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Canada Graduate Scholarships (CGS) Program and Related Programs Review

Final Report for the Natural Sciences and Engineering Research Council's (NSERC) Related Programs:

Postgraduate (PGS) and Industrial Postgraduate (IPS) Scholarships

Prepared for

The Natural Sciences and Engineering Research Council

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This evaluation study was conducted independently by R.A. Malatest and Associates Ltd. and Circum Network Inc. The contents of this report reflect the findings and conclusions of the evaluation study team, and not necessarily those of the Natural Sciences and Engineering Research Council of Canada.

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Executive Summary

The present evaluation study of the Natural Sciences and Engineering Research Council of Canada's (NSERC) Postgraduate Scholarships (PGS) and Industrial Postgraduate Scholarship (IPS) programs examines indicators of program success at both the Master's and Doctoral levels. The main data sources employed in this evaluation are administrative data and the results of a survey of postgraduate students conducted in February and March 2008.

This analysis was undertaken as part of a more general mandate to evaluate the Canada Graduate Scholarships (CGS) program and related programs at the three granting agencies involved in the program: NSERC, the Canadian Institutes of Health Research (CIHR), and the Social Sciences and Humanities Research Council of Canada (SSHRC).

As both PGS and CGS have very similar program logic models, the current study examines many of the same evaluation questions and follows the same general evaluation structure as the CGS evaluation. The main focus of the present report is NSERC's PGS Program, however, data was also gathered for NSERC's Industrial Postgraduate scholarships (IPS). Thus, while the main comparisons examined are between the data for PGS recipients as compared to non-recipients (students who did not receive either a PGS, IPS or CGS award), given the similarity of the programs, information relating to CGS and IPS awards is presented and discussed in this report as well.

Evaluation Issues

An evaluation framework[1] was produced in March 2007. It identified the following evaluation issues.

Relevance: Is there a continuing need for the PGS program? Does the Program continue to be consistent with agency and government-wide priorities?

Design and delivery: To what extent is the Program appropriately designed to achieve its objectives? What changes to the Program design would make it more relevant and effective? Is the mix of direct and indirect sources of support for graduate students optimal? What overlapping issues exist between the PGS and CGS programs, such as: linkages across programs, potential overlap/redundancies and efficiencies?

Success: To what extent has the Program achieved its intended outcomes? What are the overall incremental program impacts? To what extent can outcomes be attributed in whole or in part to the PGS Program and/or other scholarship programs? What are the comparative impacts for graduate students funded through PGS, IPS, and CGS programs, and students who rely on other means of support? Have the Program's activities had any unintended impacts (positive or negative)?

Program cost-effectiveness: Is the Program delivered in a cost-effective manner? Are there more cost-effective ways to deliver the Program under the existing model? Are there alternative, more cost-effective programs/models that could achieve the same objectives?

Evaluation approach

This evaluation is based on a mixture of qualitative evidence (e.g., program documentation, key informant interviews, and a review of other programs) and quantitative evidence (i.e., administrative data and a large survey of program applicants) where the latter was given most attention, and on the comparison of relevant results obtained by four groups of students, some of whom were involved in the programs and some who were not.

[1] *Evaluation Framework for the Canada Graduate Scholarships Program (CGS) and Related Programs*, prepared by EKOS Research Associates Inc., dated March 21, 2007.

Available documentation was analysed and in-depth interviews were conducted with some 33 individuals to factor into aspects of this evaluation that could not be captured in the student survey.

The student survey benefits from a large sample size of 2,931 respondents and a reasonably good response rate, considering the groups that were targeted. Respondents were shown to have similar relevant characteristics to the non-respondent group, thus the respondent population can be shown to be representative. Similarly, respondents from the sub-sample subjected to telephone follow-ups were also shown to be comparable to respondents who were not subjected to this type of follow-up.

A large portion of the analysis is based on a comparison of recipients of CGS awards, PGS awards, IPS awards and students who applied for an award but did not receive one. These four groups of students are not strictly equivalent: one was considered worthy of the highest honour (a CGS scholarship); another one was identified as highly deserving (and received a PGS scholarship); another was similarly identified as highly deserving but was also sponsored through industry collaboration (i.e., they received and IPS scholarship with partial funding from their industry sponsor); and the fourth group, while of high calibre (otherwise, universities would not have selected them for the competition), were not awarded a scholarship. However, they all emerge from the same group of "best students"; in fact, with the exception of IPS, only students pre-qualified by universities are allowed to apply for graduate awards. This is a great advantage to this evaluation: because students in the four groups are similar, the difference among them is primarily whether they received an award and which award they received; therefore, differences in how they proceed through graduate studies can be more readily attributed to this key difference. Since there could possibly be other differences among the four groups of students, we implemented multivariate statistical control in order to focus the comparison on the impacts of the scholarships. This way, we controlled for other variables that could possibly explain differences observed in study progress among groups; after these statistical controls, if a difference persists among groups, it can probably be attributed to the effects of the programs.

Notwithstanding the strength of the design and of the data collection, there were some limitations to the available data. Administrative data, captured as part of the CGS evaluation, were produced by three independent organizations, each with their own systems and procedures. While we strived to produce data on the same basis, some of the information produced might not be entirely comparable.

Some of the documentation is dated, even though the environment is characterised by rapid change; this is particularly true of macroscopic information relative to the academic and industrial environments. Also, the in-depth interviews did not necessarily allow the collection of evidence that can be cross-referenced against hard facts; in fact, such interviews are often needed where empirical evidence is not available.

The survey of students targeted the first beneficiaries of CGS awards (in 2004, 2005 and 2006) and PGS/IPS awardees and applicants from the same years. The relatively short time elapsed between these years and the survey period in 2008 may not have allowed for the materialization of some outcomes, such as degree completion — although the relative brevity of the delay was the same for all four treatment groups.

The framework of this evaluation was based on the premise that the scholarships were designed to impact the behaviour of the best students, to increase the likelihood that they will enrol in graduate studies, that they would complete these graduate studies and contribute to the pool of highly qualified personnel pursuing research-related careers in academia, industry or government. Therefore, to assess the performance of the program, this evaluation puts this logic to the test and compares study progress for students in receipt of program benefits to those not in receipt; specifically, those whose applications were pre-selected by their institution for an award and those who were not successful. Others have suggested that this is not the appropriate test to perform because, in their view, such a counterfactual comparison does not assess the impact of CGS, PGS and other such awards programs on the whole of the graduate student population, should the CGS or PGS awards cease to be a source of funding. It is important to note that while the design for the current evaluation was appropriate for the CGS program, it does not provide as complete a picture of impacts for the PGS program because it did not include a comparison with the broader student population.

Results and Recommendations

This evaluation study has reached a number of conclusions. Those concerning program effects are methodologically strong, thanks to the reliance on a quasi-experimental approach and on multivariate modelling. The evidence concerning issues dealing with program relevance, and design and delivery is softer and must be regarded with more prudence.

RELEVANCE

The evaluation generally supports the conclusion that there is a continuing need for NSERC scholarship programs such as PGS, IPS and CGS.

The first rationale for the relevance of the awards programs is that Highly Qualified Personnel (HQP) are in great demand not only in Canada but in numerous other competitor countries. Research indicates that nearly two out of three job openings in Canada in the next ten years will require post-secondary education. A number of secondary data sources cited in the evaluation underscore the considerable demand for HQP in both academic and industrial research environments. Canada ranks sixth in a list of developed countries with regard to the proportion of the population in the HQP category, this highlights the need for a continuous influx of new HQP. While some studies conducted a decade ago question the existence of "brain drain", this evaluation uncovered that almost one-third of doctoral award applicants who were not studying at the time they were surveyed resided abroad and that just over one-third of award applicants expected to move abroad to study or to start a career. Therefore, there is a risk of loss of highly qualified personnel to other countries. The extent of this risk is uncertain and it is possible that it is countered by influx of HQP from other countries. Nonetheless, it would stand to reason that action is necessary to attract graduate students to study in the natural sciences and engineering.

The second rationale for the relevance of the awards programs is that there is a financial barrier to access graduate studies. It appears that most graduate students belonging to the program target group do not amass a very large study-related debt. This evaluation has found that the debt load of unsuccessful applicants, regardless of completion status or current level of study, averaged about $9,900 for Master's students and about $12,200 for doctoral students. While not strictly comparable, the average debt on graduation for the general graduate student population is $22,800 for Masters' students and $25,600 for doctoral students according to the National Graduate Survey, Class of 2005 (Bayard and Greenlee, 2007). The unsuccessful NSERC award applicants appear to be quite successful at securing other sources of support, such as other excellence-based awards, teaching assistantships, and research assistantships. This is not surprising, however, considering the high calibre of this respondent group: all NSERC award applicants are pre-selected by their universities as high achieving students, and even those that are unsuccessful at obtaining an NSERC award would be excellent candidates for other awards and assistantship opportunities.

Still on the financial side, Master's level PGS awards were shown to increase total student revenue from all sources by about $2,300 compared to non-recipients (whereas the award value is approximately $17,500). At the doctorate level, PGS-D awards increase total revenue by $1,250 compared to non-recipients (for an award of $21,000), while CGS-D awards increase total revenue by $9,800 (for an award of $35,000). Thus, the main income-related effect of awards was to modify sources of financial support away from earned income. While many non-recipients also received other excellence-based awards, compared to NSERC award recipients, they tended to rely more on income from work for pay (and, to a lesser degree, on other sources of funding such as loans, stipends, and bursaries).

Award programs are associated with results that contribute to the overall objectives of HQP supply and research excellence:

- awards represent an incentive to enrol in graduate studies according to the recipients' self-assessment;
- awards increase slightly actual enrolment in graduate studies;
- awards increase recipients' recognition of the federal government's financial support to research training;
- awards increase Canada's ability to attract and retain experienced researchers (as measured in terms of increased desire to pursue a career in research or teaching and finding employment that relates to the student's field of study and/or requires a graduate degree);
- at the Doctorate level, awards increase recipients' involvement in core research activities;
- awards reduce recipients' reliance on paid income and recipients' study related debt;
- awards improve recipients' self-assessed prospects of getting a job in an area relevant to their studies.

In terms of consistency with government-wide priorities, the PGS, IPS, and CGS programs represent tangible examples of the Government of Canada's commitment to build on the country's Knowledge and People Advantages. With the creation of CGS in 2003 and additional funding brought about in 2007 and 2008, the Government of Canada has demonstrated that it makes the funding of graduate studies an important component of its innovation strategy. The strategy identifies that a key method of achieving the People Advantage is ensuring an adequate supply of HQP through federal government funding for scholarships.

All in all, the rationale for supporting access to graduate studies can be argued. Given the need to support the need for HQP, NSERC should maintain the PGS and IPS programs.

Recommendation 1 NSERC should maintain its nationally competitive, merit-based student award programs

PROGRAM SUCCESS

The logic of the PGS and related programs (IPS, CGS) is based on a cascade of short-term and longer-term effects that were presented in the umbrella logic model for Scholarship and Fellowship programs. The assessment of program success is based on the extent to which programs demonstrated net or incremental impacts relative to the defined control group - namely, individuals who applied for a scholarship, but who were not successful in obtaining one of the aforementioned awards.

It should be emphasized that the identification of what constitutes an appropriate control group is subject to some debate. In this context, the control group is those individuals recommended for an NSERC award by their post-secondary institution. In effect, this group should be viewed as being "high achievers" in their own right, and do not necessarily represent the broader cohort of Masters/doctoral students. When examining these impacts, this must be taken into account as the control group will share many of the same motivations and academic qualifications as those with awards (PGS, IPS, or CGS). Furthermore, many in the control group will have accessed significant funding from excellence-based awards available to them from other sources. If it were possible to construct an additional control group, namely all individuals interested in pursuing a Masters/Doctorate program, it is likely that there would be considerably different impacts identified than is the case using unsuccessful NSERC award applicants.

Expected Outcomes for which Awards have Positive Impacts

Awards (PGS or related awards alike) were associated with *positive outcomes* with regard to the following:

Increased enrolment in graduate studies by awards recipients.

Master' students in receipt of PGS awards were 10 percentage-points more likely than the no award group to enrol in their programs (98% as compared to 88%). (At the doctoral level, the results were also statistically significant but less indicative of a conclusive impact: award recipients were 4 percentage-points more likely to enrol than non-recipients with 97% of recipients enrolling as compared to 93% of non-recipients).

Increased incentives for students to enrol in graduate studies.

The impact of scholarships on incentives to enrol in graduate studies was measured by asking recipients for their self-assessment of this impact. Only students in receipt of an award were included in this validation. The possibility of receiving an award or actually receiving an award was an important incentive to enrol for more than 70% of recipients. Close to one half said the prestige associated with the scholarship was an incentive. (As these questions were only asked of recipients these results cannot technically be cited as 'impacts' of the award in comparison to non-recipients, as per the survey design; nonetheless, the awards were positive motivators for many recipients.)

Increased incentives for doctoral students to complete their studies.

At the doctorate level, recipients of PGS-D and CGS-D awards appear to be somewhat more likely to have completed their degree at the time of the survey than students who did not get an award (23% and 18% respectively compared to 13% of non-awardees). No statistically significant differences were observed for Master's students.

Increased recognition by the research community of the federal government's financial support for research training.

Only program applicants were canvassed about their views of the federal government's support of research training. Other members of the research community were not part of this assessment. Among award recipients, about 85% agreed that the federal government makes a significant contribution to supporting research training in Canada. Non-recipients were much less likely to share this view (a difference in opinion of more than 24 percentage-points between the PGS group and the no award group).

High-quality research, as well as increased ability to attract and retain experienced researchers.

Graduate students proved to be generally satisfied with their research environment. Findings of the research confirm that Master's students who received awards were somewhat more likely to score higher levels of satisfaction, whereas scores were more equivalent between doctoral awards recipients and non-recipients.

A little over one-half of students at both levels hold positions of teaching assistantships. This proportion was the same for non-recipients as for CGS, PGS, and IPS recipients. About one-quarter of students hold

research assistantships, which are slightly more common at the doctoral level. Awards recipients were less likely to hold research assistantships than non-recipients. This stands to reason given that NSERC award recipients are ineligible to receive research assistantships paid out from NSERC Discovery Grants. Research assistantships appear to be one of the important ways non-recipients fill the funding gap.

Overall, Master's students from all groups produced similar output for academic publications (including presentations, articles, and research papers). Doctoral students in receipt of PGS-D awards were no more likely than those with no award to contribute to such publications. It may be noted, however, that CGS-D recipients were more likely than others to contribute to academic publications.

Master's students who received either PGS or CGS awards and had since completed their degree were more likely than non-recipients to hold a job that required a Master's degree, and to hold a job that relates to their studies. Differences were less discernible amongst PhD graduates who were working. However, doctoral students in receipt of PGS awards were more likely to report that their experience during their studies has increased their desire to pursue a career in research or in teaching requiring their level of training.

Improved branding of Canada as a home of research excellence and Canadian universities as world-class research centres (limited indicators).

This evaluation offers limited evidence as to the improvement of the branding of Canada as a place of research excellence. The student survey confirmed that Master's PGS recipients averaged slightly more presentations (1.1 on average) at international conferences than non-recipients (0.8). At the doctoral level, award recipients produced more international presentations (3.0) than non-recipients (2.2).

Other Positive Impacts of NSERC Awards

The evidence shows clearly that NSERC awards have significant *positive impacts* other than those that comprised the CGS logic model on which this evaluation framework was based. Some of these impacts may be intended outcomes for PGS but not common to CGS, while others may be unintended impacts.

These impacts include:

- increasing student income,
- reducing the need to work for pay,

- reducing loan burdens,
- enhancing recipients' ability to study where they prefer (though not for IPS),
- increasing doctoral students' involvement in core research activities,
- increasing Master's students' involvement in conducting research in various environments,
- increasing intellectual skills development (self-assessed),
- improving employability (self-assessed) and academic marketability.

At the Master's level, PGS and CGS offer additional benefits that are very similar. At the doctoral level, PGS and CGS generally produced the same impacts in all areas outlined above except those associated with total income and working for pay. Since the value of the CGS-D award is 67% greater than regular scholarships, it is no surprise that CGS-D impacts students' finances and work for pay more so than PGS-D.

Fewer positive impacts were observed for IPS recipients at either level of study, as compared to the other two NSERC awards. There are two reasons for this: the smaller sample of IPS recipients included in the survey, (so fewer statistically significant results); and the unique nature of the IPS program. IPS recipients appear to have more industry-oriented outcomes as would be expected by the design of the program and fewer academically-oriented outcomes than their counterparts in the other groups examined (including the no award groups). Examining the results for IPS as a whole, one may conclude that a number of the impacts uniquely observed for IPS recipients are a product of the interests of IPS applicants and their exposure to industry partnerships through the program. For example, whereas IPS recipients are less likely to work in academic jobs or publish papers (and there may be less emphasis from supervisors to do so), conversely, IPS recipients are more likely to participate in research support activities, or indicate improved prospects of finding a job in a related area.

Expected Outcomes for which Awards have No Significant Impact

The evidence indicates that the NSERC award programs (PGS and related programs alike) had *no significant impact* on the following outcomes for the graduate cohort examined:

No measurable impact on increased total enrolment in graduate studies in Canada.

Enrolment in graduate studies has been steadily increasing since 2000. The CGS was introduced in 2003 and funded a substantial number of new scholarship recipients, but the research was unable to identify a spike upwards in total overall enrolment in graduate studies that might be associated with the introduction of additional the funding.

At the doctoral level, receipt of a PGS-D award results in only a 4 percentage-point increase, in enrolment rates, which is not substantial enough to conclude a positive effect. However, the impact is more appreciable at the Master's level (10 percentage points) as noted above.

No measurable impact on the proportion of students continuing to doctoral studies after a Master's degree.

Overall, close to six out of ten Master's students plan to go on to study at the PhD level, regardless of whether or not they received an NSERC award. Of note, IPS recipients are less likely to consider doctoral studies, but this may be attributed to the nature of the IPS program and that IPS recipients may have career goals that lie within industry, where a PhD may not be a requirement for employment (compared to academe). In any case, students tend to be committed to either continuing to a PhD or concluding their studies with an MSc at the time of enrolment in a Master's program.

No measurable impact on increased capacity to meet demand for HQP.

About eight in ten Master's students, and nine in ten doctoral students, think they are likely to pursue a career in research or teaching requiring their level of training. According to data from NSERC's career survey, 92% of award recipients (nine years after their award) indicated that their current employment involves research or teaching. Upwards of 90% of survey respondents for the current evaluation agreed that graduate studies are an important element of their career goals. Notwithstanding this high response from all students, no statistically significant differences were associated with receiving an NSERC award as compared to the no award group, with the exception that IPS recipients were less likely to express interest in pursuing a career in research or teaching (which may expected given the nature of the program). It should be noted that the strength of the evidence that could be collected to address this point is relatively weak: The effects of the funding on the NSE student body as a whole could not easily be measured in this evaluation. Nevertheless, even if this evaluation cannot provide proof that NSERC awards *increase* the capacity to meet the demand for HQP, it is plausible to argue that NSERC funds, at the very least, contribute to

maintaining an HQP capacity in Canada in the natural sciences and engineering disciplines.

No measurable impact on HQP holding (or expecting to hold) positions in the faculties of Canadian universities.

About two-thirds of Master's students and three-quarters of doctoral students expressed interest in employment in the University sector. Three-quarters of those who completed a PhD went on to pursue post-doctoral research, while one in twenty of students who completed a PhD were currently employed as faculty. However, similar to the findings related to the previous outcome, it appears that receipt of an award had no statistically significant impact on the desire to seek employment in the university sector when compared to the no award cohort. On the subject of the actual outcomes examined (as opposed to aspirations), it may be too early to draw definitive conclusions as to whether or not receipt of an NSERC award influences students transitions into faculty positions: Only 19% of doctoral award applicants had completed their PhD's at the time of the survey, although, as discussed in the data quality section earlier, the timing of the survey may not have allowed for the materialization of some outcomes, such as degree completion. The data was also not corrected for the current economic climate, which has lead to hiring freezes for academic faculty. This may have had an impact on the survey results.

COST-EFFECTIVENESS AND ALTERNATIVES

Although limited objective evidence could be garnered, based on an assessment of administrative costs this study found that the award programs are delivered in a cost-effective manner. Overall for the period covered by the evaluation, the ratio of administrative costs to awards was 4.5% and showed a decreasing trend (from 5.3% to 4.1%). Key informants noted that the role played by universities and those who volunteer on the review committees significantly reduce the overhead costs associated with delivery of the awards programs.

Granting agencies have limited levers that they can use to improve the supply of HQP; direct and indirect support appear to be the two available approaches. Merit-based scholarships are an example of direct support to students that give them both the recognition of having been through a national competition as well as some control and flexibility. Funds from research grants, research partnerships grants involving industry, and networks that are used by professors to support graduate students conducting research (which translate into stipends or possibly research assistantships) are all examples of indirect support.

The survey conducted for this evaluation included a small group of students who received stipend support. Initial multivariate analyses of the data for those who received more than $7500 in stipend support identified possible areas of positive effects of stipends for Master's students (continuing with doctoral study, publishing articles, presenting at conferences, intellectual skills development, student income), and for doctoral students (desire to pursue a degree in research or teaching, job prospects in a related area). However, due to the small sample sizes and the narrow parameters of the cohort surveyed (high-achieving NSERC award applicants with access to many types of support), these preliminary results cannot be considered conclusive.

Whether the best approach is to support academic excellence directly by awarding scholarships or indirectly through stipends paid from NSERC grants, or how to achieve the best balance between such funding mechanisms, is still open to debate. This study amassed little information on the appropriateness of the mix of direct and indirect sources of support for graduate students in the natural sciences and engineering domain. Students who did not receive NSERC awards were about twice as likely to receive support from stipends, but relied more heavily on other excellence based awards, research assistantships and teaching assistantships. Additional research on stipends and research assistantships would be required to better understand whether the mix of direct and indirect sources of support for students is optimal.

More research is recommended to better understand the outcomes of alternatives to awards such as stipends and research assistantships. Such research should be conducted with a broad sample of students, should be tailored to gather information on these types of indirect funding, but, for comparability, should assess some of the same measures examined in this evaluation of scholarship programs.

Recommendation 2:	*The Agencies should consider conducting additional research on the relative merits and impacts of direct and indirect methods of supporting students.*

DESIGN AND DELIVERY

The analysis of design and delivery issues did not identify any major concerns. Positive features of NSERC PGS include: the coverage at both Master's and Doctoral levels, the assessment criteria, the application review process and the efficiency of the management of the program. Areas of concern include: limited funding and the duration of the awards.

Stakeholders interviewed as part of the main CGS evaluation were generally of the view that the scholarship programs administered by NSERC and the other agencies were well designed and should be offered to both Master's and Doctoral students. Stakeholders commented on the quality of the assessment criteria and peer reviewing process, and noted that sharing the administration of the program results in cost efficiencies. A few stakeholders noted that some very qualified students do not receive awards due to the limited funding available.

Examining PGS in relation to CGS awards, key informants commented on the large value discrepancy between CGS and the regular agency awards at the Doctoral level. Additionally, this study demonstrates that, at the doctorate level, providing 67% more funding (the difference between the $35,000 CGS award and a typical $21,000 regular agency award) produces limited incremental impacts.

Most students who received awards indicated that they were satisfied with the program design features they were asked about. However, many consider the duration of the award too short. In fact, recipients are more satisfied with the money value of the awards than with their duration; in particular, Doctoral award recipients were markedly less likely than their Master's level counterparts to be satisfied with the duration of their funding. The average time to completion of a Master's degree is certainly longer than one year and that of a doctoral degree vastly exceeds three years (six years according to Gluszynski and Peters, 2005). Even, amongst the "high achievers" surveyed for this evaluation, Master's students who had already completed their degree took 27 months on average, while those who were still in progress estimated it would take them 34 months on average. Doctoral students completed in, or estimated their time to completion as, about 4 years. By contrast, PGS-M awards provide funding for 1 year only, and PGS-D awards provide funding for no more than 3 years.

To truly affect the duration of graduate studies, it is likely that a more sustained funding effort would be required. Of course, to increase the length of awards reduce the number of individuals who could be funded. An alternate balance might possibly be found between reducing the value of CGS awards and lengthening the period of student support for all awards.

Recommendation 3: NSERC should consider the possibility of setting the duration of a Master's award to two years and that of a doctoral award to four years.

A challenge in reporting on the impacts of NSERC's award programs was that the evaluation was conducted in conjunction with the CGS program: the evaluation approach and the reporting of the agency-specific programs flows in part from the CGS logic model. Although a number of the outcomes of the two logic models are similar, the program logic for PGS is depicted in an umbrella logic model for all of NSERC's scholarships and fellowships programs and there were sufficient differences in activities and intended outcomes from CGS to make reporting a challenge. Greater consistency between or a mapping of expected outcomes of the agency specific programs and the CGS program would have facilitated the reporting process, and clarified the respective objectives of the programs.

In addition, based on the issues in the evaluation framework it appeared that a number of other impacts of NSERC awards, and the question of the balance of direct versus indirect support, was of interest. However, these impacts were not found in either of the logic models, nor were the expected outcomes of indirect forms of support modeled; the umbrella scholarships and fellowships logic model does not depict indirect support for students (although not surprisingly as it is not a funding vehicle of these programs).
If NSERC considers it important to assess the impacts student support (both direct and indirect) collectively, then these two forms of support should be modeled jointly and their respective expected results articulated. While the umbrella model could be retained, it would also be of use to identify the specific contributions of each of the direct forms of support. Findings relating to program success from this and the CGS evaluations should be considered during any revisions of the logic models.

Recommendation 4:	*NSERC should revisit its umbrella logic model for its Scholarships and Fellowships programs, mapping program specific outcomes and modeling indirect forms of support for students as well.*

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Abbreviations

CAGS ..... Canadian Association for Graduate Studies
CGS ..... Canada Graduate Scholarships
CGS-D ..... Doctorate Canada Graduate Scholarships
CGS-M ..... Master's Canada Graduate Scholarships
CIHR ..... Canadian Institutes of Health Research
DFP ..... SSHRC Doctoral Fellowships Program
DRA ..... CIHR Doctoral Research Awards
HQP ..... highly qualified personnel
IPS ..... NSERC Industrial Postgraduate Scholarships
IPS-1 ..... NSERC Master's Industrial Postgraduate Scholarships
IPS-2 ..... NSERC Doctorate Industrial Postgraduate Scholarships
OECD ..... Organization for Economic Cooperation and Development
PGS ..... NSERC Postgraduate Scholarships
PGS-D ..... NSERC Doctorate Postgraduate Scholarships
PGS-M ..... NSERC Master's Postgraduate Scholarships
NSERC .. Natural Sciences and Engineering Research Council of Canada
S&F ..... NSERC Scholarships and Fellowships Program
SSHRC ..... Social Sciences and Humanities Research Council of Canada

Chapter 1: INTRODUCTION

The present evaluation study of the Natural Sciences and Engineering Research Council of Canada's (NSERC) Postgraduate Scholarship (PGS) and Industrial Postgraduate Scholarship (IPS) programs examines indicators of program success at both the Master's and Doctoral levels. The main data sources employed in this evaluation are administrative data and the results of a survey of postgraduate students conducted in February and March 2008.

This analysis was undertaken as part of a more general mandate to evaluate the Canada Graduate Scholarships (CGS) program and related programs at the three granting agencies involved in the program: NSERC, the Canadian Institutes of Health Research (CIHR), and the Social Sciences and Humanities Research Council of Canada (SSHRC).

An evaluation framework[2] completed in March 2007 identified a number of informational requirements for the CGS evaluation and argued[3] that the CGS program should be evaluated in tandem with the other granting agency student award programs, which include NSERC's PGS Program, CIHR's Doctoral Research Awards (DRA), and the SSHRC's Doctoral Fellowships. The PGS and CGS Programs administered by each agency draw from the same pool of applicants and are managed in parallel.

2 *Evaluation Framework for the Canada Graduate Scholarships Program (CGS) and Related Programs*, prepared by EKOS Research Associates Inc., dated March 21, 2007.

3 From this study Terms of Reference: "The agencies decided that it would be advantageous to simultaneously undertake an evaluation of CGS and similar agency programs for the following reasons: a) these programs serve as the delivery mechanism for the CGS at the doctoral level for all three agencies; b) combining the evaluation of CGS with evaluations of agency specific programs maximizes the agencies' time and resources; c) agency specific scholarship programs are the most logical comparison group for CGS, and a coordinated approach ensures that they are surveyed only once, d) agency specific programs have existed for many years thus outcomes of the programs will be more readily accessible, and could provide benchmarks for further evaluations of CGS."

