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**Working Paper**

## Economics research in Canada: A long-run assessment of journal publications

Research Report, No. 2007-2

**Provided in Cooperation with:**

Department of Economics, University of Western Ontario

*Suggested Citation:* Davies, James B.; Kocher, Martin G.; Sutter, Matthias (2007) : Economics research in Canada: A long-run assessment of journal publications, Research Report, No. 2007-2, The University of Western Ontario, Department of Economics, London (Ontario)

This Version is available at:

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by

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**Research Report # 2007-2**

**April 2007**



***Department of Economics  
Research Report Series***

Department of Economics  
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London, Ontario, N6A 5C2  
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# **Economics research in Canada: A long-run assessment of journal publications<sup>#</sup>**

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**April 2007**

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<sup>#</sup> We would like to thank two anonymous referees and the Managing Editor for helpful and detailed comments on earlier versions of this paper. Heidrun Brugger-Sutter, Robert Mrcic, Ganna Pogrebna and Florian Wakolbinger provided valuable research assistance. Financial support from the University of Innsbruck is gratefully acknowledged. Responsibility for any errors or omissions is our own.

# **Economics research in Canada:**

## **A long-run assessment of journal publications**

### **Abstract**

We examine the publications of authors affiliated with an economics research institution in Canada in (i) the Top-10 journals in economics according to journals' impact factors, and (ii) the *Canadian Journal of Economics*. We consider all publications in the even years from 1980 to 2000. Canadian economists contributed about 5% of publications in the Top-10 journals and about 55% of publications in the *Canadian Journal of Economics* over this period. We identify the most active research centres and identify trends in their relative outputs over time. Those research centres successful in publishing in the Top-10 journals are found to also dominate the *Canadian Journal of Economics*. Additionally, we check the robustness of our findings with respect to journal selection, and we present data on authors' Ph.D.-origin, thereby indicating output and its concentration in graduate education.

**JEL-classification:** A11, A14

**Keywords:** research in economics, Canadian economics, top journals

## 1. Introduction

As in other fields of science, economists are keen on assessing the research output of their institutions or their success in disseminating their work. In addition to the private value of this information, it may be used to help allocate resources or to assist in hiring, promotion and tenure decisions. The number of studies of research output and rankings in economics is both large and increasing. The most studied area is the U.S., but considerable work on continental Europe has now also been done. While Canada is included in a few recent studies with a global scope (Kocher and Sutter, 2001; Coupé, 2003; Kalaitzidakis et al., 2003), and while an excellent study on the ranking of its economics departments was provided by Lucas (1995), it has still received relatively little attention overall. This is despite the fact that, as we show in this paper, Canada has ranked as either the second or third most productive country in economics for many years.

This paper provides rankings of economic research institutions in Canada according to their output of articles published over the period 1980-2000 (i) in the "Top-10" journals of economics according to the journals' average impact factors, and (ii) in the *Canadian Journal of Economics*. It also ranks universities according to the publications of their Ph.D. graduates and compares Canada's output with that of other countries. In order to check the robustness of our findings with respect to journal selection, we also consider a different set of Top-10 journals.

The paper is further differentiated from other recent studies by the relatively long time-frame used. This smoothes out short-run fluctuations and allows an assessment of broad trends over time. One reason why a study using consistent methods over a long time span is important for Canada is that recent international studies suggest there may have been a regime change in top institutional rankings in the 1990's. Earlier studies found a distinct and stable "top four" group – University of British Columbia (UBC), Queen's University, University of Toronto and the University of Western Ontario (UWO) – and a second tier of about half a dozen institutions that competed vigorously with each other but did not appear to threaten the top four. Recent studies suggest that one or more of the traditional top departments may have lost elite status and that the University of Montreal has gained it. These studies do not, however, use the same methods as earlier work for Canada, such as Frankena and Bhatia (1973) or Lucas (1995). Thus trends need to be checked using consistent methods.

As is well-known, there are many somewhat subjective judgments and choices that must be made in ranking economists or institutions according to research output. Quantity can be measured in terms of number of articles or pages, with the latter sometimes being measured in terms of some standard unit, such as *AER* pages. Most studies exclude notes, book reviews, and other short contributions, but this practice is not universal. Quality has sometimes been measured in terms of citation counts, but is more commonly captured by the assessed quality of the journals in which articles appear. This can be done by assigning different weights to each of a large number of journals, often taken from Econlit. Or the journals can be divided into tiers, with all journals within a tier receiving equal weight – the approach followed e.g. by Lucas (1995), who used five tiers. Finally, attention may be confined to a relatively small number of top journals, weighted or unweighted, with the remaining economics journals effectively assigned a weight of zero.

The ranking literature in economics has been criticized, and has perhaps lost reputation, as a result of conducting large-scale comparisons across many institutions without paying enough attention to resolving obvious methodological problems or developing a common standard. For example, there is no generally agreed on selection procedure for journals or consensus on quality weighting of contributions. While alternative journal selections and weighting have little effect on international comparisons with adequate aggregation over time (Kocher and Sutter, 2001), they do affect institutional rankings, especially when the database is too small. There is some evidence that methodological discretion opens opportunities to obtain favorable results for one's own institution (see Feinberg, 1998; Griliches and Einav, 1998). Needless to say, comparisons on an individual level are even more sensitive to small alterations in methods.

The ranking used here is based on publications in the Top-10 journals, an approach we share e.g. with Kalaitzidakis et al. (1999). Focusing attention on a relatively small number of top journals is, of course, a matter of choice and reflects our particular preferences. However, our choice is not entirely arbitrary. It recognizes the disproportionate interest in, and prestige attached to, a small number of leading journals in the discipline. It also reflects the fact that different ranking methods may be appropriate for different types of institutions. For leading centres of research and graduate training looking at the top journals is arguably the best approach. As elsewhere, the leading institutions in Canada place particular emphasis on publications

in top journals. We believe that our approach is appropriate in ranking at least the top 10 institutions in Canada. As will become clear from the robustness checks at the end of the results section, the ranking of Canadian institutions that succeed in publishing in top journals is relatively insensitive to the choice of top journals.

Another important issue of ranking is discussed in this paper. Canada is one of the few countries that have a single national economics journal with high international visibility and reputation, the *Canadian Journal of Economics*. This allows us to compare rankings that are based on our international set of top journals with a second ranking based on publications in the national journal. Especially for future evaluation studies it should be of interest to see whether a special role can be played in forming institutional rankings by a study of publications in a major national journal.

This paper focuses on an assessment of economics research output for Canada as a whole and for single Canadian *institutions*.<sup>1</sup> We abstain from providing data on the individual level, because such a study would require both a broader set of journals and more information on individual researchers to be informative and reliable. It should also be noted that, unlike Lucas (1995) and in keeping with recent major international studies, we are not providing rankings of economics *departments*. All publications from a given university are included. Thus it would be premature to conclude, e.g., from the fact that the University of Toronto ranks more highly in our overall results than the University of British Columbia that Toronto has a “stronger economics department”. It may be that the top publications of economists outside the economics department at UBC are simply fewer than those of the corresponding group at Toronto. Unfortunately, our data do not allow us to resolve such uncertainties.

