



Degrees of Success

The Expert Panel on the Labour
Market Transition of PhD Graduates



CCA | CAC



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Market Transition of PhD Graduates



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The project that is the subject of this report was undertaken with the approval of the Board of Directors of the Council of Canadian Academies (CCA). Board members are drawn from the Royal Society of Canada (RSC), the Canadian Academy of Engineering (CAE), and the Canadian Academy of Health Sciences (CAHS), as well as from the general public. The members of the expert panel responsible for the report were selected by CCA for their special competencies and with regard for appropriate balance.

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The Expert Panel on the Labour Market Transition of PhD Graduates

Under the guidance of its Scientific Advisory Committee, Board of Directors, and founding Academies, the CCA assembled The Expert Panel on the Labour Market Transition of PhD Graduates to undertake this project. Each expert was selected for their expertise, experience, and demonstrated leadership in fields relevant to this project.

M. Elizabeth Cannon, O.C., FRSC, FCAE (Chair), President Emerita, University of Calgary (Calgary, AB)

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Diane Gray, Founding President and CEO, CentrePort Canada; Chair, Mitacs Board of Directors (Winnipeg, MB)

Tina Gruosso, Board of Directors, Science & Policy Exchange; Scientist, Translational Research, Forbius (Montréal, QC)

Jennifer Polk, Founder and Principal, From PhD to Life (Toronto, ON)

Susan Porter, Dean and Vice-Provost, Graduate and Postdoctoral Studies, University of British Columbia; Past President, Canadian Association for Graduate Studies (Vancouver, BC)

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Paul Yachnin, Tomlinson Professor of Shakespeare Studies, Department of English, McGill University; Director, TRaCE McGill (Montréal, QC)

Message from the Chair

Canada's PhD graduates are important contributors to our highly skilled and innovative workforce. With their depth of expertise and complex problem-solving skills, these graduates are well placed to create opportunities while addressing challenges across sectors. PhD-holders also benefit society in other ways, generating new knowledge during their studies and advancing understanding across disciplines. Furthermore, these graduates have high expectations of themselves and want to make a difference.

Despite their value, PhD grads are increasingly confronted with roadblocks on their entry into the labour market. While there has always been some variation across academic disciplines, many graduates traditionally moved into the professoriate. This path still exists but is available to fewer individuals. In the last decade, there has been a decrease in the number of assistant professor positions while the number of people graduating with PhDs in Canada has steadily increased. At the same time, expected increases in the number of high-quality industry and public sector jobs have not materialized. New graduates may face extended periods of temporary employment, underemployment, or unemployment, whether they are attempting to enter academia, or the public or private sector.

The difficulties facing PhDs raise important questions about the nature of PhD education in Canada and how to ensure the potential of PhD graduates is fully realized. The Panel's report seeks to spark a conversation about these issues by detailing the challenges faced by PhDs as they begin their careers, key factors contributing to these challenges, and promising practices to address them. The Panel recognizes that many of the challenges facing PhD graduates as they transition to the labour market are formed by their experiences during their studies. *Degrees of Success* considers how a range of stakeholders can influence those experiences at various stages in PhD students' development. These include universities, governments, employers, as well as the students and graduates themselves.

When the CCA was asked to undertake this assessment, and while the Panel deliberated, the challenges facing PhD graduates in Canada did not include entering a labour market drastically altered by a pandemic. Its long-term effects on the economy and society remain uncertain in many ways, and a near-absence of data means that this aspect could not be explored by the Panel. Having said this, the skills and aptitudes of Canada's PhD graduates can play a critical role in addressing the health, economic, and social challenges brought on by COVID-19.

Panel members brought expertise and knowledge from many disciplines and sectors; some Panel members were recent graduates able to speak to their own experiences in transitioning to the labour market. I would like to thank every member for their hard work and sustained engagement. The intensive discussions and meaningful debate were integral to the process and resulted in a comprehensive report. I would also like to thank the CCA staff for their guidance, support, and responsiveness throughout this process.

Lastly, on behalf of the Panel, I would like to acknowledge the tremendous potential and lives lost on January 8, 2020, when Ukraine International Airlines Flight PS752 was shot down over Iran. Canada's academic community was hit particularly hard by the loss of professors, researchers, and students from campuses across our country. Many of us mourned colleagues and friends. Their important work and legacies live on in their absence.

A handwritten signature in black ink, appearing to read "M. Elizabeth Cannon".

M. Elizabeth Cannon, O.C., FRSC, FCAE

Chair, The Expert Panel on the Labour Market Transition of PhD Graduates

Message from the President and CEO

Attainment of a PhD is regarded as one of the great pinnacles of academic education. Yet, any discussion of PhDs in Canada invariably leads to the question of whether we produce too few or too many. There's no straightforward answer, but we do know that, while the number of PhD graduates has climbed steadily over the past two decades, there has not been a commensurate growth in the academic positions for which they are primarily trained. We also know they face significant obstacles to entering the workforce after graduation, including the relative lack of demand from non-academic employers, which further limits their opportunities.

While PhDs, on the whole, have higher employment levels and higher earnings than master's and bachelor's graduates, this does not tell the whole story about whether the investment in PhD training effectively supports graduates in their transition to the workforce. This is particularly important given the key role these highly trained members of society can play in tackling some of our most vexing problems. In the era of COVID-19, the need for their complex problem-solving skills takes on even greater urgency.

To better understand the challenges facing recent PhD graduates, the Minister of Innovation, Science and Economic Development Canada (ISED) asked the CCA to examine the issue in detail. A 12-member expert panel drew on diverse sources of quantitative and qualitative data. By reviewing a range of economic data sets and tracking studies, the Panel examined unemployment statistics, the sectors that hire PhDs, and average levels of compensation. The report also includes personal narratives that capture the individual experiences of PhD students and graduates from a variety of disciplines.

The final report, *Degrees of Success*, shines a light on the lived experiences of students and recent graduates and their entries into the workforce. It addresses factors contributing to the international migration of PhDs; unemployment rates and salaries for PhDs in Canada; and leading practices, internationally and in Canada, to overcome the career transition challenges these graduates encounter. In short, it provides a window into the future of this important brain-trust for Canada.

I extend my thanks to the Panel Chair, M. Elizabeth Cannon, PhD, O.C., FRSC, FCAE, and the entire Expert Panel. As with every CCA assessment, the CCA Board of Directors, Scientific Advisory Committee, and the three founding Academies — the Royal Society of Canada, the Canadian Academy of Engineering, and the Canadian Academy of Health Sciences — provided key guidance and oversight during the assessment process. I thank them for their support.

A handwritten signature in black ink, appearing to read "Eric M. Meslin".

Eric M. Meslin, PhD, FRSC, FCAHS
President and CEO, Council of Canadian Academies

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Peer Review

This report was reviewed in draft form by reviewers selected by the CCA for their diverse perspectives and areas of expertise. The reviewers assessed the objectivity and quality of the report. Their confidential submissions were considered in full by the Panel, and many of their suggestions were incorporated into the report. They were not asked to endorse the conclusions, nor did they see the final draft of the report before its release. Responsibility for the final content of this report rests entirely with the authoring Panel and the CCA.

The CCA wishes to thank the following individuals for their review of this report:

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The peer review process was monitored on behalf of the CCA's Board of Directors and Scientific Advisory Committee by **David Castle**, Professor, School of Public Administration and Gustavson School of Business, University of Victoria. The role of the peer review monitor is to ensure that the Panel gives full and fair consideration to the submissions of the peer reviewers. The Board of the CCA authorizes public release of an expert panel report only after the peer review monitor confirms that the CCA's report review requirements have been satisfied. The CCA thanks Dr. Castle for his diligent contribution as peer review monitor.

Executive Summary

Canada's PhD graduates are important contributors to society and the economy, bringing valued skills and new knowledge to a range of sectors. Indeed, the abilities of PhDs to think creatively and solve problems are widely viewed as important to innovation and to developing and maintaining competitiveness in knowledge intensive industries — a long standing public policy priority as a result of Canada's consistent underperformance on a range of innovation metrics as compared to its international peers.

For all their potential value to Canada's prosperity, many PhDs face significant challenges entering the labour market after graduation. A lack of demand from employers, among other factors, is contributing to the underutilization of PhDs in the workforce. This has given rise to important questions for both students and Canadian society about the value of PhD training investment, and about how to optimize students' education and experiences to ensure their potential contributions can best be realized in the Canadian economy.

To respond to student needs, many universities implemented initiatives to support the transition of PhD graduates from school to work. This, however, has not quieted concerns raised by students, graduates, universities, governments, and employers about the availability of meaningful employment for PhDs or their ability to adapt to new environments. Recognizing that little is known about the specific challenges facing recent PhD graduates as they enter the labour market, Innovation, Science and Economic Development Canada (ISED) asked the Council of Canadian Academies (CCA) to undertake an evidence-based, authoritative assessment on the following question:



What are the main challenges that PhD students in Canada face in transitioning to the labour market, and how do these differ by field of study?

To answer this charge, the CCA assembled The Expert Panel on the Labour Market Transition of PhD Graduates, a multidisciplinary panel of 12 experts chaired by M. Elizabeth Cannon, O.C., FRSC, FCAE, and President Emerita of the University of Calgary. The Panel brought together scholars and practitioners with knowledge of labour economics, psychology, education, sociology, university administration, and professional development, as well as experts from the industrial sector.

Panelists who were recent PhD graduates were also able to speak to their own experiences in transitioning to the labour market following graduation. The resulting report seeks to shine a spotlight on the lived experiences of students and recent graduates, many of whom find themselves unprepared for the workforce, or in a state of precarious employment without job security or prospects for career advancement.

From the outset, the Panel emphasized how important it was to recognize that many of the challenges facing PhDs as they transition to the labour market are shaped by their experiences during their studies, well before graduation. Thus, the charge required looking at the broader context surrounding PhD students and graduates and includes the influence of a range of stakeholders such as universities, government, employers, as well as the students and graduates themselves. All of these groups play a role in shaping the experiences of PhD graduates, both positive and negative. Additionally, while the Panel recognized the importance of labour market indicators in measuring employment outcomes, it also stressed that, for many PhDs, personal motivations extend beyond economic aspirations. These include opportunities to make a significant contribution to new knowledge, to carry out research, to make meaningful change in society, or to become an expert on a subject they are passionate about. Therefore, for these graduates, a successful outcome would be finding a rewarding position that allows them to use their skills and advanced abilities, and provides opportunities for advancement.

Main Messages

Over the past 30 years, there have been significant efforts to expand Canada's supply of highly qualified personnel, including PhDs. There has also been a push to boost investment in research at universities more broadly. This means that each year there are increasing numbers of PhD graduates from a range of disciplines entering the labour market. During the same period, the basic core structure of PhD programs in Canada has remained relatively constant despite variation in support and specific requirements across disciplines and institutions.

The number of PhD graduates in Canada is growing while the number of open tenure-track positions is stagnant or declining.

Traditionally, PhD programs in many disciplines have followed a model wherein one generation of faculty trains the next. This approach is one reason why many PhDs graduating from Canadian institutions view being a tenure-track¹ professor as the ideal, or do not feel prepared for other types of careers. This model is

¹ The tenure-track includes assistant, associate, and full professor positions. An assistant professorship is the first tenure-track tier on being hired, and is a non-tenured position. Associate and full professor positions are tenured roles.

increasingly outdated, since fewer PhDs are moving into tenure-track positions in universities. The number of tenure-stream professors in Canada has been almost constant since 2009, with a declining number of assistant professor positions — normally the entry position for new faculty. In 2009, there were over 10,500 assistant professors in Canada, but by 2017 this had fallen to about 8,600 as universities did not fully replenish their ranks after promoting assistant professors to associate professor positions. Over that same period, the number of PhDs graduating from Canadian institutions rose steadily. The combination of increased PhD production and declining numbers of new tenure-track positions has led to greater competition for fewer jobs. Furthermore, academia is an international labour market, so Canadian graduates are competing with graduates from all over the world for a diminishing number of positions. Looking forward, it is unlikely that the receptor capacity for tenure-track positions in Canada will grow in the foreseeable future, although some turnover will occur as senior professors decide to retire.

Fewer tenure-track positions is not the only challenge facing PhD graduates who wish to enter the professoriate. Academic culture can promote the idea that any career other than a tenure-track position for PhD graduates is a failure and that seeking work outside academia is a betrayal of graduates' and faculty ideals. This may be one reason why, despite stagnant or declining numbers of tenure-track positions, at least half of recent PhD graduates are still working in higher education in various capacities. Some of these graduates are finding positions as tenure-track professors, while others have careers in administration or research support (e.g., lab managers). Many recent PhD graduates hold temporary transitional positions, however the most common of these are sessional instructor (a contracted employee focused exclusively on teaching) or postdoctoral fellow (PDF) positions.

These temporary roles are considered a prerequisite for obtaining tenure-track positions in certain disciplines or a way to keep connected with the academic world. Evidence suggests that sessional instructors are being relied upon more frequently to teach undergraduate courses, and many holding these positions have a PhD and often depend on sessional work as their primary form of income. PDF positions have traditionally been seen as a direct step towards a tenure-track position in the sciences and medicine, but most PDFs in Canada will not become professors. Some graduates take on consecutive sessional or PDF contracts in universities hoping to increase their chances of obtaining a tenure-track position, or to simply stay in academia because they perceive it as the best fit. Others end up trapped in a cycle of temporary positions because they are not aware of other employment or do not know how to obtain positions outside of academia. Additionally, accumulating multiple, sequential short-term PDFs may be looked

upon negatively by industry, hindering the ability of PhD graduates to integrate into the private sector.

Non-academic sectors have not significantly increased their uptake of PhD graduates.

Outside of academia, PhD graduates in Canada are finding employment in the private, public, and not-for-profit sectors as, for instance, researchers, scientists, advisors, and managers. Some, but not all, of these jobs require and/or benefit from having a PhD. The evidence suggests, however, that the opportunity to expand the presence of PhDs in non-academic sectors brought about by increasing numbers of graduates is not being fully realized.

Private industry is the largest sector of employment for PhDs outside of academia; evidence suggests that about one fifth to one quarter of recent graduates are working for private companies. This statistic is tied to significant differences among disciplines, however. PhD graduates in engineering, for example, are most likely to find positions in the private sector by some margin. Recent graduates in humanities are least likely to be employed by the private sector, with fewer than 10% holding positions in private companies. PhD graduates are also working in the public and not-for-profit sectors, although these account for a much smaller proportion of employment.

Research and development (R&D) both inside and outside the academy enables innovation and supports the Canadian economy. While many PhDs work in R&D, not all research personnel have (or require) PhDs, nor do all PhDs working in the private sector work in R&D. Having said this, private sector R&D capacity in Canada is related to its overall capacity for employing PhDs. Evidence suggests this capacity is low compared to peer countries and has been trending downward. Canada's gross domestic expenditures on R&D (GERD) as a percentage of gross domestic product (GDP) dropped from 1.9 in 2009 to 1.6 in 2017; in 2009, the OECD average was 2.3 and rose to 2.4 by 2017. This means that, compared to other OECD countries, Canada invests less in R&D overall. Industry and government conduct a significantly smaller proportion of Canada's research, while academia conducts a larger proportion compared to other OECD countries. For instance, just over 50% of R&D expenditures in Canada occur in business enterprises while the OECD average is over 70%. Additionally, the per capita number of researchers employed in Canada has been shrinking since 2010, but increasing in the United States and for the OECD overall. Canada's unique R&D environment, which is smaller and more heavily concentrated in universities than that of its peers, demonstrates that Canadian industry does not create the same pull for PhD graduates in comparison with other OECD countries.

The labour market outcomes for PhDs vary significantly by gender and discipline, and the economic return of a PhD is lower for younger graduates compared to PhDs in general.

Taken as an aggregate, PhD graduates experience lower levels of unemployment and higher earnings than graduates with master's or bachelor's degrees. However, this masks important differences in the outcomes of PhDs in the labour market. The earnings of PhDs vary widely, and the gap between the highest and lowest income earners widens during the first five years post-graduation. Furthermore, younger PhD graduates have similar, or higher, unemployment levels than bachelor's or master's graduates.

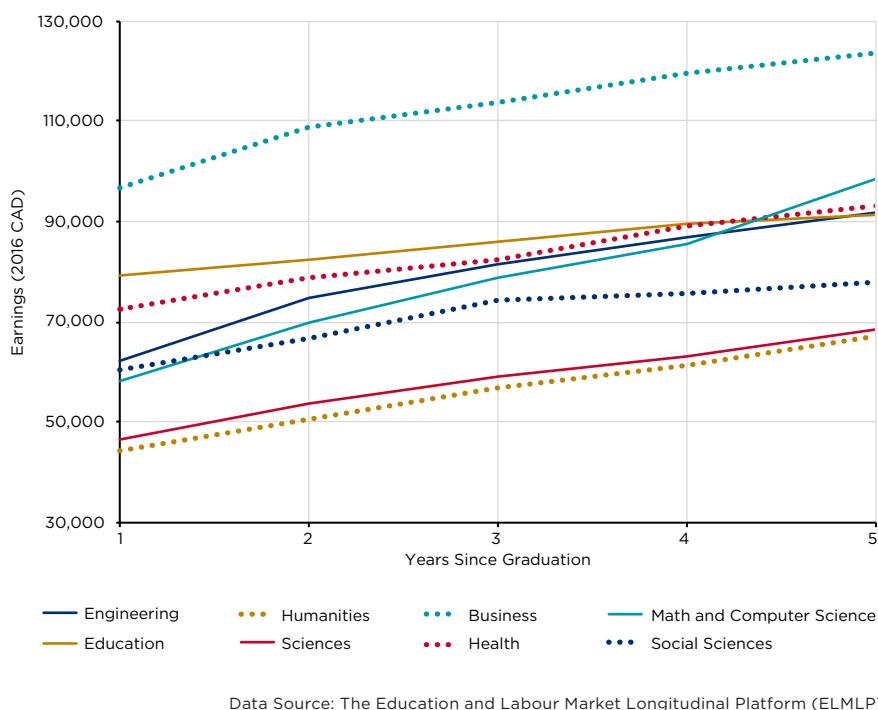
Concerning gender, and consistent with graduates holding other degrees, men with PhDs earn appreciably more than women. For instance, the earnings of men are an average of 19% higher than women five years after obtaining their PhDs. Women with PhDs are also more likely than men to be unemployed or working part-time. The differences in outcomes cut across fields of study. Unemployment rates among women with PhDs are higher than men across most disciplines, while women's earnings are always lower, likely at least in part because more women are employed in part-time positions. Evidence does suggest, however, that the overall earnings difference between men and women has narrowed over time for full-year, full-time employed PhD graduates.

The economic return of a PhD is defined as the average proportional difference in earnings between PhD and master's graduates (excluding MBAs) for individuals with the same number of years of potential labour market experience; this return has declined for men. In 2006, men under 40 years old with PhDs earned over 30% more than those with a master's, while in 2016, this return had fallen to less than 15%. When opportunity costs are considered (i.e., earnings foregone by choosing to continue studying for a PhD rather than enter the workforce with a master's), the declining returns of a PhD for men are more substantial. In 2006, it took 8 years for men under 40 with PhDs to catch up to their potential level of earnings had they stopped at a master's degree, and by 2016, this time had increased to 16 years.

In contrast, the economic return for women with PhDs versus a master's has almost doubled over the last three censuses, though this advantage is less pronounced for graduates under the age of 40. Even when considering opportunity costs, women with PhDs do not start their careers earning less than they would have if they had stopped after a master's degree, though the Panel notes that PhD graduates are an average of five years older on entering the labour market.

The challenges facing PhD graduates vary by discipline and this is reflected in the average earnings (Figure 1). The earnings data illustrate the importance of considering differences among disciplines beyond the broader STEM and

non-STEM (or BBASE) designations.² Business PhDs are the top earners five years after graduation. They are followed by PhD graduates in engineering, mathematics and computer science, health, and education, all of whom have similar earnings. The lowest earners are PhD graduates in humanities and sciences. The differences in earnings are significant, with PhD graduates in business earning over 80% more than those in humanities and sciences at the five-year mark. For the most part, PhD graduates do earn more than master's graduates when looking within the same discipline, with the notable exception of the sciences, where PhD and master's holders have approximately the same earnings trajectories in the first five years after graduation.



Data Source: The Education and Labour Market Longitudinal Platform (ELMLP)

Figure 1 Earnings Trajectory of PhD Graduates by Field of Study, 2010 Cohort

The mean earnings trajectories of PhD graduates in the 2010 cohort vary greatly by discipline. Graduates with degrees in business have the highest mean earnings by some margin, while graduates with degrees in humanities and sciences have the lowest mean earnings.

² STEM: Science, technology, engineering, and mathematics; BBASE: Business, humanities, health, arts, social science, and education.

As sessional instructor positions are usually part-time, PhDs in these roles often have low earnings even if they hold multiple appointments. While PDF positions are generally full-time, they are not highly paid and can also be precarious. That these roles appear to be most common in the humanities (sessional instructor) and sciences (PDF) is likely linked to the fact that recent graduates from these disciplines experience the lowest earnings of all PhDs in the first five years after graduation. Evidence shows that, three years after graduation, PhDs in the sciences and humanities have a high probability of working in a transitional role and low probability of being a full-time professor.

Academic culture can support or hinder the transition of PhDs to the labour market.

Central to the challenges faced by many PhD graduates is academic culture (i.e., the norms and values that shape academia and the people working within it). Academic culture can promote a community for people with common interests, enabling them to collaborate, to learn, and to develop and share new ideas. At the same time, some aspects of academic culture can contribute to the challenges felt by PhDs during and following their studies, particularly for those who do not want to stay in academia or for those who feel as if they have “failed” in achieving their desired academic career. The norms, practices, and values of academic research do not necessarily align well with those of different sectors or employment groups, nor do they always align with those of students themselves.

Rates of depression and anxiety among PhD students tend to be higher than among the general population and may be exacerbated or caused by the high demands and expectations of academic culture. A number of factors contribute to the high incidence of mental health issues including burnout over trying to balance the competing demands of work and personal life. This may be more pronounced for students in the sciences, where unrealistic demands are routinely reported by those expected to commit long hours to lab work. For students in the humanities and social sciences, there is an elevated risk of depression and anxiety related to the isolation that is commonly associated with independent research and writing. These mental health issues can extend beyond graduation, creating additional challenges for PhDs as they transition to the workforce.

The PhD is the primary pathway to becoming a professor in many disciplines, and the traditional view still exists that a faculty member’s role in PhD education is to train the next generation of faculty. The PhD student’s supervisor has a large hand in guiding them toward academic success and is also a key figure in shaping expectations and career ambitions. Academic supervisors, having themselves been trained in academia, may be ill-prepared or even unwilling to help their

students transition to non-academic careers, which may demand different skill sets and ways of approaching research and scholarship.

Equity, diversity, and inclusion (EDI) is an increasingly important issue for Canadian universities, and most include EDI initiatives in their institution's long-term strategic plans. There are considerable benefits that flow from a diverse PhD student population and an equitable and inclusive environment. Greater numbers of PhD students from underrepresented groups can contribute to transforming universities by introducing other experiences, ways of doing research and teaching, and potentially by making the professoriate more diverse. Additionally, more diverse populations in PhD programs will lead to highly trained people of all backgrounds and identities able to take up leadership roles in a range of non-academic sectors. While there is a lack of data and research about the experiences of Indigenous students, racialized students, first-generation students, and students with disabilities, it is known that they often face additional and unique challenges during the course of their PhD. The development of mentoring and support networks geared toward students in these groups may be one way to help address these challenges and increase overall diversity in universities.

Many graduate programs in Canadian universities are implementing programs to address some of the counterproductive elements of academic culture. These include: offering professional development opportunities, where faculty are exposed to various models of academic mentorship that can guide them in improving their practice; using tools that encourage and direct early conversations between academic supervisors and their PhD students relating to student interests and career plans; and engaging alumni who have found success outside academia. Beyond these programs, efforts are underway to broaden the PhD itself by rethinking its meaning, use, and design. These efforts seek to allow graduates to better adapt to and be adept in different environments and ways of working, while preparing them to tackle 21st-century problems. With such re-envisioned PhD pathways, universities may expand the types of students drawn to PhD programs, thereby reaching those who may not quite fit into the traditional academic mould. This can also support EDI at universities by welcoming and appealing to people with a wider variety of experiences and backgrounds.

PhD graduates may not be aware of the skills and abilities they could bring to a future employer, or there may be a mismatch between the capabilities desired by employers and those gained by PhD graduates during their studies.

Movement between jobs, including for reasons of career advancement, is common among PhD graduates across disciplines. If PhDs can expect to hold multiple jobs

over their careers, they must have transferable skills as well as the ability to learn new ways of working. While PhDs generally graduate with a clear sense of the knowledge they have created and gained, they often lack recognition of their skills and abilities — a so-called skills awareness gap. PhD graduates may also be unaware of careers outside the academy or how to pursue them. Many PhDs complete their studies without having developed non-academic networks or learning the skill of networking, despite its importance for finding employment.

PhD graduates are also challenged by the fact that some private sector employers do not perceive benefits in hiring PhDs, believing they lack certain essential attributes or professional skills. While the private sector recognizes that PhDs have highly specialized knowledge, it also perceives them as lacking adaptability, practicality, certain communication and teamwork skills, and skills increasingly needed for 21st-century work, such as collaborating with diverse actors and incorporating multiple perspectives that cross discipline and sector boundaries. That several Canadian industries report a skills shortage while some PhD graduates face challenges in entering the labour market may also be reflective of a skills mismatch.

There are promising practices being implemented that seek to address the disconnect between employers outside of academia and PhD graduates. Among these are transitional initiatives that help PhD students or recent graduates gain the essential skills desired by employers, or that create links between non-academic sectors and PhD students. The latter type of program can help create receptor capacity by demonstrating to employers that there are benefits to hiring PhD graduates. Some programs are administered by universities themselves, while others are run by government and/or non-government organizations.

PhD graduates from Canadian institutions are presented with the opportunity, or in some cases necessity, of seeking employment outside Canada following their studies.

PhDs often leave their countries to work abroad and participate in the global knowledge economy. Canadian post-secondary institutions have a strong international reputation, and the country offers a high quality of life. This means that Canada is seen as a favourable destination for PhD students, but the strength of its institutions also contributes to the ability of its own PhD graduates to explore opportunities abroad.

The increased internationalization of universities in Canada includes shifts in the nationality of the Canadian PhD student population. The proportion of international students graduating with PhDs from Canadian institutions is growing, reaching over a quarter of all graduates in 2016. These graduates are more mobile than domestic students. This increased mobility is likely due to the fact that people who relocate for their studies have a tendency to remain mobile

(for numerous reasons), and also because there is a greater proportion of international students in STEM fields (whose graduates are generally more mobile). Data suggest that international PhD graduates from Canadian institutions who choose to stay in Canada have lower earnings than domestic PhD graduates, and that those with the lowest earnings may then choose to leave.

As universities worldwide become increasingly internationalized, mobility is viewed as a requirement for PhDs seeking to remain in academia. The majority of evidence on mobile PhDs relates to PDFs whose primary motivations for mobility are the same across countries—namely the prestige of international institutions or researchers, and the opportunity to maximize their chances of obtaining an academic position. That said, compared to graduates from most other countries, Canadian PhDs generally express a stronger desire to return to their home country should suitable employment opportunities become available.

There are limited data related to the motivations of mobile Canadian PhDs outside of academia. The extent to which PhD graduates, whether international or domestic, migrate from Canada could not be determined; however, evidence from university tracking surveys and qualitative evidence, suggests that a lack of high-quality employment opportunities in Canada is a motivating factor for accepting non-academic positions, often in the United States.

Conclusion

The question of whether there are too few or too many PhDs in Canada does not have a cut-and-dried answer. The evidence is clear that many more people are graduating with PhDs from Canadian institutions than there are available academic positions—the role for which they are primarily trained in most disciplines. It also appears that the supply of meaningful jobs outside of the academy has not kept up with the growing numbers of PhD graduates in Canada. The net result is that the economic return of a PhD is lower for more recent PhD graduates than it once was. PhD graduates are key actors in innovation and provide benefits to society and the economy. They can only do so, however, if they are employed in jobs where they can apply, and continue to develop their high-level skills and knowledge. Improving outcomes for PhD graduates in Canada will benefit them as individuals, but will also benefit society as Canada moves towards a more knowledge-based economy. A range of promising practices are being implemented in Canada and elsewhere that demonstrate some efforts towards improvement, but PhD graduates would benefit from more widespread actions and greater uptake of existing programs. The growing knowledge economy demands a highly skilled workforce, and the PhDs graduating from Canadian institutions can play a key role in tackling the challenges facing Canada in the 21st century.

Glossary

Academic culture: The norms and values that shape academia and the people working within it. Examples of academic culture may be the expectation that PhD students in the sciences devote long hours to lab work, or that all PhD graduates must strive for academic careers.

Cohort: A group of people who share a common characteristic (e.g., year of graduation) and who have been studied and/or followed for statistical purposes.

Highly qualified personnel (HQP): These are considered to be “individuals with university degrees at the bachelors’ level and above” (McKenzie, 2007).

Integration: The process of a person learning and adopting the culture and values of a workplace once they have begun working there (DOCENT, 2010).

International mobility: The migration of PhD holders across national borders in order to accept jobs in other countries.

Postdoctoral fellow (PDF): “An individual holding a completed research doctoral degree (e.g., PhD) . . . and is in a temporary period of mentored research and advanced training, linked to a university or an affiliated institution, to industry or government research labs” (Jadavji *et al.*, 2016).

Professoriate: This refers specifically to the professional group of faculty in higher education. This term is used in order to differentiate tenure-track professors from those working in non-faculty positions in the university system, such as administrators or contract researchers. Those in the professoriate hold full-time, indeterminate positions on a different pay scale from *sessional instructors*.

Receptor capacity: The ability or propensity of the private, academic, public, and other sectors to hire and benefit from PhD graduates.

Sessional instructors: Contracted temporary employees within universities who are focused exclusively on teaching (and the associated preparation and marking work). Sessionals differ from those in the *professoriate* (i.e., tenure-track professors).

Teaching-stream faculty: These can be tenure- or non-tenure-track professors whose primary role is instruction, and who therefore generally carry higher teaching loads than their research-focused counterparts.

Tenure-track: The process by which professors obtain job promotion and security. Tenure is typically granted based on committee review of the applicant's contributions to research, teaching, and university service.

Transition: The period characterizing movement into the labour force post-graduation (regardless of employment sector). During this period, graduates may begin to put their training into practice and build their careers (Finnie, 2004). The transition period can vary in length according to individual experience, and may be more challenging for PhDs entering non-academic sectors than for those remaining in academia (Edge & Munro, 2015).

List of Abbreviations

ABD	All but dissertation
BHASE	Business, humanities, health, arts, social sciences, and education
CAGS	Canadian Association for Graduate Studies
CAPS	Canadian Association of Postdoctoral Scholars
CGPSS	Canadian Graduate and Professional Student Survey
CID	Carnegie Initiative on the Doctorate
CIHR	Canadian Institutes of Health Research
EDI	Equity, diversity, and inclusion
ELMLP	Education and Labour Market Longitudinal Platform
ESF	European Science Foundation
FYFT	Full-year full-time
GERD	Gross domestic expenditures on research and development
HQP	Highly qualified personnel
ISED	Innovation, Science and Economic Development Canada
NAICS	North American Industry Classification System
NGS	National Graduates Survey
NSERC	Natural Sciences and Engineering Research Council of Canada
OECD	Organisation for Economic Co-operation and Development
PDF	Postdoctoral fellow
PhD	Doctor of Philosophy
PUMF	Public Use Microdata Files
R&D	Research and development
SPE	Science & Policy Exchange
SSHRC	Social Sciences and Humanities Research Council
STEM	Science, technology, engineering, and mathematics
TRaCE	Track Report Connect Exchange
UBC	University of British Columbia
UofA	University of Alberta
UofT	University of Toronto
WIL	Work-integrated learning

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Introduction

- 1.1 Charge to the Panel
- 1.2 Scope of Assessment
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- 1.4 Evidence Considered
- 1.5 Structure of the Report

Discussion and debate about the value of PhDs, and the career prospects of PhD graduates, have increased in recent years. Within Canada, reports on the career outcomes of PhDs have examined this issue nationally (Edge & Munro, 2015), at the provincial level (Maldonado *et al.*, 2013; Ministère de l'Éducation et de l'Enseignement supérieur, 2016), and from a university-specific perspective (Porter *et al.*, 2017). This topic has also been addressed internationally, especially among member nations of the Organisation for Economic Co-operation and Development (OECD) (Auriol *et al.*, 2013). While many universities have responded by developing programming intended to ease PhD graduates' transition to the labour market, this has not quieted concerns over employability raised by students, graduates, governments, and employers.

The pathways taken by PhD graduates are extremely varied, and at times non-linear. While there have always been variants across academic disciplines, many PhD graduates in the past would move into the professoriate, with or without a transitional postdoctoral period beforehand. While this path still exists for some, it has become less common as the number of tenure-track positions has declined relative to enrolment. Instead, universities have increased their hiring of contract, part-time instructors (Kezar *et al.*, 2015). Some graduates may experience a prolonged period of temporary employment, underemployment, or unemployment before launching a career (Desjardins & King, 2011; Desjardins, 2012).

Degrees of Success, differs from previous reports on the career outcomes of PhDs in several ways. First, this report describes the challenges faced by PhDs as they launch their careers — whether inside or outside academia — and identifies key contributing factors. Approaches to a renewed vision of PhD education in Canada and abroad are outlined, as are promising practices to address specific challenges. Second, this report examines the labour economics of PhDs in Canada and offers up the latest data as evidence. While the Panel recognizes that much of the existing literature focuses on the dichotomy between academic and non-academic employment, its members sought to avoid privileging one form of employment over the other. Instead, this report strives to advance the conversation, moving away from this typical language surrounding career outcomes where possible, and toward a broader picture of where and how PhDs work. Lastly, this report recognizes that the most pressing concerns are the lived experiences of students and recent graduates. While many are successful in transitioning into meaningful and stable employment following graduation, others find themselves unprepared for the workforce, or in a state of precarious employment without job security or prospects for career advancement.

1.1 Charge to the Panel

This assessment was requested by Innovation, Science and Economic Development Canada (ISED) (the Sponsor), which asked the CCA to undertake an evidence-based assessment on the challenges facing PhD students and graduates in Canada as they transition to the labour market. Specifically, this report answers the following questions and subquestions:



What are the main challenges that PhD students in Canada face in transitioning to the labour market, and how do these differ by field of study?