The mandate given to the evaluation team was "the actual conduct of the CGS evaluation as well as the evaluation of each agency's nearest equivalent program as described above." (*Request for Proposal, June 2007*). The main work of the CGS evaluation was undertaken between July 2007 and May 2008, including the student survey on which much of this NSERC PGS evaluation relies. The design of the CGS evaluation was based substantially on comparison between the data for CGS recipients and two control groups: PGS recipients and unsuccessful applicants.

As both PGS and CGS have a very similar program logic, the current study examines many of the same evaluation questions and follows the same general evaluation structure as the CGS evaluation. The main focus of the present study is an evaluation of NSERC's PGS Program. However, data was also gathered for NSERC's related Industrial Postgraduate scholarships (IPS), and it was of interest to NSERC to see the CGS statistics for reference. Thus, while the main comparisons examined are between the data for PGS recipients as compared to non-recipients (students who did not receive either a PGS, IPS or CGS award), given the similarity of the programs, information relating to CGS and IPS awards is presented and discussed in this report as well.

This document is structured as follows:

Chapter 2 presents a description of the programs, including an overview of program activities, outputs and outcomes.

Chapter 3 of this report describes the evaluation issues, the study approach, and methodology.

Chapters 4 to 7 deal with the study issues: program relevance, design and delivery, success, and cost-effectiveness.

Chapter 8 concludes the study with overall findings and observations.

Chapter 2: PROGRAM DESCRIPTION

This chapter of the evaluation report begins with an overview of NSERC's objectives, history, and broad program scope. NSERC scholarship programs are then described in more detail. The chapter concludes with a discussion of the inputs, outputs, activities, and intended outcomes of the PGS Program.

1. NSERC Objectives and Programs

Natural Sciences and Engineering Research Council (NSERC). NSERC was established on May 1st, 1978 and is the national instrument for making strategic investments in Canada's capability in science and technology. NSERC is a separate employer of the Government of Canada, reporting to Parliament through the Minister of Industry. It is governed by a president and a council of 21 distinguished members selected from the private and public sectors, and universities.

The Council supports both basic university research through discovery grants and project research through partnerships among universities, governments and the private sector, as well as the advanced training of highly qualified people.

Objective. NSERC's objective is to advance Canada's prosperity and high quality of life by supporting the creation and transfer of knowledge in

the natural sciences and engineering in Canada, and by ensuring people are trained to create and use that knowledge[4].

Program Delivery and Administration. NSERC has an annual budget of approximately $900 million. Through its programs, NSERC helps to build Canada's capabilities in science and technology, and supports innovation that drives the economy.

NSERC administers and delivers funds and programs in collaboration with a number of other agencies. The Council's research partnership agreements with the NRC, the Department of National Defence (DND), Agriculture and Agri-Food Canada (AAFC), Natural Resources Canada (NRCan), and the Social Sciences and Humanities Research Council of Canada (SSHRC) create synergy between the private sector, researchers in universities, and federal departments and agencies. Other programs, such as Strategic Project Grants, also encourage collaboration between government, the private sector and university scientists.

NSERC also has close ties with SSHRC and CIHR, which allows the three granting agencies to develop effective and consistent policies in areas such as ethics in research and ethical conduct for research involving humans. Furthermore, the three agencies also jointly administer funds for the Canada Research Chairs, Canada Graduate Scholarships, Indirect Costs, and Networks of Centres of Excellence, in which Industry Canada is also a partner Franklin Gothic Book[5].

Overview of NSERC Programs[6]. Each year, NSERC invests in programs in three core areas: people, discovery, and innovation. *People Programs* are investments in people through scholarship and fellowship programs for student researchers, from the undergraduate to the postdoctoral level. *Discovery Programs* support the discovery process by providing funds through Discovery Grants for excellent university-based researchers to conduct basic research in fields within the Natural Sciences and Engineering (NSE). *Innovation Programs* support project-based research involving partnerships with industry and government.

Approximately 7,500 students and post-doctoral fellows receive direct support through scholarship and fellowship programs. Furthermore, an estimated 10,000 additional students receive indirect support through the grants and partnership programs, for example, professors may hire graduate students using funds from their discovery programs.

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4 The Natural Sciences and Engineering Research Council: Results-based Management and Accountability Framework, February 2004

5 http://innovation.gc.ca/gol/innovation/site.nsf/en/in04842.html

6 http://innovation.gc.ca/gol/innovation/site.nsf/en/in04842.html

2. Post-Graduate Scholarship Programs.

NSERC offers a number of programs at the masters, doctoral, and post-doctoral levels to support learning and research. Of these, NSERC's PGS program is the main focus of this evaluation report, while information on the parallel CGS and IPS programs are also reported for reference.

In 2007/08, $93.6 million, or 33.3% of the *People Programs* budget, was allocated to post-graduate scholarship funding.

Postgraduate Scholarships (PGS-M, PGS-D). The NSERC Postgraduate Scholarships (PGS) provide financial support to high-calibre scholars who are engaged in a master's or doctoral program in the natural sciences or engineering. The support provided by these awards allows funded students to fully concentrate on their studies and to seek out the best research mentors in their chosen fields.

A major objective of these awards is to assist in the training of highly qualified scientists and engineers, and by doing so, ensure a reliable supply of highly qualified personnel to meet the needs of Canada's knowledge economy.

The value of a PGS Master's (PGS-M) award for students in their first or second year of graduate studies is $17,300 per year, and scholarship support is usually for one year. The value of a PGS Doctoral (PGS-D) award for students enrolled in a PhD program in their second, third, fourth or fifth year of graduate studies is $21,000 per year. Scholarship support is for either two or three years.

Applications are evaluated on the basis of merit (rewarding excellence), and not on financial need. Evaluations are made on the basis of various criteria relating to: academic excellence (50% weighting for Master's; 30% weighting for Doctoral); research ability or potential (30% for Master's; 50% for Doctoral); communication, interpersonal and leadership abilities (20% for both Master's and Doctoral); and professional and relevant extracurricular activities. PGS awards are usually awarded for study at Canadian universities, however, each year, NSERC approves a limited number of scholarships for tenure at universities outside of Canada.

Industrial Post-Graduate Scholarships (IPS-1, IPS-2). NSERC also administers a type of postgraduate scholarship called the Industrial Postgraduate Scholarship (IPS), at both the Master's and doctoral levels, which are offered in partnership with eligible organizations. The scholarship is intended to allow highly qualified natural sciences and engineering students to gain research experience in industry while

pursuing their studies. It is hoped that this research experience will encourage scholars to pursue research careers in industry.

The IPS is an award of $15,000 per year, with at least an additional $6,000 from a sponsoring company. The program provides up to two years of support at the Master's level or two to three years of support at the PhD level. The IPS program requires that students spend a minimum of 20% of their time at their sponsoring organization working on activities related to their thesis project

IPS recipients are not the main focus of the analysis in this report, although some comparisons between PGS and IPS may be made for certain issues related to the differences between the programs.

Canada Graduate Scholarships (CGS-M, CGS-D). The CGS Program was created in 2003 to provide financial support to exceptional students pursuing masters or doctoral studies at a Canadian university. One of the objectives of the CGS is, through the training of highly qualified scientists and engineers, to help ensure a reliable supply of highly qualified personnel (HQP) to meet the needs of Canada's knowledge economy. This objective is consistent with the objectives of the NSERC PGS, although there are some differences between the two programs.

NSERC's Canada Graduate Scholarships (CGS) are offered to the top-ranked applicants in the PGS competition, based on the recommendations of the Scholarships and Fellowships Selection Committees.

The value of the CGS-M award for students at the Master's level is for up to $17,500 per year, and the value of the CGS-D award for students at the Doctoral level is for up to $35,000 per year at the doctoral level. While the Master's level CGS-M and PGS-M awards are of almost the same value, at the doctoral level, CGS-D awards are considerably larger than PGS-D at $21,000 (See Exhibit 2.1).

CGS awards are administered by NSERC, CIHR, and SSHRC, alongside each agency's own PGS awards and through the same program delivery mechanisms. At NSERC, the Program is branded as the Alexander Graham Bell CGS Program. In 2007-08, the plan was for 800 CGS-M and 800 CGS-D awards, while 746 CGS-M awards and 676 CGS-D awards were given out. This is the greatest number of awards given out in the program's history.

CGS is branded as a very prestigious award. This is intended to distinguish the Program from the other scholarships provided by the granting agencies, and to provide an additional incentive for students to enter and remain in graduate studies. That is, by awarding scholarships

to a larger number of students and by making those awards financially attractive, the Program aims to improve the attractiveness of pursuing graduate studies in Canada relative to the immediate financial reward of employment or the attractiveness of financial packages offered by foreign universities. The program is intended to support the government's goal to increase Canada's ranking in R & D investment per capita from 14th to among the top five, by increasing the number of highly qualified R & D employees, including a higher proportion with advanced degrees. In 2008, the federal government added to the CGS program a new $25 million, two-year investment to establish a new CGS award, the Vanier Scholarship, for top Canadian and international doctoral students.

Similarities Between Scholarship Programs. A common application process is used to apply for NSERC's PGS and CGS awards. The PGS and CGS awards may differ in perceived prestige (and in value at the doctoral level), but are also quite similar in terms of eligibility requirements.

Exhibit 2.1 outlines the basic parameters of the scholarship Programs offered through NSERC for Master's and Doctoral students. It shows that the benefits from the PGS scholarships are somewhat smaller than the CGS program at the doctoral level, but that, at the Master's level the benefits for PGS and CGS programs are similar.

EXHIBIT 2.1
NSERC Postgraduate Level Scholarships - Program Parameters

	PGS	IPS	CGS
MASTERS			
Name	PGS-M	IPS-1	CGS-M
Duration (years)	1[(a)]	1 to 2	1
Annual value ($)	17,300	21,000[(b)]	17,500
DOCTORATE			
Name	PGS-D	IPS-2	CGS-P
Duration	2 to 3	2 to 3	2 to 3
Annual value ($)	21,000	21,000[(b)]	35,000

Source: *Evaluation Framework*, March 2007; NSERC website.
[(a)] During the period of this evaluation study, the maximum number of years of funding for PGS-M recipients changed from 2 years to 1 year.
[(b)] IPS: $15,000 from NSERC and at minimum $6,000 from a sponsoring company

Common eligibility requirements for these scholarship programs include:

- Canadian citizenship or permanent residence;
- Possession of a degree in science or engineering from a university whose standing is acceptable to NSERC (with degrees in other fields of studies accepted at NSERC's discretion);

- Intent to pursue in the following year full time graduate studies and research in the level applied for in one of the areas of the natural sciences or engineering supported by NSERC;
- First class average (a grade of "A-") in each of the last two completed years of study;
- If applying at the Master's level, completion of less than 12 months in the degree program for which funding is requested;
- If applying at the doctoral level, completion of less than 24 months in the PhD program (or 36 months if direct entry into PhD) for which funding is requested; and
- Not eligible to receive scholarship in qualifying year of study.

NSERC scholarship support is limited to a maximum of four years full-time-equivalent at the graduate level, through PGS, IPS, CGS, or combination thereof, with no more than 24 months at the Master's level, and no more than 36 months at the doctoral level.

Other funding may also be available to recipients of these post-graduate scholarships. Graduate students in receipt of PGS or CGS may also receive Postgraduate Supplements. These supplements provide students engaged in certain fields of study with the opportunity to receive additional funds from other organizations.

SSHRC and CIHR administer similar post-graduate scholarship programs for students in their relevant fields of study. Like NSERC, both granting agencies offer CGS awards at both the Master's and Doctoral levels. However, NSERC is differentiated from these other agencies in that the two agencies administer their own PGS awards at the Doctoral level only, whereas NSERC awards PGS at both the Master's and Doctoral levels.

While the main focus of this report is on NSERC's PGS program, given the similarity of the PGS, CGS, and IPS programs, research data for both the NSERC-administered PGS, CGS, and IPS awards are presented side by side for reference.

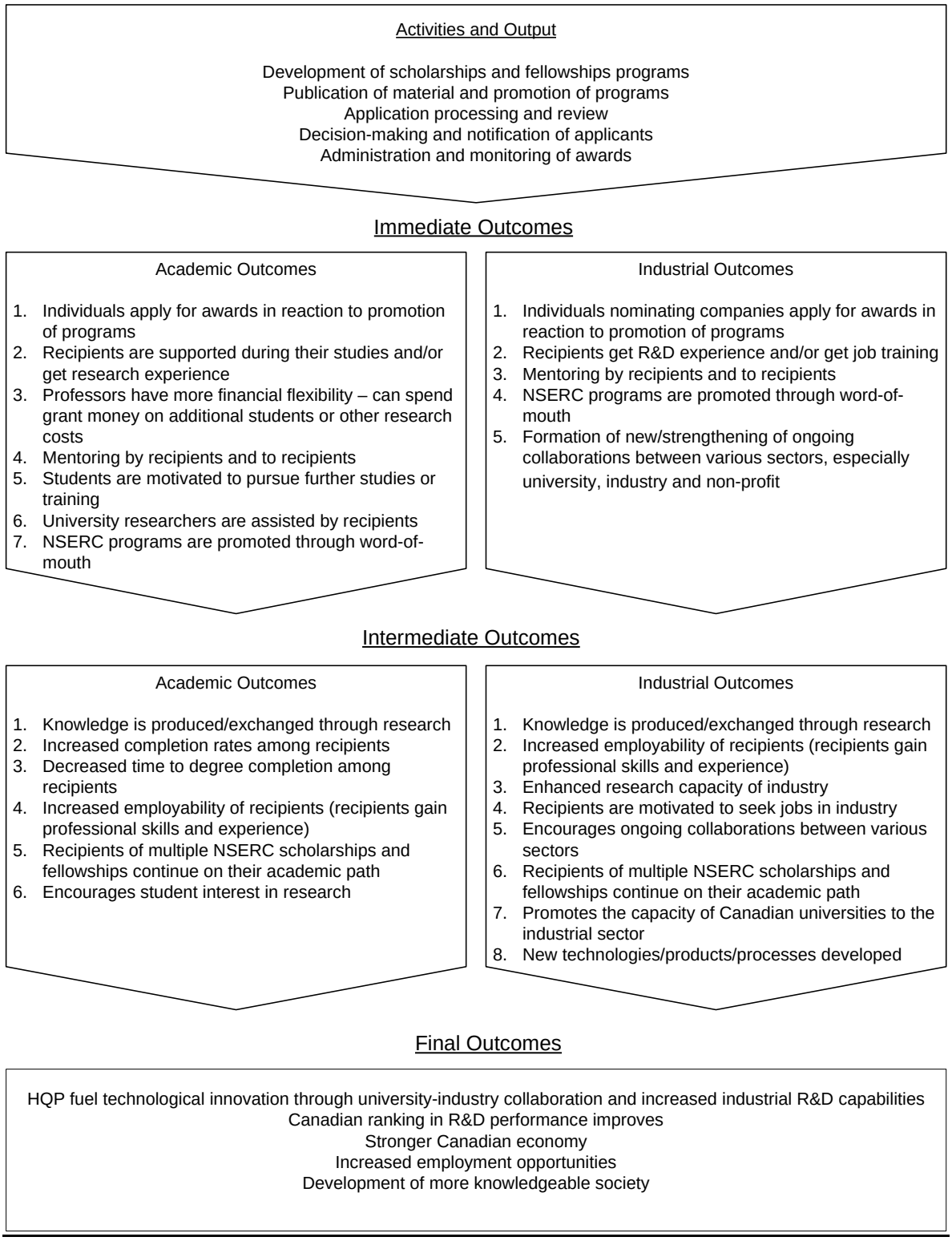
Readers are referred to the main report of the *2008 Canada Graduate Scholarships (CGS) Program and Related Programs Review* for the evaluation of the CGS program against its own program objectives, some of which are specific to the federal goals for the CGS.

3. Program Logic Models

S&F Logic Model. Exhibit 2.2 (following page) presents the umbrella logic model under which the PGS and IPS programs operate, as well as the other scholarship and fellowship programs for which NSERC is responsible.

The inputs, activities, outputs, and intended outcomes of the PGS are described in more detail below. It may be noted that the program logic model for the CGS is very similar to that of the scholarship and fellowship programs, although there are some differences in activities and intended outcomes.

Exhibit 2.2: Umbrella Logic Model for NSERC Scholarships and Fellowships Programs



***Inputs*.** Exhibit 2.3 outlines NSERC agency expenditures and scholarship funding for 2007.

EXHIBIT 2.3
NSERC Program Inputs

2007-2008 Expenditures	(M)
Total Agency expenditures	$969.6
Support for Students and Fellows	$131.6
PGS	$50.3
IPS	5.9
CGS	$37.3
Source: administrative data	

Activities. The PGS and CGS Programs are managed in parallel, with many program activities shared across programs and resourced from the same operating budgets. NSERC is the main deliverer of its postgraduate scholarship Programs, although universities play an important role. The activities and outputs are entirely within the control of NSERC staff, and the managers of the S&F programs are directly accountable for them.

Key activities in relation to the PGS and the other scholarship Programs are as follows:

- ***Administration of the Program.*** NSERC is responsible for the administration of the competitions (setting application deadlines and selection procedures, calculating the number of awards possible within budget) and day-to-day management of the Programs. Competitions are held annually for the scholarships to be funded. Applications are reviewed by an arms' length and peer reviewed assessment of applications by the Scholarships and Fellowships Selection Committee. The committee is an expert panel comprised of researchers with experience supervising graduate students. In addition, NSERC is responsible for ongoing performance monitoring of the Programs.

- ***Promotion of the Program.*** Program promotion includes various internal and external communications activities designed to make students and universities aware of the existence of the scholarship Program, competition procedures, and deadlines.

- ***Management and oversight of applications, scholarship funds and research.*** The universities have an important role as co-deliverers of the Programs. Postgraduate scholarship awards are not paid directly to students; instead, they are paid to recipient institutions. The recipient institutions administer the scholarship

accounts and, where appropriate, the research allowance accounts on NSERC's behalf. In addition to administering the scholarships, the recipient institution's administrators advise graduate students on program policies and procedures, screen applications, oversee the conduct of research and use of scholarship funds, and manage reporting systems, all in close cooperation with NSERC. Much of this work, and the liaison with NSERC, is handled by each university's graduate studies office in collaboration with the relevant academic departments. The cost of providing these services is borne by the institutions.

Key responsibilities of the universities in administering NSERC PGS and CGS awards are to:

- rank each Master's and Doctoral scholarship in eight broad discipline categories[7];
- decide the distribution of applicants by discipline and level to fill their NSERC quota;
- submit to NSERC the lists of the ranked applicants recommended;
- verify that the successful applicants meet all of the conditions of the award;
- pay students their awards according to the university's payment schedule;
- administer an annual progress report on NSERC's behalf;
- and issue T4a tax forms to students.

Exhibit 2.4 reports the number of applications received with regard to NSERC's postgraduate level scholarship programs. There is no particular application process specific to PGS or to CGS, as both programs are managed in tandem.

EXHIBIT 2.4
Number of applications to PGS, IPS and CGS Programs

	2003-04	2004-05	2005-06	2006-07	2007-08
MASTERS	1757	1717	1779	1747	1639
DOCTORATE	1086	1248	1582	1571	1496
Source: administrative data					

***Outputs*.** Outputs refer to the tangible products, goods and services that are produced by the Program activities.

- **Funded scholarships.** As a result of the peer-reviewed competitions, new PGS recipients are selected and funded by NSERC on an annual basis.

[7] The eight broad discipline categories are: engineering; electrical engineering and computing sciences; mathematical sciences; physics and astronomy; chemistry; earth sciences and ecology; cellular and molecular biology; and life sciences and psychology.

- **Communications products.** Communications and promotional materials include news releases and Web sites.
- **Reports on awards.** Annual reports, which are submitted by each of the agencies, constitute an important source of data for input into the performance-based management system. In addition, periodic evaluation reports will be produced. PGS recipients also submit annual progress reports at their university.

Exhibit 2.5 reports the number of PGS and CGS scholarships awarded over the past five years.

EXHIBIT 2.5
Number of PGS and CGS scholarship awards

Type	2003-04	2004-05	2005-06	2006-07	2007-08
MASTERS					
PGS-M	852	738	543	338	466
CGS-M	134	345	568	642	588
DOCTORATE					
PGS-D	571	578	765	573	677
CGS-D	143	148	280	295	216
Source: administrative data					

Immediate Outcomes. Immediate outcomes refer to the external consequences (e.g., changes, benefits) attributed to the Program as a direct result of an activity taking place or an output being produced. Immediate outcomes take place over the short term.

NSERC S&F Programs have two distinct categories of outcomes. The first one refers to all *academic outcomes* that occur as a direct result of the activities undertaken by program staff. These revolve mostly around the scholarships and fellowships held in universities. The second one refers to all *industrial outcomes*. These focus mainly on the scholarships and fellowships held in industry. Some immediate outcomes are common to both the academic and industrial contexts. It should be noted that NSERC staff has no direct control over immediate outcomes; rather they have some measure of influence over their occurrence.

There are a number of academic (A) and industrial (I) immediate outcomes NSERC's post-graduate awards are intended to produce.

- Individuals apply for awards in reaction to the promotion of programs (A).
- Recipients are supported during their studies and get research experience (A).
- Recipients get R & D experience and/or job training (I).

- Professors have more financial flexibility and can spend their own grant money on additional students or other research costs (A).
- Mentoring by recipients and to recipients. PGS recipients receive opportunities to learn in close collaboration and under the supervision of experienced researchers. (A&I)
- Undergraduate, Master's, and doctoral students are motivated to pursue further study or training (A).
- University researchers are assisted by recipients.(A)
- NSERC programs are promoted by word-of-mouth (A&I).
- Formation of new, or strengthening of, ongoing collaborations between various sectors, especially university, industry and non-profit.(I)

Intermediate outcomes. Intermediate outcomes refer to external consequences that flow from the immediate outcomes. Intermediate outcomes tend to take place over the medium-term (usually three to five years or more). They also have been divided into academic and industrial outcomes.

Intermediate outcomes are more subject to influence from other mitigating factors, and so it can only be said that the S&F programs contribute to their outcomes; the intermediate outcomes cannot be attributed directly to the programs.

- Knowledge is produced and exchanged through research, and the dissemination of research, that recipients have contributed to because of their scholarship (A&I).
- Increased completion rates amongst recipients as compared to non-recipients (A).
- Decreased time to degree completion amongst recipients as compared to non-recipients (A).
- Increased employability of recipients. The experience and professional skills gained through the studies and research funded by the scholarships should result in greater employability (higher found work rates, better types of jobs and/or starting levels) amongst recipients as compared to non-recipients (A&I).
- Recipients of PGS scholarships continue on their academic path (A).
- Enhanced research capacity of industry (I).
- Recipients are motivated to seek jobs in industry (I).
- Encourages of on-going collaborations between various sectors (I).
- Encourages student interest in research, such as pursuit of careers in research or advanced degrees (A).
- Promotes the capacity of Canadian universities in the industrial sector (I).
- New/improved technologies, products, or processes developed (I).

Final Outcomes. The final outcome is an external consequence to which the intermediate outcomes contribute (along with other factors beyond the PGS). These speak to the rationale for the programs. They represent a long-term vision towards which the S&F programs contribute to a small extent. The final outcome takes place over the longer term.

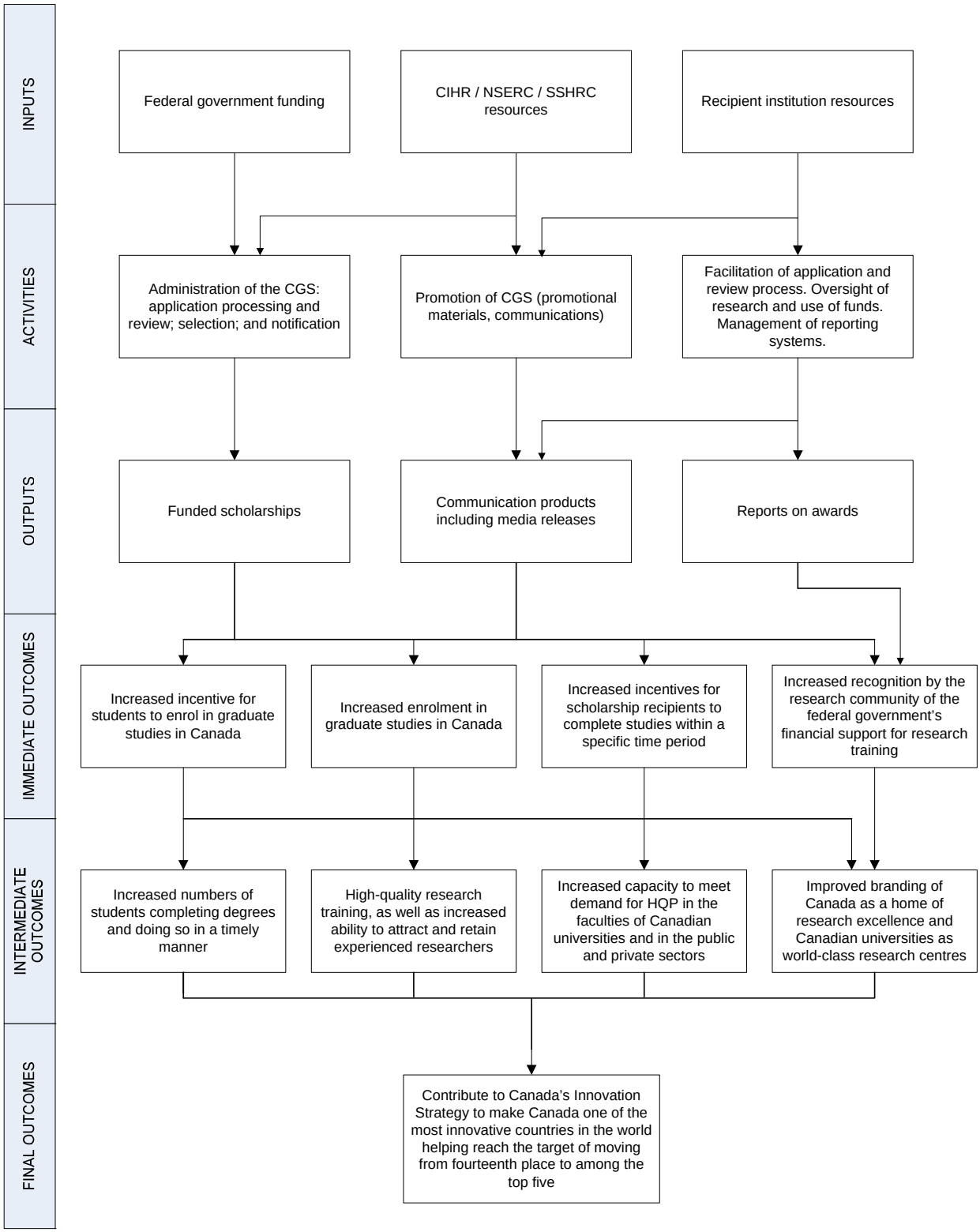
- HQP fuel technological innovation through university-industry collaboration and increased industrial R & D capacities.
- Canadian ranking in R & D performance improves.
- Stronger Canadian economy.
- Increased employment opportunities.
- Development of more knowledgeable society.

CGS Logic Model. The following exhibit presents the program logic model developed specifically for the CGS program.

This model is presented here for reference due to the similarities between the PGS and CGS programs. Furthermore, the evaluation approach for CGS and the agency programs flows in part from the CGS logic model. Thus the CGS logic model is relevant to this PGS evaluation.

Readers should take note, however, that the CGS logic model outlines intended outcomes that are not explicitly identified amongst the intended outcomes of NSERC's S&F program or PGS in particular. While evaluation information gathered on such issues is discussed in later sections of this report, where appropriate, these results are noted as of interest rather than as core measures by which to evaluate the NSERC PGS program.

EXHIBIT 2.6 · CGS Logic Model



Chapter 3: EVALUATION APPROACH

This chapter explains the evaluation approach and methodology. This evaluation of NSERC scholarship programs is part of a broad evaluation process covering the CGS program as a whole, and agency scholarships at NSERC, CIHR, and SSHRC. The evaluation study is largely based on the results of a survey completed with over 2,900 NSERC scholarship applicants who applied for awards in 2004, 2005, and 2006. The evaluation study also draws on evidence gathered from literature, documentation, and by informant interviews conducted as part of the broader CGS evaluation.

3.1 Evaluation Issues

The following issues and questions for the present evaluation were identified during an evaluation planning process, which resulted in the *Evaluation Framework for the Canada Graduate Scholarships Program (CGS) and Related Programs*, dated March 21, 2007.

The objective of the present evaluation is to answer the questions that are relevant to the NSERC's PGS program. Limited or no information was gathered for certain questions. Such evaluation questions are included here nonetheless, as they may suggest topics for future investigations.

Relevance

Is there a continuing need for the PGS Program?

