Canadian Association for Graduate Studies
Association canadienne pour les études supérieures

Educating the Best Minds for the Knowledge Economy:

Setting the Stage for Success

As part of the preparation for the 2001 CAGS Conference, and in follow-up to the National Issues project discussed at the 1999 and 2000 CAGS conferences, the Executive Committee commissioned the attached paper to explore the issue of graduate student funding and achieve a position to guide our advocacy and future activities.

Graduate students form an integral part of the research and scholarship effort of the university and the production of highly qualified master's and doctoral graduates is an essential component of the knowledge society and economy.

To attract the best minds to graduate schools, it is necessary to offer excellent programs. It is equally important to be able to offer a sufficient level of financial support to allow graduate students to commit to their studies with all the enthusiasm and energy required for successful and timely outcomes. This means ensuring that their basic financial needs are met.

We acknowledge that students who commit to graduate studies derive personal benefits in terms of intellectual satisfaction and employment opportunities. However, this benefit must be weighed against the cost to the student of foregone income, additional debt and time. Further, society as a whole also derives benefits from having a larger cadre of highly qualified people to drive the knowledge economy, and so it is appropriate for the country to contribute to the investment graduate students make by providing financial support to them. Increasing the number of master's and doctoral graduates is an essential element for the success of the federal government's agenda of moving from 15th to 5th position among OECD nations in terms of relative R & D investment by 2010.

We trust that the membership of CAGS as a whole is prepared to ensure that graduate student financial support continues to be at the forefront of the CAGS agenda.

I am, therefore, pleased to present this paper on behalf of the Executive Committee of CAGS,

Louis Maheu, President
October 2001

Educating the Best Minds for the Knowledge Economy:

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a position paper prepared for the Executive Committee of

The Canadian Association for Graduate Studies

Nicole Bégin-Heick & Associates Inc.
340 Roger Rd
Ottawa, ON, K1H 5C4
nbegin@magma.ca
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EXECUTIVE SUMMARY

The Canadian Association for Graduate Studies (CAGS) includes among its principal aims: to contribute to the development of quality standards for Canadian graduate studies, so that they compare to the best in the world, and to identify and promote the status and needs of Canadian graduate studies, nationally and internationally.

CAGS has identified **Student Financial Support** as a priority on which it should focus its efforts.

This paper provides information on the current and anticipated demand for graduates of master's and doctoral programs for the economy in general and also for academia. This paper also provides information on current funding available to graduate students. CAGS concludes that the output of master's and doctoral graduates must double to meet the anticipated demand, and that more student financial support is needed to enable larger numbers of prospective graduate students to access graduate education.

CAGS recommends that financial support provided to graduate students must be improved by:

- Increasing the awards budgets of the federal granting agencies
- Increasing the number and value of research grants through which research assistantships are paid
- Providing greater tax relief on scholarships, research assistantships and other means of research students' support
- Improving student loan programs

In addition, CAGS recommends that that in order to provide the necessary environment for graduate studies:

- Adequate funding must be provided for the indirect costs of research
- Funding must be provided to deal with the problem of deferred maintenance in the Universities

INTRODUCTION

The Canadian Association for Graduate Studies (CAGS) includes among its principal aims: to contribute to the development of quality standards for Canadian graduate studies, so that they compare to the best in the world and to promote the status and needs of Canadian graduate studies, nationally and internationally.

Prior to the 1999 Annual General Meeting (AGM) of CAGS, workshops were held in each region (Atlantic, Quebec, Ontario, West) to identify the most important issues facing graduate study in Canada and to consider what roles should be assumed by CAGS in addressing these issues. The results of the regional processes were combined at the 1999 AGM, leading to the identification of four national issues on which CAGS should focus its efforts. One of these was student financial support and its links with the ability of Canadian universities to attract the most talented students to graduate programs in order to produce the highly qualified people needed for Canada's transition to the Knowledge Economy.

A highly skilled workforce is necessary to fuel a country's ambition for, and achievement of, healthy economic growth, enhanced quality of life and quality of democracy. The OECD terms this the human capital investment.[1] In this context, there is an increased demand for higher education. The 1960s and 1970s saw a rapid increase in the number of post-secondary education institutions in Canada, particularly in Quebec and Ontario. In the 1990s continuing into the new century, various strategies are being employed by governments and institutions of higher learning to enhance access to post-secondary education.

Given the needs to balance budgets and pay down the debt, the 1990s unfortunately saw a period of under-investment in post secondary education and research, which was associated with ever increasing difficulties for universities to attract and retain talented faculty. In addition, in Canada, there continues to be a gap between the supply of doctoral graduates and the number of Ph.D.-qualified individuals needed to fill vacant faculty positions. These vacant positions include those that have become available through faculty retirements and those that need to be created to accommodate the growing student demand. In turn, this growing demand reflects the needs of the public and private sectors for more highly qualified people educated to the master's and doctoral levels.

In the 2001 Speech from the Throne[2], the federal government stated the objective of having Canada move by 2010 from 15th to 5th place (the 15th to 5th shift) among OECD nations in terms of relative R & D investment. To achieve this goal, we need a highly educated and innovative population.

