sector of activity. Since plants in our dataset also report up to four secondary NAICS codes, we can also conduct a more 'extensive' analysis that includes all plants that report at least some manufacturing activity. We exploit the fact that plants report several industries to analyze how plants may switch between closely related industries.

Turning to the geographical dimension of the data, as already explained we geolocate plants by using latitude and longitude data of postal code centroids obtained from Statistics Canada's *Postal Code Conversion Files* (PCCF). These files associate each postal code with different geographical classifications that are used for reporting census data. We match plant-level postal code information with geographical coordinates from the PCCF, using the postal code data for the next year in order to consider the fact that there is a six months delay in the updating of postal codes. Postal codes are geographically very fine-grained, especially in denser and more urban areas, and thus provide a fairly precise description of microgeographic location patterns. For example, there were 818,907 unique postal codes postal as of May 2002, and 890,317 unique postal codes as of October 2010. Postal codes are less fine-grained in rural areas, but those areas contain much fewer plants. Most of the localization measures that we will be using are smoothed across observations, thereby further reducing the impact of less precise geocoding in more rural areas. Since clusters are located in more urban areas, the precision of the geocoding should be fairly accurate.

3.2 Industry-level data

Our international trade data are at the industry and province level and come from *Innovation, Science and Economic Development Canada's Trade Data Online*. The data report import and export values by NAICS 6-digit industry from 1992 to 2011. All trade flows are broken down by countries or origin or destination, and at the province level. We concord the data to our stable NAICS classification. We complement our industry-level data with the aggregate version of the ASM, which reports industry values for employment (both production and non-production), value-added, and revenue. Last, we use detailed input-output tables at the 6-digit level. Those tables are constructed from the publicly available more aggregated tables (L-level tables), and we break them down to the 6-digit level using either sectoral employment or sales weights.

The international trade data are supplemented by data on quotas on Chinese imports. As explained in Section 2, some quotas on Chinese imports in the T&C sector have been removed in 2001 while others have been removed in 2005. Khandelwal et al. (2013) provide information on quotas faced by Chinese exporters in Canada and the year of removal of these quotas. Products subject to quota restrictions are described in the Chinese HS8 nomenclature. We then aggregated the products at the HS6 level and then use the correspondence table developed by Pierce & Schott (2009) to have information on quotas at the NAICS level.[10]

3.3 Delimiting the T&C industry

As explained before, we restrict our analysis to the textile and clothing (T&C) industry. Hence, we have to first delimit that industry. Table 2 summarizes the way we define the T&C industry. We use a cluster algorithm to group 4-digit industries into 'clusters', based on different measures of industrial relatedness, s_{ij}. We use four such measures: (i) the share of plants in industry i that report secondary activities in industry j; (ii) the strength of input-output links between industries i and j, based on national input-output tables; (iii) the similarity of industries i and j in terms of 553 occupational categories that they employ; and (iv) the frequency with which industries cite patents originating in other industries. The latter three measures are constructed as in Ellison et al. (2010). For each measure s_{ij} we group all 4-digit industries into clusters of industries that are similar within clusters, and dissimilar between clusters.

Table 2 summarizes our results. As can be seen from Table 2, the T&C industry is well delineated by NAICS 3131 to NAICS 3169. Roughly speaking, this comprises all textile mills, apparel, cut-and-sew clothing, leather and hide, and footwear industries.[11]

Tables 22 and 23 in the Appendix, provided additional information for our T&C industry. Table 22 summarizes the aggregation of the T&C industry and its link to our stable NAICS classification. We have 22 T&C industries at the 6-digit level, and 11 T&C industries at the 4-digit level, that constitute our aggregate T&C industry. Table 23 provides a measure of 'upstreamness' – i.e., distance from final demand – for each of our 22 6-digit T&C industries. A distance of one

[10]We consider that a NAICS industry was subject ot quotas until 2005 if at least 90% of HS6 products in that industry were subject to quotas until this date.

[11]Our classification is very close to the 'T&C cluster' definition of Delgado et al. (2015) in their 'Benchmark Cluster Definition': it encompasses their four clusters 'Apparel', 'Footwear', 'Leather and related products', and 'Textile manufacturing'. Note that we include the 'Leather and footwear' part in our T&C cluster. As can be seen from Table 2, according to the 'Within-firm complementarity' metric, firms and plants engaged in T&C manufacturing also heavily engage in footwear and leather-related activities. This, when combined with the fact that the MFA also included the footwear industries, provides our rationale for not separating these two components in our analysis.

Table 2: T&C clusters based on different 'relatedness measures' (MCL clustering algorithm for 85 4-digit industries).

Metric used	Cluster 1	Cluster 2	Cluster 3	Remainder
Within-firm complementarity	3141, **3379** Rugs and funiture	3131, 3149, 3133, 3132, 3159, **3231** Textile mills and printing	3151, 3161, 3162, 3169, 3152 Apparel and footwear	
Max input-output links	**3116**, 3161, 3162, 3169 Footwear, leather, and meat	3131, 3132, 3133, 3141, 3149, 3151, 3152, 3159 Textiles mills, apparel and 'cut-and-sew'		
Occupational employment correlation	3131, 3132 Textile mills	3133, 3141, 3151, 3149, 3152, 3159, 3162 Textiles, apparel, and 'cut-and-sew'	3169 (a singleton cluster)	3161 (alone in a big cluster)
Knowledge flows	3161, 3162, 3169 Leather and footwear	3159, 3152 Cut-and-sew	3132 (a singleton cluster)	3131, 3133, 3149, 3141 (together in a big cluster)

Notes: The four metrics are constructed as follows: (i) 'Within-firm complementarity' is the share of firms in a 4-digit primary NAICS i that report a secondary code in another 4-digit sector j; (ii) 'Max input-output links' is the maximum element in the input-output tables between i and j; (iii) 'Occupational employment correlation' is the correlation coefficient between i and j's shares of 553 occupations; and (iv) 'Knowledge flows' is the use-based number of patents that originate in i and are embodied in j. The clustering is done using the Markov cluster algorithm (MCL) by Stijn van Dongen ("A cluster algorithm for graphs. Technical Report INS-R0010, National Research Institute for Mathematics and Computer Science in the Netherlands, Amsterdam, May 2000; see `http://micans.org/mcl/`). The graph is constructed with positive weights for all links above the median, and zero weights below the median, in order to allow for more variability.

means that the production is entirely dedicated to final consumption – e.g., personal services like ‘Passenger car leasing’ (NAICS 532112) – while intermediate inputs that are used at the beginning of the vertical production chains – such as chemical products like ‘Alkali and chlorine manufacturing’ (NAICS 325181) – correspond to the most upstream industries. The measure is computed using the methodology developed by Antras et al. (2012) using our detailed 6-digit input-output tables which include all service industries and final demand. As shown in Table 23, roughly 50% of the T&C industries can be considered as *intermediate* (e.g. ‘Fibre, Yarn and Thread Mills’), and one third as *final* (e.g. ‘Clothing Accessories’). Four out of 22 industries have intermediate values of upstreamness and cannot be clearly assigned to either final goods or intermediates.

4 Aggregate facts on the T&C industry

We first review the broad facts concerning the changes in T&C industries and in international trade in T&C in Canada.

4.1 Imports and exports

Table 3 contains descriptive information on changes in Canadian import values by industry and countries of origin. We distinguish three types of imports: imports from China, from other low-income countries, and from high-income countries. Following Bernard et al. (2006), low-income countries are defined as countries whose GDP per capita is lower than 5% of US GDP per capita, and high-income countries are countries whose GDP per capita is higher than 95% of US GDP per capita. This table shows that all T&C industries experienced a massive increase in imports from China over the period 1999–2011. For instance, import values from China in the ‘Cut and Sew Clothing Manufacturing’ (NAICS 3152) increased by more than 1.6 billion C$ between 2003 and 2007. The rise in Chinese exports to Canada has been particularly strong in industries oriented towards *final* consumption as compared to *intermediate* industries (NAICS 3131, 3132, and 3133 in particular). Besides, while this trend is primarily driven by China, imports from all low-income countries have also increased in most industries. Finally, this surge in imports from low-wage countries has occurred at the expense of high-wage countries that have seen the value of their exports to Canada fall sharply between 1999 and 2011 in almost all industries of the T&C industry (the only exception being ‘Other Leather and Allied Product Manufacturing’, NAICS 3169). The fall in imports from high-wage countries has been especially pronounced in intermediate goods. For ‘Fabric mills’ (NAICS 3132), imports fell by an amazing 600 million C$ between 2003 and 2007. This shows that not only the final sector has been hit, but also the intermediate sector that is more upstream: a small part of that effect is due to import diversion (sourcing from China), but the bulk of it is due to the general disengagement of Canada from the T&C industries.

The left panel of Figure 3 depicts these changes in imports for selected industries over two

Table 3: Changes in import values, all T&C industries.

			Imports from China			Imports from low-income countries		
NAICS	Type	Industry name	Δ1999 – 2003	Δ2003 – 2007	Δ2007 – 2011	Δ1999 – 2003	Δ2003 – 2007	Δ2007 – 2011
3131	INT	Fibre, Yarn and Thread Mills	-0.7013	0.5346	3.7972	-30.8598	-41.4847	-10.7351
3132	INT	Fabric Mills	59.35901	-10.9772	9.7909	-45.2149	-64.5152	-1.9970
3133	INT	Textile and Fabric Finishing and Fabric Coating	5.1687	4.4554	8.1127	.5474	2.5310	1.9122
3141	INT	Textile Furnishings Mills	147.0935	289.4660	102.7474	94.7453	73.4808	11.3419
3149	UNC	Other Textile Product Mills	65.8869	80.4713	48.0528	13.0685	26.8001	39.0752
3151	FIN	Clothing Knitting Mills	40.1699	557.5818	177.5836	77.2275	109.9740	163.6169
3152	FIN	Cut and Sew Clothing Manufacturing	744.4456	1624.7570	77.2621	459.3938	259.1500	835.0002
3159	FIN	Clothing Accessories and Other Clothing Manufacturing	89.1302	89.1241	120.1234	9.7309	14.6381	33.1973
3161	UNC	Leather and Hide Tanning and Finishing	2.6261	1.2444	0.8643	1.9760	-1.4035	-1.4529
3162	UNC	Footwear Manufacturing	181.7469	344.4463	236.7850	19.5069	15.2499	110.0145
3169	UNC	Other Leather and Allied Product Manufacturing	79.3275	204.5109	170.0349	1.5441	0.8909	27.2447
			Imports from high-income countries					
	Type		Δ1999 – 2003	Δ2003 – 2007	Δ2007 – 2011			
3131	INT	Fibre, Yarn and Thread Mills	-140.9937	-98.8841				
3132	INT	Fabric Mills	-447.6230	-587.6605	-168.2797			
3133	INT	Textile and Fabric Finishing and Fabric Coating	-38.3291	-37.2166	-51.6110			
3141	INT	Textile Furnishings Mills	-4.9659	9.0851	-118.2777			
3149	UNC	Other Textile Product Mills	-54.6668	-65.0080	-44.6556			
3151	FIN	Clothing Knitting Mills	1.4468	-181.9226	-26.6707			
3152	FIN	Cut and Sew Clothing Manufacturing	-52.8369	-662.4982	-192.1193			
3159	FIN	Clothing Accessories and Other Clothing Manufacturing	-3.4216	-21.4442	-3.2766			
3161	UNC	Leather and Hide Tanning and Finishing	-18.6632	-106.7531	-39.9087			
3162	UNC	Footwear Manufacturing	-92.2243	-69.2085	-80.6066			
3169	UNC	Other Leather and Allied Product Manufacturing	27.8445	22.8187	12.2334			

Notes: Author's computations, using *Innovation, Science and Economic Development Canada's Trade Data Online* from 1999–2011. Low-income countries are defined as in Bernard et al. (2006) by all countries with a GDP per capita lower than 5% of US GDP per capita. The types of goods produced by each industry are classified as INTermediate, FINal, or UNClassified (see Table 23 in the Appendix). All values are expressed in millions of current C$.

decades. We focus here on three industries: 'Cut and Sew Clothing' (NAICS 3152), 'Fibre, Yarn and Thread Mills' (NAICS 3131), and 'Footwear' (NAICS 3162). We see that footwear and clothing imports from low-income countries have steadily increased over the two decades, and that this increase has been particularly strong for Chinese exports to Canada. It is also clear from the figure that this increase has come together with a decrease in Canadian imports from high-wage countries. In the footwear industry, China accounts for the lion's share of Canadian imports from low-income countries. In the clothing industry, the level and evolution of Chinese imports were not very different from those of other low-income countries until 2001. After China's WTO accession in 2001, Chinese exports to Canada started to increase at a higher pace than those of other low-income countries. After the end of the MFA in 2005, Chinese exports surged again and overtook those of all other Canadian imports from high-income countries.

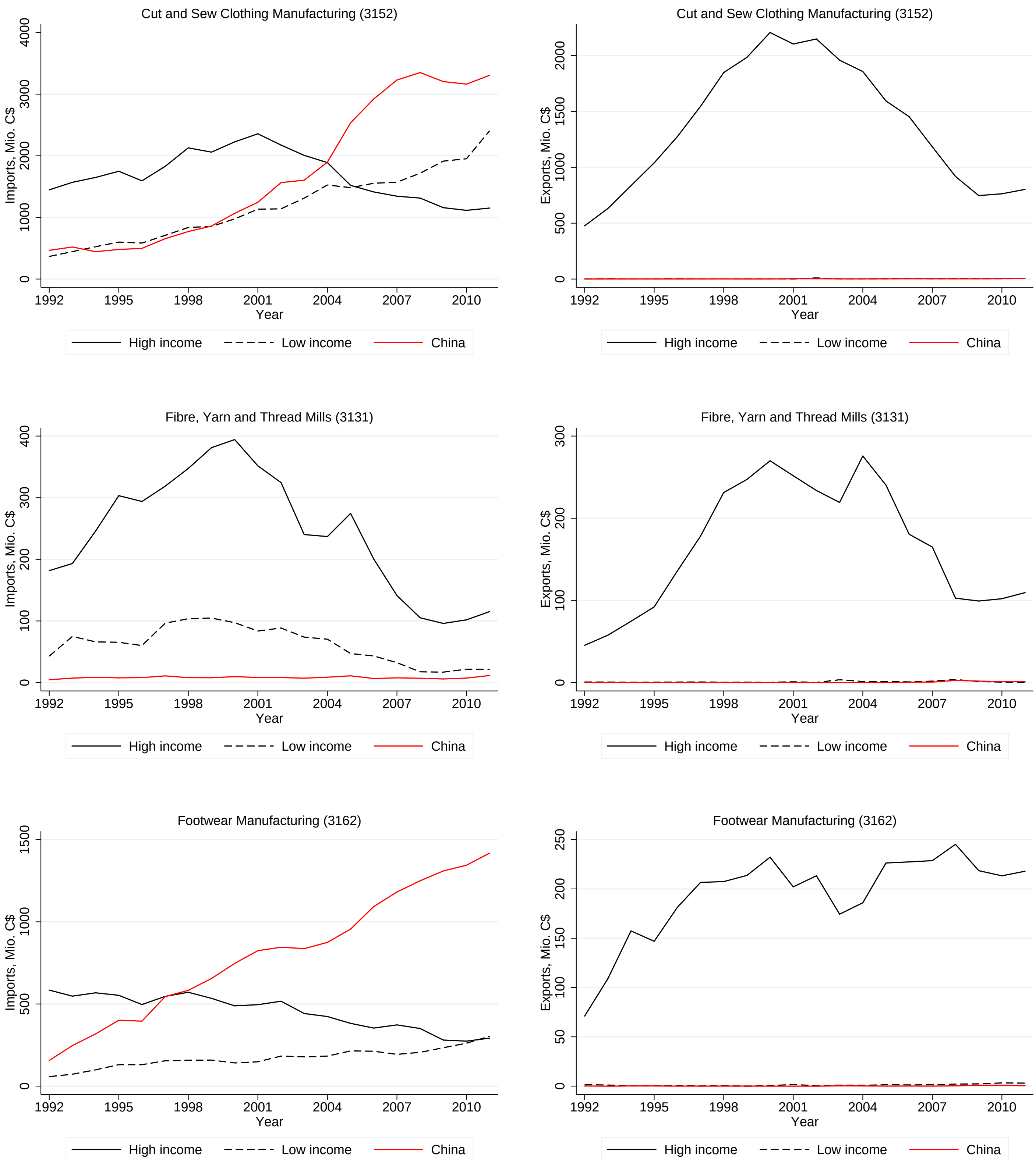
The foregoing evolutions contrast with those of imports in the 'Fibre, Yarn and Thread' industry (NAICS 3131). In this industry, imports from China and from other low-income countries are very low and have been stable over the entire period. We can also notice that exports from high-income countries to Canada shrank as of 2000. The 'Fibre, Yarn and Thread' industry being a key intermediate input in the production of T&C products, the drop in overall imports of this type of manufactured goods is consistent with a lower demand for intermediates due to a production collapse in the Canadian T&C industry during the period. This decline is very clear when looking at Canadian exports in this industry, as shown in the right panel of Figure 3. Eventually, we see that exports in that industry drops from more than 250 millions Canadian dollars in 2004 to about 100 millions in 2011.

It is clear from Figure 3 that the decline in Canadian exports is not restricted to *intermediate* T&C industries. The *final* industry 'Cut and Sew Clothing' (NAICS 3152) also experienced a dramatic fall in exports. While exports to low-income countries remained negligibly small from 1992 to 2011, T&C trade with high-wage countries has collapsed as of 2000. This suggests that the increase in imports from low-income countries – and especially China – was associated with a decline in Canadian production and exports. This finding will be confirmed in our econometric analysis when looking at the number of plants, since the number of plant deaths has been dramatic in this industry. It will also be reflected in industry-level employment.

Finally, it is worth noting that the patterns are different for the 'Footwear' industry (NAICS 3162). In this sector, the rise in imports from China has not been associated with a decline in Canadian exports. Exports to high-income economies remained fairly constant after the end of the MFA. This is probably due to the niche market for Canadian winter boots, most of which are sold to the US and other high-income countries.[12]

[12] See http://www.statcan.gc.ca/pub/33-251-x/1998/4059323-eng.htm (last accessed on March 26, 2016).

Figure 3: Selected Canadian T&C imports (left panel) and exports (right panel).



4.2 Changes in trade barriers

In 2005, Canada abandoned all quotas on imports from China. Quotas on Chinese exports have been phased out progressively starting 2001, but major industries remained subject to quotas until 2005.[13] These industries are listed in Table 4. As can be seen, Chinese exports to Canada in industries subject to quotas have increased dramatically from 2001 to 2013. For instance, Chinese exports of 'Hosiery and Sock Mills' (NAICS 315110) have been multiplied by 17 between 2001 and 2013. We can further see that China's market share in Canadian imports jumped between 2001 and 2013 in industries that were subject to quotas prior to 2005.

Figure 4: Changes in T&C imports and exports by quota status.

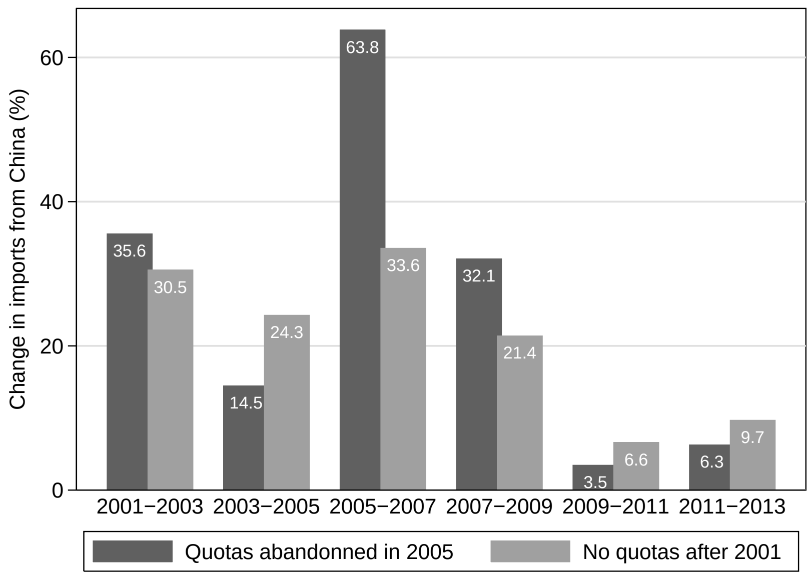


Figure 4 depicts the evolution of Chinese exports to Canada in industries subject to quotas until 2005 versus other T&C industries. For these two groups, the value of exports increased steadily over our whole study period. For most sub-periods, there is not marked difference in the evolution of exports between the two types of industries. However, there is a remarkable difference during the 2005-2007 period. In the aftermath of the quota removal, industries that were subject to import restrictions indeed experienced a strong increase in their imports from China, by about two-third. By contrast, industries which were not subject to quotas have seen their exports increase by 'only' 30%. This suggests that the quota removal has had a strong impact on the growth of Chinese exports to Canada in these formerly protected sectors. We will exploit this fact later in this report.

[13] As mentioned before, Canada did not implement any safeguard measures after January 1st, 2005, so the end of the quota system is de facto in 2005.

Table 4: MFA quotas in the T&C industries.

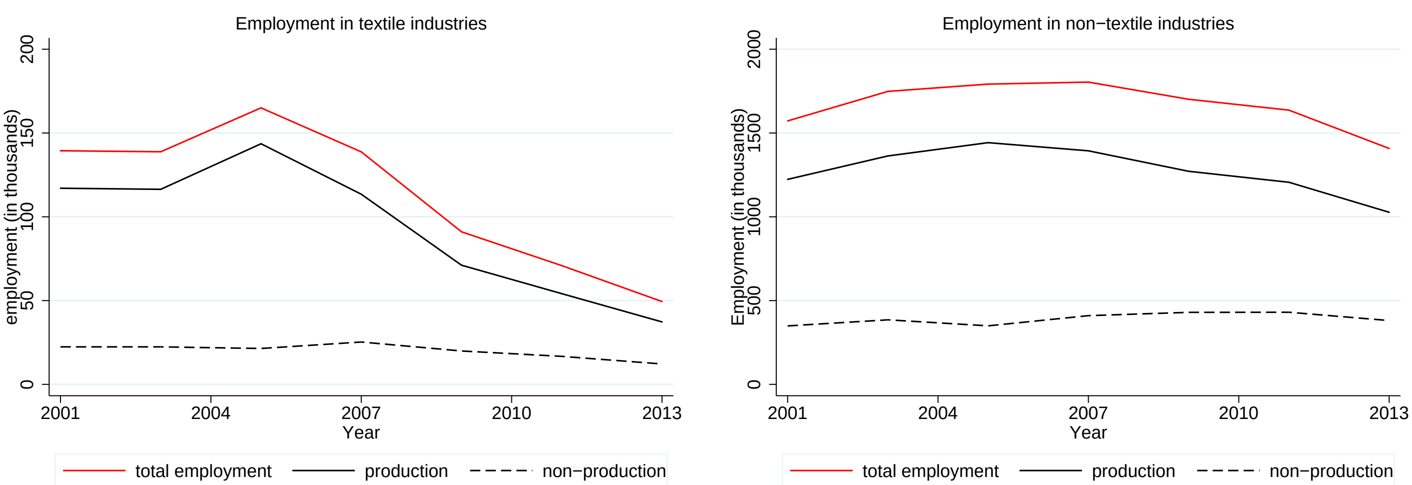
		Subject to quotas	Imports from China		Chinese market share	
NAICS	Industry name	until 2005	2001	2013	2001	2013
313210	Broad-woven fabric mills	**Yes**	91.8	120	0.06	0.19
313320	Fabric coating	**Yes**	1.3	17.4	0.00	0.09
315110	Hosiery and sock mills	**Yes**	5.6	137	0.05	0.50
315220	Men's and boys' cut and sew clothing manufacturing	**Yes**	347	973	0.22	0.38
315249	Women's and girls' cut and sew clothing manufacturing	**Yes**	381	1,920	0.21	0.53
315990	Clothing accessories and other clothing manufacturing	**Yes**	154	452	0.47	0.69
313110	Fibre, yarn and thread mills	No	7.8	11.5	0.02	0.08
313220	Narrow fabric mills and machine embroidery	No	3.3	17.4	0.03	0.22
313230	Nonwoven fabric mills	No	364	13.6	0.00	0.03
313240	Knit fabric mills	No	48	50,9	0.09	0.26
313310	Textile and fabric finishing	No	0.9	2.6	0.02	0.09
314110	Carpet and rug mills	No	12.3	57.4	0.02	0.08
314120	Curtain and linen mills	No	98.2	592	0.17	0.57
314910	Textile bag and canvas mills	No	71.2	139	0.46	0.49
314990	All Other Textile Product Mills and cut-and-sew clothing contracting	No	28.4	155	0.04	0.25
315190	Other clothing knitting mills	No	64.3	709	0.14	0.58
315291	Infants' Cut and Sew Clothing Manufacturing	No	15.4	121	0.23	0.57
315292	Fur and Leather Clothing Manufacturing	No	69	58.1	0.60	0.56
315299	All Other Cut and Sew Clothing Manufacturing	No	47.3	231	0.22	0.58
316110	Leather and hide tanning and finishing	No	1.8	6.5	0.01	0.06
316210	Footwear manufacturing	No	655	1,420	0.49	0.70
316990	Other leather and allied product manufacturing	No	280	733	0.56	0.70

Notes: All values are expressed in millions of current C$. A NAICS industry is considered as being subject to quotas until 2005 if at least 90% of the products in this industry were subject to quotas until 2005 according to Khandelwal et al. (2013).