The remainder of the paper is organized in the following way. Section 2 discusses the institutional background for Canadian research output in economics over the period 1980 – 2000. Section 3 briefly reports on related studies and prior results on Canada and Canadian economics institutions. In Section 4 we then provide an overview of the journals selected for this paper and the arguments for their selection. Additionally, we give detailed information on the data base. In Section 5 we present our results. Section 6 discusses the results from the viewpoint of economics research in Canada and concludes the paper.

## 2. Institutional Background

While government departments, the Bank of Canada, and a few think tanks play a role, most economics research in Canada is performed in universities, and we will focus mostly on the academic arena in this section. Canada has a relatively large number of universities. They are under provincial rather than central control and, further, are separately established within provinces rather than being part of province-wide institutions. This structure favors competition, which may help to explain why Canadian universities generally, and their economics departments in particular, have been quite productive in research.<sup>2</sup>

Two other important features to keep in mind are: 1) academic economists are fairly mobile between Canada and the U.S. (as will become also evident from section 5.4 below), and the North American market for high quality economists is highly integrated, 2) many Canadian universities are unionized. These two facts create an interesting tension. While the top Canadian universities were traditionally non-unionized, the union label has spread within even that circle recently, with Queen's becoming unionized in 1996 and Western Ontario in 1998. It would seem that attempting to maintain a first-rank economics department in North America while subject to the strictures of a collective agreement could present a challenge. As shown by Hosios and Siow (2004) unionized faculties in Canada, like unionized enterprises in general, exhibit a tendency towards wage compression, which of course could act against retaining high flying faculty with good opportunities in the U.S.

So much for basic features. What else changed over the period 1980 – 2000? The answer is a great deal. Dual earner families became the norm, making hiring more difficult at institutions not located in or near large cities. Economists' salaries in the U.S. rose quickly, while in Canada they rose more slowly and then stalled, most famously in the three year freeze imposed by the Ontario provincial government from 1993-95.<sup>3</sup> Economics enrolments in Canada first went up strongly, until about 1990, and

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<sup>1</sup> Our study covers all institutions that generate economics articles, not just universities. Thus we include, e.g., government departments, Statistics Canada, the Bank of Canada, and think tanks. The ranks of the top institutions are, however, dominated by the universities.

<sup>2</sup> The forces of competition are reduced by provincial control of the rate of growth of tuition fees and other forms of regulation by provincial governments. Nevertheless, we think it is important to put some emphasis on the effects of the important element of competition that exists in this sector.

<sup>3</sup> The freeze in fact caused a small nominal salary reduction, since university staff, like anyone else paid largely from provincial funds, were deemed to be taking several days off each year – the famous “Rae days”.



then began to decline at many universities. And finally, Canadian governments ran up large debts and deficits in the 1980s, leading to increasingly serious cuts in funding for universities as the debt/deficit problem was addressed in the 1990s. The seriousness of the latter development is reflected in Figure 1 which indicates that since 1980 there has been a strong upward trend in real per student government funding for public universities in the U.S., compared with a strong downward trend in Canada. The greatest decline in Canada occurred from 1990 to 1997, with the largest year-over-year decrease occurring in 1996. Since 1997 funding has rebounded in Canada, but there has been little change in the Canada – U.S. gap.

*Figure 1 about here*

The strong market for economists in the U.S. over the period since 1980 has been a problem for all top Canadian institutions engaging in economics research, both inside and outside academia. Top people leave, starting salaries go up to remain competitive, and institutions may substitute away from economists towards researchers in cheaper disciplines. Combine this with enrolment difficulties, and it is not surprising that the typical economics department at a Canadian university shrank between 20% and 30% over the 1990s in terms of faculty numbers. Both the reduction in numbers, and the loss of top scholars, had to affect output. What is surprising, perhaps, is not that output went down, but that it did not fall more in the face of the difficulties faced.

The fact that Canadian economics departments remained productive through the 1990s bodes well for the future because governments did become serious about their fiscal problems and have dealt with them fairly successfully. The federal government has been in surplus every year since 1997 and Canada has now for several years had the lowest deficit/GDP ratio in the G8. While the Ontario government still struggles with a deficit, it is not of crisis proportions, and Canadian governments overall are in healthy fiscal shape, especially compared to the U.S. federal government. This improvement on the fiscal side has made possible the significant increase in university funding in Canada since 1997. Also due to large tuition fee increases that were allowed in the late 1990s, the universities are in better financial condition than they have been for a long time. Provided an adequate share of the available resources are directed toward economics departments, it is not unreasonable to expect substantially increased output of economics research in the future.

There is, however, at least one reason why some observers are not so sanguine. As mentioned above, over the 1980s and 1990s an increasing number of Canadian universities unionized. Chant (2005, p. 14) surveys 42 Canadian universities, at 29 of which faculty are now unionized and have the right to strike.<sup>4</sup> While it is true that Western Ontario and Queen's are the only universities with major economics departments where faculty have the right to strike, if the trend towards increased unionization were to continue, one might expect that more top Canadian economics departments could fall into the unionized category in the future. On the other hand, the harsh fiscal conditions of the 1990s that many believe were responsible for certification at Western and Queen's may not soon be repeated.

Hosios and Siow (2004) found that unionization at Canadian universities, on average, leads to wage compression, but also found an effect that may mitigate that impact to an extent. At Medical/Doctoral universities, a category that includes most Canadian universities with major economics departments, unionization led to an increase in faculty salaries of about five percent. The possible impact of wage compression therefore has to be weighed against that of higher average salaries.

Chant (2005) studies the impact of how faculty are paid at Canadian universities on research and teaching performance. He finds that performance is much stronger where faculty receive annual increments based partly or wholly on merit, rather than on seniority. Interestingly, there is far from a perfect correlation between how faculty are paid and union status. This is very striking among the 12 Medical/Doctoral universities. In this group there are nine unionized universities, of which six use merit rather than seniority increments. While at three of the nine unionized universities there is no right to strike, even among the six where there is the possibility of strike, half use a merit scheme. Chant finds that the critical issue is not whether faculty are unionized, but what payment scheme is in force. There are some grounds for optimism that merit schemes will remain important even at top-tier unionized universities in Canada.<sup>5</sup>

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<sup>4</sup> At four universities (Alberta, Calgary, Lethbridge, and British Columbia) the faculty association is recognized as a union but does not have the right to strike.

<sup>5</sup> One of the authors (Davies) was chair of the economics department at Western from 1992 to 2001. In the six years before unionization, which occurred in 1998, he was only called on to distribute merit pay twice. Since unionization, career progress salary increments have, in contrast, been based on merit over three successive collective agreements.

### **3. Canada and Canadian institutions in previous ranking studies – An overview**

Frankena and Bhatia (1973) were the first to rank Canadian institutions and economists in an international setting. They replicated methods used by Moore (1972) to rank U.S. economics departments. The two leading Canadian departments, according to total output in 35 "relatively high quality" economics journals from mid-1968 to mid-1972, were the University of British Columbia (UBC) and the University of Western Ontario (UWO). The University of Toronto was close behind. If inserted in the U.S. rankings, the authors reported, these three schools would rank between 17th and 24th.