Does the Program continue to be consistent with agency and government-wide priorities?

Design and delivery

To what extent is the Program appropriately designed to achieve its objectives?

What changes to the Program design would make it more relevant and effective?

Is the mix of direct and indirect sources of support for graduate students optimal?

To what extent has the Program been delivered by the agency and universities as intended? (Not evaluated.)

What overlapping issues exist between the PGS and CGS programs, such as: linkages across programs, potential overlap/redundancies and efficiencies?

Should a portion of PGS scholarships be allocated to certain disciplines or should budgets for disciplines be determined by the number of applications received? (Not evaluated.)

Success

The following evaluation questions relating to success are drawn from the program logic model and intended outcomes developed for the CGS evaluation which has many of the same elements as the NSERC S&F model. The CGS model also has a number of intended outcomes which are not specifically outlined in the NSERC scholarship model (e.g. increased prestige associated with the 'branding' of the CGS). Where relevant, the discussion in this report highlights information that may have been particularly relevant to the CGS evaluation, but which may simply be of interest in relation to PGS and IPS.

To what extent has the Program achieved its intended outcomes?

a) Increased incentives for students to (1) enrol in, and (2) complete graduate studies in Canada (Master's and/or PhDs)
b) Increased enrolment in graduate studies in Canada
c) Increased recognition by the research community of the federal government's financial support for research training

d) Increased numbers of students completing (or expecting to complete) graduate degrees in a timely manner
e) High-quality research training
f) Increased ability to attract and retain experienced researchers
g) Expected increased capacity to meet demand for highly qualified personnel (HQP) in public and private sector organizations
h) Recipients/highly qualified personnel holding (or expecting to hold) positions in the faculties of Canadian universities
i) Improved branding of Canada as a home of research excellence and Canadian universities as world-class research centres

What are the overall incremental program impacts? To what extent can outcomes be attributed in whole or in part to the PGS Program and/or other scholarship programs?

What are the comparative impacts for graduate students funded through PGS, IPS, and CGS programs, and students who rely on other means of support?

a) Reasons for attending graduate school
b) Expected completion date
c) Career goals and aspirations
d) Interaction with faculty on research projects
e) Loans/debt worries
f) Sources of support (for both scholarship and non-scholarship students)
g) Employment during graduate school
h) Mobility
i) Barriers to continuing post-graduate studies
j) Marketability (especially for PGS-IPS comparison)
k) Amount of funding
l) Type of projects
m) Industry projects/collaborations
n) Professional skills development (CGS, PGS, IPS)

Is the Program's performance monitoring (of outputs and outcomes) appropriate and adequate?

Have the Program's activities had any unintended impacts (positive or negative)?

Program cost-effectiveness

Is the Program delivered in a cost-effective manner?

Are there more cost-effective ways to deliver the Program under the existing model?

Are there alternative, more cost-effective programs/models that could achieve the same objectives?

3.2 Evaluation Design

This evaluation study design is based on a balanced mixture of qualitative and comparative evidence from multiple sources. Both descriptive and comparative data were employed.

Descriptive data

Descriptive data were assembled using existing documentation, administrative databases, key informant interviews and a survey of students. Using these descriptive data, we can develop profiles (for example, the level of student debt) and we can report perceptions of program impacts and effects. As is often the case in program evaluation, descriptive data can offer rich contextual information but limited definitive evidence of program effects.

Comparative data

Program impacts and effects are more convincingly demonstrated using comparative data. While the primary focus of this report is the PGS, this evaluation study benefits from the comparison of responses from four categories of students: (1) students who received CGS funding, (2) students who received PGS funding, (3) students received IPS funding, and (4) students who did not receive funding from NSERC (but could have received funding from a provincial government or a university).

Comparing data obtained from Groups 1, 2, and 3 contributes to the demonstration of similarities and differences between the PGS, CGS, and IPS programs.

Comparing information from the scholarship recipients to Group 4, the 'no-award group', parcels out the effects associated with the federal scholarship model itself. Together, the analysis of the results in the four groups of students allows us to document the impacts that may be specific to differences between scholarship programs from the impacts that may be generally attributed to all federal scholarship programs.

Statistical tests

In making comparisons among groups of students, it is important to base conclusions on statistical tests which distinguish the statistically supported inferences from the results that may be due to mere chance.

The dependent variables were specified in the analysis plan. Where the dependent variable was naturally of a continuous nature (e.g., expenses), it was kept as such. In instances where the dependent variable could be represented as a quasi-continuous variable or as a dichotomous variable (e.g., opinions on seven-point scales), the latter form was used to avoid making assumptions about the normality of the distribution of the dependent variable.

Bivariate analyses involved breaking down the dependent variable according to award groups, within levels of study. There were four award groups (or treatment groups): CGS award recipients, PGS award recipients, IPS award recipients, and non-recipients. The bivariate statistical tests were a binomial test of difference of proportions for categorical data and a t-test of the difference of means for continuous data. These statistical tests included a Bonferroni correction.

Multivariate analyses were conducted to better isolate the differences in the dependent variables associated with the award groups from the possible contaminating influence of significant distinguishing factors associated with the award groups. Logic models were used for dichotomous dependent variables; ordinary least squares multiple regression was used for continuous dependent variables. All independent variables were coded as binary variables to avoid any assumption regarding the functional form of the relationships; all used an effect-coding scheme except the three variables representing the award groups, which were dummy-coded with the non-recipient group left as the reference category. The list of independent variables is presented in Appendix A. In all cases, the models were built in a stepwise fashion where all independent variables were entered sequentially according to their explanatory power; independent variables representing the award groups were entered last in a forced manner.

The main CGS evaluation, the study on which this NSERC PGS evaluation is based, used this same approach. One notable difference in the multivariate analysis used in this evaluation is in the definition of the binary variable indicating receipt of stipend funding: In the CGS evaluation, this variable received a positive value if the student had received any stipend funding. In this NSERC PGS evaluation, only students in receipt of significant stipend funding of $7,500 or more were thus coded. The variable was modified in order to explore whether the multivariate analysis would identify any significant differences in

outcomes or opinions between those who received substantial stipend funding and those with no or marginal stipend funding. As will be discussed, it was uncommon for stipend recipients in this study sample to show significant differences from non-stipend-recipients with respect to most evaluation questions. It should be noted that the design of the current research was focussed on agency scholarship applicants. Research with a broader cohort of students who have received stipend funding might better serve to explore the issue of the affect of stipends on student outcomes and student experience.

3.3 Documentation and administrative data

As part of the work done for the main CGS evaluation, and all three agency-specific reports, relevant administrative data were identified from the *Evaluation Framework.* Particular attention was paid to Section 3.3 Currently Available Performance Information and Section 4.2 Evaluation Issues/Questions, Indicators and Data Sources of the framework. They were used to compile a list of relevant data, which was in turn submitted to NSERC in order to confirm/refute the availability of such data. Once feedback was received, a request was made for the data to be produced.

Administrative data were not necessarily available from all agencies. Some data were available on paper only, that is, data was collected but not recorded electronically into a database. Therefore, some of the expected administrative data could not be retrieved and some evaluation indicators could not be informed as expected. Where possible they are addressed through other lines of evidence, such as survey or literature review.

It may be noted that NSERC administers a Career Survey and an Exit Survey. It was not within the scope of the current PGS evaluation to analyse the data from these surveys.

3.4 Review of other programs

Under the umbrella of this general evaluation process, which included the main CGS evaluation and agency-specific evaluations (of which this is one), a brief overview was conducted of research funding initiatives within Canada and other countries that may be considered comparable to CGS. The main objectives of this overview were to help place the CGS program into the context of Canadian and international programs designed to support students, and to help contextualize and interpret the results. This review of other programs informed the overall evaluation process, but may only be noted in this report where relevant to the context of the PGS.

Comparable programs were selected based on the following criteria:

- the program is funded and administered by a government department or agency;
- the program provides funding for graduate students, either at the Master's level, at the Doctoral level or at both Master's and Doctoral levels;
- one of the program's main objective is to retain or attract national graduate students (i.e. the program is not intended for international students); and
- need-based scholarships or bursaries are excluded.

Within a jurisdiction, efforts were made to select programs that are open to students from all disciplines/fields.

An Internet scan was conducted in order to identify initiatives similar to the CGS program; 19 initiatives were identified (9 Canadian and 10 international).

Information was obtained by means of Internet searches for documentation from primary sources funding (i.e. Government and Research Council Web sites in the US, UK and Australia, and Canadian Government Web sites). These sources were supplemented by searches of secondary sources such as institutions and financial aid departments.

3.5 Interviews

Also as part of this broader process of the evaluation of the CGS program and the PGS programs conducted at all agencies, a number of in-person interviews were conducted. Twenty-three interviews were conducted with a total of thirty-three respondents, as two or more people participated in some interviews. Interviews were conducted with program management staff at CIHR, SSHRC and NSERC, senior federal government officials at other relevant departments, peer reviewers, university representatives and university / student associations.

EXHIBIT 3.1
Number of interviews and interviewees by sector

Subgroup	Interviews	Respondents
Program management at CIHR, SSHRC, NSERC	7	13
Senior federal government officials	3	4
Peer reviewers / selection committee members	6	6
University representatives	5	6
University / student associations	2	4

While these interviews influenced this broad evaluation process as a whole, the main focus of the interviews was on the relevance, administration, and outcomes of the CGS program. The content of these interviews is only quoted in the evaluation results in this report where it is generally applicable or specifically relevant to NSERC scholarship programs.

3.6 Survey of Students

Questionnaire design and pretest

The student questionnaire was designed to feed directly into the information needs of each evaluation issue. On January 29, 2008, 260 e-mail invitations were sent to pretest the student questionnaire. Six days later, 57 individuals had completed the questionnaire and 10 more had initiated it without completing it. Of these 10, five only read the introduction page.

Objectively, the pretest questionnaire took 29 minutes to complete, on average, including the time respondents took to supply comments on the questionnaire. The subjective duration reported by respondents was 23 minutes, on average. Fifty out of 57 respondents (88%) who completed the questionnaire indicated that its length was reasonable.

As part of the pretest, participants could leave comments related to any of the questions of the questionnaire as well as regarding the entire experience, at the end of the questionnaire. To all extent possible, comments were acted upon.

Sampling

A group of 26,207 students was identified as belonging to the population of students who have submitted applications for masters or doctoral awards to one of the three agencies in 2004, 2005 and 2006.
Of these, 8,885 were students who made applications for NSERC awards, the focus of this evaluation report. Of the NSERC applicants, 4,581 were applicants for awards at the Doctoral level, while 4,274 were applicants for awards at the Master's level.

Initially, it was planned that only about 31% of individuals would be sampled and invited to complete the study questionnaire. However, because of the low marginal cost of additional invitations to the on-line survey and with a view to ensure that sufficient completed questionnaires would be collected, all students were invited by e-mail to complete the questionnaire.

Protocol

On February 8 and 9, 2008, potential respondents received an e-mail invitation to complete the survey via the Web. A first reminder was sent to non-respondents, also by e-mail, on February 15 and 16, 2008, and a second reminder was e-mailed on February 22 and 23, 2008.

Respondents were provided with a secure link to a personalized questionnaire. All communications between the respondent and the server were SSL-encrypted. Respondents could stop answering the questionnaire and resume on the same questionnaire page in another sitting.

Respondents were provided with an e-mail address to ask questions or voice concerns. A few hundred such messages were handled by the Malatest hotline service.

Telephone reminders were initiated on February 13, 2008 with individuals who were part of the original sub-sample of 31% and for whom we did not have a current e-mail address. All non-respondents belonging to the original sub-sample of were added to the telephone follow-ups on February 23, 2008. Telephone follow-ups continued until March 3, 2008.

Field results

For the overall survey of award applicants from all agencies, the raw response rate in the sub-sample subjected to telephone follow-ups was 42%, while it was 31% in the group that was not subjected to telephone follow-ups. The overall raw response rate across all agencies was 35%. This response rate does not exclude individuals for whom no contact information was available. Factoring in the questionnaires completed among cases not sampled for follow-up calls, 232% of the original completion target was reached.

For the NSERC cohort of 8,885 applicants, the cohort of interest to this report, the overall gross response rate was 33%, with a total of 2,931 surveys obtained from Master's and doctoral award applicants.

Non-response and response bias

With an overall response rate of 33% for the NSERC sample, the representativeness of the respondent group must be assessed. We are able to compare respondents to non-respondents with regard to the following characteristics (and only those characteristics as other data are not available):

- the reference agency;

- the level of study;
- the success of the application;
- the year of application.

Since the first three characteristics were used to stratify the population and draw non-proportional samples for follow-up purposes, it is not surprising to find that respondents are different from non-respondents in these regards. These differences can be corrected using *ex-post facto* weighting.

The likelihood of responding was higher among doctoral students than master's students — it could be because the e-mail addresses were more likely still active for doctoral students who are involved in longer-term programs. The response rate for the NSERC cohort of applicants at the Doctoral level was 37%, as compared to 33% for the cohort of applicants for awards at the Master's level.

The response rate was lowest for unsuccessful applicants (21% at the Master's level, 25% at the Doctoral level), followed by PGS applicants (PGS-M, 28%; PGS-D, 39%) and IPS applicants (IPS-1, 35%; IPS-2, 41%), with CGS applicants having the highest response rate (CGS-M, 37%; CGS-D, 51%). One explanation of this situation is that the questionnaire was positioned mostly as a CGS questionnaire, so that regular program awards may not have felt as concerned with it as CGS awards. As for unsuccessful applicants, comments left indicated that there is a tangible level of acrimony for some non-recipients such that the motivation to participate in the survey is less than among successful applicants.

EXHIBIT 3.2
Response Rate by Award Group

Type	CGS	PGS	IPS	No Award	Overall
MASTERS					
Population	1,505	1,418	405	1,253	**4,581**
Surveys Completed					**1,352**
Response %					**30%**
DOCTORATE					
Population	761	2,099	224	1,190	**4,274**
Surveys Completed	385	811	91	292	**1,579**
Response %	51%	39%	41%	25%	**37%**
Source: administrative data in survey sample files					

We found that recency of application correlated with more participation. Here again, the recency of the e-mail information may factor in. As a consequence, we used year of application in the weighting scheme. However, it should be noted that there could be a bias here in that older,

unsuccessful applicants may have been more difficult to reach than more recent, successful applicants.

In view of these observations, a weighting scheme was developed to redress the sample of respondents to the proportions observed in the population for the cross-classification of these four characteristics.

Sampled vs. non sampled participants

One final concern has to do with the equivalency of the answers provided by the sampled and non-sampled groups of respondents (i.e., the group sampled for the telephone/on-line survey, and the non-sampled remainder who were later invited by e-mail to fill out the on-line survey, without the benefit of telephone follow-up). If it can be shown that their answers are similar, we will be able to merge sampled and non-sampled participant answers in the analysis of the results.

We compared the answers provided by the two groups throughout the questionnaire. While there were statistically significant differences between the groups[8], on key outcome variables, the answers of the two groups were either not statistically different or were statistically significant but with actual differences that were not meaningful. For example, a difference between a proportion of 30% and a proportion of 32% may be statistically significant with large enough samples, but not meaningful in substantive terms.

Key indicators that the two groups are similar include (no statistically significant difference in the following):

- whether the respondent has completed the program of study;
- whether the respondent is still studying in original program;
- number of years before completing the program of study;
- enrolment in another university program;
- current student status (statistically significant but substantively the same);
- involvement in research with the supervisor (statistically significant but substantively the same);
- importance of the scholarship;
- having held a job during graduate studies;
- closeness of job to graduate studies;
- geographical location after graduate studies (intention);
- likelihood to pursue a career in research.

We merged the answers of sampled and non-sampled cases so as to benefit from the full power of a large data set in the upcoming analysis.

[8] Statistical significance is relatively easy to reach with a sample as large as the one available here.

Weighting

A weighting scheme was developed to redress the distribution of the sample of respondents to the distribution of the population for the cross-classification of the following four factors:

- the reference agency;
- the level of study;
- the success of the application;
- the year of application.

Master's level and Doctoral level samples were treated as self-contained data sets for the weighting, as for much of the analysis, for this evaluation. Users of both this report and the *2008 CGS Programs and Related Programs Review* should be aware that while the source data set is identical for both studies, the data weighting used for the NSERC PGS evaluation differs slightly. The CGS evaluation grouped PGS and IPS together as 'regular agency awards'. This evaluation separates these groups, and the weighting had to be adjusted accordingly. This may explain differences between figures presented in this report, and NSERC figures presented in the CGS evaluation. Most such differences are very slight.

For the sample of Master's level NSERC applicants, the weighting scheme has a minimum value of 0.58 (for 2006 IPS-1 recipients), and a maximum of 4.20 (for 2004 unsuccessful applicants). The variance of the weight variable is 0.31.

For the sample of Doctoral applicants, the weighting scheme has a minimum value of 0.62 (for 2006 CGS-D recipients) and a maximum value of 2.94 (for 2004 unsuccessful applicants). The variance of the weight variable is 0.20.

3.7 Data quality

This evaluation is based primarily on a mixture of qualitative evidence (e.g. program documentation, key informant interviews and a review of other programs), and quantitative evidence (i.e. administrative data and a large survey of program applicants) where the latter was given most attention, and on the comparison of relevant results obtained by four groups of students, some of whom were involved in the programs and some who were not.

Available documentation was analysed and in-depth interviews were conducted with some 33 individuals to factor into aspects of this evaluation that could not be captured in the student survey.

The student survey benefits from a large sample size of 2,931 respondents and a reasonably good response rate, considering the groups that were targeted. Respondents were shown to have similar relevant characteristics to the non-respondent group thus the respondent population can be shown to be representative. Similarly, respondents from the sub-sample subjected to telephone follow-ups were also shown to be comparable to respondents who were not subjected to this type of follow-up.

A large portion of the analysis is based on a comparison of recipients of CGS awards, PGS awards, IPS awards and students who applied for an award but did not receive one. These four groups of students surveyed and compared are not strictly equivalent:

1 one was considered worthy of the highest honour (a CGS scholarship);
2 another one was identified as highly deserving (and received a PGS scholarship);
3 another was similarly identified as highly deserving but was also sponsored through industry collaboration (i.e. they received an IPS scholarship with partial funding from their industry sponsor);
4 and the fourth group, while of high calibre (otherwise, universities would not have selected them for the competition), were not awarded a scholarship.

However, they all emerge from the same group of "best students"; in fact, with the exception of IPS, only students pre-qualified by universities are allowed to apply for graduate awards. This is a great advantage to this evaluation: because students in the four groups are similar, the difference among them is primarily whether they received an award and which award they received; therefore, differences in how they proceed through graduate studies can be more readily attributed to this key difference. Since there could possibly be other differences among the four groups of students, we implemented multivariate statistical control in order to focus the comparison on the impacts of the scholarships. This way, we controlled for other variables that could possibly explain differences observed in study progress among groups; after these statistical controls, if a difference persists among groups, it can probably be attributed to the effects of the programs. Factors that were subjected to statistical control are listed in Appendix A and the literature on which the selection of these factors was based is presented in Appendix B. Notwithstanding our efforts, it is possible that some significant factor was left uncontrolled.

Notwithstanding the strength of the design and of the data collection, there were some limitations to the available data. Administrative data captured as part of the CGS evaluation were produced by three

independent organizations, each with their own systems and procedures. While we strived to produce data on the same basis, some of the information produced might not be entirely comparable.

Some of the documentation is dated, even though the environment is characterised by rapid change; this is particularly true of macroscopic information relative to the academic and industrial environments. Also, the in-depth interviews did not necessarily allow the collection of evidence that can be cross-referenced against hard facts; in fact, such interviews are often needed where empirical evidence is not available.

The survey of students targeted the first beneficiaries of CGS awards (in 2004, 2005 and 2006) and PGS/IPS awardees and applicants from the same years. The relatively short time elapsed between these years and the survey period in 2008 may not have allowed for the materialization of some outcomes, such as degree completion — although the relative brevity of the delay was the same for all treatment groups.

The framework of this evaluation was based on the premise that the scholarships were designed to impact the behaviour of the best students, to increase the likelihood that they will enrol in graduate studies, that they would complete these graduate studies and contribute to the pool of highly qualified personnel pursuing research-related careers in academia and industry or government. Therefore, to assess the performance of the program, this evaluation puts this logic to the test and compares study progress for students in receipt of program benefits to those not in receipt specifically, those whose applications were pre-selected by their institution for an award and those who were not successful. Others have suggested that this is not the appropriate test to perform because, in their view, such a counterfactual comparison does not assess the impact of CGS, PGS and other such awards programs on the whole of the graduate student population, should the CGS or PGS awards cease to be a source of funding. It is important to note that while the design for the current evaluation was based on a comparison of award recipients with comparable non-recipients who had gone through a pre-selection process at their institution; it did not include a comparison with the broader student population. While this was appropriate for the CGS program, it does not provide as complete a picture of impacts for the PGS program.

Chapter 4: RELEVANCE

In brief

The evaluation generally supports the conclusion that there is a continuing need for NSERC scholarship programs such as PGS, IPS and CGS. HQP are in high demand not only in Canada but also in numerous other competitor countries. Canada ranks sixth in a list of developed countries with regard to the proportion of the population in the HQP category; this highlights the need for a continuous influx of new HQP. According to information offered by students, there is a risk of loss of highly qualified personnel to other countries; counter action is necessary. However, most graduate students do not amass a very large study-related debt, making the financial barrier to obtaining of a graduate degree a less than compelling argument for student support.

4.1 Is there a continuing need for the NSERC PGS Program?

The PGS program and related scholarship awards programs are founded on the hypothesis that the cost of financing graduate studies is a significant barrier to access. Moreover, they were initiated because of the perception of a need to augment the number of graduates from Master's and doctorate programs available to universities, the private sector and the public sector where the demand for highly qualified personnel exceeds the supply.

Assessment of the supply of and demand for HQP

Statistics Canada defines highly qualified personnel as "an individual with a university degree at the bachelor's level and above" (McKenzie, 2007). However, CGS and related programs focus on the Master's and doctoral levels.

Relevant data on the supply of HQP in Canada are relatively rare. In 2006, 774,655 people had a Master's degree and 142,180 people had a Doctorate degree in Canada according to Statistics Canada (2008a). The same report indicates that the proportion of the population with a university degree at the bachelor's level or above stands at 23% in Canada. This places Canada sixth behind Norway and the United States (30%), the Netherlands (28%), Denmark and Iceland (26%); and *ex aequo* with Australia and Korea. Japan (22%) and Sweden (21%) follow. Canadian universities have been graduating about 4,000 PhDs a year (CAGS, 2006b).

Various indications point to an increasing demand for HQP.

- From 1991 to 2001, the labour force increased by 1.3 million people and 50% of that growth was in occupations requiring a university degree (Statistics Canada, 2003).

- According to HRSDC's 2006 National Occupational Classification, 10.9% of all Canadian occupations require a university degree (excluding management positions). If management occupations are included, then 12.2% of all occupations require a university degree.

- The proportion that HQP (bachelors and above) represent of the workforce has grown from about 16% in 2001 (Statistics Canada, 2003), to 22% in 2005 (Lapointe et al., 2006) and 23% in 2006 (Statistics Canada, 2008b).

- From 2006-2015, two out of every three job openings will require post-secondary education (university, college or apprenticeship). The highest rate of expansion will be in occupations requiring a university degree (annual average rate of 1.6%). This will represent 70% of all new job openings in 2006-2015 (Lapointe, Dunn, Tremblay-Côté, Bergeron and Ignaczak, 2006).

- For the past few years, the fastest growing industries were those who required the highest level of education and employers are now looking for employees with an advanced degree and those who have research and analytical skills (AUCC, 2005).

- Today's industries are knowledge intensive, that is, they require their employees to bring new knowledge and ideas to their companies to create new technologies and/or processes in order for them to stay competitive and survive (AUCC, 1996).

- Bégin-Heick & Associates (2001), Berkowitz (2003) and the Canadian Association for Graduate Studies (CAGS) (2004) estimated that Canada needed to replace 30,000 to 40,000 university professors by 2010-11 in order to fill the vacancies from retirements and create new positions to meet enrolment demand. (It may be noted that half of these positions were expected to be in the Humanities and Social Science fields.)

- According to Vinet (2002), cited in Borgmann Crago (2002), the government of Canada estimated that 50,000 more researchers were needed in the non-university sectors of the economy in order to meet its objective to rank fifth in the world in R&D among OECD countries.

Overall, therefore, there appears to be a continued need to increase the proportion of Canadians who complete graduate studies.

According to key informants, the key challenges to ensuring a supply of HQP in Canada are (1) increasing the number of graduate students in Canada, both from within Canada and by attracting the best from abroad and (2) continuing to reduce the brain drain problem by ensuring opportunities for young Canadians to increase their skills and ensure we do not lose them. To that effect, a reasonable level of funding must be offered to attract students and sufficient places and capacity must be developed in universities to accommodate such students.

Loss of highly qualified personnel

Information available from the student survey is somewhat contradictory. The evidence available from the survey of students regarding this issue is limited by the fact that the sample is not representative of the graduate student population: it includes only students who have applied for awards.

That being established, the proportion of graduate students expecting to leave, or actually leaving Canada is not inconsequential:

Amongst the NSERC applicants surveyed, one quarter (25%) of individuals who applied for a Master's award who are *currently students* "expect to move outside Canada to continue [their] training and/or to start [their] career" (n=784, respondents who agreed or strongly agreed with this statement). The figure is 35% at the doctoral level (n=1,345).

Similar results were obtained by Darren King (2008) from the 2004-2005 Survey of Earned Doctorates.

Applicants' responses when asked directly about their plans for work after graduating (in Canada vs. outside of Canada) are somewhat contradictory. Fewer individuals expressed an intention to work outside of Canada after they graduate: only 5% of Master's award applicants who are *currently students* indicated this (n=707); the figure is 9% at the doctoral level.

The actual outcomes of individuals who are *not currently students* are revealing. Of Master's award applicants who are no longer studying, only 8% currently reside outside of Canada (n=318). This seems closer to the intentions of current Master's students to work in or outside of Canada once they graduate. Of doctoral award applicants who are not currently students, the figure is markedly higher, with 31% reporting that they currently live abroad (n=758). In contrast to the Master's level, this result supports the expectations of current doctoral students that they would move abroad to continue their training or start their career.

These observations support the notion that there is still a risk of consequent loss of highly qualified personnel to other countries, particularly for students who are on an academic/career path beyond the Master's level.

Assessment of students' financial and other needs

Another rationale for the existence of CGS and related programs is to address the perceived financial hardship of graduate students as well as reduce the level of debt they contract by the end of their studies.

The sources available on this issue don't actually support this perception. Gluszynski and Peters (2005) reported that 56% of doctoral students did not accrue a debt to finance their graduate education and that only 14% had a debt higher than $20,000. Based on the 2004-2005 Survey of Earned Doctorates, Darren King (2008; 17) indicated that "59% of students reported having no debt from their graduate studies and 50% reported having no debt from either their graduate or undergraduate studies upon completion. [...] Fifteen percent of the 2004/2005 graduates reported owing over $20,000 from their graduate studies." At the Master's level, the average debt was $20,300 according to a 2006 study of Master's students (CAGS, 2006a).

These findings are supported by Statistics Canada's National Graduates Survey (NGS), Class of 2005, which reported that Master's students averaged $22,800 in study-related debt from all sources on graduation (n=24,800); for doctoral students, the average debt on graduation was

$25,600 (n=3,200). Examining the results of the NGS by discipline for fields of study in the NSE reveals considerable variation in debt on graduation at the Master's level, but generally somewhat less than the average for all disciplines:

- $16,000 for physical/life sciences and technologies graduates;
- $17,700 for mathematics, computer and information sciences;
- $17,700 for engineering graduates;
- $18,700 for agriculture, natural resources, and conservation; and
- $24,400 for architecture and related services and interdisciplinary.

At the doctoral level, the NGS figures for average debt in NSE-related disciplines similarly ranged from $19,200 for graduates of PhD programs in the physical and life sciences and technologies to $24,000 for mathematics, computer and information sciences graduates, again somewhat less than the average across all doctoral disciplines (Bayard and Greenlee, 2007).

According to the student survey conducted as part of this evaluation, students who are not supported by NSERC awards (but who could receive support from the provincial government or from the university) declared an annual income of $25,770 on average in their last year of study, and household expenses of $24,313.[9] Their accumulated study-related debt averaged $9,892 for Master's students and $12,197 for doctoral students. These figures are averages for all students surveyed, regardless of completion status or current level of study. On the subject of debt, the survey asked respondents how much study-related debt the *currently* carried at the time they were surveyed; given the mix of current work/school statuses and time enrolled and/or time since graduation, it would be challenging to extract consistent or conclusive data on debt levels for NSERC award applicants. Chapter 6 of this report does, however, examine students' reliance on loans and paid work during the last 12 months of study.

