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Innovation Capabilities: Comparing Science and Engineering Employment in Canadian and U.S. Cities

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Preface

In recent years, cities have become increasingly interested in their ability to generate, attract and retain human capital. One measure of human capital is employment in science- and engineering-based occupations. This paper provides a comparison of the employment shares of these specialized occupations across Canadian and U.S. cities by using data from the Canadian and the U.S. censuses from 1980-1981 and 2000-2001. The paper, therefore, provides a perspective on how Canadian cities performed relative to their U.S. counterparts over a 20-year period. It also seeks to evaluate how cities of different sizes have performed, because large cities may be advantaged over smaller cities in terms of factors influencing both the demand for, and supply of, scientists and engineers.

Keywords: human capital, science and engineering occupations, urban economies, innovation, economic growth, and urban labour markets

Executive summary

It has long been argued that one of the keys to economic growth is investment in human capital. In Canada, there is evidence that increases in human capital are associated with higher levels of productivity growth, which in turn is an important contributor to long-run economic growth.

We measure human capital in this paper by looking at employment in science and engineering (S&E) occupations. These are occupations that require large investments in human capital. Moreover, the activities of scientists and engineers are seen by many as essential to technological innovation and economic growth.

In recent years, cities have become increasingly interested in attracting human capital. At least in part, this interest stems from the positive association between high levels of human capital and population growth across cities. Naturally following from this interest is a need to find a basis of comparison—that is, to see how individual cities are performing relative to each other. As Canada is increasingly integrated into a North American labour market for skilled professionals, Canadian cities have begun to compete on a continent-wide basis. Therefore, there is not only a need to compare Canadian cities with each other, but also with their U.S. counterparts. This paper helps to fill this need.

The comparison of North American cities is facilitated by data derived from the Canadian and U.S. censuses from the early 1980s (1980 United States and 1981 Canada) and the early 2000s (2000 United States and 2001 Canada). Therefore, the paper provides both a recent measure of how Canadian and U.S. metropolitan areas (or, more simply put, cities) compare, but also how they have performed relative to each other over time.

We find that in 1980 and 1981, the science and engineering share of employment in Canadian cities lagged slightly behind U.S. cities (2.9% versus 3.0%). But in the ensuing two decades science and engineering employment in Canadian cities grew at a faster pace than in U.S. cities, such that by 2000 and 2001 the share of S&E employment in Canadian cities was somewhat higher than their U.S. counterparts (5.6% versus 5.1%).

Science and engineering employment is not spread equally across cities. For some cities, 1 in 10 employed workers are in science- and engineering-based occupations, while in others this ratio falls to only 1 in 100. Yet, whether one city does better than another is not purely random.

There is a strong positive association between city size and the share of its workforce in science and engineering occupations. On average, cities with a population over 4 million have an S&E employment share of 6.3%, while the S&E share of employment in cities with a population between 100,000 and 249,999 is 3.3%.

Not only are larger cities advantaged, but their advantage has been increasing. On average, larger cities experienced a greater increase in their S&E employment share between the years 1980 and 1981 and the years 2000 and 2001.

In addition to addressing these broad themes, the study also provides a detailed comparison of Canadian and U.S. cities. The analysis demonstrated the following:

- Across 316 cities in North America in 2000 and 2001 with a population over 100,000, 4 Canadian cities ranked in the top 30 based on their level of S&E employment. Toronto ranked 7th (161,600 S&E employees), followed by Montréal, which ranked 16th (91,500), Ottawa–Gatineau, ranked 21st (65,300) and Vancouver, ranked 26th (51,300).

- As measured by their S&E share of overall employment, 3 Canadian cities made the top 30. Ottawa–Gatineau ranked 2nd, with an S&E share of 11.6%. Only San Jose, which forms the core of 'Silicon Valley', had a higher share. Meanwhile Calgary ranked 22nd and Toronto 30th.

- When compared to cities of similar size, Canadian cities performed as well as their U.S. counterparts. Notably, Toronto ranked 3rd out of the 10 cities with a population greater than 4 million. Montréal ranked 8th out of 15 cities with a population between 2 and 4 million. Ottawa–Gatineau ranked 2nd out of the 28 cities with a population between 1 and 2 million. Calgary ranked 2nd out of 43 cities with a population between 500,000 and 999,999. Meanwhile, Victoria ranked 17th out 78 cities with a population between 250,000 and 499,999 and St. John's ranked 22nd out of 142 cities with a population between 100,000 and 249,999.

- In terms of S&E employment share change between 1981 and 2001, Ottawa–Gatineau increased its share more than any other Canadian city. Ottawa–Gatineau's S&E employment share rose from 5.2% in 1981 to 11.6% in 2001. Toronto was second to Ottawa–Gatineau, increasing its share by 3.5 percentage points from 3.2% to 6.7%. Montréal saw the third highest share change, increasing its S&E share from 2.6% to 5.5%. The smallest share increases were in St. Catherines–Niagara (0.3 percentage points), Saguenay (0.6 percentage points) and Greater Sudbury (0.8 percentage points).

Chapter 1. Introduction

It has long been argued that one of the keys to economic growth is investment in human capital.[1] In Canada, there is evidence that increases in human capital are associated with higher levels of productivity growth, which in turn is an important contributor to long-run economic growth.[2]

Human capital can be measured in several ways. Educational attainment combined with years of working experience is the most commonly used method of quantifying human capital. In this paper, we take a simpler approach and identify individuals who work in occupations that require large investments in human capital. Scientists and engineers figure prominently in this regard. Moreover, their activities are seen by many as essential to technological innovation and economic growth. For instance, the Progressive Policy Institute begins its analysis of changes in engineering and science employment by noting that "[t]echnological innovation is one of the key drivers of overall economic progress, and it is fuelled by a strong engineering and scientific workforce".[3] Similarly, the National Science Foundation notes that scientists and engineers "contribute enormously to technological innovation and economic growth, research, and increased knowledge".[4] Given the importance given to scientists and engineers as drivers of technological change and economic growth, we limit our measure to workers in science and engineering (S&E) occupations.

In recent years, cities have become increasingly interested in attracting human capital.[5] At least in part, this interest stems from the positive effect that high levels of human capital can have on future growth.[6] Naturally following from this interest is a need to find a basis of comparison; that is, to see how individual cities are performing relative to each other. The purpose of this paper is to provide such a comparison.

As Canada is increasingly integrated into a North American labour market for skilled professionals,[7] Canadian cities have begun to compete on a continent-wide basis. Hence, it is necessary to compare the performance of Canadian cities to U.S. cities.[8] To this end, this paper provides an evaluation of the relative strength of employment in science- and engineering-based occupations in cities across Canada and the United States.

Performance is measured in two ways. First, Canadian and U.S. cities are compared based on the share of their employed population in S&E occupations in the early 2000s. Here we use the most recently available data to determine whether S&E employment is more or less important in Canadian and U.S. cities. Many analysts are interested not only in how Canadian

cities fare in general, but also how individual metropolitan areas perform. To this end, we present the S&E employment shares of individual Canadian cities and how they rank on a North American wide basis.

The mechanics of how we go about comparing cities, be they in Canada or in the United States, is important. There is a growing literature[9] that suggests larger cities tend to have higher shares of workers with highly specialized skills, like scientists and engineers. Hence, we not only show how Canadian cities rank compared to all cities in North America, but also how they compare to their peer cities of similar size (e.g., Toronto and Boston, or Halifax and Ann Arbor).

Second, in addition to providing a snapshot of Canadian and U.S. cities at the turn of the last century, we also compared them in terms of their performance over the previous 20 years. As a result, we are able to determine whether the trend in S&E employment shares is favourable or unfavourable for Canadian cities. We also ask which cities have experienced the strongest increase in their S&E employment shares over the past two decades.

The remainder of the paper is organized as follows. In the next section (Section 2), we describe the sources of the data for the analysis and how we define science and engineering occupations. This is followed by a brief overview of how the Canadian and U.S. labour forces compare in terms of S&E employment in the 1980 and 1981 period and the 2000 and 2001 period (Section 3). After this, the paper focuses on how Canadian and U.S. cities compare. The analysis is divided into two sections that address first how Canadian and U.S. cities compare in 2000 and 2001 (Section 4) and second, how they have changed over time between the 1980 and 1981 period and the 2000 and 2001 period (Section 5). The paper ends with a brief conclusion (Section 6).

Endnotes

1. Lucas (1988).
2. See Gu et al. (2003).
3. Atkinson and Court (1998: 41).
4. National Science Board (2004: Chapter 3, 5).
5. See Florida (2002a, b) and Gertler et al. (2002).
6. Glaeser and Saiz (2004).
7. Devoretz and Coulombe (2005: 436) in their extensive review of the evidence on North American integration conclude that there is substantial labour market integration for selected occupations.
8. Recent comparisons of the economic and social characteristics of Canadian and U.S. metropolitan areas can be found in Gertler et al. (2002) and Polèse and Tremblay (2005).
9. This literature is discussed in more detail in Section 4.2.

Chapter 2. Data

The data for this project are derived from the 1980 and 2000 U.S. censuses and the 1981 and 2001 Canadian censuses.[10] Both censuses provide information on the location and occupation of workers. The locational information allows us to link workers to specific cities, while the occupational information allows us to identify scientists and engineers.[11]

We base our definition of scientists and engineers on the National Science Foundation's S&E occupational framework. The S&E occupations are drawn from five categories: computer and mathematical scientists, life and related scientists, physical and related scientists, social and related scientists, and engineers. Table 1 outlines a more detailed description of these occupations.

Table 1 Description of science and engineering occupations

Computer and mathematical scientists
Computer and information scientists
Mathematical scientists
Post-secondary teachers–computer and mathematical sciences
Life and related scientists
Agricultural and food scientists
Biological and medical scientists
Environmental life scientists
Post-secondary teachers–life and related sciences
Physical and related scientists
Chemists, except biochemists
Earth scientists, geologists and oceanographers
Physicists and astronomers
Other physical and related scientists
Post-secondary teachers–physical and related sciences
Social and related scientists
Economists
Political scientists
Psychologists
Sociologists and anthropologists
Other social and related scientists
Post-secondary teachers–social and related sciences
Engineers
Aerospace and related engineers
Chemical engineers
Civil and architectural engineers
Electrical and related engineers
Industrial engineers
Mechanical engineers
Other engineers
Post-secondary teachers–engineering

Source: National Science Foundation (NSF).

Canadian cities are defined as Census Metropolitan Areas (CMA) and Census Agglomerations (CA) as defined by Statistics Canada. U.S. cities are defined using the Metropolitan Statistical Area (MSA) definition of cities utilized by the U.S. Census Bureau. Since MSAs are limited to those areas with a population of 100,000 or more we exclude Canadian CMAs/CAs with a population less than 100,000. In 2000 and 2001, of the 316 metropolitan areas in our sample, 282 are U.S. and 34 are Canadian. For ease of exposition, throughout the paper we will describe CMAs/CAs and MSAs as simply 'cities'.

Endnotes

10. Since we require occupational information, we need data from the more detailed 'long forms' that are distributed to approximately every one in six households in the United States, and every one in five in Canada (Census 2B). For the U.S. data, we used the PUMS data file, which is composed of a sample drawn from the one in six household sample that amounts to 5% of the U.S. population.
11. See Beckstead and Gellatly (2006) for a discussion of alternate measures of the incidence of scientists and engineers.

Chapter 3. Change in science and engineering and related employment between 1981 and 2001

The proportion of employed workers in S&E occupations in Canada and the United States both increased between the 1980 and 1981 period and the 2000 and 2001 period (see Table 2). In 1980, 2.6% of employed workers in the United States worked in S&E occupations, while in 1981 this share was 2.3% for Canada. By 2000, the share of workers in the United States in S&E occupations had increased to 4.5% and this share was matched by Canada.[12]

Table 2 provides us with an overall picture of the importance of S&E occupations, but it does not provide us with a picture of how cities in general have performed. We do not know whether S&E occupations are more prevalent in larger urban centres relative to smaller centers and rural areas nor whether employment has become more concentrated in larger urban centres over time. To answer these basic questions, we divide employed workers into two groups: (1) workers who are living in relatively large cities with a population of 100,000 and more (Cities) and (2) workers who are living in smaller cities and rural areas (Small Urban-Rural). Table 3 presents the results of this breakdown.

Table 2 Canada and United States science and engineering employment shares, for the years 1980, 1981 and 2000, 2001 (percentage)

	1980 and 1981	2000 and 2001
Canada	2.3	4.5
United States	2.6	4.5

Source: Canadian censuses (1981 and 2001) and U.S. censuses (1980 and 2000).

Table 3 Cities and small urban-rural science and engineering shares of employment, for the years 1980, 1981 and 2000, 2001 (percentage)

	1980 and 1981		2000 and 2001	
	Cities	Small urban-rural	Cities	Small urban-rural
Canada	2.9	1.3	5.6	2.0
United States	3.0	1.6	5.1	2.3

Source: Canadian censuses (1981 and 2001) and U.S. censuses (1980 and 2000).

Science and engineering employment accounts for a larger share of employment in Cities than in Small Urban-Rural areas in both countries and this gap has widened over time. In 1980, the share of employment in cities was roughly twice that of Small Urban-Rural areas in the United States at 3.0% and 1.6%, respectively. Cities in the United States increased their S&E share of employment by 2.1 percentage points between 1980 and 2000, while Small Urban-Rural areas increased their share by only 0.7 percentage points. The same pattern was repeated for Canada. There appears to be an urban focus in terms of the incidence *and* the growth in science and engineering occupations. This is a theme that we will return to in the two subsequent sections.

Table 3 also provides evidence that much of the difference in S&E employment shares between Canada and the United States in 1980 and 1981 was due to relatively low levels of S&E employment in Small Urban-Rural areas in Canada. In Small Urban-Rural areas in the United States, the incidence of S&E employment was 1.6%. It was 1.3% in Canada. This gap continued to be present in 2000 and 2001.

In contrast to Small Urban-Rural areas, Canadian cities have performed well relative to their U.S. counterparts. In 1980 and 1981, their share of employment in S&E occupations was just behind that of U.S. cities and by 2000 and 2001 the S&E employment share in Canadian cities was above that of U.S. cities.