Lucas (1995) did a careful study of the ranking among Canadian economics departments, but did not consider their position internationally.<sup>6</sup> In terms of total output, he identified the same top three institutions as Frankena and Bhatia, except that the order was altered to UWO first, Toronto second, and UBC third. In fourth place was Queen's University, as in Frankena and Bhatia. Beyond this point the rankings differ significantly, with a "second tier" of schools, including Alberta, Carleton, Waterloo, McMaster, Montreal, Simon Fraser, and York vying for inclusion in the leading 4 or 5 institutions below the "big four". Interestingly, Montreal rose from 13th place in Frankena and Bhatia to 6th place in Lucas. This reflects a rise in relative standing that is confirmed in our results, and which we find continued through the 1990's.

In both Frankena and Bhatia (1973) and Lucas (1995) there was a distinct drop in output from the leading four departments to the second tier. However, there was no such dividing line between the second tier and lower ranked institutions. We thus have a picture of a stable group of four leading departments, and a group of following departments jockeying for status. This picture remained accurate until quite recently as we will see below. However, we find that in the last decade the sharp division between the top four and other departments seems to have broken down.

Turning to recent international studies, there are quite a few that restrict themselves either to European institutions (e.g., Kirman and Dahl, 1994, 1996; Combes and Linnemer, 2003; Lubrano et al., 2003) or to the U.S. (Conroy and Dusansky, 1995;

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<sup>6</sup> An important feature of Lucas (1995) is that he carefully measured inputs, in the form of the number of faculty members in each department, as well as outputs. This is not a trivial contribution, since measuring the number of faculty using a rigorous and consistent definition across departments requires contact and discussion with department chairs and checking with other sources. Lucas found that ranking departments according to productivity produced broadly similar results to ranking according to total output. This result should perhaps reassure us about the value of the present study, and the great majority of other ranking studies, which also do not measure inputs.

Scott and Mitias, 1996; Dusansky and Vernon, 1998; Thursby, 2000). Naturally, Canada or Canadian institutions are ignored in these studies. Nevertheless, there is a sufficient number of recent contributions considering also Canada to allow some conclusions to be drawn.

Kalaitzidakis et al. (2003) find that in the period 1995-99 the top four Canadian universities, in terms of total output, were Toronto, Montreal, UBC, and Queen's, in descending order. UWO had fallen out of the top four, and ranked just 49th in the world compared to a spread of 23-33 for the top four. Coupé (2003) obtained the ranking UBC, Toronto, Queen's, Montreal, and UWO for the same period, with UBC and Toronto ranking 26th and 28th in the world, and the three others 54th, 56th, and 57th respectively.<sup>7</sup> While these two studies agree that Montreal had joined the top group in this period, they differ in their ranking of the top four. Further, the methods they use differ sharply from those of Lucas. Lucas ranked using (quality-weighted) articles in 329 economics journals, whereas the Kalaitzidakis ranking is based on publications in a list of top 30 journals, and Coupé is eclectic – using the average of rankings produced by 11 widely varying methods. Thus, it is not clear whether the apparent regime change in the 1990's is real, or an artifact of different methods. Clearly, there is a need for a consistent comparison over the period 1980-2000.

On the country level, Canada's strength in economic research becomes apparent in the recent studies. The relevant results are more reliable than those for single institutions, simply because they are less sensitive to methodological choices due to aggregation and larger numbers. The main distinction here is between those studies that try to adjust for inputs or resources and those that do not.

Without any input adjustment, Canada finishes in third position in Hodgson and Rothman (1999), in Kocher and Sutter (2001) and in Sutter et al. (2002). This result seems to be quite insensitive with regard to methodology, journal selection and the like, and it is remarkable, because Canada leaves many larger European countries, like France or Germany, clearly behind. Precisely why Canada does so well is an open question. However, it should be noted that the editorship of most of the journals considered in the studies mentioned above is U.S.-based. Due to geographic proximity it may be easier for Canadian economists to become attuned with the preferences and

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<sup>7</sup> Coupé studied the whole period 1990-2000 and provides results for all five-year periods from 1990-94 to 1996-2000 on his website. (See <http://student.ulb.ac.be/~tcoupe/ranking.html>) The 1990-94 top five are, in order starting with the highest ranked, UBC, Toronto, UWO, Queen's and Montreal. Again there

standards of leading U.S. economists and the journals they edit and referee. This effect may be strengthened by the fact that a relatively high proportion of Canadian economists have Ph.D.s from the U.S. We find below that the majority of Canadian economists who succeed in publishing in our Top-10 journals received their graduate education in the U.S.

When adjusting simple article counts by input proxies like manpower or financial resources devoted to research it has been shown that the Canadian position remains largely unchanged (Kocher and Sutter, 2001; Kocher et al., 2006; Sutter et al., 2002). Canada finishes among the top four nations in the world, along with the US, UK and Israel.

#### **4. Journal selection and output data base**

Due to the large and increasing number of economics journals it is clearly necessary to select a subset of journals to arrive at a tractable data base of research output in economics.<sup>8</sup> In order to minimize arbitrariness or discretion we rely on an objective measure of a journal's visibility: the journal *impact factors*.<sup>9</sup> This journal selection criterion is based on the work of Kocher and Sutter (2001), Sutter and Kocher (2001) and Sutter et al. (2002), which examined a wide selection of countries. It has not been chosen to cast any Canadian institution in a favourable or unfavourable light.

The impact factors of journals have been published annually in the *Journal Citations Reports (JCR)* by the Institute for Scientific Information since 1977 and they are based on the Social Science Citation Index. We decided to choose the 10 journals in the economics section of the JCR with the highest average impact factor over the time period 1980-2000.<sup>10</sup> By considering two decades we avoid one of the major shortcomings of several studies in this field, i.e. relying on short time periods such as one to three years. A limited time horizon clearly reduces the relevance of the results,

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was a separation between the top two and the three others. UBC and Toronto ranked 25th and 26th in the world, while the three other institutions were in 49th, 52nd, and 53rd place.

<sup>8</sup> Different universities may of course have different aims and weightings of the various forms of faculty members' output. This study focuses on the internationally comparable part of university output, i.e. publications in highly reputed economics journals.

<sup>9</sup> The impact factor is a measure of citations relative to citable items published, including a time lag. See Garfield (1972) or Sutter and Kocher (2001) for further details and ways of calculating journal impact.

<sup>10</sup> Each journal assigned to the economics section in the JCR for 2000 and at least published since 1980 was considered for selection. *The Economist* has been excluded, because it is generally not considered a scientific journal. The *Rand Journal of Economics* (formerly *Bell Journal*) and the *Economic Journal* are ranked 11<sup>th</sup> and 12<sup>th</sup>.

especially for smaller institutions, because publication records of small institutions may not be evenly distributed over time.