DEMAND FOR MASTER'S AND DOCTORAL GRADUATES

Table 1[3]
Participation rates per capita in Canada, the USA and the UK

	Canada	USA	UK
Population (1998)	30,563	274,028	58,649
Undergraduate enrolments	708	7,124	1,032
Rate	2.3	2.6	1.8
Graduate enrolments	119	1,750	410
Rate	0.4	0.6	0.7
Total	827	8,874	1,442
Rate	2.7	3.2	2.5

In the USA, the Council on Competitiveness views the decline in the share of national resources committed to frontier research and the decreasing numbers of science and engineering graduates in every field outside the life sciences as a vulnerability that undercuts the long-term capacity for innovation. It concludes that the required levels of R&D investment and technical talent cannot be declining in an economy driven by knowledge creation and the deployment of technology.[4]

By the same measure, Canada is highly vulnerable, given the current state of its higher education and its desire to improve its performance at the same time as other nations have similar ambitions.

Based on 1998 statistics, the participation rate in graduate studies as a proportion of population is lower in Canada than it is in the USA or the United Kingdom (see **Table 1**).

These data show that participation rates for undergraduate students in Canada are lagging behind those in the USA. Moreover, Canada lags behind both the USA and the UK in participation rates at the graduate level. In view of the prevailing demographic trends in Canada (see below), this gap takes an even more dramatic character,

Other United Nations demographic indicators, such as the proportion of 0-15 year olds and of 65+ year olds, show that, currently, a larger proportion of the Canadian population is between 15 and 60 years old, compared to the USA. Further, the U.K. and the population of Canada is predicted to grow faster between now and 2050 than that of the other two countries.

ALL DISCIPLINES NEED TO PRODUCE MORE GRADUATES

The Advisory Council on Science and Technology (ACST) Expert Panel on Skills recent report[5] concluded:

"…*we cannot afford to be complacent. The pressures of economic, technological and scientific change, combined with an ageing work force, and intensifying global competition for skilled people, will soon strain our skills development system to the limit. Indeed, the signs are already present.*

...our education and training systems are showing unmistakable signs of stress.

...a decade of budget restrictions has significantly weakened our college and university establishments."[5]

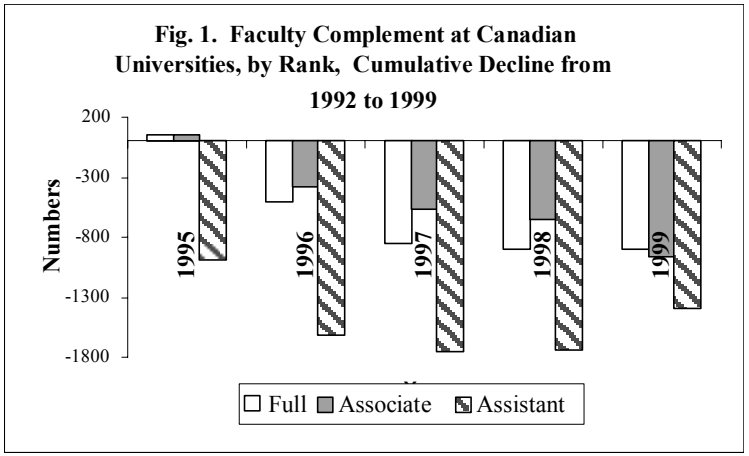
While there is abundant evidence of the needs of the new economy in terms for more scientists and engineers to conduct the levels of R & D necessary to stimulate innovation, all disciplines contribute to the needed highly qualified people. Allen[6] argues that educational programs should be assessed in terms of their contribution to economic development. He stresses that educational programs should be supported if they raise labour productivity anywhere, given that the Canadian standard of living depends on the output per worker in the economy as a whole. In this context, he provides data showing that unemployment rates are lowest among people with post secondary education and, within that group, lowest among those with graduate degrees. He concludes that: "*the demand for graduates in the social sciences and humanities is growing rapidly, ... they earn high salaries, and ... the rate of return to investing in their education is as high as that of sciences and engineering.*"

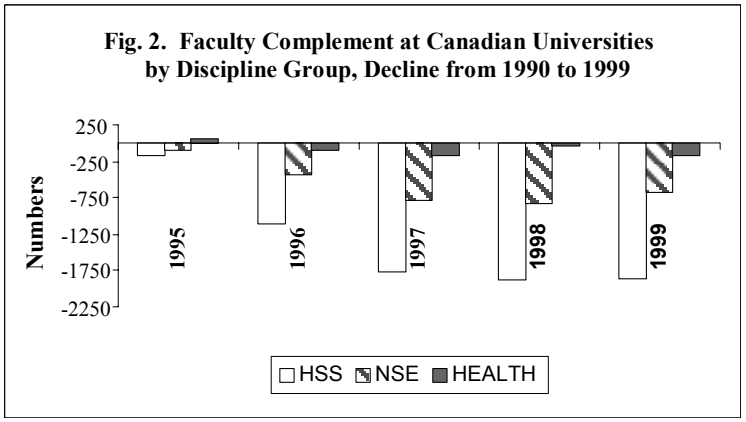
The Canadian Advanced Technology Alliance (CATA*Alliance*)[7] estimates that: "*The high tech industry is not the only one which suffers from a lack of educated employees. The problem is pervasive. The baby boomers are approaching retirement. Replacing them presents an enormous problem in many professions. ...Nurses, doctors, school teachers, university professors and many other professionals will be in short supply over the next five to ten years*."

