Commercialisation Performance Indicators North America, Australia and the UK

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Abstract

The Association of University Technology Managers (AUTM) has conducted annual surveys of the commercialisation of intellectual property developed at U.S. and Canadian universities since 1991. Five performance indicators from the AUTM reports are analyzed here, on a *per annum* basis. Results from the 2003 survey of 29 Canadian universities and 181 U.S. universities and other research institutions were analyzed, and compared with the results from 1991 onward and with results for the UK and Australia. The raw data are normalized by total research expenditures to draw interesting conclusions about commercialisation productivity.

Introduction

This report is an update and extension of the author's original November 19, 2000 study of the transfer of technology from Canadian universities to the private sector, *Technology Transfer at Canadian Universities*, and its three previous updates dated January 11, 2002, May 29, 2003, and January 29, 2004. The original study was based primarily on the FY 1999 Licensing Survey conducted by the Association of University Technology Managers (AUTM) and previous AUTM Licensing Surveys; the updates are based on subsequent AUTM Surveys. The present report focuses on presentation, analysis and interpretation of new quantitative data from the FY 2003 AUTM Survey. It also comprises an extension and update of parts of the *Addendum* to the 2002 update, dated July 31, 2003, in which performance measures were traced over time and compared between regions of Canada. All of the author's prior reports can be obtained at http://www.sfu.ca/vpresearch/vprreports.htm

The AUTM Survey

AUTM carries out its Licensing Survey each year, consistent with its mission to collect information on its members' programs. The Survey results provide objective information, in consistent format, related to technology transfer from the academic sector. The FY 2003 report contains annual and some cumulative data for the thirteenth consecutive year of data collection. The results of the FY 2003 Survey were released to the author on January 6, 2005, for inclusion in this report.

The data referenced from the *AUTM Licensing Survey: FY 2003* comprise individual entries for 29 Canadian post-secondary educational institutions, the Canadian particle and nuclear physics national laboratory TRIUMF, five Canadian hospitals and health institutes, plus 181 universities, colleges, hospitals and other research institutions in the United States. As is typical, there is are minor changes in the composition of responding institutions from the previous year's Survey.

The five specific performance indicators from the AUTM report used for further analysis herein are:

- Invention Disclosures Received,

- o Licenses and Options Executed,
- o U.S. Patents Issued,
- o License Income Received, and
- o Start-Up Companies Formed,

all on a per annum basis.

Some points/cautions must be considered when interpreting the data:

- The inclusion of research expenditures and commercialization of intellectual property generated at research hospitals affiliated with universities is not always treated in a consistent manner across the responding institutions.
- Entries for University of Calgary / UTI, Inc. include commercialization of non-University IP as well as that flowing from the University of Calgary; in their most recent report, one-quarter of their disclosures and one-third of the companies assisted were non-University of Calgary.
- The AUTM definition of "Start-Up Company" is sometimes interpreted differently at different universities.

The 2003 fiscal year used by AUTM was July 1, 2002 - June 30, 2003. The mismatch between this fiscal year and that used in most Canadian institutions (April 1 - March 31) has occasionally caused confusion; AUTM brought all institutional reports into consistency in 1998, resulting in repeated entries of data for a few universities that year. Note also that the "License Income Received" in later tables refers to the gross royalty revenue from licenses <u>and</u> from sale of equity in spin-off companies, less amounts that were transferred to other institutions under existing agreements.

Results and Analysis

We first consider the results from the most recent AUTM Survey – for FY 2003. The effects of institutional diversity are amply demonstrated in a casual scan of the data in Table 1. There is great variability of the results for most of the measures, even among institutions of similar size and with similar levels of research funding. The institutions are unique, in terms of program mix, size and age, and length of time actively promoting technology transfer, among other attributes. This is evident in the AUTM results and is quantified in the very large standard deviations found in the distributions of the results.

We attempt to reduce or eliminate the effects of some of the variability noted above by normalizing the data. One can normalize for size of the institution in a number of ways – for example, by number of faculty members or students, by operating budget or by Research Expenditures. The most common and most useful normalization is by Total Research Expenditures. This involves dividing the output indicator – for example, number of Invention Disclosures Received at a particular institution – by that institution's Total Research Expenditures for that period to arrive at Invention Disclosures Received per dollar of Total Research Expenditure….a measure of "Commercialisation Productivity."

We apply this approach to the FY 2003 AUTM data and find the ratios given in Table 1 (the table follows the Appendix, at the end of this paper) for the 21 Canadian post-secondary institutions with the greatest Research Expenditures; we omit reference other eight institutions since their Research Expenditures are much less than the others (by more than a factor of 2.5), as are most of their output measures. Tables 1 of the four prior reports contain the same ratios for the fiscal years 1999 - 2002 AUTM data. Composition of responding Canadian universities differs somewhat for each of these years, complicating interpretation.

On page 2 of Table 1 are the AUTM results for the top 21 U.S. universities individually and total results for all 181 respondents, including normalizations by Research Expenditures. We note that the Canadian university with the largest Research Expenditures in FY 2003 (University of British Columbia at $268M – which includes affiliated hospitals) expends less per annum than does the 49th ranked U.S. university (University of Utah). The non-payment of indirect costs of research by almost all Canadian funders of research in FY 2003 distorts the comparisons, as we shall describe below.

For the top 21 Canadian and the top 21 U.S. universities in Table 1, statistical information about the distributions follows the individual institutional listings. In the first row below the individual listings (Rows labeled A and I for Canada and the U.S. respectively) are shown in **bold type** the **total**s of institutional values of the directly measured data (Research Expenditures, Disclosures, etc.) that are presented in the columns directly above them. Shown in those same Rows (A and I), in *italics*, are the derived, *cumulative* results - that is, the results of dividing, for example, the **total** number of Invention Disclosures by the **total** Research Expenditures for those 20 institutions. In the next three Rows (B, C and D for the Canadian universities and J, K and L for the U.S.) are shown basic statistical attributes (average, median and standard deviation) of the distributions of the individual institutional data themselves. In addition, we compile in Row N on page 2 of Table 1 the **total** and *cumulative* figures for <u>all</u> responding U.S. universities (virtually all of which had Research Expenditures in excess of $10 million).

Canadian Results

On the first page of Table 1, the comparison of the *cumulative* Canadian data from AUTM between the top 10 (in Row E) and the top 21 (in Row A - which of course includes the top 10) is informative. We note that all the *cumulative* measures (in *italics*) agree fairly closely. This shows the dominance of the sums by the ten institutions with the highest Research Expenditures, whose **totals** comprise between 60% and 78% of the overall **totals** for the top 21.

However, there are differences noted and, similar to what was seen in most previous reports, most are in the direction of the top 10. This suggests a separate calculation (results shown in Row F of Table 1) of the *cumulative* results for the “last 11.” This shows clearly that cumulatively, the top 10 outperform the last 11 only in terms of “U.S. Patents Issued” whereas the last 11 significantly outperform the top 10 in the other areas. In the previous four reports (based on the FY 1999 - FY 2002 AUTM Survey results) the last 9 also consistently outperformed the top 9 on almost every measure.

The distributions of individual, unnormalized Canadian results for Research Expenditures and License Income Received are strongly skewed, as evidenced by medians (Row C) displaced below the averages (Row B) and by large (in some cases statistically meaningless) standard deviations (Row D) in relation to the averages. Upward skewing of Research Expenditures is due mostly to the very large Research Expenditures at the largest universities, and the normalized License Income Received is skewed significantly by the very high License Income Received by the Université de Sherbrooke.

It is worth digressing to point out that the lion’s share of the income at the Université de Sherbrooke is derived from one core technology - ACELP speech compression within wireless and internet applications - which has been adopted into hundreds of millions of devices world-wide. Other universities have had similar experiences with one “big hit” producing prodigious amounts of continuing royalty revenue. McGill enjoyed another type of “big hit” in FY 2001 in the (one-time) sale of equity in a start-up; then, in FY 2002, their reported License Income dropped by over 80%! There will be further discussion of these phenomena later in this report.

Returning to Table 1, we note that the distributions of the normalized results are slightly better behaved. There are still large variations in the normalized measures, but the normalized results for Licenses and Options Executed and for Invention Disclosures Received are somewhat closer to normal distributions, with standard deviation smaller than the average and with the median fairly close to the average. However the other three measures display wide variations, even after normalization by Research Expenditures. This is also readily apparent from inspection of the normalized results for the individual institutions.

The variability of these results is fully consistent with that seen in the previous four reports. It also vividly points out the difficulty of using averages of these types of measures – normalized or unnormalized – to draw any meaningful conclusions from aggregated data. The difficulty is compounded when comparing surveys taken over a period of time, especially when the composition of the survey respondents changes from survey to survey. These are the main shortcomings of the otherwise useful surveys performed by Statistics Canada. As described below, solutions have been pursued in the present study by looking at the longer-term performance of the recurrent respondents to the AUTM Surveys and using multi-year rolling averages to identify longer-term trends.