Table 1 gives an overview of the journals included in our sample. The development of impact factors is very stable over the two decades studied (Sutter and Kocher, 2001), which allows us to conclude that the selected journals in this paper stand for foremost visibility of publications in the field of economics.<sup>11</sup> For reasons of comparison – as discussed in the introduction – we also include the *Canadian Journal of Economics (CJE)* in our data base. At the end of the results section (see section 5.5) we report some robustness checks in order to validate our main findings derived from the selection of journals according to average impact factors.

We restrict ourselves to the even years of our sample period, from 1980 to 2000. For the Top-10 journals listed in Table 1 this yields 5384 papers. The *CJE* published 599 papers in the same years. We consider all authors of a paper and the institutional affiliations they state. No articles have been disregarded, except editorial notes, obituaries, book reviews and similar non-scientific contributions.<sup>12</sup>

Table 1  
*Journal sample*

Journal	Average IF <sup>a</sup> (1980-2000)	Journal	Average IF <sup>a</sup> (1980-2000)
Journal of Economic Literature	5.01	Quarterly Journal of Economics	2.12
Journal of Financial Economics	2.65	American Economic Review	1.68
Brookings Papers on Economic Activity	2.53	Journal of Law and Economics	1.63
Journal of Political Economy	2.38	Review of Economic Studies	1.34
Econometrica	2.17	Journal of Monetary Economics	1.33
Canadian Journal of Economics (42.)	0.43		

<sup>a</sup> IF: Impact factor; Source: Journal Citation Reports (1980-2000).

In the case of multiple authors, in line with most other studies we weight the contribution of each author equally and require these contributions to sum to 1. Letting  $N_i$  be the number of authors of article  $i$ , then the weight assigned to each author is just

<sup>11</sup> Some might object to the inclusion of the *Journal of Economic Literature*, the *Brookings Papers on Economic Activity* and the *Journal of Law and Economics*. The former two largely contain invited work and the latter journal is at the intersection of law and economics. In our view, to respond to these objections by excluding these journals would be to show just the kind of arbitrariness for which ranking exercises are often criticized. Since these three journals account for less than 15% of publications in our set of Top-10 journals, though, we are confident that their inclusion does not change the qualitative findings from our paper. However, in order to actually proof that our choice of ten top journals provides robust results, we will present some alternative specifications of Top-10 journals in section 5.5.

<sup>12</sup> We exclude the Papers and Proceedings of the *American Economic Review*, because, generally, papers published therein do not undergo a standard reviewing process.

$1/N_i$ .<sup>13</sup> The same logic is applied to multiple institutions. When aggregating publications for single institutions or on the country level, we simply add the weighted number of papers written by authors affiliated with a given institution or in a given country.

## 5. Empirical results

### 5.1. Canadian publications in the Top-10 journals and in the *CJE*

Figures 2 and 3 display the share of authors – weighted by the number of authors per paper – who are affiliated with an institution in one of the three countries that lead in economics research output, Canada, the UK and U.S.

In the Top-10 journals shown in Figure 2, 77% of all papers are written by authors affiliated with a U.S. institution. This share is fairly stable, ranging from 70.5% in 2000 to 81.9% in 1996. The UK and Canada, ranked second and third in an overall country ranking, account for 5.1% and 4.8% of papers respectively over the period as a whole. All other countries in the world together contribute less than 13% of papers in the Top-10 journals in economics.

Canada's share ranges from 3.1% in 1996 to 7.2% in 1988. There seems to be a marginal downward trend, since from 1980 to 1990 the share of Canadian contributions was 5.4%, dropping to 4.1% from 1992 to 2000.

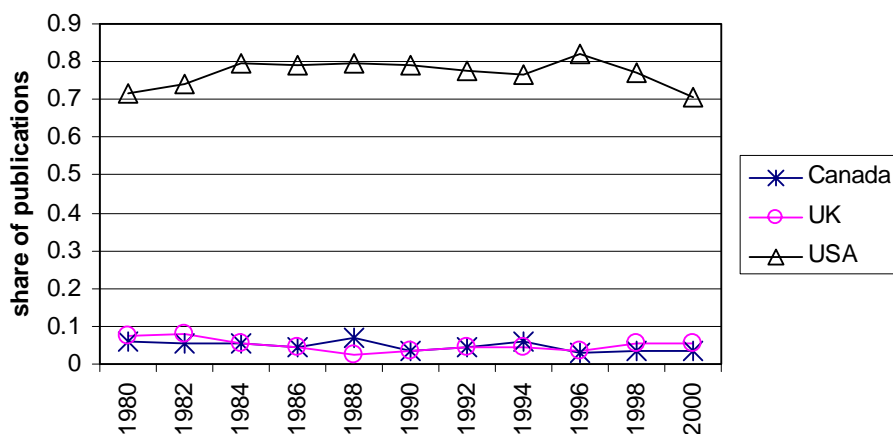


Figure 2. Leading countries in top 10-journals

<sup>13</sup> Some authors take also article length into account for weighting. Kalaitzidakis et al. (1999, 2003), for instance, count pages per article and convert them to *American Economic Review* standardised pages. Unfortunately, this seems to have become standard in rankings, although its justification is not obvious. Rational journals will aim to assign space such that the marginal value of the last page in each article equals or exceeds the shadow value of a page in the journal. However, the contribution of each page in a short but brilliant article may greatly exceed this shadow value. There is no necessary relation between

Not surprisingly, the picture is different when considering the *CJE* only, which is shown in Figure 3. Authors affiliated in Canada account for 55% of publications in the *CJE* in the even years from 1980 to 2000. However, the presence of Canadian authors seems to have weakened from the mid-1980's on, since the share of papers was above 70% in 1980 and 1982, but stayed below 60% later on. In the year 2000, only 42% of authors were affiliated with an institution in Canada.

In the *CJE*, the U.S. is ranked second with an average of 27% of papers, with a marked increase in the early 1980's, which mirrors the decrease in Canada's share. The UK is ranked third with an average of 2.3% of publications in the *CJE*, followed by Japan (1.5%) and Australia (1.3%).

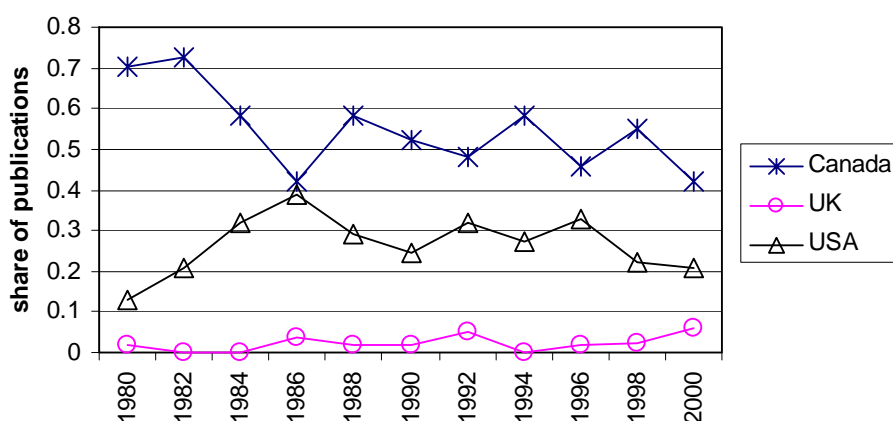


Figure 3. Leading countries in the Canadian Journal of Economics

## 5.2. Canadian authors' affiliations

We now examine the output of single Canadian institutions and compare it with that of selected institutions in other countries. Table 2 reports the weighted number of papers written by authors affiliated with the respective institutions. The first column on each side of Table 2 presents the data for the *CJE*, the second column for the Top-10 journals. As regards the Canadian institutions (see left hand side of the table), the top five in both sets of journals are the University of Western Ontario, the University of Toronto, the University of British Columbia, Queen's University and McMaster University.<sup>14</sup> In total, we have been able to identify 33 different Canadian affiliations of

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the length of articles and their total scholarly value, and no reason to expect proportionality (as if the value of a 20-page paper was double the value of a 10-page one).