When the Ontario SuperBuild Fund was targeted to technical programs, members of the CATA*Alliance* rose to the defence of the liberal arts, saying that all disciplines were important in the digital economy.

The Conseil de la Science et de la Technologie (Québec)[8] believes that human and social sciences have a double role to play in the innovation process, whether it be social or technological: by producing of knowledge used by other actors to improve their practices and products and by studying the understanding, management and diffusion of innovation. Until now, science, technology and innovation policies have given little attention to the double strategic role of human and social science research in the knowledge society. We now realize that innovation is primarily a social process, that human factors are present at each step of this process and that the human and social sciences are essential to the appropriate support of science and technology and of the outcomes of R&D.

DEMAND FOR UNIVERSITY FACULTY

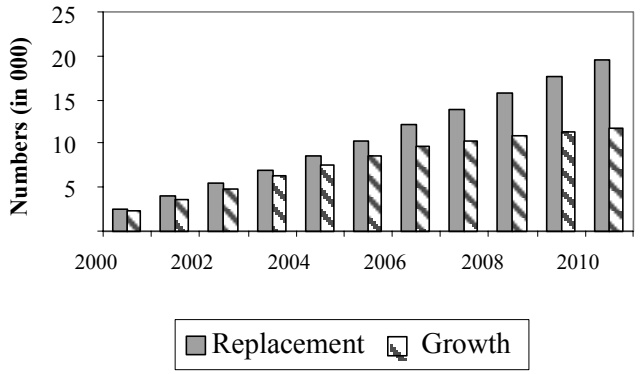




Canadian universities have lost about 3,500 faculty since 1992[9] due in large part to universities' inability to replace retiring faculty owing to cuts to university core budgets.

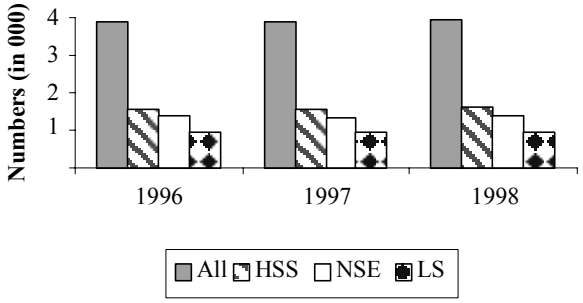
In the 1980s, faculty recruitment kept pace with attrition, but in the 1990s new hires did not take place at the former rate and retirement incentives were offered to senior faculty (**Fig 1**).[10] This attrition has occurred in all disciplines, although it is less pronounced in the health area (**Fig 2)**.

Fig. 3. Projected Cumulative Requirement for Hiring of Faculty at Canadian Universities



AUCC estimates that Canadian Universities' hiring needs will be between 2,500 and 3,000 new faculty a year until 2006,[11] and that by 2010 more than 30,000 faculty will need to have been hired or replaced (see **Fig 3**).[12]

Fig. 4. Doctoral Degrees Awarded by Discipline Group, 1996-98



This intense need for faculty will quickly deplete the talent pool. In the last three years for which statistics are available from Statistics Canada, the rate of graduation of doctoral degree holders at Canadian universities has been less than 4,000 per year (see ***Fig. 4***).

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AUCC is of the view that[13] "[e]ven a very small increase in participation over the next 10 years – a projection of 1.3 percentage points for women and 2. 3 percentage points for men -- would have a huge impact on enrolment. This very conservative estimate of participation rate increases, coupled with population growth, would see total full-time enrolments increase in the range of 20 to 25 percent, from the current number of 575,000 students to about 700,000."

Such a demand for post-secondary education is increasing pressures on the professoriate, happening as it is at the tail of budgetary compressions that have seen the number of faculty drastically reduced. Most of the enrolment increase has been, and will be, at the undergraduate level. This threatens graduate studies because it impedes the ability of faculty members to carry out research at a level necessary to ensure their competence in the delivery of quality graduate research programs. As well, increased teaching demands at the undergraduate level decreases the potential number of graduate students who can be trained since faculty have less time for graduate supervision.

Not all new graduates of doctoral programs are available to take up faculty positions. Many leave the country for better opportunities and many are attracted to positions in government and industry. This poses a challenge: to maintain the appropriate level of industrial and government research and to replace and renew the professoriate, we need to increase significantly the production of doctoral graduates, and this needs to be done immediately. As will be shown below, the imbalance between the number of doctoral graduates and the number of new faculty that will be required suggests that we need to double the size of our graduate programs.

It is increasingly clear that a career in academe is only one occupational choice for our graduates. As the Census data indicates universities do not have a monopoly on PhD graduates. Indeed, other sectors employ the majority of our graduates — historically between 60 and 70 percent.

Robert Giroux, President of AUCC, Speech to CAGS, October 2000.