- What unique challenges do PhD graduates working in Canada face in launching their careers within academia?
- What unique challenges do PhD graduates working in Canada face in launching their careers outside academia?
- What are the key motivations behind the migration of PhD graduates in and out of Canada? Is brain circulation simply a feature of a highly globalized, knowledge-based economy, or is it caused by a lack of opportunities for PhD graduates?

To address the charge, the CCA assembled a multidisciplinary panel of 12 experts (the Panel). The Panel brought together scholars and practitioners with knowledge of labour economics, psychology, education, sociology, university administration, and professional development, as well as experts from the industrial sector. Panelists who were recent PhD graduates were also able to speak to their own experiences in transitioning to the labour market following graduation. Each member served on the Panel on a *pro bono* basis as an informed individual rather than as a representative of a discipline, organization, or region. Between May 2019 and April 2020, the Panel held five meetings (four in-person and one virtual) in order to complete its work.

1.2 Scope of Assessment

At the beginning of the assessment process, the Panel met with the Sponsor, as well as with representatives from Employment and Social Development Canada (ESDC) and the tri-agencies: the Natural Sciences and Engineering Research Council of Canada (NSERC), the Social Sciences and Humanities Research Council (SSHRC), and the Canadian Institutes of Health Research (CIHR). This meeting

allowed the Panel to acquire a full understanding of the charge and to confirm which issues were in scope and which were out of scope.

The Sponsor identified several key areas to be addressed in the assessment, including the transition of PhDs into the labour market; promising programs and approaches that support transition; the receptor capacity of Canadian industry to hire PhDs; and equity, diversity, and inclusion (EDI) in regards to students and graduates. The Panel was also asked to consider the roles played by post-secondary institutions and educators, federal and provincial/territorial governments, PhD graduates, and employers. Other areas in scope include differences across academic disciplines, and the motivations of PhD graduates who leave Canada. The Panel chose not to focus on those who obtained PhDs in other countries and subsequently moved to Canada. Finally, the Sponsor indicated an interest in identifying existing data gaps in order to direct future research.

This report does not address issues related specifically to undergraduate, master's, and college graduates, or those related to professional or other terminal degrees (including professional doctoral degrees), nor does it consider how many PhDs Canada requires. Finally, consistent with all CCA assessments, this report does not provide recommendations.

1.3 The Panel's View of Transition

While deliberating, the Panel sought to consider PhD graduates as individuals, as members of particular discipline cohorts, and as a whole. A number of factors affect the experiences of PhDs during their studies and transition to the labour market, including personal characteristics, discipline of study, and goals. While much of the discussion on the success of PhDs centres on labour market indicators, the personal motivations of many graduates extend beyond economic and career aspirations. They may seek out the opportunity to make a significant contribution to new knowledge, to carry out research, to make meaningful change in society, or to become an expert on a subject they enjoy. The diversity in the group is reflected in the variety of career destinations experienced by PhDs in the labour market (Figure 1.1). Because of this diversity, a successful outcome for some graduates may not always be related to employment sector or income (Raddon & Sung, 2009; Edge & Munro, 2015). Taylor (2006) also takes this view, defining success for new PhD graduates as “acquiring a rewarding position that offers legitimate opportunities for professional advancement, whether or not that job happens to be in academia.” As noted by Walker *et al.* (2008):

The PhD is a route to many destinations, and those holding the doctorate follow diverse career paths. Some seek out a life in academe . . . [o]thers — the majority in some fields — end up in business or industry, or in government or non-profit settings. All of these, we would argue, are scholars, for the work of scholarship is not a function of setting but of purpose and commitment.



Figure 1.1 Labour Market Destinations of PhD Graduates

PhDs are employed across all sectors of the labour market. This figure is designed to show a broad diversity of potential career destinations. Unemployment is considered to be a labour market sector, and is defined as a person who is available for and actively seeking work, but does not currently hold a position (StatCan, 2015).

For stakeholders other than graduates, a successful outcome might be defined differently or include other variables. Universities and faculty members may

define success as graduating students who become stewards of the discipline, regardless of sector of employment (Walker *et al.*, 2008). For governments and funders, success might be defined as the balance of public and private returns relative to the costs of research training (Group of Eight, 2013). For society overall, success may be defined as the production of individuals whose research and knowledge make an overall positive contribution to Canada's economy and society (Edge & Munro, 2015). This includes the further development of a knowledge-based economy, which some evidence suggests relies on a growing need for PhDs in a variety of sectors (Naylor *et al.*, 2017).

1.4 Evidence Considered

In carrying out the assessment, the Panel sought evidence and knowledge from a wide range of sources, including peer-reviewed articles, grey literature, and government statistics. In order to yield additional insights, Panel members also carried out themselves, or commissioned, new analyses of publicly available data. The Panel heard industry views on the labour market transition of PhDs, as well as perspectives from Mitacs, an organization that creates linkages between PhD students or graduates and businesses.



This assessment also includes 11 personal narratives (PhD Pathways) captured from various sources. These narratives are used throughout the report to highlight a small sample of career pathways and outcomes.

CCA staff also undertook a literature review using the academic databases ProQuest and Web of Science. Based on preliminary scoping, a number of keywords were identified and searched for in the English-language literature. In order to identify the most current and relevant issues, the search was limited to articles published after 2012, and was particularly focused on identifying sources related to the Canadian experience. In addition to this, the Panel provided references and research guidance throughout the assessment process.

This assessment also includes 11 personal narratives captured from various sources that include published interviews found online and in university reports tracking alumni. The narratives have been used to convey the individual experiences of PhD students and graduates from a variety of disciplines. Personal narratives can illuminate the struggles and successes that PhDs face while transitioning to the labour market. What these narratives make clear is the uniqueness of each person's journey. As each embarks on a path to their career, their period of transition may vary in length, and a successful outcome may be

defined differently depending on their own goals and values. The narratives used throughout this report highlight a small sample of these variations and career pathways and outcomes.

In considering the evidence, the Panel recognizes that there are limitations to the data, and that these at times have constrained this report. For example, while the Panel has made every attempt to present differences among disciplines, in some instances, this level of detail proved to be unavailable. The Panel also found there were significant data gaps related to where PhDs work, the average length of time that they remain in transitional roles before launching careers, the numbers employed as postdoctoral fellows (PDFs) and sessional instructors, and demographic breakdowns (beyond gender). There was also very little evidence on international mobility outside of academia or comprehensive surveys on job satisfaction. As indicated throughout the report, where the Panel lacked information from a Canadian context, and where appropriate, it relied upon international evidence.

1.5 Structure of the Report

Chapter 2 provides background and context on PhD education in Canada. It includes details on the basic structure of PhD programs in Canada, as well as an examination of how many degrees are being awarded, and in what disciplines. Chapter 2 also considers how funding of universities has shifted in the last 30 years, and the impact that a greater emphasis on research has had on university operations and the professoriate.

Building on Chapter 2, Chapter 3 focuses on the current experiences and perceptions of PhD students, graduates, and PDFs, including the impact of academic culture on all three groups. Discipline-specific aspects are pointed out where evidence permits. Chapter 3 also explores the role that academic supervisors play in transmitting academic culture, and the potential role that they can play in reshaping it, as well as factors that may prevent them from doing so. This chapter looks at the various motivations for pursuing a PhD, and the expectations of students versus the reality upon graduation, especially pertaining to financial and labour market dimensions. Finally, given that personal experiences vary greatly, Chapter 3 pays particular attention to issues such as gender, race, indigeneity, disability, and other factors in a PhD context that may influence different individuals' experiences.

Chapter 4 then focuses on the receptor capacity to hire PhDs, looking at the sectors in which PhDs are employed in Canada. This chapter relies on both quantitative and qualitative data in order to capture the challenges faced by PhDs in transitioning to employment in various sectors, illustrating how there is no one

model of transition. Chapter 4 also looks at issues related to skills mismatches and whether PhDs are graduating with the skills and experience that are sought by hiring managers — especially among non-academic employers — and whether there are issues related to translating skills learned during PhD studies to the workplace.

In Chapter 5, the Panel examines the labour market outcomes of PhDs once they enter the workforce. The chapter includes a discussion of unemployment rates and earnings for PhDs in Canada, and of recent graduates in particular. Through new analyses of publicly available data, the Panel considers the economic returns of pursuing a PhD and whether the outcomes and earnings for PhDs are different for recent graduates in comparison with earlier cohorts.

The global movement of PhD graduates is the focus of Chapter 6. It introduces the factors contributing to the international migration of PhDs, and investigates the mobility and migration of PhDs in and out of Canada in the context of the knowledge economy. The Panel chose to use the term *international migration* over the term *brain circulation*, which was used by the Sponsor in the original question. This chapter also addresses specific reasons why Canadian PhDs choose to leave, via new analyses of data from a large international survey of PhD graduates. Finally, Chapter 6 sheds light on the experiences and challenges faced by PhD graduates who came to study in Canada from abroad, and who comprise a diverse and increasing proportion of the graduate cohort.

Chapter 7 points the way forward by looking at leading practices used or under consideration internationally and in Canada to overcome the career transition challenges faced by PhDs. These include practices within higher education, such as professional development programs, transition support, and changes that challenge some of the traditional paradigms of PhD education, as well as government-led initiatives related to skills translation, training, and funding. This chapter makes clear that success moving forward will depend upon a system-wide approach involving all the key players, including graduates, universities, funding agencies, governments, and industry.

Lastly, Chapter 8 sums up the Panel's conclusions as it addresses the questions presented in the charge, lists outstanding knowledge gaps, and includes the Panel's final reflections on the topic.

2

Institutional and Funding Context

- 2.1 PhD Graduates in Canada
- 2.2 PhD Student Funding
- 2.3 The Funding and Operations of Universities
- 2.4 Summary



Chapter Findings

- The number of people graduating with PhDs in Canada has been increasing at a relatively steady rate since the turn of the 21st century.
- The proportion of PhD graduates who were international students has grown substantially in this century; as of 2016, they made up more than a quarter of all PhD graduates in Canada.
- There has been a significant shift in the balance of total federal and provincial government financial support to universities over the last 30 years, with an increased focus on investments in research.
- University budget constraints, combined with growing student enrolment, have led to shifts in how university courses are taught, with sessional instructors and teaching-stream faculty taking on an increasingly important role.

While the term *doctorate* has been used in the context of education since the Middle Ages, PhD programs as we know them are much more recent. Early in the 19th century, Wilhelm von Humboldt, in collaboration with others, founded a university that combined teaching with research, and viewed professors and students as “equal in the pursuit of knowledge” (Pritchard, 2004). The University of Berlin, now called Humboldt University, is widely considered the first modern research university (Wyatt, 1998). From the outset, the PhD was the highest degree awarded at the university, required original and creative research, and was considered an apprenticeship in scholarship (Blume & Amsterdamska, 1987; Goodchild & Miller, 1997). The PhD model spread and reached Canada a century later when the first PhD was awarded to John C. McLennan in 1900 (a degree in physics from the University of Toronto) (Jones, 2018; UofT Department of Physics, 2020). There were few PhD graduates in Canada, however, until the post-World War II expansion of higher education (Jones, 2018). Since then, the number of PhD programs has continued to grow, and the number of graduates has increased substantially (Jones, 2018). Although the PhD model has evolved in Canada (and elsewhere), its core continues to be original research with related coursework and examinations.

PhD graduates working in R&D are often viewed as exemplars of the highly skilled worker, essential for strong economies. The OECD explains that “doctoral graduates are key players in research and innovation. They are specifically trained to conduct research and are considered best qualified to create and diffuse scientific knowledge” (OECD, 2013). The federal government’s 2017 report, *The*

Fundamental Science Review, points out that PhD graduates are “particularly well-equipped to help improve [Canada’s] lagging productivity and innovation indices” and therefore strengthen the economy as a whole (Naylor *et al.*, 2017).

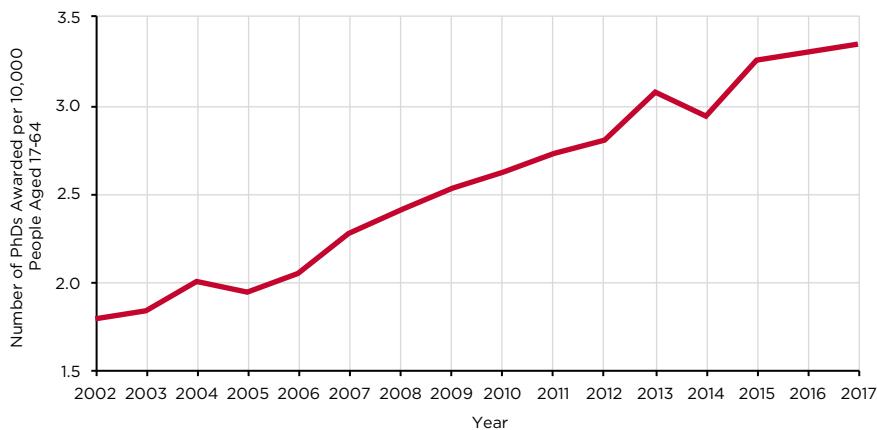
PhD graduates benefit society in ways beyond the economic. The creation of new knowledge during their studies in and of itself is a contribution that advances understanding in a range of fields. More important, however, may be the complex problem-solving and creative thinking skills that can develop through PhD studies (Naylor *et al.*, 2017). Some of the central aptitudes associated with PhD programs have benefits for graduates in their future endeavours across disciplines and sectors. Namely, PhDs’ abilities to amass and critically assess knowledge, and “piece together and solve problems” (Törnroos, 2017) can support fruitful research, storytelling, policy-making, and program development among many other activities that benefit society as a whole.

2.1 PhD Graduates in Canada

PhD programs in Canadian universities have a relatively common structure. These programs are based on a combination of elements from the French and British models that emphasize original research and a long thesis, and American programs that emphasize a significant amount of coursework on the front end (Jones, 2018). This means that Canadian PhD programs generally include four steps: coursework, one or more comprehensive exams, a period of intensive research, and a doctoral thesis to be examined by a committee that includes one or more external examiner(s). There is considerable variability beyond this basic structure across disciplines and institutions. For example, while the four basic steps are done sequentially in some programs, in others coursework and comprehensive exam(s) may be done at the same time as the period of residency. Comprehensive exams also take on a range of forms including take-home essays, timed written exams, project proposals, and/or oral presentations and exams. While the fundamental structure of PhD programs across Canada is similar and has remained relatively constant, there have been changes to specific requirements. For instance, many programs across the country used to require that students demonstrate proficiency in a second language; however, this was “largely abandoned” in the 1980s (Jones, 2018). Promising approaches regarding changes in program structure and content, student assessment, and the nature of the dissertation — as these relate to making the transition into the workforce — are discussed in Chapter 7.

2.1.1 The Number of PhD Graduates in Canada is on the Rise

The number of people graduating with PhDs in Canada has been increasing at a relatively steady rate since 2002. In that year, 3,723 students graduated from PhD or equivalent programs across the country (StatCan, 2020h). The number rose to 5,946 by 2010 and by 2017 had more than doubled, reaching 7,947. The number of PhD graduates has continued to grow at a rate faster than the population in Canada aged 17 to 64 (which encompasses the majority of people in the labour market) (StatCan, 2020a, 2020h) (Figure 2.1). The rate of growth for PhD graduates is also higher than the growth rate for bachelor's graduates. For instance, while there was a 113% increase in the number of PhD graduates between 2002 and 2017, the increase in bachelor's graduates was 52% (StatCan, 2020h).



Data Source: StatCan (2020a, 2020h)

Figure 2.1 Number of PhDs Awarded Per 10,000 People Aged 17-64 in Canada

The number of people graduating with PhDs from Canadian institutions has been on the rise since the early 2000s, growing at a rate faster than that of the working-age population. As a result, since 2002, the number of PhDs being awarded by Canadian institutions each year as a function of the population of Canada aged 17-64 has been steadily increasing.

This increase in the number of PhD graduates did not occur by accident. Many government-led initiatives (at both the provincial/territorial and federal levels) have had the express goal of increasing the number of highly qualified personnel (HQP) graduating from Canadian institutions. This resulted in the acceptance of more PhD students and the hiring of more PDFs to carry out research (Section 2.2).

Despite this growth, Canada still has fewer PhDs per capita compared to many other peer countries. *The Fundamental Science Review* examined data from the G7 and other peer countries with similar populations and found that Canada produces fewer PhDs per capita than all others except Japan, Italy, and Israel (Naylor *et al.*, 2017). Similarly, in its 2010 comparative ranking of the number of PhD graduates (per capita) from 16 international peers, the Conference Board of Canada ranked Canada 15th overall (CBoC, 2019b). It would have been necessary for Canada to add 3,200 PhD graduates per year, an increase of over 50%, in order to match Australia, which was 8th in those rankings (CBoC, 2019b; StatCan, 2020h). While there are important contextual differences between PhD programs in Australia and Canada, the magnitude of the difference in the number of PhD graduates illustrates that Canada's production is far below that of many peer countries.

2.1.2 Time to Completion and Graduation Rates Vary by Discipline

The amount of time it takes students to complete a PhD program in Canada varies considerably. The most detailed and comprehensive Canadian information comes from the Survey of Earned Doctorates (SED),¹ an “annual census of doctorate recipients” (StatCan, 2009). According to the 2005–2006 edition of the SED, the median length of time it took students to complete a PhD was five years and four months (King *et al.*, 2008). This is consistent with data on students from the U15 who started their degrees in 2007; PhD graduates were registered in a median number of 15 terms (5 years) before they graduated (UofT, n.d.-b).² Since then, however, several universities in Canada have sought to shorten the time it takes students to complete a PhD (Task Force on Time-to-Completion, 2010; Krogman, 2014; Time to Completion Task Force, 2014; UofT, n.d.-a). Many universities in Canada (and worldwide) are exploring ways to reduce completion times by, for instance, providing cash awards for completion within a time limit, modifying coursework, and setting stricter time limits (Tamburri, 2013). For example, at McGill University, there is a time limit of seven years (McGill University, 2019), while at Queen’s University the limit is four years (though a particular department may extend the limit to five years if there are “discipline-related” circumstances) (Queen’s University, n.d.-a).

Time-to-completion varies significantly by field of study. Data from the SED show that PhD graduates from STEM³ fields tend to have shorter completion times than

¹ The SED has been inactive since 2008.

² This median value excludes University of Toronto (UofT). The median for the 2007 cohort of UofT students was 5.33 years (16 terms).

³ Defined by Statistics Canada as including science and science technology; mathematics and computer and information sciences; and engineering and engineering technology.

those in Bbase⁴ disciplines (King *et al.*, 2008). This is also observed in the U15 data for the 2007 cohort (excluding the University of Toronto, or UofT), where the median time to completion for humanities and social sciences PhD graduates was one year (three terms) and eight months (two terms) longer, respectively, compared to STEM graduates (UofT, n.d.-b). This may be the result of students in the sciences having more frequent contact with their supervisors, and working in “more cohesive and competitive . . . research environments” (Elgar, 2003). Another factor may be a lack of funding, requiring PhD students to take on paid work during their studies (Task Force on Time-to-Completion, 2010), something that may occur more frequently among those studying outside of STEM (Elgar, 2003).

Canada-wide data are available on how many students in the 2010–2011 cohort graduated within five years. When considering all disciplines, 36% of this class graduated within five years, while an additional 8% graduated but without a PhD (e.g., with a master’s degree instead) (StatCan, 2019g, 2019f). As with the 2007 U15 cohort, there were significant discipline differences: 47% of STEM students had graduated by year five, compared to 25% of students in Bbase fields (StatCan, 2019g). This illustrates that a significant percentage of PhD students either take longer than five years to complete their degrees, transfer to a different university, or leave their programs without graduating.

Detailed completion data beyond five years are elusive. The most recent data identified by the Panel come from eight U15 institutions, relating to a cohort of PhD students who began their studies in 2001. After nine years, 71% of this cohort had completed their PhDs, with the highest completion rates observed for students in health sciences (78%), followed by physical sciences and engineering (75%), social sciences (65%), and humanities (56%) (Tamburri, 2013). Again, these data illustrate that attrition and/or long completion times appear to be a larger issue for PhD students in some Bbase disciplines compared to STEM.

There is also little data available on attrition. The only recent data identified by the Panel are limited to how many students leave their programs within the first year or two. According to Statistics Canada, 9 to 10% of PhD students who began a Canadian program in 2011–2015 withdrew within one year, while a further 5% were no longer registered after two years (StatCan, 2019g). This is not necessarily problematic; some attrition early on is expected as some students realize that a PhD program is not an appropriate fit for them. The greater issue lies with slow attrition, particularly for students who have completed all program requirements save for the dissertation and subsequent defence (“all but dissertation,” or ABDs). Discussion on the causes of attrition is provided in Section 3.4.

⁴ Defined by Statistics Canada as including arts and humanities; social and behavioural sciences; legal professions and studies; healthcare; education and teaching; and trades, services, natural resources, and conservation.

2.1.3 PhD Graduates in Canada Are Evenly Split Between STEM and Bbase Fields

When looking at Canada's PhD population as a whole, 58% hold degrees in STEM disciplines, while the remaining 42% have degrees in Bbase fields (Wall *et al.*, 2018). When looking at graduates from only the last decade, the respective proportions of students graduating with STEM and Bbase degrees are more even. In 2017, the number of granted PhD degrees was almost evenly split between STEM and Bbase fields (StatCan, 2020h). More specifically, the top fields of study for PhD graduates in 2017 were the STEM fields of physical and life sciences at 24% and architecture, engineering, and related technologies (hereafter referred to as engineering) at 22%, followed by the Bbase field of social and behavioural sciences and law (hereafter referred to as social sciences) at 19% (StatCan, 2020h).

There has been growth in the absolute number of PhD graduates in almost all disciplines, with the only exception being education, where the number of graduates has remained relatively constant since 2000. The result is that, in most disciplines, there is a growing number of PhD graduates entering the labour market each year. The rate of growth, however, is not constant across disciplines (StatCan, 2020h). Between 2002 and 2017, in STEM fields, growth was greatest in engineering (which accounted for 22% of all PhD graduates in 2017). Over the same period, in Bbase fields, the largest proportional growth was in health and related fields, but this remains relatively small in terms of the total number of graduates (accounting for 9% of all PhD graduates in 2017) (StatCan, 2020h).

2.1.4 Recent PhD Graduates are Relatively Evenly Split Between Men and Women

Among the entire population of PhDs in Canada, men make up the greater proportion (63% men versus 37% women) (StatCan, 2019e). This gap narrows significantly for more recent cohorts: among 2017 PhD graduates from Canadian institutions, there was a more even split between men (54%) and women (46%) (StatCan, 2020h). This is not the case across all disciplines, however, with women dominating education, social sciences and health, while men dominate mathematics, computer and information sciences (hereafter referred to as math and computer science), and engineering (Table 2.1).

Table 2.1 PhD Graduates from Canadian Institutions, by Field of Study and Gender, 2017

	Men	Women
All Graduates	54%	46%
Discipline (Statistics Canada Labels)		
Education	30%	70%
Visual and performing arts, and communications technologies	50%	50%
Humanities	51%	49%
Social and behavioural sciences and law	38%	62%
Business, management and public administration	55%	45%
Physical and life sciences and technologies	54%	46%
Mathematics, computer and information sciences	78%	22%
Architecture, engineering, and related technologies	77%	24%
Agriculture, natural resources and conservation	50%	50%
Health and related fields	39%	61%

Data Source: StatCan (2020h)

The gender distribution of PhDs who graduated from Canadian institutions in 2017, by discipline. Some rows do not add up to 100% due to rounding.

The Panel notes that the gender distribution of PhD graduates within a given discipline can also vary significantly by sub-field — for example, biology compared to physics (both sciences) or philosophy compared to history (both humanities).

There are limited reliable data on the demographic makeup of PhD graduates from Canadian institutions beyond gender. Results from the 2016 census indicate that just under one-third of PhDs in Canada identify as being part of a visible minority (StatCan, 2019d), while less than 1% identify as Indigenous (StatCan, 2019c). Current PhD students were asked about minority status in the 2019 Canadian Graduate and Professional Student Survey (CGPSS), a cross-country survey targeting current graduate students undertaken every three years. The 2019 survey received responses from over 20,000 PhD students. According to this

survey, 4% of respondents “self-identify with, or have ancestry as” an Indigenous person. Additionally, 11% considered themselves West Asian, 10% East Asian, 7% South Asian, 7% Black, 6% Latin American, and 2% Southeast Asian (CRIEVAT, 2019). Overall, 54% responded that they did not belong to a visible minority (CRIEVAT, 2019). Similarly, the 2016 Canadian Association of Postdoctoral Scholars (CAPS) survey⁵ asked about ethnicity and found that, while the majority of respondents identified as White (64%), 8% identified as South Asian, 7% as Chinese, 4% as Latin American, 4 % as West Asian, 3% as Arab, and 2% as Black. Another 1% of respondents or less identified as Korean, Southeast Asian, Japanese, Métis, Filipino, or First Nations (Jadavji *et al.*, 2016).

Research commissioned by the Panel using the Education and Labour Market Longitudinal Platform (ELMLP; see Chapter 5) demonstrates that younger people (i.e., aged 36 and under) made up the majority of PhD graduates between 2010 and 2014. This share increased slightly over time, rising from 70% in 2010 to 73% in 2014. The only disciplines in which those aged 37 and older represented more than half of PhD graduates were education (80%) and business (57%). Statistics Canada data on the class of 2017 indicate that 18% of PhD graduates were over 40 (StatCan, 2020h). Results from the 2018 National Graduates Survey (NGS), which looks at graduates from the class of 2015, found that, on average, people obtained their PhD at 35, with a median age of 32 (StatCan, 2020g). These values are relatively consistent with the results for the classes of 2010, 2005, and 2000.

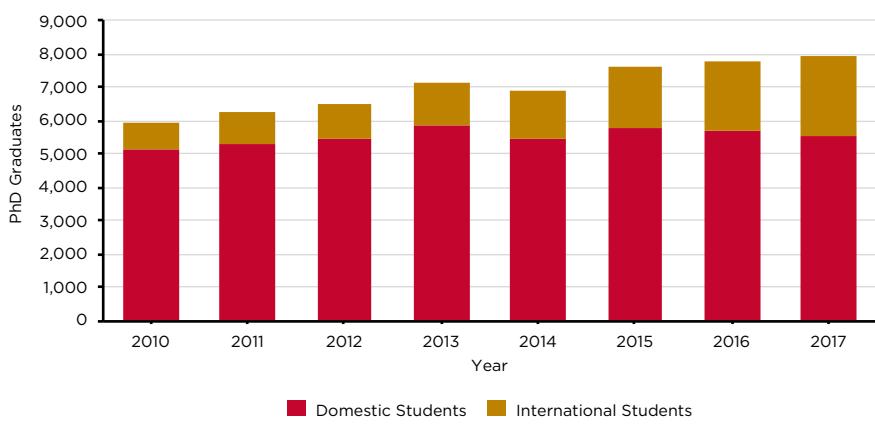
2.1.5 The Proportion of PhDs in Canada Who Are International Students Is Growing

Many PhDs in Canada come from abroad. In the 2016 census, just over 50% of all PhDs in Canada were immigrants,⁶ while 45% were non-immigrants, and 4% were non-permanent residents (StatCan, 2019e). Most PhDs in Canada earned their degree at Canadian institutions (57%); non-immigrants were more likely to earn their PhD at a Canadian institution (78%), but a substantial percentage of immigrants did as well (40%) (StatCan, 2019e). Some of these international students are choosing to stay in Canada. For example, large-scale surveys of University of British Columbia (UBC) and UofT PhD graduates found that 38% and 27% of their international students, respectively, were still in Canada at the time of the survey (Porter *et al.*, 2017; Reithmeier *et al.*, 2019). More detailed information on these surveys can be found in Chapter 4, while mobility among PhDs and the role of international students at Canadian institutions are discussed in Chapter 6.

⁵ The survey targeted both PDFs working in Canada and PhD graduates who are Canadian citizens completing PDFs abroad (Jadavji *et al.*, 2016).

⁶ The term *immigrant* refers to all people in Canada who were not citizens at birth.

When looking specifically at PhDs awarded at Canadian universities, the proportion awarded to international students each year is on the rise (Figure 2.2). In 2010, the proportion of all PhD graduates who were international students at graduation was 13% (StatCan, 2020f). Since then, this proportion has steadily grown, and was more than a quarter of all graduates (30%) in 2017. This is much higher than in the overall Canadian post-secondary system, where 14% of all graduates were international students in 2017 (StatCan, 2020f). Nor does this include students who begin their PhDs as international students but become landed immigrants before graduating (and would then be considered domestic students). These results are relatively consistent with the 2019 CGPSS, where approximately 59% of respondents were Canadian citizens, 8% were permanent residents, and 33% were on a student or other non-immigrant visa (CIREVAT, 2019). While there are no official numbers for PDFs, 29% of the respondents to the 2016 CAPS survey were international and on a work permit (Jadavji *et al.*, 2016).⁷



Data Source: StatCan (2020f)

Figure 2.2 Number of PhDs Awarded to International and Domestic Students, Respectively

International students (represented by the yellow bars) are making up an increasingly large share of the total number of PhD graduates from Canadian institutions. Domestic Students (represented by the red bars) refers to Canadian citizens and landed immigrants.

Among international students, the divisions across disciplines do not mirror those among domestic students, as a greater proportion are studying STEM fields

⁷ These data do not tell us whether graduates obtained their degrees in Canada or elsewhere.

(StatCan, 2020f). The most common discipline among international students is engineering; about 34% of international PhD graduates in Canada obtained degrees in this discipline in 2017 compared to 17% of domestic students. Further, in that same year, 47% of all those who obtained engineering PhDs were international students (recall the average for all disciplines was 30%) (StatCan, 2020f).

2.2 PhD Student Funding

PhD students enter programs under a variety of financial circumstances, and differences among universities and disciplines affect how much funding students receive, and the tuition rates they pay, while pursuing their degrees. As a result, there is considerable variation in students' earnings across the country, which — in combination with variations in the cost of living in different Canadian regions, among other factors — means that PhD graduates leave their programs under diverse financial circumstances. Some will have student debt, some will have no debt but little savings, while others will have been able to save during their studies. Approximately 45% of the respondents to the 2019 CGPSS who were PhD students reported having some graduate educational debt. Of those who report having graduate debt, just under half had debt greater than \$20,000 (CRIEVAT, 2019).

A student's financial situation may affect their labour market options upon graduation. For example, students with high levels of debt and no other sources of income (e.g., from a working spouse) may feel forced out of academia because they cannot afford a low-paying transitional position (PDF or sessional role), which in some disciplines may be a requirement for a tenure-track professoriate position. Others who feel they absolutely cannot withstand a period of unemployment may choose to take consecutive low-paying contracts in transitional jobs. These issues are discussed further in Section 4.1.

Graduate students, like undergraduates, are charged tuition for their studies. The cost of PhD tuition varies across provinces, universities, and departments. A quick review of the websites of several universities across the country reveals that full-time tuition and fees are generally in the range of \$4,000 to \$8,000 per year for domestic PhD students (MUN, 2019b, 2019c; UofT, 2019a; USask, n.d.-a, n.d.-b). As part of their tuition and additional fees, PhD students often have the option of accessing some extended health benefits and/or dental coverage as long as they are registered as students. Once they graduate, however, they lose these benefits.

Many PhD students receive funding from scholarships or fellowships from a range of different sources. From a student perspective, there are several benefits to

receiving direct funding,⁸ as demonstrated in the results of a survey by the Science & Policy Exchange (SPE) of current and recent graduate students and PDFs in Canada. Respondents to the SPE survey reported that, compared to receiving funding from a supervisor's grant, scholarship or fellowship awards provided the following benefits: prestige (84%), salary security (70%), better salary (66%), and greater control over their research (50%) (SPE, 2019). Students (and supervisors) may focus on the criteria used to evaluate scholarship applications during their studies in an attempt to improve their odds of being selected for a scholarship. These criteria often include grades and traditional research outputs (e.g., peer-reviewed publications, conference publications) (GC, 2019g).

The federal government directly supports PhD students in Canada through several scholarships distributed through the tri-agencies: NSERC, SSHRC, and CIHR. Just over a third of PhD respondents to the 2013 NGS (which looked at graduates from the class of 2010) received a tri-agency fellowship during their studies (Walters *et al.*, 2020). The largest federal award for PhD students, the Vanier Canada Graduate Scholarship, is valued at \$50,000 per year for three years and is available to Canadians and international students studying in Canada (GC, 2019c). The program was launched in 2008 with up to 500 active Vanier scholarships at any one time. A more common award is the Canadian Graduate Scholarship (CGS) available to domestic students studying for a master's or PhD at Canadian institutions. The CGS was launched in 2003 and is valued at \$35,000 per year for up to three years at the PhD level; there were 2,727 CGS PhD students in 2012–2013, the most recent period for which the Panel could identify publicly available data, though the program is still active (CIHR, 2016). In the 2019 budget, the federal government pledged to create an additional 167 CGSs per year (GC, 2019d).

The monetary values of both the CGS and the Vanier have not increased since they were launched (GC, 2003; CIHR, 2014; GC, 2019c, 2019g), while average PhD tuition fees have increased. For example, between 2008 and 2018 fees increased by 28% for humanities and 59% for sciences (StatCan, 2020e). In practice, therefore, these awards have lost significant value as a result of inflation. NSERC and SSHRC also provide other fellowships of lower monetary value for study at Canadian universities (SSHRC doctoral fellowships at \$20,000 per year; NSERC post-graduate scholarship at \$21,000 per year) (NSERC, 2019a; SSHRC, 2019a). Like the CGS and Vanier awards, the value of NSERC and SSHRC's other awards has remained constant since the early 2000s (NSERC, 2005, 2019a; SSHRC, 2019a).

Beyond federal government scholarships, provincial graduate awards are available to students studying in certain provinces (e.g., Ontario Graduate Scholarship, Quebec's Doctoral Research Scholarship). Just under a quarter of PhD respondents

⁸ *Direct funding* refers to scholarship or fellowship money that is awarded directly to a particular student to support their research.

to the 2013 NGS received a provincial scholarship (11% of this group also had a tri-agency fellowship) (Walters *et al.*, 2020).

