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Are Small or Large Producers Driving the Canada-U.S. Labour Productivity Gap? Recent Evidence from Manufacturing

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Are Small or Large Producers Driving the Canada-U.S. Labour Productivity Gap? Recent Evidence from Manufacturing

Jianmin Tang*,
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Abstract

This paper examines the contribution of manufacturing plant size to the Canada-U.S. productivity gap. It finds that while the higher share of small plant employment in Canada compared to the United States is an important factor in the Canada-U.S. manufacturing labour productivity level gap, it did not contribute to the widening of the gap in the 2000s. In addition, it shows that while the weaker productivity performance of small plants in Canada than in the United States accounted for much of the gap in a particular year, the deterioration in the productivity performance of large plants in Canada was responsible for most of the widening gap since 2000.

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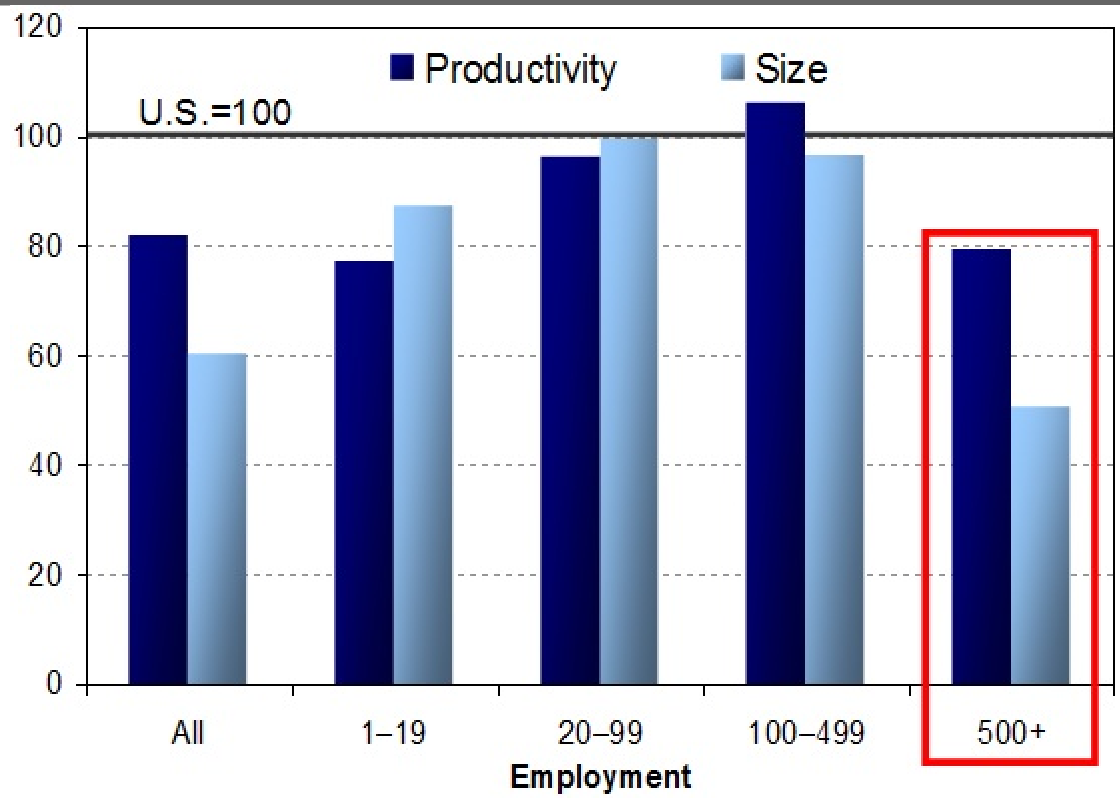
1. Introduction

The Canada-U.S. labour productivity gap has widened over the past three decades, especially in the manufacturing sector in the post-2000 period (Boothe and Roy 2008). There have been numerous studies that aim to examine the underlying factors.[1] Many of those studies have taken an approach along the lines of Restuccia and Rogerson (2008) and Hsieh and Klenow (2009) to see if differences between the two countries in resource allocation among heterogeneous producers are responsible for the productivity performance gap between the two countries. Differences in producer productivity are large and persistent, even within narrowly defined industries with relatively homogenous products (Syverson 2011). Holding other factors constant, if country A is for some reason able to allocate more factor inputs to productive producers than country B, then the former will have a higher productivity level than the latter at the aggregate level.

Some of these studies consider whether producer size differences cause the deviation in productivity performance between Canada and the United States.[2] The producer size distribution is important because small producers are generally less productive than large ones.[3] The literature has compared the importance of small producers in Canada to the United States (Baldwin et al. 2004; Leung et al. 2008). It has shown that Canada has a larger proportion of its employment in small producers, mainly because Canada's very large producers are smaller than their U.S. counterparts (figure 1). The literature suggests that the firm size distribution differences play a significant role in explaining the productivity gap between Canada and the United States.

Figure 1: Average Productivity Level and Employment Size in Canada by Employment Size Group (U.S.=100), 1997[*]



Source: Leung et al. (2008)

[*] It covers all industries except public administration

Another branch of the literature focuses on industrial structure. Like producer size, industrial structure matters because industries differ widely in productivity performance. Some studies in this area have examined whether Canada's disadvantage stems from its reliance on early-stage natural resource industries or whether the U.S. advantage comes from its possession of more mature or more cutting-edge high value added industries (e.g., Nadeau and Rao 2002; Chan et al. 2012). This literature has shown that the industrial composition difference between Canada and the United States appears to account for only a small fraction of Canada's relatively weaker productivity performance.

These topics have been subjects of continuing interest for researchers and policymakers in the debate on how to improve Canada's productivity performance, especially when Canada is facing increased competition from emerging economies and with its industrial structure being shifted to resource-based industries by global economic forces. These structural factors may be responsible for the widening of the Canada-U.S. productivity gap, but a real and important research question is whether these factors are the driving forces or whether there are other factors that play the key role. The answer to the question has important ramifications for economic policy at improving Canada's productivity performance.

This paper has two objectives. First, it updates trends in industrial structure and plant size distribution in Canada and the United States in the manufacturing sector, using recent microdata records (up to 2007) collected by the Census of Manufactures programs in the two countries, and highlights the differences that have emerged between two countries. The literature on firm/plant size distribution has so far largely relied on data up to 1997 (e.g., Baldwin et al. 2004; Leung et al. 2008).

Second, an effort is made to determine the sources of the Canada-U.S. labour productivity growth and level gaps in the manufacturing sector.[4] Is Canada's relatively weak performance in aggregate manufacturing labour productivity due to industrial structure, plant size distribution, and/or weak underlying productivity performances of plants with different sizes? Unlike the previous studies, this paper estimates simultaneously the contributions of these factors at the industry level. Traditionally, the contributions of industrial structure and plant size distribution are analyzed separately.

Several interesting findings emerge from this paper. In terms of the plant size distribution in the manufacturing sector, the employment share of small plants, defined as those plants with fewer than 500 employees, increased from 1997/1998 to 2007 in both Canada and the United States, and the increase was larger in the United States than in Canada. Despite the larger increase in the United States, however, the employment share of small plants was still higher in Canada than in the United States in 2007 (79.6 percent for Canada and 72.0 percent for the United States). While the higher employment share of small plants in Canada mattered for the Canada-U.S. manufacturing labour productivity level gap, it was not responsible for its widening between 2002 and 2007.

The Canadian manufacturing sector was more concentrated in resource-based industries such as paper and primary metal, and less in computer and electronic product industries. The pattern has not substantially changed for the past decade. The industrial structure differences between Canada and the United States only played a minor role in the Canada-U.S. labour productivity gap and its widening between 2002 and 2007.

Canada lagged the United States in productivity performance for both small and large plants. However, the gap widened between 2002 and 2007 especially for large plants. The paper shows that while the weaker productivity performance of small plants in Canada than in the United States was responsible for much of the Canada-U.S. manufacturing labour productivity level gap in any given year, the deterioration in productivity of large plants in Canada was responsible for most of the widening gap over this period.

1 See Syverson (2011) for a general review of productivity determinants.

2 See Simon and Bonini (1958) and Lucas (1978) for a discussion of the size distribution of firms and the forces determining firm size.

3 There are many factors underlying this stylized fact. Small producers are less likely to benefit from economies of scale. In addition, they have a tougher time obtaining financing than large producers, which may lead to being less capital intensive than large producers. Furthermore, small producers are less attractive to skilled labour, an important driver of innovation and productivity, because they are less likely to offer a high wage rate and have a higher risk of failure (e.g., Winter-Ebmer 2001). Finally, small producers tend to be domestic-controlled firms that are on average less productive than foreign-controlled firms. For a general discussion of the economic impact of foreign direct investment in Canada, see Rao et al. (2009).