The observations above about the (inferior) performance of the top 10 universities versus that of the last 11 prompt a separate analysis of the outputs from the universities from the "G-10" group of large Canadian universities, most of which have medical schools. Again, as in FY 2001 and 2002, all ten are represented in the AUTM Survey for FY 2003 - they are those ranked 1 - 6, 8, 9, 11, and 14 in Table 1 and are marked with asterisks. The results for these ten - labeled "G-10" - are shown in Row G of Table 1, along with the results for the remaining 11 respondents, in Row H. As in the comparison above between the top 10 and the last 11, we see that only in terms of “U.S. Patents Issued” does the G-10 outperform the others.

U.S. FY 2003 Results and Comparison with Canadian FY 2003 Results

The distributions of U.S. top 21 results on page 2 of Table 1 are qualitatively similar to those of Canadian top 20 results. We again see skewing of the distributions of most of the unnormalized (absolute) results with averages significantly higher than the medians and very large standard deviations. However, the variations in both the absolute and the normalized measures are somewhat less extreme, due no doubt to the more homogeneous nature of the top 21 U.S. universities.

However, in contrast to the Canadian data set, and as expected in view of the much larger data set, the top 21 results do not dominate the overall group of 181: their contributions to any of the measures comprise well less than half the national **total**. This is especially significant when we note that the *cumulative* results for the top 21 in the U.S. (Row I of Table 1) agree closely with the *cumulative* results for the overall data set of 181 in Row N, again in marked contrast to the Canadian data. This is remarkable and implies that, as a group, U.S. universities commercialize their intellectual property at a more consistent rate per dollar of Research Expenditure, virtually independently of the size and research intensity of the institution.

We turn now to a comparison between the FY 2003 Canadian and U.S. data in Table 1. These data should be adjusted to take into account one very significant difference between the two countries: U.S. Research Expenditures include explicit recognition of the indirect costs of research whereas Canadian data do not. The rates charged by universities in the U.S. for indirect costs range from 15% to 115%, with an average value of 52.3% of total direct costs (reference: *Indirect Costs Reimbursement in the U.S.A.: Facts and Fiction,* AUCC Research File, June 2000).

Although imprecise, since it is an average taken over a different set of universities than reported here and because some, relatively minor, sponsors of FY 2003 Canadian research did make contributions toward indirect costs, applying an adjustment to the U.S. figure for Research Expenditures based on this average value is a reasonable approximation. The results are shown in the Table below, with data extracted from Rows A, M and O of Table 1.

Subject Group	*Cumulative* Normalized Measure per $1M - FY 2003				
	Invention Disclosures Received	Licenses & Options Executed	License Income Received	U.S. Patents Issued	Start-Ups Formed
Canada Top 21	0.526	0.179	$16,452	0.074	0.023
US Top 21 Adjusted	0.522	0.162	$35,000	0.144	0.014
US All 181 Adjusted	0.595	0.170	$46,696	0.151	0.014

We now note that, on this basis, the U.S. results for U.S. Patents Issued and License Income Received (per $1M) exceed the Canadian results by substantial margins and that Canada forms considerably more start-ups (per $1M). Otherwise, Commercialisation Productivity rates are similar.

Trends

AUTM Surveys began in FY 1991 and Canadian universities have participated from the start. Eight responded for FY 1991, with increasing numbers of participants since then. As mentioned above and as is the case in the rest of this report, reference is not made to those Canadian universities whose Research Expenditures are much less than those the other responding universities.

The five output measures considered here have been used continuously, in most cases from the beginning, and thus provide the opportunity for analysis of long-term trends. The changes in composition of the responding group limits the usefulness of the results. In order to eliminate the variability caused by changes to the composition of the sample, the nine Canadian institutions that responded most consistently over the 12-year period were selected. The nine recurrent respondents are listed in the table entitled **Recurrent Respondents.** With the exception of the University of Manitoba and Simon Fraser University, each reported all or nearly all of the performance measures in all eleven years; these two started reporting in 1993. We shall present results graphically for the whole data set each year, as well as for these recurrent respondents. Unfortunately, no institutions in the Province of Quebec are among the recurrent respondents.

As suggested above, forming multi-year averages will reduce the effects of the high inter-year variability of the plotted results. It is also attractive in the Canadian context since institutional allocations of Canada Research Chairs, payments toward the Indirect Costs of Research and CFI New Opportunities awards are all based on such a rolling average – specifically, a three-year rolling average. The first set of results shown in Figures 1 a– f (the figures follow the text starting on Page 11) comprise the rolling averages of totals of the five output measures considered herein as well as total annual Research Expenditures for all Canadian, all U.S. and nine recurrent Canadian respondents over the entire period. They are useful for defining the scale of activity over that period. Note that the vertical scales for the U.S. are a factor of 10 larger than for Canada, except for License Income Received which is a factor of 100 larger for the U.S. Because collection of data on U.S. Patents Issued and Start-Up Companies formed were collected and reported consistently first in 1993 and 1994 respectively, data in Figures 1d and 1e start in those years in these and subsequent plots. Data points for the UK and Australia taken from other recent studies are included for comparison where available. These are not corrected for overhead payment – to the extent that overhead payments have been included, the normalized measures would be correspondingly increased.

The next set of results in Figures 2 a – e show the rolling averages of five normalized output measures for all Canadian respondents and for the recurrent Canadian respondents, compared with those from all U.S. respondents over the entire period. The cumulative results for each country – that is the national total output measure divided by national total research expenditures – are shown. The U.S. results are corrected for the provision of overhead payments in the U.S., as described above. U.S. and Canadian vertical scales are the same.

Recurrent Respondents
Queen's University*
Simon Fraser University
University of Alberta*
University of British Columbia*
University of Calgary/UTI, Inc.
University of Manitoba
University of Toronto*
University of Waterloo*
University of Western Ontario*
*Canadian "G-10" University

Discussion

High Variability

Among the Canadian results, there is no apparent correlation between institutional size, type ("Medical/Doctoral" versus "Comprehensive," to use the categories used by Maclean's magazine), or age and an individual institution's performance on any one of the measures, whether normalized by Research Expenditures or not. This points to the highly idiosyncratic nature of the process of technology transfer, with relatively small numbers of outputs (Disclosures, Patents, Licenses, Start-Ups Formed) emerging in a given time period, wide variations in the degree of commercial success of the technologies transferred and large variations from one FY to another. There are an increasingly large number of instances in which the commercialization of one or two technologies is responsible for the large variations. This may occur in one of two modes:

- A technology is successfully commercialized via license(s) to one or more established firms and the technology is widely adopted, generating large royalty streams. Two examples are the licensing of a particular pharmaceutical by UBC to QLT Inc. and the licensing of ACELP speech compression technology by the Université de Sherbrooke to over 72 companies worldwide. In each case, the commercial success of the technology led to multimillion dollar increases in revenue from FY 2000 to FY 2002, with further funding from the same sources anticipated in future years – until license agreements expire.
- A technology is successfully commercialized via a start-up company in which the university holds an equity position. When the university "cashes in" its equity holding, a major one-time rise in revenue can occur. For example, at SFU, the sale of NCompass Labs to Microsoft was responsible for most of a 12-fold increase in revenue between FY 1998 and FY 1999, with another similar (but smaller) event between FY 2001 and 2002. At McGill, a similar (but much larger) sale of equity in a spin-off was responsible for the almost 10-fold increase in their revenue between FY 2000 and FY 2001. As noted above, the absence of such a large infusion of income in FY 2002 or 2003 resulted in dramatic decreases to a much lower level.

Another contributor to the inter-institutional variation seen in these data must be variation in institutional commitment to technology transfer and variation in support for these activities from internal and external sources – especially when an institution is seen to "under-perform" consistently over a number of years. Further discussion of this point will follow in a section below.

Large-scale studies that report *cumulative* results from similar types of universities may still be helpful in pointing at the factors that lead to success in technology transfer, but performance by individual institutions remains difficult to correlate with input measures, especially for the small, diverse Canadian data set.

It is important to note here the similarity of the normalized Canadian and U.S. results for Invention Disclosures Received and Licenses and Options Executed over the long term in contrast to the consistent differences in the other measures, especially License Income Received and Start-Up Companies Formed. Equally striking is the similarity of normalized results from the Recurrent Canadian and All Canadian respondents, especially in view of fact that in recent years, the recurrent group comprised only one-half the Canadian respondents.