The growing share of international PhD students in Canada has inconsistent access to Canadian scholarships; they are eligible only for the Vanier fellowship at the federal level, and there is variability in their access to provincial and institutional awards (e.g., FRQSC, 2020a; Gov. of ON, 2016).

The effective devaluing of federal scholarships may be one reason that the majority (65%) of students with scholarships who responded to the SPE survey stated they required additional sources of funding beyond their award. These other sources included other scholarships (30%), previous savings (19%), part-time employment (18%), parental and family support (14%), and loans (9%) (SPE, 2019). As explained by one respondent, “I have been funded by NSERC . . . and I had to pinch pennies to survive and, even then, required other financial aid. Also, I was a single person with no dependents” (SPE, 2019).

The SPE survey also asked participants to consider the statement “elite awards provide greater levels of support and prestige for select trainees, but the investment required reduces the total number of potential awards available” (SPE, 2019). In response, 39% stated they believed elite scholarships (e.g., Vanier) should be reduced, 25% believed they should be maintained, 23% stated they should be abolished, 6% believed they should be increased, and 7% had no opinion (SPE, 2019). A majority of respondents to the survey did not necessarily support elite awards but instead were in favour of harmonization and re-evaluation across the tri-agencies of all doctoral and postdoctoral awards, proposing annual median values of \$35,000 and \$50,000 respectively (the median values recommended by respondents) (SPE, 2019).

In some disciplines, particularly STEM fields, the primary source of funding for students who do not hold fellowships is through research assistantships paid from their supervisor’s grants. Often, one of the purposes of tri-agency research grant funding is to support the development of HQP. Grants are therefore used to pay stipends, defined as “financial support given to a recipient of a training award, or provided by a grant recipient to a trainee, to support them while they are working on their research thesis and/or gaining research experience” (GC, 2020a). Many PhD students also receive income from their universities through employment as teaching assistants (TAs). Almost 60% of PhD respondents to the 2013 NGS reported working as a TA during their studies (Walters *et al.*, 2020). While earnings as a TA are considered taxable income, research stipends are often (but not always) considered scholarship earnings and are therefore not taxable (GC, 2017). A review of the websites from several universities found that the funding amounts offered to full-time PhD students not holding a large fellowship or scholarship

range widely: some receive less than \$15,000, others receive over \$30,000, and in some cases, no funding is guaranteed at all (MUN, 2019b, 2019c; UofT, 2019a; USask, n.d.-a, n.d.-b).

2.3 The Funding and Operations of Universities

While the requirements of PhD programs have remained largely constant in Canada for the past 25 years, PhD students and graduates have been affected by shifts in university structures and funding. The funding changes have been influenced by evolving societal views on the purpose of universities and jurisdictional authority over higher education institutions in Canada.

2.3.1 Authority Over Universities is Complex

While the line between provincial and federal authority over universities is not always clear or agreed upon, it is apparent that both orders of government play an important role in PhD education in Canada. Briefly, education, including universities, is under the jurisdiction of the provinces and territories. This includes responsibility for providing core operating grants (Usher, 2018a). The federal government also plays an important role in education, indirectly through transfer payments to the provinces and territories, but also directly through its authority over economic development. The latter includes funding research that requires infrastructure, equipment, and supplies at universities, but also personnel such as research chairs and PhD students.

Although education falls under the purview of provinces and territories, universities have considerable autonomy in decision-making on academic matters generally resting with university senates (Jones *et al.*, 2001). This means that decisions related to standards and curricula, along with quality assurance, are largely left to universities, although in Ontario and Quebec there is some oversight by the provincial association of universities (Weinrib & Jones, 2014; Jones, 2018). The existence of discipline silos, however, can make the implementation and coordination of policies across departments within a university challenging (Berdahl & Malloy, 2019).

2.3.2 Research Funding Has Grown in Importance for Universities

The funding of post-secondary institutions in Canada has undergone several changes in the past 25 years, resulting in increasing numbers of PhD graduates (and consequently the number seeking to enter the labour market), as described in Section 2.1. The federal government made significant cuts in the 1990s as it sought to balance the budget (Usher, 2018b). This led to significant reductions in federal

transfer payments to the provinces for post-secondary education (among other areas) that resulted in reduced core support for Canadian universities. In 1995, the provinces gained autonomy to spend transfer payments (through the Canada Health and Social Transfer fund) as they saw fit, with no funds tied directly to post-secondary education.⁹ At the same time, the federal government reduced direct funding for research (and students) through decreases in tri-agency funding (Williams, 2005). There was also a reduction in PhD enrolments across the country starting in 1996 (StatCan, 2020d), followed by a period of stagnation in the number of graduates between 1997 and 1999, and declines until 2001 (StatCan, 2020h).

With the elimination of the federal deficit in the late 1990s and early 2000s, the federal government began increasing transfer payments to the provinces and territories (some of this funding went to post-secondary education) and reinvested directly in higher education with a particular focus on R&D and innovation (Polster, 2007; Usher, 2018b). Universities were collaborators in the development of Canada's 1996 R&D policy, *Science and Technology for the New Century: A Federal Strategy* (Munroe-Blum, 2011). This document identified “supporting research in universities” as one of the federal government’s core science and technology (S&T) activities (GC, 1996). Investments in universities focused on supporting particular research programs and attracting top research talent by, for example, increasing tri-agency funding, creating specific programs such as the Vanier scholarships and the Canada Research Chair (CRC) program, and creating the Canada Foundation for Innovation (CFI) (Polster, 2007).

These direct investments in research reflected the view that universities in Canada were important for creating and supporting a knowledge-based economy (Williams, 2005; Polster, 2007). Strong R&D and innovation, in particular, were seen as critical for Canada’s economic success (Martin, 1998). Some provinces also created (or modified) programs to support R&D at their universities (e.g., creating Centres of Excellence in Ontario, directing some Heritage Fund support in Alberta) (Williams, 2005). Greater numbers of graduate students and PDFs were needed to support the increased level of research at universities. Additionally, the purpose of many research investments was to increase the production of PhDs (or graduate students) in Canada. While many efforts were directed towards STEM fields, others targeted all disciplines; one example was the CGS program, which significantly increased the number of federal fellowships available to PhD students (Williams, 2005). Significant growth in the number of PhDs was considered critical for several reasons, such as addressing an impending faculty

⁹ In 2004, the Canada Health and Social Transfer fund was split into the Canada Health Transfer (CHT) and Canada Social Transfer (CST) (Usher, 2018b). According to Usher (2018b), 30.7% of the CST is “deemed related to post-secondary education.”

shortage (due to retirements) and providing industry with a workforce of innovators who would help address Canada's productivity gap compared to "competing jurisdictions" (Rae, 2005). Universities across the country welcomed research investments, growing their research capacity in terms of infrastructure and personnel (COU, 2011; U15, 2013; StatCan, 2019i).

Direct federal government investment in universities continues to focus almost exclusively on supporting research programs (e.g., through tri-agency funding and the Canada Research Chair program) (StatCan, 2017). In 2017–2018, the tri-agencies distributed just over \$2B to support higher education research across the country (StatCan, 2019b). This investment was distributed, for example, through grants to support ongoing research programs, specialized research tools, and the development of Canadian and global networks, as well as student fellowships and postdoctoral awards. The majority of this funding was distributed by CIHR (45%), followed by NSERC (41%), and SSHRC (14%) (StatCan, 2019b).

While federal government investments go towards university research, provincial government funding is primarily focused on operations and capital spending. Since 2000, the percentage of university revenues coming from the federal government (primarily targeted to research) has remained relatively constant — representing 10% of all university revenues in 2000–2001 and 2017–2018 (StatCan, 2019b). The proportion of total university funding coming from the provinces has dropped; provincial funding represented 43% of all university revenues in 2000–2001, and was 36% in 2017–2018 (StatCan, 2019b).

Universities needed to adapt to this reduced government funding for operations. As the percentage of funding from governments dropped in the 1990s, university budgets became more heavily dependent on student tuition and fees, and private revenue sources (Robertson, 2003). Private revenue streams include donations, bequests, and non-government grants and contracts. Since 2000, the proportion of revenues for universities (and degree-granting colleges) attributed to donations and non-government grants has remained relatively constant at about 10% (StatCan, 2019b). Tuition and other fees, however, have continued to increase in importance; in 2000–2001, these sources represented 19% of all revenue while in 2017–2018 they represented 28% (StatCan, 2019b).

While the revenues from different sources represent a Canadian average, there are significant provincial variations as each province has its own approach for funding institutions. For example, according to KPMG calculations based on data from the Canadian Association of University Business Officers, Ontario universities obtain almost equal proportions of their revenue from government grants (36%) and tuition and fees (35%), while Quebec universities obtain

significantly more of their revenue from government grants (62%) compared to tuition and fees (16%) (KMPG, 2019).

These differences across provinces are significant and demonstrate that there is no single funding model. It is, however, beyond the scope of this report to conduct a detailed analysis of the funding models and university revenue distributions within each province. These models are complex, based on different inputs and formulas that tie funding to enrolment to different extents. The examples in Box 2.1 illustrate some of the complexity of provincial funding approaches. Several provincial governments are proposing to tie a greater share of their funding directly to labour market indicators, although details are limited. For example, the Ontario government announced that it plans to tie increases in the proportion of funding to universities to a range of outcomes (including labour market indicators) (Gov. of ON, 2019; Friesen, 2020). It is unclear exactly how the different components of the current funding model will shift to accommodate this change (Gov. of ON, 2019). Governments in Alberta and Manitoba are also moving towards tying university funding more closely to specific outcomes (Canadian Press, 2020; Smith, 2020). The differences in funding approaches mean that the incentives for universities to create more (or fewer) PhD positions will vary by province.

Box 2.1 Examples of Two University Funding Models in Canada

Ontario¹⁰

Ontario, which produces the largest number of PhD graduates in Canada, uses an allocation model to fund universities. While the model has been altered since its creation in the late 1960s, its core components have remained unchanged. Currently, funding includes a basic operating grant (based on historic enrolment), grants that support growth in both undergraduate and graduate programs, performance-based funding, and “Special Purpose Grants” that provide funding for specific projects and government priorities (Ontario MTCU, 2015). In 2015-2016, about 1% of the budget was allocated based on performance indicators (including employment after graduation) (Ontario MTCU, 2015).

(Continues)

¹⁰ On November 26, 2020, the Ontario Government released the 2020–2025 Strategic Mandate Agreements for each of that province’s publicly assisted universities. These agreements tie a greater portion of funding to ten performance-based indicators. The agreements were issued after this report was finalized and thus are not reflected in the discussion.

(Continued)

The basic operating grant for graduate students for a given university was based on the number of students enrolled in 2007-2008, with additional funding coming from the graduate expansion grant that provides funds on a targeted per-space basis. Ontario MTCU (2015) explains that “funding is the lesser of enrolment actuals and Ministry-set grad space targets,” meaning that if a university does not meet the targets for graduate enrolment, it will not receive maximum funding. These targets are set out in Strategic Mandate Agreements (SMAs) between the provincial government and each university (and college) in Ontario (Gov. of ON, 2020).

New Brunswick

New Brunswick’s approach to funding its universities has traditionally been to provide an operating grant through the Maritime Provinces Higher Education Commission, which uses a formula developed in 1979 (AGNB, 2019). The total budgeted amount allocated by the Ministry of Post-Secondary Education, Training and Labour is divided into two components: “75% for the flat grant and 25% for the enrolment grant” (AGNB, 2019). The flat grant was distributed among New Brunswick’s four universities based on past distributions (i.e., those universities that traditionally receive a larger portion of the grant will continue to do so). The enrolment grant was distributed by considering the weighted full-time equivalent student enrolment at each institution (not including international students), with weightings affected by discipline (e.g., an arts student was assigned a weight of 1.5 while a computer science student’s weight was 3.0). There were also other small funding provisions; for example, l’Université de Moncton also received a supplementary grant to offset its additional costs as a French-language institution. In 2019, the Auditor General of New Brunswick noted that university funding in the province was no longer allocated based on the 1979 formula because “the formula has been frozen since 2015/2016” (AGNB, 2019). In its place, the three universities that have PhD programs signed a Memorandum of Understanding with the province and have been receiving set increases in operating grants. For example, the 2019-2020 operating grants were 1% higher than those of 2018-2019. The Auditor General notes that this university funding “equates to a flat grant that does not take into account enrollment” (AGNB, 2019).

2.3.3 Budgets Have Changed Who Is Teaching University Courses

Shifts in funding and an increased emphasis on research have had an impact on university budgets and operations. Many universities have become more research-intensive, focusing on growing their research programs and celebrating their successes. Universities have also placed a large emphasis on innovation and translation of their research to the marketplace, as illustrated by many institutions having vice-presidents of research and innovation. The importance of PhD students has therefore grown, since they are essential for research operations and provide a relatively low-cost labour force. This is true across different types of institutions. Although the majority of PhD graduates in Canada come from research-intensive institutions, many other universities, including some primarily undergraduate institutions, also depend on PhD students to support research operations (Jonker, 2016).

At the same time that research funding has grown in importance, university budgets in general have been constrained, necessitating changes in who is teaching courses, particularly at the undergraduate level (Usher, 2018a).

Undergraduate enrolment has been rising since the turn of the century (StatCan, 2020d) and, as a result, there are increasing numbers of courses to be taught. The number of tenure-track professors (i.e., full, associate, and assistant professors) employed in Canada has remained, however, relatively stable for a decade (StatCan, 2019j). Some universities have introduced teaching-stream faculty in certain departments; this terminology is sometimes used for positions that are term-limited, full-time positions (usually one to five years), as well as those on the tenure track (Sanders, 2011; COU, 2018). The primary role of teaching-stream professors is instruction; they therefore have much higher teaching loads than their research-focused counterparts, and typically earn lower salaries (Sanders, 2011). Teaching-stream professors permit universities to teach undergraduate students at a lower cost while providing traditional faculty more time to focus on research or graduate programs. These employees have some degree of job security, and can often focus on developing teaching expertise as well as supporting ongoing curriculum development. In 2011, 14 out of 20 publicly funded Ontario universities had some version of a teaching-stream professor in at least one department (Sanders, 2011). Data presented by the Council of Ontario Universities (COU) show that 6% of academic staff who taught at 17 Ontario universities in the 2014–2015 academic year were full-time, non-tenure-stream professors (these data do not include teaching-stream faculty who were on the tenure track) (COU, 2018).¹¹

¹¹ The 17 Ontario universities that contributed data to the study are not named. The authors note that data from Ontario's largest university, UofT, were not included.

Beyond teaching-stream faculty, there has been an increase in the number of sessional instructors (i.e., those working on a contract, and often part-time, basis) teaching undergraduate courses (Section 4.1). While Canada-wide data are not available, it is known that 50% of the undergraduate courses at the 17 Ontario universities surveyed by COU were taught by part-time instructors in 2014–2015 (COU, 2018). As noted by Gopaul *et al.* (2016), “the traditional university model in Canada, whereby a near totality of university faculty members focus on both research and teaching, is increasingly viewed as a legacy of a bygone era marked by economic growth and predictable budgets.” Additional discussion of Canada’s receptor capacity for tenure-track professors (including those in teaching streams), and the growing role of sessional instructors, can be found in Section 4.1.

2.3.4 The Elimination of Mandatory Retirement Has Affected the Age of the Professoriate

Across the country, the abolition of mandatory retirement for employees under provincial/territorial jurisdiction led to significant changes in the operations of Canadian universities. The process to eliminate mandatory retirement for professors was gradual. It started in the 1980s in Quebec, but by the 2010s, universities in all provinces had removed mandatory retirement as a result of court rulings, legislation, and collective bargaining (Worswick, 2005; Klassen, 2010).

Before the elimination of mandatory retirement, university professors were required to retire once they reached 65 years of age. Since the rules were changed, many professors have chosen to continue working beyond their 65th birthday (Naylor *et al.*, 2017). This has partially contributed to an increase in the average age of professors in Canada. While the median age for professors has risen for all ranks, it has been most significant at the full professor level. In 1990–1991, the median age of full professors in Canada was 52, rising to 55 by 2000–2001, before climbing to 57 in 2010–2011 (after which it has remained relatively steady) (StatCan, 2019j). Over this same period, the proportion of full-time university academic teaching staff over the age of 65 has steadily increased — from 2% in 2000–2001 to 10% in 2016–2017 (StatCan, 2018d). At the same time, the proportion of professors under the age of 50 has dropped slightly from 50% to 46% (StatCan, 2018d).

The decrease in the proportion of professors under 50 has cost implications for universities, as older professors (who are more likely to have associate or full rank) generally receive more compensation than their younger counterparts (StatCan, 2018a, 2019j). In addition, new hires are affected when older professors delay retirement and therefore do not yet need to be replaced. In *The Fundamental*

Science Review, Naylor *et al.* (2017) note that the elimination of mandatory retirement “is likely to constrain opportunities for early career researchers over the next decade.”

2.4 Summary

PhD programs in Canada have remained largely unchanged in the last 30 years, and are relatively similar across the country. At the same time, there have been significant changes in how universities are funded and how they operate. The importance of university research has grown, requiring a concomitant increase in the number of PhD students and PDFs to conduct this research. In the last 20 years, the number of PhD graduates in Canada has continued to climb at a rate that is faster than the growth rates of the working-age population as well as those obtaining bachelor’s degrees. Increases in PhD enrolment are occurring across most disciplines, including both STEM and BHASe fields. This means that each year an increasing number of PhD graduates with a range of backgrounds are entering the labour market. A growing number of these graduates are international students, as this group comprises an increasingly large share of all PhD graduates from Canadian institutions (over a quarter of the total in 2016).

As universities have become more research-intensive, the importance of PhD students and PDFs to the university system has grown. At the same time, elimination of mandatory retirement has led to an aging of the professoriate while growing enrolments and budgetary constraints have shifted how university courses are taught (e.g., increasing reliance on sessional instructors). These factors influence the PhD student experience and the receptor capacity for PhD graduates within academia across Canada — issues that will be discussed in Chapters 3 and 4.

Understanding the Challenges of the PhD Student Experience

- 3.1 Students Have Different Reasons for Pursuing a PhD
- 3.2 The Role of Academic Culture
- 3.3 Awareness of Career Options and Outcomes
- 3.4 Attrition Among PhD Students
- 3.5 Prioritizing EDI in PhD Programs
- 3.6 Summary



Chapter Findings

- PhD students are acculturated in an environment that privileges the production of academically oriented research over other types of learning and broader forms of research and scholarship. This emphasis is increasingly outdated due to the limited availability of faculty positions and the need to prepare graduates for a variety of potential career outcomes.
- Faculty and academic supervisors play a crucial role in transmitting academic culture and can therefore help reshape it. However, current academic structures, paradigms, and traditions may hinder this.
- Few students embark on a PhD with an awareness of their potential career opportunities or labour market outcomes on graduation other than remaining in academia and becoming a professor.
- Many PhD students show a declining interest in academic careers as they progress through their academic program. Some of this decline can be explained by students realizing they will likely encounter significant difficulties with the academic job market because of the limited availability of faculty positions.
- Rates of depression and anxiety among PhD students tend to be higher than among the general population, and may be exacerbated or caused by the high demands of academic culture and an uncertain future.
- Universities across Canada are increasingly recognizing the need to prioritize issues related to EDI.

As outlined in the previous chapter, universities in Canada have undergone significant transformations in the past 30 years, with a greater focus on research activities. These changes have shaped current funding and hiring practices, which in turn have influenced academic culture and affected students, faculty, and administrators. Chapter 3 looks at current challenges faced by PhD students, their motivations for undertaking a PhD, their career expectations, and how they navigate academic culture itself. This chapter also explores issues related to EDI within academia. Where possible, the Panel drew upon Canadian surveys and studies; however, due to a paucity of Canadian data, the Panel also relied on international sources, especially from the United States. While Canada's education and social systems differ from their American counterparts, the Panel believes there are enough similarities that U.S. findings

can be used to draw relevant conclusions about Canadian PhD students and graduates.

3.1 Students Have Different Reasons for Pursuing a PhD

There are a variety of reasons why individuals choose to pursue a PhD in any given field; however, the desire for a career in academia consistently ranks among the top reasons identified by students (Desjardins, 2012; Maldonado *et al.*, 2013; Woolston, 2019). The goal of joining the professoriate tends to rank highest among students of the humanities (Desjardins, 2012; Maldonado *et al.*, 2013). In a 2019 international survey of PhD students in the sciences, 56% of respondents indicated that academia remained their first career choice, while just under 30% chose industry, and the remainder listed research careers in government, medicine, and the not-for-profit sector (Woolston, 2019). In the 2013 NGS conducted by Statistics Canada, which looked at graduates from the class of 2010, the percentage of PhD students seeking to become a university professor was relatively consistent across disciplines. For example, students in the fine arts and humanities indicated the highest level of interest (72%), while those in health and fitness indicated a slightly lower level of interest (66%). Students in the social sciences and education both ranked at 69%, while those in the sciences (including engineering) ranked at 68%. It is important to note, however, that the NGS options for answering the question on motivation were limited in that they only included eventual career options (e.g., career as a professor, starting a business) and therefore did not capture whether students entered PhD programs for non-career related reasons (StatCan, 2013).

When non-career-related reasons are presented as survey options, answers reveal a greater diversity in the motivations behind PhD enrolment. For example, in the 2019 CGPSS, which surveyed over 20,000 students across disciplines in Canadian universities, “[t]o satisfy my interest in the field, regardless of career prospects” was one potential answer to the question “[w]hat was your primary reason for enrolling in your program?” In this example, 36% of students responded that their primary reason for enrolling was a career in academia, while 25% of students identified interest in the field as the prime motivator (CRIEVAT, 2019).

3.1.1 The Career Goals and Expectations of PhD Students Are Not Static

While the data related to career goals among PhD students are limited and even inconsistent, there are some general findings worth noting. A number of studies show that, among PhD students, career expectations and goals often change as

people progress through their academic program (Sauermann & Roach, 2012; Roach & Sauermann, 2017; CIE, 2018). This trend is highlighted below in the first of several narratives that are used throughout this report to show a variety of real-life experiences of PhD students and graduates (PhD Pathway 1). In a 2017 survey of 291 graduate students, PDFs, and individuals who had completed a graduate degree in Quebec in the last five years, the Comité intersectoriel étudiant (CIE) found that 42% of students and PDFs had changed their career plans since beginning their graduate studies (CIE, 2018).

Most commonly, studies show a declining interest in academic careers as students near the end of their degree. In a 2010 survey of 4,109 students in chemistry, physics, and life sciences at 39 of the most research-intensive American universities, the percentage of respondents who identified a faculty position with an emphasis on research as the most attractive career path was significantly higher for those beginning their degree versus those near the end (Sauermann & Roach, 2012). The same results tended to hold true when controlling for student cohorts. In a longitudinal study of 854 science and engineering students surveyed over the course of their PhD training, the vast majority (80%) indicated an interest in an academic career at the outset of their studies, but this had fallen to 55% three years later, with 25% of the students losing interest entirely in securing an academic position (Roach & Sauermann, 2017).

Based on NGS data for the classes of 2000 and 2005, a number of Ontario PhD graduates across a variety of disciplines indicated a preference for non-faculty positions. Their reasons varied but most commonly were: a lack of opportunities in academia; better career opportunities outside of academia; “other,” including a preference for clinical or practical work, a lack of interest in teaching, and unhappiness with academic life (Desjardins, 2012). Results from the CIE survey suggest that a perceived lack of opportunities in the academic sector was the primary reason for changing career directions (CIE, 2018).

While some surveys indicate that students in the sciences and engineering often lose interest in academic careers (Sauermann & Roach, 2012; Roach & Sauermann, 2017), these results have not necessarily been mirrored among PhDs in the social sciences and humanities. A survey of social sciences and humanities PhD holders in 13 European countries, working in a range of professions in various sectors, found that respondents’ desired career goals tended to remain focused on academic and research positions (Ackers *et al.*, 2014). While graduates were able to face the reality that an academic career might not be forthcoming, and were willing to embark on alternative careers, their desire for an academic position remained. In fact, the authors found that PhD training in these disciplines tended to reinforce a preference for an academic career, with “many who had not initially considered an academic career changing their minds during their studies” (Ackers

et al., 2014). Without a comparable Canadian study, it is difficult to determine whether this phenomenon is unique to European social sciences and humanities PhDs or whether it also reflects the experience of Canadian students in these fields. The experiences of panel members indicate that becoming a professor still dominates the aspirations of PhDs in the humanities.



PHD PATHWAY 1

David Asgeirsson, Manager, Technology and Venture Development, MaRS Innovation (2017)*

David Asgeirsson was working towards a PhD in physics when he realized partway through his program that obtaining a secure academic position was not only unlikely in his field, but would also require years in a PDF position at a reduced salary. While this realization did not cause Asgeirsson to abandon his PhD, it did lead him to change his career goals. Instead of academia, Asgeirsson decided to pursue work in the private sector.

Through what Asgeirsson calls “networking and serendipity,” he landed a position with MaRS Innovation, working in the field of university knowledge transfer. He describes the work as “the interface between intellectual research and technical production, helping researchers turn their ideas into businesses.” Asgeirsson relies upon the skills learned during his PhD to understand the science behind the business plans he works on, as well as to analyze and solve high-level problems. According to Asgeirsson, “ultimately, our economy and all industries are becoming knowledge-based. A PhD is the highest level of training that you can get in analysis, in how to draw insights out of data.”

Adapted from Porter et al. (2017)

*As of 2020, David Asgeirsson works in Research Partnerships and Intellectual Property at Xanadu Quantum Computing in Toronto (Asgeirsson, 2020).

Shifting career motivations are not only limited to PhD students but also apply to PDFs. In the past, graduates assuming a postdoctoral position were believed to be on the path to an academic position; however, this is no longer necessarily the case. Some people turn away from academia during their postdoctoral period. In a 2016 CAPS survey of 2,109 PDFs (including those working in Canada, Canadian citizens completing PDFs abroad, and former PDFs who completed their positions within four years), 75% of respondents reported that obtaining a tenure-track position was a career goal before taking a PDF; however, 27% of all respondents changed their career goals after starting their PDF positions. The most common

reason for a shift in career goals was an unfavourable job market (Jadavji *et al.*, 2016), suggesting that a more acute awareness of career prospects could result in fewer PhD graduates becoming PDFs in favour of exploring other career options. Research also demonstrates that some PhD graduates took on PDF positions as a default as opposed to an intentional choice because they were not yet sure what career they actually wanted to assume and desired more time to figure out their options, or to leave the academic door open “just in case” (McAlpine & Amundsen, 2016; Gibbs & Griffin, 2017). As noted by one career scientist who had completed a PDF: “I didn’t know what I was going to do when I left grad school. I just knew I didn’t want to stay in academia.” She goes on to state her PDF gave her the time to “figure out exactly what I’m going to do” (Gibbs & Griffin, 2017). The CAPS survey showed that the declining interest in academic positions was accompanied by a corresponding rise in other career goals, including private sector research, consulting, public service, NGO research, and entrepreneurship (Jadavji *et al.*, 2016).

3.2 The Role of Academic Culture

There are a number of ways to define academic culture; however, this report uses the oft-cited definition provided by Kuh and Whitt (1988):

[Academic culture] is the collective, mutually shaping patterns of norms, values, practices, beliefs, and assumptions that guide the behaviour of individuals and groups in an institute of higher education and provide a frame of reference within which to interpret the meaning of events and actions on and off campus.

Broadly speaking, the norms and values of academic culture are reflected in the measures of success for the professoriate, especially the record of research publications in peer-reviewed outlets (Schimanski & Alperin, 2018). During the tenure process, a professor’s publication record is often assigned a higher value than more nuanced assessments of the impact of the research, or of teaching and service to the community (Otten *et al.*, 2015; Schimanski & Alperin, 2018).

Academic culture is partly what socializes PhD students into embracing these same values. Socialization is defined as “the process through which an individual learns to adopt the values, skills, attitudes, norms, and knowledge needed for membership in a given society, group, or organization” (Gardner, 2010b). Learned aspects of academic culture can potentially reinforce the idea among some students that the skills acquired during the PhD make them unfit for any position outside of academia, or that they lack the relevant skills for these environments (IPLAI & McGill University, 2013; CAGS, 2018).

Academic culture differs from institutional culture, which is subjective in nature and varies across university campuses (Tierney & Lanford, 2018). Institutional culture can be dependent on any number of factors, including (but not limited to) institutional size and reputation. Institutional culture is seldom codified, but may guide everyday interactions among faculty, students, and administrators, including expectations for office hours or grading practices. Furthermore, institutional culture may vary across academic departments (Tierney & Lanford, 2018).

3.2.1 The Traditional Model of PhD Education Is No Longer Sufficient

Historically, doctoral education was designed as an apprenticeship model in which one generation of faculty members trained the next. Presently, in most disciplines, the typical North American PhD program (Section 2.1) continues to teach students the skills and knowledge of the professoriate both formally (e.g., by way of seminars and the mentorship provided by their supervisors) and informally (e.g., through role models in the academy) (Spronken-Smith, 2018).

As PhD career pathways have diversified, the traditional model is slowly and sporadically evolving (Section 7.1.1). There continues to be a need to enculturate at least some students to the norms of the professoriate, and all students to the fundamental norms of research and scholarship. Nevertheless, many students also require mentorship, support, and role models for the broader types of work they may undertake as researchers, experts, and scholars outside the professoriate, or as working professionals who perform a variety of job functions across many different types of employment in a range of industries and economic sectors. This mentoring and support is not always easily provided by supervisors or the academic community (Berdahl & Malloy, 2019).

Furthermore, many PhD graduates are doing, or could do, scholarship (broadly defined) that differs in purpose, use, approach, and mode from that which is learned through their faculty supervisors. Often, their work is, or could be, oriented to bringing about change, rather than solely improving understanding; it is also, or could be, highly collaborative or community-based, rather than individually driven or solitary. The ability to address the complexity of current problems or challenges may require intellectual habits and abilities that are not necessarily inculcated in the academy — these include broad, cross-boundary thinking; design and systems thinking; lateral and abductive thinking; and adaptability (Porter, 2017; Winter-Simat *et al.*, 2017; OECD, 2018; Riedy *et al.*, 2018).

Unfortunately, anecdotal evidence suggests that it is not uncommon for students or graduates to worry about being cast aside by supervisors or deemed

“unserious” when they decide to pursue or express an interest in a career outside of the academy (Wood, 2014), or if they express values that conflict with those of their academic discipline (Pyo, 2018). Writing from the perspective of the humanities and social sciences, Malloy and Berdahl (2018) assert that the “academia-first” (or even “academia-only”) mentality is still central to many graduate programs. As the authors put it:

the academia-first mentality is implicit and ingrained in many PhD programs, even when not intended. Programs and faculty may be attuned to the volatile academic job market and difficulties faced by graduates, but the assumption of academic careers as the default outcome of a PhD still runs deep. After all, PhD programs are taught at universities by people who previously earned PhDs and now have tenure-stream jobs, and revolve around scholarly peer-reviewed research written by academics. Most faculty have spent their entire careers in the academic world and transmit its distinct values to students implicitly (and sometimes explicitly).

3.2.2 The Culture of Academia Has an Impact on Personal and Professional Identity

Professional identity is defined as the “constellation of attributes, beliefs, values, motives, and experiences” by which individuals define themselves in relation to their professional role (Schein, 1978; as cited in Ibarra, 1999). One’s sense of self and professional identity (or lack thereof) is pivotal to performance in the workplace and powerfully informs one’s sense of meaning and well-being (Ashforth *et al.*, 2008; Caza & Creary, 2016).

Academic culture plays a crucial role in forming one’s personal and professional identity, and this culture has an impact that extends beyond graduation from a program. Among graduate students and PDFs, professional identity is responsible for imbuing one with “a sense of community and belonging among others who share similar attitudes, beliefs, and values” (Wilson-Grant, 2015). Those who are unable to secure tenure-track positions (along with those who actively choose not to pursue these positions) may view themselves as failures, or find themselves questioning their personal and/or professional identities (Yachnin, 2015). Even after graduates launch successful careers outside of academia (whether or not by choice), they may similarly find themselves struggling with issues of identity if their alma maters and faculty fail to recognize varied career paths or if they view all other careers outside of academia as Plan B or fall-back positions. For some graduates, leaving behind an academic community and their academic identity has been equated to a grieving process (Wilson-Grant, 2015). As expressed by one history PhD graduate in a widely circulated blog post, once she definitively

decided to give up on finding an academic position, “I don’t know what I’m going to do. I don’t know what I’m good for . . . I don’t know how to come to terms with the fact that the life I imagined is not going to happen” (Bartram, 2018).

Moving away from an academia-first mentality need not diminish scholarly training, but it can allow for a cultural shift that creates more space for diversity —among the type of students pursuing PhDs, and in what successful outcomes look like for graduates. As Malloy and Berdahl (2018) write, “[t]he ideal replacement for the academia-first mentality, we suggest, is not ‘academia-last,’ but rather ‘academia-and.’”

Reforming academic culture is a complex and systems-wide task tied to challenging, long-held ideas and assumptions about what it means to pursue, and ultimately to be a PhD. Incremental changes happening at institutions across Canada, such as those described in Chapter 7, may be a first step in initiating a broader cultural shift within academia.

3.2.3 Academic Culture Varies by Academic Discipline

When supervision works well, it supports PhD students; when not done well, it can exacerbate anxiety, stress, and depression among students (Section 3.2.5) and can be a significant contributing factor to attrition (Section 3.4). While supervision is a significant component of PhD programs across academia, the form that the supervisor/student relationship takes can vary significantly by discipline (Gopaul, 2013). For example, in the sciences and engineering, students are more likely to be associated with one faculty member and to be engaged in the work of that faculty member’s lab (Walker *et al.*, 2008; Gopaul, 2013). In some cases, the relationship between supervisor and student may resemble an employment contract with routine hours spent in the workplace (i.e., the lab) (Gopaul, 2013). While this is part of the longstanding culture of science departments, it is also linked to funding models that tie students to a single faculty member (the principal investigator or PI on a funded grant) and where success and funding are based on the quick production of data (Walker *et al.*, 2008).