4 Mainly due to data limitation, this paper deals with only labour productivity, and covers only the manufacturing sector. The manufacturing sector is of particular interest because it is a main source of the post-2000 slowdown in business sector labour productivity growth in Canada relative to the United States (e.g., Almon and Tang 2011).

2. Data

This paper makes use of the microdata records collected by the Census of Manufactures (CM) programs in the two countries, which are quite similar in their collection of data on output and labour inputs.[5] These data are at the establishment level for both Canada and the United States (this paper uses establishment and plant interchangeably).[6] Data for the United States are from the public website of the U.S. Bureau of Census, by industry and plant size for 1997, 2002 and 2007. The manufacturing industries are based on the North American Industry Classification System (NAICS). To match the U.S. data, this paper obtains Canadian CM data through a special tabulation from Statistics Canada for 1998, 2002 and 2007. It does not use the 1997 CM data for Canada since they are SIC-based and are not comparable to the data in NAICS.

This paper extends the literature dealing only with the manufacturing sector as a whole (e.g., Baldwin et al. 2004; Leung et al. 2008) to examine manufacturing industries at the 3-digit NAICS level. For the analysis, this paper follows the literature and defines small plants as those plants with fewer than 500 employees.[7] To ensure that the confidentiality policy at Statistics Canada is not compromised, however, this paper has to combine some of 21 industries groupings, ending up with 13 industries as shown in table 1.

In examining data on the differences between small and large plants, it is important to keep in mind how the data are constructed. Generally, for both Canada and the United States, the CM databases consist of survey data on all large establishments and some small ones, and imputed data for other small establishments, which were developed using industry averages in conjunction with administrative data such tax files.[8]

For all three years in the United States and for 2002 and 2007 in Canada, the CM data do not include central administrative offices, warehouses, or other establishments that serve manufacturing establishments within the same organization.[9] Such establishments are classified according to the nature of the service they provide. For example, separate headquarters establishments are reported in NAICS Sector 55, Management of Companies and Enterprises. In addition, the CM data for some years in both Canada and the United States may exclude establishments of firms with no paid employees. These "nonemployers" are typically self-employed individuals or partnerships operating businesses that have not chosen to incorporate.[10]

It should be noted, however, that value added records from the CM, which is often referred to as census value added to distinguish it from value added from the national accounts, include payments for purchased services. In addition, census value added for Canada is manufacturing census value added, while for the United States it is total census value added. The latter consists of both manufacturing census value added and value added from non-manufacturing activities such as merchandising operations (i.e., the difference between the sales value and the cost of merchandise sold without further manufacturing, processing, or assembling).[11]

To be consistent, this paper adjusts census value added to value added from the national accounts at the industry level, as the national accounts are used to estimate the Canada-U.S. manufacturing labour productivity gap.[12] Also, by applying an implicit industry value added deflator, the adjusted industry nominal value added is then converted into real value added in 2002 dollars. For the Canada-U.S. level comparison, this paper further adjusts Canada’s real value added in 2002 Canadian dollar into 2002 U.S. dollar, using industry value added purchasing power parities (PPPs) in 2002. The adjustment of real value added to a common currency using industry-specific PPPs is necessary for a level comparison between two countries in order to reflect the price differences in the two countries in 2002. Industry value added PPPs in 2002 are from Hao et al. (2008).[13]

Similarly, this paper makes adjustments to labour, census employment, from CM in both countries.[14] The adjustment is made at the industry level to be consistent with the official data on hours worked, as the official data on hours worked estimates are used to estimate the Canada-U.S. manufacturing productivity gap.[15] More specifically, the number of employees from the CM is first benchmarked to the number of employees from the national accounts, and then it is converted to hours worked, taking into account work intensity (hours worked per employee).[16] The number of employees from the CM is not exactly equal to the number of employees used by the statistical agencies to produce the official productivity statistics. Various adjustments are made by statistical agencies to the latter to reflect self-employment, part-time employment, sick leave and statutory holidays, among others. In Canada, the official estimate of total employment comes from the Labour Force Survey (LFS). To derive the official industry employment estimates, Statistics Canada split the total employment across industries based on employment information from the Survey of Employment, Payrolls and Hours (SEPH). For the United States, it is based on the Current Employment Statistics Survey (CES), supplemented with self-employment data from the Current Population Survey (CPS).

5 The Census of Manufactures is also commonly called Annual Survey of Manufacturers (ASM).

6 About 73 percent of establishments are single-plant firms.

7 The results may be sensitive to the size classification. Unfortunately, the special data from Statistics Canada does not allow for an analysis based on a different size definition.

8 For Canada, the CM database derives data from surveys of truncated population of all plants in manufacturing, where the truncation cuts off plants below a certain dollar threshold. Data for other plants are imputed from administrative information (tax files). The proportions of data collected with questionnaires and obtained from administrative files vary from one year to the next, from one province to another and from industry to industry, depending on the resources available as well as the survey's target coverage at the national, provincial and industry levels. For the United States, the CM database is created in a similar fashion, that is, data for large establishments and some small establishments are derived from surveys and data for other small establishments are derived from administrative tax records. For the survey, all establishments with less than 5 employees were excluded, while all establishments with more than 20 employees as well as a sample of establishments with the number of employees between 5 and 20 were surveyed.

9 According to Statistics Canada, central administrative offices, warehouses or other establishments that serve manufacturing establishments within the same organization tend to be small. Such small establishments accounted for about three percent of total manufacturing employment in 1997, while such large establishments accounted for one percent.

10 The importance of this group in the manufacturing sector is small. According to Statistics Canada CANSIM table 282-0012, unincorporated self-employed with no paid employees accounted for on average about 1.2 percent of total manufacturing employment in the period 1997–2007.

11 Non-manufacturing activities in the manufacturing sector exclude all non-manufacturing activities that are outsourced (i.e., legal, accounting, and engineering services). Thus, they play a very small role in total census value added in the manufacturing sector. According to the 1997 CM in Canada, value added from non-manufacturing activities in the manufacturing sector was about four percent of total census value added.

12 Official industry value added for Canada is a special tabulation from Statistics Canada, which is consistent with CANSIM tables 379-0023 for value added in nominal dollars and 383-0021 for real value added. The implicit value added deflator is derived by dividing nominal value added by real value added. For the United States, they are from the U.S. Bureau of Economic Analysis (BEA). For Canada-U.S. comparisons, the original value added data at the basic prices for Canada are adjusted to value added at factor costs, using information on net indirect taxes on production from input-output tables from Statistics Canada. For the United States, value added at market prices is adjusted to value added at factor costs, using information on net indirect taxes on both products and production that are also from BEA.

13 For a discussion of the methodology and the estimation of industry value added PPPs between Canada and the United States, please see Rao et al. (2004). There are no better alternatives, but PPP estimates, especially at the industry level, may be subject to measurement errors, which will affect the Canada-U.S. level comparisons. Measurement errors may arise because price data on some products for both Canada and the U.S. are not available and because there is a persistent deviation of real exchange rate from PPP (Crucini and Shintani 2008). In addition, at the industry level, the price comparisons between the two countries may be further complicated by the fact that the some Canadian industries (i.e, computers and electronics manufacturing) are compositionally different from their U.S. counterparts. Nonetheless, it is believed that the main results may not be very sensitive to the use of industry PPPs, given that those results are mainly associated with the widening of the Canada-U.S. productivity gap.

14 Employment from the CM consists of all full-time and part-time employees on the payrolls of operating manufacturing establishments, including employees on paid sick leave, paid holidays, and paid vacations.

15 For both Canada and the United States, hours worked data at the industry level are hours worked for all jobs. The data for Canada are from a special tabulation, which are consistent with CANSIM table 383-0009. For the United States, they are from the Bureau of Labor Statistics.

[16] Due to data limitations, the same adjustment ratios are applied to both small and large plants. The bias of one group against the other from the adjustments is not expected to be a significant issue. First, the analysis stays at a fairly aggregated level — an industry is only divided into the small and the large, with the small accounting for on average more than 70% of the output. Second, according to the Labour Force Survey in Canada, the number of hours worked per employee for small firms is similar to that for large firms for paid employees. For example, in 2007, the number of hours worked per employee for small firms was 99.5 percent of the number of hours worked per employee for large firms. For the United States, the number of hours worked per production worker for small plants was 99.1 percent of the number of hours worked per production worker for large plants in the manufacturing sector.

3. The Analytical Framework

To analyze the data, this paper develops an analytical framework for simultaneously estimating the contributions of industrial structure, plant size distribution, and the underlying productivity performance of different plant size groups to Canada-U.S. manufacturing labour productivity differences. Denote V and P as nominal value added and the value added deflator in the manufacturing sector, and v_i and p_i as nominal value added and the value added deflator for industry i . The sum over industry nominal value added is equal to manufacturing nominal value added, that is, $V = \sum_i v_i$. In addition, let H and h_i be total hours worked for the manufacturing sector and industry i, respectively.