Demand for the scholarship programs

One last indicator of program relevance would be an increase in the number of applications received and, possibly, a decrease in the proportion of the applications that the programs are able to meet. Note that, because universities filter applications and limit their numbers, this logic is not left to play out naturally and, hence, this indicator is faulty.

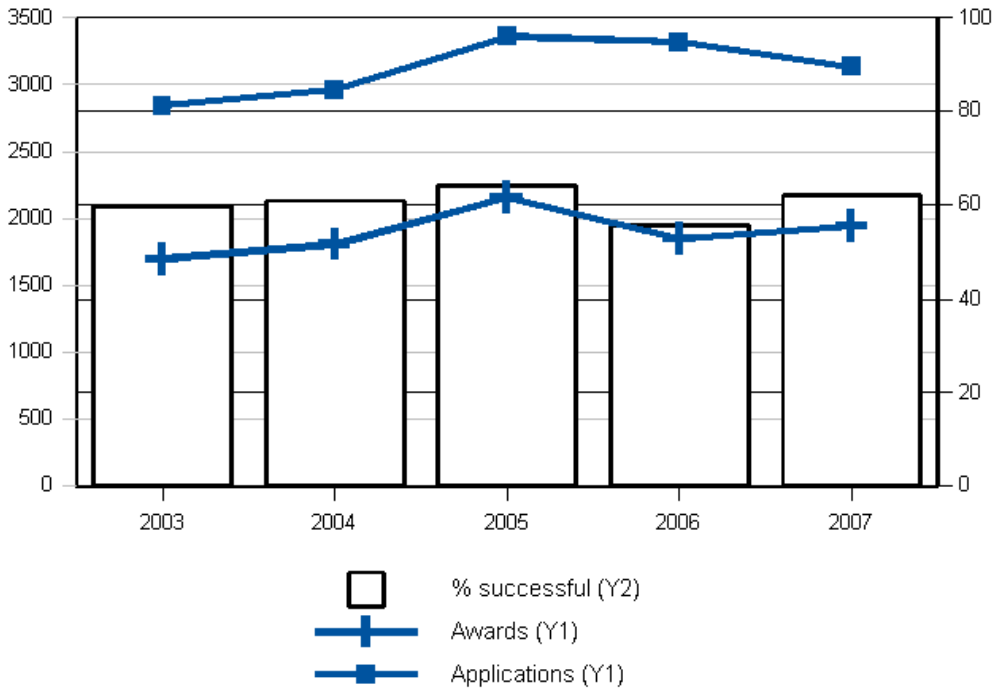
Exhibit 4.1 describes the number of applications for NSERC scholarships between 2003 and 2007. Applicants increased from 2,843 in 2003 to 3,361 in 2005, and down to 3,135 in 2007.

[9] The caveat concerning the representativeness of the results expressed earlier applies here again.

The proportion of applications that are met with a positive response has decreased from hovered in the range of 55% to 60% in this span, with the actual number of awards ranging from a low of 1,700 in 2003 to a high of 2,156 in 2005, and back down to 1,947 in 2007.

EXHIBIT 4.1

Applications and sholarships awarded



This indicator does not suggest that the demand for the program is growing. However, given that the number of applicants is controlled by NSERC and the universities, this may not be the best indicator of the level of need for the program.

Perspectives from key informants

In the research for the main evaluation on CGS and related programs, informants were unanimous in stating their belief that if there were no CGS or agency-specific awards there would be far fewer students undertaking post-graduate studies. Canada would then have difficulty in filling research positions in academia and industry. Another effect would be that the time to completion for post-graduate studies would be extended significantly, thus further impacting the supply of HQP. It would make it more difficult for universities to attract students and keep them, and the onus would fall more on the universities and the provincial governments. It was also mentioned that without the CGS and the

agency-specific awards there would be higher instances and higher levels of student debt.

4.2 Does the Program continue to be consistent with agency and government-wide priorities?

The Federal Budget of 2007 emphasized the importance that the Government of Canada attaches to supporting graduate studies, and to CGS in particular. While NSERC's PGS program is the main focus of this report, the following discussion is illuminating with respect to government priorities for all post-graduate scholarship programs.

The budget document outlines actions related to a "stronger", "safer", and "better" Canada. According to the 2007 Budget, a stronger Canada will be achieved through a stronger economy via five areas of action (Department of Finance Canada, 2007, 149): fiscal action, infrastructures, entrepreneurship, taxation and knowledge. Within the "knowledge advantage", a number of initiatives are described. CGS is introduced as follows (Department of Finance Canada, 2007, 208-209):

> The ability of Canadian firms to be at the forefront of research and innovation depends crucially on their access to highly skilled personnel. To encourage more Canadian students to acquire advanced skills, Advantage Canada committed to increasing graduate scholarship support.
>
> To encourage Canadians to pursue advanced studies, the granting councils provide internationally competitive financial support to the best Canadian graduate students through Canada Graduate Scholarships. These scholarships are provided to the top 2,000 masters and 2,000 doctoral students each year. Students at the master's level receive one-year awards worth $17,500, while doctoral students receive three-year awards worth $35,000 per year. To recognize the outstanding contributions of Canadian researchers and entrepreneurs who have made a real and lasting impact on our lives, Canada's New Government will be dedicating Canada Graduate Scholarships to the memory of Sir Frederick Banting and Dr. Charles Best, Alexander Graham Bell, and Joseph-Armand Bombardier...
>
> ...To enable additional young Canadians to pursue graduate-level studies, Budget 2007 provides $35 million over two years to expand these scholarships. When the new

> scholarships are fully in place, the councils will support an additional 1,000 graduate students each year, including 400 new scholarships delivered by each of CIHR and NSERC, and 200 delivered by SSHRC.

The fact that the key messages on graduate awards and CGS were repeated in the Budget speech itself (Flaherty, 2007, 16) is a further demonstration of the importance that the Government attaches to these programs.

The 2008 Budget plan includes yet another measure: “Providing $3 million over two years to establish a new international study stipend for Canada Graduate Scholarship recipients who wish to study at international institutions.” (Department of Finance Canada, 2008, 14). The stipend will have a value of up to $6,000 for one semester of foreign studies.

Financial support for graduate students is also central to the Government of Canada’s Science & Technology Strategy. This strategy includes a framework for promoting innovation and economic growth through creating three Science & Technology Advantages for Canada: the Entrepreneurial Advantage, the Knowledge Advantage and the People Advantage. The People Advantage is founded on the premise that Canada “must grow its base of knowledge workers by developing, attracting, and retaining the highly skilled people we need to thrive in the global economy” (Industry Canada, 2007, 12). The strategy identifies a key method of achieving the People Advantage is ensuring an adequate supply of HQP through federal government funding for scholarships. While the strategy has a primary focus on the sciences, it recognizes the contribution and role of other disciplines in supporting innovation, and describes federal support provided by SSHRC, CIHR, and NSERC, including through the CGS and agency scholarship programs.

Finally, the PGS allows eligible Canadian students to study outside of Canada, thereby contributing to the internationalization of Canadian doctoral studies and helping to building strong academic connections around the world. This, in turn, contributes to achieving Government of Canada objectives related to knowledge and people advantages under the Science & Technology Strategy.

Chapter 5: DESIGN AND DELIVERY

In brief

The analysis of design and delivery issues did not identify any major concerns. Positive features of NSERC PGS include: the coverage at both the Master's and Doctoral levels, the assessment criteria, the application review process and the efficiency of the management of the program. Areas of concern include: limited funding and the duration of the awards. Students were more satisfied with the money value of the awards than with their duration. In particular, Doctoral award recipients were markedly less likely than their Master's level counterparts to be satisfied with the duration of their funding. Examining PGS in relation to CGS awards, key informants commented on the large value discrepancy between CGS and regular agency awards at the Doctoral level.

5.1 To what extent is the Program appropriately designed to achieve its objectives?

Evidence of progress to date toward achievement of Program objective / expected results

Achievement of the program objectives would suggest that the programs are appropriately designed. Chapters 6 and 7 supply information on objectives achievement.

Stakeholder opinions on program design

This section of the report draws on key informant interviews conducted as part of the main evaluation of CGS and related agency awards. There are many commonalities (such as shared objectives and a common administration process) between these programs and the NSERC PGS. Thus the stakeholder comments about the programs generally are also relevant to the design of the NSERC PGS program.

Stakeholders were generally of the view that the scholarship programs administered by the agencies are well designed. Key themes to stakeholder comments on program design included the following:

- The assessment criteria are good, although a few thought they are too rigid and too academic.
- The awards are peer reviewed which ensures excellence and a high level of adjudication integrity.
- They are managed efficiently, with low administration costs — although a few informants felt that is not appropriate to delegate the administration of the awards to universities.
- It is beneficial to offer awards programs at both the Master's and Doctoral levels. Of the three agencies, only NSERC offered awards at the Master's level before the advent of CGS Master's level awards.
- The advent of the CGS has increased the number of awards overall.

Notwithstanding this generally positive view, some stakeholders raised the following issues.

- Because of limited funding, the accessibility bar is very high and some very qualified students do not receive awards.
- Some informants were not comfortable with the duration of the awards; they suggested that a longer period of funding would better assist students.
- The value discrepancy between CGS-D and other awards (such as PGS-D and IPS-2) creates different tiers of awards. Some were of the view that a larger number of awards of a lower dollar value would be better than a smaller number of richer awards. Some others indicated that awards could be larger to keep up with living costs.

Student satisfaction with program characteristics

Satisfaction with the monetary value of awards is high, although not as many students are as positive about the number of years that they could receive funding.

The plurality (nine out of ten) of Master's students who received awards are of the opinion that the size of the scholarships is appropriate, whether they were in receipt of PGS-M ($17,300), CGS-M ($17,500), or IPS-1 ($21,000). Not quite as many, but still the majority of all Master's scholarship recipients, 83%, are also of the opinion that the number of years that funding was available to them was appropriate. Of note, during the period of awards examined in this study (2004-2006), many PGS-M recipients were eligible to secure a second year of funding through the program; the current program design allows for only one year of PGS funding at the Master's level. Therefore, the level of satisfaction with respect to award duration amongst the subjects of this evaluation study cannot necessarily be generalized to current PGS recipients.

EXHIBIT 5.1
Student satisfaction with program design features

Satisfaction with…	CGS (a)	PGS (b)	IPS (b)
Master's			
The number of years that funding was available to you under the scholarship	83%	84%	83%
The amount of funding available to you under the scholarship	89%	88%	90%
n	428	295	138
Doctorate			
The number of years that funding was available to you under the scholarship	74%[c]	70%[c]	55%[ab]
The amount of funding available to you under the scholarship	96%[bc]	80%[a]	78%[a]
n	446	818	91

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.

At the doctoral level, the majority, four out of five, of PGS-D recipients were satisfied with the size of their award ($21,000). Somewhat fewer, but still seven out of ten, PGS-D recipients were satisfied with the number of years funding was available to them.

Statistically significant differences in opinion are apparent between recipients of the different types of Doctoral level award, with CGS recipients the most satisfied. In contrast to the other awards recipients, virtually all CGS-D recipients are satisfied with the size of their award ($35,000), while close to three-quarters are satisfied with the duration of their award. Examining IPS-2 recipients, almost four out of five are satisfied with size of their awards, but considerably fewer (55%) are satisfied with the duration of their awards.

5.2 What changes to the PGS Program design would make it more relevant and effective?

The research conducted for this evaluation did not set out to obtain input directed to the question as to how the NSERC PGS in particular could be improved. However, key informant opinion with respect to CGS and all agency programs as a whole can be reviewed to add context to the evaluation of NSERC administered programs. Key informants' main issues with the current CGS design were related to the value discrepancy between CGS and other programs; limited funding that constrains accessibility; the duration of the awards; and limitations to studying abroad. Key informant recommendations, while not consensual pointed toward reducing the funding gap between CGS and related awards; reducing the value of CGS awards and increasing the number of awards; lengthening the period of funding to two years at the Master's level and to four or five years at the doctorate level; and allowing international studies.

Suggested modifications to the overall scholarship awards system included the following:

- increasing the number of awards to meet the demands of the economy over the next decade;
- adjusting the adjudication schedule to announce winners six to eight weeks earlier;
- automatically increasing the value of the awards based on inflation;
- increasing the public recognition to celebrate excellence;
- eliminating the use of the letter of reference that some see as of little value;
- increasing the emphasis in the research project.

Again, it should be noted that these suggestions were given in relation to CGS and award programs in general at all three funding agencies.

5.3 Is the mix of direct and indirect sources of support for graduate students optimal for students in the Natural Sciences and Engineering domain?

Little information was amassed on this issue as part of the evaluation study. Key informants did not comment on it and no information was garnered from the literature.

The survey of students allows us to document the proportion of students who were in receipt of a stipend (defined as "amounts paid to you to conduct your own research" in the questionnaire) and the average value of stipends.

The proportion of students in receipt of a stipend is higher among those who did not receive an award. 10% of Master's PGS recipients received stipend support, as compared to 17% of non-award students; at the doctoral level, 7% of PGS recipients received stipend support as compared to 19% of non-award students.

EXHIBIT 5.2
Students in receipt of a stipend

	% in receipt of a stipend				n			
	CGS (a)	PGs (b)	IPS (c)	No award (d)	CGS (a)	PGs (b)	IPS (c)	No award (d)
Master's								
	11%$_{d}$	10%$_{d}$	8%$_{d}$	17%$_{abc}$	454	311	139	198
Doctorate								
	4%$_{d}$	7%$_{d}$	9%	19%$_{ab}$	461	862	92	309

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

The average sizes of stipends reported by students in receipt of such funding are presented by level and group in the next exhibit. Sample sizes do not allow the same level of detail with regard to the average value of the stipends, thus differences between the award and no-award groups do not test as statistically significant.

It can be observed nonetheless that doctorate level stipends are larger on average than Master's level stipends.

The level of support provided by stipends varies greatly. For students in receipt of stipends at the Master's level, stipend support in the last 12 months of study ranged from as little as $300 to as much as $26,000. For stipend recipients at the Doctoral level, the amounts paid to students in the last 12 months of study to conduct their own research ranged from as little as $500 to more than $48,000.

EXHIBIT 5.3
Value of stipend support (in the last 12 months of study)

	Average stipend of those in receipt of a stipend		n	
	Master's (e)	**Doctorate (f)**	**Master's**	**Doctorate**
CGS (a)	6,591	7,997	50	19
PGS (b)	6,153	9,322	29	64
IPS (c)	8,042	8,156	12	8
No award (d)	7,978	11,268	35	54
All Students	**7,080**	**10,163**	**126**	**145**

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.
e The value is statistically different from that of the Doctoral-level group at least at the 0.05 level.
f The value is statistically different from that of the Master's level group at least at the 0.05 level

From these limited data, it is not possible to determine if the mix of direct and indirect support to students is optimal. It can be observed though, that the highest frequency of stipends is among students who did not get an award (Exhibit 5.2), and that those students received, on average, modestly higher levels of stipend funding than those who received awards, particularly at the doctorate level (Exhibit 5.3).

It is also interesting to note that, for the small percentage of awards recipients who received stipends, the average value of stipends received by award recipients is substantial even in light of the size of their awards. For example, the 7% of recipients of PGS-D awards who also received stipends, received an average of about $9,300 in stipend funding, in addition to the $21,000 provided by their scholarship.

Individuals studying in the Natural Sciences and Engineering (NSE) may draw on a number of different direct and indirect sources of funding that may support their own research. Support for their own research may also come in a form even more indirect than stipends: research assistantships. Research assistantships typically involve monies or direct wages paid to students for work on a university researcher's subject of interest, with the source of the funds often originating in a grant awarded to the researcher. In the NSE domain, the subject of a student's thesis often aligns closely with the subject of their thesis supervisor. Thus, it follows that a student who is engaged by their supervising researcher in a research assistantships *may* be getting paid for work that furthers their own thesis. While the design of the current study does not allow for a more in depth exploration of this source of funding vis-à-vis the optimal mix of direct and indirect funding, this may nonetheless be an interesting consideration for future research on this

issue. (Readers are referred to the section on sources of income in Chapter 6 for a discussion of the average levels of support students receive through scholarships, stipends, research assistantships, teaching assistantships and other sources of income.)

Key informants were not unanimous on the issue of direct and indirect funding. Many were in favour of as much direct support as possible but some note a trend away from that. But most did not know how the current situation can be improved, though one university association representative noted that it is not a case of “either/or” but a need for more of both direct and indirect funding. This was echoed by a peer reviewer informant who said that there is never enough money and changing the mix would not make much of a difference. Another said that although the balance is good the overall level of support is not sufficient. There is a concern that, if student funding is insufficient, students might have to take on teaching work — with negative impacts on their own research.

Also of note, while it is not the goal of this report to compare funding programs at different agencies, when examining stipends received by NSERC students in relation to those received by applicants to other agencies, it can be observed that stipends received by CIHR students tended to be larger than stipends received by NSERC students, which were in turn larger than stipends received by SSHRC students. This suggests differences in the mix of funding sources available to students in different domains.

5.4 What overlapping issues exist between the PGS, IPS and the CGS?

Little information was collected with regard to issues resulting from the overlapping existence of both the agency awards and the CGS awards. It may be noted that key informants interviewed as part of the research for the main CGS evaluation noted that the creation of two tiers of awards might communicate the message that there are two distinct tiers of students, whereas there may in fact be very slight differences in academic standing between CGS and other award recipients. In fact, some recipients of agency awards may be very well qualified to receive CGS, but are ineligible because they chose to study outside of Canada.

5.5 Should a portion of scholarships be allocated to certain disciplines or should budgets for disciplines be determined by the number of applications received?

As part of the broader CGS evaluation, one government informant noted that there is currently a view that we should start targeting a few specific areas in which Canadians can be leaders and have an impact (such as environmental health, natural resources, energy). However, most key informants were firmly against the notion of any form of targeting. Several informants stated that students should make their choices regarding what they see as opportunities, and excellence should be the basis for determination of support. Some informants, particularly at the universities, held strong opinions that there should be no trying to predict which disciplines or research topics might be important for the future.

Chapter 6: SUCCESS

In brief

The evidence indicates that the award programs (PGS, IPS and CGS) were associated with a number of positive impacts on the "high achiever" cohort of award applicants studied: increased enrolment in graduate studies by awards recipients; increased incentives for students to enrol in graduate studies; increased incentives for doctoral students to complete their studies; increased recognition by the research community of the federal government's financial support for research training; high-quality research (in a limited way); increased ability to attract and retain experienced researchers (in a limited way, and mostly for Master's level awards); improved branding of Canada as a home of research excellence and Canadian universities as world-class research centres (limited indicators). Fewer positive impacts were observed for IPS at either level of study, as compared to the other two NSERC awards. There are two reasons for this: the smaller samples of IPS students included in the survey, (so fewer statistically significant results); and the unique nature of the program (with more emphasis on industrial partnerships and less emphasis on certain academic research activities).

Awards (PGS or related awards alike) had no significant impact on the following outcomes: increased total enrolment in graduate studies in Canada; continuing doctoral studies after a Master's degree; increased capacity to meet demand for HQP; HQP holding (or expecting to hold) positions in the faculties of Canadian universities.

With regard to unintended effects associated with PGS and other award programs, the evidence shows clearly that NSERC awards have

significant positive unintended impacts such as reducing the need to work for pay, reducing loan burden, and improving employability (self-assessed) and academic marketability.

At the Master's level, PGS and CGS generally produced the same positive unintended impacts in all areas except those associated with conducting research in various environments and reducing the need to work during graduate studies, where only PGS shows positive impacts. At the doctoral level, PGS and CGS generally produced the same impacts, with the notable difference that CGS appears to have a greater positive impact on students' finances and need to work for pay, which is natural due to the larger size of the CGS-D award.

6.1 To what extent has the Program achieved its intended outcomes?

This issue comprises a number of facets. The evaluation questions assessed in this section of the report are intended outcomes that are generally common to all three awards programs examined (PGS, CGS, and IPS).

a. Increased incentives for students to enrol in, and complete graduate studies in Canada (Master's and/or PhDs)

Increased incentives to complete graduate studies are an intended outcome of NSERC's scholarship programs that is identified in the agency's umbrella logic model for its Scholarship and Fellowship programs. *Increased enrolments* and increased incentives for students to enrol in graduate studies are intended outcomes of the CGS program only.

Enrolments

Overall, there has been a significant (57%) increase in full-time graduate studies enrolment (Masters and PhD) from 1996-2006 (AUCC, 2007). According to CAGS (2006b), student enrolment at the Master's level was stable from 1992 to 1998 and has been increasing slightly every year since 1998. However, the increase has been more pronounced since 2000. At the Doctoral level, student enrolment has been relatively stable from 1992 to 2000 and has been increasing slightly since then.

Factors associated with enrolment growth in graduate studies include job requirement inflation (AUCC, 2005), increased research support from federal and provincial governments and increased university operating

budgets from the provincial governments (AUCC, 2002) and, more generally, government investments in education.

In the next 10 years, enrolment growth is expected to be between 9% and 18% but it will depend on the country's ability to supply and finance the resources required to accommodate this growth (AUCC, 2007).

Scholarships and Decisions to Enrol

The survey of students conducted as part of this evaluation provides empirical evidence concerning the impact of scholarship awards and related programs on enrolment in graduate studies and completion time.

The possibility of receiving a scholarship was an important incentive to almost three-quarters of master's level scholarship recipients, while actually receiving a scholarship was an important incentive to more than three quarters (78%) of recipients at this level.

At the doctorate level, both the possibility and the actuality of receiving a scholarship were also important to seven out of ten award recipients. PGS award recipients at both the master's and doctoral levels assigned slightly less importance to the possibility of, or actually receiving an award, than recipients from other types of scholarship.

A little less than half of all award recipients assigned importance to the prestige of the scholarship as an incentive to enrol. This proportion was similar at both the master's and doctoral levels.

IPS recipients at the master's level were most likely to assign importance to the possibility of receiving a scholarship, but least likely assign importance to the prestige of the scholarship.

CGS scholarship recipients were asked whether a regular scholarship would be as meaningful to them as a CGS scholarship. Almost four Master's CGS-M recipients in ten (39%) agreed that a regular agency scholarship would have been as meaningful to them as a regular PGS-M award, while about half (53%) disagreed, with the remainder neither agreeing nor disagreeing with the statement. The proportion of CGS-D recipients sharing the view that a regular award would have been as meaningful is 21%, while the proportion who disagreed is 74%. Thus the survey results suggest that the majority of CGS recipients assign greater meaning to receiving the more prestigious scholarship. This is particularly true of doctoral recipients, for whom the prestige of CGS is also accompanied by a much greater monetary award.

EXHIBIT 6.1
Importance of various factors in the decision to enrol in graduate studies

(% important)	CGS (a)	PGS (b)	IPS (c)	All
Master's				
The possibility of receiving a scholarship	75%[b]	67%[ac]	81%[b]	73%
Receiving a scholarship	81%	74%	83%	78%
The prestige associated with the scholarship	48%[c]	45%	35%[a]	45%
n	433	295	139	867
Doctorate				
The possibility of receiving a scholarship	70%	67%	77%	68%
Receiving a scholarship	71%	68%	79%	70%
The prestige associated with the scholarship	46%	47%	48%	47%
n	448	820	91	1,359

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.

Between 2004 and 2006, according to program data, 6,412 different individuals were offered a either a Master's or doctorate level scholarship. Of them, 5,726 (89.3%) accepted the offer and 686 (10.7%) declined.

Scholarship Applicants, Offered and Accepted Awards 2004-2006

(%important)	CGS (a)	PGS (b)	IPS (c)	All
Master's				
Applications	4,168		413	4,581
Scholarship Offers	1,505	1,418	405	3,328
Awards Accepted	1,274	1,218	405	2,897
Doctorate				
Applications	4,048		226	4,274
Scholarship Offers	761	2,099	224	3,084
Awards Accepted	713	1,892	224	2,829

Source: *sample file of 2004-2006 applicants included in student survey frame. CGS and PGS applicants are combined due to the common application process*.

Scholarship Acceptance

Based on the survey data, of those who accepted any of the three postgraduate scholarships offered through NSERC, 89% were currently studying in Canada. By type of scholarship, 83% of PGS recipients, 98%

of CGS recipients, and 100% of IPS recipients who accepted a scholarship and were currently studying in the same program for which they applied for their scholarship reported that they currently resided in Canada.

Students who declined awards were asked the main reason they declined: 44% did so because of their plans to study outside of the country; 25% decided not to pursue graduate studies; 17% accepted a different scholarship; and 12% decided to change their field of study.

That so many of those who declined attributed this to plans to study abroad is not surprising. During the period covered by this study (2004-2006), PGS recipients could only study outside of Canada if they justified their case for studying abroad to an NSERC committee and were approved to do so. (Currently, PGS recipients may receive a scholarship when studying abroad if they have received a previous degree in natural sciences and engineering at a Canadian university.) CGS awards are only tenable at Canadian universities, which precludes recipients from studying outside the country[10]. .

Other survey results further confirm that reasons for declining often relate to accepting an offer to study abroad. Of those who declined an offer of any of the postgraduate scholarships and who were still studying at the time of the survey, only 40% were studying in Canada (n=118). By scholarship type, 45% of those who declined a PGS award were studying in Canada and only 33% of those who declined a CGS award were studying in Canada. None of those surveyed who were offered an IPS declined the award. This is likely due to the nomination and application process for IPS, which requires partnerships with industry to be confirmed prior to application for the award.

Degree Completion

Graduation rates vary greatly across universities and across disciplines (CAGS, 2004). At the Master's level, graduation rates vary from a low of 53% in Humanities to a high of 93% in Life Sciences. At the Doctoral level, graduation rates vary from a low of 34% in Humanities to a high of 92% in Life Sciences (Berkowitz, 2003).

Since our study sample goes back only to 2004, it is not surprising that only about one half (48%) of Master's students had completed their degree at the time of the survey. Many students' programs were still in progress at the time of the survey.

[10] It is not known why 2% of CGS recipients who were currently studying in the same program reported they currently reside outside of Canada. Presumably they were either on leave from studies, were working on their studies from outside the country but were still enrolled at a Canadian institution, were no longer in receipt of their CGS funding, or incorrectly replied to one of the questions on the survey.

Among Master's students, recipients of PGS-M awards appear to be slightly more likely to have completed their degree than non-recipients. CGS-M recipients appear to be less likely than PGS-M recipients to have completed their degree. However, after statistical control in a multivariate model, these differences disappear, and it appears that PGS-M and CGS-M recipients are no more or less likely to already have completed their degree than students in the no-award group. The multivariate model did, however, suggest that IPS-1 recipients were *less likely* than all other groups to have already completed their degrees at the time of survey.

At the doctorate level, recipients of PGS-D awards appear to be somewhat more likely to have completed their degree at the time of the survey than students who did not get an award. The bivariate analysis did not reveal any statistically significant differences between for CGS-D or IPS-2 recipients. However, after statistical control in a multivariate model, both the PGS-D and CGS-D groups turn out to have a higher likelihood of completion of their doctorate degree than students in the no award group. The results for IPS-2 recipients were not statistically significant in either the bivariate or multivariate models.

EXHIBIT 6.2
Completion of degree

% who have completed their degree	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
	43%	55%	44%	48%
n	450	307	117	281
Doctorate				
	18%	23%	14%	13%
n	461	858	91	308

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

b. Increased enrolment in graduate studies in Canada

Likelihood to enrol in graduate studies was significantly higher among students who were offered scholarships, when compared to students who did not receive an award.

At the Master's level, PGS-M and CGS-M recipients were about ten percentage points more likely to enrol in graduate studies. The impact of the awards programs may be described as modest. This may be due to the fact that the no award group are also "high achievers", and as such

may also be highly motivated to pursue their studies and have good access to other sources of support (as demonstrated in the section on sources if income later in this chapter). These results were confirmed by multivariate analyses. At the Master's level, both PGS-M and CGS-M awards had a statistically significant positive effect on likelihood of enrolment.

At the doctoral level, award recipients were about four percentage points more likely to enrol. PGS-D and CGS-D awards produced the same effects, while the results for IPS awards cannot be considered statistically significant. In the multivariate analysis, PGS-D awards also had the same effect. However, for CGS-D recipients, the positive effect of the doctoral awards did not quite reach the expected level of statistical significance in the multivariate model.

Comparing the results of this evaluation with the results of the main CGS evaluation revealed one difference of note: the main evaluation found that, across all agencies, 94% of Master's level applicants who did not receive a CGS or agency award went on to enrol in graduate studies; however, among unsuccessful NSERC awards applicants, this percentage was lower, with 90% continuing on to enrol in graduate studies. For highly qualified students in the NSE domain, receipt of a scholarship has a greater impact on likelihood of following through with their planned studies, while students from other domains are somewhat more likely to enrol no matter the outcome of their scholarship application.