<sup>14</sup> Interestingly, these institutions are the only ones to also appear in the list of the top seven in both the studies of Frankena and Bhatia (1973) and Lucas (1995). Note that our results are not strictly comparable



authors in the *CJE*, respectively 30 different affiliations in the Top-10 journals. The correlation between publication scores in the *CJE* and in the Top-10 journals is remarkably high ( $r = 0.90$ ;  $p < 0.01$ ), indicating that those institutions which are successful in publishing in the Top-10 journals also dominate the “home” journal, the *CJE*. The set of top 10 institutions is the same whether one uses the Top-10 journals or the *CJE*.

Table 2

*Institutional affiliation of authors in Top-10 journals and in CJE (1980-2000)*

Canadian institutions	CJE-Score <sup>a</sup>	Top 10-Score <sup>a</sup>	Selected other institutions	CJE-Score <sup>a</sup>	Top 10-Score <sup>a</sup>
Acadia U	1.0	1.0	Australian National U	3.0	15.6
Bank of Canada	2.8	4.2	Hebrew U	2.5	37.2
Brock U	5.3	-	Tel Aviv U	0.7	53.2
Can Inst for Advanced St	-	0.3			
Carleton U	12.8	12.6	LSE	3.0	74.5
Concordia U	9.0	1.5	U Cambridge	0.5	19.8
Dalhousie U	4.6	1.0	U Oxford	-	25.2
Howe Research Inst	-	0.5			
Industry Canada	-	0.5			
Lakehead U	4.0	-			
McGill U	5.3	2.8	<i>Top 10 USA</i>		
McMaster U	18.0	14.7	Harvard U	0.5	263.4
Queens U	30.5	21.3	U Chicago	1.0	225.4
Simon Fraser U	4.2	10.2	MIT	3.0	209.2
Statistics Canada	-	1.0	Stanford U	4.0	165.8
Trent U	3.0	-	Princeton U	1.0	149.5
U Alberta	15.2	7.3	U Pennsylvania	2.3	139.0
U British Columbia	36.1	37.5	Northwestern U	0.8	127.5
U Calgary	11.3	1.3	Yale U	-	120.4
U Guelph	6.5	4.0	UC Berkeley	3.0	101.8
U Laval	6.5	3.7	Columbia U	3.0	91.0
U Lethbridge	0.5	-			
U Manitoba	3.0	-			
U Montreal	17.3	10.1			
U New Brunswick	2.0	1.0			
U Ottawa	4.5	3.3			
U Quebec	6.0	2.2			
U Regina	2.0	-			
U Saskatchewan	5.5	1.7			
U Toronto	22.5	46.2			
U Victoria	5.0	0.5			
U Waterloo	6.0	3.7			
U Western Ontario	45.8	53.1			
U Windsor	6.3	2.5			
U Winnipeg	1.5	-			
Wilfried Laurier U	8.0	0.5			
York U	11.0	4.8	Number of papers	599	5384

<sup>a</sup> Total for even years from 1980 to 2000. Weighting by  $1/N_i$ , where  $N_i$  denotes the number of authors per paper.

with these earlier studies, however, since they confined their attention to works authored by members of economics departments. Several of the larger Canadian institutions have a significant number of economists located outside their economics department. Their publications *are* included in our study.

Checking for the concentration of publication scores across single Canadian institutions we find that the Herfindahl index is considerably lower in the *CJE* (0.064) than in the Top-10 journals (0.121). As we discuss in Section 6 this seems to suggest that *CJE*-based rankings may be an efficient way of getting reliable information both for the top 10 institutions and for smaller or lower-ranked institutions, which are better represented in the *CJE* than in the Top-10 journals.

On the right hand side of Table 2, we report publication scores in the *CJE* and in the Top-10 journals for some selected foreign institutions, in particular for the leading ones in Australia, Israel, the UK and the U.S.. Authors from these institutions rarely publish in the *CJE*, but are generally very successful in publishing in Top-10 journals. Note, for instance, that the publication score of Harvard University accounts for 4.9% of all publications in the Top-10 journals. This share is larger than the corresponding share for *all* Canadian institutions together. The leading Canadian institution, UWO, would be ranked about 25th in the U.S.. Western Ontario had about a quarter less publications in the Top-10 journals than the LSE, the top ranked institution in Europe, and it had slightly more publications than Tel Aviv University, the leading institution in Israel.

### **5.3. Ranking of Top 10 Canadian institutions**

In Table 2 we did not list institutions in any rank order. While publications in the Top-10 journals are a good ranking tool for higher ranked institutions they are evidently inappropriate for lower ranked institutions. We see in Table 2, for example, that 7 institutions had *no* publications in the Top-10 journals in the even years from 1980 to 2000. Still these institutions did publish in the *CJE*, and no doubt elsewhere. In this subsection, where we want to use our Top-10 journal results explicitly for ranking purposes, we confine attention to the top 10 Canadian institutions. Table 3 shows both the ranking for the whole period 1980-2000, and for sub-periods containing four of our (even-numbered) years of observation: 1980-86; 1986-92; and 1994-2000.<sup>15</sup> We see that there have been some interesting changes in the ranking over time.

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<sup>15</sup> Note that the first two sub-periods overlap. We felt that it was important to have at least four years of observation in each sub-period in order to reduce sampling variation.

Table 3

*Ranking of Top 10 Canadian economic research institutions by weighted publications in Top-10 journals, 1980-2000 and sub-periods*

Rank	1980 – 86	1986 – 92	1994 – 2000	1980 – 2000
1	8.60 Western Ontario	5.65 Western Ontario	3.17 Toronto	4.83 Western Ontario
2	4.13 British Columbia	5.06 Toronto	3.06 British Columbia	4.20 Toronto
3	4.00 Toronto	3.17 British Columbia	1.59 Western Ontario	3.41 British Columbia
4	2.63 Carleton	2.04 Queen's	1.29 Montreal	1.94 Queen's
5	2.38 Queen's	1.63 McMaster	1.22 Queen's	1.34 McMaster
6	1.21 Simon Fraser	0.79 Montreal	1.10 McMaster	1.15 Carleton
7	1.19 Alberta	0.71 York	0.87 Simon Fraser	0.93 Simon Fraser
8	1.00 McMaster	0.67 Simon Fraser	0.79 Waterloo	0.92 Montreal
9	0.75 Ottawa	0.63 Alberta	0.50 York	0.66 Alberta
10	0.50 Montreal	0.63 Guelph	0.48 Québec à Montréal	0.44 York

Numbers before institution names are average annual weighted publication scores.