In contrast, students in the humanities might have multiple supervisors, some of them dedicated to various aspects of their training, such as teaching or research (Walker *et al.*, 2008). However, even with multiple mentors, and a direct link to an academic supervisor, the academic model for PhD students in the humanities and social sciences remains a largely independent one. Following coursework and comprehensive exams, PhD candidates in the humanities and social sciences are more likely to immerse themselves in the solitary work of researching and writing a dissertation that makes an original contribution to their respective field. In this regard, they often have more individual control over their own schedule, but may

also receive less direction and experience longer times to degree completion (Gopaul, 2013; Tamburri, 2013). On average, PhD students in the humanities and social sciences take longer to complete a PhD than those in the sciences and engineering (Section 2.1.2). This has been linked in part to discipline conventions, the cultural norms of individual scholarship in the humanities and social sciences versus the primacy of collaboration in the sciences (Gopaul, 2013; Tamburri, 2013), and a number of other factors associated with attrition that are described in Section 3.4.

The amount of time that supervisors spend with students can also vary significantly across disciplines (Gopaul, 2013). Understandably, to some extent this depends on individuals; for example, some supervisors may allot their time based on how much support is required to help a particular student, or the time required to relay necessary information. Likewise, the amount of time that a supervisor invests in a student may be based on how proactive a student is in requesting meetings (Walker *et al.*, 2008). However, even with these factors taken into account, differences among disciplines persist. In a survey conducted by the Carnegie Initiative on the Doctorate (CID), among American PhD students in their final year of study, the majority of those in history and English departments reported meeting monthly with their supervisors (Walker *et al.*, 2008). The majority of students in education and mathematics, on the other hand, reported having weekly meetings. In contrast, students in chemistry and neuroscience — who typically share lab and office space with faculty — reported meetings several times per week (Walker *et al.*, 2008). Discussing the differences in the amount of time invested in students from the faculty perspective, one CID leader noted, “in the lab sciences every student is worth a paper a year, and in math every student costs me a paper a year” (Walker *et al.*, 2008).

3.2.4 Faculty Play a Key Role in Transmitting Academic Culture

Socialization is vital to the graduate school experience, and the failure of students to be properly integrated into their programs has been identified as a top contributor to attrition (CGS, 2004; Gardner, 2010a) (Section 3.4). There are several pathways to socialization, including the interaction of students with their institution, and the interactions among students themselves in the same program. However, the socialization that occurs between faculty and students is arguably the most important pathway through which the latter become familiarized with academic culture. Methods of socialization can be formal (e.g., faculty transmitting norms through course instruction) or informal (e.g., individual conversations between faculty and students) (Gardner, 2010a). Faculty also foster socialization by example. For instance, if an academic supervisor spends an inordinate amount of time at work, this same expectation may be indirectly

communicated to a student, whereby the student might conclude that the path to success lies in total devotion to their academic program, at the expense of work/life balance.

Because faculty play a role in academic culture and the formation of student identity, they are also able to help reshape the culture of academia. There are a number of ways they could contribute to this cultural shift, such as initiating early discussions of career goals, interests, and values with their students, and supporting these when possible; encouraging and mentoring students who wish to broaden their research and dissertation to incorporate different forms of knowledge creation and dissemination; holding broader discussions of potential career outcomes in other forums, including conferences and journals; allowing and encouraging students to pursue opportunities that may lie outside the framework of PhD requirements; and inviting alumni who have launched successful non-academic careers to come and talk about their experiences with students (Berdahl & Malloy, 2018; CAGS, 2018; Malloy & Berdahl, 2018). By reframing career paths in other sectors as a valued choice, rather than as a second or inferior choice, faculty can take a significant step towards shifting the academic culture. Programs designed to help faculty fulfill this role are discussed further in Chapter 7.

Emphasizing the importance of faculty in graduate education is not to suggest that they alone are responsible for changing a longstanding culture. While faculty are in a position to initiate change, they too are also hampered by, and beholden to, the prevailing culture where promotions and grants often favour the production of new knowledge and research, and one that often relies on an increasing intake of PhD students and PDFs (Taylor, 2006).

3.2.5 The Relationship Between Mental Health and Academic Culture

In an international study of 2,279 graduate students (90% PhD students) across academic disciplines, representing 26 countries and 234 institutions, it was found that graduate students were six times likelier than the general population to experience depression and anxiety (Evans *et al.*, 2018). A U.S. study found that PhD students exhibit a higher level of depressive symptoms compared to master's students, indicating that some unique features of PhD programs might contribute to mental health issues (The Graduate Assembly, 2014; Mackie & Bates, 2019). Furthermore, statistics may worsen the longer one spends in a PhD program. For example, a 2017–2018 survey of 513 students in economics PhD programs from eight top-tier American universities found that 18% reported experiencing moderate to severe symptoms of depression and anxiety (Barreira *et al.*, 2018). Students who were five years or more into their program reported moderate to

severe symptoms of anxiety and depression 25% of the time (Barreira *et al.*, 2018). The limited evidence available suggests that, for some, these problems may worsen during the PDF period. A 2018 survey conducted by the Quebec Student Union (QSU) of all post-secondary levels across Quebec found that PDFs reported higher rates of psychological distress and more severe symptoms of depression than master's and PhD students (Berard *et al.*, 2019).

A number of issues have been identified as contributing to the high incidence of mental health issues among graduate students. Students often report a sense of uselessness — the feeling that their research lacks meaning (Levecque *et al.*, 2017). There is also the danger of emotional burnout tied to trying to balance the competing demands of work and one's personal life. Fifty-six percent of students surveyed by Evans *et al.* (2018) and who experienced moderate to severe anxiety disagreed with the statement "I have a good work-life balance." For students in the sciences, this feeling may be caused by unrealistic job demands and the expectation to commit long hours to lab work (Evans *et al.*, 2018). In an international survey conducted by *Nature*, 76% of PhD students in the sciences reported working in excess of 41 hours per week, and 49% agreed with the statement "There is a long-hours culture at my university, including sometimes working through the night" (Woolston, 2019). In the humanities and social sciences, students may be especially at risk of depression and anxiety related to the isolation that is commonly associated with independent research and writing (Levecque *et al.*, 2017).

Other stressors that can negatively affect mental health included financial uncertainty, uncertain job prospects, large workloads, unclear program expectations, and the stress of managing poor student-supervisor relations (Levecque *et al.*, 2017; Sverdlik *et al.*, 2018; Mackie & Bates, 2019). Half of the students who experienced depression and/or anxiety in the Evans *et al.* (2018) survey disagreed with the statement that their PI or supervisor provided mentorship or ample support. In addition to antagonistic or unsupportive relationships with PIs or supervisors, students also reported avoiding meetings due to their own anxiety about making a bad impression, doubting their intelligence, or fears of being judged over a lack of academic progress (Barreira *et al.*, 2018). Finally, there is evidence that students who have little or no interest in academic careers have poorer mental health than those wanting to stay in academia (Levecque *et al.*, 2017). Similarly, mental health is better for students who feel that their PhDs are preparing them for a career outside academia compared to those who do not. Evidence shows that many of these issues continue into the PDF period, a time increasingly defined by casual and precarious labour that can chip away at mental well-being (Jones & Oakley, 2018).

The resolution to some of these issues may necessitate a significant change in academic culture; however, as stated by Evans *et al.* (2018) in reference to graduate studies in the sciences, “[w]ork-life balance is hard to attain in a culture where it is frowned upon to leave the laboratory before the sun goes down,” and where the competition to produce data in order to secure limited funding is intense. That said, university leaders need to be aware of the growing body of literature suggesting a crisis of mental health among graduate students (Evans *et al.*, 2018; Pain, 2018). In response, changes have been recommended, including suggestions that faculty and administration lead by example in self-care and balance (Barreira *et al.*, 2018). It has also been suggested that faculty and supervisors encourage students to engage in research or other activities that provide them with meaning and purpose (Barreira *et al.*, 2018). In addition, as will be discussed in Chapter 7, a number of other more formal initiatives have been proposed or already implemented to address the high incidence of mental health issues among PhD students.

3.3 Awareness of Career Options and Outcomes

While most PhD students enter their program having researched their academic program, department, and supervisor, few of them undertake the same level of investigation into potential career opportunities or outcomes that may result from their multi-year commitment (McAlpine & Emmioğlu, 2015). For many, this trend continues well into their PhD studies and even into their PDF position.

While the research is still limited, a small study of 95 early-career and late-stage chemistry PhD students in the United States found that the majority had little knowledge of career paths outside of university professor or industry professional (Thiry *et al.*, 2015). Moreover, they had only a limited understanding of the actual responsibilities and lifestyles associated with those positions. As they neared graduation, students tended to exhibit either apathy or anxiety rooted in “their lack of knowledge about career options” (Thiry *et al.*, 2015). In their interviews with 32 late-stage students, Thiry *et al.* (2015) found that, among those who demonstrate anxiety, there is a greater likelihood of taking on career exploration activities; however, without guidance, these attempts were described by the authors as “incoherent” and “haphazard.” Those students demonstrating apathy often delayed career decision-making until near or after graduation, with many of them choosing to pursue a PDF despite not knowing how it may advance their career. As described by one student who was within one year of graduation,

I don't know tons, but I know there's plenty of options in academia, industry, government work. I dunno. There's kind of a lot out there. I haven't gotten to the point yet where I'm actively trying to search for jobs, so I'm not quite sure if I know as much as I should.

Thiry *et al.*, 2015

Instead of delaying career decision-making until closer to graduation, students might turn to certain tools and initiatives, such as Individual Development Plans (Section 7.2.1), which have been created to encourage them to build their knowledge about career paths while they are still in their PhD programs.

3.3.1 Academic Supervisors Play a Crucial Role in Supporting Career Development

While the duties of graduate faculty members may differ across institutions and disciplines, there are typically a number of roles common to academic supervisors. These include helping students select and manage a research topic, being available for student meetings, and making students aware of program guidelines and potential funding opportunities (Galt, 2013; UBC, n.d.-c). In addition to these roles, academic supervisors often serve as the gatekeepers of their students' futures.

The choice of a supervisor is one of the most consequential decisions a student makes when embarking on a PhD (Lovitts, 2004; Galt, 2013; Sverdlik *et al.*, 2018). For example, data suggest that supervisors are the most important factor in PhD attrition. Students who complete a PhD are twice as likely to be satisfied with their choice of supervisor as those who do not (Lovitts & Nelson, 2000). This relationship between supervisor and student has been found to be of particular importance in STEM fields (De Welde & Laursen, 2008), “where students’ research efforts (including their dissertation) are more closely intertwined with the work of their supervisors” (Sverdlik *et al.*, 2018). Relationships between students and supervisors are highly variable and can either pose significant challenges or provide benefits to PhD students. Toxic supervisor-student relationships can contribute to anxiety and depression, but more positive relationships can lead to not only academic success, but also help set students up for career success (Woolston, 2017).

For many PhD students, their supervisor is one of their most important resources for career guidance as they move towards graduation and prepare for employment. Guidance can take various forms, including providing opportunities for networking (e.g., assisting with conference attendance, setting up meetings with potential contacts), advising on how to prepare job applications, or by simply

initiating discussions with students about career goals. However, some supervisors do not provide this guidance and support. In the 2019 CGPSS, 32% of respondents disagreed or strongly disagreed with the statement that “[m]y advisor encouraged discussions about current job market and various career prospects” (CRIEVAT, 2019).

One of the biggest challenges for faculty members, especially as it relates to the current labour market, is their own lack of knowledge about non-academic careers. For example, while many faculty are conducting work that relies on diverse perspectives, or are moving in this direction, others have little experience in the breadth of scholarship that their students will undertake throughout their careers, or their experience is limited to academia. In addition, some faculty discourage the pursuit of employment outside of the academy, even though in many cases the chances of students making the professoriate may be slim. A lack of knowledge and outright disdain of non-academic pursuits is frequently noted by many PhD students across disciplines. A survey of PhD students in the sciences in 39 American universities reported that their supervisors and departments “strongly encourage” careers in academic research and are “less encouraging” of other types of careers (Sauermann & Roach, 2012). According to Sauermann and Roach (2012), this has the potential to worsen labour market imbalances and to create additional stress for students who may believe that they are failing their supervisors. A 2017 UBC study echoed many of these same concerns, noting that “we know students often feel encouraged by faculty to pursue the professorial path to the exclusion of other possible careers, and sometimes feel misled about the realistic prospects of such a future. Students have also often said they felt their education was solely directed to that end” (Porter *et al.*, 2017). As articulated by one of the UBC study participants who had since gone into self-employment,

[s]elf employment is NOT what I had imagined when I began in the PhD program, nor was it ever discussed as a viable option while I was in the program – in fact nothing except an academic career was discussed, and even then the realities of the current academic job market remained a complete mystery to me until after I had graduated which is too late.

Porter *et al.*, 2017

The fact that supervisors tend to encourage academic careers over others is not always the result of their belief that such a career is inherently better, but because supervisors themselves have chosen and succeeded in an academic career. It bears mentioning that the median age of full-time academic staff in Canada in 2017–2018 was 51 years, and that age rose by rank so that the average age of a full professor was 58 years (StatCan, 2018a). It is likely that many of these professors

were hired into an academic labour market that was dramatically different in the past. Because of this, faculty may be less familiar with other pathways to success and may not feel qualified to offer advice or to direct students towards those careers (Sauermann & Roach, 2012; Berdahl & Malloy, 2019). That said, it should be acknowledged that the majority of PhD graduates not becoming professors is not a new phenomenon and that, since at least the late 1970s, there has been concern about their career trajectories (Von Zur-Muehlen, 1978; Fullick, 2015).

Many faculty may lack the required information necessary to fully inform students of potential career pathways. For example, in a survey of department chairs in political science at Canadian universities, respondents indicated that they lacked current information on the types of non-academic jobs occupied by graduates, as well as what skills non-academic employers would find useful (Berdahl & Malloy, 2019). The factors described above suggest that PhD graduates might benefit from having multiple and/or diverse mentors throughout their studies (Section 7.2.1).

The role of the academic supervisor also needs to be understood within the context of the larger university system. A typical university faculty member is under significant job pressure and faces competing demands for their time (e.g., teaching, research, administrative tasks, publishing, securing grant funding) (Austin, 2002). As noted in Chapter 2, the priorities of the academy often emphasize the production and publication of new research and knowledge. Even if professors wish to devote more time to mentorship, many feel compelled to respond to the demands of funders and university administrators first, because “the reality is that, on far too many campuses, teaching is not well rewarded, and faculty who spend too much time counselling and advising students may diminish their prospects for tenure and promotion” (Boyer, 1990). Tying supervision effectiveness to tenure and promotion has been considered as a response to this issue, and is discussed further in Chapter 7 of this report.

3.4 Attrition Among PhD Students

Concerns about the attrition rates of PhD students are not new. Throughout the 1960s and 1970s, when PhDs were in higher demand during the expansion of the university system in Canada, many pointed to the time it took to complete a PhD, and to the number of students who chose to leave their program before completion (Elgar, 2003).

While a certain level of attrition (especially in the early years of a PhD program) is considered normal and unavoidable, concerns remain about the high number of students who leave their programs before completing dissertations (CGS, 2004; Tamburri, 2013). As noted in Section 2.1.2, rates of completion and time-to-degree

can vary widely by discipline. For example, high attrition rates are especially pronounced in the humanities and social sciences (CGS, 2004; Tamburri, 2013). A number of reasons for the lower graduation rate among humanities and social sciences students have been cited, including discipline conventions, less access to external funding, and less contact with their supervisors and peer groups (Elgar, 2003; Gopaul, 2013). Across disciplines, there are multiple reasons why students abandon their programs; however, studies tend to show that an interplay of factors influence decisions, including inadequate funding, high stress and poor mental health, poor thesis management and supervision, and a lack of preparation (Elgar, 2003; Tamburri, 2013). Some features of graduate programs could also contribute to PhD attrition rates, such as a lack of departmental organization and cohesiveness (Elgar, 2003). Finally, for some students, the decision to leave academia comes down to job prospects. As Nadeen El-Kassam, a former PhD student in adult education, noted, “I was not a fan of the idea of locking myself up for as long as it took to complete my dissertation, only to discover that there were no jobs for me at the other end, and that I had lost touch with my community and the people around me” (CBC, 2018).

Across disciplines, attrition has also been linked to departmental expectations and other issues. This can be seen in a 2009 study by Gardner (2009) of 60 PhD students and 34 faculty members at a U.S. research university, across six disciplines (English, oceanography, communication, psychology, mathematics, and electrical and computer engineering). This study found that faculty were quick to blame attrition on students, while students more often cited institutional or departmental issues. Among the reasons for attrition, faculty consistently blamed a lack of drive, focus, or motivation on the part of students; students who should never have entered graduate school in the first place; and personal problems among students. As Gardner (2009) writes, the findings suggest that “faculty feel removed from the issue of attrition in their programs.” In contrast, students across academic departments attributed attrition to personal issues, departmental issues, or a mismatch between a student and their program. Specific departmental issues included “bad advising, lack of financial support, faculty attrition, and departmental politics” (Gardner, 2009). As one student in the study noted in regard to departmental politics, “[t]he faculty being unhappy filtered down to us. They had the power to make us unhappy” (Gardner, 2009). Without access to up-to-date data on PhD attrition rates in Canada, or similar Canadian-based studies, it is impossible to draw further conclusions on the extent or causes of these rates.

Students who choose to abandon their PhD before completion show some commonalities. For example, ABDs tend to be older students with multiple commitments in addition to academia (e.g., spouses, caring for children or older

adults, outside employment), leaving them with less time to devote to on-campus engagement with professors, peers, and campus services (Smith, 2000; as cited in Elgar, 2003). James McKee's story, highlighted in PhD Pathway 2, describes some of these challenges in more detail. Members of underrepresented groups are also less likely to complete graduate studies (Gardner, 2009; DeClou, 2016). No meaningful difference in the academic performance of students has been found between those who leave academia before receiving a PhD and those who remain (Lovitts & Nelson, 2000).



PHD PATHWAY 2

James McKee, Director of Research, Executive Council, Government of Alberta (2017)*

James McKee completed his MA in political theory before beginning a PhD program in international relations at the University of Toronto. Following a particularly stressful year that included family health emergencies, raising two young children, teaching, writing, and attempting to choose a manageable dissertation topic, McKee reconsidered his decision to pursue a PhD. In addition to the stress of balancing graduate school and family life, McKee cites a change in his career motivations, which crystallized his decision to try something new. As he states, “I was pretty burned out on teaching and didn’t see the life of an academic in the way I maybe did when I started out in grad school. It wasn’t long after I started that the 2008 recession made things look even harder for many.”

When offered a contract position with a polling firm, McKee took the opportunity to put a pause on his graduate studies. From this position, he built his own practice and eventually leveraged his skills to become a Director of Research with the Government of Alberta, where he is responsible for overseeing the ministry’s research program. Of his position, McKee states, “Most of what I do now is unrelated to what I did in my PhD program [but] the fundamental interest that I had in tackling ideas and problems that got me interested in pursuing a career as an academic in the first place — and the skills I honed through many years of university — are skills that serve you well, wherever you might consider going next.”

Adapted from Polk (2017b)

*As of 2020, James McKee works as Director of Research in the Digital Innovation Office of the Government of Alberta (Gov. of AB, 2020).

In contrast, and across disciplines, research shows that the predictors of degree completion include high research productivity, full-time enrolment, mentorship, and holding a funded position as a teaching and/or research assistant. Lovitts and Nelson (2000) showed “a high correlation between integration into a department’s social and professional life (becoming part of the community) and successful completion of the Ph.D.” They went on to conclude “that the real problem is with the character of graduate programs rather than with the character of their students” (Lovitts & Nelson, 2000).

3.5 Prioritizing EDI in PhD Programs

Universities throughout Canada are increasingly recognizing the need to prioritize issues related to EDI. While efforts are being made to address the recruitment, retention, and experience of underrepresented groups, university administrators in Canada generally feel that progress has been hindered by “difficulty attracting and retaining diverse talent, including senior leadership,” and a lack of resources and data (UC, 2019). Because of the paucity of data for most EDI groups in the student population (with the exception of gender), universities are “missing opportunities to understand the academic pipeline and ensure that they are attracting and retaining diverse PhD and postdoctoral students who could potentially move up the pipeline into university academic and leadership positions” (UC, 2019).

A 2019 survey conducted by Universities Canada, with 88 universities responding, found that 77% have included EDI initiatives in their institution’s long-term strategic plan. However, there is regional variation. For example, while more than 80% of institutions in Atlantic Canada, Ontario, and Western Canada reference EDI in their plans, the same is only true of 55% of Quebec institutions. The survey found that 45% of university presidents want EDI values and priorities to be incorporated even more into their institutional policies and decision-making (UC, 2019). Promoting EDI requires more than recruiting students and faculty from underrepresented groups; it will take a shift in the prevailing academic culture. As described by one university president, “[m]any within the institution view EDI as merely a numbers game. The deeper work of changing institutional culture is much more challenging and not broadly understood or appreciated” (UC, 2019).

The following sections identify a variety of issues and/or concerns that may be relevant to a number of PhD students and graduates identified under the EDI rubric. The list of groups below is by no means exhaustive, and the Panel recognizes that some students or graduates may not see themselves reflected due to a paucity of data (e.g., LGBTQ+). A full accounting of EDI challenges is not the intention, nor possible within the scope of this report. Furthermore, while each

section below deals with the unique experience of individual groups (e.g., women, Indigenous students), the Panel also recognizes the intersectionality of many of these groups (e.g., Indigenous women), and that this intersectionality may exacerbate the challenges. It was not possible within the scope of this report, however, to fully explore this intersectionality.

3.5.1 Challenges for Women Who Are PhD Students and Women Pursuing Tenure-Track Positions

Women enter PhD programs at rates relatively equal to, or, in some cases, greater than men, yet the data show that this has not translated into equal representation in the professoriate. For example, in the United States, women in the biomedical sciences earn about half of the PhDs, yet represent 33% of tenure-track faculty who have not yet gained tenure (i.e., assistant professors, the most recently hired professors on the tenure track) (NRC, 2011). Research suggests that, on completion of their PhDs, women in biomedical sciences are less likely to have an interest in faculty positions at research institutions than men who identify as Asian/Asian American or white (Gibbs *et al.*, 2014). Interest is lowest among women from underrepresented groups. These differences remain even when controlling for the “level of interest in career path at Ph.D. entry” and other objective measures such as the rate of first-author publications and the time to completion (Gibbs *et al.*, 2014). While the numbers of women in academia have increased overall, growth has been fastest in non-tenure track and part-time positions and, as a result, women are more likely than men to hold these typically lower-paid and less secure positions (Field & Jones, 2016; Finkelstein *et al.*, 2016).

The reasons for the underrepresentation of women among the professoriate and the unique issues facing women reveal themselves before the search for tenure. One U.S. study found that, among PhD students in the sciences and engineering, women “give a poorer rating to faculty-student interactions and publish fewer research papers than men. Many women graduate students report feelings of isolation” and “[a]mong postdoctoral scholars, women report lower satisfaction with the experience, and women are proportionately underrepresented in the applicant pools for tenure-track faculty positions” (NASEM, 2007). Furthermore, there is evidence that subtle acts of discrimination and bias affect PhD students and graduates who are women in significant ways. For example, studies have found that women face more skepticism about their abilities and research results (Vettese, 2019), and that they tend to receive shorter recommendation letters from referees that focus less on the quality of their research (Trix & Psenka, 2003).

Sexual harassment adds another dimension to the experience of PhD students who are women, which can hinder academic progress by forcing them to change supervisors, departments, or to take time off to deal with stress or trauma (Vettese, 2019). In an international survey of over 6,000 PhD students in the sciences, a quarter of the respondents who identified as women reported experiencing harassment or discrimination; the most frequently reported perpetrators were academic supervisors (Woolston, 2019). The highest rates of discrimination and harassment were reported in North America.

After PhD completion, women are more likely than men to make career sacrifices for their partners or children, or seek to achieve greater work/life balance. They also often pursue PhDs at a greater personal cost (Nerad, 2007). For example, in the United States, “women doctorate holders in social science careers were more likely [than men] to leave faculty positions, less likely to be coupled, more likely to postpone or forego having the children they wanted, less likely to be geographically mobile, and generally experienced more work-family conflict” (Nerad, 2007). A 2008 study showed that, within heterosexual academic couples (dual PhD holders), men are most likely to consider their career to be more important than their partner’s, while women are more likely to state that their career was of equal importance (Schiebinger *et al.*, 2008). Among LGBTQ+ couples, these same statistics do not hold true, as lesbians and gay men typically give equal weight to their partners’ careers (Schiebinger *et al.*, 2008). Finally, once a tenure-track position has been secured, the evidence shows that women typically take longer than men to be promoted (Hahm, 2009).

Given these challenges, a greater number of women are unable to find a place within academia. The reasons for this include dissatisfaction with work/life balance; the lack of security and the perpetual need for mobility associated with the PDF phase; the competitive and isolated nature of the work; and the sacrifices that women feel they must make in order to achieve professional success (Lober Newsome, 2018). The departure of women in underrepresented racialized groups from academia remains an even bigger issue (Gibbs *et al.*, 2014). More research into the links between social identity and career choice, especially research that takes an intersectional approach and considers the interplay of race/ethnicity and gender (Box 3.1), will likely help to illuminate some of the reasons behind this trend (Gibbs *et al.*, 2014).

To address these gender disparities, a number of solutions have already been proposed and/or implemented, including greater diversity on university search committees and tenure panels, and the extension of tenure clocks (i.e., the tenure-track probationary period) in order to address the impact of parenting and other family responsibilities, which typically fall disproportionately onto women (Hahm, 2009; Vettese, 2019). However, even the use of delayed tenure clocks has

had unintended consequences. In a study of American economics departments offering the delay to new parents, women tended to focus on childcare while men used the extra time to research and publish. The policy therefore provided an unintended benefit for men, and did not address the gender-specific career lags associated with having children (Antecol *et al.*, 2018).

Box 3.1 Intersectionality and the Under-Studied Link Between Social Identity and Career Motivations

While certain strides have been made in recruiting women and underrepresented racialized people into PhD studies, it has not led to equitable representation among tenure-track faculty. A study by Gibbs and Griffin (2017) suggests that this may be linked in part to the role that personal values and social identity (i.e., race/ethnicity, gender) play in career decision-making. Controlling for social identity, researchers examined factors influencing career decisions in focus groups with 38 American biomedical scientists who obtained their PhD between 2006 and 2011. Among the participants were 18 people from groups underrepresented in the field (14 Black participants and 4 Latinx participants). Twenty-three participants were women (11 from underrepresented groups). The majority of all participants (55%) indicated they had undefined job goals when they began their PhD, while a passion for their subject area was consistently given as a reason for pursuing a PhD. Similarly, decisions to pursue a PDF were also often made without a clearly delineated career path in mind.

Among those who had begun or were pursuing a faculty position, academic freedom was a primary motivator for individuals from well-represented groups in the biomedical sciences (white/Asian). However, among other participants with a high interest in an academic career, including women and those from underrepresented groups, their decisions were often motivated by the opportunities to make an impact on their communities through either applied research or mentorship. Among those who eventually made the choice to search for a career beyond academia, the ability to have an impact on others was again a prime motivation over other factors, including the quality of the student-supervisor relationship. Several women of colour described wanting to have an impact in their own communities, a goal they believed was more achievable outside academia. As one participant noted, academic work “was so incrementally small compared with the big picture in terms of where I thought I wanted to make a change” (Gibbs & Griffin, 2017).

(Continues)

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While lack of mentorship and hostile training environments have been cited as reasons that members of underrepresented groups hold fewer positions in the professoriate (Thomas *et al.*, 2007), the work of Gibbs and Griffin (2017) suggests that personal values and social identity may be under-studied factors. If this is true, it would indicate that diversifying the academic workforce may require more than nurturing promising individuals from various backgrounds, but also instituting broader systemic reforms and a deeper understanding of what ultimately drives career choice (Gibbs & Griffin, 2017).

3.5.2 Challenges for Underrepresented Racialized PhD Students Pursuing PhDs

While efforts have been made to diversify higher education, evidence from the United States shows that the higher the degree, the less responsive the system is to underrepresented racialized populations (e.g., Black, Latinx), and that these students face particular challenges in the STEM fields (Tapia & Johnson, 2009). Supports weaken as students climb the ranks, often resulting in the decision to either not pursue or to abandon a PhD. This has resulted in less minority representation in the sciences and engineering, both in faculty positions and in managerial positions in business and industry (Tapia & Johnson, 2009).

When students from underrepresented groups begin a PhD, they may find that their skills and experiences are undervalued and that they lack peers (among students and faculty) who can identify with their particular challenges. Research shows that students from underrepresented groups tend to do better in cases where “they have diverse faculty and role models” to draw on at their university (UC, 2019). Suggestions for providing this mentorship are discussed further in Chapter 7.

3.5.3 Challenges for Indigenous PhD Students

Indigenous PhD students face a number of issues that affect their university experience as well as their early attempts to enter the labour market. A lack of Indigenous mentors may contribute to students’ feelings of isolation, and to having less access to established networks that benefit non-Indigenous students seeking employment after graduation (Henry *et al.*, 2017). They may also face the issue of marginalization, as described in PhD Pathway 3. Indigenous academics cite “tokenism” as a significant draw on their time and energy, which may delay or affect their research. For instance, they may be invited to forums (e.g., panels,

committees) more often than their non-Indigenous colleagues, in order to represent Indigenous perspectives (Henry *et al.*, 2017). Likewise, some Indigenous PhD students may also have to balance the desire to represent their views against the need to preserve time for their own research or other commitments.

With higher education being a major focus of the reconciliation process, Canadian universities are devoting resources to increasing the presence of Indigenous students and scholars on campus (UC, n.d.). Recent efforts encouraged by the Truth and Reconciliation Commission's (TRC) *Calls to Action* (TRC, 2015) are having an impact. In a 2019 survey of university presidents, senior leadership, and EDI leaders at 88 Canadian universities, in which respondents were asked about successes resulting from their university's EDI policies, the most frequently highlighted success was increased Indigenous representation on campus, as well as an increase in on-campus services for Indigenous students (UC, 2019). Furthermore, university presidents listed the recruitment and retention of Indigenous faculty, staff, and students as among their top priorities for the following year (UC, 2019).

Many Canadian universities have also responded to the TRC's call for increased Indigenous content. For example, UC (2017) reported that two-thirds of its 96 members were “incorporat[ing] Indigenous knowledge, methods and protocols into research practices and projects” and “striving to integrate Indigenous knowledge and teaching methods into classrooms on campus.” Additional programs with a focus on training the next generation of Indigenous scholars have also been developed, including the compressed PhD program in Indigenous Studies at the University of Alberta (UofA), which accepted its first cohort of students in 2017 (Graney, 2017).

However, Indigenous leaders warn that success cannot just be measured by increasing the number of Indigenous students. Successful outcomes include the provision of mentorship and culturally relevant supports to incoming Indigenous graduate students (Section 7.3.4), many of whom will be first-generation graduate students (Section 3.5.5) (MacDonald, 2018).



PHD PATHWAY 3

Michelle La Flamme, Associate Professor,
English, University of the Fraser Valley (2017)*

Michelle La Flamme completed undergraduate and master's degrees at Simon Fraser University before starting a career working in the arts and on social justice initiatives. Eight years later, La Flamme made the decision to return to academia to pursue a PhD at UBC. Her decision was motivated by the encouragement and support of mentors, and by a passion for her subject matter.

La Flamme describes a number of challenges encountered during her PhD studies. She writes that, as an Indigenous student, “[i]t was a struggle for me to feel a sense of belonging and to find the right to express my own voice . . . I experienced the typical loneliness that comes from doing focused graduate studies, but there was also an extra loneliness I felt by not seeing people who looked like me, or professors who looked like me, and never being exposed to texts which resonated with my own experience as a mixed blood woman of colour.”

In spite of the early challenges, La Flamme ultimately found the experience of pursuing her PhD to be rewarding. Through fellow academics and mentors in the Department of English, she found opportunities to merge her creative and social justice work with the world of academia, including helping to create and teach a course on the history of Indigenous theatre.

La Flamme completed her degree and credits much of her success to her supervisor, the cultural supports offered by UBC’s First Nations House of Learning, and to a supportive community that she found both in and outside of the university. Following graduation, La Flamme worked for three years as an education coordinator at the Justice Institute of British Columbia before accepting a tenure-track position in the English Department at the University of the Fraser Valley.

Adapted from La Flamme (2017)

*As of 2019, Michelle La Flamme is on contract with Wilfrid Laurier University Press to revise her body of research for her first book.

3.5.4 Challenges for PhD Students with Disabilities

There is a critical lack of research related to the experience of disabled graduate students in Canada and abroad. It is known that disabled students in Canada are least likely to study physical and life sciences, and that there is a significant drop in their numbers between undergraduate and graduate levels (Sukhai & Mohler, 2016). A major hurdle to science education is the labs themselves, which have been described as “unwelcoming to persons with physical disabilities” and “at worst, inaccessible” (Sukhai & Mohler, 2016). There is also evidence that requests for disability accommodations are increasing and broadening to include invisible as well as visible disabilities (Rose, 2010). Some invisible disabilities, whether physical or mental health issues, tend to be harder to accommodate since they can be situational and intermittent (Rose, 2010).

To address this lack of evidence, Canada’s National Task Force on the Experience of Graduate Students with Disabilities was created by the National Educational Association of Disabled Students (NEADS) (NEADS, 2016). This task force gathered a variety of evidence, including national online surveys of disabled graduate students, focus groups involving professionals who work with disabled people in higher education, and informational interviews with subject matter experts.

NEADS (2016) resulted in a number of recommendations aimed at incorporating reasonable accommodations, levelling the playing field for students with disabilities, and building on existing knowledge. Among the NEADS recommendations were broadening the understanding of what disabled students need — in addition to time and flexibility — in order to succeed, and strengthening on-campus disability services. NEADS called for a re-examination of financial aid to students with disabilities, noting that disabled students must often use a portion of their graduate funding to pay for assistive technology (e.g., screen readers, voice recognition software, page turners). Furthermore, PDF positions may not recognize or include funding for accommodations, which may contribute to the higher proportion of disabled scholars exiting academia at the PDF level. Finally, NEADS called for the collection of further data in order to provide additional knowledge and inform training, especially for those who work in professional development on campus, so that they may understand the unique issues related to disability, accessibility, and accommodation (NEADS, 2016).