4.3 Plants and industry employment

Figure 5, based on the aggregate industry-level *Annual Survey of Manufacturers'* dataset, presents the evolution of employment in the manufacturing and T&C sectors. The figure further breaks down employment into production and non-production jobs. It shows that manufacturing employment has experienced a small increase from 2001 to 2007, followed by a slight decrease in the aftermath of the 2008 financial crisis. The evolution of employment is more marked in the T&C sector. More specifically, employment in this sector has declined sharply as of 2005. In 2005, about 160,000 Canadian workers were active in the T&C sector. In 2013, there were only 50,000 workers left in that sector. This decline has been mostly driven by production workers as the number of non-production workers remained relatively stable over the study period. This implies that the share of non-production workers increased from less than 15% to almost 50% in the T&C sector. This evolution is consistent with skill upgrading induced by competition from low-wage countries, as documented by the extant literature. It is also probably a manifestation of the 'factoryless production', where design, research, and marketing is done in Canada but where the physical production takes place overseas.

Figure 5: Employment trends in manufacturing industries.



The fall in employment in the T&C sector goes hand-in-hand with a drop in the number of active plants in this industry. Table 1 above shows that the number of T&C plants fell from 4,465 in 2001 to 2,057 in 2013. The decline in the number of plants has been remarkably stronger in the T&C industry compared to the rest of the manufacturing sector as the share of T&C plants in Canada fell from 8.5% to 5.8% between 2001 and 2013. Table 1 further documents the evolution of plants sizes and export status over time. It shows that the share of exporters increased in the T&C sector, which suggests that either the exporters were better equipped to face competition from low-income countries, or that more plants started exporting in the more globalized environment. Interestingly, the average plant size in the T&C industry has decreased over time. This suggests that large firms have suffered more than smaller firms from the changes in the economic environment. This is consistent with the view that large firms producing standardized products are more exposed to increased competition than smaller niche producers (Holmes & Stevens 2014). This can also be seen from the last column of Table 1, which shows that the share of multiunit plants fell much more strongly in the T&C industry than in the remaining manufacturing industries. We show later in our plant-level analysis that this is consistent with the findings that, conditional on plant-level characteristics such as size, multiunit firms are more likely to shut down their plants – or move them abroad – in the face of adverse economic shocks (Bernard et al. 2006).

Table 5: Changes in number of plants, all T&C industries.

			Number of plants		
NAICS	Type		$\Delta 2001-2005$	$\Delta 2005-2009$	$\Delta 2009-2013$
3131	INT	Fibre, Yarn and Thread Mills	-9	-10	-18
3132	INT	Fabric Mills	-26	-40	-25
3133	INT	Textile and Fabric Finishing and Fabric Coating	-134	-34	-23
3141	INT	Textile Furnishings Mills	-10	-61	-111
3149	UNC	Other Textile Product Mills	33	-204	-186
3151	FIN	Clothing Knitting Mills	-61	-44	-27
3152	FIN	Cut and Sew Clothing Manufacturing	-360	-386	-370
3159	FIN	Clothing Accessories and Other Clothing Manufacturing	-29	-42	-33
3161	UNC	Leather and Hide Tanning and Finishing	-8	-12	-4
3162	UNC	Footwear Manufacturing	-15	-12	-19
3169	UNC	Other Leather and Allied Product Manufacturing	-43	-48	-37

Notes: Authors' calculations, based on plant-level information from the *Scott's National All Business Directories*. The types of goods produced by each industry are classified as INTermediate, FINal, or UNClassified (see Table 23 in the Appendix).

Table 5 splits the decline in the number of plants by T&C industries and time periods. It shows that the number of active plants has decreased in all T&C industries over the 2001–2013 period. Yet, the decline was far from uniform. For example, the 'Cut and Sew Clothing Manufacturing' industry (NAICS 3152) experienced a net exit of almost 1,000 plants over the sample period. To put the magnitude of that effect into perspective, note that there were 1,667 plants in 2001 in that sector. Given the exit of 360 plants between 2001 and 2005, this represents an exit rate of almost 23.4% compared to the base year. Interestingly, the timing of exits also varies across industries. In some industries (NAICS 3141 and 3149), the number of plants started to fall sharply only after 2005, while on other cases (NAICS 3133, 3151 and 3152), this decline has been particularly important prior to 2005. We will discuss below how the end of the MFA could explain that pattern, and how it is linked to the progressive phasing out of the quotas. Note already that our findings suggest that the end of the MFA has no specific impact on plant exit, thus suggesting that exit was 'anticipated' before the phasing out of the quotas. However, employment adjustments and industry switching show a clear time profile that is consistent with the impact of the quota removal in 2005.

4.4 Entry and exit

Table 6 displays the total number of plant exits in T&C and non-T&C industries. We define exit as a plant being out of the sample for at least 4 years. Note that this condition is less stringent for exit between 2011 and 2013 since we do not observe plants in 2015.[14] As can be seen from Table 6, the exit rates are systematically higher for T&C plants than for the other plants. Furthermore, there is substantial exit (and entry, not shown here), and the magnitudes of our 2-year rates are broadly in line with what is know from other studies in the US and Canada.[15] As always, exit is defined from a 'national perspective': the plant leaves, but whether this is due to real exit, or to relocation abroad, or to a change in name via a take-over cannot be ascertained using our dataset.

Table 6: Descriptive statistics for plants by year.

	Non-T&C plants				T&C plants			
	Active in $t-2$	# of exit	Share	Net change	Active in $t-2$	# of exit	Share	Net change
2001-2003	47,583	11,660	24%	-79	4,465	1,404	31%	-79
2003-2005	47,504	6,617	14%	-2,084	4,386	807	18%	-583
2005-2007	45,420	6,960	15%	-2,323	3,803	870	23%	-633
2007-2009	43,097	3,826	9%	-1,328	3,170	386	12%	-260
2009-2011	41,769	5,814	14%	-2,251	2,910	511	18%	-214
2011-2013	39,518	9,838	25%	-6,244	2,696	829	31%	-639

Notes: For comments on the exit rate between 2001 and 2003, see footnote 13. Exit in year t is defined as a plant being out of the base in $t+2$ and $t+4$.

As can further be seen from Table 6, the number of plant exits in the T&C industry has also been strong between 2005 and 2007. Eventually, 23% of T&C plants 'died' (disappeared) over that two year period, against 16% for other manufacturing plants. During that period, the large number of exits in the T&C sectors has not been compensated by the entry of new plants, as shown by the large net change in the total number of active plants in this sector. We can notice that the number of exits is also very large for the last period (2011–2013). However, as underlined above, this large number of exits could be explained by a less stringent definition of plant exit because of right truncation due to the end of our study period. In all case, we see from Table 6 that the share of plant exits was larger in the T&C industry as compared to other manufacturing industries, and that this finding holds over our entire study period.

[14] We can see from Table 6 that the number of exits has been particularly high between 2001 and 2003, both for T&C and non-T&C plants. Indeed, the share of exiting plants reaches 25% in the non-T&C sectors, and a staggering 32% in the T&C industries. However, we see that the total number of plants active in both sectors remained almost constant between 2001 and 2003. The net change in the total number of firms is only 79 plants in both sectors. We thus suspect this large churning of plants between 2001 and 2003 to be explained – at least partially – by statistical problems in the dataset. Indeed, *Scott's* changed the plant identifiers from 'legacy' to 'Scott's ID', and we have not been able to fully adjust for this change in identifiers between 2001 and 2003. We will, therefore, conservatively exclude all changes at the plant level between 2001 and 2003 from the analysis when investigating the influence of trade on the plant adjustment channels in our plant-level analysis.

[15] Dunne et al. (1988) document that the exit rate for US manufacturing firms between any two census years (5 year intervals) in the 1970's and 80's was 40-50% for all firms, and 30-40% when excluding the smallest firms.

4.5 Changes in location and industry

Plants can react to industry-specific shocks other than by pure exit: they may change their location or their primary activity. We now provide several descriptive statistics on changes in firms' location and industry. Table 7 reports the average distance of plants' moves. Note that the large number of location changes of less than 2 kilometers are essentially due to measurement error: plants are geocoded at their postal code centroid, and those are revised and slightly change over time. Therefore, we consider that plants that do not move by more than 2 kilometers are *immobile*. Besides, as we will use a diameter of 30 kilometers later to delimit our geographical clusters, plants moving by more than 30 kilometers are bound to exit a cluster area. As a result, we distinguish these two types of mobility.

Table 7: Change in location.

	Non-T&C		T&C	
Distance	# of plants	share	# of plants	share
0 to 2 km	36,973	66%	3,320	71%
2 to 30 km	17,542	31%	1,257	27%
More than 30 km	1,532	3%	93	2%

Notes: Authors' calculations, based on the *Scott's National All Business Database*.

As can be seen from Table 7, the extent of geographical mobility is quite low. About two-thirds of plants remain in the same location over the period 2001 – 2013. Besides, only 3% of non-T&C and 2% of T&C plants changed location by more than 30 kilometers.[16] There is no clear differences in the patterns of mobility between T&C and non-T&C plants. Two comments are in order. First, geographical mobility is likely to be very imprecisely measured. Indeed, a lot of moves may be abroad, and we cannot track those in our data. Second, moves are often accompanied by other changes at the plant level: a change in activity or a change in ownership. The latter is not distinguishable from the exit of one plant and the entry of another.

Table 8 presents the number of T&C plants that have changed their primary activity at some point between 2001 and 2013. We focus here on plants declaring a new activity outside of T&C, i.e., we disregard plants that switch their primary activity but remain in the T&C industry. About 8% of T&C plants changed their primary business activity over the sample period. Out of these 401 plants, one-third switched to 'Commercial Screen Printing' (NAICS 323113). Interestingly, Delgado et al. (2015) mention that they found a *link* between clothing and printing industries in the US. However, the absence of theoretical relations a priori between these two industries leads them to consider this matching as an 'outlier' in their data. Our descriptive analysis of industry switching suggests that these industries may indeed be related, since a substantial fraction of T&C firms that changed their activity as of 2001 changed it for printing activities.[17] Apart from this more

[16]These figures are in line with what is known from US data. Lee (2008, p.438) documents that "On average, less than 3% of plants operating in a state are relocated to other states in a given census year."

[17]There is also a substantial fraction of T&C plants that report NAICS 3231 as a secondary activity. That share

Table 8: Change in industry for T&C plants.

NAICS		# of plants
323113	Commercial screen printing	127
339990	All other miscellaneous manufacturing	37
326198	All Other Plastic and Rubber Product, Door, and Boat Building	29
333299	All Other Industrial Machinery Manufacturing	25
337920	Blind and shade manufacturing	22
321999	Other wood product and household furniture manufacturing	14
323119	Other printing	13
339950	Sign manufacturing	12
332329	Other ornamental and architectural metal product manufacturing	9
337121	Upholstered household furniture manufacturing	9
–	All others	104
Total # of industry switching		401

Notes: We consider that T&C plants switch industry between t and $t+2$ if they reported a primary NAICS code in T&C in t, and a different non-T&C primary NAICS code in $t+2$.

important switch from T&C to printing activities (NAICS 323113 and 323119), we cannot identify any clear pattern in terms of industry switching.

5 A spatial view of the T&C industry

As mentioned in Section 2.4, many studies have substantiated that the T&C industry is geographically strongly concentrated. We now show that this also applies to the Canadian case. We then use our measures of geographic concentration and clusters to investigate how firms' responses to industry-specific shocks differ depending on the clustering of the industry.

5.1 Geographic concentration

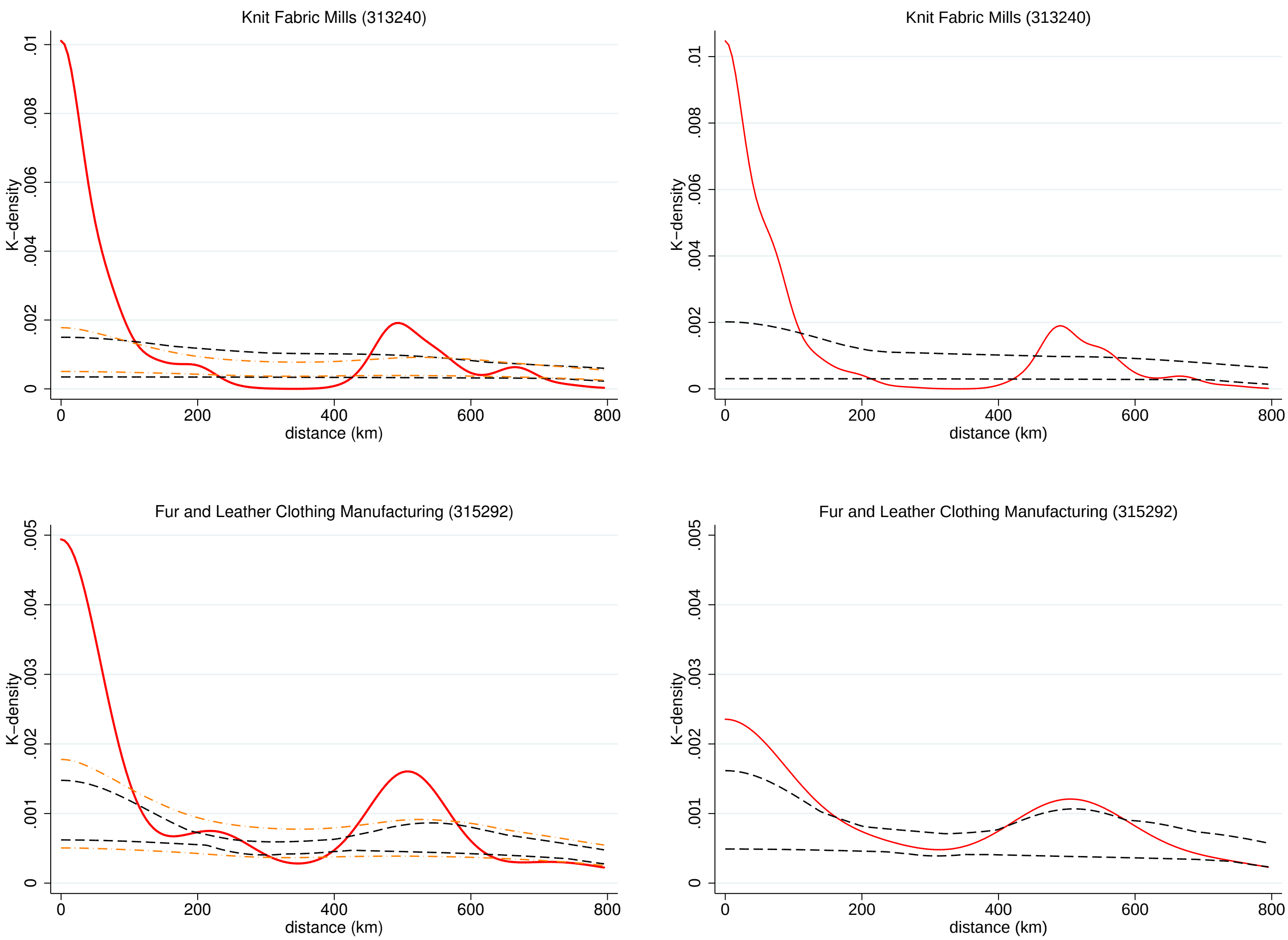
We exploit the microgeographic dimension of our data and measure the geographic concentration of industries using the distance-based K-density approach by Duranton & Overman (2005, henceforth DO). We first briefly summarize the logic underlying that methodology. A more technical description is provided in Appendix A. The idea is to apply sampling and bootstrapping techniques to determine the distribution of bilateral distances between the plants in an industry, and to compare it to a set of bilateral distances obtained from samples of randomly drawn plants. There are four steps. First, we compute the pairwise distances between all plants in an industry and estimate a kernel density function of the distance distribution. Second, we construct a distribution of counterfactuals to assess whether the location pattern of a given industry departs statistically significantly from randomness. The counterfactuals are constructed on the basis that the plants in a given industry are located randomly among all possible locations where we do observe manufac-

increased from 2.36% in 2001 to 6.60% in 2013. This suggests that there may be technological complementarities between T&C and printing, which would explain why printing is often a secondary activity of T&C plants and why they tend to switch into that activity.

turing activity. Third, we construct confidence intervals using our counterfactual random location distributions. Last, we test whether an industry is localized or dispersed, by comparing the actual distribution of bilateral distances with the confidence bands derived from the sampling.

Figure 6: Some examples of strongly localized T&C industries (2001).

(a) Plant counts (b) Employment weights



Notes: We report the K-density (in solid red) and the confidence bands (in dashed black) for two strongly localized industries. The left panel also reports the (unweighted) average K-density for all manufacturing industries (in dashed orange). Panel (a) depicts the localization measures using plants as the statistical unit of analysis, while panel (b) uses employment weights.

Figure 6 depicts examples of the K-density (in solid red) and the confidence bands (in dashed black) for some of our T&C industries. We also report the (unweighted) average K-density for all manufacturing industries in the left panel (the confidence bands in dashed orange).[18] Panel (a) depicts the localization measures using plants as the statistical unit of analysis, while panel

[18]As can be seen from comparing the dashed orange and black lines (which look fairly similar), the random

(b) uses employment weights. As can be seen from the two top panels in Figure 6, 'Knit Fabric Mills' (NAICS 313240) is a strongly and significantly localized industry, both in terms of plants and employment, especially at short distances (below 100 kilometers) and at intermediate distances (about 500 kilometers, which corresponds to the distance between Toronto and Montreal; see Figures 1 and 2). Indeed, the K-density exceeds the upper bound of the confidence band in those distance ranges. As can be seen from the two bottom panels in Figure 6, 'Fur and Leather Clothing Manufacturing' (NAICS 315292) is a strongly and significantly localized industry in terms of plants, but less so in terms of employment. Again, the localization measures exhibit peaks at short distances (below 100 kilometers) and at intermediate distances (about 500 kilometers).

Table 9 provides details on the statistically significantly localized industries in the different years, both at the 4- and at the 6-digit level. The left panel reports figures for non-T&C industries, while the right panel reports figures for the T&C industries. In the T&C sector, in 2001, 10 out of 22 6-digit industries are found agglomerated based on plant counts. If we measure agglomeration based on employment, then 14 out of 22 industries are found agglomerated. At the 6-digit level, the share of agglomerated industries is significantly higher in the T&C sector than in the rest of manufacturing. In 2001, 26% to 30% of industries belonging to non-T&C are agglomerated, against 45% to 63% in the T&C sectors. Looking at the evolution of the share of agglomerated industries, we see that both T&C and non-T&C have experienced a deconcentration of activities between 2001 and 2013 (see also Behrens & Bougna 2015, and Behrens et al. 2015). The T&C industries remain more concentrated than the rest of manufacturing when measuring localization at the 4-digit level, though the gap is smaller. This suggests that industries are strongly concentrated at the 6-digit level in the T&C industry, but less across 6-digit industries.

We next look at the T&C industry from an aggregate perspective to examine its location patterns. The reason for doing so is that we will define our 'clusters' for the T&C industry as a whole (NAICS 3131–3169). We hence 'pool' plants in all T&C industries and compute their K-densities and counterfactuals, both with and without employment weights. Unsurprisingly, the T&C industry is significantly localized in all years, both in terms of plant counts and in terms of employment. However, the strength of localization decreases quite substantially over the years, especially at short distances. This already suggests that plants in clusters – the concentration of plants at short distances – have been hit harder than unclustered plants. We come back to this point later in our econometric analysis. Figure 7 summarizes the changes in the T&C K-densities for 2001, 2005, 2009, and 2013, using employment weights. Figure 14 in the Appendix provides the same information using only plant counts. As can be clearly seen from the two bottom panels of Figure 7, the strength of agglomeration has clearly fallen over the years, especially at short distances, both in terms of employment weights (panel (a)) and in terms of plant counts (panel (b)). Figure 8 displays the level of clustering in the T&C sector and in other sectors. More

sampling procedure basically amounts to comparing the industry to the average location patterns of all the other industries.

Table 9: Agglomeration summary (4- and 6-digit NAICS, plant counts and employment weights).

	6-digit NAICS							
	Non-T&C industries				**T&C industries**			
	Plant counts				**Plant counts**			
Year	Random	Agglomerated	Dispersed	Share agglo	Random	Agglomerated	Dispersed	Share agglo
2001	130	57	31	26.14%	12	10	0	45.45%
2003	135	57	26	26.14%	11	10	1	45.45%
2005	137	57	24	26.14%	13	9	0	40.90%
2007	136	54	28	24.77%	15	7	0	31.82%
2009	139	53	26	24.31%	14	8	0	36.36%
2011	135	53	30	24.31%	13	8	1	36.36%
2013	150	42	26	19.26%	16	6	0	27.27%
	Employment weights				**Employment weights**			
2001	140	64	14	29.36%	7	14	1	63.64%
2003	139	59	20	27.06%	9	12	1	54.55%
2005	137	62	19	28.44%	9	13	0	59.09%
2007	142	59	17	27.06%	12	10	0	45.45%
2009	147	55	16	25.23%	14	8	0	36.36%
2011	151	49	18	22.48%	12	10	0	45.45%
2013	159	45	14	20.64%	16	6	0	27.27%
	Number of industries: 218				Number of industries: 22			

	4-digit NAICS							
Year	Random	Agglomerated	Dispersed	Share agglo	Random	Agglomerated	Dispersed	Share agglo
2001	20	41	13	55.40%	5	6	0	54.54%
2003	23	36	15	48.65%	5	6	0	54.54%
2005	23	37	14	50.00%	5	6	0	54.54%
2007	25	36	13	48.65%	5	5	1	45.45%
2009	23	35	16	47.30%	5	5	1	45.45%
2011	23	36	15	48.65%	4	6	1	54.54%
2013	31	28	15	37.84%	5	6	0	54.54%
	Employment weights				**Employment weights**			
2001	26	40	8	54.54%	3	8	0	72.73%
2003	30	33	11	44.59%	4	7	0	63.64%
2005	29	37	8	50.00%	3	8	0	72.73%
2007	26	37	11	50.00%	5	6	0	54.54%
2009	27	36	11	48.65%	5	6	0	54.54%
2011	26	35	13	47.30%	5	6	0	54.54%
2013	35	27	12	36.49%	6	5	0	45.45%
	Number of industries: 74				Number of industries: 11			

Notes: All computations are based on Duranton and Overman (2005). The K-densities are evaluated at 5 kilometer steps, with 1,000 bootstrap replications to construct the confidence bands for the significance tests. We report the 'global significance' tests for 242 concorded 6-digit industries and 85 concorded 4-digit industries.

specifically, it plots the cumulative density of the distance between any two plant pairs – in the T&C sector and in other sectors. Looking at the first graph in the left panel of Figure 8, we see or instance that about 25% of plant pairs in the T&C industries are separated by less than 200 kilometers against 18% of plant pairs in other sectors. The figure unambiguously shows that plants in the T&C sector are more clustered than in the rest of manufacturing (on average). This fact holds in 2001 and in 2009, and is robust to the measure of agglomeration used. In the bottom panel of Figure 8, we report the cumulative distribution of distances between plant pairs in the T&C sector in 2001 and 2009. As can be seen, plants were closer in 2001 than they were in 2009.