The remainder of the paper will focus on those metropolitan areas in Canada and the United States that fall within the Cities classification. We ask how specific Canadian cities compare to their U.S. counterparts in 2000 and 2001 and how they have evolved since 1980 and 1981.

Endnotes

12. See Beckstead and Gellatly (2006) for a more detailed discussion of trends in S&E employment at the national scale.

Chapter 4. Comparing Canadian and U.S. cities in 2000 and 2001

The objective of this section is to develop a comparison of S&E employment across Canadian and U.S. cities. The comparison is based on the absolute size of S&E employment and on the S&E share of employment in each city. The former provides a measure of which cities are the most important locations for S&E employment, while the latter helps to identify cities whose employment is concentrated in S&E occupations. The S&E share of employment also serves as a measure of the ability of urban economies to support S&E employment.

The main purpose of any city comparison is to see how cities rank relative to each other. However, as will become clear, this is not purely a matter of listing the highest ranked cities—although this is done. Rather, since there is such a strong positive relationship between city size and S&E employment shares, it is also necessary to compare cities of similar size. Arguably, this peer-based comparison provides a more appropriate measure of performance. Finally, it is important to note that, given the large number of cities in our sample, it is impossible to present them all in the main text of the paper. For the interested reader, all comparative measures developed in this section are presented in Appendix A for all 316 Canadian and U.S. cities.

4.1 Ranking Canadian and U.S. cities by science and engineering employment

The first step in the analysis is to compare levels of S&E employment across Canadian and U.S. cities. This provides us with a measure of how Canadian cities rank in terms of the absolute size of S&E employment. Presented in Table 4 are the levels of S&E employment for the top 30 cities of the 316 Canadian and U.S. cities in our sample, or about the top 10%. Also reported in the table are the population and the population ranks of these same cities.

In term of absolute size, the New York, Washington and Los Angeles metropolitan areas have the largest S&E workforces. There are four Canadian cities that make the top 30. Toronto ranks seventh in terms of S&E employment, as it also does in terms of population. Montréal ranks 16th for S&E employment, slightly behind its 13th population rank. Remarkably, Ottawa–Gatineau ranks 21st in term of S&E employment, while ranking only 51st by population. Finally, Vancouver ranks 26th in term of S&E employment and population.

Table 4 Science and engineering (S&E) employment levels for the top 30 North American cities, 2000 and 2001

	S&E employment	Rank	Population	Rank
New York-Northeastern, N.J.	369,193	1	17,244,066	1
Washington, D.C./Md./Va.	271,804	2	4,733,359	6
Los Angeles-Long Beach, Calif.	239,237	3	12,368,516	2
Chicago-Gary-Lake, Ill.	211,198	4	8,804,453	3
San Francisco-Oakland-Vallejo, Calif.	184,596	5	4,645,830	8
Boston, Mass.	167,285	6	3,951,557	12
Toronto	161,552	7	4,682,898	7
Dallas-Fort Worth, Tex.	156,797	8	5,043,876	5
San Jose, Calif.	133,121	9	1,688,089	28
Philadelphia, Pa./N.J.	126,213	10	5,082,137	4
Detroit, Mich.	124,992	11	4,430,477	9
Atlanta, Ga.	118,578	12	3,987,990	11
Houston-Brazoria, Tex.	114,318	13	4,413,414	10
Seattle-Everett, Wash.	105,929	14	2,332,682	21
Minneapolis-St. Paul, Minn.	100,067	15	2,856,295	16
Montréal	91,523	16	3,426,350	13
Denver-Boulder-Longmont, Colo.	90,420	17	2,198,801	25
Baltimore, Md.	84,918	18	2,513,661	19
San Diego, Calif.	78,935	19	2,807,873	17
Phoenix, Ariz.	75,590	20	3,070,331	15
Ottawa–Gatineau	65,332	21	1,063,664	51
Raleigh-Durham, N.C.	62,994	22	1,182,869	45
St. Louis, Mo./Ill.	62,202	23	2,602,448	18
Austin, Tex.	56,210	24	1,167,216	47
Portland-Vancouver, Ore./Wash.	51,372	25	1,789,019	27
Vancouver	51,280	26	1,986,965	26
Sacramento, Calif.	47,303	27	1,632,863	31
Pittsburgh-Beaver Valley, Pa.	47,224	28	2,285,064	22
Cleveland, Ohio	44,366	29	2,255,480	23
Columbus, Ohio	44,319	30	1,443,293	39

Source: Canadian Census (2001) and U.S. Census (2000).

Absolute size provides one perspective on the variation in S&E employment across cities. Alternatively, we can observe the share of employed workers who are employed in S&E occupations—a measure of how important S&E employment is for each city. The average S&E share of employment for Canadian cities in 2001 was 4.2%, while the average for the United States is slightly lower at 4.0%. These averages are less than those presented in Table 3 (above), because they are not weighted by the level of S&E employment in each city. Smaller cities are more numerous than large cities and, as we will illustrate, they tend to have lower S&E employment shares. As a result, the unweighted or arithmetic averages presented here are lower than those presented in Table 3.

The top 30 cities ranked by share are presented in Table 5. Three Canadian cities make the top 30 in terms of S&E employment shares—Ottawa–Gatineau, Calgary and Toronto. Ottawa–Gatineau ranks second only to San Jose, which encompasses much of 'Silicon Valley'.[13] Ottawa–Gatineau's high placing suggests its moniker of 'Silicon Valley North' is not without justification—see Box 1 for a more detailed comparison on Ottawa–Gatineau and San Jose. The remainder of the Canadian contingent in the top 30 is made up of Calgary (ranked 22nd) and Toronto (ranked 30th).

Table 5 Science and engineering employment shares for the top 30 North American cities, 2000 and 2001

	Share (%)	Rank
San Jose, Calif.	15.7	1
Ottawa–Gatineau	11.6	2
Huntsville, Ala.	11.1	3
Nashua, N.H.	11.1	4
Washington, D.C./Md./Na.	10.9	5
Raleigh-Durham, N.C.	10.0	6
Rochester, Minn.	9.6	7
Ann Arbor, Mich.	9.2	8
Austin, Tex.	9.0	9
Santa Fe, N.Mex.	8.9	10
Seattle-Everett, Wash.	8.6	11
Boston, Mass.	8.3	12
Yolo, Calif.	8.0	13
Fort Collins-Loveland, Colo.	8.0	14
San Francisco-Oakland-Vallejo, Calif.	8.0	15
Trenton, N.J.	8.0	16
Dutchess County, N.Y.	7.9	17
Santa Cruz, Calif.	7.8	18
Melbourne-Titusville-Cocoa-Palm Bay, Fla.	7.8	19
Denver-Boulder-Longmont, Colo.	7.8	20
Colorado Springs, Colo.	7.8	21
Calgary	7.6	22
Madison, Wis.	7.5	23
Richland-Kennewick-Pasco, Wash.	7.4	24
State College, Pa.	7.1	25
Bloomington-Normal, Ill.	7.0	26
Baltimore, Md.	6.9	27
Wilmington, Del./N.J./Md.	6.9	28
Champaign-Urbana-Rantoul, Ill.	6.7	29
Toronto	6.7	30

Source: Canadian Census (2001) and U.S. Census (2000).

Comparing the top 30 Canadian and U.S. cities provides us with a picture of the top end of the distribution of S&E employment and employment shares, but it does not provide an overall picture of how Canadian and U.S. cities compare or how shares of S&E employment vary by city size.

4.2. Science and engineering share of employment by city population size

Large cities may be particularly advantaged as locations of science and engineering employment. This advantage stems from factors that influence the demand for scientists and engineers by larger urban economies and the supply of scientists and engineers to them. Although it is often difficult to disentangle demand and supply factors, we will address them separately below.

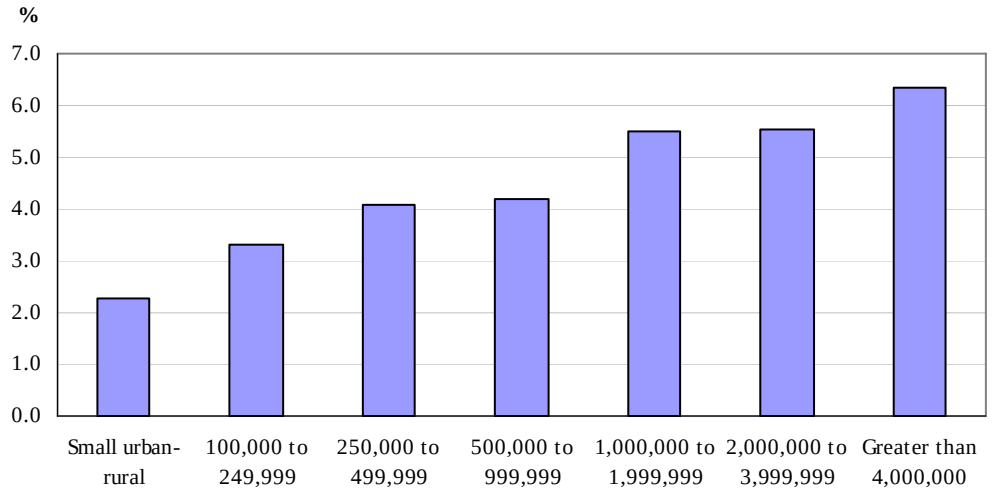
The supply of scientists and engineers may be influenced by two forces. The first force relates to the difficulty of matching the highly specialized skills of scientists and engineers with the skill requirements of employers. Large labour markets help to improve the efficiency of this matching process and the quality of the matches because they offer a large set of employers and potential workers.[14] Improving the efficiency of the matching process potentially reduces the search costs of employers and the period of unemployment for workers. Improving the quality of matches increases the productivity of workers, possibly resulting in higher worker wages. Higher wages combined with potentially shorter periods of unemployment raises the incentive for scientists and engineers to move to larger cities.

The second force concerns the incentives that large urban labour markets create for workers to invest in their level of human capital. Large cities have a large number of firms that, in turn, create demand for a wide variety of specialized skills. This creates an incentive for workers to invest in their human capital because there is more likely to be a close match between their skills and the needs of local firms.[15] In other words, the extra investment that workers make in specialized training is more likely to result in a higher paying job if the city is larger. For workers in a smaller city, there is less incentive to invest in these specialized skills because there will be fewer local firms that would require them, reducing the possibility of a good match. With imperfect information about job opportunities in other cities, combined with the economic and social costs of moving, it is likely that fewer students will invest in a specialized set of skills in a small city compared to a large one. Hence, irrespective of their ability to attract highly skilled workers, large cities may be more effective than smaller ones in generating a supply of specialized forms of human capital, like scientists and engineers, that their employers demand.

On the demand side, the benefits of more efficient and effective labour market matching that helps to attract scientists and engineers may also attract potential employers. Employers in larger labour markets will tend to have lower search costs and will find workers with a better match to their needs. Both of these may draw employers to larger urban economies. Larger urban areas may also have a higher demand for scientists and engineers because of their industrial compositions. Industries that tend to demand the skills of scientists and engineers may also tend to locate in larger centres. For instance, Information and Communication Technology (ICT) industries that drove the so-called 'New Economy' during the 1990s are heavily concentrated in large cities.[16] Although we cannot discount the possibility that high technology industries are attracted to larger cities because of their large pools of highly skilled labour, it is also likely that they are attracted to these centers because their highly diverse industrial structures help to facilitate the transmission of new ideas across firms[17] and allow firms to access a wide variety of inputs in a stage of their life cycle when there is considerably uncertainty about which inputs they require.[18]

We will not attempt to identify the relative significance of these demands and supply factors here. Rather the point to be drawn is that there are reasons to believe both the demand for and the supply of scientists and engineers may be higher in large cities, and therefore, we should consider population size when we are comparing cities.

Figure 1 Science and engineering average employment shares by size class, 2000 and 2001



Source: Canadian Census (2001) and U.S. Census (2000).

To test the relationship between the location of S&E occupations and city size, we divide cities into six size classes. Within each size class, there is at least one Canadian city. The largest size class (cities of 4 million persons or more) includes only 10 cities, while the smallest size class (cities between 100,000 and 249,999 persons) includes some 142 cities. The proportion of workers in S&E occupations is averaged across cities within each size class. To further illustrate the relationship between size and S&E employment shares, Figure 1 also includes the S&E share of employment for Small Urban-Rural areas across Canada and the United States.[19]

Figure 1 shows that there is a strong positive association between city size and the share of employment in S&E occupations. For instance, cities with a population greater than 4 million have almost twice the S&E employment share as cities with a population between 100,000 and 249,999 and almost 3 times the S&E employment share of the Small Urban-Rural class. Further statistical testing confirms the positive association between city size and S&E employment shares.[20]

One of the implications to be drawn from Figure 1 is that we should be comparing Canadian and U.S. cities of similar size in order to see how Canadian cities rank relative to their U.S. counterparts. Table 6 presents Canadian and U.S. cities for each of the six city-size classes, with each city ranked by its S&E employment share. Since there are 316 cities in our data set, it is difficult to present all of them in this table (see Appendix A). Therefore, for each city-size class we report the top three cities, the median city and the bottom city. We also report all Canadian cities that fall within each city-size class.

Table 6 Science and engineering (S&E) employment shares of total employment by city size class, 2000 and 2001

City size class	S&E share (percentage)	Rank	
Greater than 4,000,000			
Washington, D.C./Md./Va.	10.9	1	
San Francisco-Oakland-Vallejo, Calif.	8.0	2	
Toronto	6.7	3	
Detroit, Mich.	6.1	5	Median
Los Angeles-Long Beach, Calif.	4.5	10	
Average	6.3	...	
2,000,000 to 3,999,999			
Seattle-Everett, Wash.	8.6	1	
Boston, Mass.	8.3	2	
Denver-Boulder-Longmont, Colo.	7.8	3	
Montréal	5.5	8	Median
Miami-Hialeah, Flo.	2.5	15	
Average	5.6	...	
1,000,000 to 1,999,999			
San Jose, Calif.	15.7	1	
Ottawa–Gatineau	11.6	2	
Raleigh-Durham, N.C.	10.0	3	
Vancouver	5.2	12	
Salt Lake City-Ogden, Utah	5.0	14	Median
Las Vegas, Nev.	2.2	28	
Average	5.5	...	
500,000 to 999,999			
Colorado Springs, Colo.	7.8	1	
Calgary	7.6	2	
Québec	6.2	3	
Edmonton	4.5	17	
Akron, Ohio	4.1	21	Median
Hamilton	3.9	24	
Winnipeg	3.8	26	
McAllen-Edinburg-Pharr-Mission, Tex.	1.2	43	
Average	4.2	...	
250,000 to 499,999			
Huntsville, Ala.	11.1	1	
Ann Arbor, Mich.	9.2	2	
Trenton, N.J.	8.0	3	
Victoria	5.2	17	
Kitchener	4.9	22	
Halifax	4.8	23	
Oshawa	4.6	25	
London	4.0	34	
Windsor	3.8	39	Median
St. Catharines–Niagara	2.3	66	
Visalia-Tulare-Porterville, Calif.	1.0	78	
Average	4.1	...	