3.5.5 Challenges for First-Generation PhD Students

Both first-generation students, as well as international students (Section 3.5.6), can face similar challenges, since many are also members of underrepresented racialized groups (Roksa *et al.*, 2018). A first-generation PhD student is defined as one whose parents did not receive an undergraduate education. Studies have found that

these students experience unique challenges stemming from a lack of familiarity with the norms of higher education (e.g., structures, processes) (Gardner & Holley, 2011). Data on first-generation students are difficult to obtain, as some do not self-identify at both the undergraduate and graduate levels (Hayes, 2015). Furthermore, while there have been numerous studies on first-generation undergraduates, very little comparable research has examined the experiences and outcomes of first-generation PhD students (Roksa *et al.*, 2018; Smolarek, 2019). What is known is that underrepresented groups are more likely to consist of first-generation students, and more likely to report having educational debt (Hoffer *et al.*, 2003).

Interviews conducted in 2009 with 20 first-generation PhD students in the United States, across a range of disciplines, showed that a lack of knowledge, and being unaware of these knowledge gaps, had an impact on this subset of students. For example, first-generation students noted they had not been aware that their choice of institution might subsequently have an impact on their ability to obtain a faculty position (Gardner & Holley, 2011). Once in university, they lacked the insider knowledge often immediately available to those whose parents have higher education. As one study participant noted, “[my peers] knew things that I didn’t. I always felt like I was slowly behind everyone else,” while another commented, “[t]heir parents are educated and have degrees so they kind of know what the system is and how to work it and how to apply that directly to what was expected of them. For me, I kind of have to feel my way around and learn as I go” (Gardner & Holley, 2011).

Throughout the interviews, first-generation students described themselves as belonging to two worlds: “the world of their upbringing and that of higher education” (Gardner & Holley, 2011). In most cases, the students described feeling as if they did not fully fit into either world. At home, students may find that their family does not understand, or worse, does not support the long-term process of obtaining a PhD. As one student commented, her family “really didn’t understand it, and the more I went to school, the more it just confused the hell out of them” (Gardner & Holley, 2011). The students also frequently described experiencing imposter syndrome or guilt as they began to acquire status (Gardner & Holley, 2011).

The above study shows that, while first-generation students tend to be resilient and self-motivated, this does not discount their need for social supports to help them negotiate graduate school. The authors also note that the limited nature of their study and the dearth of other studies related to this subset of students show that more research is needed on a larger sample of students across institutions and disciplines, and over their career trajectories, in order to form a better understanding of first-generation students’ particular needs (Gardner & Holley, 2011).

3.5.6 Challenges for International PhD Students

Students who leave their home countries to enroll in PhD programs in Canada find themselves in a new and potentially challenging environment. A survey of international students enrolled at a western Canadian university (571 responded) found their main issues were housing, finances, and integrating into their new educational and social environments (Calder *et al.*, 2016). These students also need to navigate new bureaucracies at federal, provincial, and university levels, as well as the unique challenges of integrating into a new country and potential culture shock associated with that (Calder *et al.*, 2016).

The importance of the relationship between students and supervisors can be accentuated for international PhDs, given their limited access to Canadian scholarships and potentially increased reliance on funding through research grants. In STEM fields in the United States, students report a fear of losing their funding or visas and feel pressure to outwork domestic students, leading them to feel that they carry a different status than their domestic peers (Cantwell *et al.*, 2018). These feelings are corroborated by higher rates of discrimination reported by international students compared to domestic students in Canada (roughly 30% versus 20% in a recent survey of PhD students) (Woolston, 2019).

Challenges continue for international PhD graduates who remain in the academy. As is the case for international PhD students, international PDFs may have limited access to Canadian funding sources. The federal government's Banting fellowships for PDFs are open to all applicants regardless of citizenship status (GC, 2019h); however, these are highly competitive grants with only 70 awarded per year across the tri-agencies (GC, 2020b). The more numerous NSERC and SSHRC postdoctoral fellowships are, on the other hand, only available to Canadian citizens or permanent residents (NSERC, 2019c; SSHRC, 2019b). In Quebec, funding is available to PDFs on temporary visas through the Fonds de recherche du Québec – Société et culture (FRQSC), provided the award is held at a Quebec institution and that the applicant has been living in the province for six of the seven months prior to the application deadline (FRQSC, 2020b).

Beyond funding, a study on PDFs in scientific disciplines in the United Kingdom and United States revealed additional double standards based on their nationality, which could influence career outcomes (Cantwell & Lee, 2010). Interviews with administrators, PDFs, and faculty members highlighted prejudices in academia that affect international PhDs hired into PDF positions. These interviews revealed that the professional experience of a PDF can be strongly linked to their ethnic background, due to biases held by their supervisors. For instance, supervisors tended to apply traits linked to “broad ranging in thought” (considered an attribute needed to gain a faculty position) to their PDFs from Europe or North

America, and assigned them corresponding tasks and responsibilities. In the same interviews, the supervisors described their PDFs from countries outside of Europe, North America, and Australia as “hard working” and “dedicated,” and assigned them technician-like work. In this respect, there can be two tiers of PDFs: a first tier, destined for faculty positions, composed chiefly of North American, European, and Australian PDFs, and a second technical tier, composed primarily of PDFs from Asia (Cantwell & Lee, 2010).

These examples illustrate how international PhDs in Canada may face systemic issues with the potential to affect their labour market transition, beginning very early in their PhD education and becoming more acute if they pursue careers in the academy.

3.6 Summary

Beyond the statistics indicating that faculty positions are becoming increasingly rare, the experiences of students and graduates can tell us much about the current state of PhD education in Canada and the potential changes that are needed to prepare PhDs to thrive in any number of careers. Well before graduation, universities can play a role in helping to ease people’s transition from PhD student to professional by asking administrators and faculty to examine the culture they create through policies and actions. Questions stakeholders may ask themselves include the following: Is academic culture contributing to the growing mental health problems among graduate students, or helping to reduce them? Are Canadian universities doing everything necessary to promote diversity on campus, or do their policies have unintended consequences that limit recruitment or contribute to attrition among underrepresented groups?

Beyond academic culture, universities are increasingly being asked to consider the needs of all PhD students, not just the few who follow the tenure track. In accepting graduate students, universities may have to account for their outcomes — this includes making sure they have the necessary skills and confidence to transition to a variety of positions in the Canadian labour market.

4

Employer Capacity to Hire PhDs in Canada

- 4.1 Higher Education Sector
- 4.2 The Private, Public, and Other Sectors
- 4.3 Summary

Chapter Findings

- PhD graduates in Canada are finding employment as researchers, advisors, and managers among many other positions, and applying their skills and aptitudes across multiple sectors.
- While the number of PhD graduates in Canada continues to rise, the receptor capacity for tenure-track professors in the country is stagnant or declining.
- Some PhD graduates take multiple sequential short-term transitional positions at universities, hoping to improve their chances of landing a tenure-track position; this may be because they lack knowledge on how to successfully seek secure employment outside of academia, or because they do not have the time or resources to seek alternative employment.
- PhD graduates may not be aware of the skills and abilities they could bring to a future employer, or there may be a mismatch between the capabilities desired by employers and those gained by PhD graduates during their studies.
- Canada invests less money in R&D compared to similar countries and a greater proportion of R&D is done in higher education institutions.

Despite receiving training tailored primarily for an academic career, many PhD graduates from Canadian institutions are working outside of academia or higher education. PhD graduates find employment in public, private, and not-for-profit sectors as researchers, scientists, analysts, and managers among many other positions, including leadership roles. This demonstrates that PhDs bring a variety of skills to the job market that are transferable to a wide range of sectors, and that scholarship in a broad sense is not limited to the academy. *The Fundamental Science Review* underscored the potential value of PhD graduates to Canada's wider economy, noting that, because "immersion in research changes the way people think and solve problems," PhDs are ideal for improving Canada's innovation performance (Naylor *et al.*, 2017). Such a view is consistent with major economic trends towards knowledge-intensive services, digitization, and innovation for which PhDs' aptitudes and skills are well suited.

However, as this chapter shows, the reality facing Canada's increasing number of PhD graduates is marked by challenges not only in the academic sector in which they were trained (Section 4.1), but also in other sectors (Section 4.2). Evidence from across all sectors of the economy provides insight into the role of PhDs in the

labour market; this evidence comprises university studies tracing the market outcomes of graduates, government census data, and academic surveys. While there are limitations to comparing these data, the Panel's analysis suggests that Canada's receptor capacity for PhD graduates is not reaching its potential, especially in the context of widely recognized industry skills shortages.

4.1 Higher Education Sector

While evidence makes clear that most PhD graduates from Canadian institutions do not become tenure-track professors, higher education remains the largest employer (see Box 4.1 for a description of the sources of evidence, and their limitations). Results from large-scale university tracking studies suggest that, overall, half or more PhD graduates for whom employment information could be found are employed in this sector in some capacity (56% for UofA, 54% for TRaCE McGill, 51% for UofT, 51% for UBC, and 74% for Stage 1 of TRaCE) (TRaCE, 2016; Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019; Lee, 2020). These percentages are higher than the survey results of PhD graduates from Quebec institutions collected by Bangali *et al.* (2019a), where 45% of respondents were working in a university or research centre. Positions in the higher education sector beyond tenure-track professor include administrator, facility manager, research associate, laboratory coordinator, college lecturer, PDF, and sessional instructor.

Box 4.1 Data Sources for Career Information on PhD Graduates

The key sources of evidence that show where recent PhD graduates are employed are four large-scale tracking studies produced by (i) UofA (classes of 2005-2017), (ii) TRaCE McGill (classes of 2008-2018), (iii) UBC (classes of 2005-2013), and (iv) UofT (classes of 2000-2015), plus Stage 1 of the TRaCE project, which looked at humanities PhD graduates from several Canadian universities (classes of 2004-2015) (TRaCE, 2016; Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019; Lee, 2020). These studies identified the sectors of employment based on survey completion or web research. Employment data were found for 85% of PhD graduates from UofA, 85% from McGill, 91% from UBC, 85% from UofT, and approximately 79% of those PhDs applicable to Stage 1 of TRaCE (TRaCE, 2016; Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019; Lee, 2020).

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Another key source of information is a study by Bangali *et al.* (2019a), which considers surveys targeting recent PhD graduates (classes of 2005-2015) from institutions in Quebec,¹² and employers.

Statistics Canada was also a key source of data. It provided the Panel with evidence from the census, the National Graduates Survey (NGS), and the Education and Labour Market Longitudinal Platform (ELMLP). The ELMLP, released in 2018 with the support of Employment and Social Development Canada, is a collection of data on students taken from the administrative records of publicly funded Canadian post-secondary institutions, and from income tax information provided by the Canada Revenue Agency. Research commissioned by the Panel using the ELMLP offered important insights related specifically to PhDs in the first five years after graduation.

The Panel notes that, while these sources examine employment, it is often not possible to directly compare or combine the results stemming from the different data sets. This is because of variations in classification systems for sectors of employment and disciplines of study. For example, while university-specific studies used a category of post-secondary education that omits elementary and secondary teaching, some Statistics Canada documents included all teaching positions in the same category (primary, secondary, and post-secondary). An example of the challenges associated with discipline of study is that, depending on the source, engineering is sometimes combined with physical sciences, while other times physical sciences are combined with life sciences.

The Statistics Canada census offers a glimpse into the overall population of PhDs in Canada (those who obtained degrees domestically as well as those who obtained them elsewhere) through the two- or three-digit North American Industry Classification System (NAICS) codes. The census enables an examination of how many PhDs are working in *educational services* (i.e., education), defined as “establishments primarily engaged in providing instruction and training in a wide variety of subjects,” but does not allow universities and colleges to be separated from other educational institutions (e.g., secondary schools) (StatCan, 2018c). While the census data can therefore not be directly compared to the data on recent PhD graduates (tracking surveys and the ELMLP research done for this report), they still provide important insight.

12 The French-language survey was sent to graduates from all PhD-granting institutions in Quebec.

Panel analysis of three Public Use Microdata Files (PUMFs)¹³ for the 2006, 2011,¹⁴ and 2016 Canadian census reveals that a significantly higher percentage of PhDs work in education compared to those holding bachelor's or master's degrees (Table 4.1). In the 2016 census, 39% of men and 45% of women holding PhDs in Canada worked in education, and these percentages have been fairly stable since 2006. According to the full sample, women are more likely than men to work in education at all three degree levels. Among younger people only, however, the share of women in the education sector (41%) is essentially the same as for men. This suggests that non-academic employment is more common for younger women than it was for earlier cohorts. This is not true for men, however, as the percentage of male PhDs in educational services is essentially the same for those under 40 as it is for the full sample.

Table 4.1 Percentage of Bachelor's, Master's, and PhD Graduates Working in Education, by Gender and Census Year

	Men			Women		
	2006	2011	2016	2006	2011	2016
Bachelor's	7.5%	7.1%	5.9%	18%	17%	15%
Master's	14%	13%	11%	23%	23%	20%
PhD	40%	40%	39%	46%	44%	45%
PhD (under 40 only)	43%	40%	41%	45%	39%	41%

Data Source: Panel analysis of PUMF data for the 2006 and 2016 Canadian censuses, and the 2011 National Household Survey. Individuals are defined as working in education if they hold an education-related position in an education industry or sector.

4.1.1 University Receptor Capacity for Tenure-Track Professors in Canada Is Stagnant or Declining

The data demonstrate that the receptor capacity of Canadian universities to hire tenure-track professors is not growing despite an increasing number of PhDs graduating from Canadian institutions. As mentioned in Chapter 2, the number of tenure-track professors across the country has remained relatively stable at about 40,000 to 41,000 between 2009 and 2018 (StatCan, 2019j), while the number of students enrolling in PhD programs has risen (StatCan, 2020d); the latter is partly due to new PhD programs being offered. The relatively constant number of professors combined with increasing levels of enrolment could have a negative

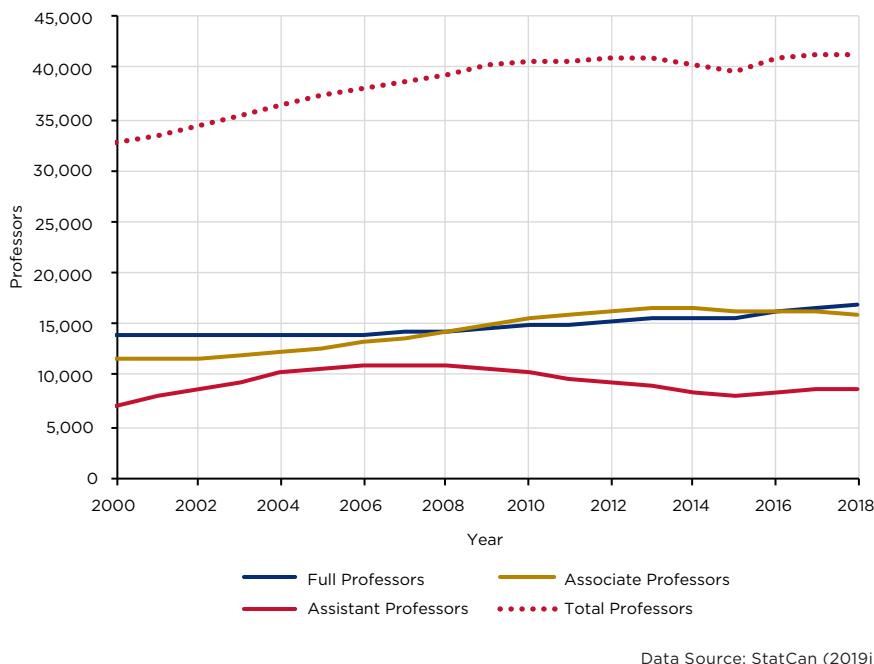
¹³ The PUMF for the Canadian census "provides access to non-aggregated data covering a sample of 1% of the Canadian households" (StatCan, 2019k).

¹⁴ In 2011, the Canadian census was replaced with the National Household Survey.

impact on the quality of supervision if some professors are overseeing a greater number of students (Tamburri, 2013). This may also be an issue elsewhere in the world, since increasing PhD enrolment and flattening trends in the number of tenure-track professor positions are not unique to Canada (The Economist, 2010; OECD, 2020b).

While there are no definitive data on the numbers of new tenure-track professor hires or those leaving the profession (because of retirement or career change), the number of professors employed at different levels (assistant, associate, and full) suggests there is a stagnant or declining receptor capacity for new professors (Figure 4.1). Before the economic downturn of 2008, the number of tenure-track professors in Canada was steadily rising, primarily owing to increasing numbers of assistant professors (i.e., the first tenure-track tier on being hired). In the last 10 years, the number of full and associate professors has risen, but at the same time, the number of assistant professors has declined (Figure 4.1). This decline, combined with the rise in associate professors, indicates that people in assistant professor positions are being promoted at a faster rate than new assistant professor positions are being created. As discussed in Section 2.3.4, the elimination of mandatory retirement has led many professors to continue working beyond the age of 65, likely constraining opportunities for researchers early in their careers (Naylor *et al.*, 2017). Since almost all PhDs starting a career in academia do so at the assistant professor level, it would appear there are now fewer open or new tenure-track positions than in the past. Additionally, the pool of candidates seeking professor positions in Canada is not limited to PhD graduates from Canadian institutions. Universities in Canada are part of a global knowledge economy, so institutions often seek to recruit top PhD graduates from around the world to the professoriate (Section 6.1).

Unfortunately, it is difficult to conclusively determine how many PhDs in Canada are obtaining these tenure-track positions, because classification systems often combine professors with other roles. For example, the NAICS three-digit code for educational services includes all levels of education. Another system, the National Occupational Classification (NOC), has the class “university professors and lecturers,” which includes tenure-track (and tenured) professors, as well as lecturers and PDFs (who hold non-tenured positions) (StatCan, 2019l). Census data analysis reveals that 35% of all PhDs in Canada in 2016 were “university professors and lecturers,” with a lower percentage in STEM fields (27%) than in BHASE fields (45%) (Wall *et al.*, 2018). While the inclusion of lecturers (who are often in temporary positions) and PDFs means this classification should not be considered an accurate estimate for the tenure-track university professor receptor capacity, it does provide an upper bound.



Data Source: StatCan (2019j)

Figure 4.1 Number of Tenure-Track Professors at Universities in Canada, by Rank

The number of assistant professors (solid red line) in Canada has declined since reaching a peak in 2007. Over the same period, the number of associate (solid yellow line) and full (solid blue line) professors has increased. The total number of tenure-track professors (dotted red line) has been relatively constant since 2009.

A simple method for estimating the proportion of PhDs specifically in tenure-track positions is to consider the total population of PhDs in Canada in the labour force (about 177,000 in 2016) versus the total number of PhDs holding tenured and tenure-track positions across the country that same year¹⁵ (approximately 34,000) (StatCan, 2019a, 2019j). This method suggests that 19% of PhDs in the labour force are tenure-track professors. The Panel notes that this calculation does not take into account those holding tenure-track positions in Canada who are not residents of Canada.

Further insight can be found in the four large-scale studies of targeted groups of PhD graduates (Box 4.1). Among those graduates for whom employment

¹⁵ Statistics Canada data demonstrate that 80–85% of tenure-track professors hold PhDs (StatCan, 2019j). Other qualifications held by professors include medical degrees or Master's of Fine Arts (MFA), for example.

information could be identified, the percentage in non-teaching-stream tenure-track positions was 26% (UofA), 23% (TRaCE McGill), 24% (UBC), 26% (UofT), and 34% (Stage 1 of TRaCE)¹⁶ (TRaCE, 2016; Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019; Lee, 2020). The actual percentages of PhD graduates finding tenure-track positions from these institutions will be slightly lower, however, as employment information for some graduates was not found (Box 4.1). The results therefore are only slightly above the crude estimate of 19% from the previous paragraph in most instances. In contrast, other data sources indicate a smaller percentage of recent PhDs across Canada are working as professors. An analysis of data from the 2013 NGS found 12% of PhD graduates from the class of 2010 were in tenure-track positions three to four years after graduation (Walters *et al.*, 2020). This is likely an underestimate of the total number, however, as some people obtain a tenure-track position more than three years after completing their degrees.

In the case of the university-specific and Stage 1 TRaCE surveys, the higher percentage of tenure-track professors may be the result of their including PhD graduates from the early 2000s (assistant professor numbers in Canada peaked in 2007, as shown in Figure 4.1). For example, as of 2016, 38% of UofT PhD graduates from 2000–2003 were tenure-track faculty compared to 27% of graduates from 2008–2011 (UofT, 2017). Also as of 2016, while 32 to 40% of sciences and health sciences PhD graduates from UBC’s 2005 cohort were research-intensive faculty, the same was true for 7 to 9% of graduates from the 2013 cohort (Porter *et al.*, 2017). The results from TRaCE McGill also demonstrate that “the more recently individuals graduate, the less likely they are to be in a tenure-track position” (Lee, 2020). Evidence also suggests that PhD graduates from Canada’s research-intensive universities (which include McGill, UofA, UBC, and UofT) are more likely to obtain tenure-track positions than graduates from other universities (Jonker, 2016; Wood, 2017).

As noted, the results from the TRaCE survey (which looked only at humanities graduates) indicate over a third of respondents are in professor positions, but the exact number of tenure-track versus non-tenure-track positions is unclear. In the UofT and UBC studies, humanities and social sciences PhD graduates (compared to those in the natural sciences) are significantly more likely to be in tenure-track positions (Porter *et al.*, 2017; Reithmeier *et al.*, 2019). Analysis of the 2013 NGS yielded the same observation; however, the differences across disciplines were small. Graduates from the social sciences, education, fine arts, and the humanities were more likely to be professors three years after graduation (15%), while graduates from physical and life sciences were less likely (12%) (Etmanski *et al.*, 2017).

16 The authors of the TRaCE project summary note that, unlike the other surveys, they cannot conclusively determine what percentage of these are tenure-track employees (TRaCE, 2016). Other minor methodological differences among the four surveys mean direct comparisons of these surveys should be done with caution.

Some PhD graduates obtain tenure-track positions that are predominantly (or completely) focused on instruction (i.e., teaching-stream professors), with little or no requirement to carry out research (Sanders, 2011) (Section 2.3.3). For example, the UBC and the UofT surveys report that 9% and 2%, respectively, of PhD graduates are working in permanent teaching-focused faculty positions (Porter *et al.*, 2017; Reithmeier *et al.*, 2019). While teaching-stream positions have become more common, the data from UBC and UofT illustrate they are a minority of tenure-track positions.

There are challenges facing PhD graduates entering the tenure track (in either the research or teaching streams) beyond simply obtaining a position. While a detailed examination of these issues is beyond the scope of this report, some are briefly described in Box 4.2.

Box 4.2 Challenges Facing New Tenure-Track Professors

Studies show that graduate programs are not preparing students for a future role in the professoriate (Austin, 2002; Bieber & Worley, 2006; Golde, 2006; O'Meara & Jaeger, 2006). Many new faculty members report not feeling equipped to carry out the roles asked of them, particularly related to teaching. Some PhD graduates complete their degrees without having done any formal teaching and/or without having been a teaching assistant. This issue may be more common among “top” PhD students who receive the largest fellowships and who may be most likely to end up in the professoriate. In the SPE survey, 41% of respondents who received a tri-agency fellowship reported that the award gave them the “ability to study without a teaching assistantship” (SPE, 2019). Additionally, PhD graduates often have little or no training in managing research teams, even though teams are the basis of academic research for certain disciplines (e.g., life sciences). These issues illustrate that there is a skills mismatch facing PhD graduates entering the academic labour market.

New professors face challenges due to an academic culture that can reward research activity above all, nor do they generally receive any training in this area (O'Meara & Jaeger, 2006).

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Other difficulties identified by new professors in Canada include confusion about rules and norms used to judge them (e.g., expected productivity), securing funding, work-life balance, feelings of pressure and surveillance, and anxiety and shame (O'Meara & Jaeger, 2006). Through interviews with new social sciences professors in Ontario, Acker and Webber (2016) found that new professors tolerate and normalize stressful experiences because they feel their “chance at an academic life” is at stake. All participants noted they loved their work and some were “uncomfortably aware of their privileged position and do not want to risk losing it.” Acker and Webber (2016) express the view that tenure processes promote homogeneity by encouraging new professors to not “stray too far from the norm.”

It is unlikely that the receptor capacity for tenure-track positions in Canada will grow in the foreseeable future. The elimination of mandatory retirement, and university budgetary constraints in general, have likely each contributed to lower numbers of open or new tenure-track professor positions (Section 2.1). Both of these factors are expected to persist.¹⁷

4.1.2 Many PhD Graduates Working in Higher Education Are in Non-Professoriate Roles

Although the receptor capacity for tenure-track professors appears to be declining, this does not mean that more PhD graduates are leaving academia. Instead, they are taking different, often temporary, roles at universities. The proportion of recent PhD graduates working at post-secondary institutions in Canada (approximately half) and the proportion in tenure-track positions (likely well under 25%) suggest that there are significant numbers working in other positions at higher education institutions across the country (TRaCE, 2016; Etmanski *et al.*, 2017; Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019).

Beyond tenure-track professor, there are many full-time careers in higher education — either permanent or contract — in which PhDs can apply the aptitudes obtained during their studies in long-term roles. These include laboratory technicians and other research support staff, roles that are relatively common for certain disciplines. A significant number of PhD graduates from UBC's health sciences and sciences programs were associate researchers in higher education institutions (11% and 10% of all health sciences and sciences PhDs

¹⁷ The Panel acknowledges that Ontario has proposed implementing rules that would prevent professors from accessing university salaries and pensions concurrently from age 71 (Friesen, 2019).

working in higher education, respectively) (Porter *et al.*, 2017). Other career paths for PhDs within higher education include student affairs, educational development, teaching and learning support, research administration and development, institutional research and policy, scholarly publishing, and program management, among a range of other paths (McDonald, 2011; Kotsopoulos, 2014; TRaCE, 2016; Porter *et al.*, 2017). The employment of PhDs in university administration has been on the rise, at least at some institutions (Kotsopoulos, 2014). Both the UBC and TRaCE projects report that some PhD graduates tracked in those studies were working in university administration (TRaCE, 2016; Porter *et al.*, 2017).

A sizable proportion of non-professoriate positions in higher education institutions are transitional roles, such as PDFs and sessional instructors. For example, as of 2016, 10% of UofT humanities PhD graduates from the 2000–2003 cohort working in post-secondary education were sessional instructors; the same was true for 17% of those who graduated in 2008–2011 (UofT, 2017). The Panel notes that some people with PhDs may choose to make careers through these transitional roles (and are happy to do so), but most do not see such positions as the goal or end-point when entering the labour market.

Analysis of the 2013 NGS (which examined graduates of the class of 2010) provides compelling evidence that many PhD graduates remain in these transitional positions three years after graduation (Walters *et al.*, 2020). The authors found that 27% of participants were in transitional roles three years after graduation, compared to 12% in tenure-track professor positions (Walters *et al.*, 2020).

Regression analysis of the NGS data finds that science PhD graduates are most likely to be in transitional positions three years after graduation, and least likely to be full-time professors (Walters *et al.*, 2020). Humanities and fine arts PhD graduates also have a high probability of being in a transitional role and low probability of being a full-time professor. Overall, PhD graduates from the majority of disciplines (fine arts, humanities, science, math, engineering, computer science, and health) are more likely to be in transitional roles than in full-time professor or researcher positions (Walters *et al.*, 2020). The only disciplines where, three years after graduation, PhD graduates are more likely to be in full-time professor positions than in transitional positions are those with degrees in social sciences and business/economics (Walters *et al.*, 2020).

These transitional jobs are generally based on contracts and are therefore insecure. Cohen (2018) defines *job insecurity* as the combination of “being hired on temporary, fixed-term contracts” and “perceptions of precariousness” with no presumption of long-term tenure. Evidence demonstrates a correlation between job insecurity and the symptoms of chronic mental stress (e.g., depression, anxiety), physical health problems, and poorer self-rated health, particularly for those whose insecurity is persistent (Strazdins *et al.*, 2004; Burgard *et al.*, 2009).

4.1.3 Sessional Instructors Are Frequently Used to Teach at Universities

Sessional instruction is a contract position focused exclusively on teaching (and the associated preparation and grading); as such, those who work in these positions are temporary employees. It is important to distinguish sessional instructors from teaching-stream faculty at universities, who hold full-time, indeterminate positions on different (higher) pay scales (Section 4.1.1).

Traditionally, sessional instructors were people with specialized expertise in a subject who taught one or two classes a year, but who were not reliant on the income (e.g., accountants, lawyers, retired professors) (Rajagopal, 2002). While this is still the case for some sessional lecturers, a survey of “part-time, non-full-time, non-tenure-track instructors” at publicly funded universities in Ontario found the majority of respondents had PhDs (66%) and most (61%) indicated that sessional teaching was their primary source of income (Field & Jones, 2016). This differs from the results of a study by the Council of Ontario Universities (COU), which found that 34% of sessional instructors at 17 Ontario universities in 2014–2015 had a PhD (COU, 2018). This may be because the highest proportion of sessional instructors of all disciplines were in education and law, which are professional programs (COU, 2018). Additionally, 21% of sessional instructors were graduate students (COU, 2018).

As discussed in Chapter 2, the increase in research intensity at Canadian universities combined with budget constraints has fuelled the need for more sessional instructors. It is difficult to estimate the full role of sessional instructors at Canadian universities because of a paucity of data. The best data on the current use of sessional instructors come from the COU, which shows that 50% of undergraduate courses at 17 universities in Ontario were taught by part-time instructors in the 2014–2015 academic year (COU, 2018). Sessional instructors were less common at the graduate level, where they were responsible for teaching 31% of students (COU, 2018).

There is a general consensus that the use of sessional instructors has increased around the world. At a meeting related to academic salaries that included researchers from 28 countries, all reported a “dramatic increase in part-time contracts” for teaching (Reisberg, 2010). The American Association of University Professors found that, in 2016, between 30 and 35% of instructional appointments in the United States were held by tenure-track faculty at institutions where bachelor’s or higher degrees represented at least half of all degrees (AAUP, n.d.).

Comprehensive data tracking the increase in sessional instructors for undergraduate teaching in Canada can be found in Brownlee (2015). This study on the changing frequency of contract instructors in Ontario universities focused primarily on humanities and social sciences departments between 2000 and 2010.

The author found a significant increase in full- and part-time contract faculty appointments over that period compared to tenure-track appointments.¹⁸ At two of the universities examined (out of 16), there were more part-time appointments than tenure-track positions. Of the remaining universities, three had approximately equal numbers of part-time appointments and tenure-track appointments. At all universities, there was a growing reliance on part-time contract faculty, with the increase at some universities being quite significant. Obtaining accurate information from Ontario universities is challenging, however, and creates a data gap in this area; Brownlee (2015) found that many institutions do not keep track of contract faculty or do not wish to share this information.

The COU data provide insight into how various disciplines use sessional instructors. The discipline with the lowest proportion of sessional instructors was engineering, followed by sciences, and medical sciences (COU, 2018). Of the non-professional programs, arts and humanities had the highest proportion of sessional instructors, followed by social sciences (COU, 2018). This is consistent with evidence showing that humanities and social sciences departments tend to rely more heavily on contract instructors (Rajagopal, 2002; Omiecinski, 2003). These instructors may be more likely to depend on teaching as their primary source of income (Rajagopal, 2002; UofT, 2017). Similarly, Porter *et al.* (2017) found that the proportion of UBC PhD graduates in contract teaching positions was highest for humanities graduates. This trend was also observed in the UofT survey; most respondents in part-time/sessional instructor positions obtained their degree in the humanities (Reithmeier *et al.*, 2019). These results are consistent with the experiences of the Panel — namely, that humanities PhD graduates are most likely to take sessional appointments after graduating, and some see these temporary positions as a step on the path to the tenure track (PhD Pathway 4).

A survey of 1,680 sessional instructors across 12 Ontario institutions provides a demographic view (Field & Jones, 2016). Most respondents were women (60%), two-thirds had PhDs (66%), and 41% were between 30 and 44 years old. On average, older respondents were far more likely to be traditional sessional instructors (i.e., those with other careers), while people under age 50 were much more likely to identify their sessional work as their primary source of income (precarious sessionals). While survey respondents had generally worked as sessional instructors for some time (61% had five or more years' experience), the majority were on contracts of six months or less (54%) (Field & Jones, 2016). In terms of salary, about 45% of respondents reported making less than \$19,930 per

¹⁸ For tenure-track faculty, the number of appointments almost always equals the number of individuals. In some cases, the number of contract faculty appointments may be slightly higher than the number of contract faculty individuals, as some people have contracts with multiple departments or across universities (Brownlee, 2015).

year (which was the low income measure after tax, or LIM-AT, at the time of the survey) for their sessional work and many had alternative sources of income. Even when taking into account all income, 30% of sessional instructors still reported their income as below the LIM-AT (Field & Jones, 2016).

Although sessional instructors play an important role within the university (i.e., teaching courses), many respondents to the Ontario survey did not feel valued. Just under half of precarious sessional instructors (44%) agreed or strongly agreed with the statement “I feel invisible. No one cares what I do” (Field & Jones, 2016). Additionally, many respondents reported not receiving support or access to tools (e.g., sample syllabi, office space). One respondent provided the following example:

Another thing that is demoralizing . . . is when my teaching contract — and therefore my access to student marks management and online forms — ends on April 30 and I am expected to mark late exams/assignment and change marks but don't have electronic access to the system. This has happened to me more than once, and the system delivers a message saying that I am not employed by the university. Right. I am working, but not being paid. Being told through an automatized message that I don't work there is a slap in the face.

Field & Jones, 2016

Given that many sessional instructors are working on short-term contracts and have low incomes, it is not surprising that many respondents hoped their current position was not the end-point of their career (Field & Jones, 2016). Three-quarters of respondents (76%) reported they would prefer to have a full-time position in the academy, but only 40% would leave academia if they found “secure work in another field.” This may reflect an academic culture that perpetuates the message that any job in the academy (regardless of the quality) is preferable to an external job, and that leaving the academy is a moral failure (Section 3.2). Follow-up interviews showed that, while many precarious sessional instructors likely began teaching with the intent of obtaining a tenure-track position, some had “given up” after years in precarious positions (Field & Jones, 2016). Despite the challenges of sessional positions, it is worth noting that the majority of sessional instructors report taking pride in their teaching position (Field & Jones, 2016).



PHD PATHWAY 4

Ross Bullen, OCAD English Lecturer and ACCUTE Representative (2017)*

Ross Bullen obtained a PhD in English from Western University. During his studies, he held a variety of TA positions and found he most enjoyed those with tutorial interactions with students. During his final year, Bullen had an opportunity to teach his own class for which he created the syllabus. That year he also held a paid position on a campaign seeking to unionize PDFs.