In other words, there has been dispersion across plants and jobs in the T&C sector between 2001 and 2009.

Table 10 summarizes the ten most localized industries in 2001, 2005, and 2009, based on the cumulative distribution of the K-density using plant counts. It shows that 3 T&C industries are among the 10 most geographically concentrated industries.[19] 'Fur and leather clothing' and 'Women's and girls' cut and sew clothing' have been in the top 10 in 2001, 2005, and 2009. 'Knit fabric mills' has left the top ten in 2009. This confirms that T&C industries are highly localized, but also that the sector has experienced a deconcentration trend over the last decade. Table 24 in the Appendix paints a similar picture using the measure of agglomeration based on plants' employment and not simple counts. With this alternative measure, the 'Hosiery and sock mills' industry appears among the 10 most clustered industries in 2001, but then exits from the list in 2005 and 2009.

Table 11 ranks all industries in 2001 in decreasing order of their cumulative DO measure of geographical concentration. Out of 242 manufacturing industries, half of the industries in T&C were in the top third in terms of agglomeration, and two-third of T&C industries are more agglomerated than the median industry. This confirms the extreme geographic concentration of activities in the T&C sector. Observe that there is usually slightly more concentration in terms of employment than in terms of plant counts.

5.2 Identifying clusters

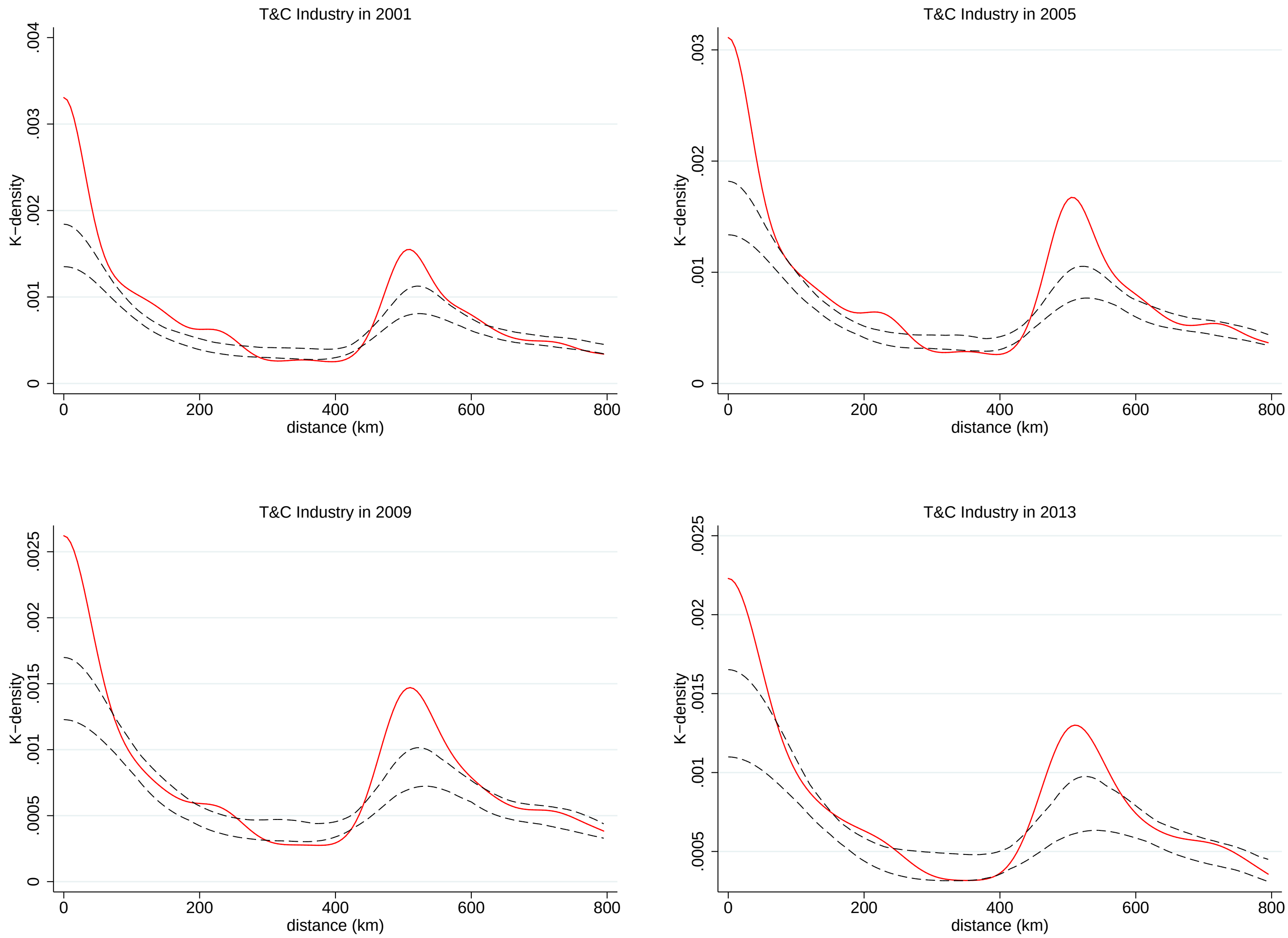
Until now, we have documented the broad (Canada-wide) location patterns of the T&C industry. We now turn to a more *local* analysis and identify geographical clusters as follows. First, for each plant i, we compute the number of *other* T&C plants and the number of other non-T&C plants in a radius of 15 kilometers around the plant. Assume that there are n_i T&C plants and m_i non-T&C plants within that radius. Assume also that there are N T&C plants in the total population of manufacturing plants, and M non-T&C plants. Then, the probability that there are more than n_i T&C plants among the $n_i + m_i$ total plants around plant i can be computed from the cumulative distribution of a hypergeometric distribution. Assume that this value is 0.05 for plant i. This means that there is only a 5% chance of having more than n_i T&C plants around plant i, conditional on having $n_i + m_i$ plants in total around plant i and conditional on the overall share of T&C plants in the manufacturing population. Clearly, this means that we are very unlikely to observe that many T&C plants around plant i.[20]

In what follows, we define two types of clusters: 'core clusters' and 'secondary clusters'. They

[19]Note that some of the most localized industries have been aggregated. See, e.g., Behrens & Bougna (2015), who show that 'Women's and Girls' Cut and Sew Lingerie, Loungewear and Nightwear Manufacturing' was extremely localized in 2001–2009.

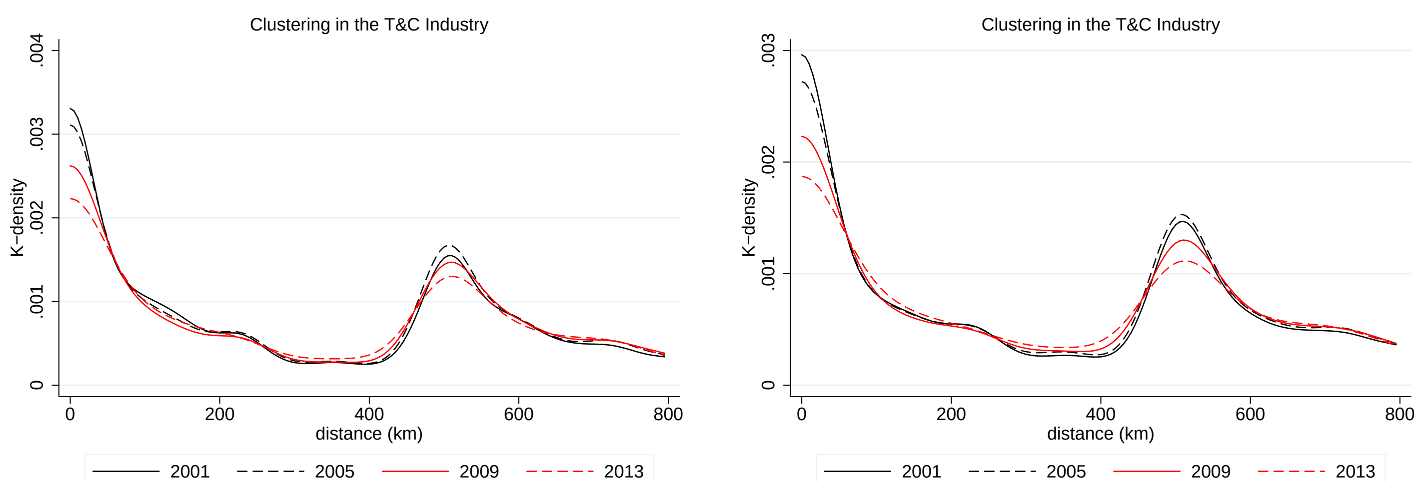
[20]Observe that the counterfactual is similar in spirit to the one used in the Duranton-Overman approach. It corresponds to a random reshuffling of plant types (their sectors) across all manufacturing sites.

Figure 7: Changes in the spatial concentration of the T&C industry, employment weights, 2001–2013.



(a) Employment weights

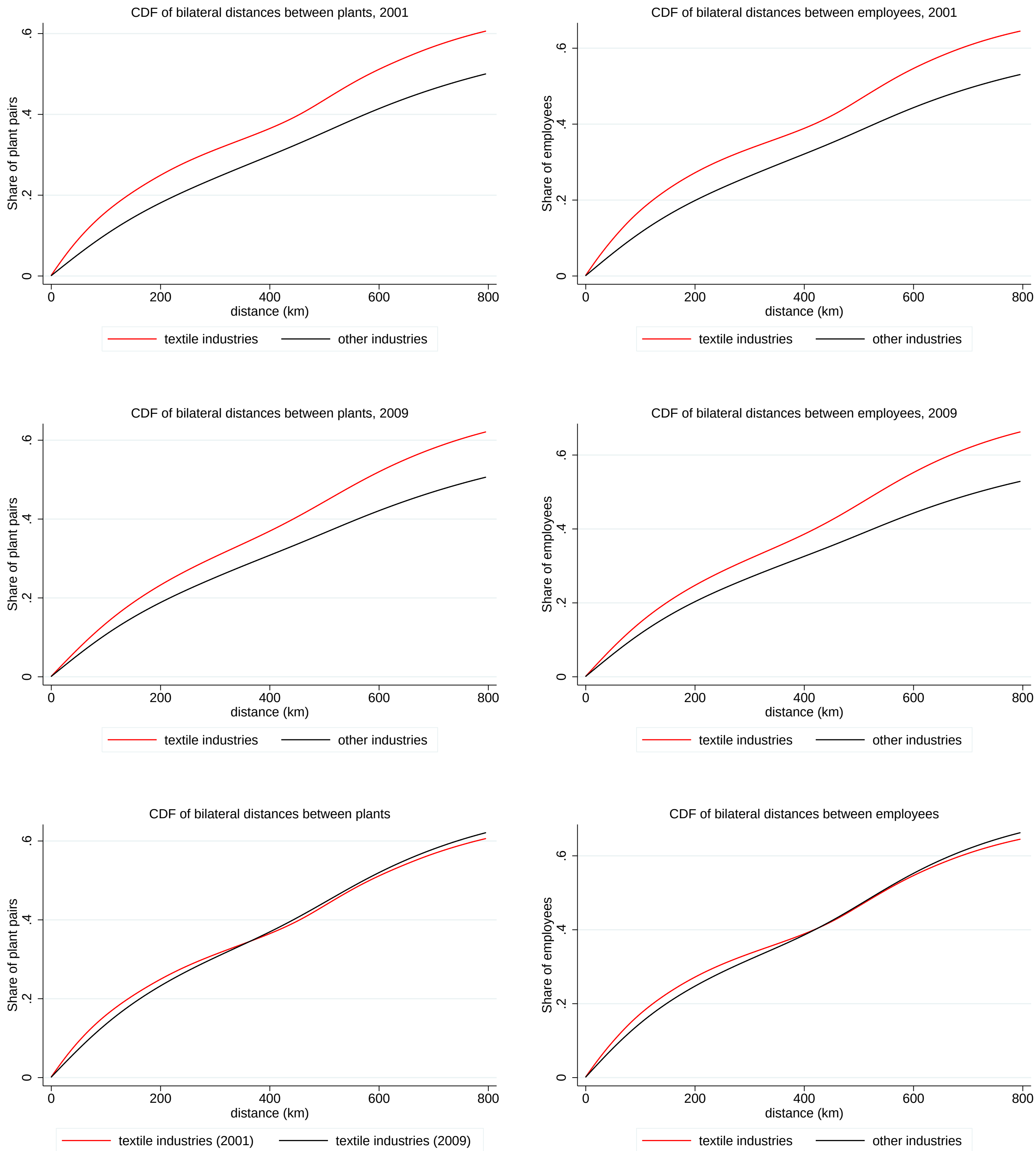
(b) Plant counts



Notes: The top four panels report the K-density (in solid red) and the confidence bands (in dashed black) for the T&C industry in 2001, 2005, 2009 and 2013 using employment weights. Panel (a) at the bottom summarizes these four graphs into one. The bottom panel (b) reports the K-density for the T&C industry using plant counts.

Figure 8: Changes in the spatial concentration of industries, 2001–2009.

(a) Plant counts (b) Employment weights



Notes: We report unweighted averages of the cumulative K-densities (6-digit NAICS) for the T&C industry and the other industries.

Table 10: Ten most localized industries according to the Duranton-Overman CDF (firm counts).

NAICS	Industry name	CDF
	Most localized industries in 2001	
313240	*Knit fabric mills*	0.3886
333220	Rubber and Plastics Industry Machinery Manufacturing	0.2307
315292	*Fur and Leather Clothing Manufacturing*	0.2231
333519	Other metalworking machinery manufacturing	0.2031
325991	Custom compounding of purchased resins	0.1919
315249	*Women's and girls' cut and sew clothing manufacturing*	0.1836
332118	Stamping	0.1739
336110	Automobile and light-duty motor vehicle manufacturing	0.1691
336370	Motor vehicle metal stamping	0.1579
333511	Industrial mould manufacturing	0.1413
	Most localized industries in 2005	
333220	Rubber and Plastics Industry Machinery Manufacturing	0.3798
336110	Automobile and light-duty motor vehicle manufacturing	0.2354
332118	Stamping	0.2340
312210	Tobacco stemming and redrying	0.1998
315292	*Fur and Leather Clothing Manufacturing*	0.1893
333519	Other metalworking machinery manufacturing	0.1868
336370	Motor vehicle metal stamping	0.1824
315249	*Women's and girls' cut and sew clothing manufacturing*	0.1682
325991	Custom compounding of purchased resins	0.1659
313240	*Knit fabric mills*	0.1639
	Most localized industries in 2009	
312210	Tobacco stemming and redrying	0.2821
332991	Ball and roller bearing manufacturing	0.2797
333220	Rubber and Plastics Industry Machinery Manufacturing	0.2546
336110	Automobile and light-duty motor vehicle manufacturing	0.2446
336370	Motor vehicle metal stamping	0.1971
333519	Other metalworking machinery manufacturing	0.1773
332118	Stamping	0.1765
315292	*Fur and Leather Clothing Manufacturing*	0.1734
332720	Turned product and screw, nut and bolt manufacturing	0.1540
315249	*Women's and girls' cut and sew clothing manufacturing*	0.1462

Notes: The CDF is the cumulative sum of the K-densities (plant counts) up to distance d. Results in this table are reported for a distance of $d = 50$ kilometers. T&C sectors are italicized in the table.

are defined based on two criteria: specialization and size (see also Delgado et al. 2015). The former is assessed using the p-values that we explained above, whereas the second is assessed by using minimum numbers of plant counts around the plant. The size criteria are required to exclude areas with only few plants that happen to also host a small number of T&C plants that however make up a large share of local plants. Note that there is no agreement in the literature on how exactly to measure the geographical clustering and on how to delimit 'clusters' geographically.

Core clusters. We define core clusters based on plants with p-values below 0.1 and a size threshold of 25 other plants around them. Plants satisfying those two criteria are 'core cluster plants'.

Table 11: Agglomeration rank of T&C industries in 2001.

NAICS	Industry name	Rank 2001 Plant counts	Rank 2001 Empl. weights
313240	Knit fabric mills	1	1
315292	Fur and Leather Clothing Manufacturing	3	23
315249	Women's and girls' cut and sew clothing manufacturing	6	7
315110	Hosiery and sock mills	13	5
313110	Fibre, yarn and thread mills	14	11
315190	Other clothing knitting mills	18	25
315220	Men's and boys' cut and sew clothing manufacturing	26	29
313210	Broad-woven fabric mills	27	12
315990	Clothing accessories and other clothing manufacturing	28	35
313230	Nonwoven fabric mills	77	221
313310	Textile and fabric finishing	79	54
313220	Narrow fabric mills and Schiffli machine embroidery	84	63
314990	All Other Textile Product Mills and cut-and-sew clothing contracting	86	65
313320	Fabric coating	98	84
316210	Footwear manufacturing	103	47
316990	Other leather and allied product manufacturing	118	76
314120	Curtain and linen mills	146	237
316110	Leather and hide tanning and finishing	152	190
315299	All Other Cut and Sew Clothing Manufacturing	154	169
314110	Carpet and rug mills	157	209
314910	Textile bag and canvas mills	164	123
315291	Infants' Cut and Sew Clothing Manufacturing	235	224

Notes: Authors' calculations, based on the Duranton-Overman cumulative K-densities.

We draw a 15 kilometers buffer around these 'core cluster plants' and define the clusters as the unions of those buffers (see Buzard et al. 2015 for a similar approach).

Secondary clusters. We define secondary clusters based on plants with p-values below 0.1 and a size threshold of 5 or more other plants around them (but less than 25 of course). Plants satisfying those criteria are 'secondary cluster plants'. We draw of 15 kilometers buffer around those 'secondary cluster plants' and define the clusters as the unions of those buffers. Plants that are used to define core clusters are of course excluded from the construction of secondary clusters.

Once we have constructed our core and secondary clusters, we associate all other plants to those clusters, based on a 15 kilometer distance criteria. For plants that do not belong to clusters, we also compute their distance (in kilometers) from the nearest core and secondary clusters. Plants that belong to either type of cluster are associated a distance of 0.

Figures 9 to 12 depict our core and secondary clusters for Quebec, Ontario, British Columbia, and the maritime provinces in 2001, respectively.[21] The location of core clusters is visualized by

[21] We put a dark buffer with thick border around each core cluster plant, and a lighter buffer with thin border around each secondary cluster plant to ease the visualization of the clusters. Note that these buffers are not an accurate representation of the spatial extent of the cluster. The reason is that the constant-radii buffers would need to be distorted to account for the curvature of the map projection, and they would necessarily vary in size and shape depending on the location on the map. For simplicity, We use a custom-programmed routine to assign plants to clusters based on great-circle distance.

the bold shaded areas, and core cluster plants are depicted by red orange-filled points. Secondary clusters are depicted by light shaded areas, and secondary cluster plants are depicted by red empty circles. Last, non-cluster plants (T&C plants with a p-value above 0.1) are depicted by blue empty circles. Note that, as mentioned before, although non-cluster T&C plants do not serve to define a cluster, they may belong to a cluster (i.e., they are located less than 15 kilometers from plants that define those clusters).

5.3 Resilience of clusters

Having identified geographical clusters in the T&C industry, we now investigate their resilience to the shocks that hit the sector over the last decade. Table 12 describes the evolution of the allocation of T&C plants to T&C clusters. As explained in the previous section, we distinguish core clusters from secondary clusters. Plants that belong to both types are allocated to the core cluster. Table 12 shows that, in 2001, 61% of the T&C plants were either in a core cluster or in a secondary cluster. This share remained stable until 2005, and then declined to finally reach 57% in 2013. This first evidence suggests that plants outside clusters have not suffered more from low-income county competition than plants in T&C clusters.

Table 12: Allocation of T&C plants to T&C clusters.

Year	Number of plants	In core clusters	In secondary clusters	Not in clusters	Share cluster	Share T&C empl. in Quebec
2001	4,465	2,573	152	1,740	61.03%	53.41%
2003	4,386	2,559	127	1,700	61.24%	51.34%
2005	3,803	2,188	115	1,500	60.56%	52.60%
2007	3,170	1,754	144	1,272	59.87%	48.31%
2009	2,910	1,571	65	1,274	56.22%	47.33%
2011	2,696	1,426	77	1,193	55.75%	46.72%
2013	2,057	1,069	114	874	57.51%	45.82%

Notes: We report the allocation of plants to clusters, where clusters are defined contemporaneously (i.e., based on the current spatial structure in year t). The last column gives the share of T&C employment located in Quebec (all plants).

Figure 13 depicts the evolution of T&C clusters in Quebec between 2001 and 2013. As can clearly be seen, clusters have been 'unweaving' – they progressively vanish over time, and only a few larger clusters still remain in 2013. The full sequence of changes between 2001 and 2013 is provided in the Appendix (see Figures 15 to 21). Looking at the evolution of plants in core and secondary clusters reveals two interesting results. First, the importance of core clusters declined at a higher pace than the importance of secondary clusters. The number of plants in core clusters dropped by 59%, while the total number of plants in the T&C sector declined by 'only' 54%. Second, the evolution of the number of plants in secondary clusters has not been linear. The number of plants in secondary clusters was halved between 2007 and 2009, but then increased in 2011 and 2013. The recent increase in the number of plants located in secondary clusters is partly the result of the 'downsizing' of core clusters: as core clusters shrink, they transform into secondary clusters

Figure 9: T&C clusters in Quebec (2001).