Start-Up Formation

We suggest that the higher rate of start-up formation in Canada compared with the U.S. can be linked to Canada's lower receptor capacity. This lack of capacity has been amply documented in previous studies by the Conference Board of Canada and by the Advisory Council on Science and Technology (ACST). In Canada, especially as contrasted with the U.S., there are few pre-existing firms that can use their own existing R&D structures to take intellectual property generated in the universities to the next steps in the process of commercialization. In addition to the well-documented difficulties in attracting venture capital, especially since the “dot.com” crash, start-ups are well known to have endemic cash-flow and managerial problems, which threaten the successful exploitation of IP that they own or acquire. Venture capital is now becoming somewhat more accessible, but at nowhere near the levels of four or five years ago.

The trend shown in Figure 2e is a reduction in the rate of start-up formation per $1M research expenditure in Canada, toward the rate seen in the U.S. It remains to be seen whether this is a reflection of increasing maturity of Canadian industrial receptor capacity, shortage of venture capital for start-ups, a shorter-term result of the dot.com crash, a result of the lag time between the large infusion of research funding in Canada in the last few years (a 96% increase from FY 1999 to FY 2002) and the production of commercializable IP, or some other cause.

What is clear, however, is that Start-Ups based on university research outputs are a significant factor in Canada. A study by Clayman and Holbrook (2003) found that, in the sample studied, the “survival rate” was 73% overall and is similar at both Medical/Doctoral institutions (72%) and Comprehensive institutions (76%). Overall, 80% of the surviving companies operate in the same region as the university from which they originated and thus are significant drivers of economic activity in those regions. However, further study is needed to assess their impact, since “survival” does not necessarily connote “success.”

License Income

Recalling that License Income Received includes the proceeds of liquidation of equity, the lower normalized License Income Received in Canada versus the U.S. is a significant factor and likely stems mainly from two factors:

- the increasingly prevalent taking of equity holdings in start-up companies by Canadian universities, as an alternative to licensing income available to U.S. universities from larger, better established U.S. firms. Gains take much longer to realize through this route than via license income and do not show up in these reports until they do occur. It is worth noting that this sort of delay makes difficult the assessment of the effects of increases in research funding and of increases in commercialization efforts, since cause and effect can be widely separated in time.
- several huge "hits" (financial successes) by some U.S. universities that result in license incomes in the range of $30M - $70M per annum. The most striking example is the $62M received by Florida State University in FY 2001 almost exclusively from a licensing agreement for a semi-synthetic process for

the production of the cancer-fighting drug taxol. There has not been such a “hit” in Canada, although the $10M per annum earned by the Université de Sherbrooke is of the same order of magnitude.

Taking these factors into account, we conclude that Canadian university researchers appear to be every bit as creative and inventive as their U.S. and international counterparts (citing equivalent rates of Invention Disclosures Received) and that Canadian universities are every bit as aggressive in licensing IP generated in the institutions (citing equivalent Licenses and Options Executed). Differences in patenting rates are less significant since much IP is protected via other means, especially recently and especially in areas other than biotechnology. In addition, we have no disaggregated data - only some aggregated data from Statistics Canada - on total patents issued to Canadian university inventors. As noted above, the missing ingredients in Canada are larger-scale core research funding and a large domestic industrial base to exploit the IP efficiently and effectively.

Despite these shortcomings, it appears that some long-term commitments to technology transfer in Canada are beginning to bear fruit. Even with the time lag between investment in research and successful technology transfer – noted above – the 3-fold increase in License Income Received from 1999 to 2003 in Canada is very impressive, as is the contrast with the smaller (2-fold) increase in the U.S. In addition, the 72% increase in time-averaged Licensing Income Received per $1M Research Expenditures in Canada over the same period (referring to Figure 2c) can be contrasted with the 25% increase in the U.S. in that period.

Commitment to Technology Transfer

To test this view, correlations were sought between measures of the institutional level of commitment to technology transfer and the output measures. Several relevant output measures were plotted (not shown) against the length of time (in years) that the 21 Canadian institutions under consideration have been actively engaged in technology transfer and the staffing in their technology transfer offices, using information from the FY 2003 Survey.

Although this is not uniformly the case, institutions with larger staff and more experience at technology transfer tend to have better records of successes according to these measures. In addition to the obvious positive effects of more staff members with more experience seeking out, evaluating and exploiting technologies, an intangible aspect is the creation of an “institutional culture” of innovation, deriving from the explicit and implicit messages about the importance of innovation generated by institutional support for the activity and from the role models presented by colleagues who successfully commercialized IP that they generated..

Other Output Measures

It is unfortunate that there are no readily quantifiable performance measures related to means of technology transfer other than Patents Issued, License Income Received and Start-Ups Formed. Especially in the rapidly moving area of information technology and multimedia, much of the technology transferred is in the form of trade secrets and other types of “know-how.” Reports such as this tell only part of the story since they omit any direct reference to these forms of technology transfer, although Start-Ups Formed is loosely correlated to them. Development of means of quantitatively assessing such modes of technology transfer is highly desirable and it is hoped that AUTM and/or Statistics Canada will devote effort in this direction.

Conclusions

A number of conclusions can be drawn from the results. Most have been touched on in the discussion sections above; they are presented here with some elaboration of the rationale behind them.

1. The amount of technology that is measurably transferred from universities appears to be roughly a linear function of Research Expenditures. This is the case cumulatively for Canadian universities and for U.S. universities. It is evidenced clearly by the essentially constant rates of Invention Disclosures per $1M and Licenses and Options Executed per $1M presented in Figures 2a and 2b. The output rate - that is technology outputs (as exemplified by Disclosures and Licenses) per Research Expenditure input - is approximately the same in both countries and has been over the last decade, once indirect costs are factored out of the U.S. Research Expenditures. This applies over the very wide range of institutional settings and over a very wide range of performance by the individual institutions. Results from the UK and Australia are consistent with this finding.
2. The effectiveness of technology transfer (measured in terms of the range of outputs per Research Expenditure dollar) at the top 10 Canadian universities collectively in FY 2003 is only somewhat lower than it is collectively at the universities ranked 11 – 21, although there are very wide variations in performance. It is very encouraging, since the bulk of the research expenditures in Canada occur at those top universities. This result suggests that a stronger commitment to technology transfer, evidenced by more resources devoted to the effort, is starting to reap major benefits at those of the top 10 universities that were previously performing well below the average for the country. It is worth noting that rates of technology transfer in the U.S. have been consistently similar across the full range of universities over the life of the AUTM Surveys – i.e. no disparity as was noted previously in Canada, appears to exist in the U.S. It is a reasonable conjecture that the passage in 1980 of the Bayh-Dole act, which gave all U.S. universities the responsibility for commercializing IP generated in federally funded research, stimulated broadly based activity in universities of all sizes and types.
3. It is important to note here the similarity of the normalized Canadian and U.S. results for Invention Disclosures Received and Licenses and Options Executed over the long-term and the consistent differences in the other normalized measures, especially License Income Received per $1M (where the U.S. is ahead) and Start-Up Companies Formed per $1M (where Canada leads). Equally striking is the similarity of normalized results from the Recurrent Canadian and All Canadian respondents, especially in view of the fact that in recent years, the recurrent group comprises only one-half the Canadian respondents.
4. Local conditions, especially an institutional commitment to technology transfer, as evidenced by long term provision of resources and support for employees dedicated to technology transfer, are a major determinant of the effectiveness of technology transfer. It has been pointed out in several recent reports that the provinces of B.C. and Alberta have had long-standing commitments to technology transfer, backed by financial support from the provincial governments and the effect of this shows clearly in the results shown in Table 1 where individual results for UBC, SFU, Alberta and Calgary are shown. However important commitment by provincial governments is, institutional commitment is critical. For example, the University of Manitoba received no direct provincial support for its UILO, but its License Income figures are well above average and cumulative Canadian values. Other local conditions, such as the ready availability of venture capital and tax credits, are also important, especially where start-up companies are part of the innovation strategy.
5. There is much opportunity for further analysis of the AUTM data sets and Statistics Canada results. Longitudinal studies of the effectiveness of technology transfer at those institutions which have reported in all of AUTM's twelve Surveys have produced valuable, interesting

results. A more detailed analysis of the impacts of long-term, well-staffed technology transfer offices, involving direct contact with the offices themselves and access to their records would add to these purely statistical results.

6. There is a need for more publicly available, comprehensive information on the performance of Canadian universities in technology transfer, upon which informed decisions on public policy can be made.

