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**DO VERY LARGE PRODUCERS CONTRIBUTE TO THE CANADA-
U.S. PRODUCTIVITY GAP? EVIDENCE FROM MANUFACTURING**

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Abstract

The existence of a significant difference in the underlying productivity performance of very large producers versus other producers could have wide-reaching implications for the effectiveness of policies designed to improve Canada's productivity performance. This paper examines the productivity performance of plants with 1000 employees or more and determines what contribution this size advantage affords to Canada's relatively weak labour productivity performance in the manufacturing sector. Using Annual Surveys of Manufacturers, the study shows that very large plants in Canada are on average as productive as very large plants in the United States (U.S.) and do not contribute to the Canada-U.S. manufacturing labour productivity gap.

Key words: productivity; Canada-U.S. productivity gap; large producers

Résumé

L'existence d'un écart considérable entre la productivité tendancielle des très gros producteurs et celle des producteurs de moindre envergure pourrait avoir d'importantes répercussions au chapitre de l'efficacité des politiques conçues pour améliorer la productivité canadienne. L'étude a pour but d'examiner la productivité des entreprises de 1 000 employés ou plus et de déterminer dans quelle mesure les entreprises de cette taille jouent un rôle dans la faiblesse relative de la productivité du travail dans le secteur de la fabrication au Canada. D'après les données de l'Enquête annuelle des manufactures, les entreprises canadiennes de très grande taille sont en moyenne aussi productives que les entreprises américaines de même envergure, et elles ne contribuent pas à l'écart de productivité du travail entre le Canada et les États-Unis dans le secteur de la fabrication.

Mots clés : productivité, écart de productivité entre le Canada et les États-Unis, gros producteurs

1. Introduction

The productivity performance of Canada's business sector has been a subject of continuing interest for Canadian policymakers. The increasing level of concern surrounding the subject is hardly a surprise given the direct impacts of productivity on national living standards and the poor growth of the country in this area over the last decade. For many, it is the reported divergence in productivity performance between Canada and its chief competitor and foreign market, the U.S., that is the central concern behind this trend. Numerous prior works have identified the growing gap in productivity between Canada and the U.S. using aggregate or industry-level data such as Sharpe (2005), Baldwin and Gu (2007), and Rao et al. (2008) or using firm-level data such as Keay (1997) and Lee and Tang (2001).

Size distribution differences are often cited as one of the factors influencing the continuing divergence of the productivity growth paths of the two countries and resulting in a larger Canada-U.S. labour productivity gap. A key element of the difference in the size distribution of producers in Canada and the U.S. is the degree to which the largest U.S. producers are in fact larger and more productive than their Canadian counterparts. As there have been few studies that have focused on "very large" producers in the two nations, this paper examines the specific role played by plants with 1000 employees or more in the Canadian manufacturing labour productivity level relative to the U.S. level.

The empirical evidence of a relationship between productivity levels and the size of producers in the U.S. and Canada has a robust body of literature (Baldwin, Jarmin, and Tang 2004; Rao and Tang 2002; and Leung, Meh and Terajima 2008). However, in a sizeable

majority of these studies the definition of a large producer is fairly modest¹. There have been few studies focused on the performance of manufacturing plants with 1000 employees or greater².

This size distinction has become increasingly important as globalization encourages the development of larger multinational enterprises and accentuates the need to achieve greater economies of scale in the face of ever-expanding competitive pressures from beyond domestic borders. Political economy tells us that these very large producers form an informational lobby that holds a disproportionate amount of influence over the development of industrial policy. Large producers can be expected to have a greater stake in the gains or losses of changes from public policy and are also more likely to have access to policy-making institutions and the human and financial resources required to influence policy development. Given that they possess both the incentives and the resources to effect change, it should be unsurprising that the largest producers will be the most likely to influence the direction of public policy, to leverage their position for government aid and support, and to marshal the greatest share of media attention.

Bombardini (2008), using U.S. data, suggests that sectors with larger producers are more apt to receive protection through government policies and are the most likely to engage in political lobbying. Indeed, the acceleration of the financial crisis in late 2008 highlighted the influence that the largest producers have in the development of policy and their ability to attract more media attention as expressions such as “too big to fail” became an understandably popular

¹ Large-sized firms are typically defined as those with more than 500 employees. Some have defined the cut-off for a large-sized firm to be as few as 100 employees.

² It must be admitted that the use of 1000 employees as a cut-off mark is as subjective as the use of 500 or 100 employees in past research. Industry-specific size definitions to account for dissimilar size distributions within each industry may be worth considering for future research.

part of journalistic vernacular and political discourse. It is only the competing interests of upstream and downstream large producers, according to Bombardini, that the distortionary impact of their influence on the existing productivity pressures is reduced³. The equilibrium that results from these opposing interests, however, may not necessarily be balanced.