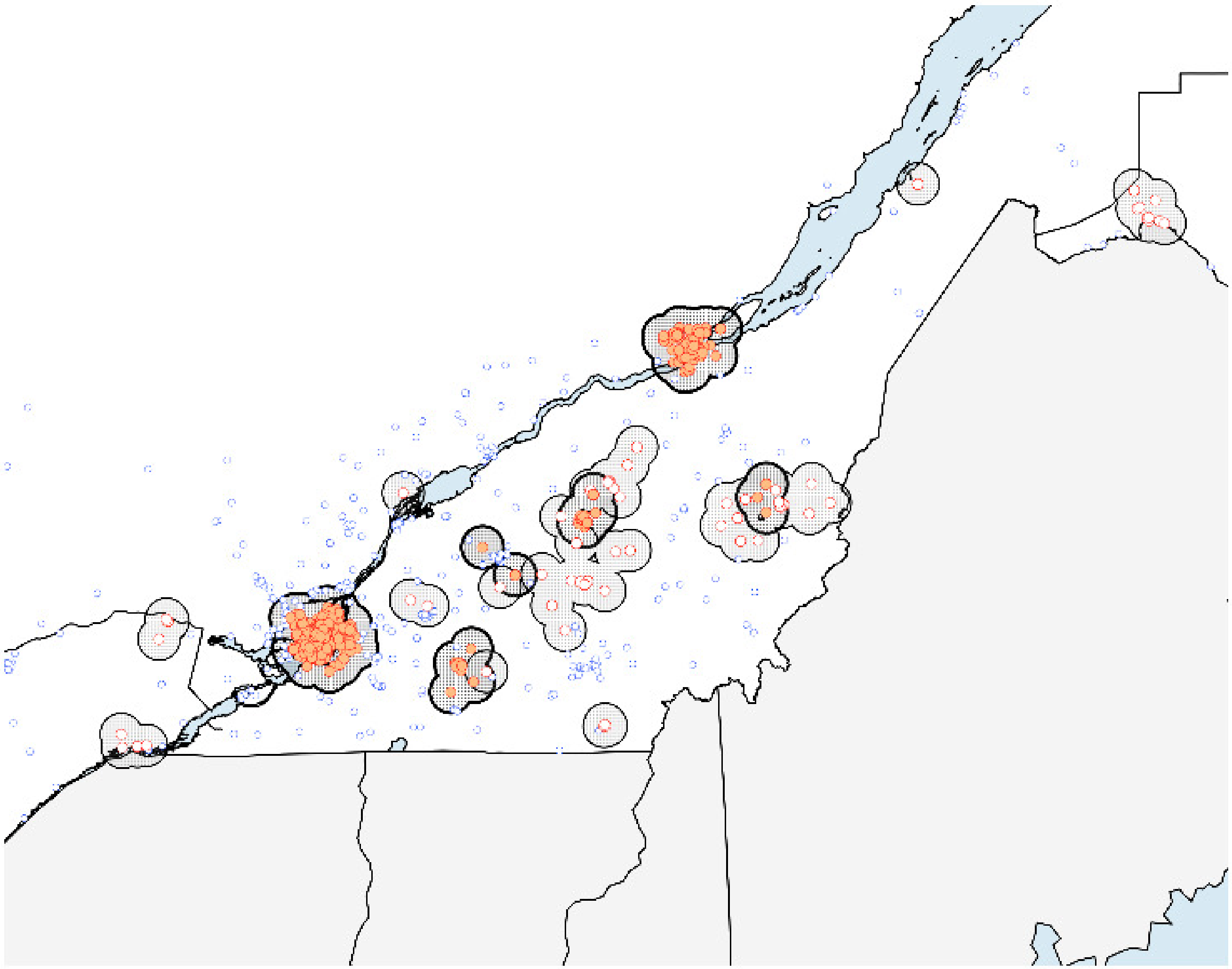


Figure 10: T&C clusters in Ontario (2001).

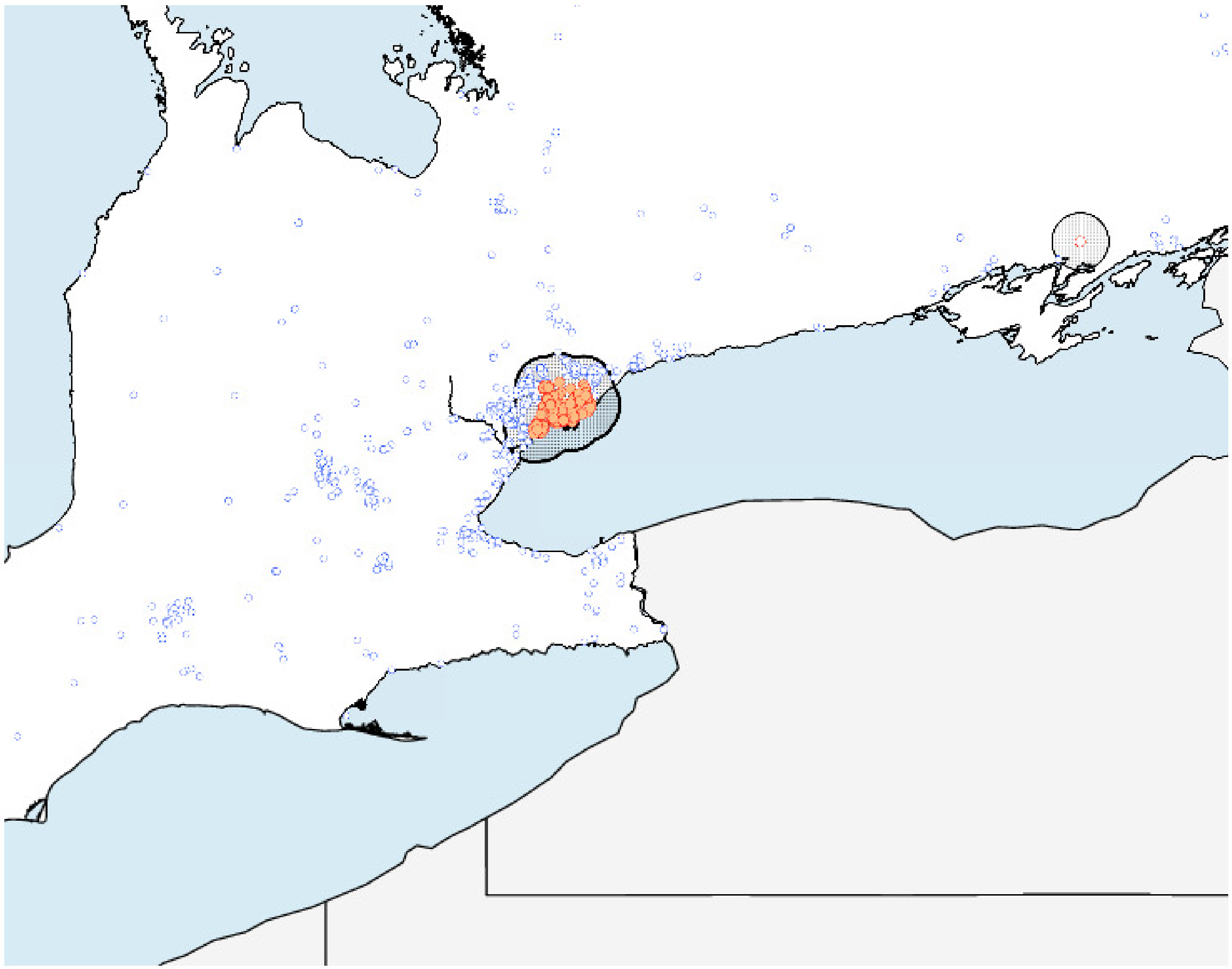


Figure 11: T&C clusters in British Columbia (2001).

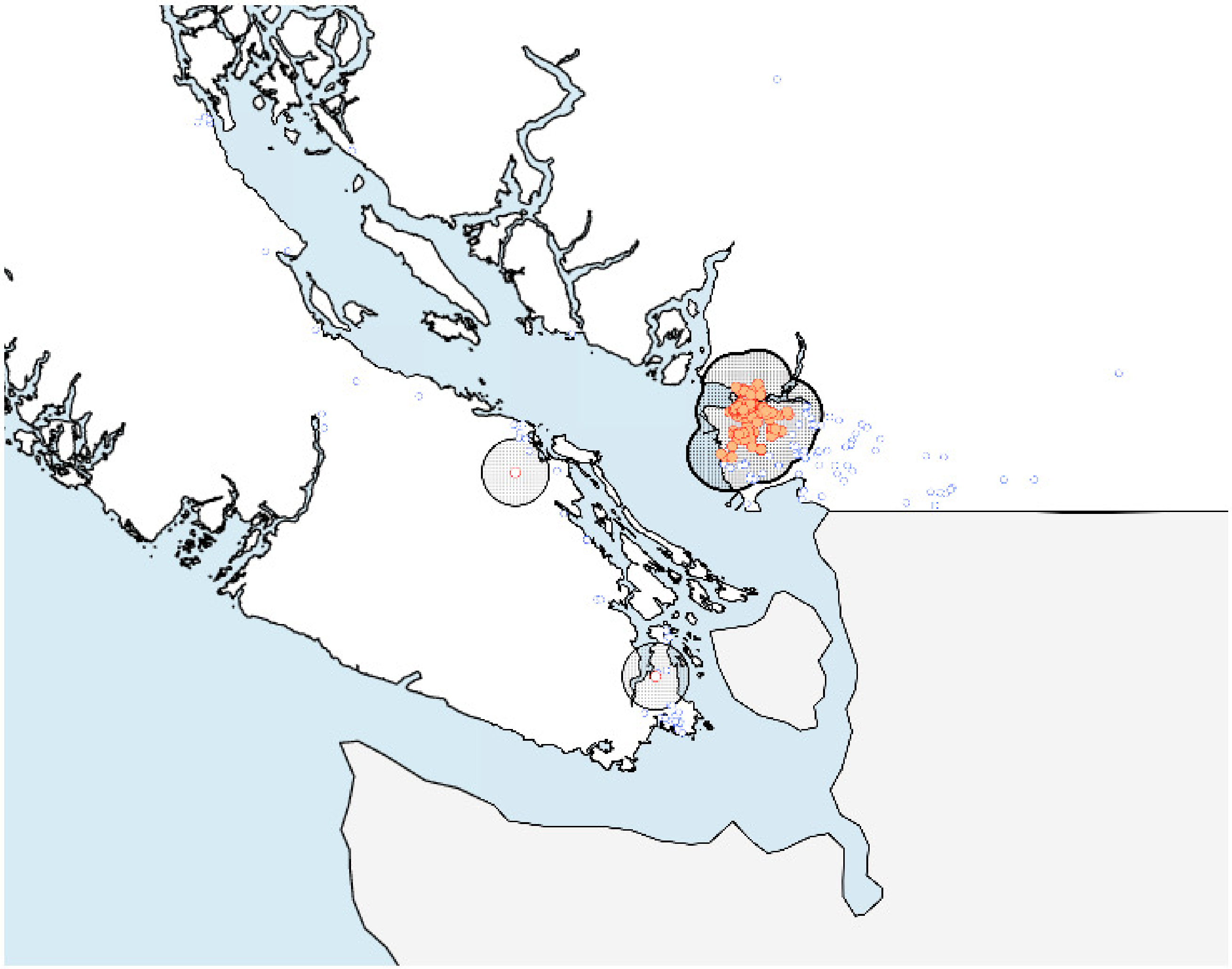
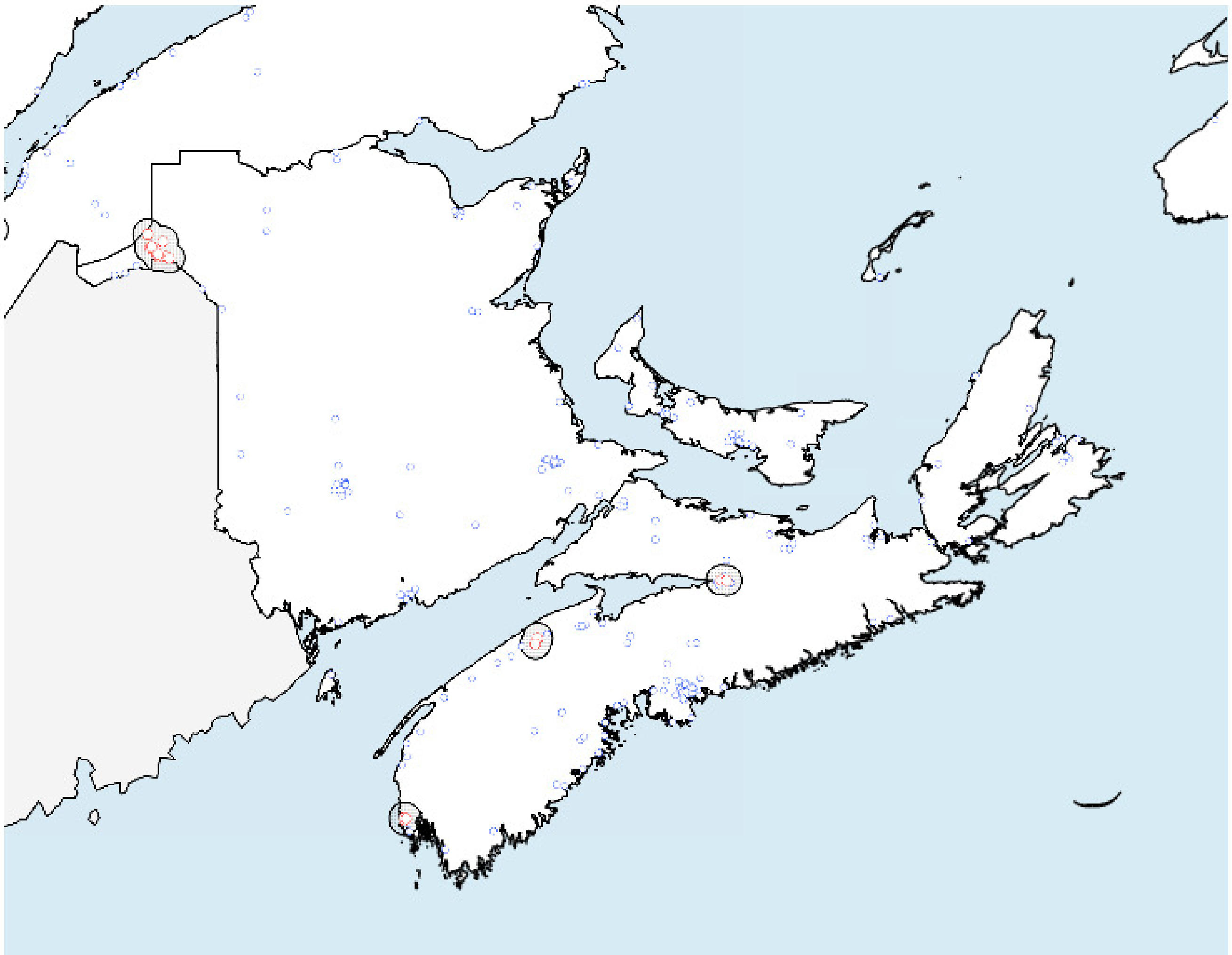


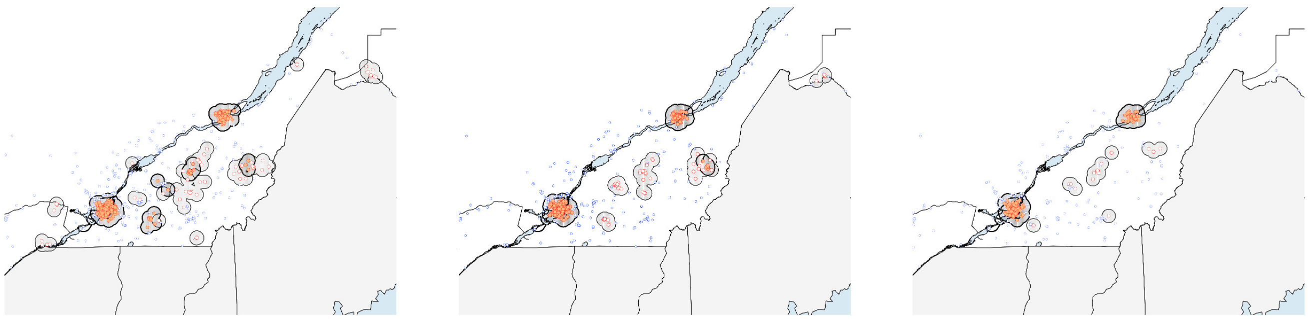
Figure 12: T&C clusters in the maritime provinces (2001).



by dropping below our size threshold of 25 plants. Note, however, that this evolution might be due to the emergence on new clusters – we will explore this aspect in future work.

Figure 13: 'Unweaving' T&C clusters in Quebec.

(a) 2001 (b) 2007 (c) 2013



Before turning to the econometric analysis, we quickly document the evolution of clusters in Quebec. Quebec is the province with the highest share of employment in the T&C sector (53% in 2001, see Table 12). A visual inspection of Figure 13 shows that many clusters have disappeared in Quebec between 2001 and 2013, and that the largest clusters downsized significantly. One interesting pattern is the change in the geography of economic activity in the T&C sector. We see that the clusters around Montreal and Quebec city have lost plants but remain key places for 'production'. In the rest of the province, many clusters have disappeared leading to more dispersion of activity in the T&C industry. Eventually, in 2013, the production in the T&C sector was located around the two main cities, Montreal and Quebec city. This might be due to an increase in the product sophistication of surviving plants, as long as this sophistication requires key inputs like skilled workers (as is the case for the 'factoryless producers' that engage primarily in design, R&D, and distribution).

6 Econometric analysis of resilience

We now turn to the econometric analysis of the resilience of clusters and plants to shocks. We first work at the industry level and then turn to a plant-level analysis.

6.1 Resilience: sectoral analysis of the impact of trade

In this section, we empirically examine how manufacturing industries reacted to changes in their trade with high- and low-income countries. We estimate a simple Ordinary Least Squares (OLS) model on three different dependent variables: employment, productivity, and the number of plants in the industry in a given year. We also estimate this model using revenue as the dependent variable. Since the latter regressions provide quite similar results than employment estimates, they are reported in the Appendix (see Tables 25 and 26). All of the following estimations include 240 industry fixed effects and 7 year fixed effects.

The impact of trade on sectoral employment. Table 13 summarizes the results of the industry-level analysis of the effect of trade on employment. It provides evidence for: (i) the employment effects of trade; and (ii) some fairly limited resilience within T&C clusters. Across all estimations, the coefficients associated with trade with high-income countries – both in terms of exports and imports – are positive and highly significant at the 1% level. Hence, sectoral trade with developed countries is associated with higher employment growth in an industry. As can be seen from all specifications, this positive effect of trade on employment holds only for imports when considering exchanges with low-income countries. Because our coefficients are standardized, we can compare the relative impact of imports from low- and high-countries. An increase of one standard deviation in imports from high-wage countries increases employment by 29% standard deviation against a 6% standard deviation for imports from low-wage countries.

Empirical estimations in Table 13 aim at exploring whether these positive effects of imports on employment are experienced by all industries, or whether systematic differences across sectors exist. In that respect, we interact sectoral imports from high- and low-income countries respectively, with several industry-specific variables. We can first notice that the statistics on the R-squared remain quite constant across all specifications. This implies that around 95% of the variation in industry employment is explained by the explanatory variables of column (1) – including industry and year fixed effects. Hence, the introduction of additional covariates such as the degree of geographic cluster or upstreamness of the industry only play a marginal role in affecting employment at the industry level. This result will be consistent across all sectoral estimations in this report.

As an example of interaction terms, columns (2) and (3) include an interaction between imports and a dichotomous variable that takes the value of one for T&C industries and zero otherwise. Strikingly, we find large and statistically significant coefficients on these interaction terms. The one in column (2) indicates that higher imports from high-income countries in T&C industries are associated with stronger employment growth as compared to other manufacturing sectors. In turns, imports from low-wage countries have the opposite effect: while imports from low-wage countries are associated with employment growth in other manufacturing sectors, T&C industries that experienced a rise in import competition from low-wage countries faced a fall in their level of employment over the sample period. A one standard deviation in imports from low-wage countries reduces employment in T&C by half a standard deviation while it increases employment by 0.3 standard deviations for other industries. These results are consistent with a negative impact of tougher competition from low-wage countries – including China – on employment in T&C industries.

Columns (4) and (5) introduce an interaction term between imports and the degree of upstreamness of the industry. The interaction term on this variable is not statistically significant in both

Table 13: Industry-level regressions: employment.

Interaction term × imports from	(1) None	(2) T&C High-income	(3) T&C Low-income	(4) Upstream High-income	(5) Upstream Low-income	(6) Cluster High-income	(7) Cluster Low-income	(8) Cluster High-income	(9) Cluster Low-income	(10) Cluster High-income	(11) Cluster Low-income
Exports HC	0.209^a	0.189^a	0.203^a	0.204^a	0.218^a	0.172^a	0.209^a	0.178^a	0.206^a	0.162^a	0.198^a
	(0.044)	(0.045)	(0.044)	(0.043)	(0.045)	(0.040)	(0.044)	(0.040)	(0.044)	(0.041)	(0.044)
Exports LC	-0.016	-0.009	-0.010	-0.017	-0.017	-0.011	-0.016	-0.013	-0.016	-0.007	-0.011
	(0.020)	(0.021)	(0.019)	(0.020)	(0.019)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.019)
Imports HC	0.291^a	0.219^a	0.269^a	0.211^c	0.282^a	0.257^a	0.288^a	0.252^a	0.283^a	0.250^a	0.271^a
	(0.041)	(0.035)	(0.040)	(0.118)	(0.042)	(0.041)	(0.041)	(0.042)	(0.041)	(0.037)	(0.040)
Imports LC	0.062^a	0.051^b	0.072^a	0.062^a	0.133^a	0.058^a	0.065^a	0.059^a	0.072^a	0.046^b	0.075^a
	(0.022)	(0.022)	(0.022)	(0.022)	(0.051)	(0.022)	(0.023)	(0.022)	(0.023)	(0.022)	(0.023)
Imports × T&C		0.695^a	-0.543^a							0.433^c	-0.422^b
		(0.221)	(0.146)							(0.244)	(0.185)
Imports × Upstream				0.037	-0.031						
				(0.047)	(0.020)						
Imports × Cluster						0.136^a	-0.012				
						(0.032)	(0.027)				
Imports × Cluster weighted								0.127^a	-0.048^c	-0.112^b	-0.010
								(0.032)	(0.026)	(0.048)	(0.016)
Imports × T&C × Cluster weighted										0.249^a	-0.104
										(0.064)	(0.109)
Observations	1,566	1,566	1,566	1,566	1,566	1,566	1,566	1,566	1,566	1,566	1,566
R-squared	0.955	0.957	0.956	0.955	0.956	0.956	0.955	0.956	0.956	0.958	0.957

Notes: This table reports the effects of competition on sectoral employment for the period 2001-2013. All regressions include 240 industry fixed effects and year fixed effects. The dependent variable is log of employment measured at the industry-level. $ExportsHC$ is the log of exports to high-income countries. $ExportsLC$ is the log of exports to low-income countries. $ImportsHC$ is the log of imports from high-income countries. $ImportsLC$ is the log of imports from low-income countries. In columns $High-income$, $ImportsHC$ is interacted with different variables. In columns $Low-income$, $ImportsLC$ is interacted with different variables. $T\&C$ equals to one if the industry is part of the T&C sector. $Upstream$ measures the distance from final demand. $Cluster$ and $Clusterweighted$ measure either count-based or employment-weighted excess agglomeration measures (at 25km distance). Huber-White robust standard errors are reported under parenthesis. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

regressions. This suggests that the negative (positive) impact of tougher competition from low (high) wage countries does not differ from *intermediate* to *final* industries.

We then examine how the geographical concentration of each industry alters the effect of import competition on employment. To this end, we interact the level of imports with two measures of industrial clustering: a measure based on a simple count of plants in columns (6) and (7), and an employment-weighted measure of excess agglomeration at 25 kilometers in the other columns. Results show that the effect of imports from high-wage country is still positive, but this impact increases as the degree of geographic concentration rises. In contrast, the coefficients on the interaction term using imports from low-income countries are not – or only weakly – statistically significant. This implies that 'clustered' industries are not particularly resilient to adverse trade shocks – such as tougher import competition from low-income exporters – than more dispersed ones.

Finally, we consider in the last two columns an additional interaction between the (weighted) measure of clustering and the dichotomous variable indicating whether or not the industry belongs to the T&C sector. The results show that firms in T&C industries experience higher employment growth when importing from high-wage partners, and that this effect is even stronger for clustered T&C sectors. This result is opposite for non-T&C industries as they experience a lower employment growth as their level of spatial clustering rises. Finally, the last column shows that T&C industries are harmed by import competition from low-wage economies and that this negative effect is independent from the degree of geographic concentration of these industries. On the contrary, other non-T&C manufacturing sectors expand as their imports from low-income countries rise. As for T&C sectors, this effect does not depend on the spatial concentration of firms in those sectors.

To summarize, Table 13 shows that: (i) trade with high-income countries is associated with higher employment and revenue growth; (ii) imports from low-wage countries harm T&C industries while benefiting to all other manufacturing sectors; and (iii) clustered T&C industries benefits even more from imports from high-wage countries than more dispersed ones, but they do not resist better to import competition from low-wage economies.

The impact of trade on productivity. Table 14 reports the estimations using productivity as the dependent variable. Productivity is defined as the manufacturing value added by production worker. The table displays very different results compared to previous regressions. First, it is clear from all specifications in this table that trade has no effect on industrial productivity, apart from exports to high-income countries which are associated with a rise in productivity. Besides, most coefficients on interaction terms turn out to be insignificant at a 5% significance level.