After completing his degree, Bullen taught courses at several universities across three provinces. He first taught a few courses at McGill before returning to Western to act as a sessional instructor for two years. During this time, Bullen interviewed for a tenure-track position at his alma mater, but was unsuccessful. He then moved to New Brunswick to teach on a nine-month contract at Mount Allison. This was followed by a one-year contract at the same university. He then returned to Ontario, having secured a three-year teaching contract at OCAD University. The nature of the contract means Bullen is not teaching in the summer and he uses this time for his own research and writing. Bullen has also taken on a position as the Contract Academic Faculty Caucus Representative (2016-2018) with the Association of Canadian College and University Teachers of English (ACCUTE). This position allows him to build on his interest in labour activism and focus on his “growing interest in precarious academic labour” in the Canadian post-secondary system.

Adapted from Nygren (2017)

*As of 2020, Bullen works as an assistant professor (teaching intensive) at OCAD University (OCAD University, n.d.).

4.1.4 Most PDFs Will Not Become Tenure-Track Professors

A PDF position is “a temporary period of mentored research and advanced training” for PhD graduates (Jadavji *et al.*, 2016), with contracts generally on the order of one to two years. The duties of most PDFs are focused on carrying out research, although other activities may include supervising the research of others (e.g., graduate students), administrative work, teaching, and academic service. Focus groups of PDFs in Quebec found that many considered themselves both employees and students, and this situation caused “a sense of discomfort” as PDFs were sometimes unclear on the

“classification of their work” (CIE, 2019). While there are PDF positions outside academia, the majority exist within post-secondary institutions (NSB, 2018).

PDFs have challenges similar to recent graduates when attempting to launch a career. A study by Hayter and Parker (2019) finds that many of the same issues that affect recent PhD graduates in the job market still exist when one emerges from the PDF period, including “the lack of relevant skills, absence of support — and in some cases opposition — from their principal investigators, and poor availability of non-academic career preparation opportunities, among others” (Hayter & Parker, 2019). PDF positions have traditionally been seen as a stepping stone to a professorship in certain disciplines,¹⁹ but the number of PDFs exceeds the number of tenure-track positions available in Canada and elsewhere; the exact number of PDFs in Canada, however, is not known (Institute of Medicine, 2014). Simply put, most PDFs will not become professors even if that is their goal (Charbonneau, 2018; Hayter & Parker, 2019).

A desire for a tenure-track position, along with too few openings and a lack of knowledge about seeking employment outside of academia, may be contributing to the situation where some PhD graduates take multiple sequential short-term positions at universities, hoping to improve their chances of landing a tenure-track position (Powell, 2015; Jadavji *et al.*, 2016) or simply to stay within the academy. As explained by one PDF in Canada, “it used to be such a short position or many people were able to skip [post-PhD] positions altogether . . . but more and more . . . there aren’t positions to move into, and those positions are expecting . . . a two-three year [post-PhD] position . . . so it has become sort of this holding pattern” (McAlpine & Emmioğlu, 2015). TRaCE McGill, UofT, and UBC data demonstrate, as would be expected, that generally, the proportion of PhDs in PDF positions tended to decrease the further removed from their year of graduation (i.e., more PhDs are in PDF positions two years after graduation compared to five years) (Porter *et al.*, 2017; Reithmeier *et al.*, 2019; Lee, 2020). Having said this, some graduates from all three universities were in PDF positions a decade after graduation. Discipline-specific information included in the UBC survey demonstrates that over 20% and 15% of that university’s health sciences and sciences PhDs, respectively, are in PDF positions five years after graduation (Porter *et al.*, 2017). Multiple, sequential short-term PDF contracts may be viewed unfavourably by the private sector, thereby hindering long-term PDFs if they seek permanent positions outside academia (Kaplan, 2012).

There are rules in place that seek to ensure that PDF positions are, in fact, transitional roles. Continuous short-term contracts are often prohibited by

¹⁹ PDFs are also seen as prerequisites for certain types of academic employment in research fields (e.g., facility managers for biology or chemistry).

institutional rules that prevent people from holding a PDF position more than five years after they graduate (e.g., UofA, 2020; UofO, n.d.). In the experiences of Panel members, it is possible to work around these rules, however. For instance, research positions (sometimes called research associates or research assistants) can be created that have the same responsibilities (and similar pay) as a PDF. The Panel notes that, while some PhDs enjoy working in these roles, they have not been observed to lead to advancement within academia.

A survey carried out by CAPS provides information on the discipline breakdown of Canadian PDFs (those working in Canada and abroad, as well as those who have recently completed a fellowship). The 2016 iteration of the survey had 2,109 eligible responses; 45% of respondents were in life sciences, 28% were in physical sciences or engineering, 16% were in social sciences or humanities, and 12% identified as interdisciplinary (Jadavji *et al.*, 2016). In the large-scale UofT survey, while only 6.9% of PhD graduates were in PDF positions, the vast majority were graduates from the physical and life sciences (Reithmeier *et al.*, 2019). Similarly, Porter *et al.* (2017) found that the proportion of UBC PhD graduates in PDF positions was highest for health sciences and sciences graduates. Having said this, the proportion of social sciences and humanities respondents to the CAPS survey obtaining PDFs has been on the rise (moving from 11% in 2009 to 16% in 2016) (Jadavji *et al.*, 2016).

The CAPS survey also presents a picture of the demographics of Canadian PDFs. The average age of survey respondents was 34 years old, they were approximately evenly split between men and women, two-thirds were married/common-law, and one-third had dependents (Jadavji *et al.*, 2016). Similar demographics were observed among PDF respondents in Quebec (CIE, 2019). The proportion of older PDFs appears to be growing. About a third of all survey respondents (Canada-wide) were over age 35 in both the 2013 and 2016 iterations of the CAPS survey, up from about a quarter in 2009 (Jadavji *et al.*, 2016). Many PDFs also reported having persistent mental health challenges (when asked about “symptoms experienced for more than a month at a time”); 33% reported hopelessness, 30% anxiety or panic attacks, and 27% depression (Jadavji *et al.*, 2016). One respondent stated, “it’s a lonely academic experience . . . more so than the PhD. No cohort, no association, in ‘no man’s land’ between faculty and students” (Jadavji *et al.*, 2016).

While there are many parallels between sessional and PDF positions, the latter are generally recognized as full-time positions — an important distinction.

According to the CAPS survey, the mean gross annual salary of PDFs in Canada was just under \$48,000 in 2016, with just over half having a gross annual salary of more than \$45,000 (53%) (Jadavji *et al.*, 2016). At the low end, 2% of survey respondents had an income of less than \$30,000, while 3% had salaries over \$80,000. The CAPS survey also found no gender differences in earnings for PDFs in

Canada, but PDFs in humanities and social sciences earned less, on average, than PDFs in the sciences and engineering (Jadavji *et al.*, 2016).

There are also wide discrepancies in the resources and benefits available to PDFs in Canada because of differences in how the role is classified (e.g., employee, trainee). CAPS data for PDFs in Quebec found that 70% did not have employee status (CIE, 2019). Variation exists in access to medical benefits and employment insurance (with some PDFs having none whatsoever), graduate school resources, and unionization (Jadavji *et al.*, 2016; Charbonneau, 2018). PDF focus groups in Quebec noted that, while obtaining a scholarship for a PDF appears to be more prestigious, at the same time it can be more “economically precarious” (e.g., no access to employment insurance, Quebec Parental Insurance Plan) compared to non-scholarship holders (CIE, 2019).

There is clear evidence of a salary gap between PhDs who become PDFs and those who do not. Ferguson and Wang (2014) found that the median salary in 2013 for a PhD graduate from 2009–2010 who took a PDF position was \$50,000 per year, compared to a median of \$82,000 for those in any other position. There is also evidence that this salary gap persists, at least in biomedicine. In one study of PhD graduates from that discipline, those who had been (or were) a PDF had lower salaries 15 years after graduation compared to those who did not complete a PDF position (Kahn & Ginther, 2017).

A lower percentage of PDFs have educational debt when compared to PhD students. Just over a quarter (27%) of respondents to the 2016 CAPS survey reported having educational debt (Jadavji *et al.*, 2016). This is significantly lower than the 44% of PhD students in the CAGS 2016 survey who reported debt (MRS, 2016). This is likely due partly to funding differences among disciplines, as science graduates are more likely to take PDF positions and less likely to have debt compared to those in some Bbase disciplines.

4.2 The Private, Public, and Other Sectors

PhD programs provide graduates with knowledge, aptitudes, and skills that have value outside of academia. These include research, analysis, management, and advisory competencies (Bangali *et al.*, 2019a) that have applicability in a range of professions. Selected examples of different job titles held by recent PhD graduates across sectors are shown in Table 4.2 (which also includes the academic roles outlined in Section 4.1). The Panel notes that there are limited data on the specific types of jobs held by PhDs, including specific job responsibilities and tasks, and how these relate to their education. For this section, the Panel considered the best available evidence to provide insight into where PhDs are working outside of higher education, and the challenges they face in transitioning to these positions.

Table 4.2 Examples of General Job Titles for PhDs in Canada, by Sector

Higher Education Sector	Private Sector	Public Sector	Not-for-Profit Sector	Self-Employment and Entrepreneurial Sector
Assistant/Associate/Full professor	Scientist Researcher	Analyst Research associate	Research associate Project director	Freelance writer Independent consultant
Sessional instructor	Analyst Sales manager	Scientist School principal	Executive director Instructor	Entrepreneur
Postdoctoral fellow (PDF)		Scientific advisor		
Director of teaching and learning		Research manager		
Facility manager				
Laboratory coordinator				
College lecturer				

Outside higher education, private enterprise is the largest sector of employment for PhDs, accounting for 29% of positions for UofA graduates, 28% for McGill graduates, 26% for UBC graduates, and 18% for UofT graduates (Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019; Lee, 2020). These values are consistent with the survey of PhD graduates working in Quebec, where 22% were employed in the private sector (Bangali *et al.*, 2019a).

As measured by the TRaCE project, the percentage of humanities graduates working in the private sector is much lower at 9% (TRaCE, 2016). This result is consistent with the discipline-specific information from UofA, McGill, UBC, and UofT (Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019; Lee, 2020). There is also consistency across all four university-specific surveys; among different faculties, PhD graduates in engineering²⁰ were most likely to work in industry (or the private sector) by some margin (Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019). For example, results from the UofA survey show that, while 58% of engineering PhDs work in the private sector, this drops to 35% for sciences graduates, and 8% for the arts (which includes social sciences and humanities) (UofA, 2019). Discipline differences may be the reason that, among the 2010–2014 PhD graduates included in ELMLP analysis, men were twice as likely as women to

²⁰ Reithmeier *et al.* (2019) include engineering under the category of physical science.

be working in the scientific and technical services industry (the only private sector category considered in that analysis) one year after graduation (14% versus 7%). As discussed in Chapter 2, men make up a greater proportion of STEM graduates, particularly in engineering, and mathematics and computer science.

The public sector (including governments, elementary and secondary schools, and many health institutions) is also a key employer; about 10% of respondents to the four university-specific surveys work in this sector (Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019; Lee, 2020). A slightly higher percentage of respondents to the survey of Quebec PhD graduates work in government (12%), with an additional 4% working in a CEGEP²¹ (Bangali *et al.*, 2019a). These results are consistent with the ELMLP, which found that, among 2010–2014 graduates, 8% worked in public administration (excluding elementary and secondary teachers, and those working in healthcare) one year after graduation. The proportion was highest among graduates who obtained their degrees in the Atlantic provinces (12%) or the Prairies (11%), and women were more likely to hold this type of position compared to men (9.0% versus 6.5%).

There are also important discipline differences related to public sector employment. The ELMLP results show that social sciences graduates are most likely to work in public administration the year after finishing their PhD (13%), followed by health graduates (9.0%). According to the TRaCE project, the percentage of humanities graduates working in government is only 3.0%, significantly lower than in the three university-specific studies. Similarly, in the ELMLP, humanities PhD graduates (5.4%) are the third least likely to be working in public administration following those in math and computer science (4.3%), and engineering (4.6%).

A significantly smaller proportion of PhD graduates are working in the not-for-profit sector: 4% or less according to the university-specific analyses, the TRaCE project, and the Quebec survey (TRaCE, 2016; Porter *et al.*, 2017; Bangali *et al.*, 2019a; Reithmeier *et al.*, 2019; UofA, 2019). Similarly, 6% or less of PhD graduates were self-employed where these data were available (TRaCE, 2016; Reithmeier *et al.*, 2019). The relatively small numbers of graduates working in these roles prevent meaningful analyses related to demographics and disciplines.

4.2.1 The Canadian Private and Public Sectors Carry Out Less Research Than Those of Other OECD Countries

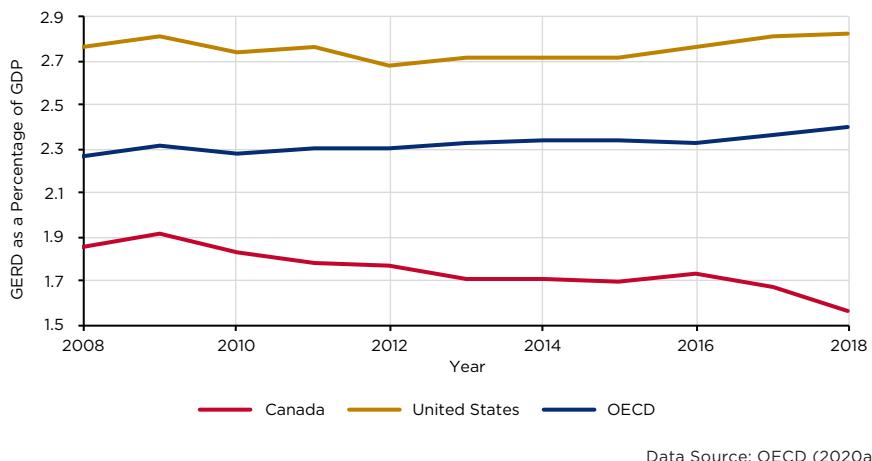
Research and development (R&D) fosters innovation and supports the Canadian economy. While there are a significant number of PhDs working in R&D, not all

²¹ CEGEPs are educational institutions in Quebec that are a step between high school and university. In the TRaCE McGill study, CEGEP positions were classified as higher education jobs.

research personnel have PhDs, nor do all PhDs working in the private sector work in R&D. Additionally, PhDs can use their knowledge to increase productivity despite not working directly in R&D. Having said this, private sector R&D capacity may partly reflect the overall private sector capacity for employing PhDs in Canada. For example, Reale *et al.* (2019) use gross domestic expenditures on R&D (GERD) as “a proxy for career opportunities available to doctorate holders.” The authors demonstrate a correlation between investments in R&D (as represented by GERD) and R&D being a preferred career destination for PhD graduates in social sciences and humanities (the only disciplines included in the analysis) (Reale *et al.*, 2019).

Canada’s GERD totalled just under \$36B in 2019, with the vast majority (\$32B) spent on natural science and engineering research (StatCan, 2020b). The majority of natural science and engineering research that year was performed by the business sector (57%), followed by the higher education sector (35%), and the federal government (6%). On the other hand, GERD in the social sciences, humanities, and the arts in 2019 totalled \$3.8B, and the vast majority was done by the higher education sector (91%), with the business sector performing just over 1%, and the federal government 6% (StatCan, 2020b).

Overall, compared to similar countries, Canada invests less money in R&D and a smaller proportion is done by industry (Figure 4.2 and Table 4.3). Canada’s GERD as a percentage of overall GDP was 1.6% in 2018, compared to the OECD total of 2.4% and the U.S. value of 2.8% (Figure 4.2) (OECD, 2020a). Additionally, while GERD levels for the OECD and the United States have remained relatively stable since 2008, they have dropped in Canada (OECD, 2020a). Among the G7 countries, in 2018 Canada had a lower GERD as a percentage of GDP than all countries except Italy (OECD, 2020a). Compared to the OECD, and the United States specifically, a much smaller proportion of GERD in Canada is performed by business enterprise, and a much larger percentage is done by the higher education sector (Table 4.3).



Data Source: OECD (2020a)

Figure 4.2 GERD as a Percentage of GDP for Canada, the United States, and OECD Countries

The percentage of total gross domestic product (GDP) that Canada (solid red line) spends on gross domestic expenditures on research and development (GERD) has consistently been lower than the percentage for both the OECD (blue line) and the United States (solid yellow line). In addition, Canada's GERD as a percentage of GDP has been declining since 2009.

Similarly, the majority of R&D employment in Canada is in the private sector; over 60% of Canada's R&D personnel²² in 2016 were working in business enterprises (StatCan, 2019i). Federal and provincial/territorial governments are responsible for a much lower percentage of employment, at 5% and 1% respectively (StatCan, 2019i). While R&D personnel work across the country, innovation tends to cluster in the largest Canadian cities (Box 4.3), illustrating the importance of mobility for HQP (Chapter 6).

Overall, the total number of R&D personnel in Canada peaked in 2008, prior to that year's economic crash (StatCan, 2019i). Starting in 2009, there was a sharp decrease in personnel employed in business enterprises, and this decline continued during most years until 2013. The decrease in R&D personnel employed in government came later, with a steady (and continued) decline from 2010 until at least 2016 (the last year for which there are data) (StatCan, 2019i). For the private, public, and not-for-profit sectors, the number of R&D personnel employed in 2016 were still far lower than they were at their peak in 2008 (StatCan, 2019i). There

²² R&D personnel include researchers, technicians and equivalent staff, and support staff participating in R&D projects (StatCan, 2019i).

were approximately 37,000 fewer R&D personnel working in the Canadian private, public, and not-for-profit sectors in 2016 compared to 2008. At the same time, the number of R&D personnel working in higher education (which includes graduate students involved in R&D) has been steadily increasing between 2000 and 2016 (StatCan, 2019i). These results illustrate that receptor capacity in non-university-based R&D has declined significantly while the number of PhDs entering the labour market is increasing (Section 2.1.1).

Among countries with small populations (such as Canada) but higher productivity and innovation indices, Canada has a “lower density of employed researchers” when considering the total working population (Naylor *et al.*, 2017). Additionally, OECD data demonstrate that the density of employed researchers in Canada has been in decline since 2011 (until 2016, the most recent year for which there are data), even as it has increased overall for OECD countries and the United States (OECD, 2019b).

Table 4.3 GERD Percentages by Sector in Canada, the United States, and OECD Countries, 2017

	Business Enterprise	Higher Education	Government	Private Non-Profit
Canada	52%	41%	7%	0.4%
United States	73%	13%	10%	4%
OECD Countries	71%	17%	10%	2%

Data Source: OECD (2019a)

Box 4.3 Innovation and Research Clusters in Canada

While R&D personnel work across the country, innovation (as measured by patents and start-ups) tends to cluster in the largest Canadian cities, and some of these clusters are growing. Toronto, Montréal, Vancouver, Ottawa, and Calgary in particular produce patents and create high-tech companies at approximately twice the rate of other cities. One important cluster is in the greater Toronto area, which has a high number of life sciences and biotech companies.

(Continues)

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Many R&D clusters in Canada relate specifically to a region's natural resources or economic sectors, and/or the presence of government laboratories or institutions. This includes "forestry in British Columbia, oil and gas in Alberta, agriculture in Ontario, mining in Quebec, and maritime resources in Atlantic Canada." R&D related to "advanced manufacturing industries [e.g., information and communication technologies (ICT), aerospace] tend to be more concentrated, often located near specialized research universities."

(CCA, 2018)

4.2.2 The Canadian Private Sector Hires Fewer PhDs Compared to the American Private Sector

The R&D system in Canada only tells part of the story of PhDs working in the private sector. While it is challenging due to data gaps to make definitive statements comparing the private sector hiring of PhDs in Canada to that of other countries, research suggests that Canada is lagging behind the United States. Data collected from the Survey of Doctorate Recipients in the United States show that 35% of all sciences, social sciences, health, and engineering PhDs worked in the private (for profit) sector in 2017 (the survey did not look at all disciplines) (NCSES, 2019). The numbers may be even higher when only recent graduates are considered. A study of funded U.S. PhD recipients from the classes of 2009–2011 found that close to 40% entered industry (this study included PhDs from across disciplines) (Zolas *et al.*, 2015). These values are higher than the proportions working in industry in Canada (Section 4.2). Industry Canada has noted that, in comparison to U.S. firms, Canadian businesses "hire fewer university graduates as a percentage of their total workforce . . . particularly fewer PhD graduates" (GC, 2007). There is also evidence that many private sector companies in Canada do not hire PhDs. In 2011, only 18% of over 1,000 R&D firms reported hiring researchers with PhDs (Expert Panel on Research and Development, 2011; Cheung *et al.*, 2012).

The low percentage of PhDs employed in the private sector stands in contrast to efforts to increase the number of PhD graduates overall. The Science, Technology and Innovation Council (STIC) noted that Canada has succeeded in increasing the number of science and engineering PhD graduates, for example, but states it has "not made the same progress in effectively absorbing advanced research talent into the private sector" (STIC, 2014). Although the number of PhD graduates in Canada continues to rise, overall the country's PhD per capita ratio remains lower

than that of most other peer countries; this may be linked to Canada's relatively low receptor capacity for PhD graduates (CBoC, 2019a).

The structure of the Canadian economy may be limiting the opportunities for graduates in industry. An analysis of Statistics Canada data completed by Nicholson (2018a) found that, despite global trends towards knowledge-intensive sectors, resource-based goods have made up about 50% of Canadian exports since 2007, while knowledge-intensive goods have hovered at around 15% in Canada. As Nicholson argues, Canadian businesses have resisted change because of their ability to prosper in the existing system (Nicholson, 2018a, 2018b). The character of Canada's technology sector, which is composed of smaller companies compared to the United States, may also be a factor (CCA, 2009). Zolas *et al.* (2015) found that U.S. PhDs (classes of 2009–2011) entering industry disproportionately secured employment at large and high-wage organizations (compared to other organizations) in the high-tech and professional service industries. The structure of the Canadian economy, as well as the relatively low levels of R&D in the private sector, are unique factors that may be affecting the private sector receptor capacity in Canada compared to other countries.

4.2.3 Some Private Sector Employers Have a Negative View of PhDs

Employers who hire PhDs have positive attitudes toward them and feel they provide value (McAlpine & Austin, 2018). Almost all (94%) of the employers who participated in the Mitacs Accelerate partner exit survey reported they were satisfied with the quality of the intern and most (88%) would recommend the program to other organizations (Mitacs, 2019a). Similarly, a survey of Canadian employers (across sectors) who had hired a PhD found that most (89%) were either satisfied or very satisfied with their most recent PhD hire (Maymon *et al.*, 2019).²³ Furthermore, 88% of employers indicated they would hire a PhD again in the future (Maymon *et al.*, 2019).

Some private sector employers, however, do not see any benefits to hiring PhDs — and may even view them negatively. Bangali *et al.* (2019a) surveyed non-academic employers in Quebec and asked why they were not inclined to hire PhDs. Of the 38 participants, the most commonly cited reasons were: the employer did not see any benefit to hiring a PhD over other university degrees (61%), they did not need any researchers (55%), and they were concerned they could not retain the PhD because the work would not be sufficiently stimulating (40%) (Bangali *et al.*, 2019a). In the survey of Canadian employers across sectors discussed above, 52% of those who

²³ There were 155 respondents to the full survey and 55% of these respondents reported previously hiring a PhD (Maymon *et al.*, 2019).

had previously hired a PhD reported observing no differences between new PhD hires compared to hires without PhDs (Maymon *et al.*, 2019).

Stories being shared by PhDs from across Canada seem to support these findings. Responses²⁴ to two tweets asking PhDs if they faced difficulties in finding jobs outside of academia (@FromPhDtoLife (Jennifer Polk), 2020) included: “I couldn’t find an industry job for six months because I was ‘overqualified and underexperienced.’ It was a real drag after 6 years working to get those letters to have all the doors shut before I got the chance” (@prenerk (Dr. Andrew), 2020); “It definitely hindered me. I think they had a hard time understanding and appreciating my skills, even when I explained how they would transfer” (@cahamstra (Caitlin Hamstra), 2020); and “[A]lso hear ‘we have some concern that the pace of work and pressure to deliver on time will be much more than academics have to deal with’ — which I’ve found to be entirely inaccurate” (@Scott_Matter (Scott Matter), 2020). Importantly, not all responses were negative; for some people, their PhDs were a neutral factor or an advantage. One respondent explained that, “in my short experience, and in my field (engineering), it seems to boil down to whether the companies already hire people with PhD and know how they fit their needs, or if this just seems too unusual to them. In the first case they told me they thought I would get bored!” (@ElsaPiollet (Elsa Piollet), 2020).

Some PhDs in Australia and the United States have reported that their advanced degrees are detrimental when trying to enter the job market (Mewburn, 2019; Ruben, 2019). In the case of science and engineering, Ruben (2019) hypothesizes that, in general, PhDs face challenges when they are looking to enter a field where their degrees are uncommon. There may be a perception that PhDs are underqualified, lacking the broad skills needed for the workforce and possessing only a hyper-focused knowledge of their own research topic (Ruben, 2019). Conversely, there may also be a perception that PhDs are “overqualified” and will balk at lower salaries or at jobs which require a bachelor’s or master’s degree. Further, those who have held PDF positions may also face the assumption that they are “settling” for a non-academic job because they could not secure a tenure-track position (Ruben, 2019). This may be a reaction to the academic culture that projects the idea that industry careers are “second best” (Section 3.2).

Further evidence from Australia supports the idea that some employers believe PhD graduates are underqualified. Mewburn (2019) interviewed eight private sector recruiters in Australia and found that lack of experience was the most common reason PhDs were not considered in the shortlisting process. A discourse analysis of these interviews revealed that the recruiters viewed “academia not as

²⁴ The Panel did not confirm whether tweeted replies were from PhDs from Canadian institutions.

a workplace, but as another ‘world’, almost completely separate from the commercial workforce” (Mewburn, 2019). This view is consistent with that of academic culture — that is, if academic culture projects the message that the private sector is an “other” to students, it is not surprising that the private sector shares this view as well.

4.2.4 There May Be Inconsistency Between PhD Experience and Employer Needs

People are likely to change jobs throughout their career (Deloitte University Press, 2017). Responses to a survey of PhD graduates from 51 U.S. institutions revealed that movement between jobs is common across disciplines (Okahana, 2019). More than half of all respondents who had earned their PhDs eight years ago started their current job within the last three years regardless of field of study except for education (Okahana, 2019). This statistic is likely influenced by the fact that some PhD graduates enter the labour market through short-term transitional roles (e.g., PDFs, sessional instructors) that last for several years (Section 4.1). The data also demonstrate, however, that even for those who obtained their PhDs 15 years earlier, a significant proportion (approximately one-third of respondents) also started their current job within the last three years (Okahana, 2019).

If PhDs can expect to hold multiple jobs over their careers, they must have transferable skills, and the ability to build on and learn new skills. Deloitte University Press (2017) notes that the shelf life of skills continues to “decrease rapidly.” ISED has recognized this, identifying that the “pressure for competencies to be portable” between careers as a key driver of change in the Canadian economy (ISED Presentation to the Panel).

If PhD education is intended to be training for permanent roles in academia (Section 3.2), it stands to reason that it may not be providing some of the skills needed in positions in other sectors. There are questions as to whether universities are adequately preparing PhD students for such careers or if they remain too focused on research and knowledge associated with academic careers (Jones, 2018). This may be particularly important given the view that employers are increasingly less likely to train new employees to provide them with the skills they need (McKenna, 2013). Some PhD graduates are reporting a mismatch between the skills they gained during their studies and those desired by employers (Bangali *et al.*, 2019a). When respondents to the survey of PhD graduates from Quebec institutions (classes of 2005–2015) were asked about the greatest obstacles to finding employment, a skills mismatch was second only to not having professional experience (Bangali *et al.*, 2019a).

Surveys of private sector employers also identified the specific skills some feel are lacking in new PhD graduates. For example, a survey of biomedical companies in Alberta found that most hiring managers believed that graduate students (both master's and PhDs) lacked project management skills (68% of 93 respondents) (Rancourt & Archer-Kuhn, 2019). Additionally, customer interaction skills (and having a “service-oriented disposition attuned to customer needs”) were identified as lacking in graduate students by 32% of respondents (Rancourt & Archer-Kuhn, 2019). In a survey of employers who had hired a PhD through Mitacs (Box 7.9), respondents were asked to identify competencies that were lacking in their most recent PhD hire. The most commonly cited competency shortage was “knowledge of the industrial environment” (identified in 10 out of 79 responses) followed by “personnel management,” “financial management,” and “delegation of responsibilities” (each identified by seven respondents) (Mitacs, 2019a).

The skills and attributes needed for 21st-century work may not be the same as those needed in the past. Examples of important 21st-century attributes include adeptness in crossing discipline and sector boundaries; abilities in lateral and systems thinking; motivation towards, and expertise in, design thinking and knowledge mobilization; and the desire and ability to seek and incorporate multiple perspectives (Partnership for 21st Century Skills, 2008; Winter-Simat *et al.*, 2017; CAGS, 2018; NASEM, 2018; OECD, 2018). Employer surveys over the last decade or so have suggested that PhD hires lack some of the abilities needed to be successful in 21st-century work. Noted concerns include inflexibility, inadaptability, inability to work in teams with diverse members (Nyquist & Woodford, 2000; Edwards & Smith, 2008; Borrell-Damian *et al.*, 2015; Vitae, 2016), “narrowness of interest” (Vitae, 2016), and suboptimal abilities in thinking creatively (Roberts, 2002), in “collaborative ways of thinking” (Nyquist & Woodford, 2000), in lateral thinking, and in solving practical, open-ended problems (Porter, 2017). These latter speak especially to a lack of ease among PhD graduates in appreciating, understanding, and using different perspectives and ways of knowing.

In the view of the Panel, these skills gaps may be the result of a misalignment of the academic identity of many PhD graduates with the mindset desired by employers. Examples include the focus of many PhDs on a deep investigation in a single area compared to the need to strategize in multiple areas on the job; the focus on long, complex scholarly writing in academia compared to concise, purpose-driven writing in other sectors; and minimal (or more self-directed) time constraints versus working to external timelines.

Evidence of a skills mismatch is also illustrated by several Canadian industries reporting a skills shortage at the same time some PhD graduates are facing challenges in entering the labour market. According to a 2018 survey carried out by

ManpowerGroup, 41% of Canadian employers report they “can’t find the skills they need” and large companies (more than 250 employees) report having more difficulty with this compared to smaller firms (ManpowerGroup, 2018). Four of the top 10 “most in demand” fields include positions that may, in some cases, be appropriate for PhDs: engineers, professionals (e.g., project managers, researchers), technicians (e.g., quality controllers), and IT specialists (e.g., cybersecurity experts). Almost a quarter of those employers who report facing a talent shortage report that the top driver of the shortage is applicants’ lack of the necessary hard skills (17%) or human strengths (7%) (ManpowerGroup, 2018). There is further evidence to suggest that, at least for some employers, there is a shortage of non-technical skills. A survey of 90 large private sector firms asked respondents to identify those areas in which they were experiencing a skills shortage; the most frequent response was leadership/management (Aon Hewitt & BCC, 2016). This was identified more frequently than skilled trades, IT, analytics, engineering, and cyber security (which followed in that order) (Aon Hewitt & BCC, 2016).

4.2.5 PhD Graduates Have a Skills Awareness Gap

Based on interviews with students and a survey of Alberta biomedical companies, Rancourt and Archer-Kuhn (2019) argue that PhD graduates entering the private sector do not have a skills shortage, but rather lack recognition of the skills they do have or how to translate these skills to a different workplace — a so-called skills awareness gap. Part of the issue may be that PhD graduates do not know how to communicate their skills to a non-academic audience (Klopp & Rancourt, n.d.), and that some potential private sector employers do not speak the same language as academia (Rose, 2013). The possibility of a skills awareness gap has been identified across disciplines. Rudd *et al.* (2008) state that social sciences PhD programs could do more to enhance student awareness of the transferability of their own skills acquired during doctoral education, while Rancourt and Archer-Kuhn (2019) explain that “part of a better science graduate education is also about learning to articulate and tease out the marketability of existing skills that are already being learned.”

Some PhD graduates report clearly seeing the link between skills gained during their time in academia and success in their jobs once they enter the workforce elsewhere. As explained by one engineering graduate from UBC, “knowledge gained in my PhD years might not have direct impact to my job, but the skills gained, e.g., how to do research, how to solve a problem, the courage trying to solve a hard problem, is super important in gaining and doing my job well” (Porter *et al.*, 2017). An example of a PhD graduate who found a meaningful position after recognizing the importance of identifying skills (as opposed to knowledge only) is provided in PhD Pathway 5.



PHD PATHWAY 5

Nicholas Dion, Senior Coordinator, Research and Programs, Higher Education Quality Council of Ontario (2015)*

Nicholas Dion graduated with a PhD in religious studies from UofT. In the final year of his studies, Dion identified four career paths he might follow: public policy, university administration, management consulting, and editing/publishing. After conversations with others and consideration of his skills and interests, Dion decided to focus his efforts on public policy.

Dion spent a few months doing informational interviews with people involved in Ontario post-secondary policy and discussing his job search with colleagues from graduate school. He notes how important it is for PhD graduates to network and meet people; this is a great way to make contacts and learn about fields a graduate might (or might not) be interested in. Eventually, a friend forwarded Dion a posting for an internship at the Higher Education Quality Council of Ontario (HEQCO). Although he had initial reservations about taking an internship, the position was paid and Dion decided he had nothing to lose in applying.

After securing an interview, Dion did his best to prepare. He talked to his contacts to find out all he could about HEQCO, reflected on his PhD studies, and researched both the challenges and policy priorities of Ontario's post-secondary system. At his interview, Dion learned HEQCO was considering hiring two interns and one of these positions fit closely to his skills. Dion notes that "academics think in terms of subject matter and knowledge, employers think in terms of skills."

Dion was successful in obtaining an internship at HEQCO and stayed in the role for four months. This was followed by four more months as a contract research analyst before he was hired on a permanent basis as a research editor. In his role as a senior coordinator, research and programs, Dion divides his time between editing, researching, and communication.

Dion points out how many people with graduate degrees he encounters in his work, whether they are in government, university administration, lobby groups, politics, or private sector research. He finds this surprising given the "stigma that still surrounds leaving academia."

Adapted from Polk (2015b)

*As of 2020, Dion was chief of staff in the office of the president at Brock University (Dion, 2020).