While theory might suggest that we should expect the largest producers to attract more attention during the development of policy, it cannot easily judge if these producers merit greater levels of attention and support with respect to their impact on the country's productivity levels. It could certainly be that the area most in need of development and attention is in government productivity policies directed towards large producers and, if so, then their influence could be justified by the size-related productivity gains that would advance domestic prosperity. By contrast, if policymakers would be better served by focusing on the productivity issues of smaller producers, especially if they should differ from those issues affecting large producers, then it could be that this influence reduces the effectiveness of the policies and programs developed by government agencies to encourage productivity growth overall.

It is the objective of this paper to estimate the contribution of these large producers to the Canada-U.S. manufacturing productivity gap and to examine the difference in the productivity performance of the largest producers versus the smaller producers within Canada and the U.S. We aim to answer the question: "Do very large producers contribute to the Canada-U.S. productivity gap?" It is our belief that understanding the size factors underlying the productivity underperformance of the Canadian manufacturing sector relative to the U.S. will have

³ Large firms are not a homogeneous group and have competing incentives. This is especially evident in topics such as tariff policy. Firms (irrespective of size) will favour lower tariffs for the goods and services that supply their production, while higher tariffs would be favourable as barriers to foreign competition of their end products. It would seem obvious that many large retailers and large manufacturers should have conflicting views towards the import-side of government trade policy, which can result in the influence of one side cancelling out the other.

implications for the effectiveness of policies designed to improve Canada's weak productivity growth with the intention of narrowing the Canada-U.S. productivity gap.

It has been a fairly popular contention over the last several years to explain away a portion of the productivity gap between Canada and the U.S. as a result of the difference between these largest producers. The average number of employees in large U.S. producers is greater than the average number of employees in Canadian large producers and conventional wisdom suggests that this would provide the U.S. a productive edge over its northern neighbour. What truth there is behind this contention, however, has been little examined. Given the natural influence of these producers, we find this a troubling break in the literature that should be of some concern to policymakers, especially as globalization encourages the further emergence of large multinational corporations and amplifies productivity performance pressures in all markets.

In section 2 of this paper, we review the trend development in the Canada-U.S. productivity gap and note a number of the possible factors that might explain its development. In section 3, we investigate the structure of the manufacturing sector in Canada and the U.S. and the inherent differences in their respective industry composition to establish the role of large plants in the manufacturing labour productivity gap between the two countries. We achieve this by first developing a decomposition technique that captures the contribution from large producers and also controls for the difference in industrial structure between the two countries. We then use data from the Canadian Annual Survey of Manufactures from Statistics Canada and the U.S. Annual Survey of Manufactures from the Census Bureau to establish what contribution towards the Canada-U.S. manufacturing labour productivity gap, if any, is attributable to plants employing 1000 workers or more. In the final section of this paper, we draw some conclusions based on our results and briefly discuss their implications going forward.

2. The Canada-U.S. Productivity Gap

It has been well established that Canada lags the U.S. in terms of labour productivity. Furthermore, the gap has not narrowed, but has instead widened over the past decade. The difference between American and Canadian labour productivity levels in the business sector has increased from 13 percent in 1984 to 25 percent in 2007 (see Chart 1). The decline in relative Canadian labour productivity is even more pronounced within the manufacturing sector: a small gap of 3 percent in 1984 expanded to 26 percent by 2007. Recent data have shown that this trend has only continued.

The explanations that have been offered for Canada's relatively weak productivity performance are numerous and often multi-faceted. Conway and Nicoletti (2007) suggest that the lack of convergence in productivity among many OECD nations could be explained by the failure of many countries, including Canada, to promptly implement regulatory reform in order to exploit the effects of the information and communication technologies (ICT) revolution introduced into the economy, referred to as the "ICT shock" of the 1990s. Brox (2008) observes that the expanding manufacturing productivity gap largely coincides with a divergence in public infrastructure investment since 1994 as infrastructure spending increased by 24 percent in the U.S. and underwent a 3 percent contraction in Canada.

The difference in industry composition in each country has also been suggested as an explanation for the divergence of Canadian and U.S. productivity. Nadeau and Rao (2002) calculated that Canadian manufacturing productivity growth between 1980 and 1996 would have been 0.3 percentage points higher if the mix of industries had more resembled the U.S. manufacturing sector. However, this composition effect appears to have only a small impact.

Tang and Wang (2004) estimated that the relative slowdown of overall Canadian productivity growth is accounted for primarily by weak productivity growth at the industry-level, even maintaining the current composition of each country's manufacturing sector.