Strikingly, the interaction terms in columns (2) and (3) have an opposite sign compared to the ones displayed in the previous table, and are highly significant. Those estimations show that imports are significantly associated with productivity in the T&C industries. Imports from low-wage countries are indeed associated with a rise in productivity in this sector, while the opposite

Table 14: Industry-level regressions: productivity.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Interaction term	None	T&C	T&C	Upstream	Upstream	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster
× imports from		High-income	Low-income	High-income	Low-income	High-income	Low-income	High-income	Low-income	High-income	Low-income
Exports HC	0.180^a	0.190^a	0.184^a	0.175^a	0.168^a	0.194^a	0.179^a	0.199^a	0.176^a	0.202^a	0.188^a
	(0.054)	(0.055)	(0.054)	(0.056)	(0.058)	(0.056)	(0.054)	(0.056)	(0.054)	(0.056)	(0.055)
Exports LC	0.035	0.032	0.032	0.035	0.037	0.034	0.035	0.033	0.035	0.031	0.031
	(0.028)	(0.028)	(0.028)	(0.028)	(0.027)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Imports HC	0.059	0.093^c	0.073	-0.014	0.070	0.071	0.033	0.082	0.046	0.100^c	0.048
	(0.049)	(0.051)	(0.050)	(0.110)	(0.053)	(0.050)	(0.050)	(0.050)	(0.050)	(0.055)	(0.050)
Imports LC	0.037	0.042	0.031	0.037	-0.056	0.039	0.061	0.039	0.052	0.043	0.052
	(0.057)	(0.057)	(0.058)	(0.058)	(0.125)	(0.057)	(0.057)	(0.057)	(0.058)	(0.057)	(0.058)
Imports × T&C		-0.330^b	0.360^a							-0.237	0.219
		(0.145)	(0.134)							(0.160)	(0.153)
Imports × Upstream				0.034	0.041						
				(0.050)	(0.039)						
Imports × Cluster						-0.050^c	-0.134^a				
						(0.028)	(0.039)				
Imports × Cluster weighted								-0.078^a	-0.074	-0.049	-0.125^a
								(0.023)	(0.046)	(0.056)	(0.038)
Imports × T&C × Cluster weighted										-0.015	0.225^b
										(0.062)	(0.090)
Observations	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564	1,564
R-squared	0.904	0.905	0.905	0.904	0.904	0.904	0.905	0.905	0.905	0.905	0.906

Notes: This table reports the effects of competition on sectoral productivity for the period 2001-2013. All regressions include 240 industry fixed effects and year fixed effects. The dependent variable is the industry-level productivity, measured by the value added per manufacturing worker. $ExportsHC$ is the log of exports to high-income countries. $ExportsLC$ is the log of exports to low-income countries. $ImportsHC$ is the log of imports from high-income countries. $ImportsLC$ is the log of imports from low-income countries. In columns $High-income$, $ImportsHC$ is interacted with different variables. In columns $Low-income$, $ImportsLC$ is interacted with different variables. $T\&C$ equals to one if the industry is part of the T&C sector. $Upstream$ measures the distance from final demand. $Cluster$ and $Clusterweighted$ measure either count-based or employment-weighted excess agglomeration measures (at 25km distance). Huber-White robust standard errors are reported under parenthesis. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

holds for trade from high-wage exporters. A one standard deviation increase in competition from low-wage countries rises productivity in T&C industries by about 0.4 standard deviation. By contrast, it has no impact on the productivity of other industries. If we combine these results with those of Table 13, it seems that import competition from low-wage countries is associated with a decline in T&C employment, but the remaining firms see their productivity increase. This is consistent with previous findings in the literature (e.g., Trefler 2004), and could be driven by the selection of the most productive plants. It could, however, also be due to investments in new technologies (which could itself be a response to increased international competition).

In addition, we see in all specifications that imports are associated – albeit often insignificantly – with lower productivity in spatially agglomerated industries. The only exception concerns the T&C sector. The last estimation indeed shows that import competition from low-wage countries has a positive effect on productivity in T&C industries, and that this effect is entirely driven by geographically more concentrated sectors.

The impact of trade on the number of T&C plants. Finally, in Table 15 we examine the evolution of the number of industrial plants. The results of these estimations show that trade with high income-countries is positively correlated with changes in the number of plants. Trade with low-wage economies, instead, has no significant impact on the number of plants. However, when including industry-specific variables, we see that imports from low-wage economies have a negative effect on the number of T&C firms – as shown by the large, negative and highly significant coefficient on the interaction term in column (3). A one standard deviation in imports from low-wage countries reduces the number of plants by 0.3 standard deviations.

In addition, introducing the interaction term between import and the degree of upstreamness of the industry yields an interesting result. Indeed, it indicates that the impact of increasing imports from low-income economies is stronger for industries mostly oriented towards final consumption. The negative effects of low-income countries competition is dampened for intermediates industries.

Finally, the rest of the estimations can be summarized as follows: tougher competition from low-wage countries has a negative impact on 'clustered' non-T&C industries while 'dispersed' ones are unaffected by imports from low-cost countries. By contrast, the degree of concentration of industries in the T&C sector does not affect the extent to which industries are harmed by this competition. Therefore, the analysis show that there is no resilience of T&C firms in geographically concentrated sectors.

Sectoral regressions of the impact of trade show that: (i) imports from low-wage countries have a negative impact on T&C employment; and (ii) even though they do not resist better to import competition from low-wage economies as compared to dispersed industries, more clustered T&C sectors benefit from a rise in productivity induced by this import competition.

Table 15: Industry-level regressions: number of plants.

Interaction term × imports from	(1) None	(2) T&C High-income	(3) T&C Low-income	(4) Upstream High-income	(5) Upstream Low-income	(6) Cluster High-income	(7) Cluster Low-income	(8) Cluster High-income	(9) Cluster Low-income	(10) Cluster High-income	(11) Cluster Low-income
Exports HC	0.106^a	0.093^a	0.102^a	0.102^a	0.095^a	0.099^a	0.105^a	0.102^a	0.103^a	0.097^a	0.099^a
	(0.025)	(0.025)	(0.024)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.024)
Exports LC	-0.005	-0.001	-0.001	-0.006	-0.003	-0.004	-0.005	-0.004	-0.005	-0.001	-0.002
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Imports HC	0.074^a	0.029	0.061^a	0.014	0.086^a	0.068^a	0.069^a	0.070^a	0.067^a	0.027	0.059^b
	(0.024)	(0.022)	(0.024)	(0.059)	(0.025)	(0.024)	(0.025)	(0.025)	(0.024)	(0.024)	(0.024)
Imports LC	0.014	0.007	0.020	0.014	-0.075^a	0.013	0.020	0.014	0.024	0.007	0.026
	(0.016)	(0.015)	(0.016)	(0.016)	(0.028)	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)	(0.016)
Imports × T&C		0.451^a	-0.334^a							0.490^a	-0.275^b
		(0.096)	(0.090)							(0.111)	(0.113)
Imports × Upstream				0.029	0.039^a						
				(0.024)	(0.011)						
Imports × Cluster						0.026	-0.030^c				
						(0.018)	(0.017)				
Imports × Cluster weighted								0.016	-0.046^a	0.000	-0.028^c
								(0.015)	(0.014)	(0.021)	(0.015)
Imports × T&C × Cluster weighted										-0.023	-0.034
										(0.028)	(0.041)
Observations	1,588	1,588	1,588	1,588	1,588	1,588	1,588	1,588	1,588	1,588	1,588
R-squared	0.985	0.986	0.986	0.985	0.985	0.985	0.985	0.985	0.985	0.986	0.986

Notes: This table reports the effects of competition on the number of plant at the industry-level for the period 2001-2013. All regressions include 240 industry fixed effects and year fixed effects. The dependent variable is the log of the number of plants. $ExportsHC$ is the log of exports to high-income countries. $ExportsLC$ is the log of exports to low-income countries. $ImportsHC$ is the log of imports from high-income countries. $ImportsLC$ is the log of imports from low-income countries. In columns $High-income$, $ImportsHC$ is interacted with different variables. In columns $Low-income$, $ImportsLC$ is interacted with different variables. $T\&C$ equals to one if the industry is part of the T&C sector. $Upstream$ measures the distance from final demand. $Cluster$ and $Clusterweighted$ measure either count-based or employment-weighted excess agglomeration measures (at 25km distance). Huber-White robust standard errors are reported under parenthesis. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

6.2 Resilience: effects of the end of the MFA on T&C industries

In Tables 16, 17 and 18, we replicate the previous analysis focusing on T&C industry only. Besides, we measure the change in low-income competition by the removal of quotas on Chinese products under the Agreement on Textile and Clothing (ATC). The ATC offers a nice quasi-natural experiment since some industries of the T&C sectors have been protected until 2005, while others have seen their quotas relaxed in 2002. We consider that industries in which quotas have been relaxed in 2005 have been treated, while other industries of the T&C sector are taken as a control group. Our specifications include industry fixed effects. Therefore, we cannot introduce a dummy variable for industries subject to quotas until 2005 separately. The permanent differences between quota and non-quota industries are already captured by the industry fixed effect. The specification further control for time dummies capturing common trend in the change in the economic environment after 2005. Last, we include the interaction between the two dummies to capture the change in the economic environment after 2005 specific to industries subject to quotas until this date. The coefficient on this variable measures the treatment effect of the end of the Multi Fibre Arrangement in 2005.[22]

Table 16: Industry-level regressions (T&C industries only): employment.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Interaction MFA:		Upstream	Quota	Cluster	Cluster-quota	Cluster	Cluster-quota
Exports HC	0.838^a	0.878^a	0.832^a	0.819^a	0.812^a	0.783^a	0.777^a
	(0.178)	(0.172)	(0.177)	(0.199)	(0.199)	(0.196)	(0.196)
Exports LC	-0.087	-0.049	-0.100	-0.086	-0.098	-0.090	-0.105
	(0.094)	(0.088)	(0.095)	(0.094)	(0.098)	(0.094)	(0.101)
MFA	-0.645^a	-0.250	-0.596^a	-0.642^a	-0.622^a	-0.632^a	-0.608^a
	(0.140)	(0.255)	(0.158)	(0.140)	(0.146)	(0.139)	(0.147)
MFA × Upstream		-0.170^b					
		(0.068)					
MFA × Quota			-0.144				
			(0.090)				
MFA × Cluster				-0.007	-0.005		
				(0.015)	(0.016)		
MFA × Cluster × Quota					-0.051		
					(0.037)		
MFA × Cluster weighted						-0.022	-0.017
						(0.015)	(0.014)
MFA × Cluster weighted × Quota							-0.041
							(0.031)
Observations	152	152	152	152	152	152	152
R-squared	0.939	0.942	0.940	0.939	0.939	0.939	0.940

Notes: This table reports the effect of the end of MFA on employment at the industry level. The sample is restricted to industries in the T&C sector. The dependent variable is the log of industry-level employment. *ExportsHC* and *ExportsLC* measure the log of exports to high- and low-income countries. *Upstreamness* measures the distance from final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subject to quotas until 2005, and zero otherwise. MFA is a dummy equal to one after 2005. *Cluster* and *Clusterweighted* measure either count-based or employment-weighted excess agglomeration measures (at 25km distance). **All regressions include 22 industry fixed effects and year fixed effects.** Huber-White robust standard errors. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

[22] This difference-in-difference estimator is correct under the assumption of parallel trend – namely that the error term is not correlated with the two dummies and the interaction term.

Table 17: Industry-level regressions (T&C industries only): productivity.

Interaction MFA:	(1)	(2) Upstream	(3) Quota	(4) Cluster	(5) Cluster-quota	(6) Cluster	(7) Cluster-quota
Exports HC	0.186	0.167	0.193	0.173	0.184	0.279^b	0.290^b
	(0.121)	(0.113)	(0.122)	(0.128)	(0.127)	(0.137)	(0.134)
Exports LC	0.096	0.078	0.110	0.097	0.116	0.100	0.131
	(0.086)	(0.090)	(0.089)	(0.086)	(0.086)	(0.085)	(0.086)
MFA	0.621^a	0.430^b	0.568^a	0.622^a	0.590^a	0.600^a	0.552^a
	(0.127)	(0.195)	(0.133)	(0.129)	(0.133)	(0.127)	(0.133)
MFA × Upstream		0.082					
		(0.065)					
MFA × Quota			0.155				
			(0.124)				
MFA × Cluster				-0.005	-0.009		
				(0.023)	(0.025)		
MFA × Cluster × Quota					0.080		
					(0.056)		
MFA × Cluster weighted						0.037^b	0.028^c
						(0.018)	(0.017)
MFA × Cluster weighted × Quota							0.083
							(0.051)
Observations	152	152	152	152	152	152	152
R-squared	0.864	0.866	0.866	0.864	0.866	0.867	0.870

Notes: This table reports the effect of the end of MFA on productivity at the industry level. The sample is restricted to industries in the T&C sector. The dependent variable is the log of productivity measured as the value added by manufacturing worker. *ExportsHC* and *ExportsLC* measure the log of exports to high- and low-income countries. *Upstreamness* measures the distance from final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subject to quotas until 2005, and zero otherwise. MFA is a dummy equal to one after 2005. *Cluster* and *Clusterweighted* measure either count-based or employment-weighted excess agglomeration measures (at 25km distance). **All regressions include 22 industry fixed effects and year fixed effects.** Huber-White robust standard errors. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

Consistent with our previous findings, Table 16 shows that exports to high-income countries is associated with higher employment growth at the industry level. On the contrary, exports to low-income economies have no significant impact on employment.

All specifications also show that the end of the Multi Fibre Arrangement is associated with employment destruction in T&C industries. This result is consistent with our previous findings that imports from low-wage countries harm T&C and clothing industries. Besides, column (2) shows that this negative effect is driven by upstream (*intermediate*) industries. Finally, the rest of Table 16 confirms that – apart from this different effect for intermediate *versus* final industries – there is no systematic difference across T&C industries on their resilience to the end of the MFA. Clustered or dispersed industries were indeed similarly affected by the end of the MFA. Likewise, industries that were subject or not to the quota removal on Chinese imports in 2005 (as documented in Section 4.1) are similarly affected by this change in trade policy. Finally, we mention that these results hold when using revenue as the explained variable. Therefore, the results of these estimations are reported in Table 26 in the Appendix.

Estimations using productivity as the dependent variable are reported in Table 17. We see that exports – both from low- or high-income economies – have no effect on an industry's productivity. Interestingly, the end of the MFA in 2005 was associated with productivity gains in T&C industries.

Table 18: Industry-level regressions (T&C industries only): number of plants.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Interaction MFA:		Upstream	Quota	Cluster	Cluster-quota	Cluster	Cluster-quota
Exports HC	0.208^b	0.197^b	0.202^b	0.229^b	0.218^b	0.223^b	0.214^b
	(0.094)	(0.093)	(0.094)	(0.099)	(0.099)	(0.099)	(0.099)
Exports LC	-0.058	-0.068^c	-0.070^c	-0.059	-0.077^c	-0.057	-0.082^b
	(0.038)	(0.040)	(0.038)	(0.038)	(0.039)	(0.039)	(0.040)
MFA	-0.567^a	-0.679^a	-0.518^a	-0.569^a	-0.538^a	-0.570^a	-0.531^a
	(0.077)	(0.101)	(0.084)	(0.077)	(0.080)	(0.077)	(0.080)
MFA × Upstream		0.048					
		(0.032)					
MFA × Quota			-0.144^a				
			(0.042)				
MFA × Cluster				0.008	0.011		
				(0.010)	(0.008)		
MFA × Cluster × Quota					-0.078^a		
					(0.019)		
MFA × Cluster weighted						0.006	0.014^c
						(0.011)	(0.008)
MFA × Cluster weighted × Quota							-0.067^a
							(0.015)
Observations	152	152	152	152	152	152	152
R-squared	0.982	0.982	0.983	0.982	0.983	0.982	0.983

Notes: This table reports the effect of the end of MFA on the number of plants at the industry level. The sample is restricted to industries in the T&C sector. The dependent variable is the log of the number of plants. *ExportsHC* and *ExportsLC* measure the log of exports to high- and low-income countries. *Upstreamness* measures the distance from final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subject to quotas until 2005. MFA is a dummy equal to one after 2005. *Cluster* and *Clusterweighted* measure either count-based or employment-weighted excess agglomeration measures (at 25km distance). **All regressions include 22 industry fixed effects and year fixed effects.** Huber-White robust standard errors. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

This result is consistent with those of Table 14. When we decompose this productivity gain across industries, we find that all T&C sectors are equally affected. The only exception is shown in the last two columns. When using an employment-weighted measure of agglomeration, we find that 'clustered' industries experienced a higher productivity growth as compared to 'dispersed' ones. However, the significance level are quite weak and do not exceed the 5% significance threshold.

Finally, the last Table 18 displays results for the number of plants. The latter are quite similar to the ones described previously. The end of the Multi Fibre Arrangement is shown to have a strong negative and significant effect on the number of plants in T&C industries in all specifications. Besides, the analysis of the interaction terms shows that industries that were initially subject to quotas on Chinese imports were strongly hit by the end of the MFA. Among those industries, the results show that plants destructions were even stronger in 'clustered' industries. Therefore, for those industries that were subject to import quotas prior 2005, the clustering of activities made the firms less resilient to the industry shock. For those that were not subject to quotas, the level of clustering had no statistical effect on their resilience to the trade policy shock.

All sectoral analyses on the effect of trade and trade policy with low-cost countries show that the latter had a negative impact on employment, revenue and the number of firms in the T&C sectors. However, the end of the MFA and increasing competition from low-wage exporters has been associated with substantial productivity gains at the industry level. Finally, the clustering of T&C industries is shown to have no – or if any, a negative – effect on the resilience of T&C industries to this trade shock. Besides, the sectoral regressions show that a large share of employment and productivity growth as well as number of plants in each industry is explained by trade variables as well as industry and year fixed effects. The inclusion of additional covariates – such as cluster or upstream variables – only marginally affect the explanatory power of the estimated model. However, this sectoral analysis does not capture all changes induced by the end of the MFA for T&C firms. Therefore, we will conduct additional empirical research on firm-level data. More specifically, we will investigate how individual firms have reacted to this change in import competition (e.g. in terms of plants' deaths, relocation or firms' change in activity). Investigating these dimensions will be the focus of our follow-up research to this study.

6.3 Resilience: probability of exit

Previous results describe the effects of import competition on employment, productivity and revenue at the industry level. In the rest of the report, we extend the empirical analysis to individual plants using our microlevel data. We first run regressions on a firm *exit status* at time t. This variable equals one if the firm exited between year t and $t+2$; and zero if it is still active in year $t+2$.

We regress this variable on a number of firm-level characteristics including employment (at the plant level, at year t), a dummy indicating whether the plant belong to a multiunit firm, and a dummy variable indicating whether the plant exports or not. Furthermore, we include a binary variable that values one if the plant belongs to a geographic cluster (either of core or secondary) and zero otherwise. We also regress this probability of exit on a set of variables linked to international trade. We use alternatively the change in imports between $t-2$ and t at the industry level, or dummy variables that reflect whether the industry in which the plant is active was subject to a quota removal by the end of the MFA. All estimations include province-year fixed effects. Since the (qualitative and quantitative) interpretation of coefficients in a logistic regression with fixed effects and with interacted terms is limited, we estimate this model using a linear probability model.[23] Table 19 summarizes the main results of our estimations.

Across all specifications, the firm-level variables are highly significant. Bigger T&C plants, as well as exporters, have a lower probability of exit. Increasing the number of employees from one to four reduces the probability of exit by 1.7%. Being an exporters reduces the probability of exit by 4%. Consistent with Bernard et al. (2006), plants belonging to multi-plant firms have a 6% higher probability to exit. The coefficient associated with the cluster variable is positive and highly significant. This implies that firms that belong to a geographical cluster have a higher probability

[23] We replicate the analysis using a logit model with fixed effects. The results are provided in Tables 27 and 28 for the exit and industry switching probability, respectively. These estimations provide very similar results, except for a few number of covariates. The latter are mentioned in the text.

Table 19: Plant-level regressions (T&C industries only): probability of exit.

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in imports				MFA	
Employment	-0.017[a]	-0.017[a]	-0.018[a]	-0.021[a]	-0.021[a]	-0.020[a]
	(-6.442)	(-6.474)	(-6.606)	(-8.213)	(-8.227)	(-8.028)
Exporter	-0.038[a]	-0.038[a]	-0.038[a]	-0.040[a]	-0.041[a]	-0.040[a]
	(-5.411)	(-5.412)	(-5.456)	(-6.019)	(-6.044)	(-6.028)
Multi-unit	0.057[a]	0.057[a]	0.065[a]	0.059[a]	0.059[a]	0.061[a]
	(3.253)	(3.261)	(3.693)	(3.574)	(3.531)	(3.702)
Cluster	0.037[a]	0.031[a]	0.029[a]	0.032[a]	0.038[a]	0.030[a]
	(4.969)	(3.730)	(3.805)	(4.488)	(4.817)	(4.123)
Δ Imports HC	0.000	-0.001	-0.001			
	(0.033)	(-0.135)	(-0.067)			
Δ Imports LC	-0.003	-0.019	0.031			
	(-0.410)	(-1.512)	(1.320)			
Δ Imports LC × Cluster		0.029[c]				
		(1.914)				
Δ Imports LC × Upstream			-0.015			
			(-1.560)			
Upstreamness			-0.019[a]			-0.010[b]
			(-4.353)			(-2.088)
Quota				0.048[a]	0.047[a]	0.037[a]
				(3.738)	(3.670)	(2.673)
MFA × Quota				0.001	0.017	-0.000
				(0.066)	(0.943)	(-0.019)
MFA × Quota × Cluster					-0.025	
					(-1.621)	
MFA × Quota × Upstream						0.001
						(0.086)
Fixed-effects	Province-year					
Observations	14,543	14,543	14,543	16,965	16,965	16,965
R-squared	0.042	0.043	0.045	0.041	0.041	0.042

Notes: The table reports the effect of plant-level and sector-level variables on the exit probability of T&C plants in Canada over the period 2003-2013 (year 2001 is excluded for reasons developed in the text). Coefficients are estimated from a linear probability model. All regressions include province-year fixed effects. The dependent variable is a dummy equal to one if the plant exit between years t and $t-2$. Exporter is a dummy equal to one if the plant was an exporter in $t-2$. Multi-unit is a dummy equal to one if the plant was part of a multi-plant firm in $t-2$. Cluster is a dummy equal to one if the plant belonged to a cluster in $t-2$. *Employment* is the log of employment in $t-2$. Δ Imports HC measures changes in imports from high-income countries between $t-2$ and $t-4$. Δ Imports LC measures changes in imports from low-income countries between $t-2$ and $t-4$. Upstreamness measures the distance to final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subject to quotas until 2005. MFA is a dummy equal to one after 2005. Huber-White robust standard errors. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

of exit. Across specification, we estimate that being in cluster increases the exit probability by about 3%. The inclusion of trade variables does not change these results across all specifications.

In columns (1) to (3), we include changes in NAICS 6-digit imports from low- and high-cost countries. These trade variables do not significantly influence the probability of a plant to exit, as shown by the insignificant coefficient on these variables. When using a logit model with fixed effects in Table in the Appendix, we find that the change in imports for low-wage economies can have a effect on the exit probability. However, the significance level is low and the sign of the estimated coefficient is unstable across specifications. In column (2), we include an interaction term between the change in imports from low-wage countries and the dichotomous variable for clustering. The positive and significant coefficient on this variable shows that, while imports from low-cost economies tend to have no – or if any, a marginally negative – effect on a plant's probability of exit, the latter rises with import competition for those that belong a geographical cluster.

In column (3), we interact the lagged changes in imports from low-wage countries with our measure of upstreamness. The results show that (i) plants that belong to intermediate industries are less likely to exit than their *final* counterparts; but (ii) that the degree of upstreamness of the industry does not influence the effect of import competition on a firm survival.