4.2.6 Networks Are Important for Identifying Jobs

Students may be obtaining their PhDs without knowing how to identify job opportunities outside of academia (Rose, 2013; McAlpine & Amundsen, 2016; McAlpine & Austin, 2018) and without developing strong networks and the skill of networking. In the Panel's experience, networks are crucial for PhD graduates inside and outside of academia (PhD Pathway 5). Surveys of graduate students and recent PhD graduates in Quebec found that personal and professional networks appear to play a large role in defining students' career aspirations (Acfas, 2018). Networks can also support students as they enter the labour market. The Quebec surveys identified networking as a key lever into the workforce outside of academia (Acfas, 2018).

The importance of networking is also illustrated by the results of the survey of large private sector employers in Canada. Respondents most commonly used employee referrals, followed by recruitment websites, to source entry-level hires (Aon Hewitt & BCC, 2016). The Maymon *et al.* (2019) survey of employers across sectors who hired PhDs found that the most common recruitment methods were job advertisements (39%) and “through [an] employer’s network” (29%). A study of PhDs in Australia found that networking doubles a graduate’s chances of job attainment compared to traditional methods (e.g., replying to job postings) (Jackson & Michelson, 2015). Reithmeier and Kelleher (2016) note that many PhD students finish their degrees with “no professional network outside of their scholarly field.” In the UBC survey of recent PhD graduates, those respondents who felt less prepared for their career outside academia identified a lack of connections with such environments as one of the reasons (Porter *et al.*, 2017). As one respondent explained, “my department . . . could do a better job of preparing students for the job market outside academia . . . In particular, more diverse experiences, connections . . . especially with industry and non-profit organizations” (Porter *et al.*, 2017).

4.2.7 PhDs Could Help Grow Canada’s Innovation Economy

The data on PhDs employed in private industry suggest that they may be an underutilized resource for the Canadian economy. Improving Canada’s innovation performance has long been a government priority, as evident from the broad suite of policies and programs that support the many facets of the innovation process. These range from support for R&D at universities to supercluster initiatives to commercialization support and scale-up of technology companies. These efforts recognize both the importance of innovation to Canada’s global competitiveness and the fact that Canada is consistently underperforming on a range of innovation metrics compared to other advanced economies (CCA, 2018). Professionals with advanced research degrees are considered “a cornerstone of modern science and

innovation systems world-wide” (OECD, 2013). This view was also shared by the Expert Panel on Research and Development (2011), which notes that it is the students coming out of Canadian universities who are the “bedrock of innovation” in this country.

Several major economic trends only increase the importance of innovation to Canada’s future prosperity. The continued shift away from manufacturing to services, the digitization of economic sectors, the shift to low carbon, and advancements in automation and artificial intelligence all have the potential to be sources of economic growth for Canada. To do so, however, requires a highly skilled workforce, which is widely acknowledged as being a necessary input for developing competitive and sustainable knowledge-intensive economic sectors. This input, for example, has been recognized by the OECD as critical to the sustained rapid growth experienced by the American ICT sector in the 1990s (OECD, 2000). Thus, there is an opportunity for Canadian PhD graduates to support industrial innovation in Canada and contribute to emerging economic sectors, even though in practice their transition into industry appears to be stagnant.

4.2.8 Some PhDs Are Self-Employed or Entrepreneurs

Some PhD graduates hold positions that they created themselves. This includes people working as independent consultants or in freelance roles, as well as those who have become entrepreneurs (PhD Pathway 6). Some have built their companies directly on their own PhD research (CDL, n.d.-b). While generally associated with STEM fields, entrepreneurship need not be restricted to certain disciplines. UBC’s survey of PhD graduates, for example, showed that businesses were created by people from all disciplines (Porter *et al.*, 2017). Additionally, the vast majority of these businesses were built in Canada (Porter *et al.*, 2017). Entrepreneurship, however, is not without significant challenges. Success can be hindered by a lack of business skills, and difficulty accessing capital in Canada (CCC, 2014; CCA, 2018). ISED data shows that, between 2002 and 2014, 63% and 43% of new firms survived past the 5-year and 10-year marks, respectively (ISED, 2018). Chapter 7 lists some examples of Canadian programs that support new entrepreneurs.



PHD PATHWAY 6

Lisa Bélanger, CEO, ConsciousWorks (2017)

Lisa Bélanger obtained a PhD in behavioural medicine from UofA. During her doctoral work, she became passionate about how “seemingly small behaviours” could have huge impacts on human health. Bélanger decided that, after graduation, she wanted to “create impact” around the research she carried out at UofA. Her first job after graduation was at a research funding agency, but the position was not a good fit. Still, she felt she left the position with “valuable connections and skills development.”

Bélanger is now CEO of ConsciousWorks, a consulting company she founded that “teaches people how insights from behavioural science can improve their personal and professional lives.” She also founded a charity called Knight’s Cabin, which provides “no cost, research-based retreats focused on physical activity, nutrition, stress, and sleep for cancer survivors and their supporters across Canada.” Bélanger continues to sit on the board of directors of Knight’s Cabin as founder and scientific director. Entrepreneurship was not new to Bélanger, who started a small personal training company during graduate school and enjoyed the challenge and flexibility of working for herself.

Bélanger notes that the thing she has found most surprising in her career is the importance of networks, both for her company and her charity. “Your network is your first, and most valuable, asset,” Bélanger explains.

Adapted from Polk (2017c)

4.3 Summary

PhD graduates in Canada are working in all sectors of the economy, including private companies, public services, university administration, not-for-profits, and the professoriate. The career fields where PhDs work are varied, as are the paths they take to get there. For many graduates, there is a period of transition, where they work in one or more temporary and insecure positions, the most common being sessional instructors and PDFs. While these temporary positions are meant to be stepping-stones to a stable career in the professoriate, some PhDs are in a holding pattern — taking consecutive sessional or PDF positions for many years after graduation. This may be the result of fewer tenure-track positions, but also the perception that there are scarce meaningful jobs outside of academia where they would “fit in.”

Evidence suggests fewer PhDs in Canada work in the private sector compared to the United States. There is no single definitive reason for the lower level of private sector receptor capacity in Canada. It may be linked to some employers having a negative view of PhD graduates, believing they lack some of the necessary skills to be successful in the private sector. In addition, some people are completing their PhDs without knowing how their skills translate beyond academia, how to identify jobs outside of academia, and having only academic networks. These issues are not exclusive to Canada, however. What is unique to this country compared to many other OECD countries is the structure of the Canadian economy, which is heavily focused on natural resources, and has lower levels of R&D within industry. Given the potential of PhDs to support an innovation economy, they may be an underutilized resource in Canada, particularly in the private sector.

Labour Market Outcomes for PhDs in Canada

- 5.1 Unemployment Rates
- 5.2 Earnings of PhDs
- 5.3 The Economic Return of a PhD
- 5.4 Measuring Meaningful Employment
- 5.5 Summary



Chapter Findings

- The earnings of PhDs vary widely, and evidence suggests that the gap between the highest and lowest income earners grows during the first five years after graduation.
- Men with PhDs earn appreciably more than women, although there is evidence that this salary difference has narrowed for recent graduates who are employed full-time. Women with PhDs are more likely than their male counterparts to be working part-time, and unemployment rates among female PhDs are higher across most disciplines.
- There are substantial differences in PhDs' earnings in the first five years after graduation based on discipline. Graduates in business have the highest earnings by some margin while humanities and sciences graduates have the lowest earnings.
- Census data show that, overall, the economic return of holding a PhD rather than a master's degree is declining for men, and that return is lower and diminishing over time for those under 40. When taking into account the opportunity costs, it took eight years for men under 40 years of age with a PhD to catch up to what they would have earned had they stopped at a master's in 2006; this increased to 16 years had they stopped at a master's in 2016.
- For women with PhDs, the economic return of that degree over a master's degree is rising, but is significantly less for those under 40. In contrast to men, women with PhDs do not start their careers earning less than they would have if they had stopped after a master's degree, though the Panel notes that PhD graduates are an average of five years older on entering the labour market.

This chapter examines how the stagnant receptor capacity discussed in Chapter 4 intersects with the labour market outcomes of PhDs in Canada, with a particular focus on recent graduates. The Panel's analysis of these outcomes is conducted primarily through a statistical lens; it extends beyond a review of the literature and uses Statistics Canada data, as well as studies based on these data. Labour market indicators such as unemployment rates and salary are considered because they are quantitative measures, allow comparisons between those with PhDs and those with other degrees, and are in themselves important outcomes. The Panel acknowledges, however, that these indicators present only part of the story. Other factors, such as job satisfaction and quality of life, also signal whether a PhD graduate has made a successful transition to the

workforce; while there is limited evidence on these other factors, they are discussed briefly in the final section of this chapter. The Panel also notes that data limitations restricted the degree to which diversity could be examined in its analyses. The discussion in this chapter therefore considers gender only and, in some cases, domestic versus international students.

5.1 Unemployment Rates

The Panel considered unemployment rates across Canada, based on results from the 2016 census. While these numbers are informative, caution should be used when interpreting them. The values reported here considered unemployment data during a single reference week (Sunday, May 1 to Saturday, May 7, 2016). Moreover, they are based on 25% sample data (as opposed to the full population) and in some cases the sample sizes are small (on the order of a thousand).

When all PhDs across Canada are considered, employment indicators are positive, although they do not provide information on the quality of a position or the number of hours worked. The unemployment rate of PhDs in Canada reported in the 2016 census was 5.1%, compared to 5.6% and 5.5% for holders of master's and bachelor's degrees, respectively (the total unemployment rate for all of Canada was 7.7%). This refers to the percentage of people active in the labour market who are not employed. It therefore does not include people who are on maternity or parental leave (who are considered employed) or people who are out of the labour market (e.g., retired, choosing not to work, choosing not to look for work). The only educational certificates, diplomas, or degrees associated with a lower unemployment rate were those in medicine, dentistry, veterinary medicine, or optometry (3.3%) (StatCan, 2019h).

Overall, women with PhDs have a higher unemployment rate than men with the same degree (Table 5.1). This is also true for 7 out of 10 disciplines. The exceptions are those with PhDs in the humanities (where the unemployment rates for men and women are equal), social and behavioural sciences and law, and education, where unemployment rates for men are higher (StatCan, 2019a). Furthermore, while women have unemployment rates higher than 7% in 4 of 10 disciplines, men's unemployment rates are below 7% in all disciplines (StatCan, 2019a). The data also illustrate that, contrary to popular assumption, PhD graduates in STEM fields do not always have lower unemployment rates than other PhDs. In fact, the highest unemployment rate is for women in architecture, engineering, and related technologies (10.1%) (StatCan, 2019a). The reason for this relatively high unemployment rate is unclear. Generally, in Canada, it has been observed that, while men with degrees (at all levels) in STEM tend to have lower unemployment rates than those with degrees in non-STEM fields, the same is not true for women,

where there is no clear difference between the two (Hango, 2013). Additionally, it may be that a larger proportion of women with PhDs in engineering obtained their degrees outside the country, as compared to other disciplines. People who acquired their PhDs abroad have a higher unemployment rate compared to those who obtained their degrees at Canadian institutions (6.3% versus 4.3%) (StatCan, 2019a). Further, there is a significant gender difference among those who obtained their degrees abroad: the unemployment rate for those men is 5.4% versus 8.0% for women (StatCan, 2019a). This differs from men and women who received their PhDs in Canada, who have approximately equal unemployment rates (at 4.4% and 4.2%, respectively).

A PhD holder's native language also leads to differences in unemployment rate. Graduates whose mother tongue is French have a comparable unemployment rate to those whose mother tongue is English (3.3% versus 3.6%, which is notably lower than the overall unemployment rate for PhD graduates in Canada). The rate, however, is approximately double (7.3%) for those who are native speakers of another language (StatCan, 2019m). Overall, those who obtained their PhD in Canada have the lowest unemployment rates, while those whose mother tongue is not one of the two official languages or who received their PhDs abroad — particularly women — have higher unemployment rates.

5.1.1 The Unemployment Picture Relative to Other Degrees Is Different for Younger PhD Graduates

The labour market statistics of younger PhD graduates relative to graduates with other degrees are less positive than for PhDs as a whole across the country. Data from the 2016 census show that, among PhDs aged 25 to 34 years, the unemployment rate is 7.1% compared to 7.1% and 5.7% for holders of master's and bachelor's degrees, respectively. Among those aged 35 to 44 years, the unemployment rates are 5.9%, 5.2%, and 4.2%, respectively (StatCan, 2019h). This means that PhDs under age 45 have the same or higher unemployment as people with bachelor's or master's degrees.

Table 5.1 Unemployment Rates Among PhD Holders in Canada

	Unemployment Rate		
	Overall	Men	Women
All Graduates	5.1%	4.8%	5.6%
Discipline (Statistics Canada Labels)			
Education	4.7%	5.3%	4.2%
Visual and performing arts, and communications technologies	8.0%	6.7%	9.3%
Humanities	6.5%	6.5%	6.5%
Social and behavioural sciences and law	3.8%	4.0%	3.6%
Business, management and public administration	5.5%	5.2%	6.0%
Physical and life sciences and technologies	5.3%	4.5%	6.6%
Mathematics, computer and information sciences	4.6%	3.8%	7.1%
Architecture, engineering, and related technologies	6.5%	5.8%	10.1%
Agriculture, natural resources and conservation	5.7%	4.8%	7.6%
Health and related fields	4.1%	3.6%	4.6%
Native Language			
English	3.6%	3.4%	4.0%
French	3.3%	3.8%	2.6%
Other	7.3%	6.4%	9.2%
Acquired Degree			
In Canada	4.3%	4.4%	4.2%
Outside Canada	6.3%	5.4%	8.0%
Age (years)			
25 to 34	7.1%	6.3%	8.1%
35 to 44	5.9%	5.4%	6.4%
45 to 54	4.4%	4.3%	4.5%

Data Source: StatCan (2019a, 2019h, 2019m)

Unemployment numbers for PhD graduates living in Canada. All data come from the 2016 Canadian census and are based on 25% sample data.

The Panel analyzed PUMF data from the last three censuses (survey years 2006, 2011, and 2016) to determine whether PhDs' labour market participation (i.e., those working or looking for a job) and unemployment rates (relative to other degree holders) have changed, focusing on those under 40 in particular (Table 5.2). PUMF data consider several variables, comparable across censuses, including those related to employment. Women with PhDs are significantly more active in the labour market than women with master's or bachelor's degrees, with higher rates of labour force participation; this gap is growing (Table 5.2). The same is not true for men under 40 with PhDs, however, as their labour force participation is similar to that of men with other degrees, and is largely unchanged. Most remarkably, by 2016 the labour force participation of men and women with PhDs is the same — a unique configuration for any level of education.

In terms of unemployment, the advantage of a PhD relative to other degrees is decreasing for men under 40. In 2006, men under 40 with PhDs had significantly lower unemployment rates than those with master's and bachelor's degrees. By 2016, there was very little advantage in this dimension. While there are no discernable trends in terms of unemployment rates among women under 40 with PhDs, the data show no significant advantage over other degrees.

Specific data on newly graduated PhDs (who are, on average, under age 45; see Section 2.1) also show no employment benefit (and a potential detriment) over other degrees during the first few years following graduation. Statistics from the 2018 National Graduates Survey (NGS, which examined graduates of the class of 2015) found that recent PhD graduates had an unemployment rate of 7% three years after graduation, compared to 4% and 6% for master's and bachelor's graduates, respectively, included in the survey (StatCan, 2020c). Likewise, a 2016 study of recent PhD graduates from Quebec institutions (targeting those living in Canada) who obtained their degrees in 2014 found that 7% of respondents reported they were looking for work (Gov. of QC, 2016). That recent PhD graduates have higher levels of unemployment compared to other degree graduates does not appear to be a new phenomenon — the unemployment rates for PhDs three years after graduation were also the same or higher than master's and bachelor's graduates in the 2013 and 2008 editions of the NGS (which looked at the classes of 2010 and 2005, respectively) (StatCan, 2020c).

Table 5.2 Labour Force Participation and Unemployment Rates for PhDs Under 40, by Gender

Labour Force Participation – People Under 40						
Degree	Men			Women		
	2006	2011	2016	2006	2011	2016
Bachelor's	93.2%	93.5%	93.6%	86.0%	86.9%	87.6%
Master's	88.7%	88.9%	90.3%	84.8%	84.6%	86.1%
PhD	92.6%	91.2%	92.4%	87.3%	88.8%	92.4%

Unemployment Rate – People Under 40						
Degree	Men			Women		
	2006	2011	2016	2006	2011	2016
Bachelor's	4.3%	4.4%	5.0%	5.3%	5.3%	5.5%
Master's	5.3%	5.9%	5.5%	6.9%	6.3%	6.8%
PhD	3.0%	4.1%	4.8%	5.2%	7.4%	6.5%

Data Source: Panel analysis of PUMF data for the 2006 and 2016 Canadian censuses, and the 2011 National Household Survey

5.1.2 Underemployment Is More Prevalent Among Women With PhDs Compared to Men With the Same Degree

The Panel also examined the *underemployment* of PhDs in Canada. Underemployed people are “part-time workers who would prefer to be working full time” or those in roles where “skills are not fully used or when the job is considered substandard because of wages or other employment characteristics” (StatCan, 2018b). While the latter is difficult to measure, labour market data related to part-time versus full-time employment provide some insight into the former. Raj Dhiman (PhD Pathway 7) is an example of a PhD graduate who experienced a period of underemployment before finding full-time employment. Results from the 2018 NGS indicate that 9% of PhD graduates were employed part-time, compared to 5% of master's graduates and 7% of bachelor's graduates. Comparing these to earlier NGS results suggests the proportion of PhD graduates in part-time work may be on the rise (it was 6% and 8% in the 2008 and 2013 studies) while it is holding relatively steady for those with a bachelor's or master's degree (StatCan, 2020c). This may be related to the number of part-time positions in the higher education sector that are often held by PhDs (e.g., sessional instructors). While some people

may prefer part-time employment, the discussion of sessional instructors in Section 4.1.3 illustrates that this is not true for all PhDs employed in these positions.

While the data suggest that recent (and/or younger) PhD graduates do not have the same employment advantage as older cohorts had at the same stage, it is not clear why this is the case. It is possible that the benefit of having a PhD in terms of employment status does not manifest itself until someone has spent several years in the labour market (after the “transition” period, in other words).

Regression analysis of the 2013 NGS data (which considered the class of 2010) carried out by Jehn *et al.* (2019) demonstrates that women with PhDs are more likely than men with PhDs to be working part-time, and less likely to be working full-time three years after graduation (this is true for all degree levels, except master’s). These results are consistent with the 2016 survey of recent PhD graduates from Quebec institutions, which found that the proportion of male respondents who were employed in full-time positions was higher than female respondents (87% versus 78%) (Gov. of QC, 2016). That same study found that the proportion of recent male PhD graduates with permanent salaried positions was 85% versus 73% for recent female PhD graduates, although the overall unemployment rate was higher for men (10%) than women (7.0%) (Gov. of QC, 2016). These are similar to results from the United Kingdom where women with PhDs are less likely than men with the same degree to hold permanent positions in the short- (0.5 years), medium- (3.5 years), and long- (7–9 years) term after graduation (Peri-Rotem, 2019). Furthermore, Peri-Rotem (2019) found that the discrepancy appears to be greater in non-academic sectors than in the academic sector itself, although it is present in both.



PHD PATHWAY 7

Raj Dhiman, Sales Training Manager at Vicinity (2015)*

Raj Dhiman obtained a PhD in bio-organic chemistry from UofT in 2011. During his studies, he did not have a clear career goal in mind; he considered aiming for a “traditional” career and taking a PDF position in another sub-field of chemistry, working in industry, or entering an MBA program. After completing his degree, Dhiman immediately began a PDF position with his supervisor that lasted a year. He made the decision halfway through this PDF that “a traditional academic career was just not for me.”

After his PDF, Dhiman considered himself “officially unemployed,” supporting himself through tutoring and “learn[ing] the very basics of running a service-based business.” Before obtaining his PhD, Dhiman had acquired several years of acting and public speaking experience, and he leaned on these skills in order to design and lead training seminars for a variety of clients, including his former department.

With student debt and other bills to pay, Dhiman decided to seek out a full-time sales role. He knew that he had the right skill set to be successful, with a potential for high earnings. Dhiman began his sales career on the sales floor with Vicinity (a division of Rogers Communication) making cold calls and selling services to small businesses. In his words, he focused on “learning the entire sales process from scratch then got very good at it.” After six months, he was promoted to sales training manager. In this role Dhiman trained new hires, managed a small sales team, and worked with the sales management team on a variety of tasks, including sales scripting, drafting hiring guidelines, and conducting interviews.

Dhiman explained that the most rewarding part of his job was leading his team of energetic sales reps and watching them become successful. He also liked having a pay structure where he was rewarded for performance through commissions and bonuses. He sees great opportunity for career growth in sales, noting that “perhaps I’ll end up selling chemicals, maybe I’ll end up selling high end airplanes, or become an independent sales trainer with large companies as my clients!”

Adapted from Polk (2015a)

*As of 2020, Raj Dhiman works as Manager, Business Development — Reward Miles for Business at Points (Dhiman, 2020).

5.2 Earnings of PhDs

The Panel carried out its own analysis using the PUMF data from the last three Canadian censuses (2006, 2011, and 2016) in order to obtain the most up-to-date picture of the labour market outcomes of PhD graduates in Canada. The PUMF data enable a comparison of labour market outcomes by level of education, with appropriate adjustments for other factors that affect earnings. The Panel also commissioned an analysis that used data from the ELMLP (described in Box 4.1). The ELMLP was used to identify all students who graduated from Canadian post-secondary institutions between 2010 and 2014, inclusively, and then track their labour market earnings on a year-by-year basis, as well as industry of employment. The ELMLP considers all earnings whether from one or multiple jobs, does not distinguish between full-time and part-time employment, and considers only people who make \$1,000 or more per year. This means, for example, that people on maternity or parental leave are included in the ELMLP data (provided they earn \$1,000 or more in a given year). This will be the case for some graduates, as the first five years after completing a PhD coincide with the years many people begin families (recall the discussion of age in Section 2.1.4). Much of the evidence in the following sub-sections is based on these new analyses of census and ELMLP data.²⁵

The Panel has included narratives within this section to present additional real-world examples of the pathways taken by PhD graduates in Canada. While these PhD Pathways themselves do not include concrete information about earnings per se, they do illustrate the changes in earnings that can be experienced by PhD graduates in their first few years in the labour market.

5.2.1 The Earnings Premium of a PhD is Changing

The Panel examined census data from 2006, 2011, and 2016 to determine the earnings premium of holding a PhD (i.e., the increase in salary associated with having the degree over a different education level) in Canada and whether it changed over time. The data illustrating this premium are presented in Table 5.3, where the earnings of PhDs are compared to those of master's and bachelor's graduates.²⁶ While the data did not permit an examination of recent PhD graduates versus those who have held their doctorates longer, the Panel did consider both the full population of PhD holders as well as younger PhD graduates (those under 40). Note that people with MBAs are excluded from the master's

²⁵ Some of the ELMLP results reported here also appear in documents produced by the Labour Market Information Council (<https://lmic-cimt.ca/>).

²⁶ Note that the sample sizes for master's and PhD holders are significantly smaller than for bachelor's holders. This means some of the variation in averages may reflect sampling error instead of genuine patterns, so caution is warranted.

category in this analysis; they represent a large number of master's degree earners (approximately one-third), have significantly higher salaries relative to those with other master's degrees, and gaining an MBA is generally not a step on the path towards a PhD in business (unlike other disciplines where a master's often precedes a PhD). In 2016, for example, men with MBAs earned an average of \$132,619 compared to \$99,001 for men with other master's degrees. For women, the comparison was \$103,859 for an MBA versus \$81,610 for other master's degrees. In assessing PhDs' labour market outcomes, the Panel also believes that other (usually research) master's degrees represent a more reasonable comparison than the professionally focused MBA. Of note, business PhD graduates are not excluded from the calculations despite their higher earnings, because these degrees are similar in type to other PhDs (i.e., research-based, including the creation of new knowledge). The sample is also restricted to people with full-year, full-time (FYFT)²⁷ earnings in order to better summarize annual salaries, and to control for potential differences in labour supply or employment status. Earnings are adjusted for inflation, and are comparable across time periods (expressed in constant 2016 dollars).

Average earnings generally rise with level of education for both men and women: master's holders earn slightly more than bachelor's holders, and in turn, PhDs earn more than holders of the other degrees (Table 5.3). For women, the differences in earnings are greater across degrees; there is a clear jump (almost \$10,000 in 2016) from a bachelor's to a master's degree, and then an even more sizeable jump in average earnings for a woman with a PhD over a master's degree (over \$25,000 in 2016).

Over time for men, the average earnings of new graduates at all three levels of education remained essentially the same. For women, earnings of new graduates rose for all three levels of education, and especially for those with PhDs. Among new PhDs under the age of 40, however, the pattern over time was one of general decline in the earnings of men with a master's or PhD, while earnings rose for women, though overall they remained substantially below earnings levels for men.

The 2016 earnings premium of a PhD over a master's (excluding MBAs) in Canada was 25% for men and 32% for women overall (Table 5.3). The premium drops by more than half for men and women under 40, however, with values of 10% and 15%, respectively. In the United States in 2019, PhD graduates received a median earnings bump of approximately 26% in comparison to those with master's degrees (including MBAs) (U.S. Bureau of Labor Statistics, 2019). As people with MBAs generally have higher earnings than those with other master's degrees

²⁷ *Full-year full-time* is defined as being employed for at least 30 hours a week for at least 49 weeks in the previous year.

(Torpey & Terrell, 2015), it is probable that the salary bump of a PhD in the United States would be even higher if MBAs were omitted. These results suggest that the earnings premium of a PhD in Canada is lower than it is in the United States.

Table 5.3 Full-Year Full-Time Earnings (2016 CAD) by Degree and Gender, Full Sample and People Under 40

Full Population						
Degree	Men			Women		
	2006	2011	2016	2006	2011	2016
Bachelor's	\$95,755	\$96,875	\$95,228	\$66,681	\$70,308	\$71,891
Master's	\$98,458	\$101,270	\$99,001	\$76,918	\$80,554	\$81,610
PhD	\$122,547	\$127,772	\$123,556	\$91,262	\$101,885	\$107,593

People Under 40						
Degree	Men			Women		
	2006	2011	2016	2006	2011	2016
Bachelor's	\$78,623	\$78,306	\$78,602	\$59,087	\$61,070	\$61,802
Master's	\$83,634	\$81,104	\$79,036	\$63,713	\$65,201	\$66,728
PhD	\$91,190	\$89,726	\$87,038	\$69,336	\$76,872	\$76,948

Data Source: Panel analysis of PUMF data for the 2006 and 2016 Canadian censuses, and the 2011 National Household Survey

Although the FYFT earnings for women with PhDs are rising while those of men are not, men continue to have significantly higher earnings overall; this holds true for the full population and for people under 40. However, regression analysis of the 2013 NGS data (which consider the earnings of people three years following graduation) finds that there is essentially no difference in the earnings between men and women with PhDs who are working full-time (Jehn *et al.*, 2019). At all other levels of education included in the NGS, men have higher earnings than women. Jehn *et al.* (2019) suggest that “this might be attributed to the significant portion of PhD graduates that are working in public sector organisations with stronger labor standards and collective agreements aimed at reducing the gender wage gap . . . and where gender equity laws are more effective and readily enforced than smaller private sector organizations.” Recall, however, that women with PhDs are more likely than men with the same degree to be working part-time (Gov. of QC, 2016; Jehn *et al.*, 2019), or to be unemployed (Table 5.1).

5.2.2 The Salary Trajectory of Recent PhD Graduates Varies Widely

The Panel used ELMLP data (for the classes of 2010–2014, and earnings up to the 2015 tax year) to look beyond fixed salaries. While this data set allows for a glimpse into PhDs' transition into the labour market following graduation, the Panel notes that this period can take longer than five years for some. The majority of the following discussion of the ELMLP results refers to the trajectory of the graduating class of 2010; however, in some cases regression results are based on all cohorts.

PhD graduates in the year 2010 entered the labour market with mean earnings of \$60,100 one year after graduation, reaching \$82,800 by year five. Significant growth in earnings is expected, as PhDs often take transitional roles immediately after graduation before moving into a higher-paid career. For instance, a science PhD graduate may work as a PDF for several years before obtaining a permanent position as a tenure-track professor or in industry. Laura Godsoe (PhD Pathway 8) is an example of a graduate whose earnings rose significantly as she transitioned into the workforce.

The mean earnings trajectory of PhD graduates tells only part of the story, as the distribution of earnings is remarkably wide (Figure 5.1). For example, when looking at the whole sample, the gap between the 75th and 25th percentiles is \$51,900 in the first year following graduation, while the difference between the 10th and 90th percentiles is \$94,900 that same year. This is not surprising, as some people will enter a full-time career role within the first year of graduation, while others take lower-paid transitional positions. Yet, one might expect the gap between the highest-paid and lowest-paid PhD graduates to narrow over time as more people move from transitional roles to career positions. This is not observed; the gap between the highest and lowest income earners instead widens over the five years after graduation. The widening is generally driven by slightly faster increases in earnings at the upper end of the distribution as compared to the lower end. Figure 5.1 clearly demonstrates that there are a significant number of PhD graduates with very low earnings, even five years after graduation.



PHD PATHWAY 8

Laura Godsoe, Partner and Diversity & Inclusion Lead at KBRS (2019)*

Laura Godsoe obtained a PhD in history from York University in Toronto. Godsoe, from Nova Scotia, chose York partially because she was “looking for a change.” She realized she was not interested in pursuing an academic career about two years before completing her PhD and found that there was little guidance for students who wanted careers outside of academia.

After graduating, Godsoe obtained a contract faculty role teaching a course at York. While she was not seeking an academic career, Godsoe notes this role gave her a “chance to figure out what my next step was.” Over the year she did some career counselling and had “a ton of networking coffees” with people in a range of industries she found interesting and where she felt her skills could make her successful.

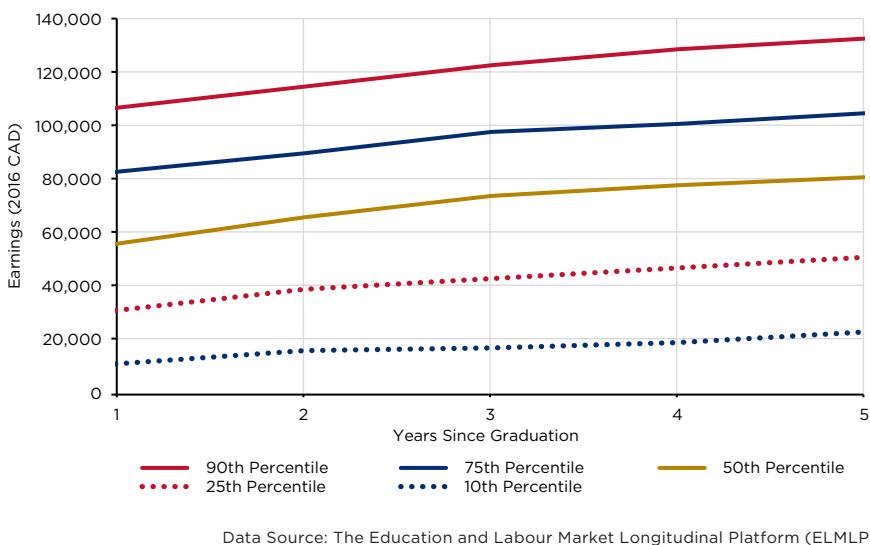
Godsoe also unsuccessfully applied for “tons of jobs” and realized that her PhD on its own was not an asset until “you explain the skills to them.” While teaching her course, she took a position working remotely for a publisher focusing on young adult literature. The job was low paying, but provided a foot in the door and gave her some experience outside of academia.

Godsoe then had a child and took a year of maternity leave, knowing she would not return to her low-paying publishing job. She then saw an advertisement for a position at a scholarly press in Toronto and successfully applied. Godsoe credits her experience at the young adult publisher for her success in obtaining the position. While she began as an acquisitions editor, Godsoe was in a manager editor role when she left the scholarly press two years later.

Godsoe decided she wanted to return to Nova Scotia and found a posting for a recruitment role helping colleges and universities find senior leaders. She applied and was successful in obtaining the job, and has been with the company for over four years. Godsoe finds her current position an “interesting way” to be connected to the academic world while working in the private sector.

Adapted from TRaCE (2019b)

*As of 2020, Laura Godsoe works as an executive recruiter at Dalhousie University (Godsoe, 2020).



Data Source: The Education and Labour Market Longitudinal Platform (ELMLP)

Figure 5.1 Earnings Distribution for PhDs, 2010 Cohort

The earnings of PhDs who graduated from Canadian institutions in 2010 vary widely, with those in the 10th percentile (dotted blue line) making almost \$95,000 less than those in the 90th percentile (solid red line) one year after graduation. The gap between the lowest and highest earners widens slightly between the first and fifth years after graduation.