According to a National Science Foundation (NSF) survey, almost two-thirds of recent USA science and engineering Ph. D. recipients entered graduate school with plans to make teaching their career choice. However, a much smaller percentage of these advanced degree-holders actually accepted an academic position in the first critical years after obtaining their doctorates. About 64 percent of the new Ph. D.-holding scientists and engineers (who received doctorates between 1990 and 1996) indicated that teaching was their career choice when they entered graduate school. But by the time they entered the workplace, only 47 percent had accepted positions in the academic sector.[14]

In Canada, historically, only 35-40% of Ph. D. graduates have been employed in academe.[15] This means that the effective number of doctoral graduates available to fill faculty positions would be only a fraction of the current number of graduates. While approximately 2,500 doctoral degree holders immigrate to Canada each year, the majority of them do not undertake academic careers, as shown by census data.[16]

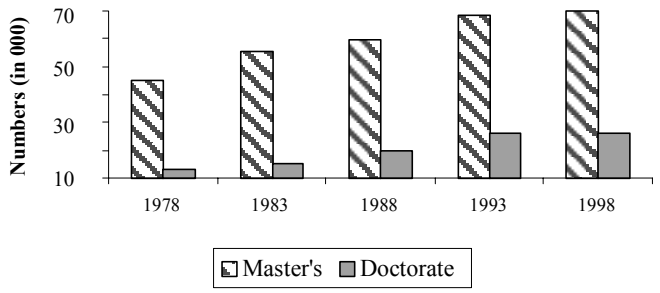
While the need for faculty renewal and expansion focuses on doctoral graduates, for industry, master's degree graduates are considered to be highly desirable.[17] This view concurs with the findings of a major study on the master's degree[18] based on the opinions of nearly 800 stakeholders: students, graduates, faculty, and employers. The master's degree was considered to provide important personal and social benefits. In particular, the authors concluded that the master's degree has most directly responded to life-long learning needs created by changes in the nature of knowledge, work and the economy.

DEMANDS OF THE ECONOMY AT LARGE

The demands of the new economy mean that at current Canadian graduation rates, the requirement for faculty could only be met if most of the doctoral graduates entered academia. This is unlikely to happen and furthermore, it is not desirable, as it would deprive the private and public sectors of the highly qualified people that they also need to meet the new challenges. Furthermore, the public and private sectors will require even more master's and doctoral graduates in the future.

Statistics show that while there was a growth in master's and doctoral enrolment between 1978 and 1993 (**Fig 5**) enrolments have remained flat since at least 1993.

Fig.5. Graduate Enrolments at Canadian Universities, by Year (Full Time + Part Time)



Not only are we letting our brains drain to the south, we are not even producing as many highly educated brains in relation to our population as we did 10 years ago. In Ontario we have no more Ph. D. students in universities now than we did in 1991 when Ontario had a million fewer people and the economy was far less dependent on skills and knowledge. The best and the brightest people in our country are our intellectual pioneers. They are the ones who make discoveries, develop theories, create new companies and strengthen existing companies. These initiatives generate jobs and taxable income for a broad array of people. This, in turn, strengthens the safety net for all Canadians.

A. Charles Baillie, Chairman & Chief Executive Officer TD Bank Financial Group to The Canadian Club Toronto, February 26, 2001

Fig. 6. Master's and Doctoral Enrolments at Ontario Universities 1991-98

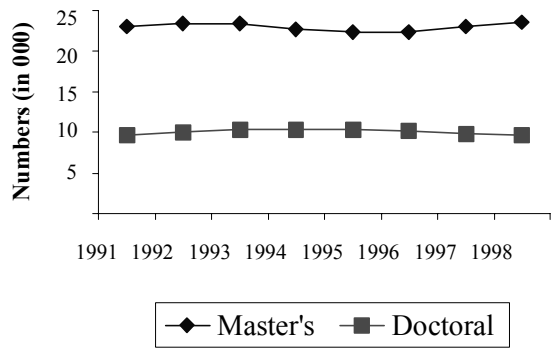
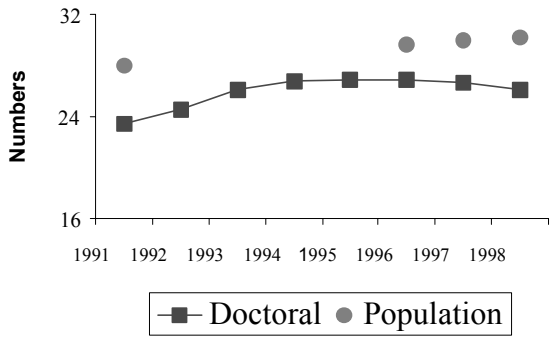


Fig. 7. Doctoral Enrolments (x 10^{-3}) vs Canada's Population (x 10^{-6}) 1991-98



Master's and doctoral enrolments have not increased in Ontario (**Fig. 6**) and doctoral enrolments have barely increased in Canada as a whole (**Fig. 7**) since 1990. The magnitude of the gap between the number of doctoral graduates going into faculty positions, and the number of faculty positions that need to be filled between now and 2010 leads to the conclusion that we need urgently to create the conditions necessary to approximately double the availability of graduates. Given that all countries are challenged by the demands of the knowledge economy, and given the mobility of knowledge workers, Canada needs to become as self-sufficient as possible in producing its own knowledge workers.

The shift to the knowledge economy means that a higher than ever proportion of the population should be highly educated. The data (**Fig. 7**) show, however, that not only is the proportion of students enrolling in doctoral programs at Canadian universities not increasing with respect to increases in the population, but it is going down. Master's level enrolment follows similar trends.

