Universities and Living Standards in Canada

Introduction

Universities are key contributors to the social and economic fabric of Canada. In the fall of 2005, more than 1.1 million Canadians are university students and 800,000 of them are studying full time. Close to 40,000 Canadians are full-time faculty and over 60,000 others are full-time employees. The combined budgets of Canadian universities exceeded $20 billion in 2004/5 and last year Canadian universities performed $9.3 billions of dollars of research and development, more than 38 percent of the Canadian total R&D. (AUCC, November, 2005, 1) It is a good bet that nearly everyone reading these notes has at least one degree from a Canadian university and many will have more than one.

Given the involvement of so many people and so much money it is proper to expect that universities will have a major and highly positive effect on living standards and the quality of life in Canada; this paper will argue that indeed they do. In fact, given that universities receive $2800 *less* operating support in real dollar terms per student than they did 15 years ago and with only 70 percent of the funding that U.S. governments invest in the academic and research operations of their publicly funded institutions, universities in Canada "punch above their weight" in Canadian society. To make this case, this paper will look first at contributions to individual well-being and then move to an examination of overall economic and social contributions.

Contributions to Individual and Social Well-being

We who work in the university sector like to think that the economic advantages to an individual of the acquisition of a university degree are well known; we are constantly amazed to discover that they are not, even by many of those who hold them. In Ontario, the employment rate of university graduates six months after graduation is consistently six to eight percentage points above the employment rate for the comparable (18-24) age cohort. The rate 2 years after graduation is consistently eight to ten points higher and is consistently well above 96 percent. (COU, Quick Facts, 2005, 6)

The average annual income of Ontarians with university degrees in 2001 was $59,036. For high school graduates it was $31,398 and for those with a certificate or diploma from a community college it was $38,404. (COU, Facts and Figures, 2005, p 1-4). Translated over a 35 year working life and even without allowing for salary growth or compounding, an individual with a university degree will earn, on average, $722,000 more than one with a college diploma.

If the market returns to individuals of a university degree are little known, the non-market returns are even less often considered and known. Barbara Wolfe and Robert Haveman of the University of Wisconsin – Madison argue that the non-market effects of schooling are probably as large as the market effects and increase in proportion to the amount of schooling received; certainly they must be taken into account in considering the

contributions of universities to our living standards and quality of life. (Wolfe and Haveman, 2001)

Wolfe and Haveman find strong intergenerational effects with positive correlation between one's own schooling and that of one's children and between the health status of one's family and the number of years of parental education. All of us in universities are aware of the evidence for that: for better or worse, the great majority of our students have parents with university education even though less than 25 percent of the Canadian population has such an education.

Even without considering the intergenerational non-market impacts of universities on well-being there are still very large direct personal benefits. In addition to the well-known relationship between a university education and better personal health these include a positive relationship between level of education and efficiency of consumer choice, better fertility choices (non-marital child bearing is much lower among those with higher levels of education) and a much lower level of participation in criminal activities. (Wolfe and Haveman, 2001, 3)

Other non-market benefits of a university education on well-being could be characterised as being of either individual or social benefit. The correlation between level of education and the propensity to vote or otherwise participate in politics has been well established since the dawn of survey research. University graduates in the US are more than twice as likely to volunteer for community service as non-graduates and higher levels of education are positively correlated with the propensity to make charitable donations at a given level of income. (Wolfe and Haveman, 2001, 9)

Macro-economic Benefits of Universities

With the, previously noted, over one million students, nearly 100,000 full-time employees and $20 billion in annual revenues, universities constitute the fourth largest public sector industry in Canada, behind only health care, general government and K-12 education. But their largest economic effects lie in lie in the impact of their graduates and their research rather than in direct employment and expenditures.

<u>The Provision of Highly Qualified Graduates</u>

While a great deal of attention is focused on the role of universities in research, development and technology transfer (a sin which this paper will soon repeat), by far the largest contribution made by Canadian universities to our national economy lies in the provision of a knowledgeable, innovative, inquiring and highly skilled labour force. Between 1990 and 2004, the Canadian economy developed more than 1.5 million new jobs that required university degrees. In the same period there were 1.2 million fewer jobs for those with less than high school graduation. And "although university graduates made up only 23 percent of the population aged 25 to 64 in 2003, they contributed 42 percent of the income tax base and received only 13 percent of direct government transfers to individuals."(AUCC, November, 2005, 6) The dependence of the Canadian economy on

the provision of highly skilled people by our universities has been increasing every year for the last half-century. (Statistics Canada, The Daily, Feb.11, 2003)