Perhaps the most widely held view is that insufficient innovation investment in the Canadian business sector has resulted in levels well-below optimum (Boothe and Roy 2008). Firm size has been shown to be a key determinant in the innovation level of producers. The innovation gap between U.S. and Canadian producers is often tied to the size difference observed between firms and manufacturing plants in each country. This is especially true when firm size is combined with other contributing factors such as less effective industrial clusters, insufficient urbanization of economic activity, weak competition intensity (especially within service-providing industries), and low levels of university educational attainment. For example, Baldwin and Sabourin (1999) cite the evidence from surveys across Canadian manufacturing industries demonstrating that ICT take-up increases as firm size increases and Pilat (2004), in noting the predominance of this viewpoint in the literature, suggests this is because large producers can draw from a wider pool of skills that might be better able to use ICT across a broader range than is the case for most smaller producers. However, this view is not without dissent and the empirical evidence remains mixed. A study of aggregate manufacturing across 12 OECD nations by Griffith, Redding and Van Reenen (2004) found that the role of innovation in Canada's productivity growth was relatively weak, perhaps concurring with the finding by Mohnen and Therrien (2003) that innovative Canadian firms do not derive a high proportion of their sales from the product of their innovative activities.

While the underlying sources of the relationship between labour productivity and producer size are still a source of some debate, an extensive body of empirical evidence has

made its existence fairly uncontroversial. Evidence of a relationship between labour productivity and producer size has been especially apparent when investigating the sources of productivity from industry-level aggregates. Even so, there has been little to suggest convincingly that the relationship between producer size and productivity is one of the driving forces behind the Canada-U.S. labour productivity gap and even less scholarship examining the role of the leading producers of each industry.

3. Decomposition of the Canada-U.S. Manufacturing Labour Productivity Gap

There are noticeable differences in the structure and composition of the Canadian and U.S. manufacturing sectors despite—or perhaps as a result of—the close economic linkages between the two nations. In Canada, for instance, we see industries related to the manufacturing of resource-related products hold a higher relative share than is observed in the U.S., whereas the U.S. has a much stronger focus on ICT manufacturing compared to Canada. Not surprisingly, firm size also differs across industries in each country. In this section, we investigate the role these differences play in the Canada-U.S. gap in manufacturing labour productivity levels by developing a framework that decomposes the Canada-U.S. manufacturing labour productivity gap into industry and plant-size components and by employing data extracted from the Annual Survey of Manufactures (ASM) of both Canada and the U.S.

3.1. Decomposition Technique

In this sub-section, we develop a technique to decompose the Canada-U.S. manufacturing labour productivity gap. We begin by first outlining the definition of labour productivity for our analysis. Labour productivity in country k in a given year is defined as the nominal value added per hour worked in that year, expressed as

$$(1) \quad P^k = \frac{V^k}{H^k} \cdot \frac{1}{PPP^k},$$

where V^k and H^k are, respectively, the nominal total manufacturing value added and the total hours worked in country k and PPP^k represents the manufacturing value added purchasing power parity for country k . For Canada, purchasing power parity will be expressed as \$CAN/\$US, while for the U.S., the equation is \$US/\$US, which equals to unity.

Under this definition of labour productivity, the overall manufacturing productivity gap between Canada and the U.S. is then defined as:

$$(2) \quad \Delta = \frac{P^U - P^C}{P^U} \times 100,$$

where Δ denotes the productivity gap between the Canadian and U.S. manufacturing sector in terms of percentage points.

The ASM provides the basic data for our decomposition analysis. All records from the ASM measure “value added”, or what is often referred to as “census value added”, and is inclusive of payments for services. It should be noted that census value added does not include the output from those who are self-employed.

Before we estimate the contribution of the difference in industrial structure to the Canada-U.S. manufacturing labour productivity gap, it is necessary that we adjust the census value added data to the National Accounts’ GDP concept, as the National Accounts’ GDP concept is used to estimate the Canada-U.S. manufacturing labour productivity gap.

In addition, census employment has to be corrected to the official data on employment and hours worked, as the official data is used to estimate the Canada-U.S. productivity gap. The number of employees from the Census of Manufactures is not exactly equal to the number of employees used by the statistical agencies to produce the official productivity statistics. In Canada, the estimate of total employment comes from the Labour Force Survey (LFS) and tends to skew higher than the employee estimates that are obtained from the Census of Manufactures. As was the case above, the census employment data also does not include those that are classified as being self-employed.