EXHIBIT 6.3
Enrolment in graduate studies

% who have enrolled in graduate studies	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
	97%	98%	100%	88%
n	469	319	139	224
Doctorate				
	98%	97%	98%	93%
n	470	883	93	334

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
d The value is statistically different from that of the no award group at least at the 0.05 level.

c. Proportion of Master's award recipients who continue with Doctoral studies

Overall, close to six out of ten (58%) of Master's students plan to attain the PhD level. The results are similar for PGS recipients, CGS recipients, and the no award group. IPS recipients, however, appear to be less

likely to plan to attain a PhD. The multivariate model confirms these results, including the result that IPS recipients are significantly less likely to plan to continue on to a PhD.

Somewhat fewer, about four out of ten students (40%), who applied for a Master's award and who have (successfully or not) completed their Master's program have actually continued on to the PhD level. Whether students were in receipt of awards or not, or awards of different types, was not statistically significant in the survey results. Within the multivariate model, the proportion is similar for students in all groups.

EXHIBIT 6.4
Master's students continuing to the doctoral level

	CGS (a)	PGS (b)	IPS (c)	No award (d)
% of Master's students who plan to attain the PhD level (ns)	61%[c]	60%[c]	39%[abd]	58%[c]
n	469	319	139	224
% of Master's students who have continued to a PhD among those who have completed or left their Master's program (ns)	48%	37%	28%	34%
n	168	151	47	81

abd The value is statistically different from that of all other groups at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.

d. Increased recognition by the research community of the federal government's financial support for research training

Award recipients are considerably more likely than non recipients to consider that the "federal government makes a very significant financial contribution to support research training in Canada". The spread in attitudes between recipients and non-recipients was largest at the doctoral level.

The survey results show that 85% of PGS-M recipients and 88% of PGS-D recipients agreed with this statement, as compared to 61% of Master's and 57% of doctoral non-recipients. Levels of support for this notion were similar for both Master's and doctoral groups, regardless of type of award.

The multivariate analyses confirmed the general results illustrated in the table, but further demonstrated that CGS recipients at the doctoral level had an even greater likelihood of supporting this notion than PGS or IPS recipients.

EXHIBIT 6.5
Perceptions regarding the federal contribution to research training

% who agree that "The federal government makes a very significant financial contribution to support research training in Canada"	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
	85%[d]	85%[d]	85%[d]	61%[abc]
n	469	319	139	224
Doctorate				
	88%[d]	88%[d]	85%[d]	57%[abc]
n	470	883	93	334

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no award group at least at the 0.05 level.

e. Increased numbers of students completing (or expecting to complete) graduate degrees in a timely manner

Gluszynski and Peters (2005) reported that, in Canada, it takes on average 70 months (6 years) to complete a doctoral program. However, there are variations according to the field of study with Physical Sciences (65 months), Mathematics, Computer and information Sciences (65 months), Health Sciences (64 months), Engineering (62 months) and Chemistry (61 months) taking less time and Humanities (82 months) and Social Sciences (77 months) taking longer. Berkowitz (2003) reported similar results from a cohort of doctoral students from 1992 to 2002.

At the Master's level, Berkowitz found that it took students from 3 to 9 terms to complete their degree. The lowest was found in the Humanities (3 terms).

According to this evaluation's student survey, Master's students who completed their degree took a little more than two years to do so (27 months on average).[11] PGS and CGS award recipients generally appear to have adopted a faster pace than non-award students and IPS recipients. The multivariate models confirm this, and provide an estimate that both PGS-M and CGS-M recipients completed their degrees 2 months faster than non-recipients or IPS-1 recipients.

Master's students who have not yet completed their degree expected that it would take them about seven months longer to complete their

[11] Note that the fact that some students were still working on their degree when they filled out the questionnaire tends to lead to an under-estimation of the duration of studies.

degrees (34 months on average). While the bivariate analysis suggests differences by program, with PGS recipients expecting to take longer (37 months on average), the multivariate model revealed no difference: the difference in actual time of completion for PGS recipients did not reach statistical significance.

It may be noted, however, that the multivariate model estimated that, controlling for other factors, IPS recipients anticipate completing their degrees 7 months faster than non-recipients and other award recipients.

At the doctoral level, respondents who had already completed their degree took four years (48 months) on average to do so, while those who had not yet completed their degree expected to do so in only one month more than this (49 months on average). No statistically significant differences in the actual or expected time to complete were observed among groups, in either the bivariate analysis or the multivariate model.

EXHIBIT 6.6
Months to complete a graduate degree

Months to complete the degree	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's, actual months for those who have already completed				
	25[cd]	27[cd]	30[ab]	29[ab]
n	157	141	47	71
Master's, forecasted months for those who have not already completed				
	32[b]	37[ac]	29[b]	34
n	286	163	90	121
Doctorate, actual months for those who have already completed (ns)				
	47	49	46	50
n	64	143	10	21
Doctorate, forecasted months for those who have not already completed (ns)				
	48	48	49	49
n	389	701	80	281

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no award group at least at the 0.05 level.

About one-half of all Master's students indicated that their progress was according to plans or ahead of plans. PGS recipients at the Master's level were of this view 52% of the time, the same as non-recipients. While IPS recipients were notably less likely to agree that their progress was according to plan or ahead of plan, this difference did not survive the test of the multivariate model: accounting for other aspects distinguishing the students, there were no differences between groups in terms of progress through the program.

At the doctoral level, just over half (56%) of all students indicated that their progress was according to plan or ahead of plan. There was no statistically significant difference between the PGS group and the non-award group. The CGS group was more likely than the non-award group to report progress according to or ahead of plan, but this difference also did not survey the test of the multivariate mode: there were no statistically significant differences between groups once other factors were accounted for.

Key reasons for being behind schedule were: the research taking longer than expected (35%), having changed supervisors (13%), teaching assistantships (12%), personal reasons (12%), and lack of funding for living expenses (7%).

Key reasons for being ahead of schedule were: having maintained the same research focus (20%), having maintained the same supervisor (19%), good funding for the research project (16%), and good funding for living expenses (15%).

EXHIBIT 6.7
Progress through the study program

% whose progress through the study program in accordance with your original plan or ahead	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
NSERC	60%[c]	52%[c]	35%[abd]	52%[c]
n	450	307	139	196
Doctorate				
All	63%[cd]	56	45%[a]	54%[a]
n	461	858	91	308

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no award group at least at the 0.05 level.

Awards were considered important by recipients in affecting the pace of their progress through their Master's degree (54%) and their doctoral program (63%). These results are highlighted in the Exhibit 6.8, following. While there appear to be some differences between award groups, there were no statistically significant differences between these groups in the multivariate model.

Awards appear to have a lesser effect on time to program completion: only one-quarter (25%) of all Master's award recipients, and even fewer of all doctoral award recipients (13%), indicated such an effect. There were no statistically significant differences between the different awards

groups at either level of study, whether in the bivariate or the multivariate analysis.

EXHIBIT 6.8
Importance of awards regarding the pace of studies

(% important)	CGS (a)	PGS (b)	IPS (c)
Master's			
The pace of your progress through the study program	54%	51%[c]	64%[b]
The time it took you to complete the program (ns)	21%	27%	30%
n	469	319	139
Doctorate			
The pace of your progress through the study program	63%	59%	68%
The time it took you to complete the program (ns)	12%	14%	8%
n	470	883	93

b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.

f. High-quality research

Nine satisfaction questions were asked regarding the research environment in which respondents studied. The answers to the nine questions were averaged to produce a scale of satisfaction with the research environment (Cronbach's alpha = 0.82)[12]. Scores can vary between 1 and 7.

The data show that award recipients were more satisfied with their research environment than non-award recipients, by a relatively small but statistically significant margin. One may speculate that awards recipients may be more likely to be able to be accepted at institutions and programs with better laboratories and research facilities, and faculty. There were no statistically significant differences between types of awards.

At the Master's level PGS-M recipients scored 5.6 on the satisfaction index, whereas non-recipients scored 5.4.

At the doctorate level, overall levels of satisfaction for award recipients and non-recipients were more equivalent. PGS-D recipients scored 5.7 on the index, and non-recipients scored 5.6.

[12] Cronbach's alpha is a coefficient of consistency used to describe the reliability of psychometric instruments. It measures how well a set of variables or items measures a single, unidimensional latent construct, by estimating the proportion of variance that is systematic or consistent in a set of test scores. The value of Cronbach's alpha will increase when the correlations of items increases, and a value of .70 is considered a minimum level of reliability.

The multivariate model confirms these overall results at both the Master's level and the doctorate level.

EXHIBIT 6.9
Satisfaction with the research environment

(average on a 7-point scale)	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
	5.7[d]	5.6[d]	5.5	5.4[ab]
n	443	303	139	193
Doctorate				
	5.7	5.7[d]	5.7	5.6[b]
n	1,463		932	2,536

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
d The value is statistically different from that of the no award group at least at the 0.05 level.

A little over one-half (54%) of Master's students hold teaching assistant positions. There were no statistically significant differences between groups in this regard, in either the bivariate or the multivariate analyses. A similar proportion (55%) of doctoral students hold positions of teaching assistant. Again, there were no statistically significant differences between groups.

With respect to research assistantships, there were statistically significant differences between recipients and non-recipients and between types of award: at both the Master's and doctoral levels, non-recipients appear to be more likely to receive research assistantships. For example, at the Master's level, twice as many non-recipients held research assistantships than did PGS-M recipients (35% vs. 18%). Of note, IPS-1 recipients were least likely to hold research assistantships, with only one in ten holding a research assistantship.

At the doctoral level, 37% of non-recipients held research assistantships, as compared to 27% of PGS-D recipients. This result holds under the multivariate analysis.

In the bivariate analysis, it may be noted that CGS-D recipients appear to be least likely to rely on research assistantships. However, this result does not hold in the multivariate analysis: while the multivariate analysis confirms that non-recipients are more likely than recipients to hold research assistantships, the incidence is least amongst the IPS group.

EXHIBIT 6.10
Teaching and research assistantship

% with teaching or research assistantship	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
% with teaching assistantship (ns)	61%	53%	53%	54%
% with research assistantship	24%[cd]	18%[d]	10%[ad]	35%[abc]
n	469	319	139	224
Doctorate				
% with teaching assistantship (ns)	54%	54%	51%	56%
% with research assistantship	19%[bd]	27%[ad]	25%	37%[ab]
n	470	883	93	334

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no award group at least at the 0.05 level.

Publications are another indicator of high quality research training. At the Master's level, the average number of presentations given by PGS recipients was higher than the number given by non-recipients (a difference of +0.4 presentations in the multivariate model). The number of research papers produced was slightly less for PGS-M recipients in comparison to non-recipients (a difference of -0.5 papers in the multivariate model). There was no difference in the number of articles produced by any group in the multivariate analysis.

At the doctoral level, PGS recipients made more presentations and produced more articles than students who did not receive awards (+0.8 presentations and +0.6 articles in the multivariate model).

There were no statistically significant differences between the PGS-D and no-award group in terms of the number of research papers produced at the doctoral level. This was confirmed in the multivariate model.

Also of note in the multivariate model, at the doctoral level, CGS recipients also gave more presentations (+0.7), produced more articles (+1.2), and produced more research papers than (+0.6) students who did not receive awards. By contrast, the multivariate model revealed that the IPS and no award groups at both the Master's and doctorate levels were equivalent in terms of output. Given the industrial content of the IPS program, which requires that students spend a minimum of 20% of their time at their sponsoring organization working on activities related to their thesis project, there may be less emphasis on producing papers.

EXHIBIT 6.11
Publications

% with teaching or research assistantship	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
Oral or poster conference presentations	2.6	3.1[d]	3.0	2.4[b]
Articles	0.8[c]	0.9[c]	0.4[abd]	0.9[c]
Research papers, books, book chapters and technical publications	0.6[d]	0.6[d]	0.5	1.0[ab]
n	457	311	137	219
Doctorate				
Oral or poster conference presentations	5.4	5.8[d]	4.3	4.6[b]
Articles	3.3[cd]	3.0[cd]	1.9[ab]	1.9[ab]
Research papers, books, book chapters and technical publications (ns)	19%[bd]	27%[ad]	25%	37%[ab]
n	469	878	89	328

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of no award group at least at the 0.05 level.

g. Increased ability to attract and retain experienced researchers

Among Master's students who completed their degree and held employment at the time of the survey, award recipients are more likely than non-recipients to hold a job that corresponds to their professional expectations. The multivariate model supports this for both PGS and CGS.

In terms of whether students hold employment related to their graduate fields, the multivariate analyses did not indicate any differences between PGS-M recipients and the no-award group. However, the model confirmed that CGS-M recipients are more likely than the other two groups to hold employment that is related to their graduate studies.

Students in receipt of a Master's level NSERC scholarship of any kind were more likely than students who did not receive an award to hold a job that demands a Master's degree. However, all groups were statistically equivalent with respect to whether their job demanded a graduate degree *in their field of study*. These results are supported in the multivariate analysis.

At the doctorate level, these relationships are not replicated, in that the differences do not reach statistical significance. This is true of both the bivariate or multivariate analyses, with the exception that employed IPS-D graduates were less likely than others to hold a job demanding a doctorate (which is consistent with the idea that, in the NSE domain, industry may be more interested in Master's level achievement than in

higher levels). At the doctorate level, due to the small sample of unsuccessful award applicants who have completed their degree and currently hold a job (n=20), one cannot conclude from the survey results whether or not award recipients are more likely than non-recipients to hold jobs requiring high qualifications.

EXHIBIT 6.12
Likelihood of holding a job requiring high qualifications

% of students who have completed their degree and current hold a job	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
% whose current job corresponds to their professional expectations	78%[d]	69%[d]	61%	44%[ab]
% whose employment is related to the graduate studies pursued	88%[bd]	68%[a]	85%	61%[a]
% whose current job demands at least a Master's degree	67%[d]	55%	67%[d]	37%[ac]
% whose job demands a graduate degree in their field (ns)	55%	51%	55%	40%
n	83	95	31	43
Doctorate				
% whose current job corresponds to their professional expectations (ns)	84%	86%	67%	77%
% whose employment is related to the graduate studies pursued (ns)	90%	97%	88%	96%
% whose current job demands at least a doctoral degree	93%[c]	93%[c]	47%[abd]	86%[c]
% whose job demands a graduate degree in their field (ns)	94%	91%[c]	77%	96%[b]
n	58	133	10	20

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of tno award group at least at the 0.05 level.

Master's students who completed their programs and currently held jobs were most commonly employed by the private sector (42%), then by the university sector (36%). Three-quarters of doctoral graduates with jobs were employed in the university sector (73%), with the private sector a distant second (16%). The expectations of current students followed generally similar lines to those described for actual employment, although current Master's students were somewhat more likely to expect to work in the university sector.

The employer of the plurality is the university sector. This is more likely the case among doctoral students than Master's students. The private sector is the second most frequent employer, followed closely by government.

Examining the survey data by type of award did not reveal notable statistically significant differences in terms of sector of employment between the PGS and no award groups.

There were, however, significant differences between IPS graduates and all other groups. IPS recipients are considerably more likely to be employed in, or expect to be employed in, the private sector, and less likely to be employed in, or expect to be employed in the university sector. This holds true at for both Master's and doctoral IPS recipients. This finding is consistent with the industrial nature of the IPS program.

The only other statistically significant difference is that CGS recipients at the Master's level appear to be less likely than the no award group to hold employment in government in their jobs after graduation (5% for CGS-M, as compared to 18% for the non-recipients).

EXHIBIT 6.13
Sector of employment

In which sector…	CGS (a)	PGS (b)	IPS (c)	No award (d)	Total
…are you employed? (of those who completed a program and have a job)					
Master's					
Private Sector	35%[c]	44%	67%[ad]	37%[c]	**42%**
Government	5%[a]	14%	17%	18%[d]	**13%**
University	43%[d]	36%[c]	15%[ab]	36%[a]	**36%**
Not for profit	17%[b]	7%[a]	0%	8%	**9%**
n	88	96	32	42	**258**
Doctorate					
Private Sector	21%[c]	13%[c]	72%[abd]	13%[c]	**17%**
Government	8%	7%	0%	10%	**7%**
University	69%[c]	76%[c]	18%[abd]	77%[c]	**73%**
Not for profit	2%	5%	10%	0%	**4%**
n	74	147	26	90	**337**
...do you expect to work when you graduate?					
Master's					
Private Sector	13%[c]	30%[c]	58%[abd]	33%[c]	**34%**
Government	17%	16%	18%	16%	**17%**
University	49%[c]	52%[c]	19%[abd]	46%[c]	**46%**
Not for profit	3%	1%	4%	5%	**3%**
n	308	180	83	132	**703**
Doctorate					
Private Sector	18%[c]	22%[c]	42%[abd]	21%[c]	**22%**
Government	10%	12%	14%	11%	**12%**
University	71%[c]	65%[c]	44%[abd]	68%[c]	**66%**
Not for profit	1%	1%	0%	1%	**1%**
n	331	571	58	245	**1205**

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

Close to three-quarters of Master's level PGS students who were recipients of awards indicated that their graduate studies increased their desire to pursue a career in research or teaching. This is somewhat more than among students who did not get these awards, where a little more than two-thirds shared this feeling. While the bivariate analysis did not reveal statistically significant differences between groups, the results are supported by the multivariate analysis.

Similar results were obtained among doctoral students although the proportion holding this feeling was larger than among Master's students.

The multivariate model confirmed that PGS-D students were slightly more likely to agree that their desire to pursue research or teaching had increased as a result of the studies.

EXHIBIT 6.14
Desire to pursue a career in research or teaching

% who agree that "The experience I have gained during my studies has increased my desire to pursue a career in research or in teaching that requires my level of training"	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
(ns)	76%	73%	75%	68%
n	450	307	139	196
Doctorate				
(ns)	85%	85%	80%	82%
n	461	858	91	308
(ns) Differences in survey results between the four groups are not statistically significant.				

h. Increased capacity to meet demand for highly qualified personnel (HQP) in public and private sector organizations

About eight in ten Master's students think they are likely to pursue a career in research or in teaching requiring their level of training. About nine in ten doctoral students have the same expectation. The proportion is similar for all groups of award recipients or non-recipients. These results are confirmed by multivariate analyses, with the exception that that Master's level IPS students are confirmed to be less likely than the other groups to consider pursuing a career in research or teaching. According to data from NSERC's career survey, 92% of award recipients (nine years after their award) indicated that their current employment involves research or teaching.

There is also a high level of consensus on the fact that graduate studies are an important element of students' career goals: upwards of 90% agree with this notion. Here again, the proportions are the same, within degree levels, for all three groups of recipients and non-recipients (and in bivariate and in multivariate analyses).

About two in three Master's students indicated that they know what their career goals are. Doctoral students are somewhat more likely to know their career goals, with about three in four agreeing that they do. There is no variation among groups of recipients and non-recipients in this regard, within degree levels, even within the multivariate analysis.

EXHIBIT 6.15
Research and training as career goals

% who agree that "The experience I have gained during my studies has increased my desire to pursue a career in research or in teaching that requires my level of training"	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
% of students likely to pursue a career in research or teaching (ns)	81%	81%	68%	78%
% for whom Master's studies are an important element of their career goals (ns)	92%	90%	95%	87%
% who know what their career goals are (ns)	64%	62%	71%	66%
n	383	228	101	167
Doctorate				
% of students likely to pursue a career in research or teaching (ns)	90%	88%	86%	87%
% for whom Master's studies are an important element of their career goals (ns)	95%	94%	93%	94%
% who know what their career goals are (ns)	74%	76%	85%	77%
n	386	711	77	297
(ns) Differences between the four groups are not statistically significant.				

i. Recipients/highly qualified personnel holding (or expecting to hold) positions in the faculties of Canadian universities

Be they Master's students or doctoral students, award recipients or not, graduate students were more interested in employment at universities, followed by government, the private sector and the not-for-profit sector. Bivariate and multivariate tests all conclude that PGS recipients were no different than non-award students in terms of their employment sectors of interest.

Of note however, the multivariate analyses confirmed differences between the aspirations of IPS recipients and students from the other groups: at the Master's level, IPS-1 recipients are more likely than others to be interested in the private and not for profit sectors, and somewhat less likely than others to be interested in the university sector; while at the doctoral level, the only difference between groups is that IPS-2 recipients are more likely to consider the private sector. This is not surprising, given that IPS recipients receive a portion of their award from, and collaborate with, an industry organization. These findings are consistent with the earlier findings on IPS recipients regarding their sector of employment, or the sector that they expect to find employment in, on graduation (see Exhibit 6.13).

EXHIBIT 6.16
Interest in employment in various sectors

% very much or extremely interested in employment in various sectors	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
Private sector (ns)	53%	52%	67%	57%
Government (ns)	55%	52%	53%	47%
University (ns)	68%[c]	64%	50%[ad]	67%[c]
Not-for-profit (ns)	33%	33%	42%	31%
n	387	230	105	167
Doctorate				
Private sector (ns)	43%[c]	46%[c]	67%[abd]	47%[c]
Government (ns)	46%[c]	49%[c]	66%[ab]	54%
University (ns)	76%	76%	71%	74%
Not-for-profit (ns)	25%	26%	31%	24%
n	395	717	78	290

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

While only 19% of all doctoral award applicants surveyed had completed their program at the time their survey interview, it is nevertheless of interest to examine their outcomes in relation to pursuing post-doctoral research and securing positions as university faculty.

Close to three in four of those who completed a doctorate degree continued on to pursue post-doctoral research. There were no statistically significant differences between PGS or CGS recipients and the non-award group, either in the bivariate or multivariate model.

The only statistically significant difference observed is that the small sample (n=11) of IPS doctoral graduates surveyed was much less likely than the other groups to pursue post-doctoral studies. This result should be interpreted with caution due to the small sample size.

EXHIBIT 6.17
Post-doctoral research

	CGS (a)	PGS (b)	IPS (c)	No award (d)
% of doctoral students who continued with post-doctoral research	75%[c]	77%[c]	26%[ab]	67%
n	69	154	11	27

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.

Of all students in the sample who completed a doctorate degree, only one in twenty held faculty positions at the time they were interviewed. Neither the bivariate analysis nor the multivariate analysis revealed any statistically significant differences among the four groups examined.

EXHIBIT 6.18
Likelihood of holding a faculty position

	CGS (a)	PGS (b)	IPS (c)	No award (d)
% of doctoral students who hold a faculty position (ns)	4%	4%	7%	11%
n	69	154	11	27
(ns) Differences between the four groups are not statistically significant.				

j. Improved branding of Canada as a home of research excellence and Canadian universities as world-class research centres

Improved branding of Canada as a home of research excellence and world-class university research centres is an intended outcome of the federal CGS program. It is not an intended outcome specifically identified for regular agency awards in NSERC's Scholarships and Fellowships umbrella logic model. However, promotion of the capacity of the Canadian universities to industry is an intended industrial outcome in the S&F model.

Master's students averaged close to one (0.9) presentation at an international conference. Recipients of PGS awards averaged slightly (but significantly) more presentations at international conferences than Master's students who did not receive an award or who received other awards, who were statistically equivalent. These results are confirmed by the multivariate analyses, in which the PGS group averaged +0.2 presentations as compared to all others.

Doctoral level students averaged 2.7 presentations at international conferences. Award recipients produced almost one presentation more than non-recipients, with the exception of IPS recipients who were equivalent to non-recipients. The multivariate model brings the estimates of the differences down somewhat, but confirms this general pattern (PGS, +0.5 presentations; CGS, +0.6 presentations).

EXHIBIT 6.19
Presentations made at international conferences

Average number of presentations at international conferences	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
	0.9	1.1[cd]	0.7[b]	0.8[b]
n	468	318	139	224
Doctorate				
% of doctoral students who hold a faculty position (ns)	3.0[d]	3.0[cd]	2.0[b]	2.2[ab]
n	469	881	92	331

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

6.2 What are the overall incremental program impacts? To what extent can outcomes be attributed in whole or in part to the CGS Program and/or other scholarship programs?

Program success was described in the previous section. Exhibit 6.20 provides a snapshot of findings regarding the incremental impact of PGS and other NSERC scholarship programs.

This summary is mainly based on the multivariate models developed using student survey data and the comparison of the treatment groups. The quality of the available evidence is also depicted. Measures with no evidence of positive or negative impact for a given award group are left as blank cells in the table.

Readers are reminded that the comparisons are made between a highly qualified group of students who received NSERC awards, and a similarly highly qualified group of non-recipients. The multivariate analysis measures the impact of NSERC awards on a cohort of highly qualified students *above and beyond* the impacts of other excellence-based awards or other sources of support accessed by non-recipients. It should be noted that this evaluation framework was not designed to measure the impact of NSERC scholarship funding on the academic system as a whole.

Readers are also reminded that, when interpreting the 'negative impacts' associated with awards programs, in some cases the overall survey response was less positive for an award group in comparison to the no award group, but nonetheless positive for all groups.

Awards (PGS or related awards alike) were associated with ***positive outcomes*** with regard to:

- increased enrolment in graduate studies by awards recipients, most notably at the Master's level (expressed in the bivariate analysis as 10% more Master's awards recipients starting their programs as compared to non-recipients);
- increased incentives for students to enrol in graduate studies;
- increased incentives for doctoral students to complete their studies;
- faster program completion (in a limited way at the Master's level);
- increased recognition by the research community of the federal government's financial support for research training;
- high-quality research (in a limited way);
- increased ability to attract and retain experienced researchers (in a limited way, and mostly for Master's level awards);
- improved branding of Canada as a home of research excellence and Canadian universities as world-class research centres.

Award programs (PGS and related programs alike) had ***no significant impact*** on the following outcomes for the cohort of "high achievers" examined, at least on the basis of the evidence examined:

- increased total enrolment in graduate studies in Canada;
- continuing doctoral studies after a Master's degree;
- increased capacity to meet demand for HQP;
- increase in HQP holding (or expecting to hold) positions in the faculties of Canadian universities.

It may be noted that there was limited evidence available to assess certain of the evaluation issues. For example, the only evidence speaking to the intended outcome of increased capacity to meet demand for HQP in Canada was examination of students' stated career goals and expectations regarding the likelihood of pursuing a career in research and teaching. Even if one cannot measure significant differences between award and no award groups in this regard, it may be argued that NSERC scholarship programs maintain and support the supply of HQP. The current evaluation framework was not designed to measure the impact on the whole of the postgraduate education system (or on the overall supply of HQP) if the funding was removed.

As well, the current design limits the ability to conclusively assess whether receipt of an NSERC award has a significant impact on increase in HQP holding faculty positions; the NSERC award recipient cohort surveyed for this evaluation was matched to the CGS cohort and as a result, many of the doctoral award recipients surveyed have not yet

completed their PhD's, so the sample sizes for questions regarding outcomes such as pursuit of post-doctoral research or securing faculty positions at Canadian universities.

At the Master's level, PGS has generally the same impacts as CGS, which stands to reason given the similarity of the awards. The analysis showed that PGS-M has incremental impacts beyond CGS-M only inasmuch as PGS recipients gave more oral or poster conference presentations and also more presentations at international conferences. The main difference is CGS's branding as the most prestigious award, and its restriction to study only in Canada.

Also at the Master's level, IPS-1 recipients differ from PGS-M recipients in that they were somewhat less likely to report progressing through their program according to or ahead of plan. They were also less likely to have continued on (or have intentions of continuing on) to academic careers. Readers are reminded that a number of the IPS impacts noted as 'negative' in the summary table may be a natural consequence of an alignment of student career goals with the nature of the IPS program, which involves close collaboration with industry. The program requires students spend at least 20% of their time at the sponsoring organization on work related to their research, and there may be less emphasis on activities such as producing papers and publishing articles.

At the doctoral level, the impacts for PGS are again fairly similar to those for CGS, with some differences. The multivariate analysis showed more evidence of positive incremental impacts for PGS-D than for the other awards programs, including: increased likelihood students will enrol in studies after being offered the award; higher levels of satisfaction with the research environment (associated with the evaluation issue of high-quality research); and, increased ability to attract and retain experienced researchers (in a limited way). Simply because there is a lack of evidence of certain impacts for the other awards, it does not necessarily follow that PGS-D is superior to CGS-D or IPS-2. At this level, PGS-D differs from CGS-D in that it has a lesser size of award and has fewer restrictions on country of study, whereas CGS-D is branded as the most prestigious award.