Acknowledgements

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Figure 1a

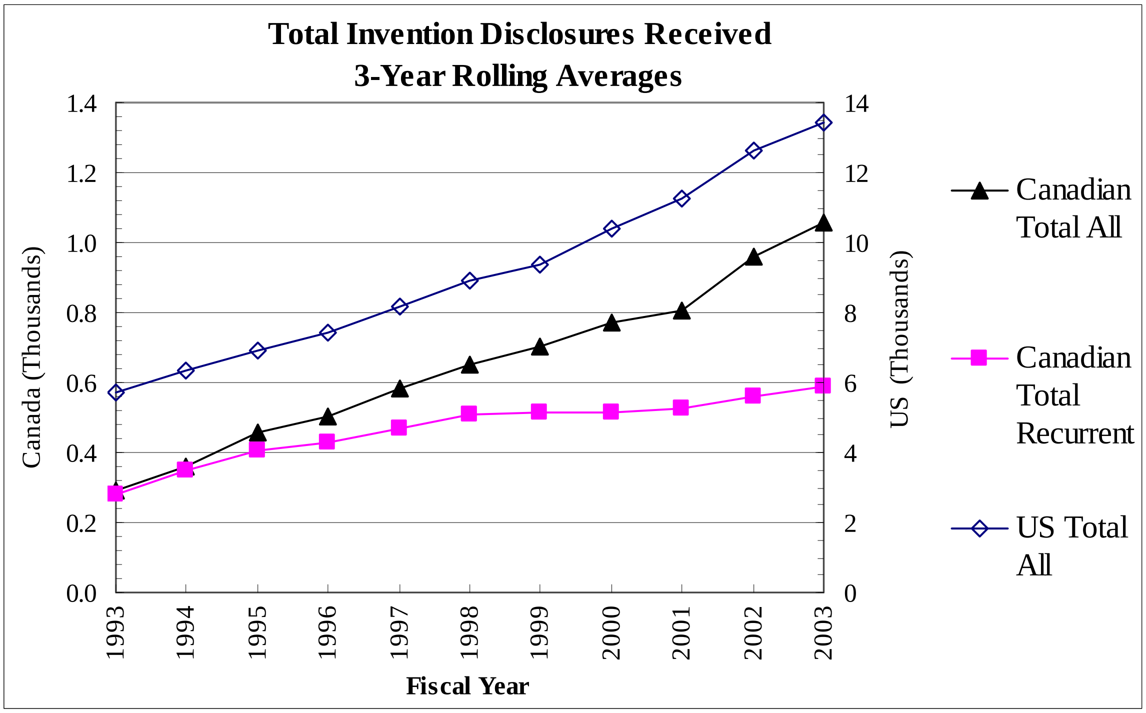


Figure 1b

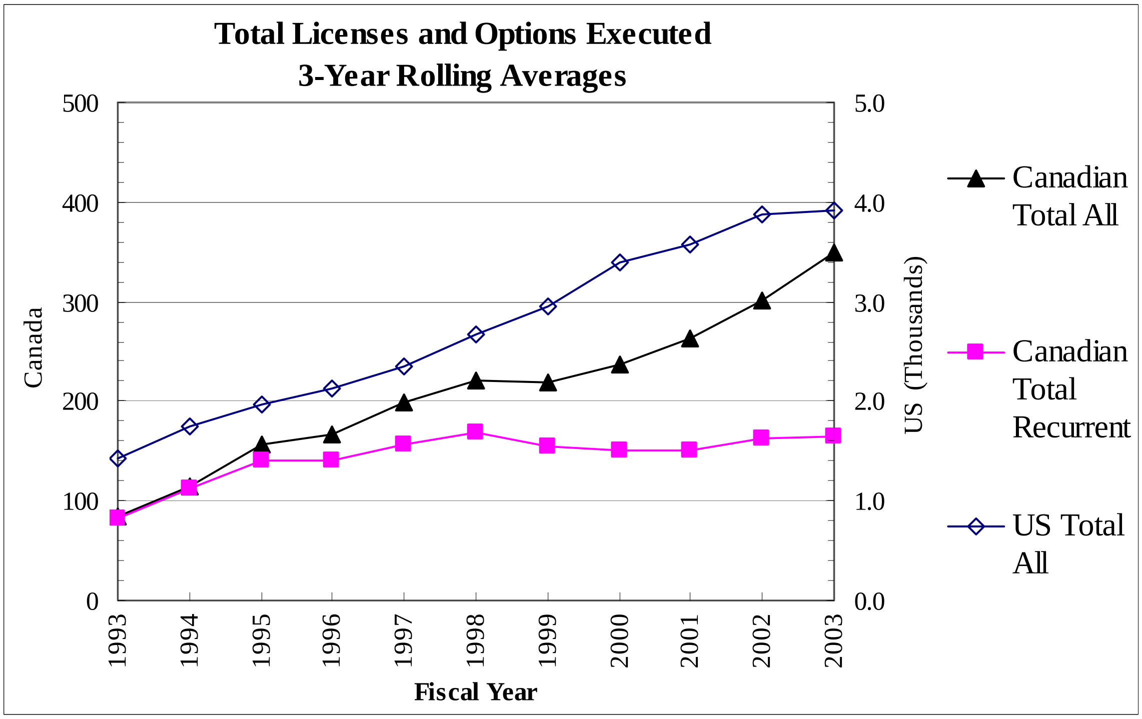


Figure 1c

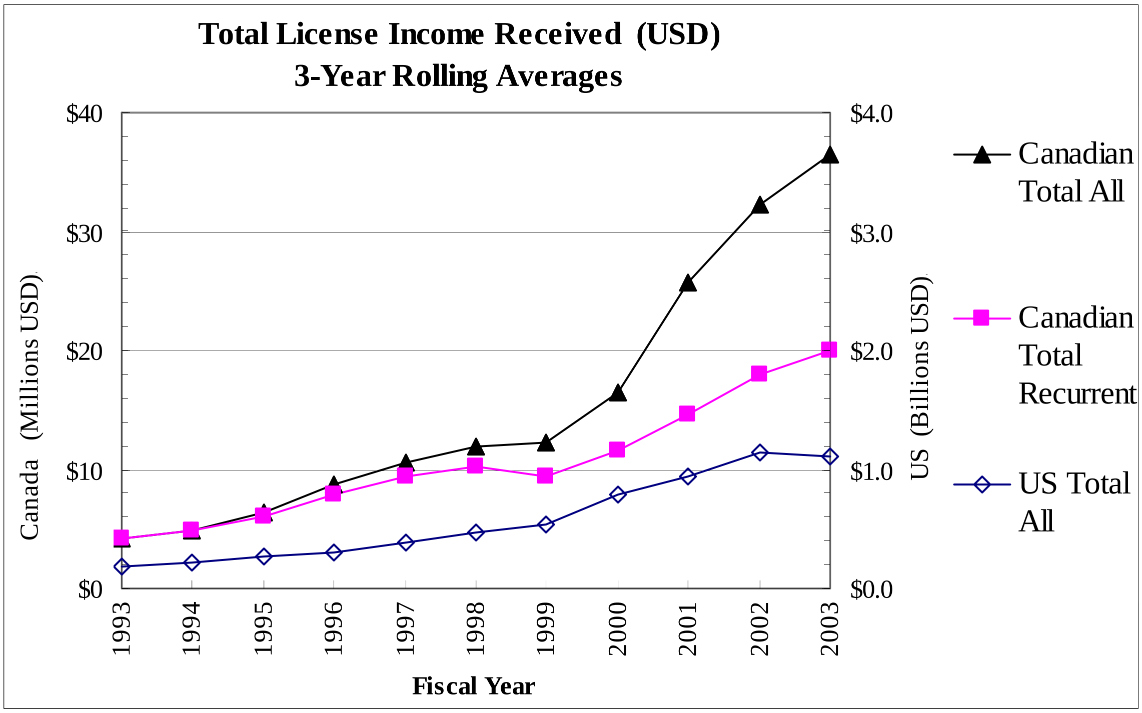
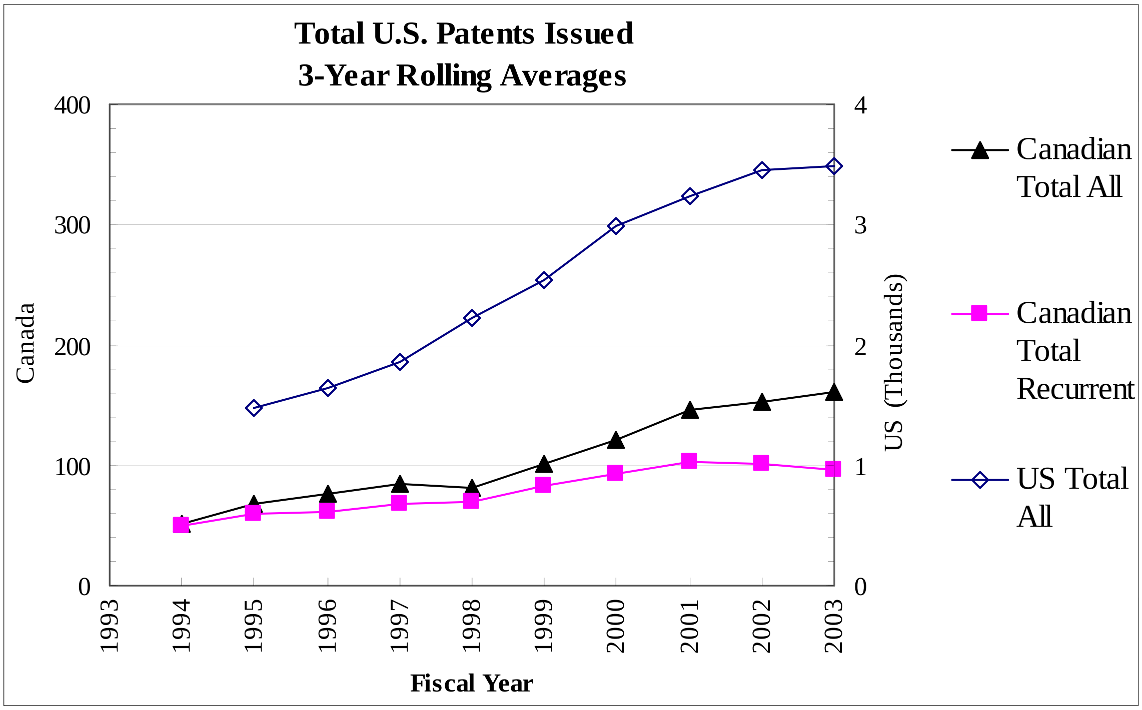