GRADUATE EDUCATION: AN INVESTMENT FOR CANADA

Investing in graduate education in all disciplines is essential in the knowledge economy; furthermore, such investments bring tangible benefits. A study of the economic impact of Canadian university research published by AUCC in 1998[19] concluded that:

University research is a powerful stimulus for economic development, leading to measurable increases both in GDP and employment.

According to the traditional approach to measuring the gross economic impact, university research sustains $5 billion of GDP and results in more than 81,000 jobs. That translates to almost one per cent of Canada's GDP in 1994-95 and more than 0.5 per cent of all jobs — a significant impact for such a small sector of our economy. In addition to such static impacts, university research has a profound effect on the underlying productivity of the economy. The total dynamic impact of university research amounts to around $15.5 billion each year. This corresponds to approximately 150,000 to 200,000 jobs.

A more recent report prepared by Enterprise Canada for the Council of Ontario Universities (COU) finds that the province receives more than $3.2 billion back in revenues generated directly and indirectly by the university sector in return for this direct $2.1 billion investment.[20]

In universities, graduate students are an important part of the highly qualified workforce. Their work as teaching assistants is essential to the university at the same time that it gives them valued communication skills. Together with professors, technologists and postdoctoral fellows, they count among the research knowledge workers and are poised to become the innovators of the future.

It, therefore, follows from the foregoing that: 1) Canada needs more graduates to fuel the innovation required by the "new economy," which will ensure our quality of life and the quality of our democracy; 2) the requirement for more graduates applies to all disciplinary and employment sectors; 3) all disciplines have important impacts on the knowledge economy; 4) the expansion of graduate enrolments must occur now because the demography provides a window of opportunity and Canada's determination to effect the "15th to 5th shift" demands it.

ATTRACTING MORE OF THE BEST

The resource gap for researchers is replicated in the gap between Canada and the United States in financial support for graduate students, and the consequences are equally serious. This is a critical point of vulnerability for the future of Canadian research and higher education that must be addressed on an urgent basis. In recent policy debates, despite some modest progress, graduate student support has not received the same attention as support for research. But it is equally important. As the Killam Trusts have so fully recognized, our graduate students are our future researchers, colleagues and innovators. It is terribly short sighted not to offer them competitive levels of support at the moment they are making potentially permanent decisions about whether or not to pursue their research careers in Canada. It is simply not reasonable to expect our most promising graduate students to cast their lot with Canada if the personal financial consequences of doing so are highly disadvantageous.

J. Robert S. Prichard, President Emeritus, University of Toronto, 2000 Killam Lecture.

Two conditions are necessary to increase our production of graduates at the master's and doctoral levels 1) we must ensure the continued availability of quality programs as well as appropriate times and rates of completion; and 2) we must create conditions that make it attractive and possible for more students to enter our programs.

CAGS' mission is intimately linked with ensuring the first condition, hence the commitment to obtain better statistics on completion rates and times and to ensure the adoption of best practices to favour the best outcomes.

Benefits do accrue to students who invest in graduate education. However, to commit to a graduate program, particularly if studying full-time at the doctoral level, students must overcome several financial hurdles: many have some degree of accumulated educational debt incurred during their previous studies; some have family obligations; all are forfeiting employment income for several years. Given these circumstances, good financial support is viewed as essential in the recruitment of top quality graduate students and in promoting timely program completion.

INSUFFICIENT FINANCIAL SUPPORT

Table 2.[21]
Average Funding of Graduate Students in a Sample of Canadian Universities

University	$/S	$/FT	*% FT*	$/D	*% D*	*% FTD*
6	1,223	6,236	*19.6*	12,337	*9.9*	*43.5*
5	1,892	2,702	*70.0*	13,613	*22.7*	*89.2*
7	2,078	2,964	*70.1*	11,724	*19.6*	*92.0*
1	2,714	3,210	*84.5*	12,450	*21.8*	*95.1*
9	3,608	4,246	*79.9*	10,987	*30.9*	*96.0*
3	4,492	5,921	*75.9*	18,316	*24.5*	*94.0*
2	4,971	6,620	*75.1*	14,957	*33.2*	*100.0*
8	5,121	7,345	*69.7*	23,546	*21.8*	*88.3*
4	6,976	13,027	*53.6*	19,650	*35.5*	*72.2*
10	7,389	9,438	*78.3*	17,841	*41.4*	*96.2*

Several Canadian universities have studied the question of graduate student support and are adopting policies to enhance their ability to compete for the best students. For example, one university[22] has recently announced guaranteed doctoral-stream student financial support of $12,000 plus tuition ($5,000, in 2001-02) per year, for five years. It is the first Canadian university to guarantee minimum financial support packages to graduate students at the institutional level.

The numbers presented in **Table 2** do not reflect what individual students actually receive as financial support. They merely provide information showing that the total financial support available in universities, if allocated evenly to all graduate students, would be grossly insufficient to meet their needs ($/S). Even if all the financial support available were allocated only to full-time graduate students ($/FT), in only five of these universities would it surpass the average graduate 2001-02 tuition fee of $4,360 in Canadian Universities. Even if all financial support available were to be distributed to doctoral students ($/D), in only three universities (#3, 8, & 4) would it exceed $18,000 a year, which has been identified in student surveys as the annual cost to a master's or doctoral student of engaging in full-time graduate study at a university outside of a large centre like Toronto or Vancouver. Overall, 90.6% of doctoral students study full-time in the universities surveyed, close to the national average of 89.6%.