EXHIBIT 6.20
Summary of findings on program success

	Master's			Doctorate			Quality of the evidence
	CGS vs. no award	PGS vs. no award	IPS vs. no award	CGS vs. no award	PGS vs. no award	IPS vs. no award	
Increased incentives for students to enrol in graduate studies	Positive	Positive	Positive	Positive	Positive	Positive	Moderate[1]
Increased incentives for students to complete graduate studies			Negative	Positive	Positive		Moderate[2]
Increased enrolment in graduate studies in Canada		Positive			Limited Positive	Limited Positive	Strong[3]
Proportion of Master's students who continue with doctoral studies				- Not applicable -			Moderate[2]
Increased recognition by the research community of the federal government's financial support for research training	Positive	Positive	Positive	Positive	Positive	Positive	Strong[3]
Increased numbers of students completing (or expecting to complete) graduate degrees in a timely manner (months to complete)	Limited Positive	Limited Positive	Positive				Strong[3]
Progress through program according to or ahead of plan			Negative	Positive			Moderate[1]
Importance of award regarding pace of study through program	Mixed Opinion	Mixed Opinion	Positive	Positive	Positive	Positive	Moderate[6]
Importance of award regarding the time it took to complete the program	Mixed Opinion	Mixed Opinion	Mixed Opinion	Mixed Opinion	Mixed Opinion	Mixed Opinion	Moderate[6]
High-quality research. (individual measures below)	Limited Positive	Limited Positive	Negative	Limited Positive	Limited Positive	Negative	Strong[3]
.... satisfaction with research environment	Positive	Positive			Positive		Strong[3]
.... hold teaching assistantships							Strong[3]
.... hold research assistantships	Negative	Negative	Negative				Strong[3]
.... oral or poster conference presentations given		Positive		Positive	Positive		Strong[3]
.... articles published			Negative	Positive	Positive		Strong[3]
.... research papers, books, chapters, technical publications	Negative	Negative	Negative	Positive			Strong[3]
Increased ability to attract and retain experienced researchers (individual measures below)	Positive	Positive	Limited Positive		Limited Positive	Limited Negative	Moderate[4]
.... current job corresponds to professional expectations	Positive	Positive					Moderate[4]
.... employment related to studies	Positive	Positive					Moderate[4]
.... job requires degree of level of study taken (Master's; doctoral)	Positive	Positive	Positive			Negative	Moderate[4]
.... job requires graduate degree in student's field of study							Moderate[4]
.... Increased desire to pursue a career in research or in teaching that requires their level of training		Positive	Positive		Positive		Moderate[4]

	Master's			Doctorate			Quality of the evidence
	CGS vs. no award	PGS vs. no award	IPS vs. no award	CGS vs. no award	PGS vs. no award	IPS vs. no award	
Expected increased capacity to meet demand for highly qualified personnel (HQP) in public and private sector organizations (individual measures below)	- Nil effect / inconclusive -			- Nil effect / inconclusive -			Weak[5]
.... likelihood of pursuing a career in research or teaching			Negative				Weak[5]
.... graduate studies an important element of career goals							Weak[5]
.... know own career goals							Weak[5]
Recipients/highly qualified personnel holding (or expecting to hold) positions in the faculties of Canadian universities (individual measures below)			Negative	- Nil effect -			Moderate[2]
.... interested in employment in the university sector			Negative				Moderate[2]
.... pursued post-doctoral research			Negative				Moderate[2]
.... doctoral students who now hold a faculty position							Moderate[2]
Improved branding of Canada as a home of research excellence and Canadian universities as world-class research centres (number of presentations at international conferences)		Limited Positive		Positive	Positive		Weak[5]

[1] Self-assessed impacts.
[2] Limited time to document effects.
[3] Comparisons could be drawn among treatment groups and time elapsed since the award was not a factor.
[4] Small sample sizes.
[5] Limited indicators.
[6] Self-assessed impacts for questions asked of scholarship recipients only, thus no comparison with the no award group is possible. Measures are listed as 'positive' if the majority of respondents answered the question positively, and 'mixed opinion' if 55% or less answered the question positively. However, the measures differ from others in the table as they are not actually the incremental impacts above and beyond the no award group.

6.3 What are the comparative impacts for graduate students funded through NSERC scholarship programs and students who rely on other means of support?

The preceding sections presented information on intended outcomes identified in the logic model on which this evaluation was based, the majority of which are common to PGS, CGS, and IPS. The evaluation also verified the existence of a number of other effects that funding may have on graduate students. Some of the measures reported on below are intended outcomes of the PGS and/or IPS programs (but not of CGS), while others may constitute positive, unintended consequences that the awards programs are not necessarily held accountable for producing.

Reasons for attending graduate school

The primary reason for which students attend graduate school is their deep interest in the field of study; more than 9 in 10 indicated that it was an important factor. The second most important reason is the challenge itself, cited by 7 in 10 respondents, followed by the necessary credentials for a desired position, cited by 6 in 10 respondents.

The relative and absolute importance scores provided by Master's students are very similar to those of doctoral students.

Amongst the NSERC award applicants surveyed, few statistically significant differences exist between award groups, whether in the bivariate or the multivariate model. Where differences exist, award recipients generally assigned more importance than students who did not receive awards. Of interest, all award recipients at the doctoral level, and PGS-M and CGS-M recipients at the master's level, were more likely than unsuccessful applicants to cite encouragement from faculty as a reason for attending graduate school. However, all in all, no telling pattern emerges from the comparison of reasons for attending graduate school according to award groups.

EXHIBIT 6.21
Reasons for attending graduate school

% stating that the following were important in their decision to enrol in a graduate study program	CGS (a)	PGS (b)	IPS (c)	No award (d)	All students
Master's					
Your deep interest in the field of study (ns)	90%	92%	94%	86%	90%
The challenge alone or the goal for its own sake (ns)	68%	71%	70%	74%	71%
The necessary credentials for a desired position (ns)	61%	61%	65%	55%	60%
Encouragement from faculty (ns)	53%	54%	48%	45%	51%
Contributing to the improvement of the quality of life for Canadians (ns)	50%	51%	54%	48%	50%
Securing another form of financial support	33%[d]	30%[d]	41%	49%[ab]	37%
n	450	307	139	196	1,092
Doctorate					
Your deep interest in the field of study (ns)	94%	93%	94%	90%	92%
The challenge alone or the goal for its own sake (ns)	72%	73%	81%	69%	72%
The necessary credentials for a desired position (ns)	68%	67%	63%	67%	67%
Encouragement from faculty (ns)	59%[d]	55%[d]	61%[d]	43%[abc]	53%
Contributing to the improvement of the quality of life for Canadians (ns)	50%	51%	54%	48%	50%
Securing another form of financial support	30%[bcd]	43%[ac]	61%[ab]	46%[a]	42%
n	461	858	91	308	1,718

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.
(ns) No statistically significant differences between groups.

Interaction with faculty on research projects

Respondents were asked to rate how involved they were in eleven research-related activities, with their supervisor and other faculty. Subjected to factor analysis, the data showed that there were three relevant groupings of the eleven activities. They were:

- core research activities:
  - participating in designing research projects and methodology;
  - collecting data and information;
  - analyzing research results;

- presenting research results at conferences;
- publishing articles or books about research results;
- using laboratory equipment and instruments;

· research support activities:
- writing grant proposals / applications;
- providing administrative support in the context of a research project;
- managing databases;

· research in different environments:
- conducting research in an interdisciplinary environment;
- conducting research in collaboration with the private sector, not-for-profit, government.

Average values of involvement were calculated for each student on each scale (Cronbach's alpha: core research activities, 0.79; research support activities, 0.64; research in different environments, 0.41[13]).

Graduate students were generally more involved in core research functions than they are in research support activities. The lowest scores were given to participation in research taking place in multi-disciplinary or non-academic settings. This holds at both the Masters and the doctoral levels.

The PGS, CGS, IPS, and no award groups showed similar patterns of participation in research activities. The multivariate analyses confirmed a few statistically significant differences between groups. At the Master's level, PGS-M recipients were slightly more likely than Master's students who did not receive awards to be involved in research in different environments. At the doctoral level, PGS-D and CGS-D recipients were more involved than their no award counterparts in core research functions.

The largest statistically significant differences with respect to research engagement were between IPS recipients and the no award group, in both the bivariate and multivariate analyses. At both the Master's and doctoral levels, IPS-1 and IPS-2 recipients were more likely than the no award groups to be involved in research in different environments, and in research support functions, with no diminution of their participation in core research functions relative to other students. This suggests that the IPS program is successful in its goal of providing opportunities for collaboration between industry and awards recipients.

[13] While the Cronbach's alpha for 'research in different environments' is lower than the commonly accepted thresholds for this test, this grouping has been maintained for consistency with the main CGS evaluation, and to maintain the other two groupings, which are within good ranges for reliable internal consistency.

EXHIBIT 6.22
Involvement in research activities

Involvement in research activities (average on a 7-point scale)	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
Core research activities	5.3	5.3	5.1	5.0
Research support activities	3.4[c]	3.3[c]	3.9[abd]	3.3[c]
Research in different environments	3.4[c]	3.5[c]	5.0[abd]	3.2[c]
n	450	307	139	196
Doctorate				
Core research activities	5.8	5.8[d]	5.6	5.6[b]
Research support activities	3.6	3.6	3.8	3.4
Research in different environments	3.6[c]	3.6[c]	5.2[abd]	3.6[c]
n	461	858	91	308

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

From a purely descriptive standpoint, it is interesting to observe that the majority of graduate students regularly interact with other researchers at their institution. At both Master's and doctoral levels, 81% of graduates indicated that they had frequent interactions with researchers in their discipline at their institution.

Just over one-third (35%) of Master's students frequently interacted with researchers from other disciplines within their institution, while fewer (22%) interacted with researchers in their own discipline at other institutions. Just over one-third (36%) of doctoral students frequently interacted with researchers from other disciplines within their institution, while a similar proportion (35%) interacted with researchers in their own discipline at other institutions. Fewer than one in ten students reported regular interactions with researchers in other disciplines at other institutions.

EXHIBIT 6.23
Interactions with other researchers (levels of study)

% involved at least frequently in interactions with researchers from...	Master's level (a)	Doctorate level (b)
your discipline at your institution (ns)	81%	81%
other disciplines at your institution (ns)	36%	36%
your discipline at other institutions	22%[b]	35%[a]
other disciplines at other institutions	4%[b]	8%[a]
n	1,092	1,718

a The value is statistically different from that of the Master's level at least at the 0.05 level.
b The value is statistically different from that of the doctoral level at least at the 0.05 level.
(ns) no statistically significant difference

Factor analysis indicated that responses to these four questions measure one common underlying factor that we labelled "interactions with other researchers". We built a summary score out of the average for these four answers (Cronbach's alpha = 0.66).

Differences in the level of interaction with researchers according to the award groups appear to be negligible. In the bivariate analysis, the multivariate analysis suggested only that CGS-M recipients are very slightly more likely to enjoy interactions with researchers.

EXHIBIT 6.24
Interactions with other researchers (treatment groups)

Interactions with researchers (average on a 7-point scale)	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
(ns)	4.0	3.9	3.9	3.8
n	450	307	139	196
Doctorate				
(ns)	4.3	4.2	4.1	4.2
n	461	858	91	308

(ns) Differences between groups are not statistically significant.

Sources of support

The graduate students selected for this survey were all preselected by their universities as highly qualified to apply for NSERC scholarships. The survey results show that the average income from all sources for these students in their last year of study was approximately $26,000 for Master's students and $30,000 for doctoral students.

The majority of monetary support for these students comes from excellence based awards, followed by teaching assistantships, research assistantships, other earned income, and stipends (defined on the

survey questionnaire as “amounts paid to do your own research”). Generally speaking, loans account for little (less than 5%) of the income of these highly qualified NSE students.

Examination of the data by award group reveals the NSERC scholarships have a measurable impact on graduate student income above and beyond other sources of funding available to these students. Income from different sources is outlined by award group in Exhibit 6.25.

At the Master’s level, PGS-M recipients declared annual income $2,300 larger[14] than non-recipients (that is, non recipients of NSERC awards). CGS-M and IPS-1 recipients had incomes in the same general range as PGS-M recipients. NSERC award recipients relied on their awards for approximately 70%-72% of their income. The group that did not receive NSERC awards relied on excellence-based awards for 40% of their income, and were more likely to rely on teaching assistantships, research assistantships, loans, earned income, and stipend support.

The overall results at the Master’s level suggests that PGS-M and other awards appear to augment student’s income by about 10% on average, reduce their work-for-pay burden, and furthermore also appear to reduce their loan burden by about $1,500 per year on average. The multivariate analyses support the conclusions above.

At the doctorate level, we see similar impacts in terms of augmentation of income, and reduction in work-for-pay and loan burdens. PGS-D recipients declared income that was $1,250 higher than that of non-recipients.[15] This suggests that the overall impact of PGS-D is a 5% augmentation of income for award recipients.

PGS-D recipients relied on their awards for approximately 69% of their income. The group that did not receive NSERC awards relied on excellence-based awards for 49% of their income, and were more likely to rely on assistantships, stipends, earned income, and loans.

The results were more dramatic for CGS-D recipients, who had incomes approximately $9,800 greater than their no award counterparts. CGS-D awards had the impact of increasing student income by approximately 36%. This is not surprising, given the size of CGS awards at the doctoral level ($35,000 per year for CGS-D compared to $21,000 for PGS-D).

[14] The descriptive statistics in the bivariate model suggest that PGS-M appears to have a positive impact, of +$2,300. The multivariate model, which controls for other factors, suggests that PGS-M has an incremental impact on income that is similar, at +$2,100.

[15] $1,200 more in the bivariate analysis. This is further reinforced by the multivariate analysis, which suggests that, when controlling for other factors, PGS-D has an incremental impact on income of $1,700.

Examining the various sources of funding accessed by doctoral students reveals that recipients of NSERC awards have decreased work-for-pay and student loan burdens than non-recipients. PGS-D appears to reduce the overall loan burden by about $1,100 per year of study, while CGS-D appears to reduce overall loan burden by about $1,400 per year.

EXHIBIT 6.25
Sources of income

Students' average income ($)	CGS (a)	PGS (b)	IPS (c)	No award (d)	Overall Average
Master's					
Loans from your friends and family?	205[d]	245[d]	343	730[ab]	365
Loans from others, including financial institutions?	400[d]	418	884	1,350[a]	784
Money given to you (excluding loans)?	432	361	183	372	373
Teaching assistantships?	3,125	2,523[d]	1,906[d]	3,497[bc]	2,938
Research assistantships?	1,335[d]	1,207[d]	634[d]	3,731[abc]	1,859
Other earned income?	614	1,224	1,407	1,869	1,188
Excellence-based awards?	19,220[d]	18,320[d]	18,816[d]	10,473	16,641
Need-based award (e.g., bursary)?	105[d]	103[d]	190	542[ab]	227
Amounts paid to you to conduct your own research?	857	647	878	1,372	933
Other sources?	417	162	388	420	343
TOTAL	26,988[d]	26,390	26,223	24,081[a]	25,983
n	379	227	105	159	870
Doctorate					
Loans from your friends and family?	76[d]	224[d]	299	659[ab]	323
Loans from others, including financial institutions?	256[d]	373[d]	1,148	1,051[ab]	582
Money given to you (excluding loans)?	479	515	271	360	450
Teaching assistantships?	2,713[d]	3,068[d]	2,119[d]	3,837[abc]	3,169
Research assistantships?	1,428[d]	2,092[d]	1,679[d]	3,958[abc]	2,475
Other earned income?	735	808	1,448	1,528	1,033
Excellence-based awards?	30,220[bcd]	19,966[d]	18,657[d]	13,451	20,048
Need-based award (e.g., bursary)?	91	149	324	290	186
Amounts paid to you to conduct your own research?	420[d]	643[d]	441[d]	2,402[abc]	1,099
Other sources?	223[c]	292[c]	1,035[ab]	396	346
TOTAL	37,272[bcd]	28,753[acd]	27,700[abd]	27,501[abc]	30,035
n	392	711	78	284	1,465

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

Again, it may be noted there is significant excellence based scholarship funding available to the unsuccessful, but otherwise highly qualified, NSERC applicants. Nevertheless, NSERC funding appears to be the

premier award for highly qualified students in terms of coverage and quantum. Excellence based scholarships account for $13,500 of non-recipients' funding at the doctoral level and $10,500 of non-recipients' funding at the Master's level. This is significantly less than the average scholarship funding provided to awards recipients.

Stipends (or amounts paid to students to do their own research) have a limited impact on overall funding support for the group of students surveyed. Stipend support contributes more to the incomes of the no-award group at the doctoral level ($2,402 on average) than to non-recipients at the Master's level ($1,370 on average). Nevertheless, stipends still account for only 9% of doctoral non-recipients' student income, and 6% of Master's non-recipients' student income. As the cohorts surveyed were all highly qualified for scholarship consideration to start with, it is not surprising that excellence based awards contribute more than stipends to the overall funding of unsuccessful NSERC applicants.

Of note, further exploration of the survey data using multivariate analysis also revealed that graduate students at both levels of study who received significant stipend income reported less income from research assistantships, which supports the notion that these high calibre students have a number of alternative sources of support available to them. However, at the Master's level, those who received larger stipends tended to have a higher average income than those who did not[16]. This suggests that for students of the calibre examined, stipends at the Master's level may function somewhat more as a *supplementary* than an *alternate* source of funding. More research would be required to explore whether this holds true for other stipend recipients who were not included this study (i.e., stipend recipients as a whole as opposed to only those nominated to apply for NSERC awards).

Employment during graduate school

Including those who declared that they typically did not work for pay during their graduate program, PGS recipients at the Master's level averaged 4 hours of paid work per week which is less than the 7 hours worked by non-recipients. CGS-M recipients worked 4 hours, IPS-1 recipients, 5 hours.[17]

At the doctoral level, PGS-D recipients averaged 4 hours of work, compared to 6 hours for non-recipients. CGS-D recipients worked 3

[16] Higher by about $3,900 according to the multivariate analysis.

[17] It may be noted that, in the main CGS evaluation, it was reported that Master's non-recipients across all agencies worked 12 hours on average. However, this research cannot determine whether this is because Master's students NSE domain have less pressure to work for income, or perhaps because they have less available time to work, than those studying in other academic domains.

hours on average, supporting the concept that larger scholarships reduce the work-for-pay burden.

Of note, IPS recipients averaged more hours of work per week than other award recipients, even though the size of their awards is the same or greater than PGS awards. This may be consistent with the nature of the IPS program: This study cannot confirm, but can postulate, that the context of collaboration with industry partners may provide additional opportunities for paid work related to the IPS student's interests.

The results at both levels are supported by the multivariate analyses.

EXHIBIT 6.26
Hours of employment during graduate studies

Weekly hours of employment during graduate studies	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
	3.6[d]	3.7[d]	5.2	6.5[ab]
n	450	307	139	196
Doctorate				
	2.9[cd]	4.0[d]	5.3[a]	5.5[ab]
n	461	858	91	308

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

Overall, close to half of all of the students surveyed held a paid job during their graduate program.

Obtaining an award decreased the likelihood of working during graduate studies. At the Master's level, 20% fewer PGS recipients worked during their program, as compared to non-recipients. This result is confirmed by the multivariate analysis.

At the doctoral level, differences were less apparent. Only 5% fewer PGS recipients were employed during their program, and the multivariate analysis did not show any distinction between the PGS and no award groups. It may be noted, however, that CGS-D awards had a statistically significant impact on whether doctoral students worked (14% fewer worked as compared to non-recipients), which again stands to reason given the size of the award.

At both graduate levels, PGS had a large effect on the reasons why students take on employment: PGS recipients were significantly more

likely than non-recipients to indicate that they worked by choice (rather than by obligation) compared to non-recipients. As might be expected, the level of choice was greater for recipients of the larger CGS-D awards.

EXHIBIT 6.27
Working during graduate studies

	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
Had a paid job during the graduate program	47%[d]	38%[d]	47%	58%[ab]
Had an academic job	43%[b]	32%[ad]	33%	47%[b]
n	450	307	139	196
(If had a job) job contributed to the CV (very much or extremely)	55%	54%	56%	44%
(If had a job) worked by choice	61%[bc]	50%[ac]	40%	31%[ab]
n	214	123	65	111
Doctorate				
Had a paid job during the graduate program	37%[bc]	46%[a]	44%	51%[a]
Had an academic job	34%[a]	41%	29%	44%[d]
n	461	858	91	308
(If had a job) job contributed to the CV (very much or extremely)	62%[c]	61%[c]	65%	44%[ab]
(If had a job) worked by choice	62%[bc]	52%[ac]	34%	28%[ab]
n	170	388	40	156

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

Mobility

Students viewed awards as providing them with more freedom to study where they wanted, rather than as a constraint to this freedom of mobility.

We interpret this to mean that the funding offered by these scholarships allow students to be mobile whereas, without the scholarship, they would have been constrained to an institution that would have demanded less of an investment from them.

Overall, approximately two-thirds of graduates students at all levels who received a scholarship of any kind (whether an NSERC award or another) were of the opinion that their award gave them more freedom to study where they wanted.

At both graduate levels, PGS and CGS recipients found the award more liberating than either non-recipients did of the awards they received from non-federal sources. The results were most marked at the Master's level, where three-quarters of PGS-M and CGS-M recipients indicated that their award gave them more freedom to study where they wanted, as compared to less than half of non-recipients. At the doctorate level, CGS and PGS scholarships were also associated with more freedom to choose universities. It is interesting to note that about half of IPS recipients felt that their award provided them with the freedom to study where they wanted, while half presumably felt somewhat constrained to study at their institution in order to collaborate with their industrial partner.

However, while the differences discussed above were significant in the bivariate analysis, there did not appear to be statistically significant differences between awards groups when controlling for the other factors tested for in the multivariate analysis.

EXHIBIT 6.28
Mobility for scholarship recipients

	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
% who stated their scholarship increased their freedom to study where they wanted	75%[cd]	75%[cd]	48%[ab]	44%[ab]
n	441	300	139	136
Doctorate				
% who stated their scholarship increased their freedom to study where they wanted	68%[cd]	67%[cd]	48%[ab]	56%[ab]
n	458	846	91	458

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

Barriers to continuing graduate studies

Overall, 58% of Master's students and 62% of doctoral students who received awards indicated that they would have pursued graduate school even without scholarship support. The proportions are similar for CGS and PGS recipients. However, IPS recipients were somewhat less confident that they would have pursued their studies without scholarships (49% of IPS-1 and only 34% of IPS-2 recipients).

Larger proportions, two-thirds of all Master's students and three-quarters of all doctoral students, stated that they would have proceeded *more slowly* without scholarship support. Here, there is no distinction between awards groups.

These results were corroborated by the multivariate analyses.

EXHIBIT 6.29
Barriers to graduate studies

	CGS (a)	PGS (b)	IPS (c)
Master's			
% who stated that they would have continued to pursue graduate school even without scholarship support	58%	62%[c]	49%
% who stated that they would have proceeded more slowly without scholarship support	71%	64%	63%
n	433	295	139
Doctorate			
% who stated that they would have continued to pursue graduate school even without scholarship support	62%[c]	64%[c]	34%
% who stated that they would have proceeded more slowly without scholarship support	76%	72%	70%
n	448	820	91

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

Marketability

According to a large majority of all students (87%), graduate studies improved their prospects of getting a permanent job in an area relevant to their studies.

Receipt of an NSERC award appears to enhance recipients' perceptions of their own marketability. At both the Master's and doctorate levels, award recipients were more likely (by 10%-15%) to feel that graduate studies enhanced their employment prospects than non-recipients. These differences were confirmed by multivariate analyses.

EXHIBIT 6.30
Impact of studies on getting employment in a related area

% who stated that graduate studies improved their prospects of getting a permanent job in an area relevant to their studies	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
	89%[d]	89%[d]	94%[d]	79%[abc]
n	404	276	129	172
Doctorate				
	91%[d]	91%[d]	88%	78%[ab]
n	431	793	87	276

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

The survey results confirm that NSERC awards have a high profile at universities. Awareness of recipients' awards was high amongst both peers and professors, and the awards almost always inspire pride amongst the recipients.

At both the Master's and doctorate levels, the visibility of the awards to peers was about 84% on average, while the visibility of the awards to professors was about 79% on average. About 90% of students at both levels of study were proud to tell others about their award.

Levels of opinion for these measures were uniform across the different awards groups. Multivariate analysis supported these findings. These findings suggest that neither PGS nor IPS students view their awards as a second class or lower prestige award in comparison to the CGS (which is branded as the most prestigious award).

EXHIBIT 6.31
Visibility of award recipients

Visibility	CGS (a)	PGS (b)	IPS (c)
Master's			
% whose peers were aware of their award (ns)	81%	87%	86%
% whose professors were aware of their award (ns)	78%	78%	77%
% proud to tell others about their award (ns)	90%	87%	91%
n	433	295	139
Doctorate			
% whose peers were aware of their award (ns)	83%	84%	83%
% whose professors were aware of their award (ns)	80%	79%	77%
% proud to tell others about their award (ns)	87%	88%	88%
n	448	820	91
(ns) no statistically significant differences between groups			

With respect to academic marketability, opinion was mixed as to whether NSERC awards factored into recipients' choice of supervisor, or the interest of supervisors in the recipients. The awards appear to be slightly more important to supervisor interest in recipients than the other way around.

At the Master's level, on average, about 44% of all recipients indicated that the award was important in their selection of a supervisor, whereas 55% indicated that the award was important in their supervisor's interest in them. Opinion was generally consistent across award groups, although IPS recipients were a bit more likely to assign importance to their award with respect to choice of supervisor. This result is supported by the multivariate analysis. Once again, the difference observed for IPS is likely due to the nature of the program, which requires that both the supervisor and student establish and maintain a partnership with industry.

At the doctoral level, NSERC awards appeared to less frequently factor into student choice of supervisors, with only 36% indicating that their award was important into this regard. Somewhat more, about 46% thought the award was important to their supervisor's interest in them. Again, opinion was generally uniform across groups, although, interestingly, somewhat fewer CGS recipients assigned importance to the award in the interest that supervisors extended them. These results are again supported by the multivariate analysis.

EXHIBIT 6.32
Academic marketability

	CGS (a)	PGS (b)	IPS (c)
Master's			
% who indicated that the award was important in their choice of supervisor	44%	40%[c]	53%[b]
% who indicated that the award was important in the interest of supervisors (ns)	57%	53%	50%
n	433	295	139
Doctorate			
% who indicated that the award was important in their choice of supervisor	33%[c]	37%	49%[a]
% who indicated that the award was important in the interest of supervisors (ns)	40%[b]	48%[a]	49%
n	448	820	91

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
(ns) No significant differences between groups.

Professional skills development

Students rated the improvement of thirteen different skills during their graduate program. The percentage of students citing improved skills ranged from 46% for societal and civic responsibilities to 94% for knowledge of the discipline. There were no meaningful differences between skill improvement patterns at the Master's and the doctorate levels.

EXHIBIT 6.33
Skills improvement during graduate studies (level of study)

% who rated their skills improvement at least noticeable	Master's level (a)	Doctorate level (b)
Theoretical/knowledge of the discipline (ns)	91%	94%
Analytical techniques/Experimental methods (ns)	90%	91%
Research competence (ns)	87%	88%
Report writing and publication (ns)	81%	85%
Critical and creative thinking (ns)	78%	82%
Research and project management (ns)	74%	77%
Communication and interpersonal skills (ns)	71%	79%
Personal effectiveness (ns)	69%	75%
Knowledge translation/transfer (ns)	68%	72%
Leadership (ns)	64%	72%
Teaching competence (ns)	63%	66%
Integrity/ethical conduct (ns)	54%	58%
Societal/civic responsibilities	47%[b]	46%[a]
lowest n	887	1,355

a The value is statistically different from that of the doctoral group at least at the 0.05 level.
b The value is statistically different from that of the Master's group at least at the 0.05 level.
(ns) No statistically significant differences between groups.

Subjected to factor analysis, the data showed that there were two relevant grouping of the thirteen skill areas. They were:

- personal and interpersonal skills: communication and interpersonal skills, personal effectiveness, integrity/ethical conduct, teaching competence, leadership, research and project management, knowledge translation/transfer, societal/civic responsibilities;
- intellectual skills: theoretical/knowledge of the discipline, analytical techniques/experimental methods, report writing and publication, critical and creative thinking, research competence.

Average values were calculated for each student on each scale (Cronbach alpha: personal and interpersonal skills, 0.90; intellectual skills, 0.86).

Graduate students reported more improvement in intellectual skills, which averaged 5.8 on a scale from 1 to 7, than personal and interpersonal skills, which averaged 4.9 on the same scale.

There were no differences among award groups, at either level, in the improvement of *personal and interpersonal* skills, whether in bivariate or multivariate analyses.

Reported improvements of *intellectual skills* are somewhat higher amongst all award groups (PGS, IPS, and CGS) at the Master's level in comparison to the non-recipient group (bivariate and multi-variate). It may be possible to postulate that these slightly higher levels of perceived intellectual improvement could be attributed to the selection for NSERC awards of the most qualified of these highly qualified students. However, the, self-ratings of improvement for recipients of the most prestigious of these awards, the CGS-M, score slightly lower in the multivariate model than those for PGS-M and IPS-1 recipients.