Making the appropriate adjustments to these problems, the official manufacturing productivity level can be linked to the census data in country k as follows:

$$\begin{aligned}
 P^k &= \frac{V^k}{H^k} \cdot \frac{1}{PPP^k} \\
 (3) \quad &= \frac{1}{PPP^k} \cdot \frac{V^k}{Y^k} \cdot \frac{L^k}{H^k} \cdot \frac{E^k}{L^k} \cdot \frac{Y^k}{E^k} \\
 &= \lambda^k \cdot \frac{Y^k}{E^k},
 \end{aligned}$$

where Y^k , L^k , and E^k are the total manufacturing nominal census value added, the official manufacturing employment, and the Census of Manufactures employment in country k , respectively. The adjustment factor (λ^k) converts from the census-based total manufacturing labour productivity (per worker) in current national dollars and into the official total manufacturing labour productivity (per hours worked) in real U.S. dollars. It is equal to the following:

$$(4) \quad \lambda^k = \frac{1}{PPP^k} \cdot \frac{V^k}{Y^k} \cdot \frac{L^k}{H^k} \cdot \frac{E^k}{L^k}.$$

The adjustment factor consists of four separate components. The first adjustment, $\frac{1}{PPP^k}$, converts all productivity measures into the U.S. currency. $\frac{V^k}{Y^k}$ is the ratio of the nominal value added to the nominal census value added and it adjusts for the differences

between census value added and actual value added. $\frac{L^k}{H^k}$ is the inverse of $\frac{H^k}{L^k}$, which represents the work intensity, defined as hours per worker, and adjusts for the differences in work intensity between the two countries. Finally, $\frac{E^k}{L^k}$ is the adjustment required to account for the differences between the employment used in productivity estimates and the data values reported in the Census of Manufactures.

With these adjustments in place, we can then decompose total manufacturing labour productivity into its various components based on the different industry and producer size classes for country k as follows:

$$\begin{aligned}
 P^k &= \lambda^k \cdot \frac{Y^k}{E^k} \\
 (5) \quad &= \lambda^k \cdot \sum v_i^k q_i^k \\
 &= \lambda^k \sum_i v_i^k (w_{i,S}^k q_{i,S}^k + w_{i,L}^k q_{i,L}^k) \\
 &= \sum v_i^k (w_{i,S}^k \tilde{q}_{i,S}^k + w_{i,L}^k \tilde{q}_{i,L}^k)
 \end{aligned}$$

where v_i^k is the census employment share of industry i in the total manufacturing sector and q_i^k is the census value added per worker for industry i ; $w_{i,S}^k$ and $w_{i,L}^k$ are the respective census employment shares of small plants (less than 1000 employees) and large plants (with 1000 employees or more) within industry i of country k ; $q_{i,S}^k$ and $q_{i,L}^k$ are the census value added per worker for small and large plants in industry i and located in country k ; and $\tilde{q}_{i,S}^k$ and $\tilde{q}_{i,L}^k$ (equal to $\lambda^k q_{i,S}^k$ and $\lambda^k q_{i,L}^k$, respectively) are the adjusted census value added per worker of small and

large plants in industry i and located in country k . The adjusted labour productivity levels for the groups of producers in different size classes for both Canada and the U.S. have been expressed in terms of U.S. dollars (requiring the application of purchasing power parity deflators to the output of Canadian plants) so that they may be compared across countries.

We should note that there are several issues that we have deliberately chosen to ignore for the purpose of this paper, but which could have an impact on the level of the labour productivity gap that is used as the foundation of this section. For this paper, we have accepted the official estimates of value added and hours worked that are used in the productivity programs of the two countries. We must note, however, that the statistical agencies of Canada and the United States develop estimates of hours worked from different types of surveys and these methodological differences could impact the estimates of the number of hours worked and, by extension, the estimates of output per unit of labour. In the U.S., employment is estimated using an employer survey, while this estimate is undertaken using a household survey in Canada. Maynard (2007) suggests that a portion of Canada's productivity gap could be accounted for by the differences in methodology in the two countries. Second, the same adjustment factor has been applied to all producers within a specific category, regardless of the size differences within that category. Among other things, this method assumes the same ratio of hours worked to employment in different size classes, which may or may not be accurate, especially if there are more part-time employees in smaller producers relative to larger producers within a size category.

With these caveats noted, we can now proceed to decompose the Canada-U.S. manufacturing productivity gap into industry and plant-size dimensions.