In the provision of university bachelor's degrees, Canada ranks near the top among G-7 countries, standing second only behind the U.S. in the proportion of our population aged 25 - 64 with a university education.(Sherman et al, 2003, 19) That's the good news. On the less good side, among the broader constellation of OECD countries, Canada ranks only fifth and several of the countries which trail us have made up almost all of the gap. Moreover, we live and trade in North America and, relative to our main trading partner and economic competitor, we significantly under invest in universities with our under investment becoming greater the higher up the education scale we go. While Ontario invested in K-12 education at 85 percent of the US level in 1999 and spends more per student in community colleges than do peer states in the U.S., it invested at only 57 percent of the US level in universities. (Task Force on Competitiveness, Productivity and Economic Progress, 2003, 24) In spite of this under investment, Ontario universities graduated slightly more bachelor's students proportional to the province's population than did their US counterparts. (Task Force on Competitiveness, Prosperity and Economic Progress, 2003, 25) But at the master's level Ontario graduated only half as many as its peer US states and at the PH.D level 33 percent fewer than the US. Similarly, while Ontario graduates slightly more engineering and science students per capita at the bachelor's level than US peer states, at the graduate level, the US outperforms Canada by 40 percent. (Institute for Competitiveness, Prosperity and Economic Progress, Nov. 2003, 24)

At the management level we are substantially undereducated relative to our main economic partner. Only 31 percent of Ontario's managers possess a university degree versus 46 percent of US managers and, rather surprisingly given the very large salary differential that they are willing to pay for university graduates, both public and private sector managers in Canada are more likely to recommend a college diploma than a university degree as the appropriate highest level of education. (Institute for Competitiveness, Prosperity and Economic Progress, Nov. 2003, 25) Fortunately, most post-secondary bound high school students note managers' revealed preferences rather than their stated ones, and opt for a university education.

Overall, the Ontario Task Force on Competitiveness, Prosperity and Economic Progress estimates that about 7.5 percent of Ontario's "prosperity shortfall" relative to US peer states can be accounted for by under investment in university education.

Innovation and University Research

While the impacts of Canada's universities on standards of living and quality of life are pervasive and are delivered mainly through the education of students, much of the attention of the federal, and, to a lesser extent, provincial governments has been on the role of university research in fostering economic growth through innovation. The AUCC points out that 38 percent of all R&D activity in Canada is carried out in universities (AUCC, November 2005,1) and 31 percent of R&D jobs reside there. Canadian industry

sub-contracts 5 percent of its R&D to universities and underwrites 12 percent of all university research. This is the highest level of university-industry partnership among OECD countries. (AUCC, September 2005, 1)

In 1999, it was estimated that "through its contribution to increased productivity, the total impact of university R&D amounts to $15.5 billion or around 2 percent of annual GDP. This corresponds to 150,000 to 200,000 new jobs or around 1 percent of employment." (Gu and Whewell, 1999, 34) Given that university (though not private sector) research has increased substantially between 1999 and 2004, the contribution will be substantially higher today.

Research Productivity

Technology transfer may lead directly to patents and licensing agreements or it may occur through a general increase in the stock of knowledge. The latter is probably the more important in the long run since it has long been considered that "applied research is a search process that eventually exhausts the technological opportunities in a given field". (Branstetter and Ogura, 2005, 4) Continued success in applied research, no matter where it is conducted requires continual augmentation of the stock of basic knowledge and, in Canada, universities are the pre-eminent source of that stock.

In this area, Canadian universities excel. While Canada has only about 0.5 percent of the world's population, it produced 4.2% of the world's scientific and engineering publications in the mid-90's and 4.5 percent of *all* research publications in 2004. Our publication productivity (publications per 100 researchers) is second only to the UK among OECD countries and is 50% higher that the US. Sixty five percent of these publications come from university researchers (versus 71% in the US) and the only other significant sources are hospitals and the federal government. Thirty two percent of all publications in Canada involve collaboration between university researchers and those of another sector so universities really do stand at the centre of the process. (Gu and Whewell, 1999, 39; AUCC, November 2005, 3,4)

Attempts to measure the importance of academic research *on* productivity have found the effects to be "important and pervasive". (Gu and Whewell, 1999, 44) The effects, naturally, occur with a time lag. In the basic sciences this is typically up to 20 years while in the applied sciences and engineering it ranges from zero to ten years. (Gu and Whewell, 1999,44) While the long time lines and wide diffusion associated with university research make it very difficult to estimate overall social impacts, US estimates of the social rates of return of research in the sciences and engineering range from 28 to 40%.

Commercialization

In many respects, Canadian researchers and universities outperform their US peers when it comes to the commercialization of research. We lead the US in inventions disclosed per dollar of research money (but allocate only half as much per capita to research) (Gu and

Whewell, 1999, 51). The Association of University Technology Managers is a Canada/US association which annually surveys North American universities with respect to commercialization of research and in those surveys, Canadian universities have continued to outperform US counterparts. We create 2.5 times as many spin-off companies per dollar spent on research as do US universities. However we receive only half as much income from each licensing agreement as US counterparts partly because of our smaller markets and partly, it can be hypothesized, because our industrial partners with whom we make the license agreements are not as adept at marketing innovation as are their US counterparts.