Figure 1d



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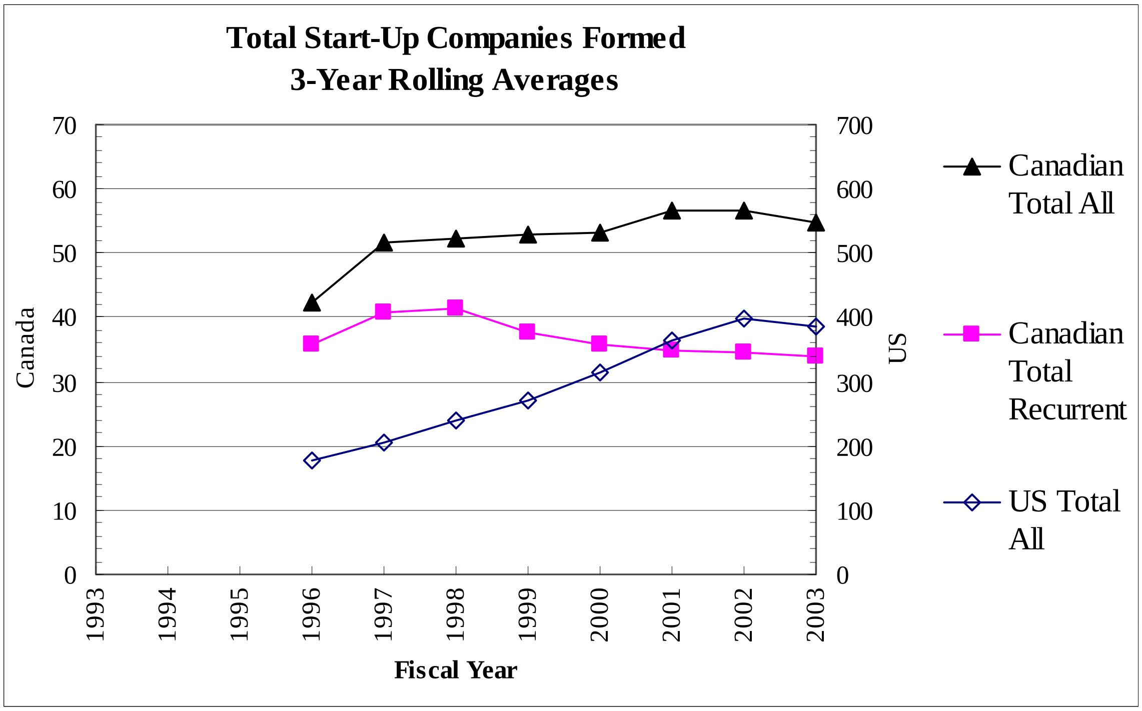

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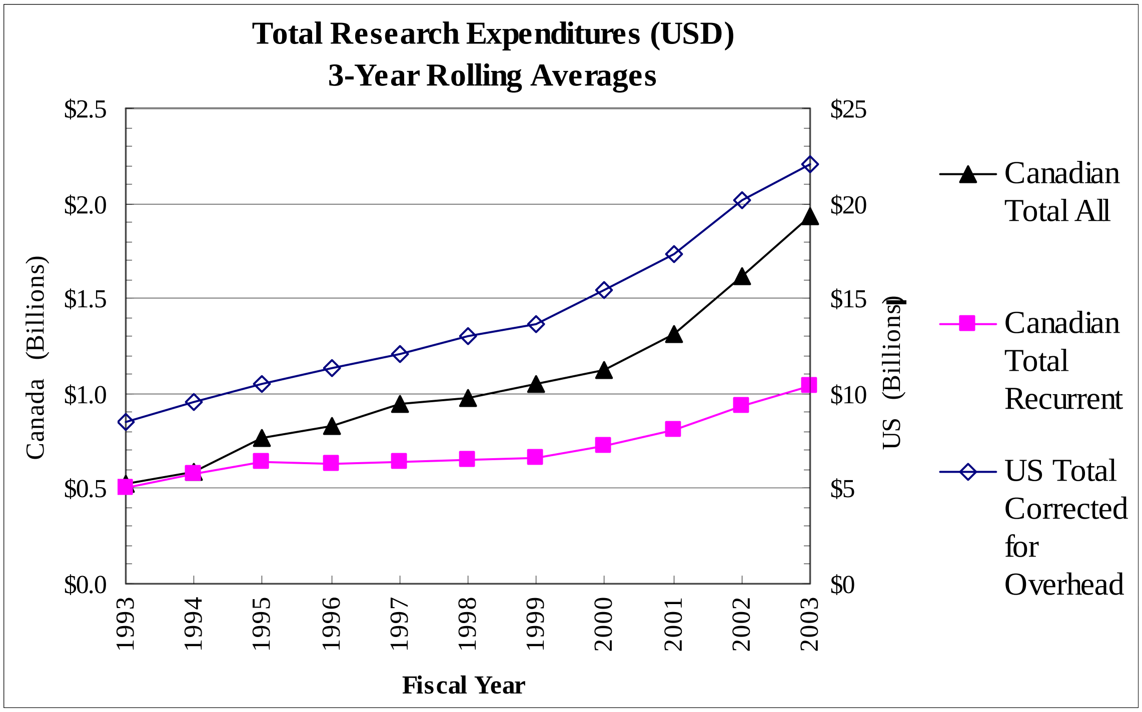