At the doctoral level, the multivariate model indicates that reported improvements of *intellectual skills* are higher amongst PGS-D recipients in comparison to non-recipients, whereas CGS-D and IPS-D are statistically equivalent to the no award group.

EXHIBIT 6.34
Skills improvement during graduate studies (treatment group)

Skill improvement during the program (average on a 7-point scale)	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
Personal and interpersonal skills	4.8	4.8	4.9	4.7
Intellectual skills	5.7[d]	5.8[d]	5.8	5.5[ab]
n	450	307	139	196
Doctorate				
Personal and interpersonal skills	5.0	5.0	5.0	4.9
Intellectual skills	5.9	5.9[d]	5.7	5.8[b]
n	461	858	91	308

a The value is statistically different from that of the CGS group at least at the 0.05 level.
b The value is statistically different from that of the PGS group at least at the 0.05 level.
c The value is statistically different from that of the IPS group at least at the 0.05 level.
d The value is statistically different from that of the no-award group at least at the 0.05 level.

Treatment extended by the department, centre, unit or program

The great majority of students, 87%, indicated that their department, centre, unit or program treated them well. Award recipients were somewhat more likely to take that position than non-recipients. There were no significant differences in opinion between awards groups. These results were validated in multivariate analyses.

EXHIBIT 6.35
Treatment extended by the department

% who stated that their department treated them well	CGS (a)	PGS (b)	IPS (c)	No award (d)
Master's				
	91%[d]	88%	87%	83%[a]
n	450	307	139	196
Doctorate				
	90%[d]	88%	87	83%[a]
n	461	858	91	308

[a] The value is statistically different from that of the CGS group at least at the 0.05 level.
[b] The value is statistically different from that of the PGS group at least at the 0.05 level.
[c] The value is statistically different from that of the IPS group at least at the 0.05 level.
[d] The value is statistically different from that of the no-award group at least at the 0.05 level.

Synthesis of other impacts

Exhibit 6.36 provides a synthesis of the other intended and unintended effects associated with NSERC scholarship programs. Results are mainly based on the multivariate analyses comparing survey results for recipients to non-recipients[18]. In the table, measures with no evidence of positive or negative impact for a given award group are left as blank cells. The table also highlights effects associated with receipt of larger stipends (>$7,500) that were found to be statistically significant in the multivariate analyses.

The summary table shows clearly that PGS and the other NSERC scholarship programs at the Master's level have significant positive unintended impacts.

It may be noted that PGS-M offers benefits that are very similar to those of CGS-M in terms of the value and duration of the award. The difference is in the branding of the CGS award as a recognition of the cream of the crop. It appears that this recognition does not produce the unintended impacts analysed here.

At the doctoral level, NSERC scholarship awards produced the same unintended impacts in most areas except those associated with total income and working for pay. Since the value of the CGS doctoral award is twice that of regular scholarships, it should come as no surprise that CGS-D has greater positive impacts on students' finances and work for pay more so than PGS-D.

[18] Certain measures based on questions only asked of awards recipients are also reported based on whether the majority of respondents noted a positive response.

At the doctoral level, as was the case at the Master's level, the branding of CGS as superior scholarship does not appear to produce significantly distinct unintended impacts as compared to PGS.

At both levels of study, IPS is similar to PGS in terms of the size of the award, and different from both PGS and CGS in that it requires industry sponsorship/collaboration. Thus some of the positive impacts observed only for IPS-1 and IPS-2 might be attributable to the nature of the program. It may be noted that sample sizes for IPS were small and thus fewer survey results were statistically conclusive, so fewer effects are noted.

The only negative unintended impacts associated with receipt of an NSERC award had to do with whether jobs held were academic. This stands to reason, as non-recipients are more likely to seek income from academic jobs such as teaching assistantships or research assistantships, whereas NSERC awards recipients are generally limited from working at research assistantships that are indirectly funded by NSERC grant programs.

EXHIBIT 6.36
Summary of other impacts

	Master's			Doctorate			Quality of the evidence
	CGS vs. no award	PGS vs. no award	IPS vs. no award	CGS vs. no award	PGS vs. no award	IPS vs. no award	
Involvement in core research activities				Positive	Positive		Strong[1]
Participation in research support			Positive			Positive	Strong[1]
Conducting research in various environments		Positive	Positive			Positive	Strong[1]
Interactions with other researchers	Positive						Strong[1]
Student income	Positive	Positive		More positive	Positive		Strong[1]
Student debt (loans from family and friends; loans from others)	Positive	Positive		Positive	Positive	Positive	Strong[1]
Student work-for-pay burden (reliance on earned income)	Positive	Positive		Positive	Positive		Strong[1]
Hours working for pay (fewer hours of paid work)	Positive	Positive		More positive	Positive		Strong[1]
Working during graduate studies (fewer who worked)		Positive		Positive			Strong[1]
If worked, worked by choice	Positive	Positive		Positive	Positive		Strong[1]
If worked, job was academic		Negative	Negative	Negative		Negative	Strong[1]
Freedom to study in desired field	Positive	Positive	Positive	Positive	Positive	Positive	Moderate[3]
Freedom to study where one wants	Positive	Positive	Mixed	Positive	Positive	Mixed	Moderate[3]
Award enabled student to pursue graduate school, and at faster pace	Positive	Positive	Positive	Positive	Positive	Positive	Weak[2]
Improvement in the prospects of getting a job in a related area	Positive	Positive	More Positive	Positive	Positive	Positive	Strong[1]
Visibility of awards recipients (proud to tell others of award; peers and professors aware;)	Positive	Positive	Positive	Positive	Positive	Positive	Moderate[3]
Academic marketability (award important in choice of supervisor; and in interest from supervisor)	Mixed Opinion	Mixed Opinion	Mixed Opinion	Mixed Opinion	Mixed Opinion	Mixed Opinion	Moderate[3]
Personal/interpersonal skills development							Moderate[2]
Intellectual skills development	Positive	Positive	Positive		Positive		Moderate[2]

[1] Comparisons could be drawn among treatment groups and time elapsed since the award was not a factor.
[2] Self-assessed impacts.
[3] Self-assessed measures asked of scholarship recipients only, and cannot be considered impacts associated with awards compared to no award. 'Positive' = measures with a majority responding positively; 'Mixed Opinion' = those with less than 55% agreeing.

Chapter 7: COST-EFFECTIVENESS AND ALTERNATIVES

In brief

Although limited objective evidence could be garnered, based on an assessment of administrative costs this study found that the award programs are delivered in a cost-effective manner. Overall for the period covered by the evaluation, the ratio of administrative costs to awards was 4.5% and showed a decreasing trend (from 5.3% to 4.1%).

Granting agencies have limited levers they can use to improve the supply of HQP. Scholarships and research grants (translating into stipends or research assistantships) appear to be the two most direct available approaches. Indirect approaches such as general support to research, excellence and indirect costs could contribute to the objective, but in a way that is less obviously tied to the end result.

More research on stipends and other sources of support such as research assistantships is recommended to better understand alternatives to awards.

7.1 Is the Program delivered in a cost-effective manner?

This evaluation was unable to collect factual information on the costs incurred by all of the agencies in the management of CGS and related programs, however some information was available from NSERC. A useful measure to assess the efficiency of program delivery is the ratio of administrative costs to the total amount of scholarships awarded. An estimate of administrative costs for the PGS and IPS programs is presented for the past eight years in Exhibit 7.1. Overall for this period, the administrative cost (operating ratio) was 4.5%, which is consistent with estimates for the Scholarships and Fellowships division (4.4%) and for NSERC as a whole (4.5%) using the same approach. Exhibit 7.1 shows that the PGS and IPS programs have been delivered in a cost-efficient manner, with the ratio of administrative costs to awards trending downward over the period covered by the evaluation. It is important to note that NSERC is able to deliver these programs in such a cost-effective manner because they include the efforts expended by universities in screening applicants and in managing the awards, as well as volunteer time provided by review committee members.

Administrative costs for the programs include both the direct and indirect costs of administering the programs. Direct costs are comprised of salary[19] and non-salary costs, which are related primarily to the adjudication of the award. Non-salary costs also include a share of the costs of relating to corporate representation and general administration for the Scholarships and Fellowships division. Other direct costs associated with administering the programs, such as post-award management (which is a centralized function carried out by the Finance division) and indirect costs, such as common administrative services for NSERC (e.g., finance, human resources and IT) cannot be provided at the program level. These other direct and indirect costs have also been included in the total calculation of costs and were estimated using the ratio of total PGS and IPS grant funds to total NSERC grant funds.

[19] Salary estimates exclude employee benefits (EBP).

EXHIBIT 7.1
Percentage of estimated PGS and IPS program spending in relation to total scholarships awarded

PGS & IPS	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Direct Salary	748,744	819,171	833,796	853,446	587,580	588,149	617,904	634,043
Direct Non-Salary	70,494	202,408	182,575	182,404	76,865	96,196	98,862	109,214
Total Direct	819,238	1,021,579	1,016,370	1,035,850	664,445	684,346	716,766	743,256
Indirect	1,931,082	2,114,935	1,958,926	1,733,223	1,551,968	1,470,692	1,447,722	1,729,375
Grants Funds Awarded	52,315,505	57,997,185	62,421,158	58,401,134	54,733,411	52,326,439	55,856,242	60,054,785
Operating Ratio								
Direct	1.6%	1.8%	1.6%	1.8%	1.2%	1.3%	1.3%	1.2%
Indirect	3.7%	3.6%	3.1%	3.0%	2.8%	2.8%	2.6%	2.9%
Operating Ratio	**5.3%**	**5.4%**	**4.8%**	**4.7%**	**4.0%**	**4.1%**	**3.9%**	**4.1%**

Note: Indirect costs include expenses indirectly attributable to the program, such as common administrative services, as well as other direct expenses (e.g., post-awards management, is a centralized function carried out by the Finance division) which are not available at the program level. Salary estimates exclude employee benefits (EBP).

Based on non systematic information available to them, all but two of the key informants interviewed in the main CGS evaluation stated that the scholarship programs are delivered by the agencies in an effective manner. Key informants noted that the role played by universities and those who volunteer on the review committees significantly reduce the overhead costs associated with delivery of the awards programs. Others commented on the promptness and fairness of adjudication of files.

Furthermore, the administration of the CGS awards in tandem with the PGS and IPS allows NSERC to benefit from economies of scale in the delivery of all awards programs.

7.2 Are there more cost-effective ways to deliver the Program under the existing model?

A minority of key informants in the main CGS evaluation were of the opinion that there were any more effective ways or models for delivery of these scholarship programs at all agencies. Suggestions made by these informants included:

- using a single application window;
- offering a fully electronic application process;
- removing the letters of reference.

7.3 Are there alternative, more cost-effective programs / models that could achieve the same objectives?

The fundamental objectives of the agency awards include facilitating access to graduate studies and augmenting graduation rates in order to

improve the supply of HQP to the Canadian economy. The awards programs use the direct financing of the best graduate students as a means to that end, based on the assumption that financial hurdles are key barriers to access and completion of graduate studies. Other avenues are conceivable.

Literature review

The direct financing of students can be offered by universities as an attractor to graduate studies and to their institution (Bégin-Heick & Associates, 2001). As an example, the University of Ottawa actively promotes its graduate scholarship package.[20]

Successfully increasing graduate enrolment also requires that institutions be ready to accept more students. According to the AUCC (2002, 2005, 2007), there is a clear link between funding received by universities and enrolment (ability to meet the demand). Historically, when funding was higher, faculty numbers were higher and more students enrolled in universities (AUCC, 2007).

The supply of HQP can also be increased by ensuring the quality of programs and appropriate times to completion, by attracting more students to programs and by ensuring that universities have enough human resources (faculty and internationally recognised researchers) to be able to meet the demand, attract students and offer high-quality education (AUCC, 2005).

Funding researchers is another way to ensure a sufficient supply of HQP because researchers can provide stipends or research assistantships to the student of their choice, whether national or international. A stipend is a grant paid to the student to work on their thesis in the researcher's area of work (CAGS, 2005). A research assistantship is paid work undertaken by a graduate student in support of a supervising researcher's own research work.

New immigration policies allowing highly skilled immigrants to work in Canada have been an important factor in the HQP increase observed in the past few years. According to the 2001 Census of Population, nearly half of HQP were recent immigrants to Canada (McKenzie, 2007).

The conclusion from this brief overview of the literature is that the granting agencies have limited levers they can use to improve the supply of HQP. Scholarships and research grants (translating into stipends and/or research assistantships) appear to be the two most direct

[20] See, for example, <http://www.etudesup.uottawa.ca/Default.aspx?tabid=1458> and <http://www.youtube.com/v/oiIUhMXo4yo&hl=en>. Visited on May 23, 2008.

available approaches. Indirect approaches such as general support to research, excellence and indirect costs could contribute to the objective, but in a way that is less obviously tied to the end result.

Impacts of stipends

Awards and stipends are somewhat competing forms of assistance to graduate students. Awards are provided directly to the student while stipends are a form of indirect support since it transits via a researcher's research grant.

Our student sample included a subgroup of individuals who declared that part of their income was from "amounts paid to you to conduct your own research". They were considered in receipt of a stipend. Multivariate analyses similar to those conducted towards the findings presented in Chapter 6 were conducted to attempt to isolate the unique effect of stipends of greater than $7500 compared to the absence of a stipend. Preliminary analyses identified some possible positive impacts for Master's students (on continuing with doctoral study, publishing articles, presenting at conferences, intellectual skills development, student income) and for doctoral students (desire to pursue a career in research or teaching, prospects of getting a job in a related area).

However, it should be noted that the multivariate analysis on the impacts of stipends was based on a limited sample of NSERC awards applicants who were in receipt of larger stipends. Further research with a larger sample of stipend recipients would be required to explore the impacts of such funding in more depth.

Impacts of research assistantships

This evaluation did not set out to examine research assistantships in depth. However, in the course of the research, the similarity of stipends and research assistantships in the NSE domain was noted.

Research assistantships entail graduate students performing paid work on a professor's research project(s). Funds for research assistantships may sometimes come from the same or similar sources as stipends, possibly including research grants. Whether research assistantships are treated as 'salaries', 'bursaries' or 'awards' or some combination thereof may vary amongst institutions and tax jurisdictions. Financial need is often a consideration in awarding (or hiring a student to) a research assistantship. It also appears that, at some universities, research assistantships are referred to as being paid in the form of monthly or quarterly 'stipends'. It may be noted that research assistantships are often viewed as a supplementary source of income, whereas teaching

assistantships are more likely to be viewed as an integral part of students' academic training.

The work performed as part of a research assistantship is not necessarily related to the student's own research topic. However, in the NSE domain in particular, a graduate student's thesis topic may align closely with their supervisor's own area of research. Thus, in some circumstances, a research assistantship may contribute to the student furthering their own graduate research.

In Chapter 6 of this evaluation, research assistantships were identified, along with teaching assistantships, as amongst key alternative sources of income for graduate students who do not receive full support from excellence based awards. Given the similarities and potential overlap with stipends, research assistantships may be an important funding source through which students may be supported in their own research.

Further research is recommended to better understand the mechanisms of both stipends and research assistantships, and their impacts with respect to NSERC goals for supporting graduate students.

Chapter 8: CONCLUSIONS AND RECOMMENDATIONS

The following chapter details the results of the evaluation of NSERC's Postgraduate Scholarships (PGS) and Industrial Postgraduate Scholarships (IPS) programs.

The research identified several main findings that are predicated on a relatively robust methodology design that incorporates a quasi-experimental approach and multivariate modelling. Analysis of the program outcomes is based mainly on data gathered in a survey of NSERC applicants, using four treatment groups (PGS recipients, IPS recipients, CGS recipients and non-recipients as the control group) to measure the incremental impact of the awards programs.

While most findings related to program outcomes are supported by relatively strong quantitative lines of evidence, findings related to program relevance, design and delivery were based on more limited lines of evidence. Information presented in this chapter summarizes the key findings of the evaluation.

8.1 Relevance

The evaluation generally supports the conclusion that there is a continuing need for NSERC scholarship programs such as PGS, IPS and CGS.

The first rationale for the relevance of the awards programs is that Highly Qualified Personnel (HQP) are in great demand not only in Canada but in numerous other competitor countries. Research indicates that nearly two out of three job openings in Canada in the next ten years will require post-secondary education. A number of secondary data sources cited in the evaluation underscore the considerable demand for HQP in both academic and industrial research environments. Canada ranks sixth in a list of developed countries with regard to the proportion of the population in the HQP category; this highlights the need for a continuous influx of new HQP. While some studies conducted a decade ago question the existence of "brain drain", this evaluation uncovered that almost one-third of doctoral award applicants who were not studying at the time they were surveyed resided abroad and that just over one-third of award applicants expected to move abroad to study or to start a career. Therefore, there is a risk of loss of highly qualified personnel to other countries. The extent of this risk is uncertain and it is possible that it is countered by influx of HQP from other countries. Nonetheless, it would stand to reason that action is necessary to attract graduate students to study in the natural sciences and engineering.

The second rationale for the relevance of the awards program is that there is a financial barrier to access graduate studies. It appears that most graduate students belonging to the program target group do not amass a very large study-related debt. This evaluation has found that the debt load of unsuccessful applicants, regardless of completion status or current level of study, averaged about $9,900 for Master’s students and about $12,200 for doctoral students. While not strictly comparable, the average debt on graduation for the general graduate student population is $22,800 for Masters’ students and $25,600 for doctoral students according to the National Graduate Survey, Class of 2005 (Bayard and Greenlee, 2007). The unsuccessful NSERC award applicants appear to be quite successful at securing other sources of support, such as other excellence-based awards, teaching assistantships, and research assistantships. This is not surprising, however, considering the high calibre of this respondent group: all NSERC award applicants are pre-selected by their universities as high achieving students, and even those that are unsuccessful at obtaining an NSERC award would be excellent candidates for other awards and assistantship opportunities.

Still on the financial side, Master's level PGS awards were shown to increase total student revenue from all sources by about $2,300 compared to non-recipients (whereas the award value is approximately $17,500). At the doctorate level, PGS-D awards increase total revenue by $1,250 (for an award of $21,000), while CGS-D awards increase total revenue by $9,800 (for an award of $35,000). Thus, the main income-related effect of awards was to modify sources of financial support away

from earned income. While many non-recipients also received other excellence-based awards, compared to NSERC award recipients, they tended to rely more on income from work for pay (and, to a lesser degree, on other sources of funding such as loans, stipends, and bursaries).

On the basis of the findings above, one might conclude that the award applicant debt load is not a major deterrent to graduate studies. This is true at least for the exceptionally well-qualified students who were studied (who were selected by their universities to apply for awards on the basis of their excellence).

It is important to emphasize that the provision of NSERC scholarship funding will naturally have 'downstream' effects on the availability of funding support for Canada's entire NSE graduate student body as a whole. As well, if fewer scholarships were awarded it would increase the competition for other sources of support, such as stipends paid from grants and create pressures on other NSERC programs. These downstream effects could not be measured within the present evaluation framework.

Award programs are associated with results that contribute to the overall objectives of HQP supply and research excellence:

- awards represent an incentive to enrol in graduate studies according to the recipients' self-assessment;
- awards increase slightly actual enrolment in graduate studies;
- awards increase recipients' recognition of the federal government's financial support to research training;
- awards increase Canada's ability to attract and retain experienced researchers (as measured in terms of increased desire to pursue a career in research or teaching and finding employment that relates to the student's field of study and/or requires a graduate degree);
- at the Doctorate level, awards increase recipients' involvement in core research activities;
- awards reduce recipients' reliance on paid income and recipients' study related debt;
- awards improve recipients' self-assessed prospects of getting a job in an area relevant to their studies.

In terms of consistency with government-wide priorities, the PGS, IPS, and CGS programs represent tangible examples of the Government of Canada's commitment to build on the country's Knowledge and People Advantages. With the creation of CGS in 2003 and additional funding brought about in 2007 and 2008, the Government of Canada has demonstrated that it makes the funding of graduate studies an important component of its innovation strategy. The strategy identifies that a key

method of achieving the People Advantage is ensuring an adequate supply of HQP through federal government funding for scholarships.

All in all, the rationale for supporting access to graduate studies can be argued. Given the need to support the need for HQP, NSERC should maintain the PGS and IPS programs.

Recommendation 1 NSERC should maintain its nationally competitive, merit-based student award programs

8.2 Program Success

The logic of the PGS and IPS programs is based on a cascade of short-term and longer-term effects that were presented in the umbrella logic model for Scholarship and Fellowship programs. The assessment of program success is based on the extent to which programs demonstrated net or incremental impacts relative to the defined control group - namely, individuals who applied for a scholarship, but who were not successful in obtaining one of the aforementioned awards.

It should be emphasized that what constitutes an appropriate control group is subject to some debate. For this evaluation, the control group is those individuals recommended for an NSERC award by their post-secondary institution; with the exception of IPS, only students pre-qualified by universities are allowed to apply for graduate awards. In effect, this group should be viewed as being "high achievers" in their own right, and do not necessarily represent the broader cohort of Masters/doctoral students. This is a great advantage to this evaluation: because students in the four groups are similar, the difference among them is primarily whether they received an award and which award they received; therefore, differences in how they proceed through graduate studies can be more readily attributed to this key difference. However, while this was appropriate for the CGS program, it does not provide as complete a picture of impacts for the PGS and IPS programs, because it does not include a comparison with the broader student population. As well, such a counterfactual comparison does not assess the impact of CGS, PGS and other such awards programs on the whole of the graduate student population, should the CGS or PGS awards cease to be a source of funding.

The discussion below summarizes, in order:

- expected positive outcomes associated with NSERC awards (for intended outcomes common to both PGS and CGS logic models);
- other positive outcomes of NSERC awards; and,

- expected outcomes for which NSERC awards appear to have no significant impact.

Expected Outcomes for which Awards have Positive Impacts

Awards (PGS or related awards alike) were associated with *positive outcomes* with regard to the following:

- **Increased enrolment in graduate studies by awards recipients.**

Master' students in receipt of PGS awards were 10 percentage-points more likely than the no award group to enrol in their programs (98% as compared to 88%). (At the doctoral level, the results were also statistically significant but less indicative of a conclusive impact: award recipients were 4 percentage-points more likely to enrol than non-recipients, with 97% of recipients enrolling as compared to 93% of non-recipients).

- **Increased incentives for students to enrol in graduate studies.**

The impact of scholarships on incentives to enrol in graduate studies was measured by asking recipients for their self-assessment of this impact. Only students in receipt of an award were included in this validation. The possibility of receiving an award or actually receiving an award was an important incentive to enrol for more than 70% of recipients. Close to one half said the prestige associated with the scholarship was an incentive. (As these questions were only asked of recipients these results cannot technically be cited as 'impacts' of the award in comparison to non-recipients, as per the survey design; nonetheless, the awards were positive motivators for many recipients.)

- **Increased incentives for doctoral students to complete their studies.**

At the doctorate level, recipients of PGS-D and CGS-D awards appear to be somewhat more likely to have completed their degree at the time of the survey than students who did not get an award (23% and 18% respectively compared to 13% of non-awardees). No statistically significant differences were observed for Master's students.

- **Increased recognition by the research community of the federal government's financial support for research training.**

Only program applicants were canvassed about their views of the federal government's support of research training. Other members of the research community were not part of this assessment. Among award recipients, about 85% agreed that the federal government makes a

significant contribution to supporting research training in Canada. Non-recipients were much less likely to share this view (a difference in opinion of more than 24 percentage-points between the PGS group and the no award group).

- **High-quality research, as well as increased ability to attract and retain experienced researchers.**

Graduate students proved to be generally satisfied with their research environment. Findings of the research confirm that Master's students who received awards were somewhat more likely to score higher levels of satisfaction, whereas scores were more equivalent between doctoral awards recipients and non-recipients.

A little over one-half of students at both levels hold positions of teaching assistantships. This proportion was the same for non-recipients as for CGS, PGS, and IPS recipients. About one-quarter of students hold research assistantships, which are slightly more common at the doctoral level. Awards recipients were less likely to hold research assistantships than non-recipients. This stands to reason given that NSERC award recipients are ineligible to receive research assistantships paid out from NSERC Discovery Grants. Research assistantships appear to be one of the important ways non-recipients fill the funding gap.

Overall, Master's students from all groups produced similar output for academic publications (including presentations, articles, and research papers). Doctoral students in receipt of PGS-D awards were no more likely than those with no award to contribute to such publications. It may be noted, however, that CGS-D recipients were more likely than others to contribute to academic publications.

Master's students who received either PGS or CGS awards and had since completed their degree were more likely than non-recipients to hold a job that required a Master's degree, and to hold a job that relates to their studies. Differences were less discernible amongst PhD graduates who were working. However, doctoral students in receipt of PGS awards were more likely to report that their experience during their studies has increased their desire to pursue a career in research or in teaching requiring their level of training.

- **Improved branding of Canada as a home of research excellence and Canadian universities as world-class research centres (limited indicators).**

This evaluation offers limited evidence as to the improvement of the branding of Canada as a place of research excellence. The student survey confirmed that Master's PGS recipients averaged slightly more presentations (1.1 on average) at international conferences than non-

recipients (0.8). At the doctoral level, award recipients produced more international presentations (3.0) than non-recipients (2.2).

Other Positive Impacts of NSERC Awards

The evidence shows clearly that NSERC awards have significant *positive impacts* other than those that comprised the CGS logic model on which this evaluation framework was based. Some of these impacts may be intended outcomes for PGS but not common to CGS, while others may be unintended impacts.

These impacts include:

- increasing student income,
- reducing the need to work for pay,
- reducing loan burdens,
- enhancing recipients' ability to study where they prefer (though not for IPS),
- increasing doctoral students' involvement in core research activities,
- increasing Master's students' involvement in conducting research in various environments,
- increasing intellectual skills development (self-assessed),
- improving employability (self-assessed) and academic marketability.

At the Master's level, PGS and CGS offer additional benefits that are very similar. At the doctoral level, PGS and CGS generally produced the same impacts in all areas outlined above except those associated with total income and working for pay. Since the value of the CGS-D award is 67% greater than regular scholarships, it is no surprise that CGS-D impacts students' finances and work for pay more so than PGS-D.

Fewer positive impacts were observed for IPS recipients at either level of study, as compared to the other two NSERC awards. There are two reasons for this: the smaller sample of IPS recipients included in the survey (so fewer statistically significant results); and the unique nature of the IPS program. IPS recipients appear to have more industry-oriented outcomes as would be expected by the design of the program and fewer academically-oriented outcomes than their counterparts in the other groups examined (including the no award groups). Examining the results for IPS as a whole, one may conclude that a number of the impacts uniquely observed for IPS recipients are a product of the interests of IPS applicants and their exposure to industry partnerships through the program. For example, whereas IPS recipients are less likely to work in academic jobs or publish papers (and there may be less emphasis from supervisors to do so), conversely, IPS recipients are more likely to

participate in research support activities, or indicate improved prospects of finding a job in a related area.

Expected Outcomes for which Awards have No Significant Impact

The evidence indicates that the NSERC award programs (PGS and related programs alike) had *no significant impact* on the following outcomes for the graduate cohort examined:

- **No measurable impact on increased total enrolment in graduate studies in Canada.**

Enrolment in graduate studies has been steadily increasing since 2000. The CGS was introduced in 2003 and funded a substantial number of new scholarship recipients, but the research was unable to identify a spike upwards in total overall enrolment in graduate studies that might be associated with the introduction of additional the funding. At the doctoral level, receipt of a PGS-D award results in only a 4 percentage-point increase in enrolment rates, which is not substantial enough to conclude a positive effect. However, the impact is more appreciable at the Master's level (10 percentage points), as noted in the earlier section on positive impacts.

- **No measurable impact on the proportion of students continuing to doctoral studies after a Master's degree.**

Overall, close to six out of ten Master's students plan to go on to study at the PhD level, regardless of whether or not they received an NSERC award. Of note, IPS recipients are less likely to consider doctoral studies, but this may be attributed to the nature of the IPS program and that IPS recipients may have career goals that lie within industry where a PhD may not be a requirement for employment (compared to academe). In any case, students tend to be committed to either continuing to a PhD or concluding their studies with an MSc at the time of enrolment in a Master's program.