... not applicable

Source: Canadian Census (2001) and U.S. Census (2000).

Table 6 Science and engineering (S&E) employment shares of total employment by city size class, 2000 and 2001 (concluded)

City size class	S&E share (percentage)	Rank	
100,000 to 249,999			
Nashua, N.H.	11.1	1	
Rochester, Minn.	9.6	2	
Santa Fe, N.Mex.	8.9	3	
St. John's	5.1	22	
Guelph	4.9	24	
Regina	4.8	27	
Saint John	4.1	35	
Kingston	4.0	36	
Moncton	4.0	37	
Saskatoon	3.7	42	
Roanoke, Va.	3.2	57	Median
Sherbrooke	3.1	63	
Barrie	3.0	64	
Trois-Rivières	2.9	70	
Saguenay	2.9	71	
Greater Sudbury	2.8	78	
Thunder Bay	2.6	81	
Kelowna	2.6	84	
Chatham–Kent	2.2	98	
Abbotsford	1.8	116	
Cape Breton	1.5	132	
Danville, Va.	0.6	142	
Average	3.3	...	

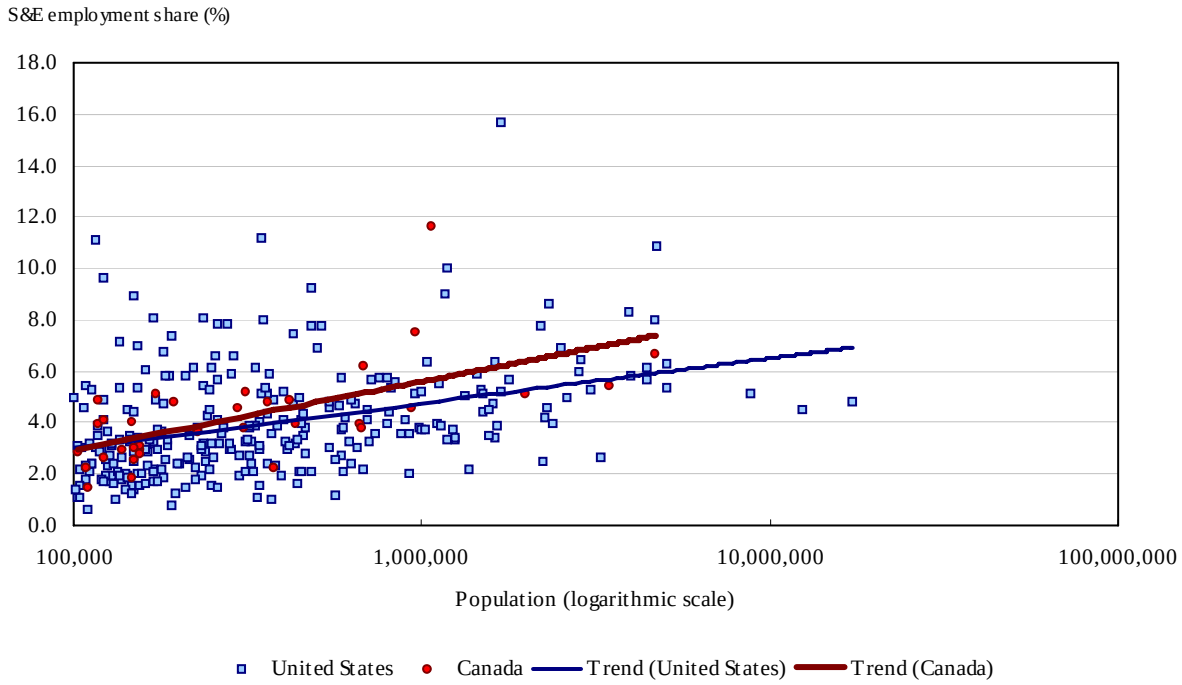
... not applicable

Source: Canadian Census (2001) and U.S. Census (2000).

Within each size class many Canadian cities perform well. For instance, Toronto is 3rd out of 10 cities with a population greater than 4 million. Montréal is in the middle (median) of 15 cities in the 2 to 4 million class. Ottawa–Gatineau is ranked 2nd and Vancouver is ranked 12th in the 28 cities in the 1 to 2 million class. In the 0.5 to 1 million size class, Calgary is 2nd and Quebec 3rd. Victoria (17), Kitchener (22) and Halifax (23) are the top Canadian cities in the 78 cities in the 250,000 to 499,999 size class, while St. John's (22), Guelph (24) and Regina (27) are the highest ranked Canadian cities of the 142 cities in the 100,000 to 249,999 size class.

It is difficult to tell directly from Table 6 whether Canadian cities fare any better or worse than U.S. cities after controlling for size. For all but the smallest size class, there are more Canadian cities at or above the median than below the median. However, with so few observations for the larger size classes, it is difficult to tell whether these differences are due to chance. Figure 2 plots the relationship between population size and S&E shares for Canadian and U.S. cities. Also included in the graph are two trend lines, one for U.S. cities and a second for Canadian cities. Both trend lines indicate a positive relationship between city size and S&E shares, with the Canadian city line being more positively sloped than the U.S. line. Although this suggests larger Canadian cities tend to have larger shares of employment in S&E occupations, there is no statistically significant difference between the

Figure 2 Science and engineering (S&E) employment share as a function of city population size, 2000 and 2001



Source: Canadian Census (2001) and U.S. Census (2000).

two trend lines.[21] Hence, Canadian cities regardless of their size are not (statistically) different than their U.S. counterparts. In short, Canadian cities in 2000 and 2001 were able to match U.S. cities in their ability to employ scientists and engineers.

Endnotes

13. San Jose includes Santa Clara County that forms the heart of 'Silicon Valley'. It does not, however, take into account all of Silicon Valley, which typically includes parts of the San Francisco MSA.
14. See Rosenthal and Strange (2004).
15. This argument is derived from Kim (1989), whose model illustrates why market size might be positively associated with larger investments in human capital.
16. Beckstead et al. (2003).
17. Jacobs (1969).
18. Duranton and Puga (2001).
19. Note that for the Small Urban-Rural category, the S&E employment share is a weighted average of the S&E shares for all urban and rural areas that fall into this category.
20. To further test the association between S&E employment shares and city populations illustrated in Figure 1, we estimated $\text{S\&E share} = \alpha + \beta \ln(\textit{population}) + \varepsilon$ using the S&E employment shares (S&E share) and populations of all 316 Canadian and U.S. cities as observations. The model shows there is a positive and statistically significant relationship between population and S&E shares across cities $\beta = 0.008$, (robust) se = 0.001, t = 7.12.
21. We test whether the coefficients for the Canadian and U.S. trend (regression) lines are different by using the following pooled model:

    $\text{S\&E share} = \alpha + \lambda \text{Canada} + \beta \ln(\text{population}) + \delta \ln(\text{population}) \times \text{Canada} + \varepsilon,$ where Canada is a binary variable that takes on a value of 1 if the city is in Canada and 0 if it is in the United States. We are specifically interested in testing the joint hypothesis that $\lambda = 0$ and $\delta = 0$. Using a Wald test that takes advantage of the heteroscedasticity corrected variance-covariance matrix of the estimators, we cannot reject the null hypothesis that both coefficients are equal to zero (F = 1.16, Prob > F = 0.31). That is, the coefficients that underlie both trend lines (their intercepts and slopes) are not statistically different from each other.

Chapter 5. Growth in science and engineering shares between the 1980 and 1981 period and the 2000 and 2001 period

The previous section provided a 'snapshot' of how Canadian cities compared to U.S. cities in 2001. However, it did not give us a picture of how Canadian cities have evolved over time in comparison to their U.S. counterparts. In this section, we provide such a picture. We also go a step further and ask whether S&E employment shares grew faster in larger cities than in smaller cities and in Canadian cities compared to their U.S. counterparts, irrespective of their size.

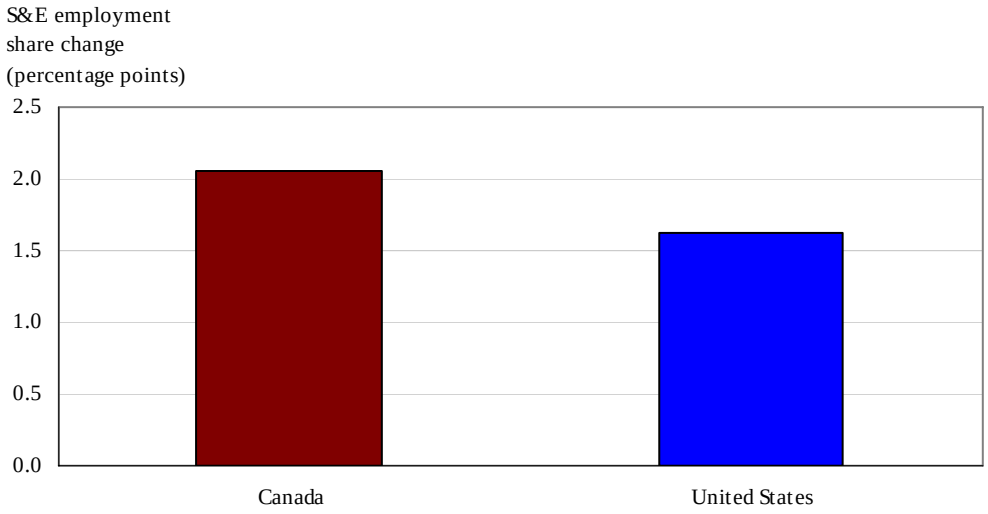
To facilitate the comparison of Canadian to U.S. cities, we utilize a subset of cities that had a population of 100,000 or more in both 1980-1981 and 2000-2001. There were a total of 264 cities across both countries that met this criterion. As above, it is very difficult to present information on all cities in the main text. However, Appendix B presents all of the measures presented in this section for all 264 cities.

Comparing the average S&E employment shares of Canadian and U.S. cities within this subset reveals stronger growth for Canadian cities. In 1980 and 1981, the average S&E employment share for U.S. cities was 2.4%, while for Canadian cities it was 2.6%. By 2000 and 2001, the average U.S. city share had risen to 4.0%, while the average Canadian city share had risen even more to 4.6% (see also Figure 3). While changes in average S&E shares of U.S. and Canadian cities suggest broad trends, they do not provide us details regarding the individual performance of Canadian cities.

Table 7 compares the S&E occupation employment shares and North American share ranks of Canadian cities in 1981 and 2001, sorted by their 2001 S&E employment shares. In both 1981 and 2001, Ottawa–Gatineau and Calgary topped the list in Canada in terms of their employment shares. In North American terms, Ottawa–Gatineau moved its rank from 8th to 2nd, while Calgary's rank fell from 9th to 17th despite its above-average S&E share increase. Remarkably, Ottawa–Gatineau increased its share by 6.5 percentage points. This was the second highest percentage point increase after San Jose (see Box 1 for a more extensive comparison of Ottawa–Gatineau and San Jose) and well above the average city increase of 1.7 percentage points.

Several cities have increased their rank substantially. These cities include Canada's largest cities—Toronto, Montréal and Vancouver. Toronto increased its rank by 26 places (51st to 25th), Montréal increased it rank by 43 places (96th to 53rd) and Vancouver increased its rank by 39 places (106th to 67th). Other notable increases in ranks were Saint John (168th to 109th), Windsor (187th to 129th) and Kitchener (132nd to 80th).

Figure 3 Average science and engineering employment share change for Canadian and U.S. cities: 1980, 1981 and 2000, 2001



Source: Canadian censuses (1981 and 2001) and U.S. censuses (1980 and 2000).

Although all Canadian cities increased their share of S&E employment, not all cities fared well relative to their North American counterparts. In particular, the Saguenay and St. Catherines–Niagara's ranks fell by 63 and 60 places, respectively.

The previous section demonstrated a strong positive relationship between the size of a city and its S&E share of employment. A cursory review of Table 7 suggests this may also be the case for S&E share growth. The cities with the largest populations tended to have the largest increases in the S&E employment shares.

There are several reasons why we might expect S&E employment share growth to be strongest in larger cities. First, if over time S&E workers have invested in more specialized skills, then more of these workers may be attracted to the larger labour markets that characterize more populous cities.[22] It may also be that as the prevalence of workers with very specialized occupations increases over time so too will the shares of couples where both partners have specialized skill sets. Satisfying the career goals of both partners—which effectively exacerbates the matching problem—would tend to further increase the attractiveness of large labour markets to skilled workers like scientists and engineers.[23] Finally, if industries that have a high demand for S&E workers are growing more rapidly in larger centres, then S&E employment growth may again be stronger in larger centres.[24]

We can test the relationship between population size and S&E employment share change by plotting S&E employment share change against population levels of all U.S. and Canadian cities in 1981 (see Figure 4). We do so by taking the average of the S&E employment share change of cities that fall into the six city size classes used in Figure 1.