In columns (4) to (6), we use our dummy variable that takes the value one as of 2005, and zero otherwise (denoted MFA). Besides, we disentangle the exit probability according to whether the plant belongs to an industry that was subject to quotas on imports from China or not (the dummy variable *Quota*). It is worth mentioning that because of the inclusion of province-year fixed effects, we cannot introduce the MFA variable separately. The latter is therefore always interacted with another explanatory variable.[24] As underlined before, plants exits between 2001 and 2003 can be due to changes in plants' identifiers that are less stable as compared to subsequent years. To avoid considering these plants as exiting, we exclude the observations for the year 2001 from the sample.

The estimation results show that firms in industries that were subject to quotas on Chinese imports experienced a lower probability of survival as compared to other T&C plants. This result is not statistically larger after 2005 – the year of the quota removal. This is consistent with the idea that the end of the MFA was highly anticipated by firms in the T&C sector. In column (5), the inclusion of an interaction term between the quota removal and the measure of geographic clustering does not statistically change the main results. Besides, the effect of this quota removal does not vary between plants that belong to a geographical cluster (of both types) or not. The results are similar when using a logistic regression as the coefficient on this interaction term is significant only at the 10% significance level. Finally, when including our measure of upstreamness, we found similar results as the ones displayed in column (3). In particular, we find that the interaction between trade and upstreamness is not statistically different from zero, but that everything else being equal, intermediate plants have a lower probability of exiting than those active in *final* industries. Overall, the results suggest that differences in the exposure to low-income countries' competition cannot explain differences in the probability of exit of plants across T&C industries.

6.4 Resilience: industry switching

As previously emphasized, firms in the T&C industry may have reacted to the trade shock by changing their business activity.[25] In Table 20, we thus evaluate the influence of trade and import

[24] In the industry-level analysis, the problem was the opposite: the *Quota* variable was already captured by the industry fixed effect.

[25] In the descriptive statistics of Section 4.5, we also consider plants' mobility as a reaction to an economic shock. As already shown, the extent of firms' geographic mobility is very low in the sample. Therefore, estimation results using mobility as the dependent variable were inconclusive: there is no effect of trade or the end of the MFA on the

competition from low-income countries on the probability of a plant to switch industry. We still focus on T&C plants and define the dependent variable as a dummy variable that takes the value of one if the plant' main sector of activity was in the T&C sector and then switch outside the T&C sector during the two years interval, and zero otherwise.

Table 20: Plant-level regressions (T&C industries only): industry switching.

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in imports				MFA	
Employment	-0.001	-0.001	-0.000	0.001	0.001	0.000
	(-0.588)	(-0.600)	(-0.178)	(0.826)	(0.845)	(0.081)
Exporter	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001
	(-0.455)	(-0.459)	(-0.440)	(-0.479)	(-0.424)	(-0.388)
Multi-unit	-0.003	-0.003	-0.010	-0.005	-0.005	-0.010
	(-0.356)	(-0.352)	(-1.229)	(-0.687)	(-0.615)	(-1.262)
Cluster	-0.025^a	-0.026^a	-0.017^a	-0.022^a	-0.026^a	-0.017^a
	(-6.577)	(-5.600)	(-4.426)	(-6.282)	(-6.323)	(-4.802)
Δ Imports HC	-0.058^a	-0.058^a	-0.058^a			
	(-6.649)	(-6.752)	(-6.238)			
Δ Imports LC	0.025^a	0.022^b	-0.021			
	(3.931)	(2.089)	(-1.425)			
Δ Imports LC $\times$ Cluster		0.005				
		(0.473)				
Δ Imports LC $\times$ Upstream			0.019^b			
			(2.333)			
Upstreamness			0.017^a			0.022^a
			(6.606)			(8.483)
Quota				-0.050^a	-0.049^a	-0.025^a
				(-9.579)	(-9.456)	(-5.324)
MFA $\times$ Quota				0.030^a	0.019^b	0.037^a
				(4.973)	(2.511)	(2.986)
MFA $\times$ Quota $\times$ Cluster					0.018^a	
					(2.933)	
MFA $\times$ Quota $\times$ Upstream						-0.005
						(-0.716)
Fixed-effects			*Province-year*			
Observations	11,809	11,809	11,809	13,517	13,517	13,517
R-squared	0.080	0.080	0.091	0.071	0.071	0.077

Notes: The table reports the effect of plant-level and sector-level variables on the probability of T&C plants in Canada to switch industry over the period 2003-2013 (year 2001 is excluded for reasons developed in the text). Coefficients are estimated from a linear probability model. All regressions include province-year fixed effects. The dependent variable is a dummy equal to one if the plant switch industry between years t and $t-2$. Exporter is a dummy equal to one if the plant was an exporter in $t-2$. Multi-unit is a dummy equal to one if the plant was part of a multi-plant firm in $t-2$. Cluster is a dummy equal to one if the plant belonged to a cluster in $t-2$. *Employment* is the log of employment in $t-2$. Δ Imports HC measures changes in imports from high-income countries between $t-2$ and $t-4$. Δ Imports LC measures changes in imports from low-income countries between $t-2$ and $t-4$. Upstreamness measures the distance to final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subjct to quotas until 2005. MFA is a dummy equal to one after 2005. Huber-White robust standard errors. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

Across all specifications, employment and export status have no significant effect on a plant' probability to switch from T&C to another activity. By contrast, plants located in a geographical cluster (either a core cluster or a secondary cluster) face a 2.5% lower probability of industrial

probability of a plant to relocate. Hence, we do not report these results in the report.

switch. Therefore, *isolated* T&C plants have a greater chance to switch industry over the sample period as compared to *concentrated* ones. Contrary to the previous table, trade variables significantly affect the probability of a change in industry. Eventually, an increase in T&C imports from low-wage countries is associated with a higher likelihood of industry switching, while the opposite holds for imports from high-income countries. Both results are highly significant. More specifically, increasing imports from low-wage countries by one percent increases the probability of exit by about 2%.

Next, we introduce an interaction term between the change in imports from low-income economies and the dummy variables for clusters. The coefficient on this variables is not significant which shows that the effect of trade does not vary if the plant belongs to a geographical cluster or not. When considering the influence of the degree of upstreamness of the industry in which the plant is active, we find that plants in *intermediate* industries have a higher probability of switching. Associated with the results of Table 19, this finding implies that intermediate plants are less likely to die, but more likely to move into another production.

The analysis of the trade variables provides interesting results. The coefficient on the change in imports from low-wage countries turn out to be insignificant at a 10% significance level. In contrast, the interaction term is positive an significant. This implies that the effect of import competition from low-wage economies is increasing with the upstream of industries. In industries oriented towards final consumption, plants have a lower probability to switch into another industry in the event of increasing competition. This result is even stronger when using a logit model with fixed effects – as shown in Table 28 in the Appendix – as the coefficient on the change in imports from low-wage economies turns out to be negative and significant in this estimation.

Results using the end of the MFA and the quota removal on Chinese exports provide interesting results too. First, it seems that industries that were subject to a quota removal were less likely to switch industry prior 2005, which might be explained by their relative upstreamness. Conditional on surviving, firms hit by the end of the quotas in 2005 have a higher probability to change industries after the end of the MFA.

We further find that the influence of the end of the MFA in industries subject to quotas depends on whether the plant is located in a cluster or not. More specifically, we find that among plants hit by the end of the MFA, those that were located in clusters have been more likely to switch industry. This result does not hold when using a logistic model as the coefficient on this interaction is insignificant in column (5) of Table 28.

Being in a cluster has thus an ambiguous effect on industry switching. On the one hand, plants in clusters are less likely than others to switch industry. On the other hand, plants in clusters directly impacted by the end of the MFA might be more likely to switch than plants outside clusters. This pattern is consistent with the specific trade-off faced by plants in clusters. Being in a cluster, they benefit from agglomeration economies and have thus little incentive to switch in regular time. When competition increases, this might attenuate the agglomeration economies. If some plants switch industry in difficult time, other plants in the cluster may benefit from information spillovers relative to the opportunity and management of industry switching. This may explain why at the end the MFA plants in clusters have been relatively more likely to change their main line of business.

Finally, the degree of upstreamness still has an independent effect on these probability as it rises the likelihood of an industrial switch. However, we find in this last estimation that the influence of the quota removal on Chinese imports is independent from this variable

Our database unfortunately does not allow us to measure productivity at the plant level. Hence, we now run regressions taking as the dependent variable the plant's employment. Employment is one of the key variables of local policy interest and is statistically correlated with productivity.

6.5 Plant-level employment

In Table 21, we regress the two-year changes in employment (at the plant level) for stayers on the same set of explanatory variables. Regarding the export status of the firm, we unsurprisingly find that exporters tend to experience higher employment growth (being an exporter increases employment growth by about 1.3%). Besides, the coefficient associated with geographical clusters is not significant. Plants belonging to multi-plant firms experienced a 3% lower employment growth.

In terms of trade variables, we find basically no impact of trade on employment growth at the plant level. Column (2) shows that the absence of impact of competition on plant-level employment is the same for plants inside and outside clusters.

Column (3) provides interesting results regarding the effect of trade across upstream and downstream industries. It shows that an increase in imports from low-wage economies is associated with a a fall in employment at the plant level, but the effect is attenuated in more downstream industries. This is consistent with previous results showing that upstream industries have been hit more severely by competition from low-income countries.

Specifications using the two dummy variables that reflects the end of the MFA and the quota removal on imports from China indicate that this trade policy shock has been associated with a fall in employment after 2005 for plants in previously protected industries. Employment growth has been 2 points lower after the end of the MFA in treated sectors than in sectors that were not protected by quotas until 2005. The introduction of interaction terms seem to show that this negative effect of the end of the MFA is not driven by *clustered* plants, or plants in more upstream industries.

7 Some policy implications

We want to stress three policy implications that emerge from the foregoing analysis.

Table 21: Plant-level regressions (T&C industries only): employment growth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in imports				MFA	
Exporter	0.013^b	0.013^b	0.014^a	0.014^a	0.014^a	0.015^a
	(2.421)	(2.413)	(2.580)	(2.689)	(2.681)	(2.743)
Multi-unit	-0.033^b	-0.033^b	-0.037^b	-0.034^b	-0.034^b	-0.035^b
	(-2.231)	(-2.233)	(-2.474)	(-2.302)	(-2.307)	(-2.378)
Cluster	0.000	-0.003	0.004	0.004	0.004	0.005
	(0.049)	(-0.404)	(0.741)	(0.677)	(0.614)	(0.823)
Δ Imports HC	-0.005	-0.006	-0.005			
	(-0.319)	(-0.368)	(-0.300)			
Δ Imports LC	0.003	-0.004	-0.069^a			
	(0.328)	(-0.327)	(-3.012)			
Δ Imports LC × Cluster		0.014				
		(0.885)				
Δ Imports LC × Upstreamn			0.030^a			
			(3.692)			
Upstreamness			0.006^c			0.008^b
			(1.658)			(2.023)
Quota				-0.006	-0.006	0.002
				(-0.619)	(-0.617)	(0.207)
MFA × Quota				-0.022^c	-0.022	0.004
				(-1.816)	(-1.551)	(0.203)
MFA × Quota × Cluster					0.000	
					(0.003)	
MFA × Quota × Upstream						-0.018
						(-1.519)
Fixed-effects				*Province-year*		
Observations	14,543	14,543	14,543	14,556	14,556	14,556
R-squared	0.011	0.011	0.013	0.013	0.013	0.013

Notes: The table reports the effect of plant-level and sector-level variables on the change in employment of T&C plants in Canada over the period 2003-2013 (year 2001 is excluded for reasons developed in the text). All regressions include province-year fixed effects. The dependent variable is the change in employment between years t and $t-2$. Exporter is a dummy equal to one if the plant was an exporter in $t-2$. Multi-unit is a dummy equal to one if the plant was part of a multi-plant firm in $t-2$. Cluster is a dummy equal to one if the plant belonged to a cluster in $t-2$. Δ Imports HC measures changes in imports from high-income countries between $t-2$ and $t-4$. Δ Imports LC measures changes in imports from low-income countries between $t-2$ and $t-4$. Upstreamness measures the distance to final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subject to quotas until 2005. MFA is a dummy equal to one after 2005. Huber-White robust standard errors. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

The sudden increase in competition from low-income countries in the T&C industry induced a strong reallocation of activity within and across sectors, and across places. Competition from low-income countries has had deep effects on the T&C sector. The number of plants and total employment has dropped. Productivity in this sector has increased, triggered by a reallocation of activities across plants. The competition has also changed the geography of activities in this sector, which is now more dispersed than it was some 15 years ago (though it remains a fairly strongly localized industry). Resources have further been reallocated across sectors as some plants switched industry during the period. The uneven distribution of economic activity in this sector implies that global adverse shocks are felt quite locally. Industrial policy and cluster policy should thus account for the very local dimension of these shocks.

Clusters do not necessarily mitigate adverse shocks. One common view is that plants in clusters benefit from agglomeration economies and spillovers from other plants. They should thus in turn be more productive than plants outside clusters and thus suffer less from global competition. This report suggests that this need not always be the case, as shown by the T&C sector. If anything, we find that T&C plants in clusters are more likely to exit, and employment is more severely hit in more concentrated industries. One explanation for this is that plants in clusters are likely to be big multiunit plants which produce more standardized products and are thus more strongly impacted by competitive pressures from low-income countries (Holmes & Stevens 2014). Furthermore, big multiunit plants are more likely to exit or, conditional on survival, to downsize employment than smaller standalone plants (Bernard & Jensen 2007). Besides, the results could be different for sectors that have a more complex supply chain than the T&C sector. Another explanation is that the positive cumulative processes within clusters may turn negative once the cluster starts to suffer. If productivity increases with more local firms due to sharing, matching, and learning externalities, thus making plants more resilient, it may fall once some local firms go out of business, thus accelerating the decline of the cluster. Little is known about these processes, unfortunately. Future policies may encourage diversification and product innovation within clusters to attenuate these effects of low-income countries' competition.

Industry switching is a potential response of plants in face of increasing competition. A potential way for a plant to avoid competition from low-income countries is to change its core business. Such adaptation seems at work in the data as 8% of firms changed their main line of production out of the T&C sector to produce non-T&C products.[26] It would be useful to design policies helping plants in their transition, in 'reinventing themselves'. We find that plants located in clusters are less likely to switch industries in normal times, yet more likely to adapt in such a way in response to a negative shock (conditional on survival). Understanding when and why plants operate a switch in their core business is of key importance for the design of innovation policies. Little is known about this in general, and next to nothing is known on how clusters, and their composition, influence and shape these industrial transitions.

8 Conclusions and future work

This report documents the evolution of the T&C sector in the aftermath of Chinese entry in the WTO in 2001 and the end of the Multi Fibre Arrangement in 2005. A special attention has been paid to the change in the geography of economic activities in this sector. The T&C sector is

[26] Some producers may have gone 'factoriless' by outsourcing the textile production part. For example, a plant formerly producing T-shirts and printing them for promotional purposes may now source the T-shirts in China while pursuing the printing activity. In that case, the main line of business would change, and would reflect the reorientation of the firm towards a different segment of the production chain.

organized around a few economic clusters. In 2001, the geographic concentration of activity was higher in this sector than in the rest of manufacturing. The sector experienced a dispersion of its activities between 2001 and 2013. We show that the T&C sector has been severely impacted by competition from low-income countries, and by the end of the MFA in 2005. Plants belonging to economic clusters seem to have been hurt even more strongly than the others. This suggests that T&C plants in clusters are more exposed than others to global competition. We find that some plants adapt to competition by switching industry. This ability to adapt and to mutate in time of crisis seems to be eased for plants located in economic clusters, though the precise channels remain elusive for now.

Our key results are in line with those by Martin et al. (2013) who show using French firm-level data that firms in clusters – defined as targeted by a specific place-based policy – are not more resilient to adverse economic shocks than non-clustered firms. In particular, they find that the 'leader', i.e., the main firm in the cluster, shapes how others fare in the face of the shock. It would be interesting to see how T&C leaders shape the fate of clusters in Canada. Our results are not in line with those by Delgado et al. (2016), who find that strong US clusters were more resilient (in terms of employment growth) to the financial crisis of 2008–2009 than non-clustered areas or weak clusters. While the difference in results is intriguing, we believe that it may be due to the different nature of the shock under consideration. While we consider a well identified industry-specific shock and look at its effects on the targeted industries, Delgado et al. (2016) consider a fairly large and diffuse macroeconomic shock. Understanding how this affects clusters in particular is fairly complicated in that setting. Clearly, more work is called for here.

We view four interesting extensions to this report. First, industry switching could be explored more systematically. Industry switching is an effective way to escape from low-income country competition. It might be interesting to examine the characteristics of plants able to change their core production. For instance, we may wonder if multi-segment plants are more likely to switch across their main lines of business. While our results suggest that plants in clusters are more likely to switch, it would also be worth exploring why. One explanation is that plants in clusters repeat what successful plants do. In such case, plants in clusters learn from the adaptation strategy of the others. Another explanation is that being in a cluster allows plants to be in touch with plants in other industries (and plants doing R&D) which help them innovate and change their core business. It would further be worth looking at the evolution of plants after they made their switching. Investigating these points is key to design effective policies that help plants to adapt to global competition.

A second extension of this report could focus more closely on the product level. Since our data report detailed product descriptions at the plant level (up to 10 products per plant), we can also look at how plants switch between products and change their product lines over time. Furthermore, we could investigate whether or not clusters differ systematically in their product mix, e.g., if they produce more 'sophisticated' products than non-clustered plants. A better understanding of these dimensions of the data is important to learn more about the adaptation dynamics at work in clusters.

A third extension of this report is the dissection of another highly localized industry: the automotive industry. The recent Trans-Pacific Partnership is likely to have adverse effects on this industry. Furthermore, this industry is highly integrated and relies heavily on a few downstream industries. The analysis of the spatial distribution of the automotive industry as well as its downstream suppliers would be key to understand what parts of Canada will be hit by an increase in competition in this industry. Such analysis is crucial to be able to anticipate the effects of the TPP on the automotive industry and its indirect implications across Canada. Furthermore, since the automotive industry is cross-border with the US, we may learn also more about the functioning and the specificities of trans-national clusters.

Last, the methodology developed in this report can readily be used to: (i) identify clusters; (ii) map clusters using microgeographic data; (iii) dissect the composition of clusters; and (iv) follow the evolution of clusters through time. This can be done for all sorts of (manufacturing) industries. Pending data availability, it can also readily be extended to include non-manufacturing industries that are of specific interest to Canada and which are highly clustered, such as the movie or the videogames industries.

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Appendix

In Appendix **A**, we briefly explain the technical details of the Duranton-Overman indices and their underlying methodology. In Appendix **B**, we provide additional tables, figures, and regression results.

A. Summary of the Duranton-Overman methodology.

To compute the kernel density distribution of bilateral distances, as well as the cumulative distribution, and to compare it with randomly drawn distributions, we proceed as follows (the following description draws heavily on Behrens & Bougna (2015).

First step (kernel densities). Consider industry A with n plants. We compute the great circle distance, using postal code centroids, between each pair of plants in that industry. This yields $n(n-1)/2$ bilateral distances for industry A. Let us denote the distance between plants i and j by d_{ij}. Given n etablishments, the kernel-smoothed estimator of the density of these pairwise distances, which we henceforth call K-density as in Duranton and Overman (2005), at any distance d is:

$$\widehat{K}(d) = \frac{1}{n(n-1)h} \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} f\left(\frac{d - d_{ij}}{h}\right), \tag{1}$$

where h is the optimal bandwidth, and f a Gaussian kernel function. The distance d_{ij} (in kilometers) between plants i and j is computed as:

$$d_{ij} = 6378.39 \cdot \text{acos}\left[\cos(|\text{lon}_i - \text{lon}_j|)\cos(\text{lat}_i)\cos(\text{lat}_j) + \sin(\text{lat}_i)\sin(\text{lat}_j)\right].$$

We also compute the employment-weighted version of the K-density, which is given by

$$\widehat{K}_W(d) = \frac{1}{h\sum_{i=1}^{n-1}\sum_{j=i+1}^{n}(e_i + e_j)} \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} (e_i + e_j) f\left(\frac{d - d_{ij}}{h}\right), \tag{2}$$

where e_i and e_j are the employment levels of plant i and j, respectively. The weighted K-density thus describes in some sense the distribution of bilateral distances between employees in a given industry, whereas the unweighted K-density describes the distribution of bilateral distances between plants in that industry. Since the K-density is a distribution function, we can also compute its cumulative (CDF) up to some distance d. The CDF at distance d thus tells us what share of plant pairs is located less than distance d from each other. Alternatively, we can view this as the probability that two randomly drawn plants in an industry will be at most d kilometers away.

Second step (counterfactual samples). Using the full distribution of all manufacturing plants in our sample, we randomly draw as many locations as there are plants in industry A. To each of these locations, we assign randomly a plant from industry A, using its observed employment. This procedure ensures that we control for the overall pattern of concentration in the manufacturing sector as a whole, as well as for the within-industry concentration. We then compute the bilateral distances of this hypothetical industry and estimate the K-density of the bilateral distances. Finally, for each industry A, we repeat this procedure 1,000 times. This yields a set of 1,000 estimated values of the K-density at each distance d.

Third step (confidence bands). To assess whether an industry is significantly localized or dispersed, we compare the actual K-density with that of the counterfactual distribution. We consider a range of distances between zero and 800 kilometers to construct our K-densities and confidence bands.[27] We then use our bootstrap distribution of K-densities, generated by the counterfactuals,

[27] The interactions across 'neighboring cities' mostly fall into that range in Canada. In particular, a cutoff distance of 800 kilometers includes interactions within the 'western cluster' (Calgary, AB; Edmonton, AB; Saskatoon, SK; and Regina, SK); the 'plains cluster' (Winnipeg, MN; Regina, SK; Thunder Bay, ON); the 'central cluster' (Toronto, ON; Montreal, QC; Ottawa, ON; and Quebec, QC); and the 'Atlantic cluster' (Halifax, NS; Fredericton, NB; and Charlottetown, PE). Setting the cutoff distance to 800 kilometers allows us to account for industrial localization at both very small spatial scales, but also at larger interregional scales for which market-mediated input-output and demand linkages, as well as market size, might matter much more.

to construct a two-sided confidence interval that contains 90 percent of these estimated values. The upper bound, $\overline{K}(d)$, of this interval is given by the 95th percentile of the generated values, and the lower bounds, $\underline{K}(d)$, by the 5th percentile of these values. Distributions of observed distances that fall into this confidence band could be 'as good as random' and are, therefore, not considered to be either localized or dispersed.

Fourth step (identification of location patterns). The bootstrap procedure generates a confidence band, and any deviation from that band indicates localization or dispersion of the industry. If $\widehat{K}(d) > \overline{K}(d)$ for at least one $d \in [0, 800]$, whereas it never lies below $\underline{K}(d)$ for all $d \in [0, 800]$, industry A is defined as globally localized at the 5 percent confidence level (this is the case for both of our industries depicted in Figure 6). On the other hand, if $\widehat{K}(d) < \underline{K}(d)$ for at least one $d \in [0, 800]$, industry A is defined as globally dispersed. We can also define an index of global localization, $\gamma_i(d) \equiv \max\{\widehat{K}(d) - \overline{K}(d), 0\}$, as well as an index of global dispersion

$$\psi_i(d) \equiv \begin{cases} \max\{\underline{K}(d) - \widehat{K}(d)\} & \text{if} \quad \sum_{d=0}^{800} \gamma_i(d) = 0 \\ 0 & \text{otherwise.} \end{cases} \tag{3}$$

Intuitively, if we observe a higher K-density than that of randomly drawn distributions, we consider the industry as localized. Similarly, if we observe a lower K-density than that of randomly drawn distributions, we consider the industry as dispersed. Last, the strength of localization and dispersion can be measured by $\Gamma_i \equiv \sum_d \gamma_i(d)$ and $\Psi_i \equiv \sum_d \psi_i(d)$, which corresponds roughly to a measure of the 'area' between the observed distribution and the upper- and lower-bounds of the confidence band. It can be viewed as the 'excess probability' of drawing a plant of the industry at a given distance from another plant of that industry.