While our study includes non-university institutions, all the institutions in these top 10 rankings are universities.

For the period 1980-2000 as a whole (see the right-hand side of Table 3) the top four institutions are the expected ones, i.e. UWO, Toronto, UBC and Queen's. Beyond this group is a second tier of very good departments: McMaster, Carleton, Simon Fraser, Montreal, Alberta, and York.<sup>16</sup> The tidy picture of four leading departments and a second tier breaks down, however, when we look at recent trends.

Earlier we referred to recent international studies that have placed the University of Montreal in the top four Canadian institutions. Those results were obtained in studies using larger samples of journals.<sup>17</sup> Our results are in agreement to the extent that we also show Montreal breaking into the top four in the period 1994-2000. However the details differ. The most direct comparison is with Kalaitzidakis et al. (2003), who used the Top-30 journals for 1995-99. As mentioned earlier, Kalaitzidakis et al. (2003) placed Montreal in second position and UWO in fifth place. Moreover, UWO ranked only 49th in the world, vs. 24th for Montreal. In contrast, we find UWO in third position and Montreal in fourth place in the period 1994-2000, with a relatively small difference in output. The difference in results is most likely due, we believe, to our concentration on a smaller group of leading journals.

Looking at the second tier we see some consistency, some churning, and some significant trends. McMaster and Simon Fraser are in the middle of the top 10 in each period. On the other hand, a number of departments (Carleton, Guelph, Ottawa, UQAM,

<sup>16</sup> Narrowly missing inclusion in the top 10 for 1980-2000 is the Bank of Canada, which had an average of 0.38 weighted publications per year in the Top-10 journals.

<sup>17</sup> As already mentioned, Coupé (2003) took the average of results from 11 different ranking methods. One of those had the same number of journals (10) as we do, but the rest used larger journal samples.

and Waterloo) only appear in one of the three sub-periods, reflecting churning. Montreal shows a strong consistent upward trend – rising from tenth place in 1980-86 to fifth in 1986-92 and fourth in 1994-2000. Alberta, on the other hand, fell from seventh place in 1980-86 to ninth in 1986-92, and did not appear in 1994-2000. A final trend that is only barely evident in the table, but nonetheless may have some significance, is the rise of other French-language Quebec institutions in addition to Montreal. This shows up in the tenth place achieved by the University of Quebec at Montreal (UQAM) in 1994-2000. Laval was also rising over the period 1980-2000, and finished in eleventh place in 1994-2000. This suggests that part of the rise of Montreal may have been due to factors that were common to French-language departments in Quebec. This would have included strong support from FCAR, the provincial research funding agency.

Though Table 3 provides a first impression of the relative ranking of Canadian institutions, it cannot answer one very important methodological question, i.e. whether different ranks mean significantly different outputs. Several possible methods could be applied to answer this question. We use pairwise non-parametric significance tests (Wilcoxon-signed ranks tests, N = 11 years) in order to check whether publications scores and, thus, ranks in Table 3 are significantly different from each other. That means we take matched observations for each pair of distinct institutions and test with a Wilcoxon-signed ranks test whether the publication scores for the entire period are significantly different. This approach is related to that of Thursby (2000). Table 4 presents the results for the Top 10 Canadian institutions.<sup>18</sup>

Table 4  
*Significance of ranks of Top 10 Canadian economic research institutions*

Rank	Institution	<i>Not significantly different from rank...</i>
1	Western Ontario	2,3
2	Toronto	1,3
3	British Columbia	1,2,4
4	Queen's	3,6,7
5	McMaster	4,6,7,8,9
6	Carleton	4,5,8-13,15-18
7	Simon Fraser	5,6,8,9,10
8	Montreal	5,6,7,9-11,12-13
9	Alberta	5,6,7,8,10-22,24-26,28-33
10	York	6,7,8,9,11-24,26,29,30,32

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<sup>18</sup> A complete list covering all Canadian institutions is available on request.

Despite the limited number of observations we cautiously use  $p = 0.05$  as the significance boundary. Table 4 reveals that there is no significant difference in publication scores for UWO, Toronto and UBC. The reverse side of this is that UWO, for instance, has significantly higher publication scores than all institutions ranked 4<sup>th</sup> or lower. Queen's is not significantly different in terms of publications from UBC, and McMaster as well as Carleton are not distinguishable from Queen's. Starting from Carleton there is also a number of middle-ranked institutions that are not significantly different. Note that these findings do not render our results uninformative but show that conclusions drawn from rankings should be cautious and qualitative. Furthermore, although it might be a matter of pride preferring, say, rank 5 to rank 9, one has to keep in mind that the difference is insignificant. Small differences in ranks should never be over-emphasized.

#### **5.4. Educational background of authors affiliated with Canadian institutions**

When evaluating research, it is not only important to measure publication output, but also to consider an institution's output in educating graduate students. In this subsection, we take a closer look at the educational background of those authors stating a Canadian affiliation. In particular, we have gathered data about the Ph.D.-granting institution. For this purpose, we have relied on the members data base of the *American Economic Association* and on numerous websites of Canadian research institutions. In the *CJE*, there were 360 different authors stating a Canadian affiliation. We were able to identify the Ph.D.-origin of 282 authors (78%). Correspondingly, we could identify the Ph.D.-granting institution of 243 out of 270 (90%) authors stating a Canadian affiliation when publishing in the Top-10 journals. Note that there were 65 authors who published both in the *CJE* as well as in a Top-10 journal.

Table 5 reports on the left hand side the country in which authors stating a Canadian affiliation got their Ph.D. (or other highest academic degree). The first column indicates the figures for the *CJE*, where we can see that about equally many authors got their Ph.D. from either a Canadian (130) or a U.S.-institution (120). The UK plays a minor role; all other countries account in sum for only 10 Ph.D.s.

Interestingly, the picture changes somewhat when considering the Ph.D.-origins of those authors with a Canadian affiliation who succeed in publishing in the Top-10 journals. Out of 245 persons where we know the Ph.D.-granting institution, 152 got their Ph.D. from a university in the U.S., but only 57 from Canada. Given that the

editorship of all Top-10 journals is centred at U.S.-institutions, receiving a Ph.D. from an U.S.-institution might raise the chances to publish in the Top-10 journals.