Define manufacturing labour productivity, Q, as real value added per hour worked. In year t, it can then be decomposed into several components across industries and plant size classes as follows:

$$Q^t = \frac{V^t}{P^t H^t} = \sum_i l_i^t \tilde{p}_i^t q_i^t = \sum_i \tilde{s}_i^t \left(w_{i,s}^t q_{i,s}^t + w_{i,L}^t q_{i,L}^t \right) \quad (1)$$

where l_i^t is the hours worked share of industry i in the total manufacturing sector; $\tilde{p}_i^t$ is the relative value added price of industry i, defined as $\tilde{p}_i^t = \frac{p_i^t}{p^t}$; q_i^t is the real value added per hour worked for industry i; $\tilde{s}_i^t = \tilde{p}_i^t l_i^t$ is the relative size of industry i, equal to the product of the industry's labour input share and its relative value added price; $w_{i,s}^t$ and $w_{i,L}^t$ are the hours worked shares of small and large plants within industry i ; and $q_{i,S}^t$ and $q_{i,L}^t$ are real value added per hour worked for small and large plants in industry i.

The relative size of an industry indicates the relative economic importance of the industry in manufacturing labour productivity, capturing the effects from a change in its employment share and a change in the relative value of its products. Capturing the latter effect is consistent with the chain Fisher index method of computing aggregated real value added in that it values industry real output more when its price rises and less when its price falls.[17]

3.1 Decomposing Manufacturing Labour Productivity Growth

For the period from year m to year t, labour productivity growth for the manufacturing sector is:

$$g = \frac{Q^t - Q^m}{Q^m} \times 100 \quad (2)$$

By combining equations (1) and (2), it can be shown that manufacturing labour productivity growth over the period can be decomposed into four components:[18]

$$g = \underbrace{\sum_i \left[\bar{\theta}_i \left(\tilde{s}_i^t - \tilde{s}_i^m \right) \right]}_{\text{Industrial Structure Effect}} + \underbrace{\sum_i \left[\overline{\theta_i} \left(w_{i,S}^m - w_{i,S}^t \right) \right]}_{\text{Plant Size Distribution Effect}} + \underbrace{\sum_i \left[\overline{\varphi}_{i,S} \left(\tilde{q}_{i,S}^t - \tilde{q}_{i,S}^m \right) \right]}_{\text{Small Plant Productivity Effect}} + \underbrace{\sum_i \left[\overline{\varphi}_{i,L} \left(\tilde{q}_{i,L}^t - \tilde{q}_{i,L}^m \right) \right]}_{\text{Large Plant Productivity Effect}}, \quad (3)$$

where $\tilde{q}_{i,S}^m = q_{i,S}^m / Q^m$, $\tilde{q}_{i,L}^m = q_{i,L}^m / Q^m$, $\tilde{q}_{i,S}^t = q_{i,S}^t / Q^m$, and $\tilde{q}_{i,L}^t = \tilde{q}_{i,L}^t / Q^m$, which scale down the labour productivity levels of small and large plants of industry i in the beginning and ending year of the period by the manufacturing labour productivity level in the beginning year of the period;

$\bar{\theta}_i = \frac{1}{2}\left(w^t_{i,S}\tilde{q}^m_{i,S} + w^t_{i,L}\tilde{q}^m_{i,L} + w^m_{i,S}\tilde{q}^t_{i,S} + w^m_{i,L}\tilde{q}^t_{i,L}\right)$;

$\bar{ø}_i = \frac{1}{2}\left[\tilde{s}^t_i\left(\tilde{q}^t_{i,L} - \tilde{q}^t_{i,S}\right) + \tilde{s}^m_i\left(\tilde{q}^m_{i,L} - \tilde{q}^m_{i,S}\right)\right]$; $\overline{\varphi}_{i,S} = \frac{1}{2}\left(\tilde{s}^t_i w^t_{i,S} + \tilde{s}^m_i w^m_{i,S}\right)$; and

$\overline{\varphi}_{i,L} = \frac{1}{2}\left(\tilde{s}^t_i w^t_{i,L} + \tilde{s}^m_i w^m_{i,L}\right)$.[19]

The four components in equation (3) reflect four different forces in influencing manufacturing productivity growth between year m and year t. The first component is associated with the change in industrial structure of the manufacturing sector, and thus is labelled as the industrial structure effect. If the Canadian manufacturing sector is concentrated more in industries with high productivity in year t than in year m, then the first effect will be positive. The second component, called the plant size distribution effect, is the contribution from a change in plant size distribution over this period. Small plants are generally less productive than large plants. Thus, if the employment share of small plants decreases by the end of the period, then the plant size distribution effect will be positive. The third and fourth components, referred to as the productivity effects, capture the improvement or deterioration in productivity performance of small and large plants over this period, respectively. If small plants and large plants in year t are more productive than in year m, then these two effects will be positive.

3.2 Decomposing the Canada-U.S. Manufacturing Labour Productivity Level Gap

The Canada-U.S. manufacturing labour productivity level gap, Δ, in a given year is defined as:

$$\Delta = \frac{Q^U - Q^C}{Q^U} \times 100, \tag{4}$$

where superscripts C and U denote Canada and the United States, respectively. It can be shown that the Canada-U.S. manufacturing labour productivity level gap in a given year can be decomposed, in the same fashion as for manufacturing labour productivity growth over a time period, into four components:

$$\Delta = \underbrace{\sum_i\left[\hat{\theta}_i\left(\tilde{s}^U_i - \tilde{s}^C_i\right)\right]}_{\text{Industrial Structure Effect}} + \underbrace{\sum_i\left[\hat{ø}_i\left(w^C_{i,S} - w^U_{i,S}\right)\right]}_{\text{Plant Size Distribution Effect}} + \underbrace{\sum_i\left[\widehat{\varphi}_{i,S}\left(\breve{q}^U_{i,S} - \breve{q}^C_{i,S}\right)\right]}_{\text{Small Plant Productivity Effect}} + \underbrace{\sum_i\left[\widehat{\varphi}_{i,L}\left(\breve{q}^U_{i,L} - \breve{q}^C_{i,L}\right)\right]}_{\text{Large Plant Productivity Effect}}, \tag{5}$$

where $\breve{q}^k_{i,S} = q^k_{i,S} \,/\, Q^U$ and $\breve{q}^k_{i,L} = q^k_{i,L} \,/\, Q^U$, which scale down the productivity levels of small and large plants in industry i in country *k* by the U.S. manufacturing labour productivity level;

$\hat{\theta}_i = \frac{1}{2}\left(\widetilde{w}^U_{i,S}\breve{q}^C_{i,S} + w^U_{i,L}\breve{q}^C_{i,L} + w^C_{i,S}\breve{q}^U_{i,S} + w^C_{i,L}\breve{q}^U_{i,L}\right)$; $\hat{\phi}_i = \frac{1}{2}\left[\tilde{s}^U_i\left(\breve{q}^U_{i,L} - \breve{q}^U_{i,S}\right) + \tilde{s}^C_i\left(\breve{q}^C_{i,L} - \breve{q}^C_{i,S}\right)\right]$;

$\widehat{\varphi}_{i,S} = \frac{1}{2}\left(\tilde{s}^U_i w^U_{i,S} + \tilde{s}^C_i w^C_{i,S}\right)$; and $\widehat{\varphi}_{i,L} = \frac{1}{2}\left(\tilde{s}^U_i w^U_{i,L} + \tilde{s}^C_i w^C_{i,L}\right)$.[20]

Thus, analogous to the decomposition of manufacturing labour productivity growth, equation (5) consists of the same four forces in influencing the manufacturing labour productivity level gap between Canada and the United States. Each component here can be interpreted the same way as it is in equation (3), although here it deals with sources of cross-country differences in productivity at a given point in time rather than sources of productivity change over time in a particular country.

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[17] See Tang and Wang (2004) and Almon and Tang (2011) for a discussion.

[18] Proof is available upon request from the author.

[19] $\bar{\theta}_i$ is the pseudo average labour productivity of industry i in years m and t, and $\bar{\Phi}_i$ is the average labour productivity difference between large and small producers for industry i over this period. Similarly, $\overline{\varphi}_{i,S}$ and $\overline{\varphi}_{i,L}$ are the average employment shares of small and large plants over this period.

[20] $\hat{\theta}_i$ is the pseudo average labour productivity of industry i in the two countries, and is the average labour productivity difference between large and small plants for industry i in the two countries. Similarly, $\widehat{\varphi}_{i,S}$ and $\widehat{\varphi}_{i,L}$ are the average employment shares of small and large plants in the two countries.

4. Recent Developments in Industrial Structure, Plant Size Distributions, and Plant Productivity

Before examining the sources of the Canada-U.S. manufacturing labour productivity gap, this paper first discusses the recent developments in industrial structure, plant size distributions, and labour productivity performance by plant size in the Canadian manufacturing sector, with a comparison to the United States.