No detailed information was gathered on each institution's funding policies. In practice, however, the focus of funding schemes in universities is on full-time doctoral and doctoral-stream students.

Master's students in all disciplines and some part-time students also require enhanced financial assistance to ensure that they can afford to access further education. However, because of financial constraints, most Canadian universities have traditionally offered very little financial support to students in professional programs, to non-doctoral stream master's students and to part-time students.

Support to graduate students comes from a variety of sources: scholarships directly to students (national, provincial or university-based); research assistantships, from supervisors' grants or institution funds; teaching assistantships, from the institution; student loans; and the student's own or family funds. Many full-time students must resort to part-time external work to make ends meet, at the risk of slowing down the pace of their studies and delaying completion. This creates a vicious cycle, which at times leads to non-completion of the degree.

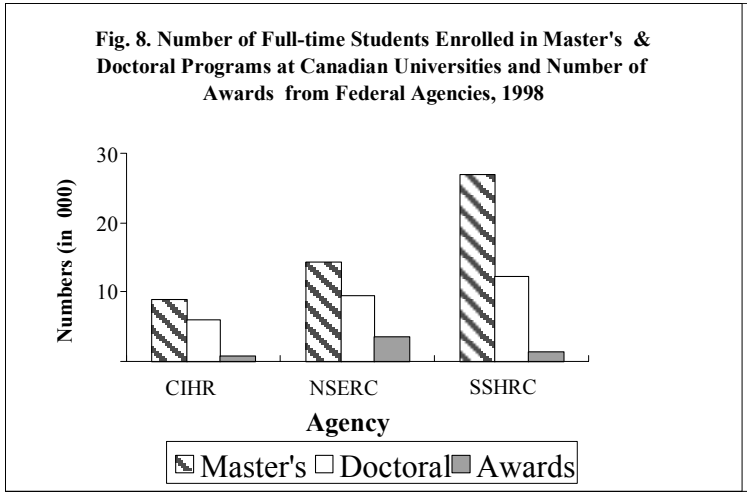
The University of Toronto Task Force on Graduate Student Financial Support has conducted the most detailed available study of graduate student support. It estimates that, prior to putting in place the new policy on support, more than 50% of full-time doctoral students in the population targeted by the policy (students in the first five years of study leading to the doctorate) received less that $17,000 per year; 16%, less than $9,000; and 13% received no financial support at all.[23] The Task Force also reviewed data on 30 American peer institutions available through the Association of American Universities Data Exchange (AAUDE). The average amount in graduate assistant compensation at American universities in 1997-98 was equivalent to CDN$12,167, in addition to tuition fees. These amounts comprise all forms of funding provided to students.

The Conseil national des cycles supérieurs (CNSC) of the Fédération des étudiants des universités du Québec (FEUQ) recently conducted a survey to document the sources and methods of support of graduate students in the province of Quebec.[24] They conclude that 20-40% of graduate students have an annual income from all sources[25] that is less than $11,000. They conclude also that the financial support of graduate students constitutes a large challenge.

The inevitable overall conclusion is that the financial support that graduate students currently receive from all sources at Canadian universities is not only insufficient to cover the students' costs, but puts them and their universities at a considerable disadvantage compared to other jurisdictions, such as the USA.

SUPPORT FROM FEDERAL GRANTING AGENCIES

Direct Support through Scholarships



The federal granting agencies[26] direct support programs offer a limited number of prestige awards directly to the best students. The CIHR Doctoral Research Awards, for which students may apply after they have completed at least 12 months of graduate studies and which are awarded to those enrolled in a PhD program, support around 800 students per year. This amount is clearly small compared to the number of doctoral students in the system.[27] Like CIHR, SSHRC only funds doctoral students and only approximately 10% of them are supported through these direct awards. In the NSERC disciplines, both master's and doctoral students are eligible for direct awards but again only approximately 10% are thus supported. The return of the federal granting agencies budget to the 1994 levels has not permitted an increase in the number of direct awards to students.

Support through Research Grants

Students are also supported through their supervisor's research grant. This is an important form of support. However, given the size of the average grant (see **Table 5**), it is evident that that there is a severe limit to the number of students who can be supported through grants from the Federal Granting Agencies and to the level at which they can be supported. For example, CIHR has a guideline stating that students supported from grants must receive a stipend of $17,000 per annum; the cost of supporting that student's research can amount to $20,000. This means that the average CIHR grantee can only support 2-3 students from a grant. Even fewer students can be supported on a NSERC or a SSHRC grant.

Table 3[28]

Success Rate and Size of Average Grant for the Three Federal Granting Agencies

	# Applic.	# funded	% funded	av. grant (000)
CIHR	2,542	804	31.5	100
NSERC	3,089	2,461	79.7	38
SSHRC	1,531	638	41.7	24

NSERC and CIHR estimate that respectively 4,400 and 2000 full-time equivalent students are supported through grants. The number supported through SSHRC grants is likely to be much smaller, given the size of the average grant and disciplinary traditions.

Therefore, compared to current needs, the effort at the federal level is low. Compared to the anticipated needs, it is lower still.