We first define $\tilde{p}_i^k = \tilde{q}_i^k / P^U$ for the group of producers with size i in country k , which scales down the labour productivity level for all size groups in both countries by the U.S. manufacturing labour productivity level. When we combine equations (2) and (5), we derive the following expression for the Canada-U.S. manufacturing labour productivity gap:

$$\begin{aligned}
 \Delta &= \sum_i [\bar{\theta}_i (v_i^U - v_i^C)] \\
 (6) \quad &+ \sum_i [\bar{\phi}_i (w_{i,L}^U - w_{i,L}^C)] \\
 &+ \sum_i [\bar{\varphi}_{i,S} (\tilde{p}_{i,S}^U - \tilde{p}_{i,S}^C) + \bar{\varphi}_{i,L} (\tilde{p}_{i,L}^U - p_{i,L}^C)]
 \end{aligned}$$

where

$$\bar{\theta}_i = \frac{1}{2} (w_{i,S}^U \tilde{p}_{i,S}^C + w_{i,L}^U \tilde{p}_{i,L}^C + w_{i,S}^C \tilde{p}_{i,S}^U + w_{i,L}^C \tilde{p}_{i,L}^U),$$

$$\bar{\phi}_i = \frac{1}{2} [v_i^U (\tilde{p}_{i,L}^U - \tilde{p}_{i,S}^U) + v_i^C (\tilde{p}_{i,L}^C - \tilde{p}_{i,S}^C)],$$

$$\bar{\varphi}_{i,S} = \frac{1}{2} (v_i^U w_{i,S}^U + v_i^C w_{i,S}^C), \text{ and}$$

$$\bar{\varphi}_{i,L} = \frac{1}{2} (v_i^U w_{i,L}^U + v_i^C w_{i,L}^C).$$

such that $\bar{\theta}_i$ is the average labour productivity of industry i in the two countries and $\bar{\phi}_i$ is the average labour productivity difference between large and small plants for industry i in the two countries. Similarly, $\bar{\varphi}_{i,S}$ and $\bar{\varphi}_{i,L}$ are the average employment shares of small and large plants in the two countries.

Equation (6) divides the manufacturing productivity gap between Canada and the U.S. into three key components. The first component is associated with the differences in the industrial structure of the manufacturing sectors of Canada and the U.S. This term is labelled as the industrial structure effect. If the U.S. manufacturing sector is more concentrated in industries with higher productivity than in Canadian manufacturing, then this first term will be positive.

The second term, called the plant-size effect, is the contribution of the difference in plant size in the two countries. If large plants are more productive than small plants, and if the U.S. has a greater share of employment in large plants than Canada, this term will be positive.

The third component, referred to as the productivity effect, captures the effect of the productivity differences between Canada and the U.S. for small and large plants, respectively. If small or large plants in the U.S. are more productive than those in Canada, then these terms will be positive.

These large Canadian plants can be expected to directly contribute to the overall manufacturing labour productivity gap between Canada and the U.S. via the productivity effect should they underperform relative to their U.S. counterparts. An indirect influence on the productivity gap is exerted by large plants through the plant size effect. The distribution of employment in the industry among small and large plants will attenuate or amplify the productivity effect's positive or negative contribution to the productivity gap.

3.2. Decomposition Results

Making use of the microdata records collected by the Census of Manufactures programs in the two countries,⁴ we are able to identify the underlying sources of the Canada-U.S. manufacturing labour productivity gap using the framework we developed in section 3.1. In particular, we can ask whether the existence of the labour productivity gap in 2002 is due to the differing industrial structure in each country or is, in fact, the result of poor relative productivity performance of small and large plants in Canada⁵. The data sources employed in the decomposition analysis are outlined in Appendix A.

We separate the total manufacturing sector into eight major industrial sub-groups: food, chemical, primary metal, machinery, computer and electronic, transportation equipment, furniture, and other manufacturing. The assignment of plants into these particular divisions was necessary to obtain our data by plant size without compromising firm confidentiality, which is vigorously guarded by Statistics Canada. As noted previously, we define large plants in this paper as being those with 1000 employees or more, unlike the existing literature that commonly defines large plants as those with more than 500 employees (e.g., Baldwin, Jarmin, and Tang 2004).

Table 1 reports the industry employment and productivity profile of the manufacturing sector in Canada and the U.S. in 2002. The two countries have somewhat similar industrial structures, but even at the aggregate some noteworthy differences are quite evident. Perhaps the most glaring disparity can be found in the computer and electronic employment share of each

⁴ The programs in the two countries are quite similar in collecting data on outputs and inputs. The survey is done annually in Canada and every five years in the U.S.

⁵ We selected the year 2002 since it is the latest year we have comparable data for the U.S.

country. The U.S. industry has a share of manufacturing employment that is nearly twice the level of the Canadian industry.