B. Additional tables, figures, and results.

Table 22: Components and aggregation of T&C industries for our T&C.

Industry name	Stable NAICS	Aggregation
Fibre, Yarn and Thread Mills	313110	
Broad-Woven Fabric Mills	313210	
Narrow Fabric Mills and Schiffli Machine Embroidery	313220	
Nonwoven Fabric Mills	313230	
Knit Fabric Mills	313240	
Textile and Fabric Finishing	313310	
Fabric Coating	313320	
Carpet and Rug Mills	314110	
Curtain and Linen Mills	314120	
Textile Bag and Canvas Mills	314910	
All Other Textile Product Mills	314990	Aggregated
Cut and Sew Clothing Contracting	314990	Aggregated
Hosiery and Sock Mills	315110	
Other Clothing Knitting Mills	315190	
Other Men's and Boys' Cut and Sew Clothing Manufacturing	315220	Aggregated
Men's and Boys' Cut and Sew Suit, Coat and Overcoat Manufacturing	315220	Aggregated
Men's and Boys' Cut and Sew Shirt Manufacturing	315220	Aggregated
Men's and Boys' Cut and Sew Underwear and Nightwear Manufacturing	315220	Aggregated
Men's and Boys' Cut and Sew Trouser, Slack and Jean Manufacturing	315220	Aggregated
Women's and Girls' Cut and Sew Blouse and Shirt Manufacturing	315249	Aggregated
Other Women's and Girls' Cut and Sew Clothing Manufacturing	315249	Aggregated
Women's and Girls' Cut and Sew Dress Manufacturing	315249	Aggregated
Women's and Girls' Cut and Sew Suit, Coat, Tailored Jacket and Skirt Manufacturing	315249	Aggregated
Women's and Girls' Cut and Sew Lingerie, Loungewear and Nightwear Manufacturing	315249	Aggregated
Infants' Cut and Sew Clothing Manufacturing	315291	
Fur and Leather Clothing Manufacturing	315292	
All Other Cut and Sew Clothing Manufacturing	315299	
Clothing Accessories and Other Clothing Manufacturing	315990	
Leather and Hide Tanning and Finishing	316110	
Footwear Manufacturing	316210	
Other Leather and Allied Product Manufacturing	316990	

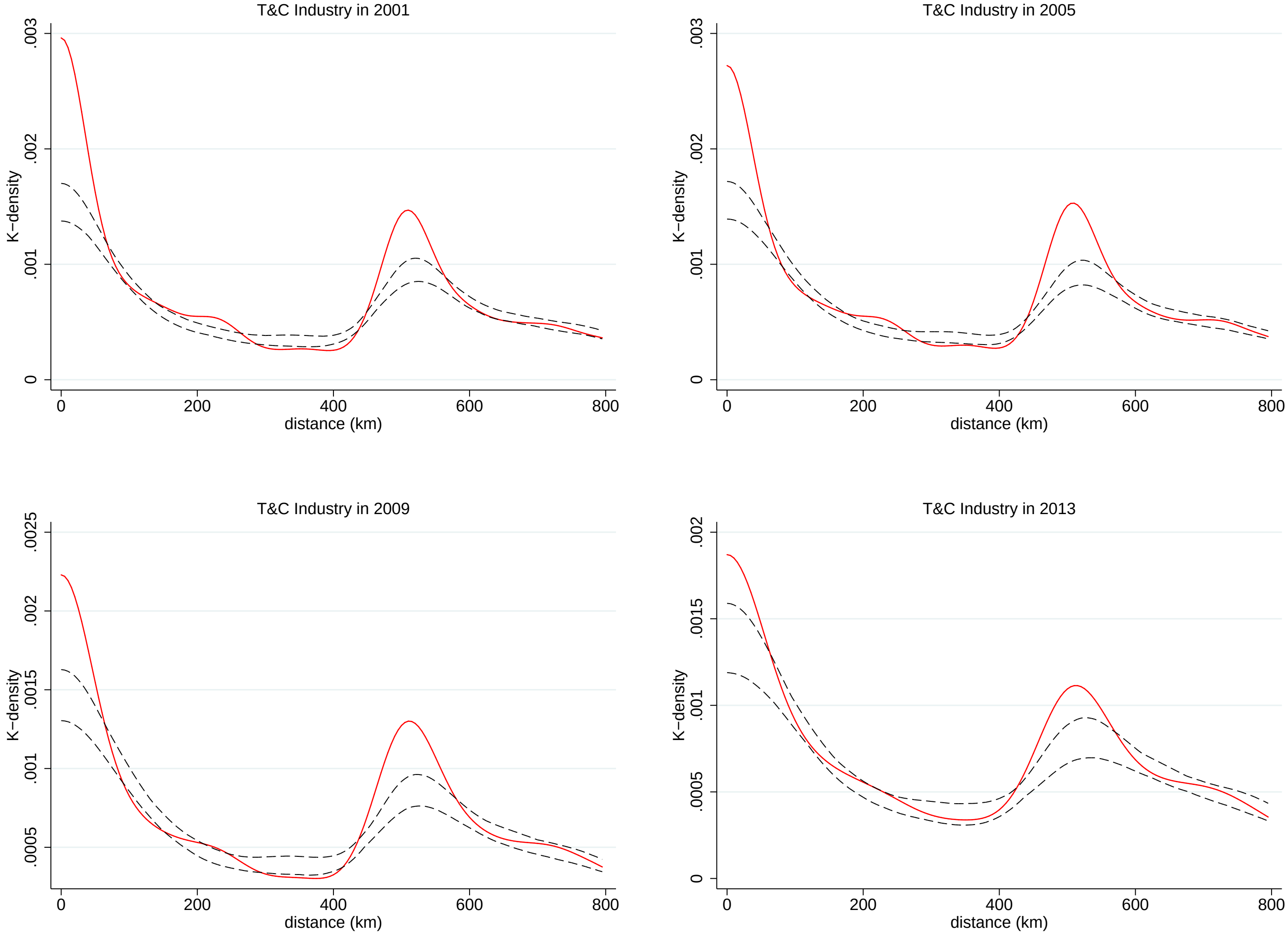
Notes: We aggregate up all industries to a stable 6-digit classification that spans NAICS 1997, 2002, 2007, and 2012. Changes within the T&C industry occur mainly between the NAICS 2007 and NAICS 2012 classifications. There are several other changes for non-T&C industries. The 4-digit classification remains stable throughout the entire 2001–2013 period. There are 85 4-digit industries since our dataset has no plants in NAICS 3391 after the concordance has been applied.

Table 23: Upstreamness of T&C industries.

NAICS	Industry name	Upstreamness	Rank	Type
315299	All Other Cut and Sew Clothing Manufacturing	1.3309	87	Final
315291	Infants' Cut and Sew Clothing Manufacturing	1.3309	88	Final
315990	Clothing accessories and other clothing manufacturing	1.3309	89	Final
315292	Fur and Leather Clothing Manufacturing	1.3309	90	Final
315110	Hosiery and sock mills	1.3309	91	Final
315190	Other clothing knitting mills	1.3309	92	Final
315249	Women's and girls' cut and sew clothing manufacturing	1.3309	93	Final
315220	Men's and boys' cut and sew clothing manufacturing	1.3309	94	Final
314990	All Other Textile Product Mills and cut-and-sew clothing contracting	2.0828	337	Unclear
316990	Other leather and allied product manufacturing	2.7906	657	Unclear
316210	Footwear manufacturing	2.7906	658	Unclear
316110	Leather and hide tanning and finishing	2.7906	659	Unclear
313220	Narrow fabric mills and machine embroidery	3.3525	781	Intermediate
313110	Fibre, yarn and thread mills	3.3525	782	Intermediate
313230	Nonwoven fabric mills	3.3525	783	Intermediate
314110	Carpet and rug mills	3.3525	784	Intermediate
314120	Curtain and linen mills	3.3525	785	Intermediate
313310	Textile and fabric finishing	3.3525	786	Intermediate
313240	Knit fabric mills	3.3525	787	Intermediate
314910	Textile bag and canvas mills	3.3525	788	Intermediate
313210	Broad-woven fabric mills	3.3525	789	Intermediate
313320	Fabric coating	3.3525	790	Intermediate

Notes: There are 864 industries in our stable classification, including all service industries. The ranks are thus reported out of 864 industries. All computations use the methodology developed by Antras et al. (2012) and are based on the 1998 L-level input-output matrix which we disaggregated to the 6-digit NAICS level using employment and sales weights for industries.

Figure 14: Changes in the spatial concentration of the T&C industry, plant counts, 2001–2013.



Notes: The four panels report the K-density (in solid red) and the confidence bands (in dashed black) for the T&C industry in 2001, 2005, 2009 and 2013 using plant counts.

Table 24: Ten most localized industries according to the Duranton-Overman CDF (employment weights).

NAICS	Industry name	CDF
	Most localized industries in 2001	
313240	*Knit fabric mills*	0.4018
336370	Motor vehicle metal stamping	0.2073
336110	Automobile and light-duty motor vehicle manufacturing	0.2027
315249	*Women's and girls' cut and sew clothing manufacturing*	0.1993
315110	*Hosiery and sock mills*	0.1926
333519	Other metalworking machinery manufacturing	0.1913
325991	Custom compounding of purchased resins	0.1733
332118	Stamping	0.1651
332720	Turned product and screw, nut and bolt manufacturing	0.1545
333220	Rubber and Plastics Industry Machinery Manufacturing	0.1449
	Most localized industries in 2005	
333220	Rubber and Plastics Industry Machinery Manufacturing	0.2878
313240	*Knit fabric mills*	0.2504
336110	Automobile and light-duty motor vehicle manufacturing	0.2440
312210	Tobacco stemming and redrying	0.2404
336370	Motor vehicle metal stamping	0.1974
332118	Stamping	0.1959
332720	Turned product and screw, nut and bolt manufacturing	0.1840
326150	Urethane and other foam product (except polystyrene) manufacturing	0.1808
315249	*Women's and girls' cut and sew clothing manufacturing*	0.1787
333519	Other metalworking machinery manufacturing	0.1750
	Most localized industries in 2009	
336110	Automobile and light-duty motor vehicle manufacturing	0.2505
312210	Tobacco stemming and redrying	0.2494
313240	*Knit fabric mills*	0.2297
332991	Ball and roller bearing manufacturing	0.2274
336370	Motor vehicle metal stamping	0.2143
333220	Rubber and Plastics Industry Machinery Manufacturing	0.2136
332720	Turned product and screw, nut and bolt manufacturing	0.2001
326150	Urethane and other foam product (except polystyrene) manufacturing	0.1694
315249	*Women's and girls' cut and sew clothing manufacturing*	0.1674
332118	Stamping	0.1644

Notes: The CDF is the cumulative sum of the K-densities (with employment weights) up to distance d. Results in this table are reported for a distance of $d = 50$ kilometers. T&C sectors are italicized in the table.

Figure 15: T&C clusters in Quebec (2001).

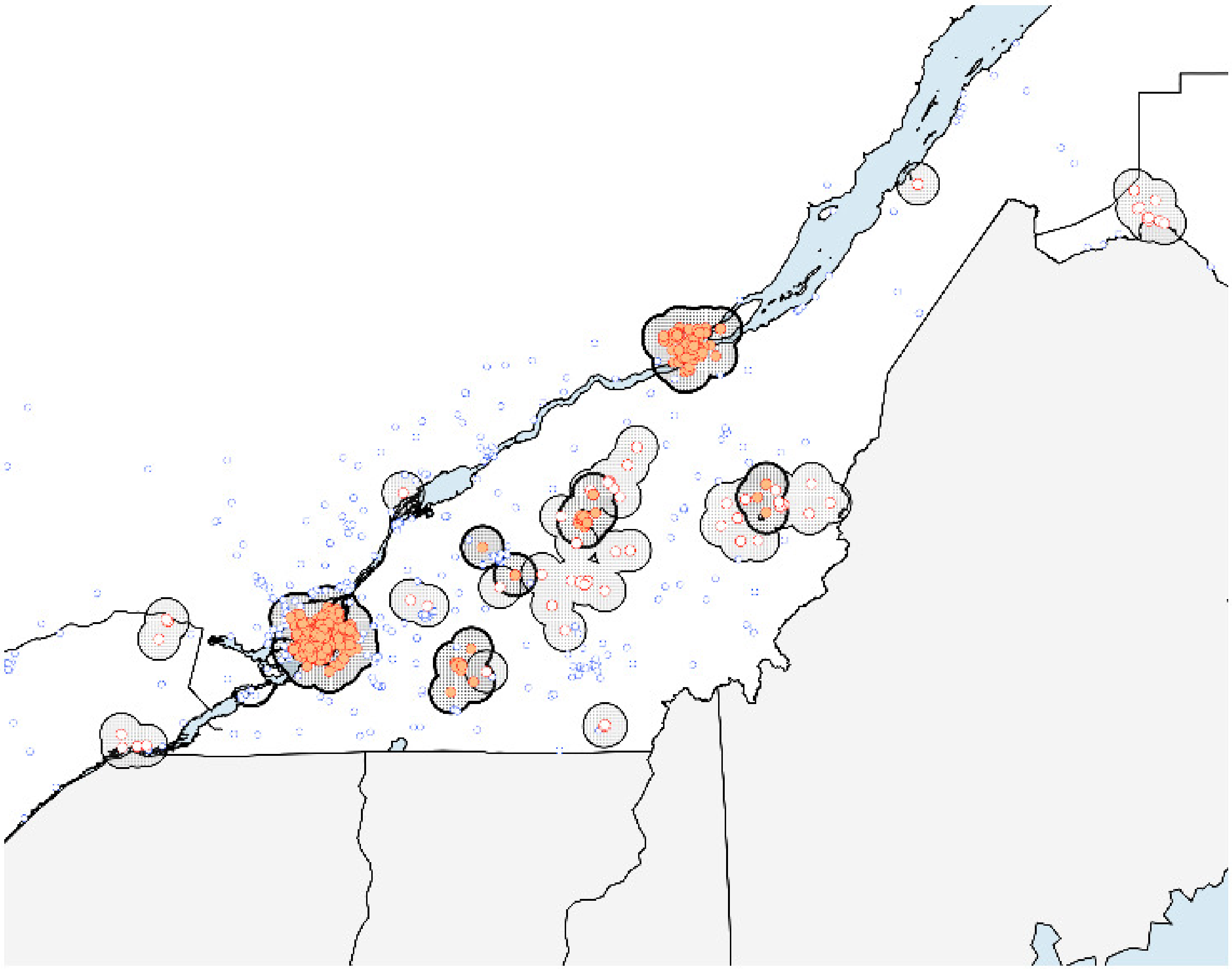


Figure 16: T&C clusters in Quebec (2003).

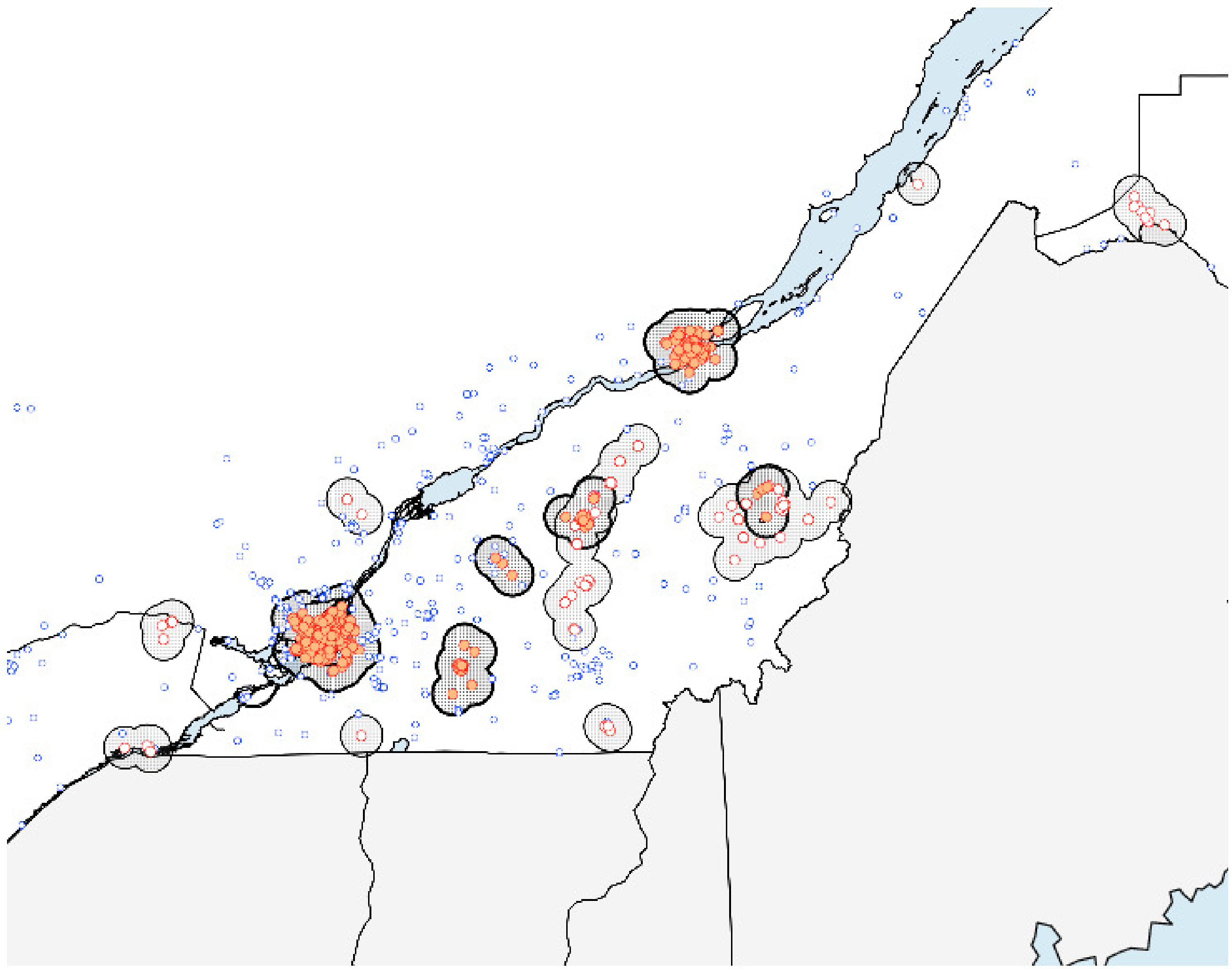


Figure 17: T&C clusters in Quebec (2005).

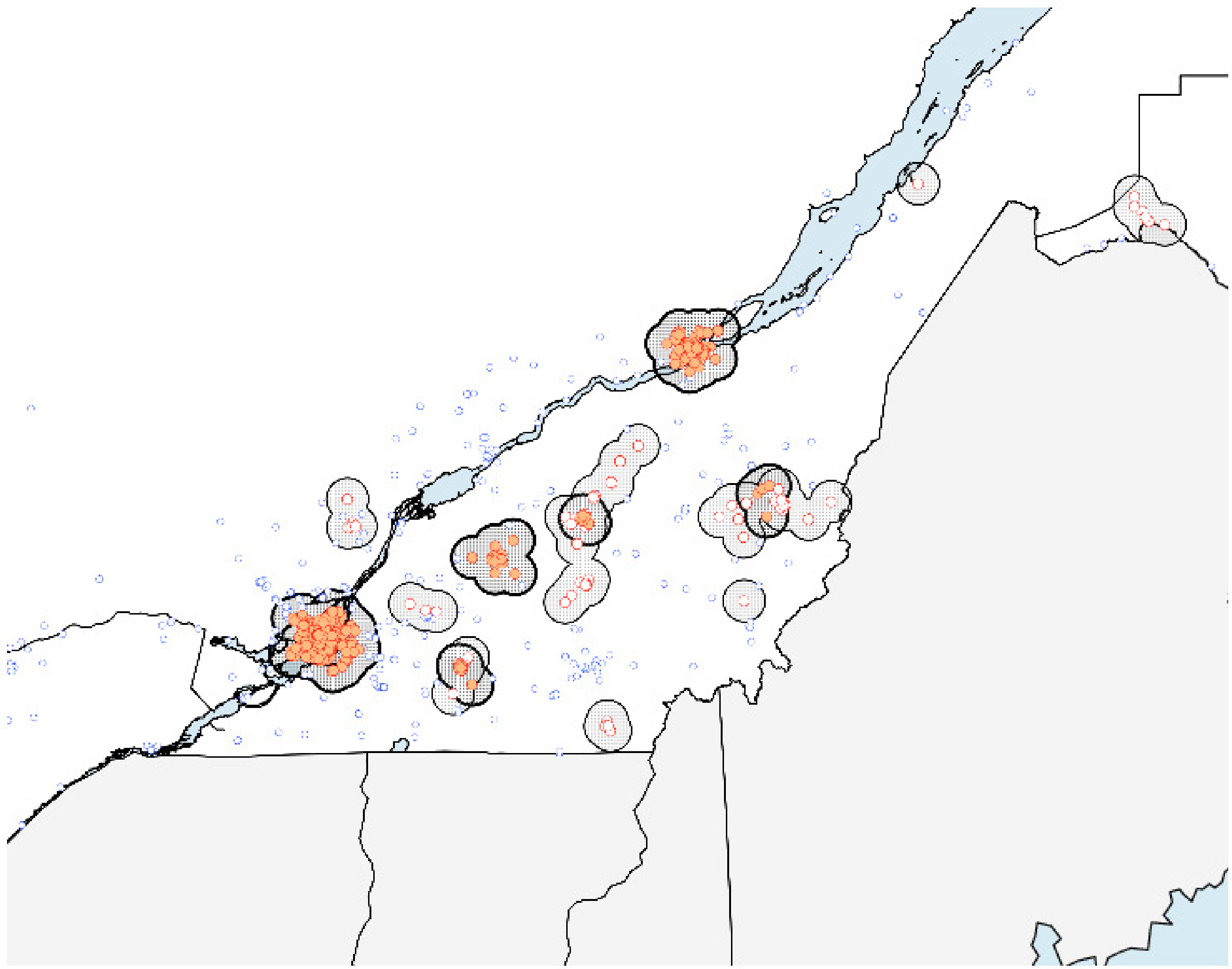
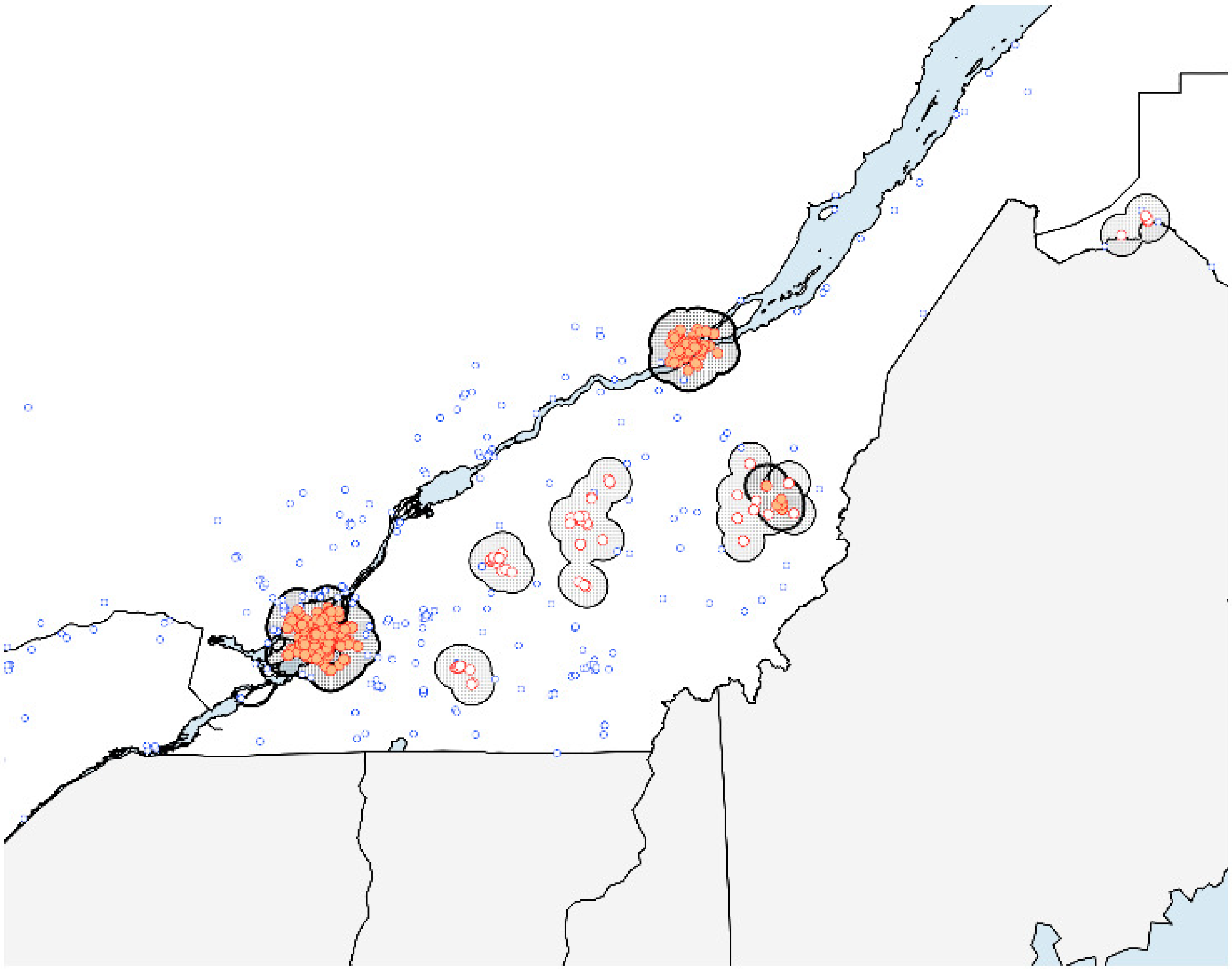


Figure 18: T&C clusters in Quebec (2007).