4.1 Recent Change in Industrial Structure

The industrial structure of the manufacturing sector is shifting because the industries are facing unequal changes in supply and demand conditions. In response to these changes, inputs are moving between industries. Over the 1998–2007 period, Canada's manufacturing experienced several significant shocks. The high-tech boom in the late 1990s and its bust in the early 2000s were closely followed by a 45.3 percent of appreciation of the Canadian dollar between 2002 and 2007. These shocks, together with competition from emerging economies, notably China, may have caused important shifts in the composition of the Canadian manufacturing sector over the period of 1998–2007. However, the direction of the movement of production resources is not necessarily from low productive to high productive industries. As suggested by Baumol (1967), resources may be absorbed predominantly by low productive industries facing high demand for their products.

In terms of nominal value added share, the industrial structure in the manufacturing sector was relatively stable between 1998 and 2002 (Table 1). The one exception was computer and electronics whose share decreased significantly from 5.4 percent in 1998 to 3.2 percent in 2002, as a result of the high-tech bust in 2001. After 2002, however, the Canadian sector experienced some important shifts, mainly from transportation equipment, paper, textile, clothing and leather to food, primary metal, fabricated metal, machinery, and computer and electronics.

In terms of hours worked share, the most noticeable changes were the decline in textile, clothing and leather (from 7.2 percent in 2002 to 5.0 percent in 2007) and the increase in chemicals (from 4.7 percent to 5.7 percent) and in other manufacturing (from 20.0 percent to 21.1 percent).

For our analysis, the importance of an industry in manufacturing labour productivity is measured by relative size, which reflects both hours worked share and relative value added price of an industry, as discussed in section 3. Between 1998 and 2002, the most significant change was with fabricated metal, which saw its relative size increased from 0.08 in 1998 to 0.10 in 2002 while for computer and electronics, it declined the most, from 0.07 to 0.05 (Table 2). Over the next period, 2002–2007, the most significant increase was with other manufacturing (from 0.20 in 2002 to 0.22) while the most significant decline was with transportation equipment (from 0.12 to 0.08).

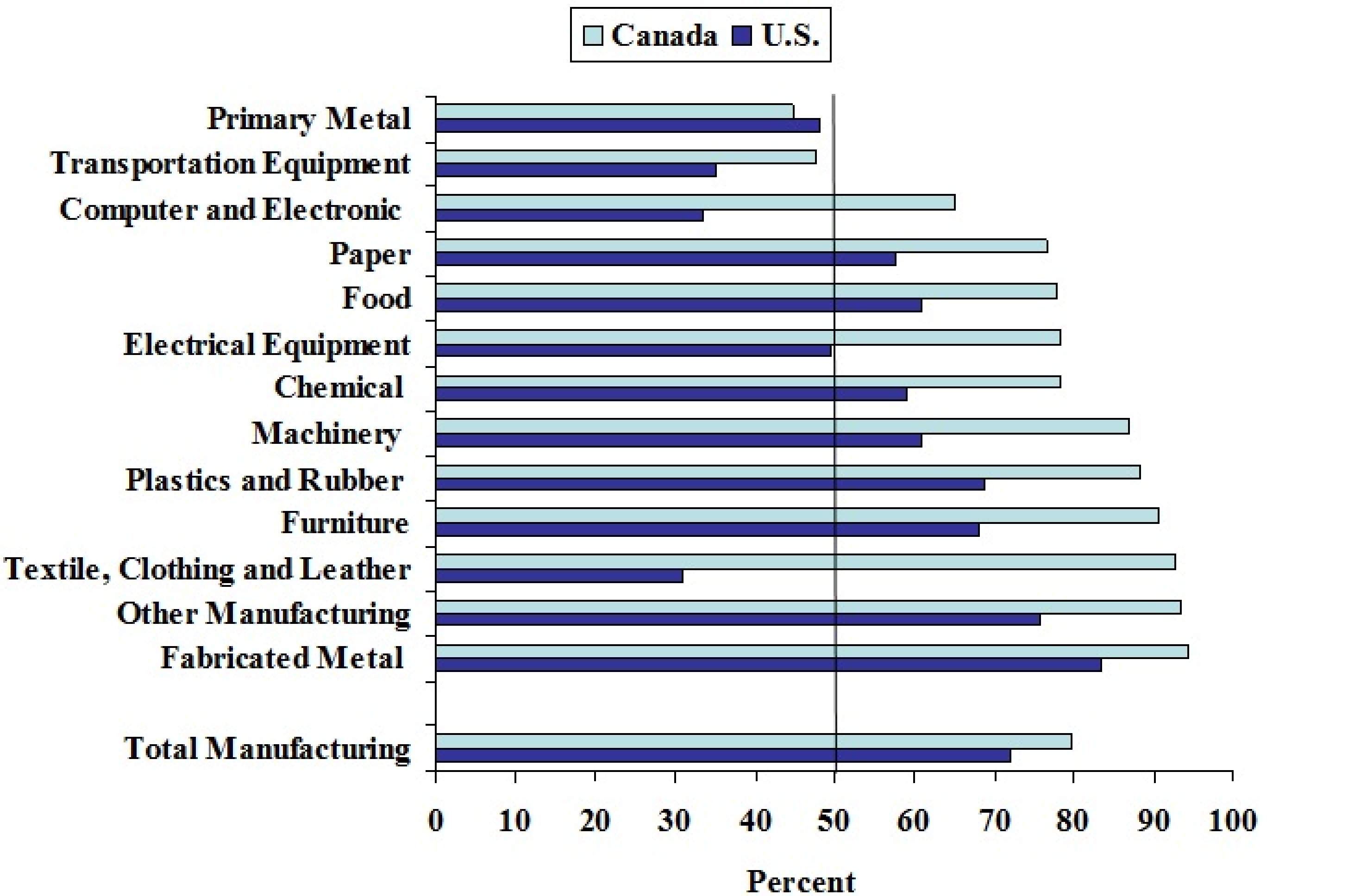
The industry composition of the U.S. manufacturing sector and its change from 1997 to 2007 were generally similar to its Canadian counterpart. However, there were several exceptions. Compared to its Canadian counterpart, the U.S. manufacturing sector was, in terms of nominal value added share or hours worked share, concentrated more in chemicals and computer and electronics, and less in food, paper, and primary metal. The most noticeable difference between the two countries was the unprecedented decline in relative value added price in the U.S. computer and electronic manufacturing industry over the period of 1997–2007.[21] As a result, the relative size of the U.S. computer and electronics manufacturing industry declined dramatically from 1997 to 2007.[22] On the other hand, the relative value added prices for primary metal and other manufacturing products (mainly petroleum and coal products) increased substantially from 2002 to 2007, leading to a substantial increase in relative size in these two industries.

4.2 The Recent Development in Plant Size Distribution

Most manufacturing plants in both Canada and the United States are small. In 2007, small plants accounted for 99.6 percent of the plant population in Canada and 99.0 percent in the United States. In terms of employment or output, however, small plants account for a much smaller share than in headcounts. In Canada, they accounted for 79.6 percent of manufacturing employment and 72.2 percent of manufacturing value added in 2007 (Table 3). In the United States, the shares were smaller: 72.0 percent in employment and 59.9 percent in value added.

For most Canadian manufacturing industries, the employment share of small plants was well above 50 percent of industry employment (Table 2). The two exceptions were primary metal (44.7 percent) and transportation equipment (47.7 percent). The importance of small plants in employment slightly increased from 1998 to 2007 for most manufacturing industries, especially in paper, plastic and rubber, furniture, and textile, clothing and leather. For the manufacturing sector as a whole, the employment share of small plants increased from 76.5 percent in 1998 to 79.0 percent in 2002 and again 79.6 percent in 2007.

Figure 2: Small Establishment Share of Employment by Industry in Canadian and U.S. Manufacturing, 2007



Except for primary metal, the employment share of small plants was larger for each of the Canadian industries than for its U.S. counterpart. The largest difference was found for textile, clothing and leather; computer and electronics; electrical equipment; and machinery. As in Canada, the employment share of small plants for manufacturing as a whole in the United States also increased from 67.5 percent in 1997 to 72.0 percent in 2007.

4.3 Labour Productivity Performance by Plant Size

For the manufacturing sector as a whole, small plants were on average less productive than large ones. However, the ratio of the productivity level for small plants to the productivity level for large plants in Canada increased from 0.54 in 2002 to 0.66 in 2007 (Table 4).[23] In contrast, for the U.S. manufacturing sector as a whole, the productivity difference between small and large plants did not show a significant change between 1997 and 2007, and the ratio maintained at about 0.58 over this period.