The transportation equipment manufacturing industries, comprised of industries such as aerospace products and motor vehicle manufacturing, had the greatest share of manufacturing employment within large plants in both countries, with a share of 38 percent in Canada and 49 percent in the U.S. The industrial group ranked immediately below transportation equipment perhaps best exemplifies the differing industrial mix of the two countries. While primary metal manufacturing industries had the second highest proportion of employment in large plants in Canada (37 percent), it was the computer and electronic manufacturing industry that followed transportation equipment in the U.S. (35 percent). In both countries, other manufacturing reported the smallest concentration of employment in large plants.

Canada had a smaller share of its manufacturing employment in large plants than was the case in most of the comparable U.S. industries. The sole exception to this trend was primary metal manufacturing. Within the primary metal manufacturing industry, the employment share of large plants was 37 percent in Canada and only 22 percent in the U.S. Across the manufacturing sector as a whole, however, the employment share of large plants was 11 percent in Canada and 18 percent in the U.S. That Canada has fewer large plants than the U.S. was expected and has been well established in the literature (e.g. Baldwin, Jarmin, and Tang 2004).

Also in Table 1, we report the labour productivity levels of small and large plants for both Canada and the U.S. These numbers are adjusted according to equation (4) and are normalized against the productivity level of the total U.S. manufacturing sector. Some interesting observations emerged.

First, small plants are less productive than large plants on average, a result we would expect. While this holds for most industries, there are two glaring exceptions: small plants in primary metal manufacturing industries are more productive than large plants in Canada and the same is also true of food manufacturing industries in both Canada and the U.S.

In the case of food manufacturing, this means the high level of concentration in small plants in Canada (93.0 percent) relative to the situation in the U.S. (79.6 percent) reduces the extent to which plants in the industry would have contributed to the manufacturing labour productivity gap. While the contribution is slightly mitigated by the plant-size composition in the industry, the overall poor performance of Canadian food manufacturing plants compared to their U.S. counterparts and to the U.S. manufacturing sector as a whole does contribute to the Canada-U.S. labour productivity gap.

Primary metal manufacturing industries pose an even more interesting problem. Not only are small Canadian plants more productive than large Canadian plants, but the Canadian industry has a concentration in these less productive large plants that is only surpassed in the manufacturing sector by transportation equipment manufacturing. Moreover, large Canadian plants are less productive vis-à-vis their U.S. counterparts. Since the industry in Canada overall is more productive than in the U.S. and also represents a greater share of manufacturing employment in Canada than in the U.S., it may be worthwhile for policymakers to examine what environmental conditions are at play that might lead to this peculiar performance and this particular allocation of labour.

Second, Canadian small plants are 17 percent less productive on average than their U.S. counterparts with respect to the total manufacturing sector without adjusting for differences in industry structure. The largest disadvantage arises in the food and chemical industries, while

small plants in the primary metals industry are (as one would expect given the above results) more productive in Canada than the U.S.

Thirdly, Canadian large plants appear to be more productive than their U.S. counterparts when observed in the context of the entire manufacturing sector. This productivity edge among large plants in Canada is primarily driven by the productivity performance of plants in the transportation equipment industry. The strong productivity performance of the industry is partially offset by the low level of concentration of Canadian manufacturing employment in large plants within the industry, relative to the allocation of labour in the U.S. In other industries, however, large plants in Canada are equally as productive as U.S. large plants or less productive.

Lastly, the results here are consistent with those in Rao et al. (2008). Although we employ a different method, we confirm their findings that Canada is more productive in primary metal and transportation equipment manufacturing industries and lags behind the U.S. in food, chemicals, and computer and electronic manufacturing industries.

Using equation (6), we decompose the Canada-U.S. manufacturing gap into components associated with industry structure, plant size structure, the differences in the productivity of small plants in each country, and the difference in the productivity of large plants in each country. The results of this decomposition are reported in Table 2. Of these four factors, our results demonstrate that while the first three factors contributed towards the Canada-U.S. manufacturing labour productivity gap in 2002, the difference in the productivity performance of large plants played no role. The largest contribution to the productivity gap stemmed from the productivity performance of Canadian small plants, as their underperformance was responsible for more than 70 percent of Canada's shortfall relative to the U.S. The contribution from the

industry structure effect and the plant-size effect were relatively small and accounted for 13 and 20 percent of the gap, respectively.

The decomposition analysis suggests that the difference in the labour productivity performance of Canadian large plants relative to the U.S. did not contribute to the gap at all, and in fact slightly offset some of the losses elsewhere, when observed at the aggregate.

4. CONCLUSIONS

Based on these results of our decomposition of the manufacturing sectors in Canada and the U.S. using industry-level data, we are able to draw some general conclusions and highlight areas that merit further research to improve the future development of policies impacting the manufacturing sector.