The last point is important for there is a tendency in government and industry to considerably overestimate the potential economic benefits to universities of investment in patents and licensing agreements. In spite of our good performance relative to the US, in 2004 such revenues to Canadian universities were only $51 millions. While this is apparently non-trivial, it represents only about 0.25% of total university revenues that year and it is not a bad bet that the costs to universities of supporting these activities approached or even exceeded the revenues. Any hope that the financial problems of Canada's universities will be solved through commercialization of research is quite forlorn and will not absolve governments of their responsibility to adequately support both the teaching and the research enterprise.

Research and Public Policy

Where we most underestimate the contribution of basic research to our quality of life is in the realm of the applicability of such research to very large policy and management issues, the economic and social consequences of which affect vast numbers of people. To cite one example we can look at the question: what really caused the collapse of the cod fishery off Canada's east coast, what are the prospects for recovery and what may be the lessons and consequences for other marine ecosystems and their fisheries? The lives and futures of thousands of people and millions of dollars depend on the answers.

Here the integration of basic scientific research from biology with remote sensing techniques based on "hard" technology filtered through interpretative techniques developed by geographers has led a team of university and government based scientists, including the recently retired Principal of Queen's University, Bill Leggett, to establish models which summarize and re-examine vast amounts of data. These models conclude, contrary to much conventional wisdom, that the decline of top predators such as cod can cause irreversible shifts in complex ecosystems which bode poorly for the future of such fisheries and the economies and societies which depend on them even after long periods of cessation of fishing. (Choi et al, 2005, 48, 49) Their models, reported recently in the highly prestigious journal, *Science*, indicate that, while over fishing may have been "the straw that broke the camel's back", in fact there are other factors such as changing water temperatures and other changes in complex ecosystems which have had more important causative effects. (Frank et al, 2005, 1621)

The impact of this sort of research on our society and economy is far greater than that of any number of patents and licensing agreements yet it is seldom recognized by policy makers in government when evaluating the effects of government money spent on research.

Growth Poles

Another contribution which universities make to productivity and the economy can be seen in the role universities play as centres of innovation and economic activity in their own regions. Like the fisheries related example cited above, these effects can be difficult to quantify and are more easily captured anecdotally. Unlike the fisheries example they are more likely to be detected by policy makers. Well known US examples include Stanford and Silicon Valley or the Research Triangle and the research oriented industries in eastern North Carolina or the constellation of highly innovative industries and great universities in Boston. In Canada, much of the prosperity of the Kitchener-Waterloo-Guelph region depends directly on the three universities located there. In Ottawa, my own university, Carleton, has provided much of the basic research which has led to regional strength in photonics and wireless communications and has produced through its graduates and research activities even more spin-off companies than have the universities of Waterloo or Guelph.

While direct patenting and licensing plays a role in these university-industrial concentrations, it is the basic research and, most importantly, the provision of highly skilled people which counts most. For example in the halcyon days of Nortel, Carleton was the largest provider in the world of skilled employees to Nortel. Most of these people worked in Ottawa and most of them still do. Many are still with Nortel and many of those who are not have gone to other start-up technology firms contributing to the next wave of technology development in the region.

Social Sciences and Humanities

It is sometimes assumed that only scientific and engineering research can make contribution to our prosperity and quality of life in Canada, but that view short-changes the very major contributions that are made by the humanities and social sciences. Historical research and writing forms the basis of much of our national identity. Geographical research applies such techniques as remote sensing to the management of our natural resources. Psychological researchers have contributed greatly to human health and well-being. Many of the techniques of modern management were developed in universities by social science based researchers. And most government policies rest (for better or worse, some would say) on a foundation of economics and political science.

Finally, before leaving the topic of innovation and university research, it will be well to remind ourselves and, especially, one hopes, those outside the university world, that the receptivity of private industry and government to innovation and the support of university

research is at least as important as work on technology transfer from inside the university. To bemoan the lack of "applicability" of research conducted in Canadian universities is fashionable but misdirected. In fact, as evidenced above, Canadian university researchers substantially outperform their American counterparts in publications, patents and licensing agreements per dollar of research support. The productivity and living standard gap between Canada and the US is not due to a lack of productivity of Canadian universities and their researchers; but it is due in significant measure to substantial under investment in both universities at large and the researchers who work in them.

In summary, then, while patent and licensing and direct industrial partnerships are easy to measure and are often the main focus of governments searching for the famous "most bang for the buck", in reality it is through the provision of skilled people, the conduct of basic research and the dissemination of knowledge across all fields of academic endeavour that universities have made and will continue to make their greatest contribution to Canadian productivity and standards of living.

Conclusion

As the forgoing will have amply signalled, I believe that Canadian universities contribute very substantially to many aspects of the quality of life in Canada. From the arts and social sciences to the basic sciences and engineering they are the centres of research, innovation and, most important of all, the transmission of knowledge and the provision of skilled, articulate and innovative people. They can do more, but they cannot do more with less: having dealt with a 25 percent drop in real funding per student over the last one and one half decades they are ripe for further re-investment. And this is one investment which will guarantee a direct pay-off in the well being of Canadians.

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