There are prestige scholarship programs in various provinces. Ontario, for example supports 2,500 students per year through the Ontario Graduate Scholarship (2000 one-year awards) and the Ontario Graduate Scholarship in Science and Technology (500 one-year awards).[29] The Quebec granting agencies: FCAR (now FQRNT), FRSQ, CQRS (now FQRSC) between them support approximately 2,000 students each year, with FCAR being the major funder.[30]

It is estimated that only approximately 16-20 % of full-time graduate students (ca. 70,000) receive some direct support through external scholarships. Admission to graduate programs calls for high undergraduate academic records and excellent assessments; this is also the basis of eligibility to apply for external scholarships. Therefore, all students admitted to research programs have the necessary qualifications for prestige awards.

CONDITIONS FOR SUCCESS

According to AUCC[31], several conditions must be met before Canada's "15th to 5th shift" can be achieved:

- More faculty conducting more research, in more universities across more disciplines
- More research output from each researcher
- More graduate student support
- Greater graduate production to fuel the required growth in other labour markets

In a recently released report, the Advisory Council on Science and Technology[32] cites the three conditions that it views as necessary to make Canada competitive:

- the quality of the researchers;
- the funds available to support the costs of research projects and
- the quality of the research environment.

All three bear on the enhancement of Canada's research capacity and the attraction and training of graduate students.

INVESTMENTS REQUIRED

Upgrading the Support to Graduate Students

It is a priority for CAGS that both the amount of support and the number of students supported must be increased to attract the best students and promote timely completion.
A variety of mechanisms could be used in combination:

Increasing the awards budgets of the federal granting agencies. As shown above, only a fraction of eligible students is currently being funded through these awards. Because of budget constraints, both CIHR and SSHRC do not fund master's students, even those in doctoral-stream programs. This creates a major hurdle to attracting the best students, as most Canadian universities now require them to be enrolled into a master's program before proceeding to the doctorate. If universities start admitting more students directly to the doctorate the pressures on the awards programs will increase in proportion. Since we believe that the number of doctoral students should be doubled, we also recommend that the number of students funded through direct award programs be doubled.

Increasing the number and value of research grants through which research assistantships are paid. Given the low proportion of students funded through direct awards, research grants are one of the major vehicles through which graduate students are supported, particularly in the natural and health sciences and in engineering. Therefore, it is imperative to increase the overall budget of the federal granting agencies to ensure that more students are encouraged to enrol and are supported adequately during their studies.

Providing greater tax relief on scholarships, research assistantships and other means of research students' support. There is a precedent for such a move. In the 1960s, scholarships from the federal granting agencies were partially tax-free. Easing the tax burden on newly recruited researchers is being used effectively in Quebec as a means to attract the best. Thus researchers recruited from outside the province see their tax reduced by 25% for 5 years. Similarly, all graduate students who receive competitive scholarship support from a provincial agency or from a university are forgiven the tax on these awards.

Improving student loan programs at the federal and provincial levels and adopting special measures to deal with the debt load of graduate students accumulated through their years of undergraduate studies and offering incentives for timely completion.

Improving the research and teaching environment at universities

Excellent students and excellent research require excellent research facilities and environment. To achieve these, the following additional measures must be taken:

Funding the indirect costs of the research. This has been recommended by AUCC and ACST, among others, as a way to build capacity and ensure that universities are relieved of the pressures of assuming these costs. This burden is detracting from the universities' ability to carry out their multiple missions, it has led to higher student/faculty ratios; it has impeded the appropriate maintenance of the physical plant and, generally, it has slowed down the pace of innovation. Funding indirect costs is an important element of capacity building and of improving the quality of education for students at both the undergraduate and graduate levels by, for example, providing better laboratory and library facilities, and by decreasing the student/faculty ratio.

Increasing research funding from federal sources. This will allow more researchers to carry out more research and to train more graduate students. Recently, the budgets of the federal granting agencies have been significantly increased. CAGS welcomes these increases, but agrees with AUCC that the new demands created by the projected increases in university faculty, the Canada Research Chairs Program, and the Canada Foundation for Innovation will create an enhanced demand on the budgets of the granting agencies. Furthermore, there is a funding gap between Canada and its key competitors that needs to be addressed if our ambition of achieving the "15th to 5th shift" is to be realized.

Dealing with the major problem of deferred maintenance. Training highly qualified graduates requires first-rate facilities. The Canadian Association of University Business Officers (CAUBO)[33] estimates that deferred maintenance of the physical plant of universities had reached 3.6 billion in 2000. AUCC views that: "*Crumbling campus infrastructure is a major impediment to universities' efforts to recruit the 30,000 new faculty members who will be needed over the next decade. …without proper investments in the necessary infrastructure, the 25 percent increase in undergraduate enrolment expected by 2010 coupled with the need to enhance graduate student placements will stretch available resources beyond their breaking point. This calls into question universities' capacity to provide higher education to the greatest possible number of qualified students and to mount the graduate programs the innovation agenda will need*." CAGS concurs. Secure and modern research facilities in which to train graduate students are essential if our graduates are to bring the appropriate skills to their future employment.

Appendix 1

Data sources for Figures:

Figs 1 & 2	Association of Universities and Colleges of Canada (AUCC) from Statistics Canada data
Fig. 3	AUCC
Figs 4, 5 & 6	CAGS Statistical Reports from Statistics Canada data
Fig. 7	CAGS Statistical Reports from Statistics Canada data for enrolments; census data for population
Fig. 8	CAGS Statistical Reports from Statistics Canada data for enrolments; federal granting agencies web sites for awards

Endnotes

[1] The OECD defines human capital as "the knowledge, skills, competences and other attributes embodied in individuals that are relevant to economic activity." Duration of schooling and levels of qualification are the standard measures. (cf: *Human Capital Investment: An International Comparis*on, 1997, pp. 17-67).