Figure 2a

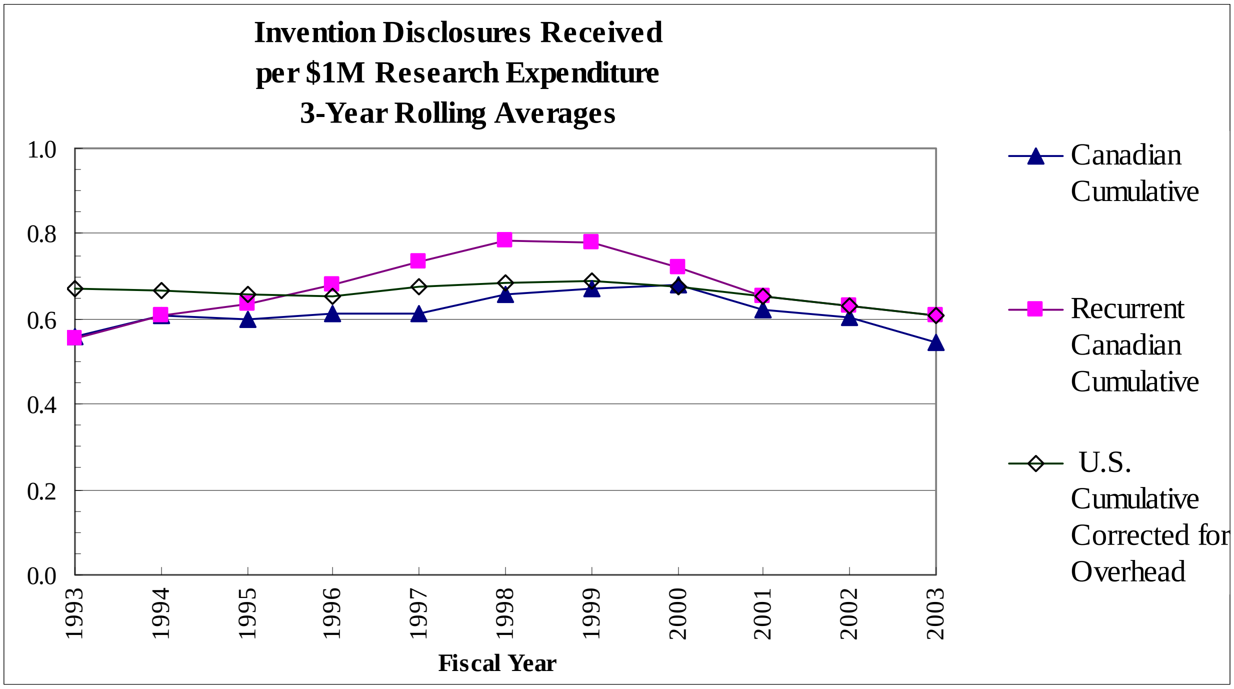


Figure 2b

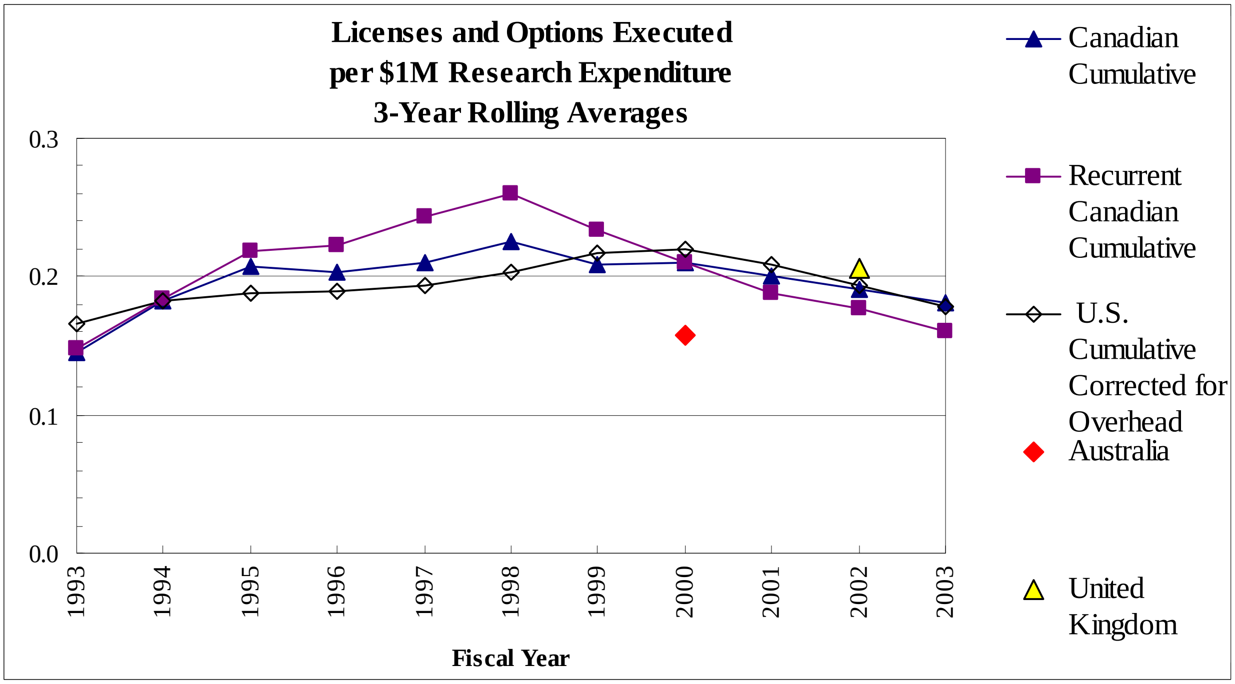


Figure 2c

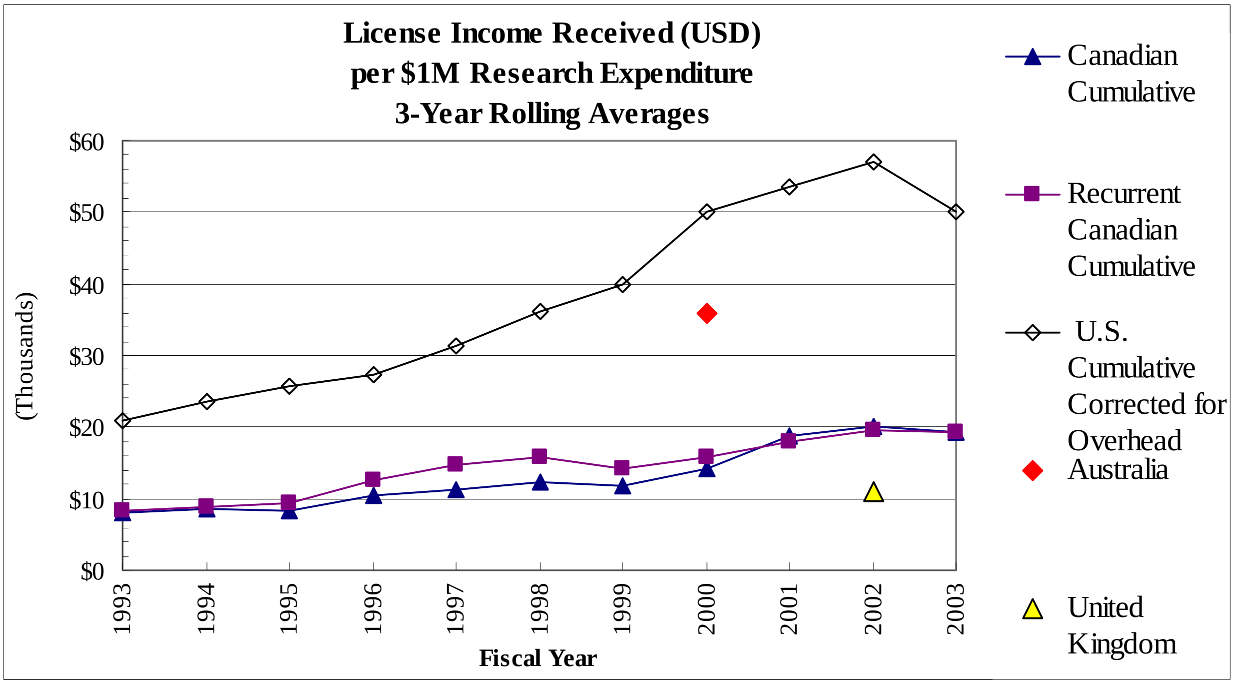


Figure 2d

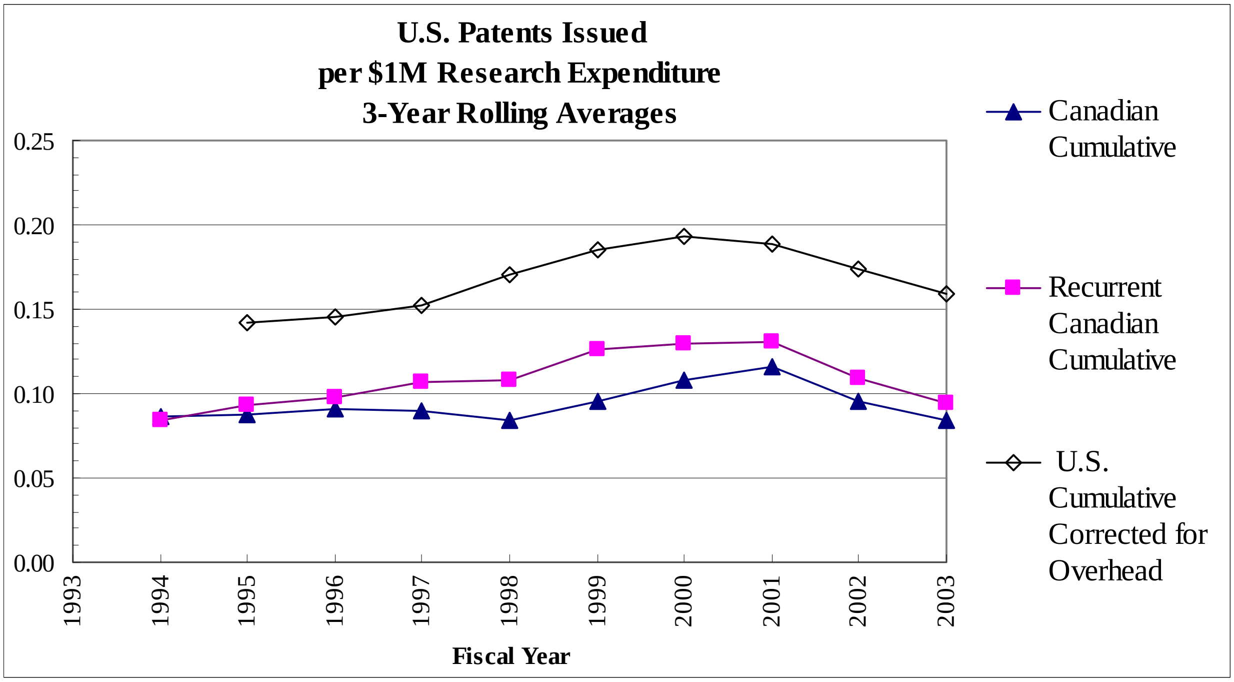
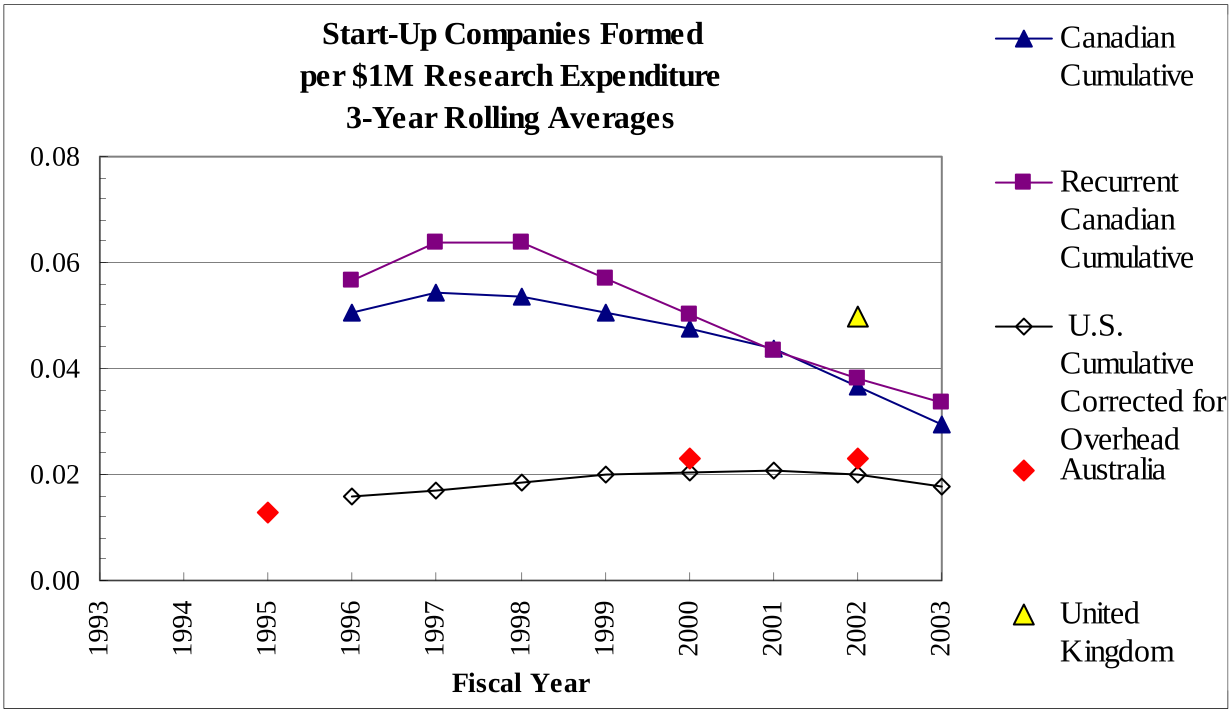


Figure 2e


Start-Up Companies Formed
per $1M Research Expenditure
3-Year Rolling Averages
0.08
0.06
0.04
0.02
0.00
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Fiscal Year
Canadian Cumulative
Recurrent Canadian Cumulative
U.S. Cumulative Corrected for Overhead
Australia
United Kingdom

Appendix A

Bibliography

Advisory Council on Science and Technology, 1999. *Public Investments in University Research: Reaping the Benefits; Report of the Expert Panel on the Commercialization of University Research*, May 4, 1999. http://www.acst-ccst.gca.ca.

Association of Universities and Colleges of Canada. *Indirect Costs Reimbursement in the U.S.A.: Facts and Fiction*, AUCC Research File, June 2000

Association of University Technology Managers. *AUTM Licensing Survey: FY 2003*. Edited by Ashley J. Stevens.

Association of University Technology Managers. *AUTM Licensing Survey: FY 2002*. Edited by Ashley J. Stevens.

Association of University Technology Managers. *AUTM Licensing Survey: FY 2001*. Edited by Lori Pressman.

Association of University Technology Managers. *AUTM Licensing Survey: FY 2000*. Edited by Lori Pressman.

Association of University Technology Managers. *AUTM Licensing Survey: FY 1999*. Edited by Lori Pressman.

Association of University Technology Managers. *AUTM Licensing Survey: FY 1998*. Edited by Daniel E. Massing.

Association of University Technology Managers. *AUTM Licensing Survey: FY 1997*. Edited by Daniel E. Massing.

Association of University Technology Managers. *AUTM Licensing Survey: FY 1996*. Edited by Daniel E. Massing.

Association of University Technology Managers. *AUTM Licensing Survey: FY 1991-FY 1995: Five-Year Summary*. Edited by Daniel E. Massing.

Association of University Technology Managers. *AUTM Licensing Survey: FY 1991-FY 1994*. Edited by Daniel E. Massing.

Association of University Technology Managers. *AUTM Licensing Survey Executive Summary and Selected Data, Fiscal Years 1993, 1992 and 1991*. Prepared by Dianne C. Hoffman, Inc.

Association of University Technology Managers. *AUTM Licensing Survey Executive Summary and Selected Data, Fiscal Years 1992 and 1991*. Prepared by Dianne C. Hoffman, Inc.