At the industry level, there are some exceptions. In Canada, small plants were 34 percent, 29 percent and nine percent more productive than large ones in 2007 for textile, clothing and leather, chemical, and electrical equipment, respectively. Ten out of thirteen industries experienced an increase in the ratio of the productivity level of small plants to that of large plants from 1998 to 2007. In the United States, small plants were more productive than large ones only in food, and the gap increased from eight percent in 1997 to 33 percent in 2007. As in Canada, the productivity performance of small plants relative to large ones also improved for most of the manufacturing industries – the ratio increased in nine industries from 1997 to 2007.

On average, both small and large plants in the Canadian manufacturing sector were less productive than their U.S. counterparts over the period 2002 and 2007, and the gaps widened for both size groups over this period (Table 5). The widening gap was much larger for large plants (increased from 4.5 percent in 2002 to 35.1 percent in 2007) than for small plants (from 13.4 percent to 25.6 percent).

There were significant variations across manufacturing industries in Canada's productivity performance relative to the United States. Three industries (paper, primary metal and transportation equipment) were more productive in Canada than in the United States in 2007. The productivity advantage for Canada was driven by small plants in the paper industry and by both small and large plants in the other two industries. For all remaining industries, the United States was more productive than Canada for small or large plants. The largest productivity gap was in computer and electronic products, followed by textile, clothing and leather.

21 The relative value added price (2002=1.00) for the computer and electronic manufacturing industry decreased from 1.26 in 1998 to 1.06 in 2007 in Canada and from 3.51 in 1997 to 0.56 in 2007 in the United States. The substantial difference in the movement of relative value added price in the computer and electronics manufacturing industry between Canada and the United States is puzzling. Given the complexity in estimating industry price deflators by statistical agencies, however, it is difficult to approve or disapprove the difference.

22 As discussed in section 3, the direction of the movement in relative size is consistent with the chain Fisher index method of computing aggregated real GDP, which values an industry output more when its price increases and less when its price declines. The index method has been adopted by statistical agencies in both Canada and the United States. Note that when the analysis is based on a fixed-base index, the decline in relative size of the U.S. computer and electronics manufacturing industry would only represent the decline in labour share of the industry from 1997 to 2007.

23 This reflected faster labour productivity growth for small plants (+3.4 percent per year) than for large plants (−1.1 percent per year) over the 2002–2007 period.

5. Empirical Analysis of the Canada-U.S. Manufacturing Labour Productivity Growth Gap

To identify the sources of the productivity growth gap between Canada and the United States, this paper decomposes aggregate manufacturing labour productivity growth in each country into four components, according to equation (3). Labour productivity in the Canadian manufacturing sector grew on average about 2.8 percent per year in 1998–2002.[24] The growth was largely due to an improvement in labour productivity of small plants and to a less extent an improvement in labour productivity of large plants (Table 6). The contribution from the change in industrial structure or in plant size distribution was small and negative. The largest industry contributor was other manufacturing (mainly due to the small plant productivity effect and the industrial structure effect), followed by transportation equipment (mainly due to the large plant productivity effect). The largest negative contributor was computer and electronics, mainly due to the decline in relative size as a result of the high-tech bust in 2000–2001.

Over the period 2002–2007, labour productivity growth in the Canadian manufacturing slowed to 1.8 percent per year. The deterioration was entirely due to the slowdown in productivity growth in both small and large plants, whose contributions were about one percentage points less than in the previous period. On the other hand, the contributions from both industrial structure and plant size distribution improved slightly in the second period compared to those in the previous period.

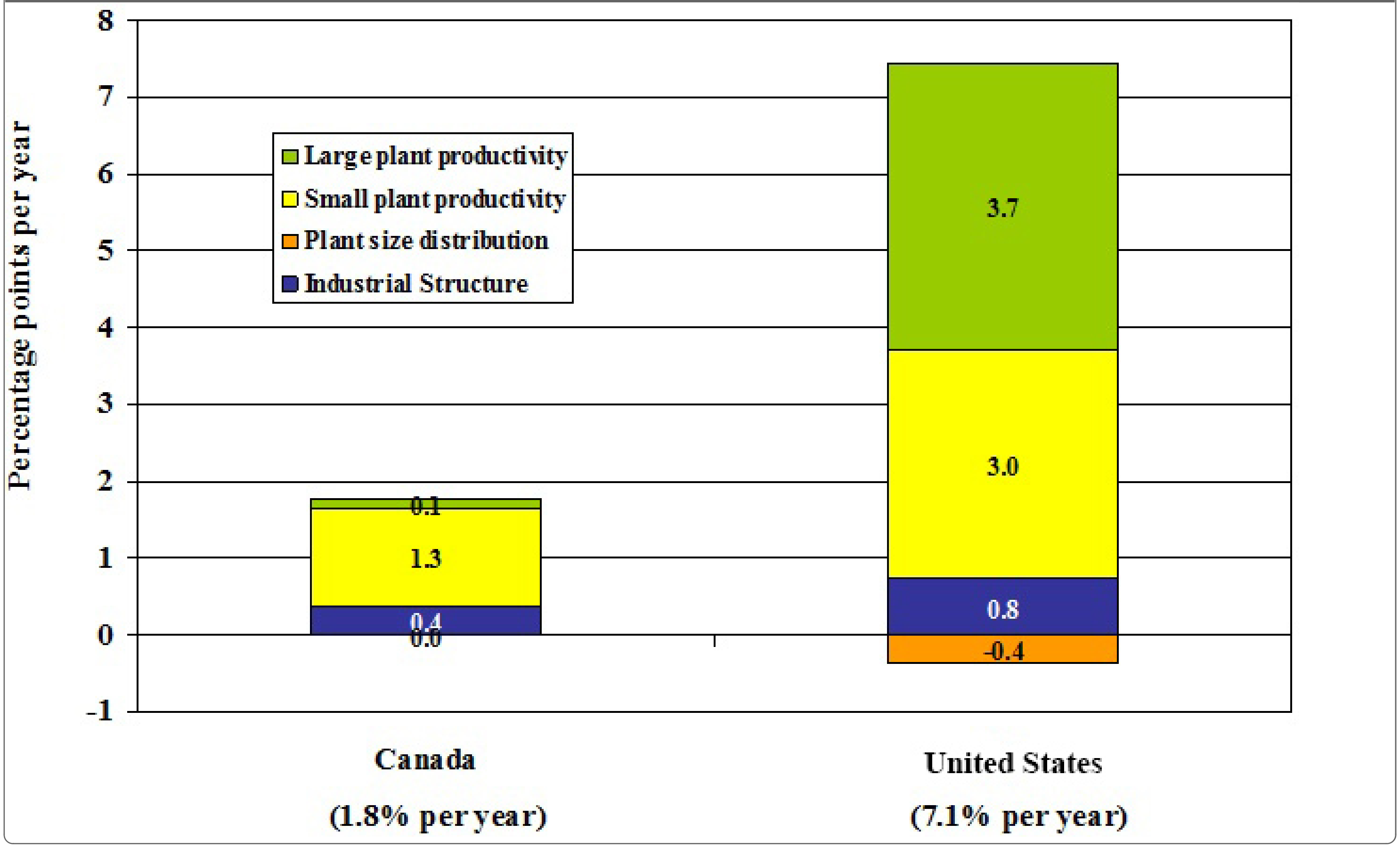
The largest contributor to the labour productivity slowdown between 1998–2002 and 2002–2007 was transportation equipment whose contribution decreased from a positive of 0.81 percentage points in the first period to a negative of 0.73 percentage points in the second period. On the other hand, the contribution from computer and electronics improved significantly from a negative of 0.40 percentage points in the first period to a positive of 0.21 percentage points in the second. Similarly, the contributions from primary metal and food increased more than 0.40 percentage points over these two periods.

Labour productivity in the United States grew at a much faster pace than in Canada, maintaining on average a rate of 7.4 percent per year in 1997–2002 (Table 7). The superior U.S. growth rate was mainly due to the large plant productivity effect (5.8 percentage points) and to a lesser extent, the small plant productivity effect (4.5 percentage points). These effects were partly offset by a negative industrial structure effect (−2.5 percentage points). Over this period, the contribution from each industry was all positive. The largest contributors, as in Canada in 1998–2002, were other manufacturing and transportation equipment, which accounted for 1.6 and 1.4 percentage points, respectively.

Unlike in Canada, labour productivity in the United States in the second period (2002–2007) continued to grow almost at the same pace as in the first period. The productivity effects for both small and large plants were significantly smaller in the second period than in the first period, but the reduced contributions were offset by a significant increase in the industrial structure effect. As a result, on balance, the U.S. manufacturing sector did not experience a slowdown in labour productivity growth in the second period. As in Canada, the transportation equipment was the biggest drag for labour productivity growth in the United States in the second period, followed by food.