Table 7 Science and engineering employment shares across Canadian cities, for the years 1980, 1981 and 2000, 2001

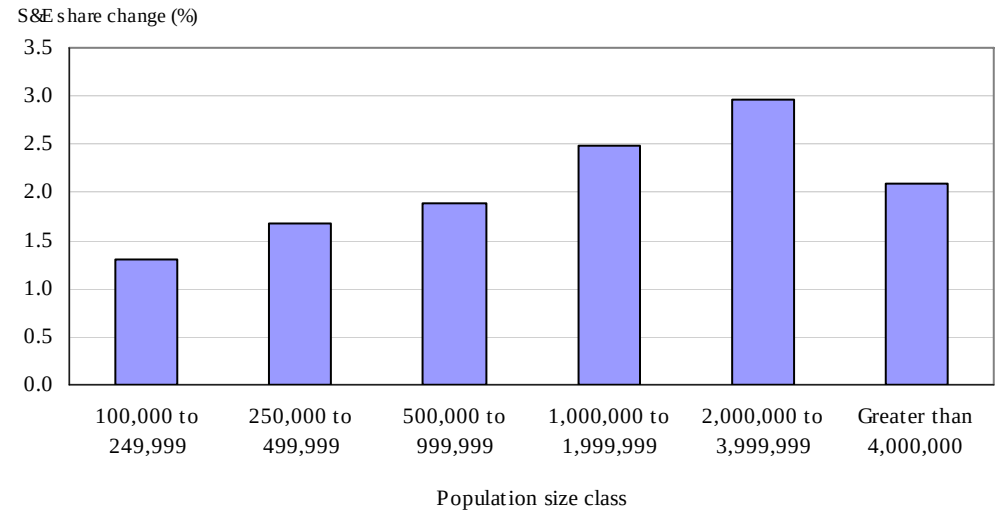
	1981		2001		Difference between 1981 and 2001		2001 Population
	Share (%)	Rank[1]	Share (%)	Rank[1]	Share (%)	Rank[1]	
Ottawa–Gatineau	5.2	8	11.6	2	6.4	6	1,063,664
Calgary	5.0	9	7.6	17	2.6	-8	951,395
Toronto	3.2	51	6.7	25	3.5	26	4,682,898
Québec	3.5	34	6.2	32	2.7	2	682,755
Montréal	2.6	96	5.5	53	2.9	43	3,426,350
Victoria	2.8	81	5.2	64	2.4	17	311,924
Vancouver	2.5	106	5.2	67	2.6	39	1,986,965
St. John's	2.7	88	5.1	69	2.4	19	172,928
Kitchener	2.3	132	4.9	80	2.6	52	414,284
Regina	2.6	101	4.8	82	2.3	19	192,802
Halifax	2.5	102	4.8	85	2.3	17	359,183
Oshawa	2.3	134	4.6	91	2.3	43	296,298
Edmonton	3.0	67	4.5	95	1.6	-28	937,840
Saint John	1.9	168	4.1	109	2.2	59	122,660
Kingston	2.5	107	4.0	113	1.5	-6	146,838
London	2.1	151	4.0	119	1.8	32	432,452
Hamilton	2.3	124	3.9	120	1.6	4	662,401
Windsor	1.8	187	3.8	129	2.1	58	307,877
Winnipeg	2.3	131	3.8	132	1.5	-1	671,275
Saskatoon	2.4	119	3.7	139	1.3	-20	225,928
Sherbrooke	1.7	190	3.1	176	1.4	14	153,821
Trois-Rivières	1.8	184	2.9	187	1.2	-3	137,507
Saguenay	2.3	125	2.9	188	0.6	-63	154,937
Greater Sudbury	2.0	163	2.8	195	0.8	-32	155,601
Thunder Bay	1.7	200	2.6	202	1.0	-2	121,985
St. Catharines–Niagara	2.0	159	2.3	219	0.3	-60	377,009

1. Cities are ranked out of 264 North American cities with a population of 100,000 or more in 1981 and 2001.
Source: Canadian censuses (1981 and 2001) and U.S. censuses (1980 and 2000).

There is a clear positive relationship across the first five size classes between 1980-1981 population size and subsequence increases in S&E employment shares (Figure 4). Cities with a population greater than four million on average experienced a smaller increase in their S&E employment share than cities with a population between one and two million. The relatively poor performance of this more populous group was largely due to Los Angeles. With Los Angeles excluded, the average share increase of this city size class was 2.8%. This is essentially the same as the second largest city size class and does suggest there is some levelling off of the effect of city size (which may be due to the initially high shares of S&E employment in these cities). More extensive statistical testing confirms the positive association between city size and S&E share change.[25]

This paper focuses on how Canadian cities compare to U.S. cities. Given our sample of cities, the average Canadian city is 85% the size of the average U.S. city, one might expect that their increase in S&E employment shares would be less than U.S. cities. As Figure 3 (above) demonstrates, the change in S&E employment share for Canadian cities, irrespective of their size, was stronger than U.S. cities. This is confirmed through more extensive statistical

Figure 4 Average science and engineering share change by 1980 and 1981 population size class



Source: Canadian Census (1981) and U.S. Census (1980).

testing. After controlling for the size of cities, and their initial S&E employment share, the difference in the share change for Canadian cities was statistically significant.[26]

The broad conclusion to be taken from this section is that not only are larger cities advantaged in their ability to support high shares of S&E employment, but also this advantage appears to be increasing over time. It also appears that S&E employment shares have grown more rapidly in Canadian cities.

Box 1. Silicon Valley: North versus South

Ottawa–Gatineau has often been given the moniker 'Silicon Valley North' in an obvious reference to the original 'Silicon Valley', which is located primarily in the San Jose metropolitan area at the southern end of San Francisco Bay. The evidence presented elsewhere in this paper suggests there may well be some merit to this comparison. In this Box, we develop a more comprehensive, but by no means complete, comparison of these two high technology centres. Table 1.1 provides a comparison of the occupational characteristics of Ottawa–Gatineau and San Jose.

Ottawa–Gatineau's population is smaller than San Jose's, but Ottawa–Gatineau's population growth has been stronger. In 1980 and 1981, Ottawa–Gatineau's population was about half of San Jose's. But between the 1980 and 1981 period and the 2000 and 2001 period, Ottawa–Gatineau's population grew more rapidly. As a result, Ottawa–Gatineau's population was about two-thirds of San Jose's by 2000-2001.

S&E employment follows a similar pattern. Ottawa–Gatineau's S&E employment was 29% of San Jose's in 1980 and 1981, but by 2000 and 2001 this proportion had increased to 40%, reflecting faster S&E employment growth in Ottawa–Gatineau over the intervening two decades.

Dividing S&E employment by the number of workers employed in the business and non-business sectors, reveals some important differences between San Jose and Ottawa–Gatineau. Reflecting Ottawa–Gatineau's status as a national capital, a much higher proportion of its science and engineering population was in the non-business sector. In 1980 and 1981, 61% of Ottawa–Gatineau's S&E workforce was in the non-business sector, while this sector accounted for only 6% of San Jose's S&E workforce. Although by 2001, Ottawa–Gatineau's S&E workforce had undergone a remarkable transformation towards a stronger private sector component—two-thirds of Ottawa–Gatineau's workforce was now in the business sector—the business sector continues to be a much stronger force in maintaining San Jose's S&E workforce.

If S&E employment is divided into its component occupations, further differences emerge. More of Ottawa–Gatineau's S&E workforce was made up of Social and Related Scientists—11% in Ottawa–Gatineau versus 3% in San Jose in 2000 and 2001. Ottawa–Gatineau's employment has also been increasingly dominated by Computer and Information Scientists (54% of S&E employment in 2001), while San Jose's employment was dominated in both 1980 and 2000 by Engineers (64% of S&E employment in both years). This does not necessarily mean, however, that San Jose was less oriented towards information technology than Ottawa–Gatineau given that 45% of San Jose's Engineers were computer software engineers in 2000. A more direct comparison can be made by combining Computer and Information Scientists with Software Engineers (and related computer hardware engineering occupations) into a separate classification—what we could call Information Technology Professionals.

In 2001, Ottawa–Gatineau had about 46,600 of these Information Technology Professionals that accounted for 71% of Ottawa–Gatineau's S&E employment, while, in 2000, San Jose had 79,800 Information Technology Professionals, which accounted for 60% of San Jose's S&E employment. San Jose's Information Technology Professionals workforce was larger, but accounted for a smaller share of its S&E employment than Ottawa–Gatineau. At the zenith of the high technology boom, Ottawa–Gatineau's science and engineering workforce was more oriented towards information technology than San Jose.

(continued on next page)

Box 1 Silicon Valley: North versus South (concluded)

Table 1.1 Ottawa–Gatineau and San Jose science and engineering (S&E) employment comparison

	Ottawa–Gatineau				San Jose			
	1981		2001		1980		2000	
Population	711,920		1,063,665		1,297,507		1,688,089	
Employment	360,050		561,871		662,452		847,345	
	Employment	Share	Employment	Share	Employment	Share	Employment	Share
S&E employment	18,720	100	65,330	100	52,273	100	133,121	100
Business sector	7,330	39	43,990	67	49,070	94	125,710	94
Non-business sector	11,395	61	21,340	33	3,203	6	7,411	6
Computer and information scientists	6,945	37	34,960	54	13,528	26	36,400	27
Life and related scientists	1,045	6	1,080	2	600	1	2,707	2
Physical and related scientists	1,355	7	1,980	3	2,500	5	5,544	4
Social and related scientists	3,470	19	7,185	11	2,242	4	3,343	3
Engineers	5,910	32	20,120	31	33,403	64	85,127	64
Information technology professionals	...	...	46,562	71	...	...	79,764	60
S&E share of employment (%)	5.2	...	11.6	...	7.9	...	15.7	...

... not applicable

Note: Share is in percentage of science and engineering employment.

Source: Canadian censuses (1981 and 2001) and U.S. censuses (1980 and 2000).

Endnotes

22. Kim (1989).
23. Costa and Kahn (2000).
24. Beckstead et al. (2003).
25. To formally test the independent effect of population levels and Canada on the percentage point change in S&E shares (ΔS&E) across cities, we estimated the following model: $\Delta \text{S\&E} = \alpha + \beta\ \text{S\&E1980} + \delta \ln(\text{1980 population}) + \gamma \text{Canada} + \varepsilon$, where S&E1980 is the S&E share in 1980 and 1981 for a city *i*, 1980 Population is the population of the city in 1980 and 1981 and Canada is a binary variable that takes on a value of 1 if the city is in Canada and 0 if it is located in the United States.

    The initial S&E share is included in the model to control for the fact that, by its very nature, percentage point share change will tend to be higher in cities with initially high S&E shares. To see why, consider an instance where looking across cities there is no difference in their rate of S&E employment growth. If S&E employment were to double, while all other forms of employment remained constant, a city with an initial S&E employment share of 1% would increase its S&E share by approximately 1 percentage point, while a city with an initial share of 5% would raise its S&E share by approximately 5 percentage points. It is important to note that the coefficient on S&E1980 does not provide us with a test of whether cities with an initially high S&E shares experience above- or below- average growth—divergence from, or regression to, the mean. If cities are experiencing a process of divergence from the mean or, up to a point, regression to the mean, the coefficient on S&E1980 will tend to be positive.

    Turning to the model's results, as expected, we find a positive and statistically significant relationship between the initial S&E share of a city ($\beta = 0.35, (\text{robust})\ \text{se} = 0.14, \text{t} = 2.36$) and its S&E employment share change. However, we also find an independent, positive and statistically significant effect of initial population size on S&E share change ($\delta = 0.0032, (\text{robust})\ \text{se} = 0.00096, \text{t} = 3.31$). Finally, the coefficient on the Canada variable is positive and statistically significant ($\lambda = 0.0041, (\text{robust})\ \text{se} = 0.0019, \text{t} = 2.21$). Hence, Canadian cities, after controlling for their initial S&E share and their population size, experienced a faster increase in their S&E share than U.S. cities.
26. As we note in footnote 20, it is unlikely the difference we observe between U.S. and Canadian cities is due to chance. Moreover, the model demonstrates that Canadian cities experienced a significantly greater increase in their S&E shares after controlling for their population levels and the initial size of their S&E share of employment.

Chapter 6. Conclusion

In recent years, cities have become increasingly interested in their ability to increase their level of human capital. In this paper, we use employment in science- and engineering-based occupations as a measure of human capital and ask how Canadian cities compare to their U.S. counterparts. We chose to compare Canadian to U.S. cities not only because the United States is often used as a benchmark for Canada, but also because the market for skilled labour is at least continental in scale. This holds not only for science and engineering workers born in North American, but also for those thinking of migrating to North American from abroad.

We find that science and engineering employment is not spread equally across cities. For some cities, 1 in 10 employed workers are in science- and engineering-based occupations, while in others, this ratio falls to only 1 in 100. Yet, whether one city does better than another is not purely random.

There is a strong positive association between city size and the share of its workforce in science and engineering occupations and the growth of this share over time. Big cities do better than small cities. Not only are larger cities advantaged, but their advantage has been increasing. On average, larger cities experienced a greater increase in their S&E employment share between the 1980 and 1981 period and the 2000 and 2001 period.

In 1980-1981, the science and engineering share of employment in Canadian cities did lag slightly behind U.S. cities. But in the ensuing two decades science and engineering employment in Canadian cities grew at a faster pace than in U.S. cities. As a result, the science and engineering base of Canadian cities was higher than U.S. cities by the end of the period, albeit on a city by city basis, there is no statistically significant difference. At the very least, these results suggest Canadian cities have held their own.

Although we provide some explanations as to why larger cities might be advantaged, the focus of this paper was not on trying to test why population size matters or whether other factors were important. A particularly important avenue for research is the question of what factors affect the growth in science and engineering employment. How important is the industrial make-up of a city? How important is the presence of universities? Does a heavy governmental presence help or hinder growth? Do factors that make cities attractive—e.g., cultural activities, climate, low-crime rates—also influence growth in science and engineering employment?