Australian Institute for Commercialisation, *The Economic Impact of the Commercialisation of Publicly Funded R&D in Australia*, September 4, 2003. www.ausicom.com/uploads/economic_impact.pdf

- 1995 data are cumulative 1985 – 1995; page 41
- 2000 data are inferred via text comparison with Canadian data; pages 47 and 48
- 2002 data are taken from text; ref 56 page 47

Clayman, Bruce P. *Addendum to Technology Transfer at Canadian Universities: Fiscal Year 2001 Update*, unpublished *(*July 31, 2003) http://www.sfu.ca/vpresearch/vprreports.htm

Clayman, Bruce P. and J. Adam Holbrook. *The Survival of University Spin-offs and Their Relevance to Regional Development*, unpublished (October 2003) http://www.sfu.ca/vpresearch/vprreports.htm

Conference Board of Canada. *Collaborating For Innovation*. Annual Innovation Report, 2000.

Gu, W. and Whewell, L. *University Research and the Commercialization of Intellectual Property in Canada: A Statistical Overview*. Prepared for the Expert Panel on the Commercialization of University Research. Micro-Economic Analysis Directorate, Industry Canada, Ottawa, ON, 1999.

Olsen & Associates, Zürich, Switzerland. *Currency Converter, 2000*. http://www.oanda.com/converter/classic.

PricewaterhouseCoopers LLP, *Regional Economic Benefits Study*, 2001, University of Waterloo. http://www.uwaterloo.ca/documents/pdf/PWC_report.pdf

Read, Cathy. *Survey of Intellectual Property Commercialization in the Higher Education Sector*, *2001*. Preliminary Releases No. 1 and 2, Statistics Canada.

Read, Cathy. *Survey of Intellectual Property Commercialization in the Higher Education Sector, 1999*. 88F0006XIB No. 01, Statistics Canada.

Read, Cathy. *Survey of Intellectual Property Commercialization in the Higher Education Sector, 2001*, Statistics Canada (October 2003)
www.statcan.ca/cgi-bin/downpub/listpub.cgi?catno=88F0006XIE2003012

Wright, Mike, Martin Binks, Ajay Vohora and Andy Lockett, *UK UNIVERSITY COMMERCIALISATION SURVEY: FINANCIAL YEAR 2002*, Nottingham University Business School, 2003. All data are from table 39. USD conversions are based on purchasing power parity.
http://www.nottingham.ac.uk/enterprise/research_publications.htm#survey

FY2003 AUTM Survey Results for Responding Canadian Universities (Top 21)

Survey Results Normalized by Sponsored Research Expenditures (All figures in US$)