First and foremost is the answer to the question posed in our title: do very large producers contribute to the Canada-U.S. productivity gap? The results of our research suggest that, in the case of the manufacturing sector, the answer is that they do not. More precisely, very large plants in Canada did not, in aggregate, directly contribute to the manufacturing labour productivity in 2002.⁶ When viewed from the vantage point of the overall manufacturing sector, the productivity performance of very large Canadian plants in aggregate appears to be more or less analogous to productivity levels at very large U.S. plants. In fact, we estimated that the

⁶ Note, however, that after controlling for the difference in capital and intermediate input intensities very large Canadian firms were less productive than their U.S. counterparts, based on our regression analysis using Standard & Poor's *Compustat* database at the firm level for both Canada and the U.S. (Almon and Tang, 2010). This is because there are more X-inefficiencies at play in the largest firms in Canada than in the U.S. These inefficiencies diminish the benefits of the economies of scale and the gains in the largest firms come from the higher input intensity of these Canadian firms. For more discussion on X-inefficiencies, please see Williamson (1967), Sutherland (1980), and Diaz and Sanchez (2008).

leading cause of the manufacturing labour productivity gap in 2002 was the poor productivity by plants in Canada with fewer than 1000 employees.

Intuitively, this result makes sense. There is evidence that Canadian multinationals are as productive as foreign multinationals (Baldwin and Gu 2005). In a study of the U.S. manufacturing sector, Doms and Jensen (1998) found that while foreign-owned plants are more productive and capital-intensive than domestic plants, controlling for a number of plant-level characteristics, such as size, does in fact reduce (though not eliminate) the productive edge held by foreign-controlled establishments. It would make sense for the largest plants to belong to firms with an outward orientation, either engaged in exports abroad or themselves the product of foreign direct investment, and that global competitive pressure would drive multi-national enterprises towards convergence in plant productivity levels. The size of most retail markets in Canada will generally be too small to encourage the development of sufficient economies of scale in firms engaged in domestic-only strategies.

At the level of individual industries, however, questions still remain. While large plants in Canada outperform U.S. manufacturing productivity at the aggregate level, the average performance within the same industry often falls short of the productivity performance of very large plants in the U.S.. Moreover, the results observed among primary metal manufacturing plants, where labour productivity by the largest plants in Canada (but not the U.S.) is surpassed by the labour productivity performance of smaller plants, raises new questions. Why is employment within the industry concentrated relatively in less productive very large plants? Are smaller plants in primary metal manufacturing more productive because they are more capital intensive? Are there policies or regulations that are leading firms to be labour-intensive rather

than capital-intensive? Deeper analysis of the policy environment is likely required and will likely have implications beyond primary metal manufacturing.

Overall, however, the results do not seem to suggest that the obvious solution to the productivity gap problem lies in focusing solely on improving the performance of Canada's largest plants vis-à-vis U.S. largest plants. The results of decomposition in fact suggest that much of the productivity gap could be overcome by addressing the productivity issues in smaller plants and, to lesser extent, determining what results in the average Canadian manufacturing industries being more reliant on small plants than in the U.S. What is evident is that the crux of Canada's persistent manufacturing productivity problem is unlikely to be found in the plants of Canada's largest producers.

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Appendix A: Data Source

Variable	Description	Data Source
Aggregate Variables for Total Manufacturing		
<i>V</i>	Manufacturing nominal value added	Canada: Canadian KLEMS database, Statistics Canada U.S.: U.S. KLEMS database, EU KLEMS Growth and Productivity Accounts.
<i>H</i>	Manufacturing hour worked	Canada: Canadian KLEMS database, Statistics Canada U.S.: U.S. KLEMS database, EU KLEMS Growth and Productivity Accounts.
<i>PPP</i>	Manufacturing value added purchasing power parity	Hao et al. (2008)
Manufacturing Variables by Industry and by Firm Size		
<i>Y</i>	Nominal census value added	Canada: Special tabulation from Statistics Canada's 2002 Annual Survey of Manufacturers U.S.: 2002 Economic Census (Manufacturing), US Census Bureau
<i>E</i>	Census manufacturing employment	Canada: Special tabulation from Statistics Canada's 2002 Annual Survey of Manufacturers U.S.: 2002 Economic Census (Manufacturing), US Census Bureau

Table 1:
Industry Profile of the Manufacturing Sector in Canada and the U.S., 2002