Appendix A. Science and engineering employment and shares: Canadian and U.S. metropolitan areas, 2000 and 2001

Table A1 Science and engineering (S&E) employment and shares: Canadian and U.S. metropolitan areas, 2000 and 2001

City name, Province/State	S&E employment	Rank	S&E share	Rank	Population	Rank
Abbotsford, B.C.	1,265	282	1.8	284	147,370	249
Abilene, Tex.	1,026	297	1.7	292	126,952	276
Akron, Ohio	14,109	80	4.1	123	692,912	74
Albany, Ga.	1,528	266	3.0	213	120,551	287
Albany-Schenectady-Troy, N.Y.	22,371	52	5.7	53	796,100	68
Albuquerque, N.Mex.	19,059	60	5.7	54	712,937	71
Alexandria, La.	984	299	1.9	281	128,075	274
Allentown-Bethlehem-Easton, Pa./N.J.	14,495	79	4.7	100	641,637	80
Altoona, Pa.	954	303	1.6	294	131,023	270
Amarillo, Tex.	2,521	220	2.5	236	215,463	195
Anchorage, Alaska	5,480	157	4.1	122	259,063	169
Ann Arbor, Mich.	23,273	49	9.2	8	479,754	99
Anniston, Ala.	1,002	298	2.1	269	110,594	300
Appleton-Oskosh-Neenah, Wis.	8,501	113	4.4	115	357,928	133
Asheville, N.C.	2,496	222	2.3	253	225,195	192
Athens, Ga.	2,584	217	3.4	171	153,445	238
Atlanta, Ga.	118,578	12	5.8	47	3,987,990	11
Atlantic City, N.J.	3,867	181	2.4	246	359,167	131
Auburn-Opelika, Ala.	2,110	242	3.9	140	116,435	293
Augusta-Aiken, Ga./S.C.	8,242	114	4.1	126	451,061	106
Austin, Tex.	56,210	24	9.0	9	1,167,216	47
Bakersfield, Calif.	7,162	123	3.1	202	650,891	79
Baltimore, Md.	84,918	18	6.9	27	2,513,661	19
Barnstable-Yarmouth, Mass.	2,325	229	3.5	167	144,360	255
Barrie, Ont.	2,310	231	3.0	203	148,480	245
Baton Rouge, La.	11,865	89	4.2	118	604,708	84
Beaumont-Port Arthur-Orange, Tex.	3,617	190	2.3	251	381,559	124
Bellingham, Wash.	2,608	216	3.1	194	169,001	224
Benton Harbor, Mich.	2,212	237	2.9	220	163,682	228
Billings, Mont.	2,070	243	3.1	195	128,660	272
Biloxi-Gulfport, Miss.	4,000	178	2.7	225	318,936	150
Binghamton, N.Y.	7,667	118	6.6	32	254,116	173
Birmingham, Ala.	16,477	73	4.4	112	803,700	66
Bloomington, Ind.	3,020	206	4.9	90	122,388	282
Bloomington-Normal, Ill.	5,758	148	7.0	26	152,616	240
Boise City, Idaho	10,192	98	4.7	97	430,161	114
Boston, Mass.	167,285	6	8.3	12	3,951,557	12
Bremerton, Wash.	5,992	146	5.4	62	234,652	186
Bridgeport, Conn.	6,324	139	4.0	129	343,379	139
Brockton, Mass.	5,326	159	4.1	121	258,188	171

Table A1 Science and engineering (S&E) employment and shares: Canadian and U.S. metropolitan areas, 2000 and 2001 (continued)

City name, Province/State	S&E employment	Rank	S&E share	Rank	Population	Rank
Brownsville - Harlingen-San Benito, Tex.	1,210	285	1.1	311	336,631	142
Bryan-College Station, Tex.	3,914	180	5.4	63	153,194	239
Buffalo-Niagara Falls, N.Y.	17,876	67	3.3	177	1,175,089	46
Calgary, Alb.	40,853	33	7.6	22	951,395	58
Canton, Ohio	6,385	136	3.3	180	408,072	119
Cape Breton, N.S.	524	312	1.5	303	109,330	302
Cedar Rapids, Iowa	5,970	147	5.8	50	188,914	206
Champaign-Urbana-Rantoul, Ill.	6,317	141	6.7	29	181,422	213
Charleston-North Charleston, S.C.	7,546	120	3.5	164	454,054	104
Charlotte-Gastonia-Rock Hill, N.C./S.C.	33,746	38	4.4	113	1,499,677	36
Charlottesville, Va.	4,706	168	6.1	42	160,421	230
Chatham-Kent, Ont.	1,132	290	2.2	255	107,709	305
Chattanooga, Tenn./Ga.	6,792	130	3.2	188	434,752	112
Chicago-Gary-Lake, Ill.	211,198	4	5.1	82	8,804,453	3
Chico, Calif.	1,966	246	2.4	244	202,375	200
Cincinnati-Hamilton, Ohio/Ky./Ind.	37,853	36	5.3	68	1,473,012	38
Clarksville-Hopkinsville, Tenn./Ky.	1,396	275	2.1	268	134,209	268
Cleveland, Ohio	44,366	29	4.2	119	2,255,480	23
Colorado Springs, Colo.	20,514	58	7.8	21	515,629	96
Columbia, Mo.	3,830	182	5.3	66	136,063	264
Columbia, S.C.	12,536	87	4.6	103	544,165	93
Columbus, Ga./Ala.	2,625	215	3.1	199	186,426	207
Columbus, Ohio	44,319	30	5.9	44	1,443,293	39
Corpus Christi, Tex.	3,644	187	3.2	193	261,023	167
Dallas-Fort Worth, Tex.	156,797	8	6.3	36	5,043,876	5
Danbury, Conn.	5,496	155	5.8	49	184,523	209
Danville, Va.	295	316	0.6	316	109,618	301
Davenport-Rock Island-Moline, Iowa/Ill.	4,991	162	3.8	147	268,781	165
Daytona Beach, Fla.	3,991	179	2.1	266	445,477	109
Dayton-Springfield, Ohio	23,450	48	5.1	80	954,465	57
Decatur, Ala.	2,115	240	3.2	185	145,469	254
Decatur, Ill.	1,576	264	3.0	206	114,926	295
Denver-Boulder-Longmont, Colo.	90,420	17	7.8	20	2,198,801	25
Des Moines, Iowa	9,992	100	4.9	88	375,685	126
Detroit, Mich.	124,992	11	6.1	38	4,430,477	9
Dothan, Ala.	1,104	295	1.8	287	138,133	261
Dover, Del.	1,388	277	2.3	252	125,613	277
Duluth-Superior, Minn./Wis.	2,280	235	2.4	241	199,548	201
Dutchess County, N.Y.	10,333	96	7.9	17	277,140	164
Eau Claire, Wis.	2,220	236	2.9	217	147,758	247
Edmonton, Alb.	22,869	51	4.5	106	937,840	59
El Paso, Tex.	5,493	156	2.2	256	676,220	76
Elkhart-Goshen, Ind.	1,757	256	1.9	282	182,252	211
Erie, Pa.	3,826	183	3.0	212	279,521	163
Eugene-Springfield, Ore.	5,064	161	3.2	183	324,317	146
Evansville, Ind./Ky.	3,272	196	2.6	230	252,410	174
Fargo-Moorhead, N.Dak./Minn.	2,913	209	4.1	120	121,173	286
Fayetteville, N.C.	2,803	213	1.9	279	299,932	157
Fayetteville-Springdale, Ariz.	4,847	165	3.3	181	309,915	154
Fitchburg-Leominster, Mass.	3,088	204	4.5	107	141,969	258
Flagstaff, Ariz.	1,924	248	3.5	168	117,109	292
Flint, Mich.	2,338	227	2.5	240	240,153	182

Table A1 Science and engineering (S&E) employment and shares: Canadian and U.S. metropolitan areas, 2000 and 2001 (continued)

City name, Province/State	S&E employment	Rank	S&E share	Rank	Population	Rank
Florence, Ala.	1,198	286	1.9	278	142,703	257
Fort Collins-Loveland, Colo.	10,359	95	8.0	14	235,532	185
Fort Lauderdale-Hollywood-Pompano Beach, Fla.	26,024	44	3.4	170	1,624,272	32
Fort Myers-Cape Coral, Fla.	3,014	207	1.6	293	440,333	110
Fort Pierce, Fla.	3,098	203	2.4	248	323,090	147
Fort Smith, Ark./Okla.	1,378	278	1.7	290	169,401	223
Fort Walton Beach, Fla.	4,126	175	4.9	92	171,551	220
Fort Wayne, Ind.	8,996	107	3.8	144	460,349	102
Fresno, Calif.	6,909	125	2.0	272	924,612	60
Gadsden, Ala.	477	314	1.1	310	102,183	314
Gainesville, Fla.	6,593	134	6.1	40	219,795	194
Galveston-Texas City, Tex.	6,962	124	6.1	41	249,853	175
Glens Falls, N.Y.	1,106	294	2.0	277	123,609	280
Goldsboro, N.C.	1,197	287	2.4	247	113,118	296
Grand Forks, N.Dak/Minn.	1,273	281	2.4	245	111,922	298
Grand Rapids, Mich.	18,475	63	3.8	150	984,107	56
Greater Sudbury, Ont.	1,956	247	2.8	223	155,601	234
Greeley, Colo.	3,184	199	3.7	156	178,872	215
Green Bay, Wis.	4,616	170	3.8	145	227,296	190
Greensboro-Winston Salem, N.C.	20,870	56	3.3	178	1,252,554	42
Greenville, N.C.	2,189	238	3.4	174	134,932	267
Greenville-Spartanburg-Anderson, S.C.	15,371	75	4.0	133	796,528	67
Guelph, Ont.	3,117	202	4.9	89	117,344	291
Hagerstown, Md.	1,914	251	3.2	187	128,316	273
Halifax, N.S.	8,737	109	4.8	96	359,183	130
Hamilton, Ont.	12,847	85	3.9	136	662,401	78
Hamilton-Middleton, Ohio	9,999	99	6.1	39	334,518	143
Harrisburg-Lebanon-Carlisle, Pa.	15,366	76	4.9	87	629,304	81
Hartford-Bristol-Middleton-New Britain, Conn.	20,531	57	5.3	67	820,437	65
Hickory-Morgantown, N.C.	2,804	212	1.6	296	342,072	140
Honolulu, Hawaii	14,968	78	3.6	162	876,066	63
Houma-Thibodoux, La.	447	315	1.1	312	103,563	311
Houston-Brazoria, Tex.	114,318	13	5.7	55	4,413,414	10
Huntsville, Ala.	18,458	64	11.1	3	344,491	137
Indianapolis, Ind.	38,263	34	4.7	98	1,603,021	33
Iowa City, Iowa	3,404	195	5.4	61	108,518	303
Jackson, Mich.	2,134	239	2.9	216	160,391	231
Jackson, Miss.	6,745	131	3.4	173	438,789	111
Jackson, Tenn.	879	305	1.8	286	107,550	306
Jacksonville, Fla.	21,446	53	4.0	131	1,101,766	50
Jacksonville, N.C.	1,151	289	1.4	305	149,091	243
Jamestown-Dunkirk, N.Y.	1,247	283	2.0	273	140,116	260
Janesville-Beloit, Wis.	1,503	269	2.0	274	151,640	241
Johnson City-Kingsport-Bristol, Tenn./Va.	4,760	166	3.3	175	314,402	151
Johnstown, Pa.	1,917	249	2.0	275	233,942	187
Joplin, Mo.	1,119	292	1.5	300	155,401	235
Kalamazoo-Portage, Mich.	8,701	110	4.0	130	451,406	105
Kankakee, Ill.	746	307	1.6	297	104,042	310
Kansas City, Mo./Kans.	44,107	31	5.2	75	1,682,053	29
Kelowna, B.C.	1,745	257	2.6	234	147,739	248
Kenosha, Wis.	3,247	198	4.4	114	148,260	246
Killeen-Temple, Tex.	3,128	201	2.1	267	313,151	152

Table A1 Science and engineering (S&E) employment and shares: Canadian and U.S. metropolitan areas, 2000 and 2001 (continued)

City name, Province/State	S&E employment	Rank	S&E share	Rank	Population	Rank
Kingston, Ont.	2,871	211	4.0	128	146,838	251
Kitchener, Ont.	10,717	92	4.9	91	414,284	117
Knoxville, Tenn.	13,052	84	4.7	101	576,512	90
Kokomo, Ind.	2,281	234	4.9	86	100,506	316
LaCrosse, Wis.	1,700	259	3.0	204	105,700	308
Lafayette, La.	3,507	193	3.2	190	247,230	177
Lafayette-West Lafayette, Ind.	4,221	173	4.7	99	181,493	212
Lake Charles, La.	2,025	244	2.6	235	183,144	210
Lakeland-Winterhaven, Fla.	4,410	172	2.1	262	482,562	98
Lancaster, Pa.	6,507	135	2.8	222	464,550	101
Lansing-East Lansing, Mich.	11,322	90	5.0	84	445,925	108
Laredo, Tex.	495	313	0.8	315	190,074	205
Las Cruces, N.Mex.	2,474	223	3.7	154	173,843	218
Las Vegas, Nev.	14,019	81	2.2	258	1,375,174	40
Lexington-Fayette, Ky.	7,784	117	5.6	57	258,129	172
Lima, Ohio	1,469	272	2.0	271	156,274	233
Lincoln, Nebr.	7,344	122	5.3	69	246,945	178
Little Rock-North Little Rock, Ark.	10,578	94	3.7	155	584,977	88
London, Ont.	8,530	112	4.0	134	432,452	113
Longview-Marshall, Tex.	1,611	261	2.2	260	170,557	221
Los Angeles-Long Beach, Calif.	239,237	3	4.5	109	12,368,516	2
Louisville, Ky./Ind.	16,040	74	3.6	160	921,599	61
Lubbock, Tex.	2,547	218	2.2	257	243,899	180
Lynchburg, Va.	3,516	192	3.5	166	213,723	196
Macon-Warner Robins, Ga.	5,502	154	3.8	148	321,450	148
Madison, Wis.	18,210	65	7.5	23	429,839	115
Manchester, N.H.	2,542	219	4.6	104	107,037	307
Mansfield, Ohio	1,425	274	2.4	243	130,084	271
McAllen-Edinburg-Pharr-Mission, Tex.	2,115	241	1.2	309	565,800	91
Medford, Ore.	1,727	258	2.2	259	179,811	214
Melbourne-Titusville-Cocoa-Palm Bay, Fla.	16,545	72	7.8	19	479,298	100
Memphis, Tenn./Ark./Miss.	17,169	70	3.7	152	998,698	54
Merced, Calif.	1,125	291	1.5	302	209,707	199
Miami-Hialeah, Fla.	22,910	50	2.5	238	2,221,632	24
Milwaukee, Wis.	38,135	35	5.1	79	1,499,015	37
Minneapolis-St. Paul, Minn.	100,067	15	6.4	33	2,856,295	16
Mobile, Ala.	6,901	126	3.0	205	540,100	95
Modesto, Calif.	3,628	189	2.1	270	450,865	107
Moncton, N.B.	2,373	225	4.0	135	117,722	290
Monmouth-Ocean, N.J.	28,009	43	5.5	59	1,128,173	49
Monroe, La.	975	302	1.5	299	146,975	250
Montgomery, Ala.	5,667	150	3.9	142	333,479	144
Montréal, Que.	91,523	16	5.5	60	3,426,350	13
Muncie, Ind.	1,599	263	2.9	218	119,028	289
Myrtle Beach, S.C.	1,240	284	1.3	307	195,205	202
Naples, Fla.	1,611	262	1.5	298	249,728	176
Nashua, N.H.	6,901	127	11.1	4	116,182	294
Nashville, Tenn.	23,640	47	3.7	151	1,234,004	44
New Bedford, Mass.	2,364	226	3.0	209	174,864	217
New Haven-Meriden, Conn.	8,743	108	5.2	77	358,125	132
New Orleans, La.	18,609	62	3.4	169	1,246,651	43
New York-Northeastern N.J.	369,193	1	4.8	95	17,244,066	1