[2] 2001 Speech from the Throne http://www.sft-ddt.gc.ca/sftddt_e.htm

[3] *Sources: population data (in 000) from: http://www.undp.org/popin/wdtrends/p98/fp98toc.htm; enrolment data (in 000) from: USA,: Digest of Education Statistics, Table 180. NB data for undergraduates and first-professional categories have been combined; Canada, Source: AUCC using data from Statistics Canada, UK; Higher Education Statistical Agency data.*

[4] The Council on Competitiveness: *US Competitiveness 2001: Strengths, Vulnerabilities and Long-term Priorities* http://www.compete.org/bookstore/book_index.html

[5] ACST Expert Panel on Skills*: Stepping Up: Skills and Opportunities in the Knowledge Economy.* http://acst-ccst.gc.ca/acst/skills/finalrepdocs/acst-s.pdf

[6] Robert Allen: *Education and Technological Revolutions: The Role of the Social Sciences and the Humanities in the Knowledge Based Economy*. A report prepared for the SSHRC, November 1999.

[7] David Peterson: *Canadian Skills Shortage*. Speech delivered to the Canadian-Italian Business and Professional Association (Ottawa chapter) http://www.cata.ca/cata/advocacy/skills_speech.cfm February 2001.

[8] http://www.cst.gouv.qc.ca/ftp/InnovSSH.pdf Innovation sociale et innovation technologique: L'apport de la recherche en sciences sociales et humaines.

[9] Faculty numbers (all ranks) dropped from 37220 in 1992 to 33660 in 1998.

[10] See appendix 1 for data sources for all figures.

[11] L. Elliot: *Revitalizing universities through faculty renewal.* AUCC Research File, March 2001

[12] AUCC: *Improving the quality of life and economic prosperity of Canadians: The crucial contribution of Canada's universities*. A brief submitted to the House of Commons Standing Committee on Finance, August 2001. http://www.aucc.ca/en/publicindex.html

[13] L. Elliot: Op.cit.

[14] For the entire Issue Brief, see: http://www.nsf.gov/sbe/srs/issuebrf/ib.htm #NSF 01-332

[15] R. Giroux: *The Changing Face of Academe: The Challenge of Graduate Studies in a University in Transition.* Speech to the Canadian Association of Graduate Studies, Winnipeg, October 2000 http://www.uottawa.ca/associations/cags-aces/

[16] H. O'Heron: Private communication

[17] Paul M. Romer: *Fueling High-Tech Industries*. Council on Competitiveness Summit 2001, http://www.compete.org/summit/index.html

[18] C.F. Conrad, J.G. Haworth, S.B. Millar: *A Silent Success Master's Education in the United States*. The Johns Hopkins University Press, 1993.

[19] Fernand Martin & Marc Trudeau: *The Economic Impact of University Research*. February 1998. http://www.aucc.ca/en/publicindex.html

[20] For the Record, Vol 4, # 1, February 2001. http://www.cou.on.ca/publications/RECORD/For%20the%20Record%20(February%202001).pdf

[21] The financial data on which Table 2 is based include information provided by the universities on support available to their students from all sources (external awards, internal awards, need-based funding, and research and teaching assistantships) excluding student loans programs. Data on enrolments were obtained from the latest CAGS statistical report.

[22] Final Report of the Task Force on Graduate Student Financial Support May 31, 2000. http://www.utoronto.ca/provost/gradfinanc/FinalMay2000/finalMay.htm

[23] These % include OISE/UT students, but exclude Faculty of Medicine departments.

[24] CNS/FEUQ *Les sources et les modes de financement des étudiants aux cycles supérieurs. Étude*. October 2001. http://www.feuq.qc.ca/

[25] Including student loans, work outside the university, family contributions, etc.

[26] The federal granting agencies are Canadian Institutes for Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Social Sciences and Humanities Research Council of Canada (SSHRC).

[27] In 2001, CIHR also introduced a Training Program Grant scheme, which will provide block grants to excellent, innovative and transdisciplinary training programs. The grant can be used to recruit and support trainees at any stage of their research careers, as well as to develop and disseminate innovative research training materials and methods. The first competition is currently in progress. Each Centre will have a budget ca. $300,000. This initiative will see the number of competitive awards increased from a total of 760 to almost 1400.

[28] Data from the individual federal granting agencies' web sites.

[29] Students may reapply in subsequent years.

[30] The allocation of training awards among the agencies may change once the reorganization is complete.

[31] AUCC: *Enhancing Innovation Capacity in Canadian Universities*, May 2001. http://www.aucc.ca/en/publicindex.html

[32] ACST: *Creating a Sustainable University Research Environment in Canada: The Role of the Indirect Costs of*

Federally Sponsored Research, July 2001. http://acst-ccst.gc.ca/home_f.html

[33] CAUBO: *A Point of No Return: The Urgent Need for Infrastructure Renewal at Canadian Universities*, April 2000. http://www.caubo.ca/index2.html