	Canadian University	Total Sponsored Research Expenditures	Invention Disclosures Received	Invention Disclosures Received per $1M	License & Options Executed	Licenses & Options Executed per $1M	License Income Received	License Income Received per $1M	U.S. Patents Issued	U.S. Patents Issued per $1M	Start-up Companies Formed	Start-up Companies Formed per $1M
1	University of British Columbia*	$268,962,957	141	0.524	37	0.138	$9,756,996	$36,276	19	0.071	4	0.015
2	McGill University*	$228,902,134	99	0.432	38	0.166	$1,460,601	$6,381	45	0.197	5	0.022
3	Université de Montréal*	$223,144,484	80	0.359	29	0.130	$604,474	$2,709	11	0.049	3	0.013
4	University of Toronto*	$219,401,967	138	0.629	40	0.182	$2,109,400	$9,614	3	0.014	7	0.032
5	University of Alberta*	$186,048,255	61	0.328	18	0.097	$1,068,384	$5,743	11	0.059	4	0.021
6	Université Laval*	$126,129,631	34	0.270	10	0.079	$127,752	$1,013	8	0.063	3	0.024
7	University of Calgary / UTI, Inc.	$120,831,629	124	1.026	20	0.166	$2,935,162	$24,291	13	0.108	3	0.025
8	University of Western Ontario*	$100,435,434	29	0.289	18	0.179	$281,514	$2,803	4	0.040	0	0.000
9	Queen's University*	$94,978,228	57	0.600	6	0.063	$3,479,052	$36,630	14	0.147	0	0.000
10	University of Saskatchewan	$89,412,556	40	0.447	26	0.291	$954,608	$10,676	2	0.022	3	0.034
11	McMaster University*	$86,290,242	47	0.545	48	0.556	$633,198	$7,338	3	0.035	0	0.000
12	University of Guelph	$76,247,150	155	2.033	41	0.538	$576,803	$7,565	5	0.066	0	0.000
13	University of Ottawa	$72,810,336	15	0.206	6	0.082	$42,608	$585	4	0.055	1	0.014
14	University of Waterloo*	$67,528,018	9	0.133	15	0.222	$590,121	$8,739	6	0.089	13	0.193
15	University of Manitoba	$60,324,127	35	0.580	6	0.099	$1,682,750	$27,895	5	0.083	0	0.000
16	Université de Sherbrooke	$58,079,340	14	0.241	23	0.396	$10,182,867	$175,327	1	0.017	1	0.017
17	Dalhousie University	$53,679,777	8	0.149	2	0.037	$17,667	$329	7	0.130	0	0.000
18	Memorial University	$36,405,168	18	0.494	3	0.082	$126,347	$3,471	0	0.000	0	0.000
19	Simon Fraser University	$31,180,498	26	0.834	1	0.032	$61,235	$1,964	4	0.128	4	0.128
20	University of New Brunswick	$22,042,227	15	0.681	8	0.363	$80,478	$3,651	1	0.045	1	0.045
21	University of Victoria	$17,885,020	33	1.845	6	0.335	$92,797	$5,189	0	0.000	0	0.000
A	Can. Totals & Cumulative: Top 2	**$2,240,719,179**	**1,178**	*0.526*	**401**	*0.179*	**$36,864,815**	*$16,452*	**166**	*0.074*	**52**	*0.023*
B	Can. Average: Top 21	$106,700,913	56.1	0.602	19.1	0.202	$ 1,755,467	$ 18,009	7.9	0.068	2.5	0.028
C	Can. Median: Top 21	$86,290,242	35	0.494	18	0.166	$ 604,474	$ 6,381	5	0.059	1	0.015
D	Can. Standard Deviation: Top 21	$74,808,041	47.6	0.498	14.8	0.155	$ 2,897,765	$ 37,746	9.9	0.051	3.2	0.047
E	Can. **Totals** & *Cumulative:* Top 1	**$1,658,247,276**	**803**	*0.484*	**242**	*0.146*	**$22,777,944**	*$13,736*	**130**	*0.078*	**32**	*0.019*
F	Can. **Totals** & *Cumulative:* Last 1	**$582,471,903**	**375**	*0.644*	**159**	*0.273*	**$14,086,871**	*$24,185*	**36**	*0.062*	**20**	*0.034*
G	"G-10" (*) **Totals** & Cumulative	**$1,601,821,351**	**924**	*0.577*	**273**	*0.170*	**$23,226,995**	*$14,500*	**127**	*0.079*	**29**	*0.018*
H	Non-G-10 **Totals** & Cumulative	**$638,897,829**	**483**	*0.756*	**142**	*0.222*	**$16,753,324**	*$26,222*	**42**	*0.066*	**13**	*0.020*

FY2003 AUTM Survey Results for Responding U.S. Universities (Top 21)

Survey Results Normalized by Sponsored Research Expenditures (All figures in US$)

	U.S. University	Total Sponsored Research Expenditures	Invention Disclosures Received	Invention Disclosures Received per $1M	License & Options Executed	Licenses & Options Executed per $1M	License Income Received	License Income Received per $1M	U.S. Patents Issued	U.S. Patents Issued per $1M	Start-up Companies Formed	Start-up Companies Formed per $1M
1	University of California System	$2,623,300,000	1,027	0.391	208	0.079	$67,019,000	$25,548	323	0.123	22	0.008
2	Johns Hopkins University	$1,461,554,527	330	0.226	159	0.109	$6,712,152	$4,592	95	0.065	5	0.003
3	Massachusetts Inst. of Technol	$994,354,000	452	0.455	114	0.115	$26,824,897	$26,977	152	0.153	15	0.015
4	University of Illinois	$785,088,000	229	0.292	86	0.110	$7,700,876	$9,809	39	0.050	6	0.008
5	University of Washington	$784,411,974	199	0.254	67	0.085	$29,282,203	$37,330	46	0.059	3	0.004
6	University of Michigan	$749,344,497	257	0.343	76	0.101	$9,100,000	$12,144	64	0.085	9	0.012
7	University. of Wisconsin-Madiso	$721,248,000	406	0.563	177	0.245	$37,765,393	$52,361	87	0.121	0	0.000
8	University of Pennsylvania	$649,700,000	321	0.494	83	0.128	$11,653,155	$17,936	50	0.077	12	0.018
9	Stanford University	$639,895,454	362	0.566	128	0.200	$45,383,189	$70,923	117	0.183	12	0.019
10	SUNY System	$629,261,894	235	0.373	34	0.054	$13,726,454	$21,814	51	0.081	4	0.006
11	Penn State University	$545,031,000	156	0.286	20	0.037	$1,643,635	$3,016	58	0.106	2	0.004
12	Harvard University	$538,946,600	119	0.221	69	0.128	$24,282,171	$45,055	59	0.109	4	0.007
13	University of Colorado	$531,800,000	124	0.233	34	0.064	$3,083,185	$5,798	23	0.043	6	0.011
14	University of Pittsburgh	$513,064,000	74	0.144	44	0.086	$3,006,015	$5,859	22	0.043	8	0.016
15	University of Minnesota	$508,557,000	218	0.429	56	0.110	$38,083,275	$74,885	54	0.106	4	0.008
16	Cornell University	$504,600,000	186	0.369	50	0.099	$3,293,000	$6,526	53	0.105	13	0.026
17	Duke University	$474,953,669	125	0.263	39	0.082	$2,793,574	$5,882	50	0.105	1	0.002
18	Washington University St. Louis	$474,328,000	91	0.192	41	0.086	$12,815,429	$27,018	54	0.114	3	0.006
19	Texas A&M University System	$456,235,000	117	0.256	81	0.178	$7,311,571	$16,026	27	0.059	5	0.011
20	University of Arizona	$454,941,000	111	0.244	23	0.051	$1,076,870	$2,367	12	0.026	2	0.004
21	Ohio State University	$416,000,000	130	0.313	42	0.101	$565,877	$1,360	21	0.050	4	0.010
I	U.S. Totals & Cumulative: Top 21	**$15,456,614,615**	**5,269**	*0.341*	**1,631**	*0.106*	**$353,121,921**	*$22,846*	**1,457**	*0.094*	**140**	*0.009*
J	U.S. Average: Top 21	$736,029,267	250.9	0.329	77.7	0.107	$16,815,330	$22,535	69.4	0.089	6.7	0.009
K	U.S. Median: Top 21	$545,031,000	199	0.292	67	0.101	$9,100,000	$16,026	53	0.085	5	0.008
L	U.S. Standard Deviation: Top 21	$492,775,654	208.1	0.119	52.1	0.050	$17,926,195	$22,057	67.0	0.039	5.4	0.006
M	U.S. Totals & Cumulative: Top 21 adjusted for indirect costs @52.	**$10,089,174,031**	**5,269**	*0.522*	**1,631**	*0.162*	**$353,121,921**	*$35,000*	**1,457**	*0.144*	**140**	*0.014*

FY2003 AUTM Survey Results for <u>All</u> Responding U.S. Institutions (N = 181)

	U.S. University	Total Sponsored Research Expenditures	Invention Disclosures Received	Invention Disclosures Received per $1M	License & Options Executed	Licenses & Options Executed per $1M	License Income Received	License Income Received per $1M	U.S. Patents Issued	U.S. Patents Issued per $1M	Start-up Companies Formed	Start-up Companies Formed per $1M
N	U.S. Totals & Cumulative: N=181	**$37,175,077,087**	**14,431**	*0.388*	**4,132**	*0.111*	**$1,133,105,742**	*$30,480*	**3,673**	*0.099*	**348**	*0.009*
O	U.S. Totals & Cumulative: N=181 adjusted for indirect costs @52.3%	**$24,265,716,114**	**14,431**	*0.595*	**4,132**	*0.170*	**$1,133,105,742**	*$46,696*	**3,673**	*0.151*	**348**	*0.014*