Table A1 Science and engineering (S&E) employment and shares: Canadian and U.S. metropolitan areas, 2000 and 2001 (continued)

City name, Province/State	S&E employment	Rank	S&E share	Rank	Population	Rank
Newburgh-Middletown, N.Y.	4,707	167	3.0	211	343,591	138
Norfolk-Virginia Beach-Newport News, Va.	34,127	37	4.5	111	1,553,838	34
Ocala, Fla.	1,502	270	1.5	301	259,712	168
Odessa, Tex.	2,884	210	2.8	221	238,692	183
Oklahoma City, Okla.	17,646	68	4.1	127	892,347	62
Olympia, Wash.	6,075	143	5.8	48	210,011	198
Omaha, Nebr./Iowa	17,457	69	5.7	51	584,099	89
Orlando, Fla.	31,344	42	3.9	137	1,652,742	30
Oshawa, Ont.	6,874	128	4.6	102	296,298	158
Ottawa–Gatineau, Ont./ Que.	65,332	21	11.6	2	1,063,664	51
Panama City, Fla.	2,316	230	3.3	179	146,122	253
Pensacola, Fla.	5,420	158	3.0	210	411,270	118
Peoria, Ill.	8,534	111	5.1	81	346,102	136
Peterborough, Ont.	1,358	279	2.9	219	102,424	313
Philadelphia, Pa./N.J.	126,213	10	5.4	64	5,082,137	4
Phoenix, Ariz.	75,590	20	5.3	71	3,070,331	15
Pittsburgh-Beaver Valley, Pa.	47,224	28	4.5	105	2,285,064	22
Portland, Maine	5,525	152	4.3	117	241,693	181
Portland-Vancouver, Ore./Wash.	51,372	25	5.7	56	1,789,019	27
Providence-Fall River-Pawtucket, Mass./R.I.	18,031	66	3.7	153	1,025,944	53
Provo-Orem, Utah	9,825	102	5.9	46	367,035	129
Pueblo, Colo.	1,118	293	2.0	276	135,990	265
Punta Gorda, Fla.	702	309	1.4	304	141,080	259
Québec, Que.	21,232	54	6.2	37	682,755	75
Racine, Wis.	3,026	205	3.3	176	185,041	208
Raleigh-Durham, N.C.	62,994	22	10.0	6	1,182,869	45
Reading, Pa.	6,377	137	3.6	161	368,284	127
Redding, Calif.	1,522	268	2.3	250	162,160	229
Regina, Sask.	4,851	164	4.8	93	192,802	203
Reno, Nev.	5,282	160	3.1	201	339,936	141
Richland-Kennewick-Pasco, Wash.	6,344	138	7.4	24	191,186	204
Richmond-Petersburg, Va.	25,839	45	5.2	74	995,112	55
Riverside-San Bernadino, Calif.	33,718	39	2.6	229	3,253,263	14
Roanoke, Va.	3,675	186	3.2	192	236,363	184
Rochester, Minn.	6,318	140	9.6	7	122,319	283
Rochester, N.Y.	31,727	41	6.4	34	1,030,303	52
Rockford, Ill.	6,014	145	3.9	139	319,846	149
Rocky Mount, N.C.	1,179	288	1.9	283	143,674	256
Sacramento, Calif.	47,303	27	6.4	35	1,632,863	31
Saginaw-Bay City-Midland, Mich.	7,484	121	4.1	125	400,853	120
Saguenay, Que.	1,917	250	2.9	215	154,937	236
Saint John, N.B.	2,292	233	4.1	124	122,660	281
Salem, Ore.	3,744	185	3.0	207	282,595	161
Salinas-Sea Side-Monterey, Calif.	3,759	184	3.2	189	281,166	162
Salt Lake City-Ogden, Utah	32,815	40	5.0	83	1,331,833	41
San Antonio, Tex.	24,475	46	3.5	165	1,551,396	35
San Diego, Calif.	78,935	19	5.9	43	2,807,873	17
San Francisco-Oakland-Vallejo, Calif.	184,596	5	8.0	15	4,645,830	8
San Jose, Calif.	133,121	9	15.7	1	1,688,089	28
San Luis Obispo-Atascad-P Robles, Calif.	4,923	163	4.5	108	246,312	179
Santa Barbara-Santa Maria-Lompoc, Calif.	9,597	103	5.2	72	400,661	121
Santa Cruz, Calif.	10,216	97	7.8	18	258,576	170

Table A1 Science and engineering (S&E) employment and shares: Canadian and U.S. metropolitan areas, 2000 and 2001 (continued)

City name, Province/State	S&E employment	Rank	S&E share	Rank	Population	Rank
Santa Fe, N.Mex.	6,637	132	8.9	10	148,785	244
Santa Rosa-Petaluma, Calif.	9,956	101	4.3	116	459,235	103
Sarasota, Fla.	6,630	133	2.7	227	587,565	87
Saskatoon, Sask.	4,191	174	3.7	157	225,928	191
Savannah, Ga.	3,168	200	3.0	208	232,087	189
Scranton-Wilkes-Barre, Pa.	6,864	129	2.4	242	624,276	82
Seattle-Everett, Wash.	105,929	14	8.6	11	2,332,682	21
Sharon, Pa.	944	304	1.8	285	120,147	288
Sheboygan, Wis.	1,860	252	3.2	191	111,021	299
Sherbrooke, Que.	2,307	232	3.1	200	153,821	237
Shreveport, La.	3,250	197	1.9	280	393,700	122
Sioux City, Iowa/Nebr.	1,571	265	3.1	196	103,140	312
Sioux Falls, S.Dak.	1,802	254	2.6	233	124,076	279
South Bend-Mishawaka, Ind.	4,531	171	3.6	159	266,264	166
Spokane, Wash.	6,033	144	3.1	198	418,375	116
Springfield, Ill.	2,991	208	5.3	70	112,222	297
Springfield, Mo.	3,445	194	2.1	265	327,829	145
Springfield-Holyoke-Chicopee, Mass.	10,797	91	3.8	143	594,643	85
St. Catharines–Niagara, Ont.	4,103	177	2.3	254	377,009	125
St. Cloud, Minn.	1,991	245	2.1	263	168,856	226
St. John's, N.L.	4,123	176	5.1	78	172,928	219
St. Joseph, Mo.	663	310	1.4	306	101,442	315
St. Louis, Mo./Ill.	62,202	23	4.9	85	2,602,448	18
Stamford, Conn.	9,332	105	5.3	65	354,363	134
State College, Pa.	4,634	169	7.1	25	134,971	266
Stockton, Calif.	5,524	153	2.5	237	562,377	92
Sumter, S.C.	978	300	2.2	261	104,047	309
Syracuse, N.Y.	12,042	88	3.5	163	731,789	70
Tacoma, Wash.	10,694	93	3.2	186	706,103	72
Tallahassee, Fla.	9,321	106	6.6	31	286,063	159
Tampa-St. Petersburg-Clearwater, Fla.	42,821	32	4.0	132	2,386,781	20
Terre Haute, Ind.	1,686	260	2.5	239	149,397	242
Thunder Bay, Ont.	1,498	271	2.6	231	121,985	284
Toledo, Ohio/Mich.	9,578	104	3.2	184	617,883	83
Topeka, Kans.	2,756	214	3.3	182	168,994	225
Toronto, Ont.	161,552	7	6.7	30	4,682,898	7
Trenton, N.J.	13,158	82	8.0	16	350,093	135
Trois-Rivières, Que.	1,792	255	2.9	214	137,507	263
Tucson, Ariz.	21,011	55	5.6	58	843,732	64
Tulsa, Okla.	15,247	77	4.5	110	694,760	73
Tuscaloosa, Ala.	2,516	221	3.4	172	164,875	227
Tyler, Tex.	1,354	280	1.7	291	174,917	216
Utica-Rome, N.Y.	3,633	188	2.7	224	300,337	156
Vancouver, B.C.	51,280	26	5.2	76	1,986,965	26
Ventura-Oxnard-Simi Valley, Calif.	20,175	59	5.7	52	754,070	69
Victoria, B.C.	8,100	115	5.2	73	311,924	153
Vineland-Milville-Bridgetown, N.J.	727	308	1.3	308	146,275	252
Visalia-Tulare-Porterville, Calif.	1,394	276	1.0	313	367,566	128
Waco, Tex.	2,470	224	2.6	232	212,313	197
Washington, D.C./Md./Va.	271,804	2	10.9	5	4,733,359	6
Waterbury, Conn.	1,049	296	2.4	249	108,117	304
Waterloo-Cedar Falls, Iowa	2,333	228	3.6	158	124,908	278

Table A1 Science and engineering (S&E) employment and shares: Canadian and U.S. metropolitan areas, 2000 and 2001 (concluded)

City name, Province/State	S&E employment	Rank	S&E share	Rank	Population	Rank
Wausau, Wis.	1,826	253	2.7	226	127,099	275
West Palm Beach-Boca Raton-Delray Beach, Fla.	18,723	61	3.9	141	1,133,519	48
Wichita Falls, Tex.	612	311	1.0	314	131,595	269
Wichita, Kans.	12,749	86	4.8	94	543,518	94
Williamsport, Pa.	978	301	1.7	289	121,501	285
Wilmington, Del./N.J./Md.	17,166	71	6.9	28	499,454	97
Wilmington, N.C.	3,553	191	3.1	197	233,637	188
Windsor, Ont.	5,723	149	3.8	146	307,877	155
Winnipeg, Man.	13,136	83	3.8	149	671,275	77
Worcester, Mss.	7,881	116	5.9	45	282,673	160
Yakima, Wash.	1,527	267	1.7	288	223,726	193
Yolo, Calif.	6,103	142	8.0	13	170,044	222
York, Pa.	7,649	119	3.9	138	383,994	123
Youngstown-Warren, Ohio/Pa.	5,574	151	2.1	264	593,100	86
Yuba City, Calif.	1,436	273	2.7	228	137,870	262
Yuma, Ariz.	851	306	1.6	295	160,196	232

Source: Canadian Census (2001) and U.S. Census (2000).

Appendix B. Science and engineering employment and shares, for the years 1980, 1981 and 2000, 2001: Canadian and U.S. metropolitan areas

Table B1 Science and engineering (S&E) employment and shares, for the years 1980, 1981 and 2000, 2001: Canadian and U.S. metropolitan areas

Metropolitan area name, Province/State	1980 and 1981			2000 and 2001			Difference between 2000, 2001 and 1980, 1981	
	Employment	Share (%)	Rank	Employment	Share (%)	Rank	Share (%)	Rank
Abilene, Tex.	841	1.6	203	1,026	1.7	248	0.1	-45
Akron, Ohio	8,750	3.1	61	14,109	4.1	108	1.0	-47
Albany, Ga.	562	1.2	240	1,528	3.0	186	1.8	54
Albany-Schenectady-Troy, N.Y.	13,112	4.0	24	22,371	5.7	47	1.7	-23
Albuquerque, N.Mex.	7,822	3.9	28	19,059	5.7	48	1.8	-20
Alexandria, La.	640	1.3	235	984	1.9	242	0.6	-7
Allentown-Bethlehem-Easton, Pa./N.J.	6,226	2.7	89	14,495	4.7	89	2.0	0
Altoona, Pa.	640	1.2	238	954	1.6	250	0.4	-12
Amarillo, Tex.	1,940	2.3	129	2,521	2.5	206	0.2	-77
Anchorage, Alaska	2,781	3.1	56	5,480	4.1	107	1.0	-51
Ann Arbor, Mich.	7,167	5.5	7	23,273	9.2	6	3.7	1
Anniston, Ala.	461	0.9	254	1,002	2.1	231	1.2	23
Appleton-Oskosh-Neenah, Wis.	2,181	1.7	199	8,501	4.4	102	2.7	97
Athens, Ga.	1,261	2.2	142	2,584	3.4	151	1.2	-9
Atlanta, Ga.	24,493	2.9	77	118,578	5.8	42	3.0	35
Atlantic City, N.J.	1,482	1.8	180	3,867	2.4	215	0.6	-35
Augusta-Aiken, Ga./S.C.	2,422	1.8	174	8,242	4.1	111	2.2	63
Austin, Tex.	11,065	4.2	21	56,210	9.0	7	4.8	14
Bakersfield, Calif.	4,602	2.8	86	7,162	3.1	178	0.3	-92
Baltimore, Md.	33,218	3.4	41	84,918	6.9	22	3.6	19
Baton Rouge, La.	6,524	3.2	48	11,865	4.2	105	1.0	-57
Beaumont-Port Arthur-Orange, Tex.	3,661	2.3	128	3,617	2.3	218	0.0	-90
Bellingham, Wash.	620	1.4	224	2,608	3.1	170	1.8	54
Benton Harbor, Mich.	1,460	2.1	150	2,212	2.9	192	0.7	-42
Billings, Mont.	800	1.6	205	2,070	3.1	171	1.5	34
Biloxi-Gulfport, Moss.	1,160	1.7	189	4,000	2.7	197	1.0	-8
Binghamton, N.Y.	5,224	5.6	5	7,667	6.6	27	1.0	-22
Birmingham, Ala.	7,723	2.4	120	16,477	4.4	99	2.1	21
Bloomington-Normal, Ill.	1,600	2.8	84	5,758	7.0	21	4.2	63
Boise City, Idaho	2,463	3.0	66	10,192	4.7	86	1.7	-20
Boston, Mass.	47,267	3.8	29	167,285	8.3	9	4.5	20
Bremerton, Wash.	2,802	4.5	13	5,992	5.4	54	0.9	-41
Bridgeport, Conn.	3,665	3.3	44	6,324	4.0	114	0.7	-70
Brownsville - Harlingen-San Benito, Tex.	620	0.9	257	1,210	1.1	261	0.3	-4
Buffalo-Niagara Falls, N.Y.	11,431	2.2	137	17,876	3.3	156	1.1	-19
Calgary, Alb.	16,884	5.0	9	40,853	7.6	17	2.6	-8
Canton, Ohio	4,463	2.8	85	6,385	3.3	158	0.5	-73