Table 5

*Ph.D. origins of authors affiliated with Canadian institutions*

Country of Ph.D.-origin	CJE	Top 10	(Canadian) institution of Ph.D.-origin	CJE	Top 10
Canada	130	57	Carleton U	7	
USA	120	152	Concordia U	1	
UK	21	18	McGill U	2	1
Argentina		1	McMaster U	4	2
Australia	1	2	Queen's U	36	13
Austria	1		Simon Fraser U	5	
Belgium	3	2	U Alberta	2	1
France	2		U British Columbia	23	12
Germany		2	U Guelph	1	
India	1	1	U Laval	1	1
Ireland		1	U Manitoba	2	
Italy	1		U Montreal	3	4
Israel		4	U Sherbrooke		1
New Zealand	1	1	U Toronto	24	10
Norway		1	U Western Ontario	19	12
Russia		1	Princeton U	9	17
			U Chicago	7	15
Number of authors with Canadian affiliation	360	270	Harvard U	6	14
Ph.D.-origin known	282	243	UC Berkeley	11	9

On the right hand side of Table 5 we present particular institutions which granted a Ph.D. to authors publishing in the *CJE* or in a Top-10 journal and stating a Canadian institution. Similar to our results on publication scores, we find four main institutions: Queen's, Toronto, British Columbia and Western Ontario. These four institutions account for 77% (82%) of (known) Ph.D.s of Canada-affiliated authors publishing in the *CJE* (Top-10 journals). Related to this finding is the fact that the Herfindahl-Index of concentration of Ph.D.-granting institutions (0.17 for *CJE*, 0.18 for Top-10 journals) is higher than the related index for publication scores, as reported in subsection 5.2. This is in keeping with results e.g. from the U.S. that indicate graduate education is more concentrated than research in economics.

### 5.5. Robustness checks

A skeptical reader could be concerned about our choice of selecting Top-10 journals according to average impact factors, because impact factors may not always reflect the “real importance” of an economics journal. For instance, many economists would, without doubt, argue that the *Journal of Economic Theory* should be considered a top ten journal, although the relative frequency of *JET*-papers being cited has left the

journal clearly below our Top-10. Whereas we prefer to argue that impact factors prevent arbitrariness in the selection of top journals, we think it is, nevertheless, important to address the issue of how robust our results are with respect to the criterion for selecting a set of ten top journals.

Here we present alternative results motivated by a journal ranking of Kodrzycki and Yu (2006) – excluding the financial economics journals.<sup>19</sup> The following list of journals can be considered to reflect an informed compromise about what might sensibly constitute an alternative set of top 10 journals in economics. While the list lacks a formal selection criterion (such as the impact factor for the journals in Table 1), we believe that the great majority of economists would regard it as reasonable even if they would individually make slightly different selections. This alternative list certainly would pass any “reality check”.

We denote the alternative set of top journals as “TOP TEN” journals (as opposed to “Top-10” journals, which denotes those in Table 1 except the *CJE*). The TOP TEN include six journals from the Top-10 list in Table 1: the *Journal of Political Economy*, *Econometrica*, the *Quarterly Journal of Economics*, the *American Economic Review*, the *Review of Economic Studies*, and the *Journal of Monetary Economics*. In addition, the TOP TEN include the *Journal of Economic Theory*, the *Review of Economics and Statistics*, the *Journal of Econometrics*, and the *Economic Journal*.

As another small robustness exercise, we also consider the importance of the *Journal of Economic Literature* for the ranking, because the *JEL* has the highest average impact factor of all economics journals. We add the *JEL* to the TOP TEN (denoted as TOP TEN+JEL) to see whether this most often cited journal (in citations per article) has any impact on the resulting ranking of Canadian institutions.

Table 6 lists the publication scores for all Canadian institutions that published in the even years from 1980 to 2000 in the TOP TEN, the TOP TEN+JEL, and the Top-10 journals from Table 1. The latter list (see the right-most column in Table 6) reproduces the publication scores from Table 2 and serves as a comparison.

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<sup>19</sup> This approach also responds to helpful comments and discussion we have had with the Managing Editor and two referees.

Table 6  
*Publication scores in TOP TEN, TOP TEN+JEL, and Top-10 journals*

Canadian institutions	TOP TEN-score	TOP TEN+JEL-score	Top-10 score (from Table 2)
Acadia U	1.0	1.0	1.0
Bank of Canada	8.0	8.0	4.2
Brock U	1.0	1.0	0.0
Can Inst for Advanced St	0.3	0.3	0.3
Carleton U	13.4	13.4	12.6
Concordia U	5.5	5.5	1.5
Dalhousie U	4.5	4.5	1.0
Economic Council Canada	1.0	1.0	0.0
Government Canada	1.0	1.0	0.0
Howe Research Inst	0.0	0.0	0.5
Industry Canada	0.5	0.5	0.5
Laurentian U	0.1	0.1	0.0
McGill U	6.3	6.3	2.8
McMaster U	24.7	24.7	14.7
Ontario Economic Council	1.0	1.0	0.0
Queens U	35.3	36.3	21.3
Simon Fraser U	12.3	13.3	10.2
Statistics Canada	2.3	2.3	1.0
Trent U	1.0	1.0	0.0
U Alberta	13.1	13.1	7.3
U British Columbia	56.6	57.6	37.5
U Calgary	2.0	2.0	1.3
U Guelph	14.1	15.1	4.0
U Laval	11.5	11.5	3.7
U Manitoba	1.0	1.0	0.0
U Montreal	32.0	32.0	10.1
U New Brunswick	1.0	1.0	1.0
U Ottawa	4.0	4.0	3.3
U Quebec	5.4	5.4	2.2
U Saskatchewan	3.1	3.1	1.7
U Toronto	79.2	80.7	46.2
U Victoria	1.5	1.5	0.5
U Waterloo	9.3	9.3	3.7
U Western Ontario	73.1	74.6	53.1
U Windsor	2.7	2.7	2.5
Wilfried Laurier U	2.2	2.2	0.5
York U	9.9	11.4	4.8

TOP TEN journals: JPE, Econometrica, QJE, AER, REStud, JME, REStat, JEconometrics, JET, EJ

TOP TEN+JEL adds JEL to TOP TEN list.

Top-10 journals: JEL, JFinE, Brookings Papers, JPE, Econometrica, QJE, AER, JLawE, REStud, JME

The first thing to notice from Table 6 is the very high correlation of publication scores across the three columns. Publication scores in the TOP TEN journals and the Top 10 (first and third columns) have a Pearson correlation coefficient of 0.98 ( $p < 0.01$ ) and a Spearman rank correlation of 0.94 ( $p < 0.01$ ). The addition of the *JEL* causes only a single change of ranks (between Alberta and Simon Fraser), but leaves all other ranks unaffected. Hence, we may safely conclude that different, but reasonable lists of top ten journals yield very similar results.

This can also be seen when examining the Canadian institutions' ranks in the different columns of Table 6. We concentrate here on a comparison of ranks in the TOP



TEN and in the Top-10. The four highest ranked institutions remain in both columns Toronto, UWO, UBC, and Queen's. Whereas UWO tops the ranking in the Top-10 list, with Toronto second, it is the other way round in the TOP TEN-list. Nine institutions are among the top 10 in both columns. York University, which is at rank 10 in the Top-10 list, drops to rank 12 in the TOP TEN, whereas Guelph University takes rank 12 in the Top-10 list, but rank 7 in the TOP TEN. Among those institutions that are in the ten best in both lists, we note that Montreal and Simon Fraser have the largest rank differences. Montreal is ranked 5<sup>th</sup> in TOP TEN, but 8<sup>th</sup> in Top-10, whereas Simon Fraser is ranked 7<sup>th</sup> in Top-10, but 10<sup>th</sup> in TOP TEN.