Over the period of 2002–2007, the labour productivity growth gap between Canada and the United States was 5.3 percentage points. The gap was largely due to the difference in the productivity effect of large plants, contributing 3.6 percentage points (Figure 3). This was followed by a difference of 1.7 percentage points in the productivity effect of small plants, and 0.4 percentage points in industrial structure. The plant size distribution did not contribute to the growth gap. In fact, it slightly offset some of the losses somewhere else by 0.4 percentage points.

FIGURE 3: Sources of Manufacturing Labour Productivity Growth in Canada and the United States, 2002–2007



The largest industry contributor to the growth gap was other manufacturing (1.8 percentage points), followed by transportation equipment (1.1 percentage points), computer and electronics (1.0 percentage points) and chemicals (0.9 percentage points). On the other hand, food made a larger contribution to labour productivity growth in this period in Canada than in the United States, which offset Canada's disadvantage by 0.5 percentage points.

24 The annual rate is calculated as the total growth rate over the whole period divided by the number of years in that period, which includes the compounding effect year over year and thus is larger than the compounding rate.

6. Empirical Analysis of the Canada-U.S. Manufacturing Labour Productivity Level Gap

This section decomposes the manufacturing labour productivity level gap between Canada and the United States into four components, according to equation (5). For the Canada-U.S. level comparison, Canada's real value added in 2002 Canadian dollar is adjusted into 2002 U.S. dollar, using industry value added PPPs in 2002. The Canada-U.S. manufacturing labour productivity level gap was 16.4 percent in 2002 (Table 8). All the four factors contributed to the gap. The largest contribution was from the productivity effect of small plants, which accounted for half of the gap. This was followed by 4.4 percentage points or 26.8 percent from the plant size distribution effect, due to a larger employment share of small plants in Canada than in the United States. The remainder of the gap was due to the productivity effect of large plants (15.2 percent) and the industrial structure effect (9.1 percent).

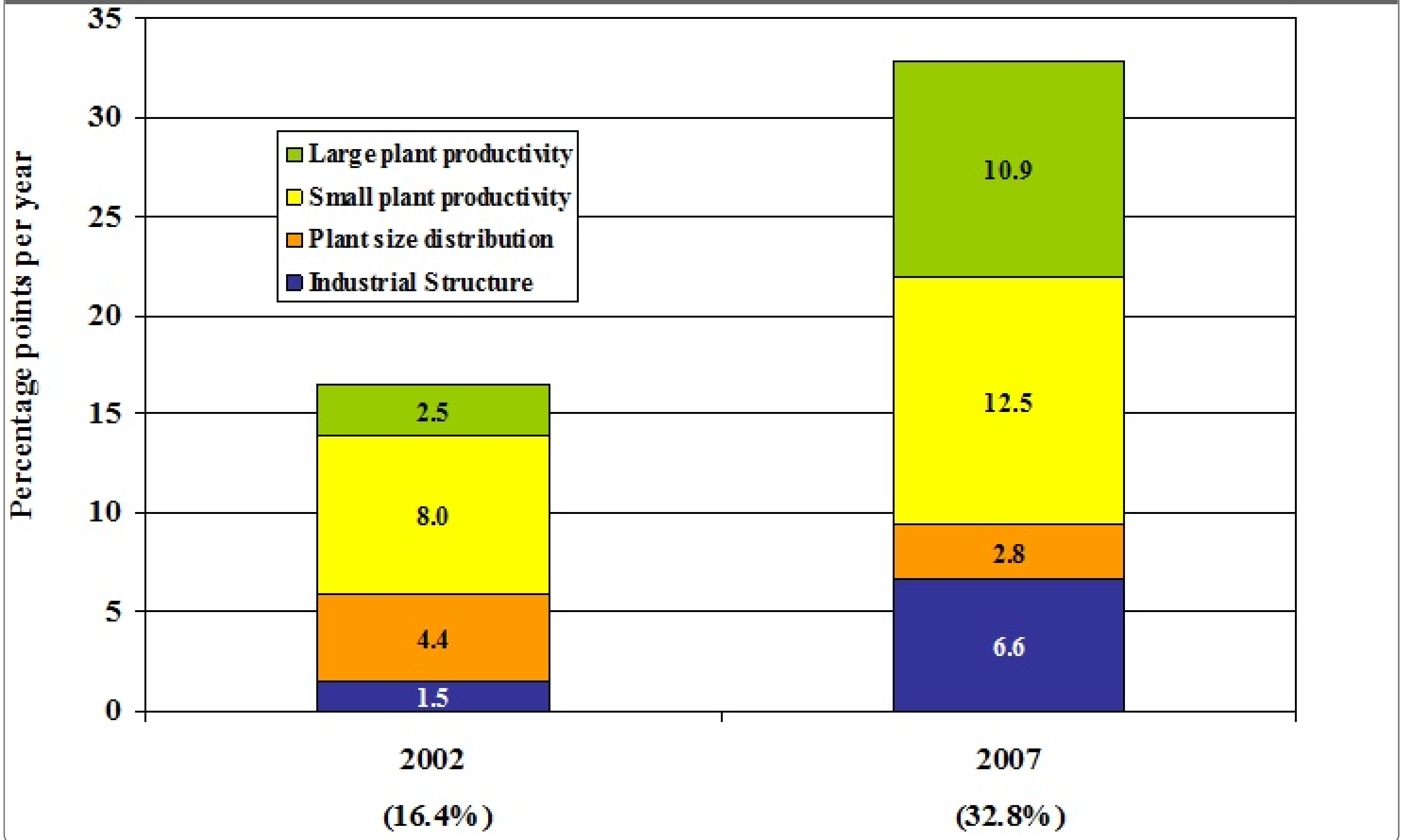
The largest industry contributor was, which accounted for 7.6 percentage points or 46.3 percent of the Canada-U.S. manufacturing gap. This was followed by chemicals, which accounted for 4.0 percentage points. On the other hand, paper and primary metal reduced the gap—they offset some of the losses elsewhere by 2.2 percentage points and 1.6 percentage points, respectively.

The Canada-U.S. manufacturing labour productivity level gap was 32.8 percent in 2007, doubled the gap in 2002. Again, the largest contribution to the gap in 2007 was from the productivity effect of small plants, accounting for 12.5 percentage points or 38.1 percent. This was followed by the productivity effect of large plants (10.9 percentage points), the industrial structure effect (6.6 percentage points) and the plant size distribution effect (2.8 percentage points).

As in 2002, the largest industry contributor to the gap in 2007 was computer and electronics (accounting for 9.4 percentage points or 28.7 percent of the gap), followed by other manufacturing (8.3 percentage points) and chemicals (6.5 percentage points). Also as in 2002, both paper and primary metal reduced the gap—they slightly offset some of the losses elsewhere by 0.8 percentage points and 1.6 percentage points, respectively.

The Canada-U.S. labour productivity level gap doubled from 16.4 percent in 2002 to 32.8 percent in 2007. The widening gap was mainly due to the widening productivity effect of large plants (from 2.5 percentage points in 2002 to 10.9 percentage points in 2007, representing 51.2 percent of the widening gap) (Figure 4).[25] The remainder was due to the widening industrial structure effect (5.1 percentage points) and the widening productivity effect of small plants (4.5 percentage points). These widening effects were offset slightly by the narrowing plant size distribution effect (-1.6 percentage points).

Figure 4: Sources of the Canada-U.S. Manufacturing Labour Productivity Level Gap, 2002 and 2007



The largest industry contributor to the widening Canada-U.S. labour productivity level gap between the two years was other manufacturing (6.6 percentage points or 40.2 percent), followed by transportation equipment (3.7 percentage points), chemicals (2.5 percentage points), and computer and electronics (1.8 percentage points).

25 Because data on price deflators and PPPs by plant size are not available, this paper applies the same industry measures to both small and large plants. These measures may be biased against large plants in Canada by underestimating their real output since large plants, who are likely exporters, tend to adjust down their product prices (in Canadian dollars) more than small plants in response to the appreciation of the Canadian dollar, as Cao et al. (2011) shows that an exchange rate movement affects producer prices in Canada and that the effect is larger for exporters than for non-exporters.

7. Concluding Remarks

Canada has lagged the United States in manufacturing labour productivity and the gap doubled between 2002 and 2007. This paper shows that while the higher small plant employment share in Canada mattered for the productivity level gap in each year, it was not responsible for its widening over this period. Similarly, it finds that while the productivity difference between Canadian and U.S. small plants was the largest contributing factor in the productivity level gap in each year, it was not the major contributor to the widening productivity gap between the two years. In fact, it was the deterioration of productivity performance of Canadian large plants relative to their U.S. counterparts that was largely responsible.