Table B1 Science and engineering (S&E) employment and shares, for the years 1980, 1981 and 2000, 2001: Canadian and U.S. metropolitan areas (continued)

Metropolitan area name, Province/State	1980 and 1981			2000 and 2001			Difference between 2000, 2001 and 1980, 1981	
	Employment	Share (%)	Rank	Employment	Share (%)	Rank	Share (%)	Rank
Cedar Rapids, Iowa	3,022	3.6	32	5,970	5.8	44	2.2	-12
Champaign-Urbana-Rantoul, Ill.	2,160	2.5	103	6,317	6.7	24	4.2	79
Charleston-North Charleston, S.C.	3,165	1.6	202	7,546	3.5	146	1.9	56
Charlotte-Gastonia-Rock Hill, N.C./S.C.	7,787	2.1	155	33,746	4.4	100	2.3	55
Charlottesville, Va.	1,380	2.6	99	4,706	6.1	37	3.5	62
Chattanooga, Tenn./Ga.	4,420	2.6	94	6,792	3.2	165	0.6	-71
Chicago-Gary-Lake, Ill.	100,890	2.9	76	211,198	5.1	73	2.3	3
Chico, Calif.	520	1.0	251	1,966	2.4	214	1.4	37
Cincinnati-Hamilton, OH/KY/IN	16,711	3.1	57	37,853	5.3	59	2.2	-2
Cleveland, Ohio	23,661	2.8	80	44,366	4.2	106	1.4	-26
Colorado Springs, Colo.	3,683	2.5	113	20,514	7.8	16	5.3	97
Columbia, Mo.	1,462	2.9	75	3,830	5.3	57	2.5	18
Columbia, S.C.	4,581	2.4	123	12,536	4.6	92	2.2	31
Columbus, Ga./Ala.	741	1.0	249	2,625	3.1	175	2.1	74
Columbus, Ohio	14,850	3.0	71	44,319	5.9	39	3.0	32
Corpus Christi, Tex.	2,342	2.0	160	3,644	3.2	169	1.2	-9
Dallas-Fort Worth, Tex.	48,052	3.2	47	156,797	6.3	31	3.0	16
Danville, Va.	360	0.7	260	295	0.6	264	-0.1	-4
Davenport-Rock Island-Moline, Iowa/Ill.	4,202	2.8	79	4,991	3.8	130	1.0	-51
Daytona Beach, Fla.	1,682	1.8	185	3,991	2.1	229	0.3	-44
Dayton-Springfield, Ohio	14,670	3.4	38	23,450	5.1	71	1.7	-33
Decatur, Ala.	1,201	2.1	147	2,115	3.2	162	1.1	-15
Denver-Boulder-Longmont, Colo.	38,400	4.7	12	90,420	7.8	15	3.0	-3
Des Moines, Iowa	2,964	1.9	166	9,992	4.9	79	3.0	87
Detroit, Mich.	59,024	3.4	40	124,992	6.1	33	2.8	7
Duluth-Superior, Minn./Wis.	1,780	2.0	164	2,280	2.4	211	0.5	-47
Eau Claire, Wis.	740	1.3	229	2,220	2.9	190	1.6	39
Edmonton, Alta.	10,747	3.0	67	22,869	4.5	95	1.6	-28
El Paso, Tex.	2,663	1.4	221	5,493	2.2	220	0.8	1
Elkhart-Goshen, Ind.	1,120	1.8	182	1,757	1.9	243	0.1	-61
Erie, Pa.	2,683	2.3	133	3,826	3.0	185	0.7	-52
Eugene-Springfield, Ore.	2,301	2.0	165	5,064	3.2	160	1.3	5
Evansville, Ind./Ky.	1,642	2.2	143	3,272	2.6	201	0.5	-58
Fayetteville, N.C.	540	0.5	263	2,803	1.9	240	1.4	23
Flint, Mich.	3,624	2.1	152	2,338	2.5	210	0.4	-58
Florence, Ala.	620	1.3	230	1,198	1.9	239	0.6	-9
Fort Collins-Loveland, Colo.	2,943	4.1	23	10,359	8.0	10	3.9	13
Fort Lauderdale-Hollywood-Pompano Beach, Fla.	7,005	1.6	204	26,024	3.4	150	1.8	54
Fort Myers-Cape Coral, Fla.	621	0.8	258	3,014	1.6	249	0.8	9
Fort Walton Beach, Fla.	1,222	2.5	108	4,126	4.9	81	2.4	27
Fort Wayne, Ind.	3,963	3.0	69	8,996	3.8	127	0.9	-58
Fresno, Calif.	2,701	1.3	233	6,909	2.0	234	0.7	-1
Gadsden, Ala.	361	0.9	253	477	1.1	260	0.2	-7
Gainesville, Fla.	2,180	3.2	46	6,593	6.1	35	2.9	11
Galveston-Texas City, Tex.	3,442	3.7	31	6,962	6.1	36	2.4	-5
Glens Falls, N.Y.	640	1.5	211	1,106	2.0	238	0.4	-27
Grand Rapids, Mich.	4,642	1.7	194	18,475	3.8	133	2.1	61
Greater Sudbury, Ont.	1,248	2.0	163	1,956	2.8	195	0.8	-32
Greeley, Colo.	681	1.3	236	3,184	3.7	138	2.4	98

Table B1 Science and engineering (S&E) employment and shares, for the years 1980, 1981 and 2000, 2001: Canadian and U.S. metropolitan areas (continued)

Metropolitan area name, Province/State	1980 and 1981			2000 and 2001			Difference between 2000, 2001 and 1980, 1981	
	Employment	Share (%)	Rank	Employment	Share (%)	Rank	Share (%)	Rank
Green Bay, Wis.	1,601	2.0	158	4,616	3.8	128	1.8	30
Greensboro-Winston Salem, N.C.	5,666	1.7	191	20,870	3.3	157	1.6	34
Greenville-Spartanburg-Anderson, S.C.	5,465	1.9	171	15,371	4.0	118	2.1	53
Hagerstown, Md.	760	1.6	209	1,914	3.2	164	1.6	45
Halifax, N.S.	3,388	2.5	102	8,737	4.8	85	2.3	17
Hamilton, Ont.	6,160	2.3	124	12,847	3.9	120	1.6	4
Hamilton-Middleton, Ohio	3,661	3.4	39	9,999	6.1	34	2.7	5
Harrisburg-Lebanon-Carlisle, Pa.	6,683	3.2	50	15,366	4.9	78	1.7	-28
Hartford-Bristol-Middleton-New Britain, Conn.	14,625	4.5	14	20,531	5.3	58	0.8	-44
Hickory-Morgantown, N.C.	260	0.5	262	2,804	1.6	251	1.1	11
Honolulu, Hawaii	6,524	1.7	195	14,968	3.6	144	1.9	51
Houston-Brazoria, Tex.	58,548	4.3	19	114,318	5.7	49	1.4	-30
Huntsville, Ala.	7,265	5.5	6	18,458	11.1	3	5.7	3
Indianapolis, Ind.	13,868	2.6	100	38,263	4.7	87	2.2	13
Jackson, Mich.	2,021	3.4	42	2,134	2.9	189	-0.4	-147
Jackson, Miss.	2,523	2.3	130	6,745	3.4	153	1.1	-23
Jacksonville, Fla.	5,385	1.8	181	21,446	4.0	116	2.2	65
Jacksonville, N.C.	240	0.4	264	1,151	1.4	256	1.0	8
Janesville-Beloit, Wis.	900	1.6	207	1,503	2.0	235	0.4	-28
Johnson City-Kingsport-Bristol, Tenn./Va.	2,582	4.2	20	4,760	3.3	154	-0.9	-134
Johnstown, Pa.	881	1.4	220	1,917	2.0	236	0.5	-16
Joplin, Mo.	681	1.3	232	1,119	1.5	254	0.2	-22
Kalamazoo-Portage, Mich.	1,940	2.0	162	8,701	4.0	115	2.0	47
Kankakee, Ill.	620	1.5	218	746	1.6	252	0.1	-34
Kansas City, Mo./Kans.	15,971	2.5	104	44,107	5.2	66	2.6	38
Kenosha, Wis.	1,080	1.9	169	3,247	4.4	101	2.5	68
Killeen-Temple, Tex.	740	0.7	261	3,128	2.1	230	1.4	31
Kingston, Ont.	1,372	2.5	107	2,871	4.0	113	1.5	-6
Kitchener, Ont.	3,328	2.3	132	10,717	4.9	80	2.6	52
Knoxville, Tenn.	8,063	3.9	26	13,052	4.7	90	0.8	-64
Kokomo, Ind.	1,181	2.7	87	2,281	4.9	77	2.2	10
Lafayette, La.	2,643	3.7	30	3,507	3.2	167	-0.6	-137
Lafayette-West Lafayette, Ind.	1,622	2.8	78	4,221	4.7	88	1.9	-10
Lake Charles, La.	1,181	2.4	117	2,025	2.6	205	0.2	-88
Lakeland-Winterhaven, Fla.	1,880	1.4	222	4,410	2.1	225	0.7	-3
Lancaster, Pa.	3,262	1.9	172	6,507	2.8	194	0.9	-22
Lansing-East Lansing, Mich.	4,725	2.4	116	11,322	5.0	75	2.6	41
Las Vegas, Nev.	2,821	1.2	239	14,019	2.2	222	1.0	17
Lexington-Fayette, Ky.	3,021	3.1	58	7,784	5.6	51	2.5	7
Lima, Ohio	1,540	1.7	196	1,469	2.0	233	0.3	-37
Lincoln, Nev.	2,501	2.5	115	7,344	5.3	60	2.8	55
Little Rock-North Little Rock, Ark.	3,865	2.2	144	10,578	3.7	137	1.6	7
London, Ont.	3,009	2.1	151	8,530	4.0	119	1.8	32
Longview-Marshall, Tex.	1,482	2.1	145	1,611	2.2	224	0.0	-79
Los Angeles-Long Beach, Calif.	154,783	3.5	36	239,237	4.5	96	1.0	-60
Louisville, Ky./Ind.	6,167	2.1	156	16,040	3.6	142	1.5	14
Lubbock, Tex.	1,522	1.5	216	2,547	2.2	221	0.7	-5
Lynchburg, Va.	1,720	2.5	110	3,516	3.5	148	1.0	-38
Macon-Warner Robins, Ga.	881	1.4	219	5,502	3.8	131	2.4	88

Table B1 Science and engineering (S&E) employment and shares, for the years 1980, 1981 and 2000, 2001: Canadian and U.S. metropolitan areas (continued)

Metropolitan area name, Province/State	1980 and 1981			2000 and 2001			Difference between 2000, 2001 and 1980, 1981	
	Employment	Share (%)	Rank	Employment	Share (%)	Rank	Share (%)	Rank
Madison, Wis.	5,986	3.5	33	18,210	7.5	18	3.9	15
Manchester, N.H.	2,281	2.9	73	2,542	4.6	93	1.7	-20
Mansfield, Ohio	1,080	1.9	167	1,425	2.4	213	0.5	-46
McAllen-Edinburg-Pharr-Mission, Tex.	740	0.8	259	2,115	1.2	259	0.4	0
Medford, Ore.	901	1.7	192	1,727	2.2	223	0.5	-31
Melbourne-Titusville-Cocoa-Palm Bay, Fla.	6,764	5.8	4	16,545	7.8	14	2.0	-10
Memphis, Tenn./Ark./Miss.	5,083	1.5	214	17,169	3.7	135	2.2	79
Miami-Hialeah, Fla.	9,047	1.3	227	22,910	2.5	208	1.2	19
Milwaukee, Wis.	16,392	2.5	111	38,135	5.1	70	2.7	41
Minneapolis-St. Paul, Minn.	35,693	3.4	37	100,067	6.4	28	3.0	9
Mobile, Ala.	2,620	1.8	176	6,901	3.0	179	1.2	-3
Modesto, Calif.	1,323	1.3	237	3,628	2.1	232	0.8	5
Monroe, La.	820	1.5	213	975	1.5	253	0.0	-40
Montgomery, Ala.	2,423	2.1	149	5,667	3.9	125	1.7	24
Montréal, Que.	33,934	2.6	96	91,523	5.5	53	2.9	43
Muncie, Ind.	902	1.7	193	1,599	2.9	191	1.2	2
Nashville, Tenn.	7,080	1.8	179	23,640	3.7	134	2.0	45
New Bedford, Mass.	961	1.3	228	2,364	3.0	182	1.6	46
New Haven-Meriden, Conn.	3,122	3.0	70	8,743	5.2	68	2.2	2
New Orleans, La.	12,228	2.6	93	18,609	3.4	149	0.8	-56
New York-Northeastern N.J.	168,428	2.6	92	369,193	4.8	84	2.2	8
Newburgh-Middletown, N.Y.	2,342	2.2	141	4,707	3.0	184	0.8	-43
Norfolk-Virginia Beach-Newport News, Va.	11,550	2.1	146	34,127	4.5	98	2.3	48
Ocala, Fla.	480	1.1	242	1,502	1.5	255	0.4	-13
Odessa, Tex.	1,020	1.8	175	2,884	2.8	193	1.0	-18
Oklahoma City, Okla.	9,984	2.5	105	17,646	4.1	112	1.6	-7
Olympia, Wash.	1,701	3.2	52	6,075	5.8	43	2.6	9
Omaha, Nebr./Iowa	4,642	2.5	114	17,457	5.7	45	3.3	69
Orlando, Fla.	7,826	2.4	121	31,344	3.9	121	1.6	0
Oshawa, Ont.	1,672	2.3	134	6,874	4.6	91	2.3	43
Ottawa–Gatineau, Ont./Que.	18,722	5.2	8	65,332	11.6	2	6.4	6
Pensacola, Fla.	2,161	1.8	178	5,420	3.0	183	1.2	-5
Peoria, Ill.	4,482	3.1	59	8,534	5.1	72	2.0	-13
Philadelphia, Pa./N.J.	61,824	3.1	62	126,213	5.4	55	2.3	7
Phoenix, Ariz.	20,436	3.0	65	75,590	5.3	62	2.2	3
Pittsburgh-Beaver Valley, Pa.	28,901	3.1	60	47,224	4.5	94	1.5	-34
Portland, Maine	1,742	2.1	154	5,525	4.3	104	2.2	50
Portland-Vancouver, Ore./Wash.	15,625	2.7	90	51,372	5.7	50	3.0	40
Providence-Fall River-Pawtucket, Mass./R.I.	4,842	1.6	206	18,031	3.7	136	2.1	70
Provo-Orem, Utah	1,702	2.2	139	9,825	5.9	41	3.7	98
Pueblo, Colo.	741	1.5	212	1,118	2.0	237	0.4	-25
Québec, Qc	8,801	3.5	34	21,232	6.2	32	2.7	2
Racine, Wis.	2,002	2.6	98	3,026	3.3	155	0.8	-57
Raleigh-Durham, N.C.	9,944	4.3	18	62,994	10.0	5	5.7	13
Reading, Pa.	3,403	2.3	127	6,377	3.6	143	1.2	-16
Redding, Calif.	641	1.6	208	1,522	2.3	217	0.8	-9
Regina, Sask.	2,122	2.6	101	4,851	4.8	82	2.3	19
Reno, Nev.	2,381	2.2	138	5,282	3.1	177	0.9	-39
Richland-Kennewick-Pasco, Wash.	4,705	9.0	1	6,344	7.4	19	-1.7	-18