Summing up the evidence from Table 6 we believe that we are safe in concluding that our main results are rather robust with regard to the selection of top journals. This latter claim – counterintuitive as it may seem – is a general conclusion from many ranking studies. It only applies, however, to sufficiently long time spans and to rankings on the institutional rather than on the individual researcher's level.

## **6. Conclusion**

We have presented an assessment of the output of Canadian economics research institutions in an international context over the period 1980-2000. Our main focus has been on publications in top journals of economics, which is appropriate when considering the output and achievements of leading institutions, since their reputation in research largely depends upon publications in the most prestigious journals. However, we have also looked at publications in the *Canadian Journal of Economics*, which broadens the study.

While Canada ranked third in a worldwide ranking according to publications in the Top-10 journals throughout the period 1980-2000, its relative output declined somewhat in the 1990s. This is in line with the combination of unfavorable external and domestic factors that reduced funding, numbers of researchers and their salaries relative to the U.S. in Canadian economic research institutions after 1990. The improvement in both public and university finances since 1997 in Canada has eased these strains. On the other hand, there are those who fear that the increased unionization of university faculty that occurred over the 1980s and 1990s may make all but a handful of institutions a poor fit for top economists (and their high salaries) in the long run. Against this is the fact that salary structure is not *dictated* by union status among research-intensive Canadian universities. Where merit pay and market conditions continue to be important

influences on salary, as they have at some top universities that have unionized in Canada, it is not obvious that there needs to be a reduction in research productivity.

We have found that authorship in the *Canadian Journal of Economics* is relatively more frequent for economists who received their Ph.D.'s in Canada, and also for authors affiliated with Canadian institutions below the top tier. These results are not surprising, since the *CJE* has a mission to stimulate economic research broadly in Canada, and it is also natural for those educated in Canada to look towards the national journal as a publishing outlet. What *is* perhaps surprising is that the institutional ranking given by publications in the *CJE* is very close to that provided by the publication scores in top journals, both for the Top 10 according to average impact factors as well as for the alternative list of TOP TEN journals discussed in section 5.5. In fact, using two partly different sets of top journals has revealed that the selection of top journals is much less crucial than often thought. The ranking of research institutions with respect to their publications in the very best journals of a profession can be considered robust.

The very high correlation of publication scores in the *CJE* and in top journals (be it the Top-10 or the TOP TEN used in this paper) suggests a possible key role for the *CJE* in ranking Canadian institutions. While top journals may be emphasized at the top end, in the middle and lower ranges greater emphasis can be placed on the *CJE* ranking. *CJE*-based studies, which are of course relatively easy to do, may be a low-cost source of basic ranking information for Canada. The possibility that similar results may hold for national journals elsewhere is intriguing, although one has to take into account possible effects on submission choices once such a policy would be announced.

Turning to institutional rankings, we have seen that in the 1980s the traditional picture of four leading economics departments combined with a second tier of about half a dozen others vigorously competing among themselves held true. However, this broke down in the 1990s, as the University of Montreal, continuing a long upward trend, rose into the top five, and two of the elite Ontario departments, Queen's and Western Ontario, slipped slightly in terms of total output (see Table 3). The rise of Montreal is echoed in an upward trend in the status of at least two other French-language Quebec institutions, UQAM and Laval, which held 10th and 11th positions in the sub-period 1994-2000, based on the top journals according to average impact factors. Earlier studies had found Montreal joining the elite group of research institutions in Canada, but UWO and Queen's dropping out. We have not been able to confirm this impression. Rather, Montreal, Queen's and UWO are shown to be fairly

closely bunched. In the period 1994-2000, for instance, the latter formed an intermediate group between Toronto and UBC on the one-hand, and McMaster, Simon Fraser and Waterloo on the other-hand.

While this study has produced some interesting insights, it is important to keep in mind its limitations. Although we have suggested that complementing a study based on the Top-10 journals according to average impact factors with a *CJE*-based ranking may provide a relatively complete picture of institutional rankings for Canada, more work would need to be done to confirm this. In particular, one would need to compare the *CJE*-based ranking for the institutions below the top 10 with rankings based on an appropriate broader sample of journals. It is also important to keep in mind that we have been ranking entire research institutions, and not individual units within them. While we believe this is justifiable in terms of identifying the leading centres of economic research, it gives a ranking advantage to large universities and those that have economists in a business school or other units in addition to their economics departments. This advantage is clearly a drawback if one is concerned more with quality than quantity of research. It could be offset by dividing output by inputs, in other words by studying productivity as well as total output. However, at the institutional level it becomes very difficult to measure inputs accurately unless attention is restricted e.g. to economics departments alone. Understandably, very few ranking studies take this approach. In our case we are reassured by the fact that Lucas (1995) found that rankings by total output and productivity produced very similar results for Canadian institutions.

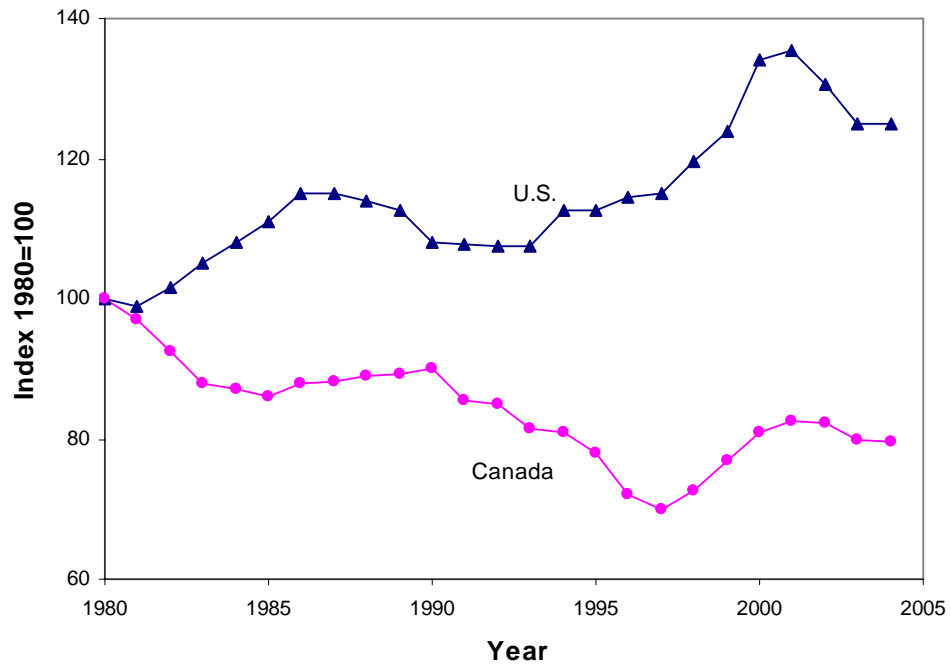
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Figure 1

**Government Funding Per Student, U.S. Public 4-year  
Colleges and Universities vs. Canadian Universities**



Source: Association of Universities and Colleges of Canada, "Backgrounder: Canada-U.S. Funding Comparisons", 2006