The main finding that large plants in the Canadian manufacturing sector were mainly responsible for the widening of the Canada-U.S. manufacturing labour productivity gap between 2002 and 2007 is consistent with a recent study by Baldwin, et al. (2011), which shows that almost all of the productivity growth slowdown in the Canadian manufacturing sector in the post-2000 period was driven by exporters who tend to be much larger in size. It is also in line with Chan et al. (2012), showing that the dramatic decline in labour productivity growth in the computer and electronics manufacturing industry was largely due to the decline in labour productivity growth of continuing plants, which also tend to be much larger in size.

The finding suggests that improving the underlying productivity performance of all Canadian plants instead of striving for favourable industrial structures and plant size distributions should be the centre of the economic policy design for raising Canada's aggregate productivity performance.[26]

[26] A natural question is why Canadian small plants performed relatively better than large plants in productivity over this period. One possible reason is that small plants tend to be non-exporters, serving domestic and niche markets. They are thus less likely affected by external demand shocks such as reduced demand from the U.S. markets (partly due to the appreciation of the Canadian dollar) and increased competition from emerging economies. In fact, non-exporters as well as plants that exited export markets and started to serve domestic markets in Canada performed better in productivity than exporters in 2000-2006 (Baldwin et al. 2011).

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Tables

Table 1: Industry Share of Value Added and Hours Worked in the Canadian and U.S. Manufacturing Sectors (Percent)

	Share in Nominal Value Added						Share in Hours Worked					
	1998/1997 *		2002		2007		1998/1997 *		2002		2007	
	Can	U.S.	Can	U.S.	Can	U.S.	Can	U.S.	Can	U.S.	Can	U.S.
Food	10.1	7.4	9.9	9.1	12	7.4	11	8.6	10.7	9.7	10.9	10.5
Textile, Clothing and Leather	4.1	4.3	3.7	3.2	2.5	2.2	7.2	7.6	7.2	5.8	5	4.2
Paper	8	4.3	7	4	5.9	3.5	5.5	3.7	5.3	3.6	5.5	3.4
Chemical	7.9	11.8	8.3	12.6	8.1	13.3	5	5.8	4.7	6.3	5.7	6.3
Plastics and Rubber	4.9	4.7	5.5	4.7	5	4.2	5.7	5.2	6.4	5.5	6.5	5.4
Primary Metal	6.8	3.7	6	3	8.3	3.5	5.2	3.8	4.8	3.4	4.6	3.3
Fabricated Metal	6.7	8.7	7.7	7.9	8.7	8.1	8.4	9.7	9.7	10.1	10.3	11.3
Machinery	6.9	8	6.7	7.1	7.7	7.3	7.5	8.9	7.3	8	7.4	8.7
Computer and Electronic	5.4	11.5	3.2	9.8	4.1	11.7	5.2	10.7	4.5	9.7	4.8	9
Electrical Equipment	2.4	3.1	2.1	3.2	2	2.7	2.4	3.3	2.5	3.2	2.4	3
Transportation Equipment	16.3	12.2	17.6	14.2	12.8	11.8	12.5	12	11.6	12.4	11.2	12.6
Furniture	2.9	2.3	3.6	2.4	3.5	2	4.7	3.5	5.3	4	4.5	3.8
Other Manufacturing **	17.5	18	18.8	18.9	19.4	22.6	19.6	17.3	20	18.3	21.1	18.5
Total Manufacturing	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

* 1998 for Canada and 1997 for the United States

** Other manufacturing consists of beverage and tobacco, wood, printing, petroleum and coal, non-metallic mineral and miscellaneous manufacturing.

Table 2: Relative Size of Industries in the Canadian and U.S. Manufacturing Sectors *

	Canada			United States		
	1998	2002	2007	1997	2002	2007
Food	0.11	0.11	0.12	0.07	0.1	0.1
Textile, Clothing and Leather	0.07	0.07	0.06	0.07	0.06	0.04
Paper	0.06	0.05	0.05	0.03	0.04	0.04
Chemical	0.05	0.05	0.05	0.05	0.06	0.07
Plastics and Rubber	0.06	0.06	0.07	0.05	0.05	0.06
Primary Metal	0.06	0.05	0.06	0.04	0.03	0.07
Fabricated Metal	0.08	0.1	0.11	0.08	0.1	0.12
Machinery	0.07	0.07	0.08	0.08	0.08	0.09
Computer and Electronic	0.07	0.05	0.05	0.38	0.1	0.05
Electrical Equipment	0.02	0.03	0.03	0.03	0.03	0.03
Transportation Equipment	0.11	0.12	0.08	0.1	0.12	0.11
Furniture	0.04	0.05	0.05	0.03	0.04	0.04
Other Manufacturing	0.19	0.2	0.22	0.18	0.18	0.27

* Relative size is equal to hours worked share multiplied by relative value added price. Relative industry value added price is defined as industry value added price divided by manufacturing value added price (indexed to 2002).

Table 3: Employment and Output Shares by Plant Size in the Canadian and U.S. Manufacturing Sectors

	Percent of Manufacturing Employment						Percent of Manufacturing Value Added					
	1998/1997 *		2002		2007		1998/1997 *		2002		2007	
	Can	**U.S.**	**Can**	**U.S.**	**Can**	**U.S.**	**Can**	**U.S.**	**Can**	**U.S.**	**Can**	**U.S.**
Small	76.5	67.5	79	69.6	79.6	72	64.7	54.6	66.9	57.6	72.2	59.9
0–19	7.4	8.6	11.7	9	13.1	9.6	3.8	5.1	7	5.7	9	5.6
20–99	28.1	22.3	27.6	23.3	27.9	24.5	19.8	15.9	20.2	17.2	22.8	17.4
100–499	41	36.6	39.7	37.4	38.6	37.9	41.1	33.6	39.7	34.7	40.4	36.9
Large	23.5	32.5	21	30.4	20.4	28	35.3	45.4	33.1	42.4	27.8	40.1
500–999	10.4	13.2	9.7	12.5	10	12.2	13.6	15.3	12.1	15.2	12.1	16
1000+	13	19.2	11.2	17.9	10.3	15.8	21.7	30.1	21	27.3	15.7	24.1

* 1998 for Canada and 1997 for the United States.

Table 4: Labour Productivity by Plant Size in Canadian and U.S. Manufacturing Industries

	Canada (Canadian Industry=100)								
	Small			Large			Small/Large		
	1998	2002	2007	1998	2002	2007	1998	2002	2007
Food	97.8	96.8	95.4	110.2	112.0	116.2	0.89	0.86	0.82
Textile, Clothing and Leather	100.0	100.1	101.9	99.9	99.1	76.1	1.00	1.01	1.34
Paper	86.6	93.3	97.1	125.1	114.7	109.6	0.69	0.81	0.89
Chemical	100.5	99.5	105.1	98.2	101.9	81.6	1.02	0.98	1.29
Plastics and Rubber	96.8	94.5	98.6	116.1	131.2	110.2	0.83	0.72	0.90
Primary Metal	88.3	89.5	82.1	109.6	108.5	114.4	0.81	0.82	0.72
Fabricated Metal	96.8	97.9	99.0	148.1	127.0	115.7	0.65	0.77	0.86
Machinery	89.7	92.4	98.6	165.7	153.8	109.6	0.54	0.60	0.90
Computer and Electronic	69.7	96.7	95.8	146.3	105.7	107.9	0.48	0.91	0.89
Electrical Equipment	97.9	99.9	101.9	110.1	100.5	93.1	0.89	0.99	1.09
Transportation Equipment	58.2	50.0	66.2	127.7	143.0	130.7	0.46	0.35	0.51
Furniture	91.7	95.5	99.6	139.1	125.7	104.3	0.66	0.76	0.95
Other Manufacturing	94.8	94.3	96.7	174.6	210.1	147.7	0.54	0.45	0.65
Total Manufacturing	**84.6**	**84.7**	**90.7**	**150.2**	**157.7**	**136.5**	**0.56**	**0.54**	**0.66**

United States (U.S. Industry=100)									
	Small			Large			Small/Large		
	1997	2002	2007	1997	2002	2007	1997	2002	2007
Food	103	107.1	110.8	95	88.7	83.1	1.08	1.21	1.33
Textile, Clothing and Leather	92.8	94.8	96.9	123	123.1	119.8	0.75	0.77	0.81
Paper	79.8	79.4	82.4	145.8	157.5	166	0.55	0.5	0.5
Chemical	88.9	82.5	90.5	117.2	128.3	117.9	0.76	0.64	0.77
Plastics and Rubber	93.5	97.6	97.8	128.2	108.6	113.1	0.73	0.9	0.87
Primary Metal	84.9	88.8	91.3	120.7	119.2	117.3	0.7	0.75	0.78
Fabricated Metal	97.3	97.8	98.6	120.9	118.4	114.8	0.8	0.83	0.86
Machinery	86.3	87.2	89.5	133.4	138.8	131.6	0.65	0.63	0.68
Computer and Electronic	64.5	71.3	73.1	128.7	129.4	130.6	0.5	0.55	0.56
Electrical Equipment	91.9	97.1	99.1	113	105.2	102	0.81	0.92	0.97
Transportation Equipment	62.2	62.7	62.6	120.3	122.2	126.1	0.52	0.51	0.5
Furniture	96.3	96.9	94.3	111.6	110.5	122.4	0.86	0.88	0.77
Other Manufacturing	82	82.6	74.7	188.6	192.1	255.1	0.43	0.43	0.29
Total Manufacturing	**80.8**	**82.7**	**83.1**	**139.8**	**139.7**	**143.5**	**0.58**	**0.59**	**0.58**