Table B1 Science and engineering (S&E) employment and shares, for the years 1980, 1981 and 2000, 2001: Canadian and U.S. metropolitan areas (continued)

Metropolitan area name, Province/State	1980 and 1981			2000 and 2001			Difference between 2000, 2001 and 1980, 1981	
	Employment	Share (%)	Rank	Employment	Share (%)	Rank	Share (%)	Rank
Richmond-Petersburg, Va.	9,425	2.6	97	25,839	5.2	65	2.6	32
Riverside-San Bernadino, Calif.	9,888	2.2	136	33,718	2.6	200	0.4	-64
Roanoke, Va.	1,681	1.6	201	3,675	3.2	168	1.5	33
Rochester, N.Y.	15,589	4.8	10	31,727	6.4	29	1.5	-19
Rockford, Ill.	3,543	3.1	63	6,014	3.9	123	0.8	-60
Sacramento, Calif.	12,986	2.9	72	47,303	6.4	30	3.5	42
Saginaw-Bay City-Midland, Mich.	2,865	2.2	140	7,484	4.1	110	1.9	30
Saguenay, Que.	1,137	2.3	125	1,917	2.9	188	0.6	-63
Saint John, N.B.	921	1.9	168	2,292	4.1	109	2.2	59
Salem, Ore.	1,481	1.8	186	3,744	3.0	180	1.2	6
Salinas-Sea Side-Monterey, Calif.	741	1.2	241	3,759	3.2	166	2.0	75
Salt Lake City-Ogden, Utah	11,869	3.0	64	32,815	5.0	74	2.0	-10
San Antonio, Tex.	7,083	1.7	198	24,475	3.5	147	1.8	51
San Diego, Calif.	27,625	3.2	55	78,935	5.9	38	2.8	17
San Francisco-Oakland-Vallejo, Calif.	61,303	3.5	35	184,596	8.0	11	4.5	24
San Jose, Calif.	52,273	7.9	2	133,121	15.7	1	7.8	1
Santa Barbara-Santa Maria-Lompoc, Calif.	5,504	3.9	27	9,597	5.2	63	1.3	-36
Santa Cruz, Calif.	2,263	2.7	91	10,216	7.8	13	5.1	78
Santa Rosa-Petaluma, Calif.	3,084	2.4	122	9,956	4.3	103	2.0	19
Sarasota, Fla.	1,143	1.5	215	6,630	2.7	199	1.2	16
Saskatoon, Sask.	1,835	2.4	119	4,191	3.7	139	1.3	-20
Savannah, Ga.	1,401	1.7	197	3,168	3.0	181	1.3	16
Scranton-Wilkes-Barre, Pa.	2,884	1.3	234	6,864	2.4	212	1.1	22
Seattle-Everett, Wash.	38,026	4.8	11	105,929	8.6	8	3.8	3
Sharon, Pa.	761	1.5	217	944	1.8	244	0.3	-27
Sherbrooke, Que.	870	1.7	190	2,307	3.1	176	1.4	14
Shreveport, La.	2,280	1.4	223	3,250	1.9	241	0.5	-18
Sioux City, Iowa/Nebr.	480	1.1	246	1,571	3.1	172	2.0	74
Sioux Falls, S.Dak.	740	1.4	225	1,802	2.6	204	1.2	21
South Bend-Mishawaka, Ind.	2,661	2.5	109	4,531	3.6	141	1.1	-32
Spokane, Wash.	1,944	1.3	226	6,033	3.1	174	1.7	52
Springfield, Ill.	2,905	3.4	43	2,991	5.3	61	1.9	-18
Springfield, Mo.	820	1.0	250	3,445	2.1	228	1.1	22
Springfield-Holyoke-Chicopee, Mass.	5,624	2.4	118	10,797	3.8	126	1.4	-8
St. Catharines–Niagara, Ont.	2,771	2.0	159	4,103	2.3	219	0.3	-60
St. Cloud, Minn.	520	1.1	245	1,991	2.1	226	1.0	19
St. John's, N.L.	1,717	2.7	88	4,123	5.1	69	2.4	19
St. Joseph, Mo.	440	1.1	247	663	1.4	257	0.3	-10
St. Louis, Mo./Ill.	31,004	3.2	54	62,202	4.9	76	1.8	-22
Stamford, Conn.	2,064	3.9	25	9,332	5.3	56	1.4	-31
State College, Pa.	1,421	3.0	68	4,634	7.1	20	4.2	48
Stockton, Calif.	1,342	1.0	252	5,524	2.5	207	1.5	45
Syracuse, N.Y.	7,104	2.9	74	12,042	3.5	145	0.7	-71
Tacoma, Wash.	3,726	1.8	183	10,694	3.2	163	1.5	20
Tallahassee, Fla.	2,400	3.2	49	9,321	6.6	26	3.4	23
Tampa-St. Petersburg-Clearwater, Fla.	11,626	1.9	173	42,821	4.0	117	2.1	56
Terre Haute, Ind.	880	1.8	177	1,686	2.5	209	0.7	-32
Thunder Bay, Ont.	957	1.7	200	1,498	2.6	202	1.0	-2
Toledo, Ohio/Mich.	6,600	2.2	135	9,578	3.2	161	1.0	-26

Table B1 Science and engineering (S&E) employment and shares, for the years 1980, 1981 and 2000, 2001: Canadian and U.S. metropolitan areas (concluded)

Metropolitan area name, Province/State	1980 and 1981			2000 and 2001			Difference between 2000, 2001 and 1980, 1981	
	Employment	Share (%)	Rank	Employment	Share (%)	Rank	Share (%)	Rank
Topeka, Kens.	2,203	2.5	112	2,756	3.3	159	0.8	-47
Toronto, Ont.	51,251	3.2	51	161,552	6.7	25	3.5	26
Trenton, N.J.	6,146	4.3	17	13,158	8.0	12	3.6	5
Trois-Rivières, Que.	786	1.8	184	1,792	2.9	187	1.2	-3
Tucson, Ariz.	6,261	2.8	83	21,011	5.6	52	2.8	31
Tulsa, Okla.	10,168	3.2	53	15,247	4.5	97	1.3	-44
Tuscaloosa, Ala.	1,041	1.9	170	2,516	3.4	152	1.5	18
Tyler, Tex.	1,361	2.3	126	1,354	1.7	247	-0.6	-121
Utica-Rome, N.Y.	3,423	3.3	45	3,633	2.7	196	-0.6	-151
Vancouver, B.C.	16,246	2.5	106	51,280	5.2	67	2.6	39
Ventura-Oxnard-Simi Valley, Calif.	10,067	4.2	22	20,175	5.7	46	1.5	-24
Victoria, B.C.	3,094	2.8	81	8,100	5.2	64	2.4	17
Vineland-Milville-Bridgetown, N.J.	581	1.1	244	727	1.3	258	0.1	-14
Visalia-Tulare-Porterville, Calif.	881	0.9	255	1,394	1.0	262	0.1	-7
Waco, Tex.	1,281	1.8	188	2,470	2.6	203	0.8	-15
Washington, D.C./Md./Va.	97,611	6.3	3	271,804	10.9	4	4.5	-1
Waterbury, Conn.	600	1.3	231	1,049	2.4	216	1.0	15
Waterloo-Cedar Falls, Iowa	1,601	2.6	95	2,333	3.6	140	1.0	-45
Wausau, Wis.	981	2.0	161	1,826	2.7	198	0.7	-37
West Palm Beach-Boca Raton-Delray Beach, Fla.	6,585	2.8	82	18,723	3.9	124	1.1	-42
Wichita Falls, Tex.	520	0.9	256	612	1.0	263	0.1	-7
Wichita, Kans.	8,061	4.4	15	12,749	4.8	83	0.4	-68
Williamsport, Pa.	541	1.1	243	978	1.7	246	0.6	-3
Wilmington, Del./N.J./Md.	7,902	4.4	16	17,166	6.9	23	2.5	-7
Wilmington, N.C.	940	2.0	157	3,553	3.1	173	1.1	-16
Windsor, Ont.	1,806	1.8	187	5,723	3.8	129	2.1	58
Winnipeg, Man.	6,722	2.3	131	13,136	3.8	132	1.5	-1
Worcester, Mass.	1,523	2.1	148	7,881	5.9	40	3.7	108
Yakima, Wash.	720	1.0	248	1,527	1.7	245	0.7	3
York, Pa.	3,764	2.1	153	7,649	3.9	122	1.8	31
Youngstown-Warren, Ohio/Pa.	3,180	1.5	210	5,574	2.1	227	0.6	-17

Source: Canadian censuses (1981 and 2001) and U.S. censuses (1980 and 2000).

References

Atkinson, R.D. and R.H. Court. 1998. *The New Economy Index: Understanding America's Economic Transformation*. Washington, DC: Progressing Policy Institute. (www.neweconomyindex.org/section3_page15.html).

Beckstead, D., M. Brown, G. Gellatly and C. Seaborne. 2003. "A Decade of Growth: The Emerging Geography of New Economy Industries in the 1990s." Statistics Canada. Catalogue no. 11-622-MIE2003003.

Beckstead, D. and G. Gellatly. 2006. *Innovation Capabilities: Science and Engineering Employment in Canada and the United States*. The Canadian Economy in Transition Research Paper Series, catalogue no. 11-622-MIE2006. Ottawa: Statistics Canada.

Costa, D.L. and M.E. Kahn. 2000. "Power couples: Changes in the locational choice of the college educated, 1940-1999." *The Quarterly Journal of Economics*. 115, 4: 1287–1315.

D.J. DeVoretz and D. Coulombe. 2005. "Labour mobility between Canada and the United States: Quo Vadis 2004?" In *Social and Labour Market Aspects of North American Linkages*. R.G. Harris and T. Lemieux eds.). Calgary: University of Calgary Press. 417–443.

Duranton, G. and D. Puga. 2001. "Nursery Cities: Urban Diversity, Process Innovation, and the Life Cycle of Products." *American Economic Review.* 91, 5: 1454–1477.

Florida, R. 2002a. "The Economic Geography of Talent." *Annals of the Association of American Geographer*. 92, 4: 743–755.

Florida R. 2002b. *The Rise of the Creative Class: And how it's Transforming Work, Leisure, Community and Everyday Life*. New York: Basic Books.

Gertler, M.S., R. Florida, G. Gates and T. Vinodrai. 2002. *Competing on Creativity: Placing Ontario's Cities in North American Context*. Toronto: Ontario Ministry of Enterprise, Opportunity and Innovation and the Institute for Competitiveness and Prosperity.

Glaeser, E.L. and E. Saiz. 2004. *The Rise of the Skilled City.* NBER Working Paper Series. Working Paper 10191. Cambridge, MA: National Bureau of Economic Research.

Gu, W., M. Kaci, J.-P. Maynard and M.-A. Sillama. 2003. “The Changing Compositon of the Canadian Workfore and its Impact on Productivity Growth.” In *Productivity Growth in Canada – 2002*. Catalogue no. 15-204-XPE. J.R. Baldwin and T.M. Harchaoui (eds.). Ottawa: Statistics Canada.

Jacobs, J. 1969. *The Economy of Cities*. New York: Random House.

Kim, S. 1989. “Labor Specialization and the Extent of the Market.” *The Journal of Political Economy*. 97, 3: 692–705.

Lucas, R.E., Jr. 1988. “On the mechanics of economic development.” *Journal of Monetary Economics*. 22: 3–42.

National Science Board. 2004. *Science and Engineering Indicators 2004, Volume 1 NSB 04-1)*. Arlington, VA: National Science Foundation.

Polèse, M. and R. Tremblay. 2005. “Le Classement des Villes dans l’Économie du Savoir : Une analyse intégrée des régions urbaines Canadiennes et Américaines.” *The Canadian Geographer*. 49, 2: 198–213.

Rosenthal, S. and W. Strange. 2004. “Evidence on the Nature and Sources of Agglomeration Economies.” In *Handbook of Urban and Regional Economics*. J.V. Henderson and J.-F.Thisse (eds.). Amsterdam: Elsevier.