- **No measurable impact on increased capacity to meet demand for HQP.**

About eight in ten Master's students, and nine in ten doctoral students, think they are likely to pursue a career in research or teaching requiring their level of training. According to data from NSERC's career survey, 92% of award recipients (nine years after their award) indicated that their current employment involves research or teaching. Upwards of 90% of survey respondents for the current evaluation agreed that graduate studies are an important element of their career goals. Notwithstanding this high response from all students, no statistically significant differences were associated with receiving an NSERC award as

compared to the no award group, with the exception that IPS recipients were less likely to express interest in pursuing a career in research or teaching (which may expected given the nature of the program). It should be noted that the strength of the evidence that could be collected to address this point is relatively weak: The effects of the funding on the NSE student body as a whole could not easily be measured in this evaluation.

Nevertheless, even if this evaluation cannot provide proof that NSERC awards *increase* the capacity to meet demand for HQP, it is plausible to argue that NSERC funds, at the very least, contribute to *maintaining an* HQP *capacity* in Canada in the natural sciences and engineering disciplines.

- **No measurable impact on HQP holding (or expecting to hold) positions in the faculties of Canadian universities.**

About two-thirds of Master's students and three-quarters of doctoral students expressed interest in employment in the University sector. Three-quarters of those who completed a PhD went on to pursue post-doctoral research, while one in twenty of students who completed a PhD were currently employed as faculty. However, similar to the findings related to the previous outcome, it appears that receipt of an award had no statistically significant impact on the desire to seek employment in the university sector when compared to the no award cohort. On the subject of the actual outcomes examined (as apposed to aspirations), it may be too early to draw definitive conclusions as to whether or not receipt of an NSERC award influences students transitions into faculty positions: Only 19% of doctoral award applicants had completed their PhD's at the time of the survey, although, as discussed in the data quality section earlier, the timing of the survey may not have allowed for the materialization of some outcomes, such as degree completion. The data was also not corrected for the current economic climate, which has lead to hiring freezes for academic faculty. This may have had an impact on the survey results.

8.3 Cost-Effectiveness and Alternatives

Although limited objective evidence could be garnered, based on an assessment of administrative costs this study found that the award programs are delivered in a cost-effective manner. Overall for the period covered by the evaluation, the ratio of administrative costs to awards was 4.5% and showed a decreasing trend (from 5.3% to 4.1%). Key informants noted that the role played by universities and those who volunteer on the review committees significantly reduce the overhead costs associated with delivery of the awards programs.

Granting agencies have limited levers that they can use to improve the supply of HQP; direct and indirect support appear to be the two available approaches. Merit-based scholarships are an example of direct support to students that give them both the recognition of having been through a national competition as well as some control and flexibility. Funds from research grants, research partnerships grants involving industry, and networks that are used by professors to support graduate students conducting research (which translate into stipends or possibly research assistantships) are all examples of indirect support.

The survey conducted for this evaluation included a small group of students who received stipend support. Initial multivariate analyses of the data for those who received more than $7500 in stipend support identified possible areas of positive effects of stipends for Master's students (continuing with doctoral study, publishing articles, presenting at conferences, intellectual skills development, student income) and for doctoral students (desire to pursue a degree in research or teaching, job prospects in a related area). However, due to the small sample sizes and the narrow parameters of the cohort surveyed (high-achieving NSERC award applicants with access to many types of support), these preliminary results cannot be considered conclusive.

Whether the best approach is to support academic excellence directly by awarding scholarships or indirectly through stipends paid from NSERC grants, or how to achieve the best balance between such funding mechanisms, is still open to debate. This study amassed little information on the appropriateness of the mix of direct and indirect sources of support for graduate students in the natural sciences and engineering domain. Students who did not receive NSERC awards were about twice as likely to receive support from stipends, but relied more heavily on other excellence-based awards, research assistantships and teaching assistantships. Additional research on stipends and research assistantships would be required to better understand whether the mix of direct and indirect sources of support for students is optimal.

More research is recommended to better understand the outcomes of alternatives to awards such as stipends and research assistantships. Such research should be conducted with a broad sample of students, should be tailored to gather information on these types of indirect funding, but, for comparability, should assess some of the same measures examined in this evaluation of scholarship programs.

Recommendation 2: The Agencies should consider conducting additional research on the relative merits and impacts of direct and indirect methods of supporting students.

8.4 Design and Delivery

The analysis of design and delivery issues did not identify any major concerns. Positive features of NSERC PGS include: the coverage at both Master's and Doctoral levels, the assessment criteria, the application review process and the efficiency of the management of the program. Areas of concern include: limited funding and the duration of the awards.

Stakeholders interviewed as part of the main CGS evaluation were generally of the view that the scholarship programs administered by NSERC and the other agencies were well designed and should be offered to both Master's and Doctoral students. Stakeholders commented on the quality of the assessment criteria and peer reviewing process, and noted that sharing the administration of the program results in cost efficiencies. A few stakeholders noted that some very qualified students do not receive awards due to the limited funding available.

Examining PGS in relation to CGS awards, key informants commented on the large value discrepancy between CGS and the regular agency awards at the Doctoral level. Additionally, this study demonstrates that, at the doctorate level, providing 67% more funding (the difference between the $35,000 CGS award and a typical $21,000 regular agency award) produces limited incremental impacts.

Most students who received awards indicated that they were satisfied with the program design features they were asked about. However, many consider the duration of the award too short. In fact recipients are more satisfied with the money value of the awards than with their duration, in particular, Doctoral award recipients were markedly less likely than their Master's level counterparts to be satisfied with the duration of their funding. The average time to completion of a Master's degree is certainly longer than one year and that of a doctoral degree vastly exceeds three years (six years according to Gluszynski and Peters, 2005). Even, amongst the "high achievers" surveyed for this evaluation, Master's students who had already completed their degree took 27 months on average, while those who were still in progress estimated it would take them 34 months on average. Doctoral students completed in, or estimated their time to completion as, about 4 years. By contrast, PGS-M awards provide funding for 1 year only, and PGS-D awards provide funding for no more than 3 years.

To truly affect the duration of graduate studies, it is likely that a more sustained funding effort would be required. Of course, to increase the length of awards would reduce the number of individuals who could be funded. An alternate balance might possibly be found between reducing

the value of CGS awards and lengthening the period of student support for all awards.

Recommendation 3: NSERC should consider the possibility of setting the duration of a Master's award to two years and that of a doctoral award to four years.

A challenge in reporting on the impacts of NSERC's award programs was that the evaluation was conducted in conjunction with the CGS program: the evaluation approach and the reporting of the agency-specific programs flows in part from the CGS logic model. Although a number of the outcomes of the two logic models are similar, the program logic for PGS is depicted in an umbrella logic model for all of NSERC's scholarships and fellowships programs and there were sufficient differences in activities and intended outcomes from CGS to make reporting a challenge. Greater consistency between or a mapping of expected outcomes of the agency specific programs and the CGS program would have facilitated the reporting process, and clarified the respective objectives of the programs.

In addition, based on the issues in the evaluation framework it appeared that a number of other impacts of NSERC awards, and the question of the balance of direct versus indirect support, was of interest. However, these impacts were not found in either of the logic models, nor were the expected outcomes of indirect forms of support modeled; the umbrella scholarships and fellowships logic model does not depict indirect support for students (although not surprisingly as it is not a funding vehicle of these programs).
If NSERC considers it important to assess the impacts student support (both direct and indirect) collectively, then these two forms of support should be modeled jointly and their respective expected results articulated. While the umbrella model could be retained, it would also be of use to identify the specific contributions of each of the direct forms of support. Findings relating to program success from this and the CGS evaluation should be considered during any revisions of the logic models.

Recommendation 4: NSERC should revisit its umbrella logic model for its Scholarships and Fellowships programs, mapping program specific outcomes and modeling indirect forms of support for students as well.

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APPENDIX A: Independent variables in multivariate models

Independent variables used in the multivariate models

Concept	Source	Treatment	Resulting variables	Reference category	Coding
Treatment group	Administrative data	Creation of three dichotomous variables	i_pgs, i_ips, i_cgs	No award	Dummy coded
In receipt of a stipend	Q45I	Creation of a dichotomous variable for those declaring stipend funding of over $7500 in the last 12 months[21]	i_stipend	No stipend	Dummy coded
Study level	PP_LEVEL	Creation of a dichotomous variable for the doctorate level	i_doctorate	Master's	Effect coded
Agency	Administrative data	Creation of two dichotomous variables	i_nserc, i_cihr	SSHRC	Effect coded
Application year	Administrative data	Creation of two dichotomous variables	i_2005, i_2006	2004	Effect coded
Gender	Q69	Creation of a dichotomous variable for women	i_women	Men	Effect coded
Age at application	Administrative data and Q70	Creation of two dichotomous variables	i_25_29, i_30_99	18 to 24	Effect coded
Study and research skills	Q74A, Q74B	Creation of a dichotomous variable isolating those declaring above average study skills (6 and 7 on a 7-point scale) and above average research skills (6 and 7 on a 7-point scale)	i_grad_skills	Lower study and research skills	Effect coded

[21] This approach differs from that used in the main CGS evaluation, in that the variable used in the main CGS evaluation identified any student in receipt of stipend funding, with the amount of stipend funding being as little as a few hundred dollars, whereas the minimum cut off of at least $7500 in stipend funding used in the present evaluation was intended to identify more tangible impacts on the evaluation issues that might be associated with significant stipend funding.

Living arrangements	Q72B	Creation of three dichotomous variables	i_with_parents, i_with_roommates, i_with_partrner	Living alone	Effect coded
Presence of dependants	Q73	Creation of a dichotomous variable for those with dependants	i_dependants	No dependants	Effect coded
Type of university at undergraduate level	Q75	Creation of two dichotomous variables	i_no_medecine, i_small_uni	University with medicine	Effect coded
Undergraduate grade point average	Q76A, Q76C	Creation of a dichotomous variable for those with GPAs of A or A+ or 90% or more	i_undergrad_gpa	Lower undergraduate GPAs	Effect coded
Research at the undergraduate level	Q80A	Creation of a dichotomous variable isolating those declaring frequent contact with research at the undergraduate level (6 and 7 on a 7-point scale)	i_undergrad_research	Less frequent contact with research	Effect coded
Mother's degree	Q78	Creation of three dichotomous variables	i_mother_undergrad, i_mother_masters, i_mother_doctorate	No university degree	Effect coded
Father's degree	Q78	Creation of three dichotomous	i_father_undergrad, i_father_masters, i_father_doctorate	No university degree variables	Effect coded
Encouragement from entourage	Q80B, Q80C	Creation of a dichotomous variable isolating those declaring high levels of encouragement from entourage (6 and 7 on a 7-point scale for both family and people close)	i_encouragement	Lower encouragement	Effect coded
Part time studies	Q5, Q6	Creation of a dichotomous variable isolating those who went from full-time to part-time studies	i_moved_to_parttime	Did not move to part time	Effect coded
Time devoted to studies	Q7	Creation of a dichotomous variable isolating those with higher than average time devoted to studies	i_time_devoted	Lower than average	Effect coded
Firmness of field selection	Q32A	Creation of a dichotomous variable isolating those who were very firm in their selection of a field of study (6 and 7 on a 7-point scale)	i_certain	Those who doubted	Effect coded
Exchanges with peers and faculty	Q32C, Q32D	Creation of a dichotomous variable isolating those with frequent exchanges with peers and faculty (6 and 7 on a 7-point scale for both)	i_exchanges	Fewer exchanges	Effect coded
Efforts invested	Q32E	Creation of a dichotomous variable isolating those who invested all of their efforts in their studies (6 and 7 on a 7-point scale)	i_effort	Lower effort	Effect coded
Personal development	Q32F	Creation of a dichotomous variable isolating those who considered that graduate studies were integral to their personal development (6 and 7 on a 7-point scale)	i_personal_development	Not an integral part	Effect coded
Forecasted effect of the degree	Q64C, Q64D	Creation of a dichotomous variable isolating those who considered that their degree will help them find a job (6 and 7 on a 7-point scale on two scales)	i_help_find_job	Smaller forecasted effect	Effect coded
Coping with stress	Q32G	Creation of a dichotomous variable isolating those who coped well with stress (6 and 7 on a 7-point scale)	i_cope_with_stress	Difficulty coping with stress	Effect coded

APPENDIX B: Models of retention and attrition

Examining the process by which students in a postsecondary establishment choose to continue (retention) or to abandon (attrition) their studies is the basis for understanding who completes their studies and why, as well as provides insight into what could be done to encourage students to pursue education beyond the bachelor's degree. For that reason, a review of conceptual models was undertaken in order to assist in the development of the student questionnaire and to gain a better understanding of the attrition and retention processes and the potential role of a modified graduate student funding program. The purpose of this appendix is therefore to introduce some of the most relevant conceptual models and to link them to the research at hand.

It should be noted that little to no literature was identified that dealt with the factors attracting students specifically to graduate studies; specifically, our sources document the dynamics of retention and attrition of students already enrolled at the undergraduate level.

A number of attempts have been made to conceptualize students' decisions to continue or abandon their studies at the post-secondary level. Some of these conceptual models, although developed some time ago, are still in use today. The two most commonly referenced and used models are presented in this section. These two models examine undergraduate student retention. A third model was also identified in the course of the review. This last model examines graduate student retention and is also presented in this section.

Tinto's Conceptual Model for Dropout from College

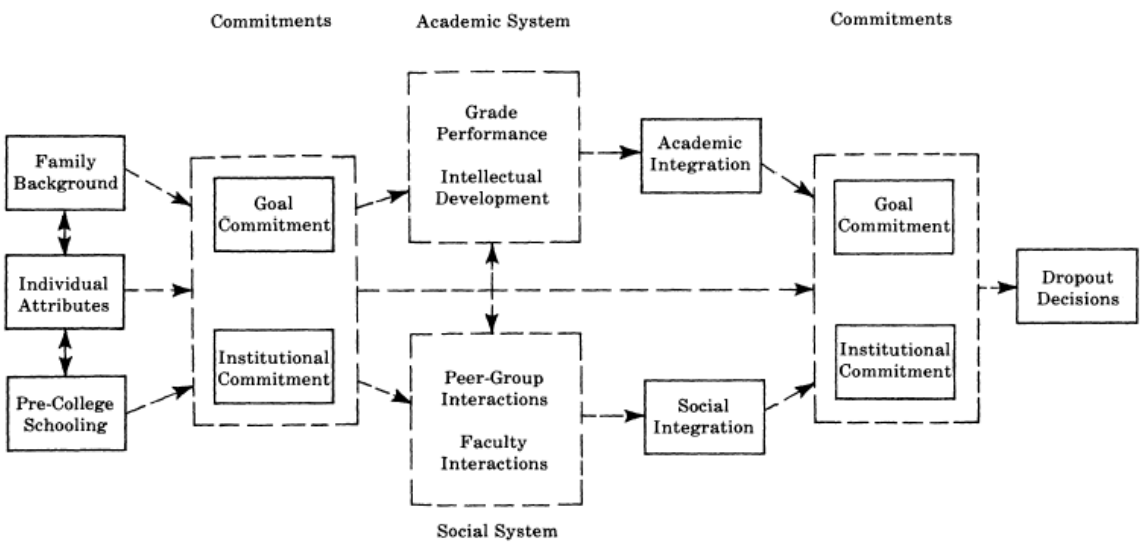
Although dated, Tinto's model is still taken into account in most current research.

Tinto first developed his theoretical model in 1975 in an attempt to explain the processes of interaction between the individual and the institution that lead differing individuals to drop out (Tinto,1975:90). Although Tinto's model may appear dated, it is still relevant. As qualified in a review of literature conducted on behalf of the Canada Millennium Scholarship Foundation, Tinto's model is “the main model of student attrition to emerge in this period, and the one that is still taken into account in most current research” (Grayson & Grayson, 2003:11). The Consultants also noted the lasting contribution of Tinto's model as all related literature that was reviewed for this literature review cited Tinto's model.

In developing his model, Tinto synthesized studies in the area of college persistence/dropout and presented or interpreted what these studies' results implied about the process of dropping out. Overall, family background, individual attributes, past educational experience, goal commitment, institutional commitment, academic integration, social integration and institutional characteristics were among the broad characteristics or predictors of persistence or attrition included in the model.

Tinto's model postulates that a student's level of commitment changes prior to dropping out. That is why, in Tinto's model, goal and institutional commitment appear before integrating the academic and social systems and after that integration. According to Tinto, a student's level of commitment can be explained by the theory of cost-benefit analysis, in which a student's perception of studying (e.g. academic attainments, personal satisfactions, friendships) and associated costs (e.g. financial, time, dissatisfaction, academic failures) affect the level of commitment (Tinto, 1975: 97-98). When the costs exceed the benefits, the level of commitment towards education changes and the student leaves for a more beneficial alternative (e.g. employment).

EXHIBIT B.1
Tinto's Student Dropout Model



The theory of cost-benefit analysis, as described by Tinto, may be applied to the decision to pursue graduate studies. Upon completing their undergraduate studies, students' decision to pursue their studies at the graduate level is likely to be driven by the perception of benefits that outweigh the costs. The perception of benefits and costs is likely to vary between students who pursue studies at the graduate level, those who end their studies after obtaining their undergraduate degree, and those who leave before obtaining their degree (either at the undergraduate or graduate level). Therefore, when examining why some students pursue graduate studies and others do not, it is important to examine several areas that may impact students' decision (e.g. family, schooling, individual characteristics, grades, socialization, etc.) and not only the cost of attending graduate studies per se. Note that there is no specific indication in this model of the role of student funding in maintaining commitment.

Bean & Metzer's Conceptual Model of Non-Traditional Student Attrition

Bean & Metzer's model focuses on non-traditional students, a profile that graduate students are more likely to fit.

Following the footsteps of Tinto, Bean & Metzer sought to develop a conceptual model of student attrition for non-traditional undergraduate students (Bean & Metzer, 1985). Bean & Metzer's model is described as one of the most important critique of Tinto's model (Grayson & Grayson, 2003:15). While the basis of their model was drawn from models of traditional students such as Tinto's, the substance of the model was

developed through an extensive review of literature on non-traditional undergraduate students.

In this model, a non-traditional undergraduate student is identified as one that:

- Is older than 24, or does not live in a campus residence (e.g. is a commuter), or is a part-time student, or some combination of these three factors;
- Is not greatly influenced by the social environment of the institutions; and
- is mainly concerned with the institution's academic offerings (especially courses, certification, and degrees).

This is particularly interesting within the context of this evaluation as Bean & Metzer's model may lend itself more to the study of graduate students' persistence than Tinto's model. Graduate students likely fit the above profile of non-traditional students (e.g. are older, likely to commute, concerned with academic offering, etc.).

While some determinants are consistent with Tinto's model presented earlier, Bean & Metzer's model also includes new determinants, as shown in Exhibit B.2. In presenting each element of their model, the authors cited relevant research that had been conducted at that time. The various indicators used in these studies, as well as the ones proposed by Bean & Metzer, include background, academic and environmental variables as well as academic and psychological outcomes. The inclusion of environmental and psychological variables (which are excluded in Tinto's model) may draw a clearer picture of those who pursue graduate studies and why.

In this model, student finances are explicitly included as an environmental determinant, The greater availability of scholarships such as the CGS could contribute to reducing dropout through this pathway.

EXHIBIT B.2

Bean and Metzer's Model of Non-Traditional Student Attrition

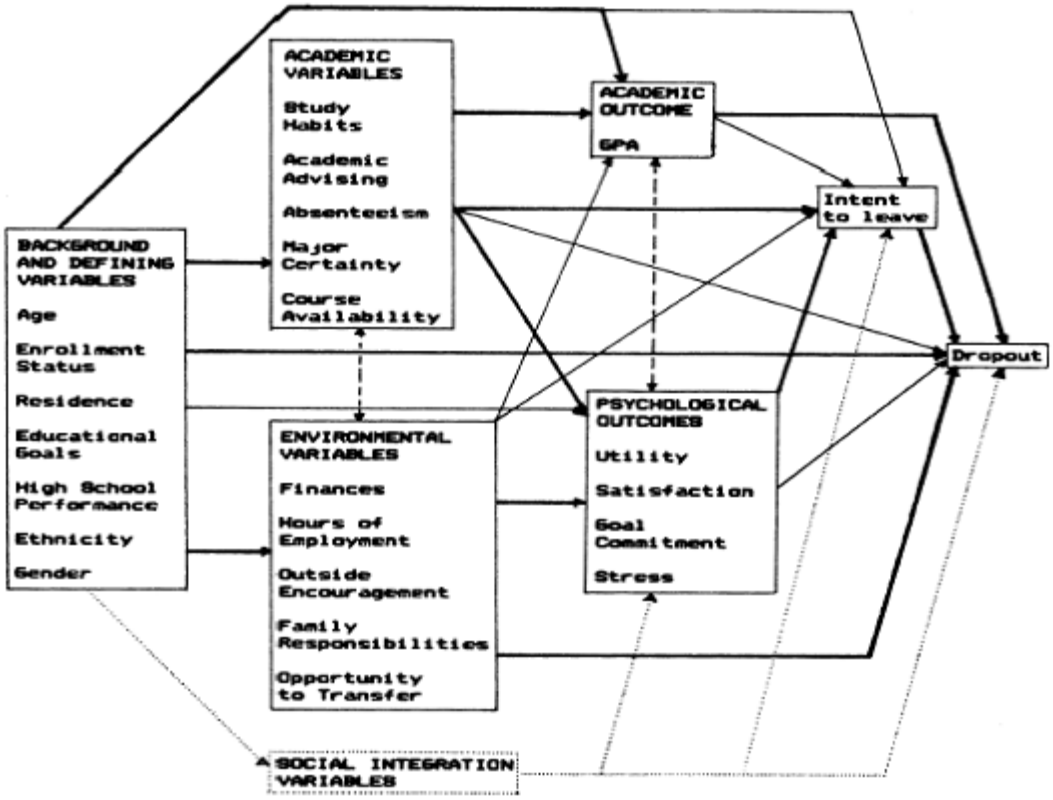


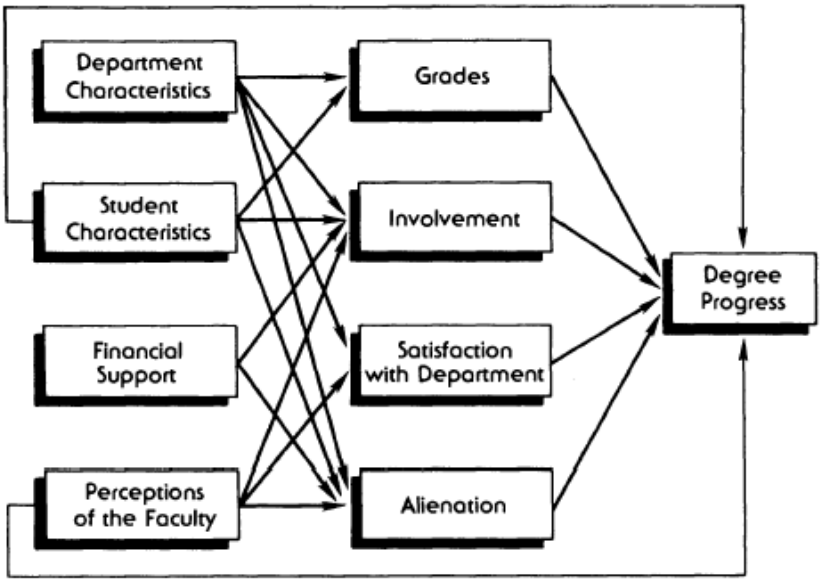
FIGURE 1. A Conceptual Model of Nontraditional Student Attrition.
Key: → Direct effects
→ Direct effects presumed most important
•-• Compensatory interaction effects
•···• Possible effects

Unlike Tinto's model, Bean & Metzer's model excludes parents' education and social integration as having a direct impact on student attrition. Additionally, as a result of their literature review, Bean & Metzer excluded parents' education from their model. They found no research on the effect of parents' educational level on the persistence of students who had been independent from their primary family for a substantial period of time (Bean & Metzer, 1985:499). They proposed that, if parents' educational level is to be examined, it should be included as one of the background variables, such as age, enrolment status, high school performance, gender. Also, Bean & Metzer's model omitted social integration as a factor influencing attrition as they found that most attrition research that examined social integration rarely found it to be a major factor in retention of non-traditional students (Bean & Metzer, 1985:520). For that reason, social integration is only included in the model as a possible effect.

Girves & Wemmerus' Conceptual Model of Graduate Student Degree Progress

Despite extensive research, only one model was found that dealt specifically with persistence among graduate students. This model, developed by Girves & Wemmerus, sought to link department and student characteristics, financial support, and student perceptions of the faculty with student grades, involvement in the program, satisfaction with the department, and alienation (Girves & Wemmerus, 1988:163). The model is based on the undergraduate models developed by Tinto and Bean & Metzer, as presented in this review, and includes other factor that the authors felt were fundamental to the graduate education experience.

EXHIBIT B.3
Girves & Wemmerus' Model of Graduate Student Degree Progress



In order to measure retention, Girves & Wemmerus examined degree progress, where a Master's degree has two steps (course work and earned degree) and a doctoral degree has three steps (course work, general examination, and earned degree). This definition allowed for the measurement of retention in terms of degree progress rather than, for example, in terms of semesters.

As a result of an empirical study, Girves & Wemmerus found that grades were the main predictor of Master's level students' progress and that involvement was the main predictor of doctoral level students' progress.[22]

[22] Empirical models illustrating these relationships are not included in this report. First, the Consultants elected to present conceptual models rather than empirical ones. Second, these empirical models would be the result of a sole empirical study as no other study on graduate students were identified during the literature review.

Following the development of their model, Girves & Wemmerus proceeded with an empirical study to test the model. They found that grades were the main predictor of Master's level students' progress and that involvement was the main predictor of doctoral level students' progress; satisfaction/alienation did not predict progress at any level (Girves & Wemmerus, 1988:186). Note that these findings are somewhat in agreement with Bean & Metzer's decision to include social integration factors solely as limited or indirect influences of student attrition. Other findings from Girves & Wemmerus' study were that the relationship with the faculty and the department characteristics were important at both Master's and doctoral levels; that the type of financial support played a more important role at the doctoral level and that student characteristics were more influential at the Master's level (Girves & Wemmerus, 1988:186). Based on these findings, Girves & Wemmerus produced empirical models for Master's and doctoral level students. Given that this is the only empirical study using this model that was found in this literature review, the empirical models are not included in this summary.

Other Research/Empirical Studies

While a number of studies have been undertaken to examine student retention and attrition, it should be noted that findings from these studies often contradicted each other, not only demonstrating the limitations of the conceptual models, but also making it difficult to paint the profile of students. For example, the authors of *Research on Retention and Attrition* examined who left college/university and why (Grayson & Grayson 2003). To do so, they reviewed American and Canadian evidence on post-secondary student attrition. Overall, the only factor that consistently had a positive effect on whether an individual pursued their studies was the intention to return the following year. Other factors, such as gender, academic integration, social integration, social-economic status (SES), and high school grades had a positive effect, no effect or a negative effect depending on the student population being studied.

One Canadian study, *Bachelor's graduates who pursue further postsecondary education* (Butlin, 2001), was identified during the literature review. As its title reads, the study examined Canadian university students who pursued postsecondary education after obtaining their bachelor's degree.[23] Using data from the 1992 National Graduates Survey of 1990 Graduates (NGS) and the 1995 Follow-up of 1990 Graduates Survey (FOG), the author identified the following as indicators (controlling for other factors) of participation in graduate studies (Butlin, 2001):

[23] Further education includes all levels of post-secondary education, i.e., community college/trade-vocational college, university certificate or diploma, bachelor's degree, first professional degree, or Master's or doctoral degree.

- Bachelor's graduates who studied part-time had lower odds of participating in Master's or doctoral programs.
- Graduates with $15,000 or more in student loans had higher odds of participating in Master's and doctoral programs.
- Men had greater odds of participating in Master's and doctoral programs.
- Graduates whose parents had a university degree had higher odds of participating in Master's and doctoral programs.
- Bachelor's graduates with more than two years of work experience had lower odds of participating in Master's and doctoral programs.

Similar to the Canadian study, an American study using data from the Baccalaureate and Beyond Longitudinal Study (B&B) from students in their last year of college in 1992-1993, with follow-ups in 1993-1994 and in 1997, was also reviewed. This study, by Mullen, Goyette & Soares (2003), found that:

- Parents' education had a positive influence on enrolment in professional and doctoral programs, a modest influence on enrolment in Master's program, and no effect on enrolment in MBA programs.
- The odds of entering a Master's program were greater for women but the odds of entering other types of programs (professional, MBA, doctoral) were greater for men.
- Age had a negative effect on enrolment in first-professional or doctoral programs but no effect on enrolment in MBA or Master's programs.

Differences among different studies may be the result of differences between student populations and institutions or the use of diverging definitions of attrition, for example, in the definition and measurement of “drop-out”.

Conclusion

This review of conceptual models and studies of student attrition shows that multiple determinants and their interactions are involved. Graduate student funding is likely one among many determinants, and may be more important for some types and levels of students than for others.