Table 5: Relative Labour Productivity by Plant Size in Canadian Manufacturing Industries (U.S. industry= 100 *)

	Small		Large		All		Value Added PPP *
	2002	2007	2002	2007	2002	2007	2002
Food	72.9	77.4	101.9	125.6	80.7	89.9	1.42
Textile, Clothing and Leather	58	41.4	44.2	25	54.9	39.4	1.97
Paper	125.3	118.9	77.7	66.7	106.7	101	1.31
Chemical	110.9	73.9	73	44	91.9	63.6	1.11
Plastics and Rubber	87.8	74.6	109.4	72.1	90.6	74	1.26
Primary Metal	109.3	141.1	98.9	153	108.5	156.8	1.52
Fabricated Metal	66	60.7	70.7	60.8	65.9	60.4	1.78
Machinery	99.7	94.9	104.3	71.7	94.1	86.1	1.27
Computer and Electronic	65.2	25.5	39.3	16.1	48.1	19.5	1.67
Electrical Equipment	61.3	49.2	56.9	43.7	59.6	47.9	1.62
Transportation Equipment	88.6	107.5	129.9	105.4	111	101.6	1.39
Furniture	71.2	77.7	82.2	62.7	72.3	73.6	1.83
Other Manufacturing	95.3	100.3	91.2	44.8	83.4	77.5	1.27
Total Manufacturing	**86.6**	**74.4**	**95.5**	**64.9**	**84.6**	**68.2**	**1.37**

* Industry value added PPPs are from Hao et al. (2008), which are used to adjust Canada's real value added in 2002 Canadian dollar into 2002 U.S. dollar for Canada-U.S. level comparisons.

Table 6: Decomposition of Labour Productivity Growth in the Canadian Manufacturing Sector (Percentage Points per Year)

	Industrial Structure Effect		Plant Size Distribution Effect		Small Plant Productivity Effect		Large Plant Productivity Effect		Total	
	98-02	**02-07**	**98-02**	**02-07**	**98-02**	**02-07**	**98-02**	**02-07**	**98-02**	**02-07**
Food	−0.15	0.34	0.01	0	0.27	0.19	0.09	0.09	**0.21**	**0.63**
Textile, Clothing and Leather	0	−0.11	0	0	0	−0.01	0	−0.01	**0**	**−0.13**
Paper	−0.39	−0.11	−0.02	−0.02	0.28	0.04	0.05	−0.02	**−0.09**	**−0.1**
Chemical	−0.29	0.32	0	0	0.5	−0.06	0.18	−0.13	**0.38**	**0.13**
Plastics and Rubber	0.11	0.04	−0.01	−0.01	0.13	0.01	0.07	−0.04	**0.31**	**0**
Primary Metal	−0.29	0.31	0	0	0.12	0.04	0.15	0.19	**−0.02**	**0.54**
Fabricated Metal	0.22	0.22	0.01	0	0.14	0.07	−0.01	0	**0.37**	**0.28**
Machinery	0	0.12	−0.02	0	0.15	0.3	0	−0.05	**0.13**	**0.37**
Computer and Electronic	−0.33	0.07	−0.01	0	0.12	0.08	−0.17	0.06	**−0.4**	**0.21**
Electrical Equipment	0	0.03	0	0	0	−0.01	−0.01	−0.01	**−0.01**	**0.01**
Transportation Equipment	0.28	−1.26	−0.24	−0.03	−0.03	0.38	0.8	0.18	**0.81**	**−0.73**
Furniture	0.13	0.02	−0.01	−0.01	0.08	0.04	0	−0.01	**0.21**	**0.04**
Other Manufacturing	0.36	0.39	−0.08	0.05	0.48	0.21	0.17	−0.14	**0.92**	**0.51**
Total Manufacturing	**−0.36**	**0.37**	**−0.36**	**−0.01**	**2.23**	**1.3**	**1.31**	**0.1**	**2.82**	**1.76**

Table 7: Decomposition of Labour Productivity Growth in the U.S. Manufacturing Sector (Percentage Points per Year)

	Industrial Structure Effect		Plant Size Distribution Effect		Small Plant Productivity Effect		Large Plant Productivity Effect		Total	
	97-02	**02-07**	**97-02**	**02-07**	**97-02**	**02-07**	**97-02**	**02-07**	**97-02**	**02-07**
Food	0.52	0.14	0	0	0.37	0.07	0.13	−0.03	**1.02**	**0.18**
Textile, Clothing and Leather	−0.17	−0.23	−0.01	−0.01	0.14	0.15	0.05	0.03	**0.01**	**−0.05**
Paper	0.06	0.09	−0.03	−0.04	0.09	0.05	0.1	0.04	**0.23**	**0.14**
Chemical	0.63	0.22	−0.01	−0.04	0.14	0.62	0.35	0.26	**1.11**	**1.07**
Plastics and Rubber	0.2	0.03	0.01	−0.01	0.16	0.14	−0.01	0.05	**0.36**	**0.21**
Primary Metal	−0.13	0.5	−0.01	−0.01	0.13	−0.08	0.1	−0.07	**0.09**	**0.35**
Fabricated Metal	0.38	0.36	0	−0.01	0.04	0.24	0	0.02	**0.42**	**0.61**
Machinery	0.12	0.12	−0.04	0	0.16	0.3	0.11	0.11	**0.35**	**0.54**
Computer and Electronic	−4.82	−1.94	−0.09	−0.04	1.72	1.19	3.58	1.98	**0.4**	**1.2**
Electrical Equipment	0.04	−0.02	0	0	0.15	0.09	0.06	0.03	**0.25**	**0.1**
Transportation Equipment	0.54	−0.43	−0.04	−0.07	0.21	0.19	0.73	0.66	**1.44**	**0.35**
Furniture	0.09	0.06	0	0	0.08	0	0.03	0.02	**0.2**	**0.07**
Other Manufacturing	0.01	1.84	−0.05	−0.14	1.1	0.01	0.51	0.62	**1.58**	**2.34**
Total Manufacturing	**−2.52**	**0.75**	**−0.29**	**−0.36**	**4.5**	**2.97**	**5.75**	**3.72**	**7.44**	**7.08**

Table 8: Decomposition of the Canada-U.S. Manufacturing Labour Productivity Level Gap (Percentage Points)

	Industrial Structure Effect		Plant Size Distribution Effect		Small Plant Productivity Effect		Large Plant Productivity Effect		**Total**	
	2002	**2007**	**2002**	**2007**	**2002**	**2007**	**2002**	**2007**	**2002**	**2007**
Food	−0.8	−1.4	0	0	2	1.4	0	−0.5	**1**	**−0.5**
Textile, Clothing and Leather	−0.6	−0.6	0	0	1.2	1.3	0.4	0.2	**1**	**1**
Paper	−1.9	−0.7	−0.1	0	−0.7	−0.5	0.5	0.5	**−2.2**	**−0.8**
Chemical	3	2	0.5	0.1	−0.7	2	1.2	2.3	**4**	**6.5**
Plastics and Rubber	−0.8	−0.7	0.1	0	0.5	1	−0.1	0.2	**−0.3**	**0.5**
Primary Metal	−1.3	0.3	−0.2	−0.3	−0.2	−0.7	0	−0.9	**−1.6**	**−1.6**
Fabricated Metal	0.2	0.4	0.1	0	2.3	2.8	0.2	0.3	**2.9**	**3.5**
Machinery	0.7	0.6	0.5	0.2	0	0.3	−0.1	0.5	**1.1**	**1.6**
Computer and Electronic	3.7	0	0.4	0.4	1	3.8	2.6	5.2	**7.6**	**9.4**
Electrical Equipment	0.5	0.2	0	0	0.8	0.9	0.4	0.4	**1.7**	**1.6**
Transportation Equipment	1	3.3	1	0.4	0.4	−0.2	−2.9	−0.4	**−0.5**	**3.2**
Furniture	−0.7	−0.4	0	0	0.6	0.4	0.1	0.1	**0.1**	**0.2**
Other Manufacturing	−1.5	3.5	2.2	1.8	0.7	0	0.3	3.1	**1.7**	**8.3**
Total Manufacturing	1.5	6.6	4.4	2.8	8	12.5	2.5	10.9	**16.4**	**32.8**