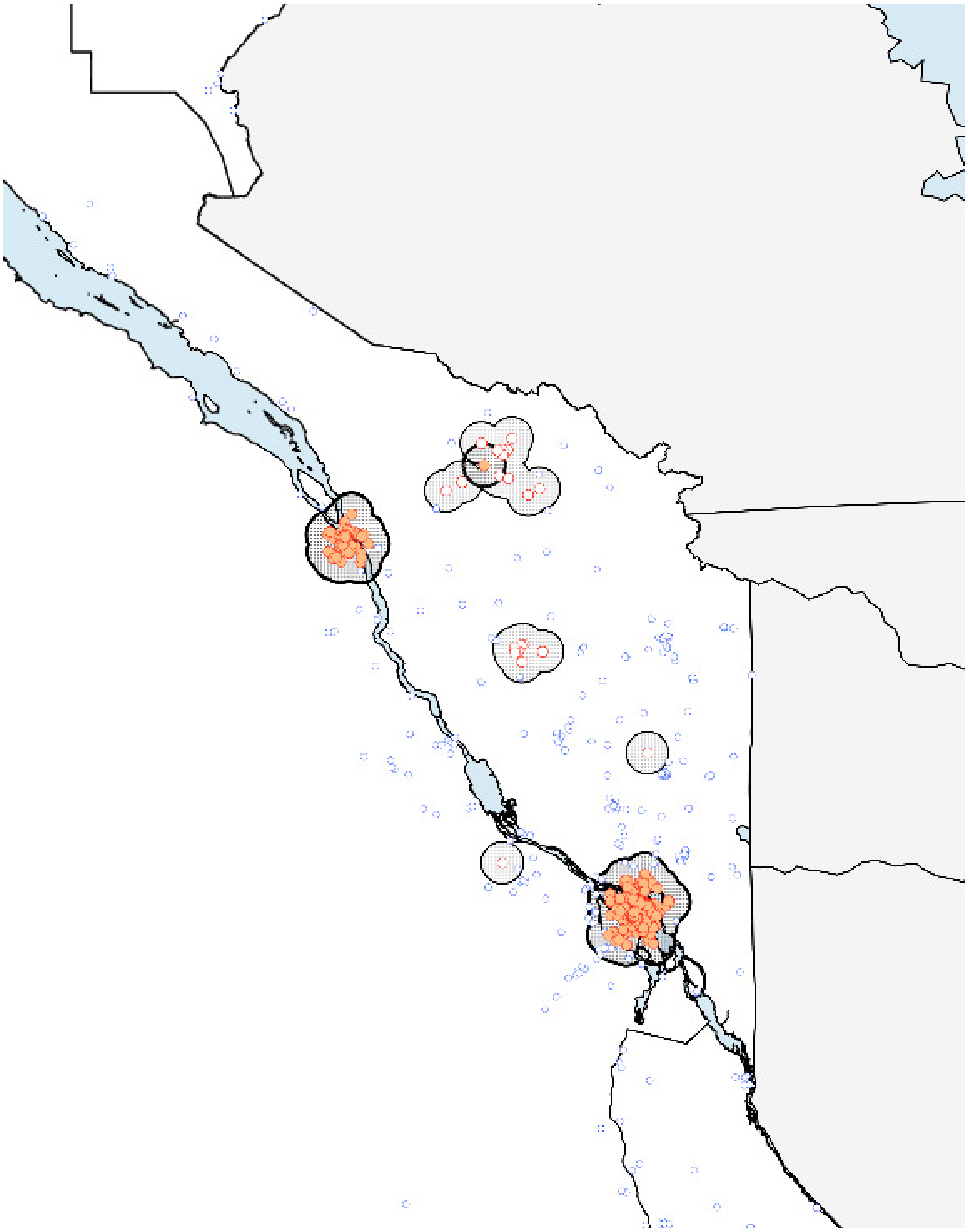


Figure 19: T&C clusters in Quebec (2009).

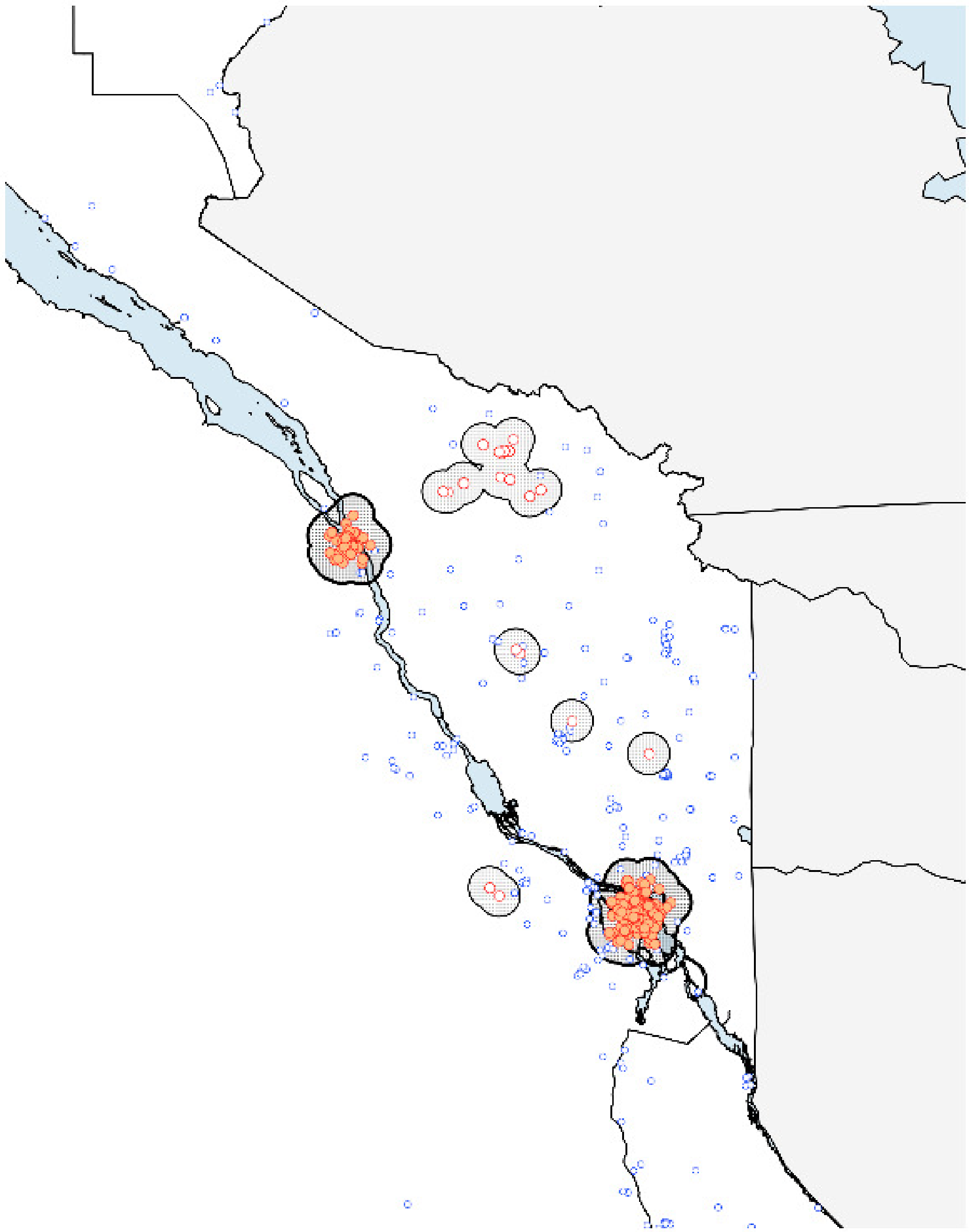


Figure 20: T&C clusters in Quebec (2011).

Figure 21: T&C clusters in Quebec (2013).

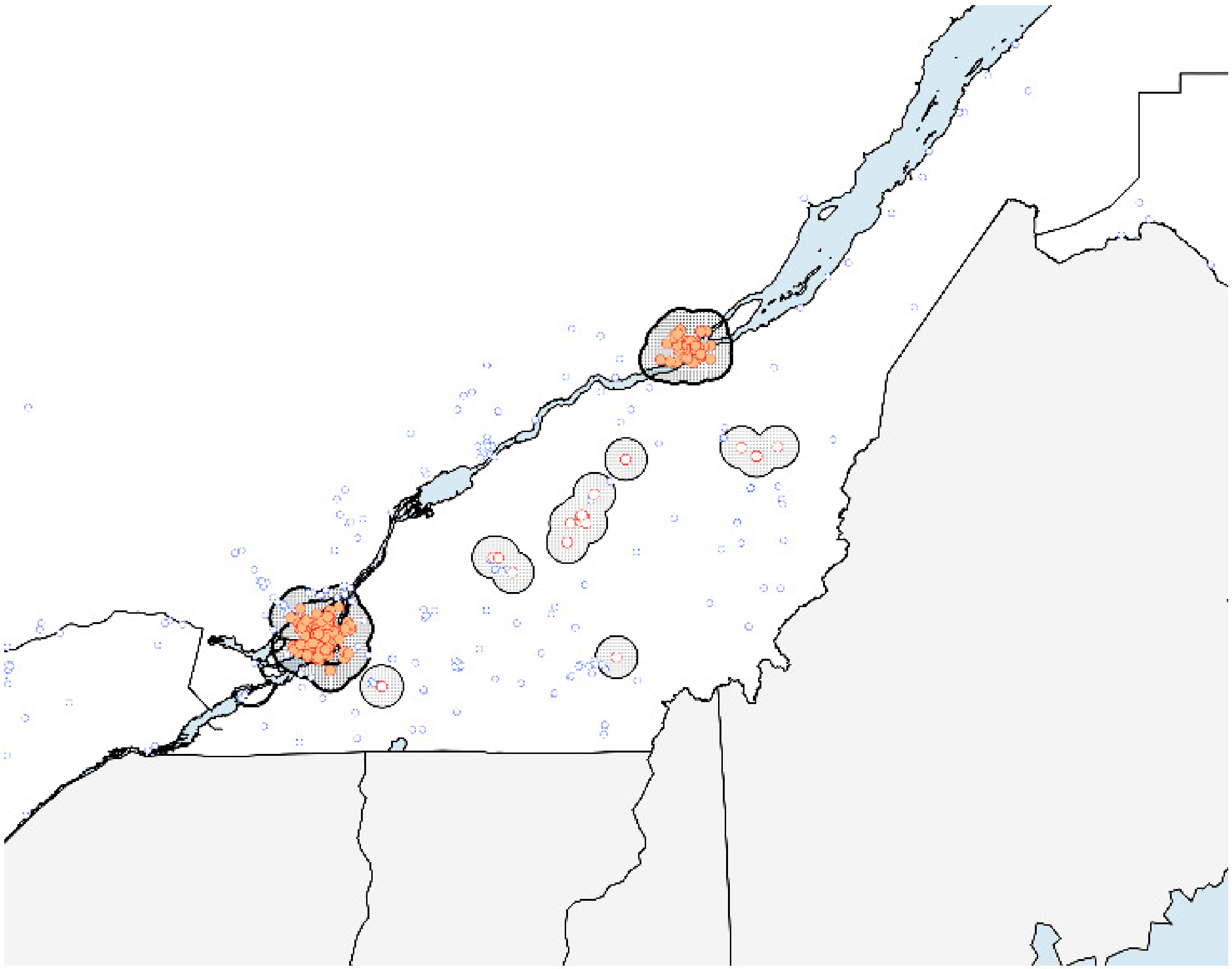


Table 25: Industry-level regressions: revenue.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Interaction term	None	T&C	T&C	Upstream	Upstream	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster
× imports from		High-income	Low-income	High-income	Low-income	High-income	Low-income	High-income	Low-income	High-income	Low-income
Exports HC	0.322^a	0.308^a	0.318^a	0.306^a	0.326^a	0.298^a	0.321^a	0.304^a	0.318^a	0.292^a	0.315^a
	(0.042)	(0.044)	(0.042)	(0.042)	(0.044)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)
Exports LC	0.000	0.005	0.003	-0.002	-0.001	0.003	0.000	0.002	-0.000	0.006	0.002
	(0.019)	(0.020)	(0.019)	(0.020)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)	(0.019)
Imports HC	0.325^a	0.276^a	0.312^a	0.079	0.320^a	0.303^a	0.313^a	0.303^a	0.314^a	0.307^a	0.306^a
	(0.040)	(0.036)	(0.039)	(0.107)	(0.041)	(0.040)	(0.040)	(0.041)	(0.040)	(0.039)	(0.040)
Imports LC	0.060^a	0.052^b	0.065^a	0.058^a	0.093	0.056^b	0.070^a	0.058^b	0.073^a	0.048^b	0.075^a
	(0.023)	(0.023)	(0.023)	(0.023)	(0.058)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Imports × T&C		0.471^b	-0.305^a							0.294	-0.247
		(0.190)	(0.116)							(0.216)	(0.155)
Imports × Upstream				0.115^b	-0.015						
				(0.045)	(0.022)						
Imports × Cluster						0.088^a	-0.060^a				
						(0.028)	(0.023)				
Imports × Cluster weighted								0.070^b	-0.066^a	-0.128^a	-0.052^a
								(0.029)	(0.018)	(0.047)	(0.018)
Imports × T&C × Cluster weighted										0.212^a	-0.013
										(0.059)	(0.075)
Observations	1,566	1,566	1,566	1,566	1,566	1,566	1,566	1,566	1,566	1,566	1,566
R-squared	0.955	0.956	0.956	0.956	0.955	0.956	0.956	0.956	0.956	0.956	0.956

Notes: This table reports the effects of competition on industry-level for the period 2001-2013revenue. All regressions include 240 industry fixed effects and year fixed effects. The dependent variable is the log of the revene at the industry-level. $ExportsHC$ is the log of exports to high-income countries. $ExportsLC$ is the log of exports to low-income countries. $ImportsHC$ is the log of imports from high-income countries. $ImportsLC$ is the log of imports from low-income countries. In columns $High - income$, $ImportsHC$ is interacted with different variables. In columns $Low - income$, $ImportsLC$ is interacted with different variables. $Textile$ equals to one if the industry is part of the T&C sector. $Upstream$ measures the distance from final demand. $Cluster$ and $Clusterweighted$ measure either count-based or employment-weighted excess agglomeration measures (at 25km distance). Huber-White robust standard errors are reported under parenthesis. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

Table 26: Industry-level regressions (T&C industries only): revenue.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Interaction MFA:		Upstream	Quota	Cluster	Cluster-quota	Cluster	Cluster-quota
Exports HC	0.798^a	0.839^a	0.794^a	0.768^a	0.765^a	0.772^a	0.771^a
	(0.160)	(0.157)	(0.160)	(0.180)	(0.181)	(0.178)	(0.179)
Exports LC	-0.022	0.016	-0.030	-0.020	-0.026	-0.023	-0.026
	(0.086)	(0.080)	(0.089)	(0.087)	(0.092)	(0.087)	(0.094)
MFA	-0.351^a	0.047	-0.323^b	-0.348^a	-0.337^b	-0.345^a	-0.341^b
	(0.125)	(0.225)	(0.144)	(0.125)	(0.132)	(0.125)	(0.133)
MFA × Upstream		-0.171^a					
		(0.059)					
MFA × Quota			-0.082				
			(0.084)				
MFA × Cluster				-0.011	-0.010		
				(0.012)	(0.012)		
MFA × Cluster × Quota					-0.025		
					(0.029)		
MFA × Cluster weighted						-0.011	-0.010
						(0.012)	(0.012)
MFA × Cluster weighted × Quota							-0.007
							(0.026)
Observations	152	152	152	152	152	152	152
R-squared	0.936	0.941	0.936	0.936	0.936	0.936	0.936

Notes: This table reports the effect of the end of MFA on the revenue of plants at the industry level. The sample is restricted to industries in the T&C sector. The dependent variable is the log of industry-level revenue. *ExportsHC* and *ExportsLC* measure the log of exports to high- and low-income countries. *Upstreamness* measures the distance to final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subject to quotas until 2005. MFA is a dummy equal to one after 2005. *Cluster* and *Clusterweighted* measure either count-based or employment-weighted excess agglomeration measures (at 25km distance). All regressions include 22 industry fixed effects and year fixed effects. Huber-White robust standard errors. Cluster measures are either count-based or employment-weighted excess agglomeration measures (at 25km distance). ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

Table 27: Plant-level regressions (T&C industries only): probability of exit. Logistic regressions.

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in imports				MFA	
Employment	-0.119^a	-0.120^a	-0.123^a	-0.137^a	-0.138^a	-0.135^a
	(-6.577)	(-6.621)	(-6.766)	(-8.398)	(-8.414)	(-8.218)
Exporter	-0.266^a	-0.265^a	-0.271^a	-0.267^a	-0.268^a	-0.268^a
	(-5.406)	(-5.400)	(-5.510)	(-6.018)	(-6.044)	(-6.048)
Multi-unit	0.390^a	0.391^a	0.443^a	0.382^a	0.378^a	0.396^a
	(3.457)	(3.462)	(3.905)	(3.750)	(3.708)	(3.874)
Cluster	0.253^a	0.205^a	0.199^a	0.207^a	0.251^a	0.193^a
	(4.976)	(3.704)	(3.847)	(4.534)	(4.879)	(4.178)
Δ Imports HC	0.000	-0.001	-0.001			
	(0.033)	(-0.135)	(-0.067)			
Δ Imports LC	-0.024	-0.170^c	0.284^c			
	(-0.387)	(-1.784)	(1.715)			
Δ Imports LC × Cluster		0.249^b				
		(2.131)				
Δ Imports LC × Upstream			-0.135^b			
			(-2.016)			
Upstreamness			-0.132^a			-0.069^b
			(-4.377)			(-2.121)
Quota				0.315^a	0.309^a	0.242^a
				(3.832)	(3.753)	(2.720)
MFA × Quota				-0.009	0.103	-0.036
				(-0.093)	(0.922)	(-0.232)
MFA × Quota × Cluster					-0.175^c	
					(-1.864)	
MFA × Quota × Upstream						0.020
						(0.233)
Fixed-effects			Province-year			
Observations	14,527	14,527	14,527	16,951	16,951	16,951

Notes: The table reports the effect of plant-level and sector-level variables on the exit probability of T&C plants in Canada over the period 2003-2013 (year 2001 is excluded for reasons developed in the text). **Coefficients are estimated from a logit model with fixed effects**. All regressions include province-year fixed effects. The dependent variable is a dummy equal to one if the plant exit between years t and $t-2$. Exporter is a dummy equal to one if the plant was an exporter in $t-2$. Multi-unit is a dummy equal to one if the plant was part of a multi-plant firm in $t-2$. Cluster is a dummy equal to one if the plant belonged to a cluster in $t-2$. *Employment* is the log of employment in $t-2$. Δ Imports HC measures changes in imports from high-income countries between $t-2$ and $t-4$. Δ Imports LC measures changes in imports from low-income countries between $t-2$ and $t-4$. Upstreamness measures the distance to final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subject to quotas until 2005. MFA is a dummy equal to one after 2005. ^{a} = significant at 1%, ^{b} = significant at 5%, ^{c} = significant at 10%.

Table 28: Plant-level regressions (T&C industries only): industry switching. Logistic regressions.

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in imports				MFA	
Employment	-0.000	-0.001	0.015	0.038	0.038	0.017
	(-0.006)	(-0.027)	(0.326)	(0.915)	(0.915)	(0.398)
Exporter	-0.152	-0.158	-0.139	-0.087	-0.087	-0.091
	(-1.262)	(-1.314)	(-1.123)	(-0.773)	(-0.774)	(-0.800)
Multi-unit	-0.103	-0.112	-0.283	-0.136	-0.137	-0.240
	(-0.351)	(-0.378)	(-0.952)	(-0.499)	(-0.500)	(-0.870)
Cluster	-0.846[a]	-0.900[a]	-0.642[a]	-0.766[a]	-0.763[a]	-0.624[a]
	(-6.423)	(-6.599)	(-4.756)	(-6.281)	(-5.956)	(-5.040)
Δ Imports HC	-1.185[a]	-1.229[a]	-1.059[a]			
	(-9.142)	(-9.378)	(-7.348)			
Δ Imports LC	0.530[a]	0.387[a]	-1.123[b]			
	(4.598)	(2.595)	(-2.264)			
Δ Imports LC × Cluster		0.005				
		(0.473)				
Δ Imports LC × Upstream			0.318			
			(1.555)			
Upstreamness			0.616[a]			0.651[a]
			(8.323)			(8.050)
Quota				-2.357[a]	-2.357[a]	-1.620[a]
				(-5.615)	(-5.616)	(-3.769)
MFA × Quota				1.338[a]	1.352[a]	1.055[c]
				(2.927)	(2.809)	(1.761)
MFA × Quota × Cluster					-0.033	
					(-0.090)	
MFA × Quota × Upstream						0.125
						(0.598)
Fixed-effects	Province-year					
Observations	11,147	11,147	11,147	12,923	12,923	12,923

Notes: The table reports the effect of plant-level and sector-level variables on the probability of T&C plants in Canada to switch industry over the period 2003-2013 (year 2001 is excluded for reasons developed in the text). **Coefficients are estimated from a logit model with fixed effects.** All regressions include province-year fixed effects. The dependent variable is a dummy equal to one if the plant switch industry between years t and $t-2$. Exporter is a dummy equal to one if the plant was an exporter in $t-2$. Multi-unit is a dummy equal to one if the plant was part of a multi-plant firm in $t-2$. Cluster is a dummy equal to one if the plant belonged to a cluster in $t-2$. *Employment* is the log of employment in $t-2$. Δ Imports HC measures changes in imports from high-income countries between $t-2$ and $t-4$. Δ Imports LC measures changes in imports from low-income countries between $t-2$ and $t-4$. Upstreamness measures the distance to final demand (the shortest distance being one). *Quota* is a dummy equal to one if the main sector of the plant in $t-2$ was subject to quotas until 2005. MFA is a dummy equal to one after 2005. [a] = significant at 1%, [b] = significant at 5%, [c] = significant at 10%.

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