Industry	Industry Employment Share		Employment Share of Large Sized Plants		Labour Productivity of Small Plants		Labour Productivity of Large Plants		Labour Productivity of All Plants	
	(%)		(%)		<i>U.S. total manufacturing = 1.00</i>					
	Can	US	Can	US	Can	US	Can	US	Can	US
Food	12.4	10.3	7.0	20.4	0.64	1.14	0.60	0.72	0.63	1.05
Chemical	4.5	5.8	11.4	24.5	1.46	2.24	2.64	2.56	1.59	2.32
Primary metal	4.4	3.3	37.4	22.0	1.21	0.85	1.07	1.09	1.16	0.91
Machinery	7.2	8.0	6.4	12.2	0.68	0.76	1.28	1.50	0.72	0.85
Computer and electronic	4.7	8.6	21.1	34.8	0.67	0.96	0.78	1.76	0.70	1.24
Transportation equipment	11.2	11.4	37.9	49.1	0.78	0.80	2.52	1.56	1.44	1.17
Furniture and related products	5.4	4.1	7.3	11.8	0.47	0.55	0.57	0.69	0.48	0.56
Other manufacturing	50.2	48.6	4.1	7.4	0.71	0.76	0.92	1.54	0.71	0.82
Total manufacturing	100	100	11.2	17.9	0.74	0.89	1.59	1.53	0.83	1.00

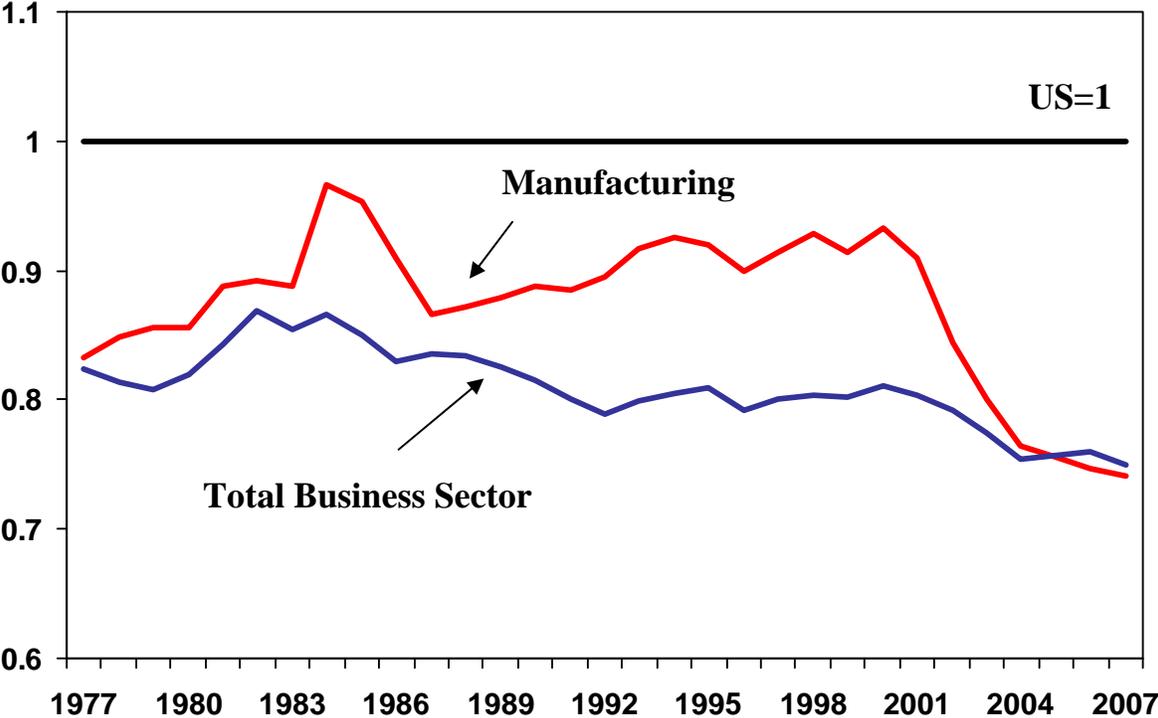
Note: Small plants – fewer than 1000 employees; large plants – 1000 employees or greater.

Table 2:
The Sources of the Canada-U.S. Manufacturing Labour Productivity Gap, 2002

Canada-U.S. Manufacturing Labour Productivity Gap:	16.8%	
Sources of the Gap:	Percentage points	Share of Productivity Gap (percent)
Industry structure effect	2.2	12.8
Plant size effect	3.3	19.8
Productivity effect		
All plants	11.3	67.4
Small-sized plants	12.0	71.3
Large-sized plants	-0.7	-4.0

Note: Small plants – fewer than 1000 employees; large plants – 1000 employees or greater.

**Chart 1:
Relative Labour Productivity in Canada, 1977-2007**



Note: Labour productivity is defined as real value-added per hour worked, PPP based.

Source: Hao et al. (2008)