5.2.3 PhD Graduates Who Were International Students in Canada Have Lower Earnings

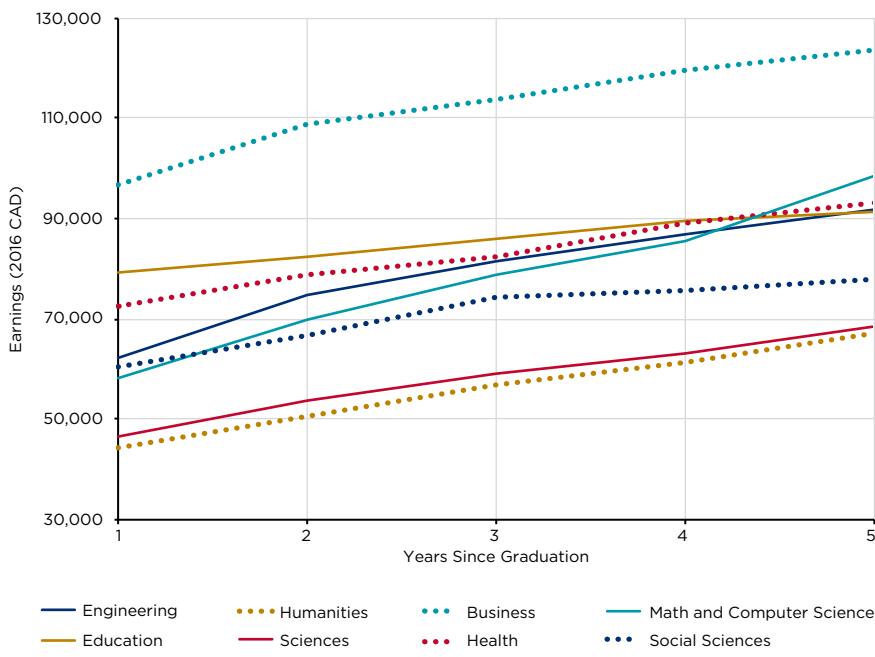
As discussed in Chapter 2, international students are making up a growing share of PhD graduates in Canada, particularly in STEM fields. The Panel considered the earnings trajectories of international versus domestic (i.e., Canadian or landed immigrant) PhD graduates from Canadian institutions in 2010, using the ELMLP to determine if there are differences in the outcomes of these two groups. Note that this analysis does not consider people who obtained their degrees outside Canada. These trajectories demonstrate that the earnings of domestic graduates are consistently higher than those of international graduates, but the difference appears to narrow over time. The gap is significant: domestic graduates earn \$60,900 in the first year after graduation compared to \$50,500 for international graduates. But, by year five, the difference between domestic and international graduates has shrunk to \$4,500, a value that is not statistically significant. This narrowing does not necessarily mean, however, that international graduates experience higher growth in their earnings compared to Canadian graduates. The

ELMLP data suggest that the decrease in the gap in earnings between domestic and international graduates may be the result of low-earning international graduates leaving Canada, which would push up the mean earnings of those remaining. The proportion of all PhD graduates who were international students reporting income in Canada decreases slowly over time (from 8% one year after graduation to 7% by year five).

5.2.4 Discipline of Study Affects PhD Graduates' Earnings Potential

The mean earnings trajectory for PhD graduates varies considerably across disciplines (Figure 5.2).²⁸ Data limitations restricted analysis to the level of discipline, but the Panel notes there is likely additional variability across different fields within disciplines (e.g., anthropology versus sociology, which are both social sciences). Overall, PhD graduates from business have the highest earnings, starting at \$96,800 and rising to \$123,600 in the fifth year after graduation (28% growth over five years). This does not represent a large number of PhDs, however, as business graduates comprise about 4% of all those in the 2010 cohort. As discussed by Desjardins (2012), part of the earnings advantage of business graduates may be due to the higher likelihood they obtained work experience before starting their PhD, and a lower likelihood they are completing their degree on a full-time basis (with the assumption that part-time students are accruing relevant work experience while in their program). Desjardins (2012) shows that less than 30% of business PhD students in Ontario enter their programs directly from a bachelor's or master's degree, as compared to more than 50% of PhD students in sciences, for example. Having said this, it is noteworthy that a large portion of business graduates (71%) included in the ELMLP analysis work in educational services (which include university employees) — the third highest of all disciplines. This result is consistent with the UBC survey that found more than three-quarters of UBC business PhD graduates (classes of 2000–2013) were in research-intensive faculty positions in higher education as of 2016 (Porter *et al.*, 2017).

²⁸ Several short form names are used in the Panel's discussion of ELMLP results. These include *social sciences* for social and behavioural sciences and law; *business* for business, management and public administration; *sciences* for physical and life sciences and technology; *math and computer science* for mathematics, computer and information sciences; *engineering* for architecture, engineering, and related technologies; and *health* for health and related fields.



Data Source: The Education and Labour Market Longitudinal Platform (ELMLP)

Figure 5.2 Earnings Trajectory of PhD Graduates by Field of Study, 2010 Cohort

The mean earnings trajectories of PhD graduates in the 2010 cohort vary greatly by discipline. Graduates with degrees in business have the highest mean earnings by some margin, while graduates with degrees in humanities and sciences have the lowest mean earnings.

PhD graduates from education, health, and engineering have the second-highest earnings behind business graduates. Although these three disciplines start with very different earnings levels (\$79,300, \$72,600, and \$62,300, respectively), by year five their earnings are about equal (at approximately \$92,000). This illustrates that the rate of growth in earnings for PhD graduates in engineering (48%) is significantly higher than for both education (15%) and health (29%). This may be related to the large percentage of engineering graduates working in the private sector (Section 4.3). As with business graduates, the high earnings of education PhD graduates are likely partially due to the greater likelihood that they are entering their studies having accrued relevant work experience, and are completing their degrees part-time. Graduates from education are most likely to be working in educational services (79% of all people included in the ELMLP

analysis), with many working at the primary and secondary levels (Desjardins, 2012).

Graduates with PhDs in the social sciences and in math and computer science enter the labour market with similar average earnings: approximately \$60,000. By year five, however, the earnings of graduates in these two disciplines are quite different. At that point, the mean earnings of social sciences graduates reach \$77,900, a growth rate of 29%. Between years one to five, the mean earnings of math and computer science graduates increase by a much larger percentage, 69%, the highest rate of any discipline by some margin, reaching \$98,700. Regression analysis of all PhD graduates from 2010 to 2014 confirms that graduates in math and computer science achieve the highest growth rates in their earnings.

The lowest mean earnings are reported for PhD graduates in humanities and sciences, who have similar earnings trajectories, with the class of 2010 starting at approximately \$45,000, growing by about 50% to reach \$68,000 five years after graduation. This represents a large number of people: taken together, these fields represent over 30% of all PhD graduates included in the analysis (in the first year after graduation among the 2010 cohort, 9% are humanities graduates while 22% have degrees in science).

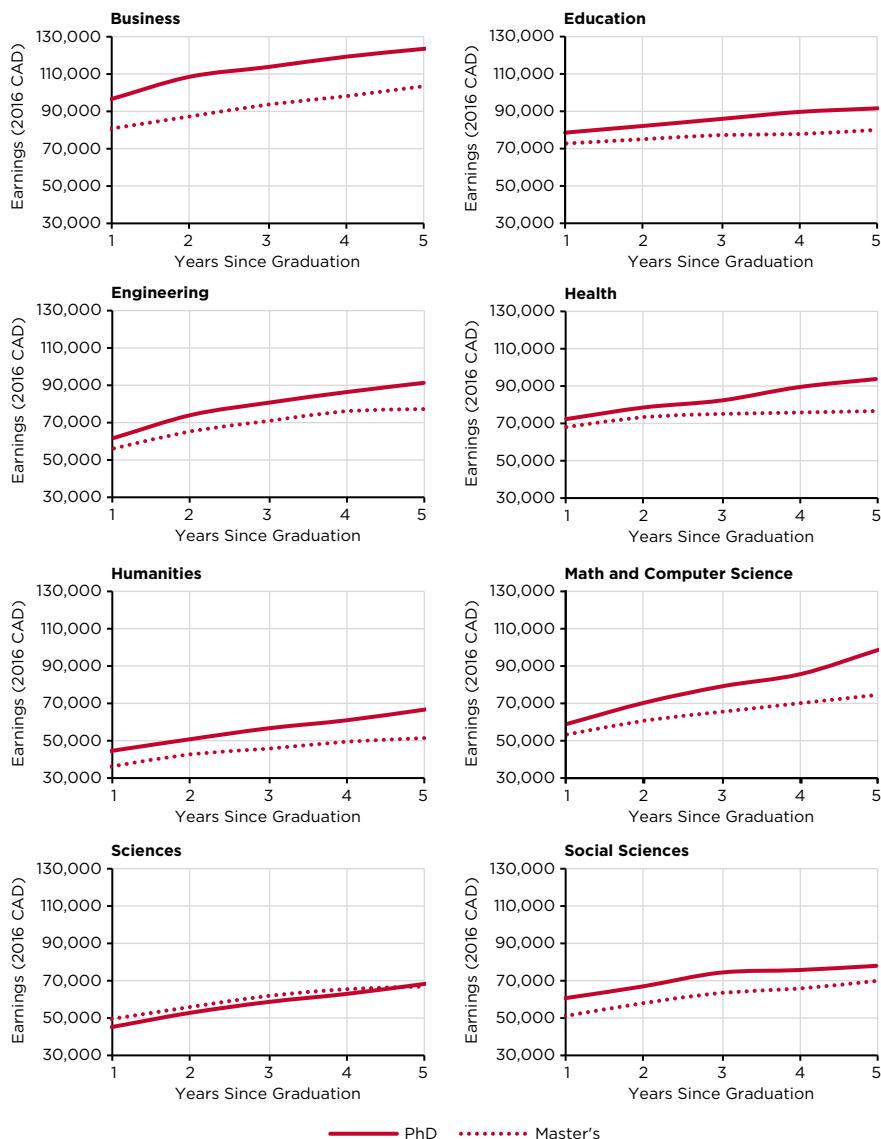
As discussed in Chapters 3 and 4, recent PhDs in the sciences and humanities are most likely to report a desire to stay in academia, and take on transitional academic roles following graduation (often in sessional work for humanities graduates and PDF roles for science graduates). This is likely the reason why humanities graduates comprise the second-highest percentage (73%) of those working in educational services one year after graduation. Unfortunately, the ELMLP data do not allow for a clear assessment of the number of science graduates working as PDFs. The data do indicate that, one year following graduation, less than half (39%) of science graduates are working in educational services. This percentage is likely not representative of all recent science PhD graduates, as some elect to take PDF positions in other countries (thus their earnings would not be included in the ELMLP). Additionally, it is likely that some PDFs are not classified as working in educational services, even if their work is associated with academia. This is because there are many different arrangements for PDFs, including formal PDFs paid by grants or scholarships, industry-sponsored positions, or an employment relationship with a university, which may be reported differently in the ELMLP.

It is clear that a significant number of graduates have earnings well below the low-income measure in Canada. For example, for PhD graduates in the humanities, the 10th percentile group (which represents about 300 people) earns on average \$7,700 one year after graduation, growing to \$19,300 by year five.

Similarly, the 10th percentile for science PhD graduates (representing about 750 people) earns \$8,300 one year after graduation and \$18,600 five years after receiving their degrees.

This discipline-specific analysis demonstrates that there is major growth in the trajectory of mean earnings (approximately 50% or more) in some disciplines: humanities, sciences, engineering, and math and computer science. This suggests that, in these disciplines, a portion of graduates are entering the labour market in transitional or lower- or entry-level positions, then moving into higher-paid positions within five years. One example of this would be the “traditional” PhD pathway of a graduate taking one or more PDF or sessional roles before acquiring a tenure-track professor position or a career position outside of academia. This is also consistent with a PhD graduate entering industry in a temporary internship and then being promoted to a more highly paid permanent position. The relatively low growth in earnings of business and education graduates is consistent with a lower likelihood that they take temporary transitional positions following graduation. Additionally, it is possible that those who completed their degrees part-time while also working were able to enter (or continue on in existing) permanent full-time positions in their industry following graduation (Desjardins, 2012).

Figure 5.3 compares the earnings trajectories of PhD and master’s graduates in the same disciplines. PhD graduates earn more than master’s graduates in all disciplines, with the notable exception of sciences, where PhD and master’s holders have approximately the same trajectories. This may be partially explained by the frequency with which science PhD graduates take PDF positions relative to other disciplines. It is noteworthy that the growth in earnings between years one and five is higher for science PhD graduates (47%) as compared to those with master’s degrees in the same discipline (35%). Despite this, however, the earnings of master’s and PhD holders in sciences remain approximately equal five years after graduation. This suggests that a sizeable population of science PhDs remain in transitional roles five years after graduation, consistent with the discussion in Section 4.1.



Data Source: The Education and Labour Market Longitudinal Platform (ELMLP)

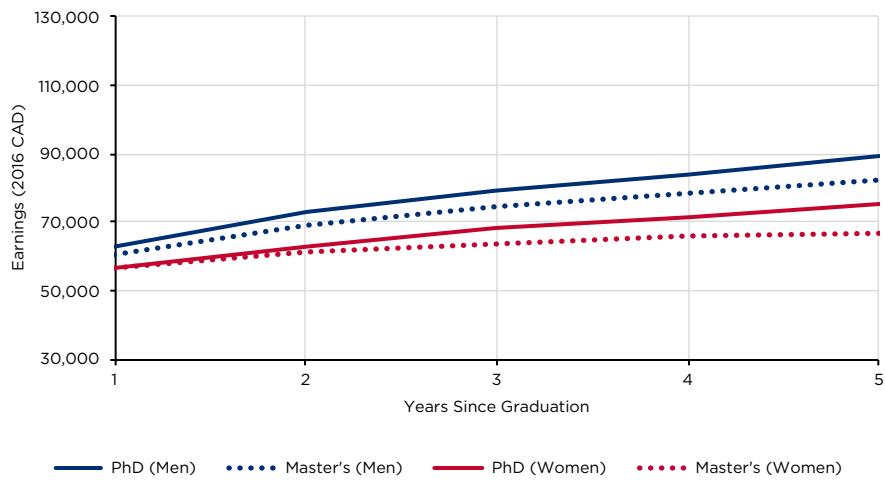
Figure 5.3 Earnings of PhD and Master's Graduates by Field of Study, 2010 Cohort

If disciplines are considered separately for the 2010 cohort of graduates, those with PhDs (solid lines) have higher mean earnings compared to those with master's degrees (dotted lines) for all disciplines except sciences, where earnings are approximately equal.

5.2.5 There Are Significant Gender Differences in Earnings and Earnings Trends

Men with PhDs have appreciably higher mean FYFT earnings than women with the same degree (Table 5.3). The ELMLP trajectory data (which consider the earnings of part-time as well as full-time employees) also show a clear pay gap that, overall, widens with time (Figure 5.4). The ELMLP results for master's graduates are also included in Figure 5.4 and demonstrate that men with master's degrees consistently have higher earnings than women with PhDs. As with the analysis on the earnings premium of a PhD (Section 5.2.1), MBAs are excluded from the master's calculations.

On average, five years following graduation, men with PhDs earn nearly 20% more than women. From year one, both men and women with a PhD have elevated earnings relative to a master's degree; however, by year five, the gap has widened considerably for women. Note that one year after graduation, average earnings for men with PhDs are \$63,100. By comparison, a master's graduate with five years of work experience has average earnings of \$82,600. This means that, even for someone completing a PhD relatively quickly, their initial earnings are well below what they would have earned if they had started working after their master's instead of pursuing a PhD. While the same pattern holds for women, the earnings difference of a master's graduate five years out versus a new PhD is greater. Moreover, earnings growth is significantly higher for women with PhDs, and the trajectory is well above that for master's graduates. The economic return of a PhD over a master's degree is examined more fully in Section 5.3.



Data Source: The Education and Labour Market Longitudinal Platform (ELMLP)

Figure 5.4 Earnings of PhD and Master's Graduates, by Gender, 2010 Cohort

For both men (blue) and women (red), PhD graduates (solid lines) have higher earnings than master's graduates with MBAs excluded (dotted lines). The gap between PhD and master's graduates increases with time for both women and men, though is more pronounced for women. Men have considerably higher earnings than women. In fact, men with master's degrees have higher earnings than women with PhDs.

While the existence of a pay gap holds true across all disciplines, there is variation in the size of the gap and how it changes over time. For those who graduated in 2010, the percentage difference in earnings between men and women is smallest for humanities graduates, at 6% after one year. The highest percentage difference in earnings occurs among the highest-paying disciplines, which have traditionally been dominated by men. One year after graduation, the largest gap between men and women is observed among engineering graduates (18%), but after five years the largest gap is among graduates in business (24%) and math and computer science (23%). The pay gap between men and women grows between the first and fifth years for most disciplines, but remains relatively stable for humanities and engineering graduates, and narrows for health graduates from 14% to 8%. As noted in Section 5.1, in some cases these gaps may be due to the greater frequency with which women are working part-time or their increased likelihood of a period of unemployment. Further, as discussed above, the first five years after completing a PhD coincide with the time when many people are starting families;

this leads to more (and longer) interruptions in labour force participation for women compared to men (Moyser, 2017).

5.2.6 Industry of Employment

The ELMLP results demonstrate that PhD graduates from the 2010 cohort worked in 10 different industries (as identified by two-digit NAICS codes). Figure 5.5 presents the mean earnings trajectories of this cohort for the top four sectors of employment: educational services; professional, scientific, and technical services (an example of industry/private sector); public administration; and healthcare and social assistance. For this cohort, 50% of PhD graduates were working in educational services after one year, dropping to 47% by year five; 9% were working in professional, scientific, and technical services, rising to 11% by year five; and 8% were working in public administration, rising to 10% by year five. The field of healthcare and social assistance has similar percentages to public administration (starting at 8% and rising to 9%), and all other industries employ <5% of PhD graduates from the 2010 cohort.

PhDs who take positions in public administration or professional, scientific, and technical services within one year of graduation have substantially higher earnings than those who remain in educational services, or those who work in healthcare and social assistance (Figure 5.5). By year five, the gap between educational services and the two higher-earning sectors has narrowed, but the mean earnings of graduates in educational services (\$81,000) remain lower than both professional, scientific, and technical services (\$89,500) and public administration (\$86,000). This narrowing is likely the result of some PhDs moving into tenure-track professor positions (which are included under educational services). The experience of Anderson Araujo (PhD Pathway 9) is one example of a PhD graduate moving from sessional work, to an international teaching professorship, and finally into a traditional tenure-track professor position in Canada. The difference between the mean salary of someone working in educational services five years after graduation (\$81,000) and the median salary of an assistant professor in Canada in 2017–2018 (\$101,600) (StatCan, 2018a) suggests, however, that many of those working in educational services in year five are in non-tenure-track positions. As discussed in Section 4.1, these likely include staff positions, but also temporary transitional roles.



PHD PATHWAY 9

Anderson Araujo, Assistant Professor, English,
UBC (Okanagan) (2017)

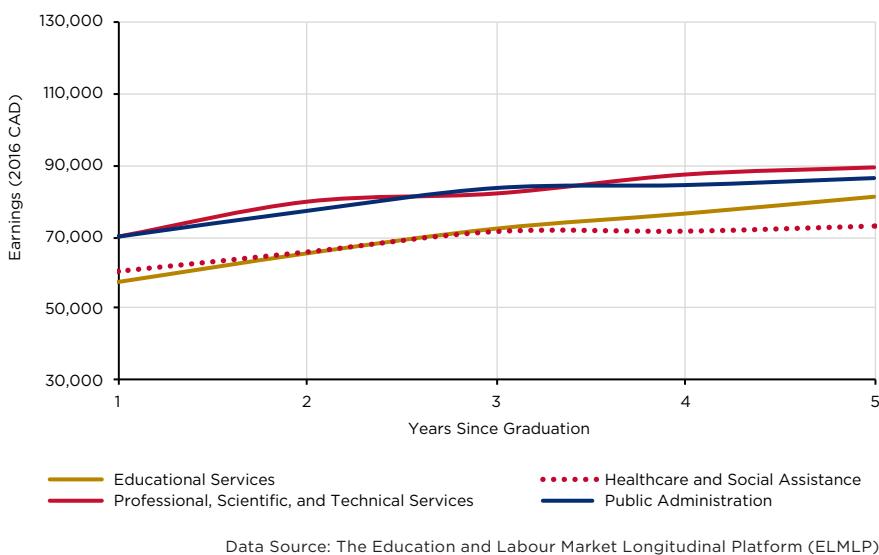
Anderson Araujo obtained a PhD in English from Western University in London, Ontario. During his studies, he taught one course and was a teaching assistant for several others. Immediately after finishing his degree, Araujo took on a “full teaching load” at Western, while also acting as a sessional instructor at the University of Windsor. He found the commute and high teaching load challenging, but felt he quickly gained an ability to “manage multiple responsibilities and adapt his pedagogical styles.”

Araujo actively sought out an academic job across North America. In one round he applied for more than 70 positions. After the economic crisis in 2008, he found his interviews being cancelled and he began to look internationally. Araujo secured an assistant professor position at the American University of Sharjah, near Dubai, gaining valuable teaching experience and interacting with a “diverse and international student body.”

Looking to have more resources to carry out research and attend conferences, Araujo successfully applied for a position at the University of British Columbia’s Okanagan campus and is now an assistant professor of English in the Faculty of Creative and Critical Studies.

Adapted from TRaCE (2017)

*As of 2020, Anderson Araujo was Associate Professor, English and Cultural Studies at UBC (Okanagan)



Data Source: The Education and Labour Market Longitudinal Platform (ELMLP)

Figure 5.5 Mean Earnings of PhD Graduates by Sector of Employment, 2010 Cohort

The mean earnings of PhD graduates working in educational services (solid yellow line) and healthcare and social assistance (dotted red line) are lower than those working in professional, scientific, and technical services (solid red line) and public administration (solid blue line). The rate of growth in mean earnings for PhD graduates is highest for those working in educational services, however, and the gap between that sector and the highest earning sectors narrows over the first five years after graduation.

5.3 The Economic Return of a PhD

Using the earnings data available in the Canadian census, the Panel estimated the economic and net (labour market) return of a PhD, and how it has changed over time. In particular, this analysis seeks to more fully measure the economic benefits associated with having a PhD relative to a master's degree: Are the additional earnings gained by PhDs high enough to offset the foregone earnings and earnings growth they might have attained by stopping at the master's degree? In short, the Panel estimates the expected level of earnings by type of degree and years of labour market experience, represented by years after attaining one's highest degree. The Panel notes that discipline of study will have a significant impact on the economic return of a PhD (as illustrated in Section 5.2.4); however,

data (sample size) and time limitations meant such an analysis could not be completed for this assessment.

The Panel cautions that there are a few standard caveats to this exercise:

Firstly, this approach measures economic returns only and does not account for other types of benefits (e.g., enjoyment of career, immersion in a discipline) nor the direct expenses associated with the degree (e.g., tuition). On the other hand, it also ignores the limited span of a working career, and the downstream lifecycle costs of deferring income. For example, the Panel notes that years of low-income earnings during graduate school and while working transitional jobs can mean some PhDs enter the housing market and start savings programs later than some other degree holders.

Secondly, as explained in the Appendix, in order to estimate “counterfactual” earnings trajectories (i.e., earnings growth with a master’s degree versus a PhD), the Panel employed a simple linear (quadratic) specification of age (and potential labour market experience). This assumption can be shown to be reasonable, at least for graduates in the first decade or two of their careers.

Thirdly, the estimated returns apply to an average individual with a given level of education, though (as discussed above) there will be variation based on discipline and other factors.

The Panel summarized the average earnings trajectories under different education scenarios using estimated returns on education and experience from a standard human capital earnings function (Appendix); this was done to assess whether PhDs earn as much as master’s graduates at similar stages of their career, but also whether the economic return of a PhD overcomes the career head-start enjoyed by master’s graduates (who enter the labour market sooner). Analyses were completed for the full sample of men and women included in the 2006, 2011, and 2016 censuses who worked FYFT in the reference year. The Panel also estimated earnings trajectories separately for the subsample of university graduates under 40 years of age. This permits a closer look at early career earnings, and relies less on the simple specification of the returns to experience holding for an entire lifecycle. It is also important to consider men and women separately given the differences in income shown in Table 5.3. The regression data tables with all values for men and women (full population and graduates under 40) and standard errors are provided in the Appendix.

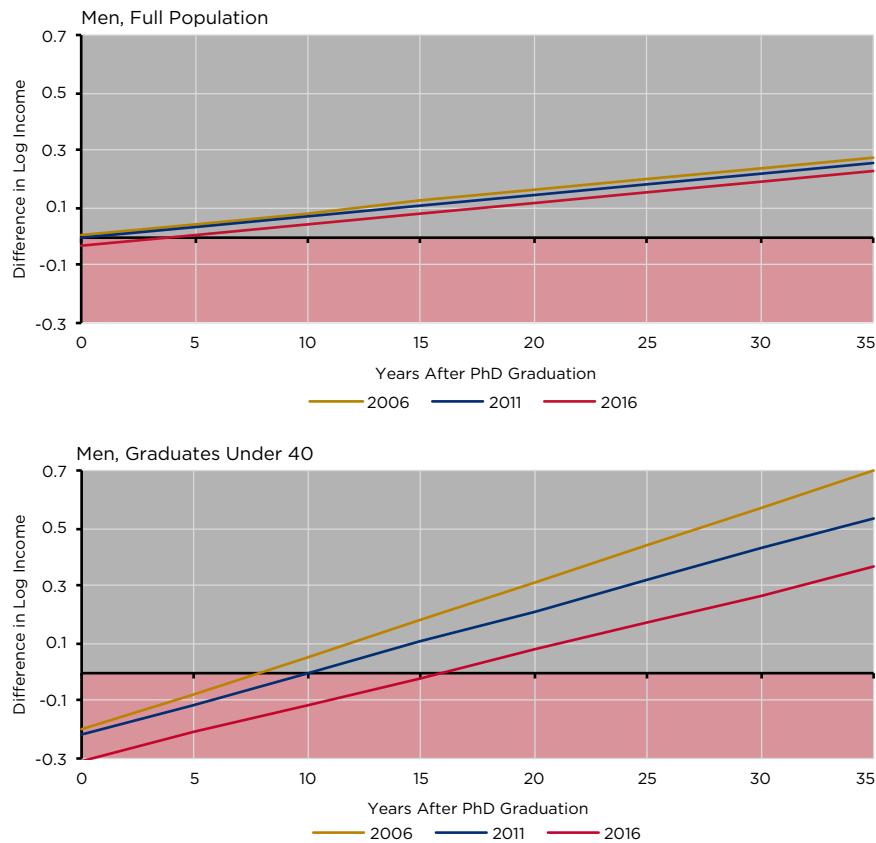
In order to summarize the regression results, the differences in estimated earnings trajectories for two individuals are plotted: a master’s graduate who starts working right away, and a master’s graduate who foregoes five years of labour market earnings to obtain a PhD, and then starts working. The master’s graduate will have a five-year head-start. The key question is, What is the relative

earnings position of the PhD upon graduation (i.e., the “net return to the PhD”)? If the PhD graduate starts out behind, do they catch up and pass the student who stopped at the master’s? The exact values are less important than signs (whether the values are positive or negative) and the trends across censuses (whether increasing or decreasing). The key information is illustrated in Figures 5.6 and 5.7, which present the relative earnings of PhDs compared to master’s holders plus five years of work experience. If the difference in log income on these figures is positive, it illustrates that the PhD holder has an earnings advantage, while a negative value indicates an earnings disadvantage.

Figure 5.6 shows the results for men. In 2006, the net return of a PhD for men in the first year following graduation was positive, with higher earnings than a master’s plus five years of work experience. The earnings advantage of a PhD then widens with years of experience. By 2016, however, the net return following graduation had fallen to zero because of the declining earnings of men with PhDs relative to those with a master’s degree. The PhD graduate “catches up,” and an advantage emerges, however, after four years of work experience.

The situation is markedly different for male PhD graduates under 40 (Figure 5.6, bottom half). For this group, the economic return of a PhD fell significantly after 2006. The combination of falling economic return and high opportunity costs (e.g., foregone earnings had they stopped at a master’s) renders the net return after the first year post-graduation as negative for men under 40, and declining over time for this group (i.e., becoming increasingly negative for those graduating in subsequent years). These calculations suggest that it would take eight years for men under 40 years with a PhD to catch up to what they would have earned had they stopped at a master’s in 2006; this increased to 16 years had they stopped at a master’s in 2016. These results confirm trends observed in the trajectory data for the class of 2010 (Section 5.2.5), namely that, for younger men, there is a low rate of return (i.e., minimum earnings benefit) for a PhD relative to a master’s degree.

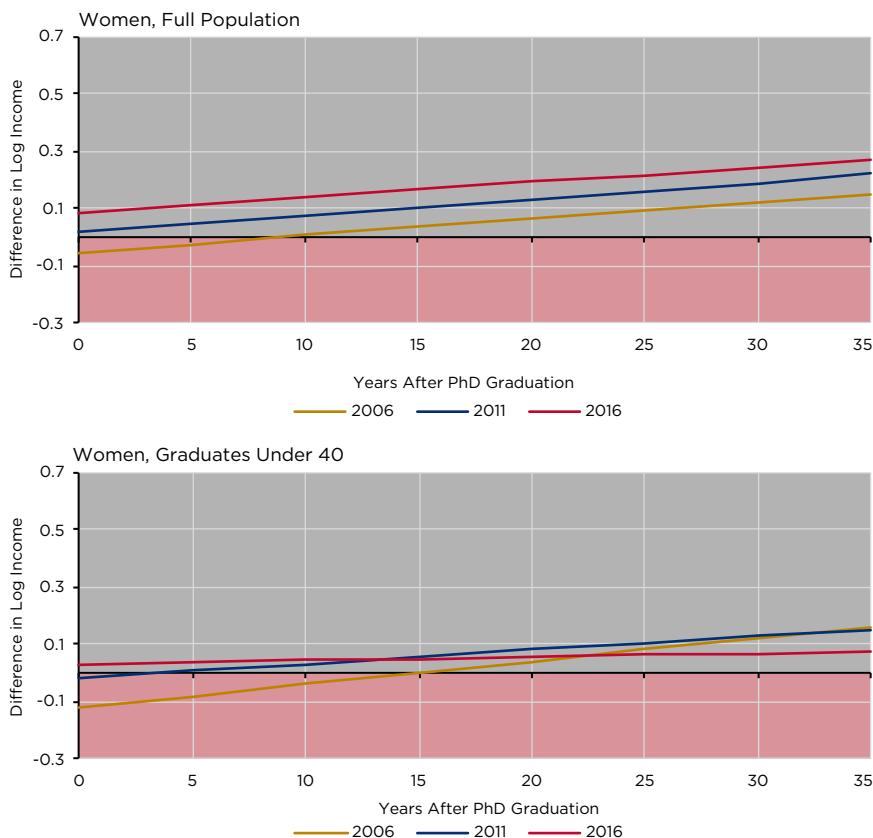
The story is quite different for women, with higher economic returns for those with a PhD (Figure 5.7). The economic return of holding a PhD relative to a master’s degree has risen substantially for women in Canada since 2006 — both for the whole population of women and for those under 40 — and surpassed the value observed for men in 2016. The estimated opportunity costs of a PhD over a master’s is lower for women than men, reflecting the generally lower rate of return on experience for women. This ties into the fact that age is a poorer proxy for labour market experience among women than men, given the former are more likely to have interruptions in labour-force participation during child-bearing and child-rearing years (Moyser, 2017). The rising economic return combined with lower opportunity costs mean the net returns of a PhD appear to be increasing for women at the same time as they are decreasing for men. For both the full



Data Source: Age-earnings profiles, estimated from the PUMFs for the 2006 and 2016 Canadian censuses, and the 2011 National Household Survey

Figure 5.6 Relative Earnings of a PhD Compared to a Master's Degree (Plus Five Years' Work Experience), Income Trajectories Since Graduation, Men (Full Population and Graduates Under 40)

These graphs present the relative earnings (log) trajectories of male PhD graduates compared to estimates of their earnings had they started working after their master's degree. The full population of men appears in the upper graph and those under 40 in the lower graph. Three graduating years are represented: 2006 (yellow line), 2011 (blue line), and 2016 (red line). The differences account for the earnings advantage (or disadvantage) of PhD graduates compared to master's graduates with five years of work experience. The graphs illustrate how this difference changes with subsequent years of labour market experience. A negative difference (area coloured pale red) indicates the PhD has an earnings disadvantage, while a positive difference (area coloured grey) indicates an earnings advantage.



Data Source: Panel analysis of PUMF data for the 2006 and 2016 Canadian censuses, and the 2011 National Household Survey

Figure 5.7 Relative Earnings of a PhD Compared to a Master's Degree (Plus Five Years' Work Experience), Income Trajectories Since Graduation, Women (Full Population and Graduates Under 40)

These graphs present the relative earnings (log) trajectories of female PhD graduates compared to estimates of their earnings had they started working after their master's degree. The full population of women appears in the upper graph and those under 40 in the lower graph. Three graduating years are represented: 2006 (yellow line), 2011 (blue line), and 2016 (red line). The differences account for the earnings advantage (or disadvantage) of PhD graduates compared to master's graduates with five years of work experience. The graphs illustrate how this difference changes with subsequent years of labour market experience. A negative difference (area coloured pale red) indicates the PhD has an earnings disadvantage, while a positive difference (area coloured grey) indicates an earnings advantage.

population and women under 40, the net return of a PhD in the first year has risen since 2006, reaching essentially zero in 2016. These results suggest that, unlike men, it does not take any time for women with PhDs to catch up to what they would have earned had they stopped at a master's degree. These results are consistent with the trends observed in the ELMLP data for the class of 2010 (Section 5.2.5).

5.4 Measuring Meaningful Employment

Earnings are only one measure of success in a career. Many people, at all levels of education, desire a career that has meaning and provides them with much more than just a salary (Šverko, 2001). Evidence suggests that, for the most part, the three top values that people seek in their careers are “personal development, ability utilisation, and achievement” (Šverko, 2001). Meaningful work has clear benefits for people, as it is associated with well-being, feelings of accomplishment, and job satisfaction (Kamdrön, 2005; Arnold *et al.*, 2007; Pavlish & Hunt, 2012; Steger *et al.*, 2012; Bailey *et al.*, 2018). There are also benefits for employers, however; meaningful work is positively associated with employees placing a higher value on their duties while having higher organizational commitment and deeper intrinsic motivation (Bailey *et al.*, 2018). Meaningful employment can therefore benefit both society and PhDs, allowing them to make use of their skill set to support art, science, health, policy, technology, or other areas.

Measuring whether a given position is meaningful is not simple, as it depends on both the nature of the job and the view of the person who holds it. Recall that there is limited information on where exactly PhDs are working in Canada and the nature of the jobs held by PhDs outside academia (Chapter 4). It is therefore no surprise that there are limited data to evaluate how many PhDs are happy with their career trajectories and how many feel they are carrying out meaningful work.

Surveys of recent PhD graduates carried out by McGill, UofA, and UBC provide some insight, although the implications are open to interpretation. Most respondents (91%) to the UBC survey (classes of 2005–2013) reported their current job was “a useful step along a desired career pathway” (Porter *et al.*, 2017), although continued tracking would be needed to determine whether these feelings persisted as PhDs grew further removed from graduation. For instance, a PhD may believe that being a sessional instructor is useful to their career pathway three years after graduation, but not have the same opinion after eight years. Just under 75% of PhD graduates (classes of 2005–2017) who responded to the UofA survey were “satisfied” or “very satisfied” with their overall career progression

(UofA, 2019). Similarly, 79% of respondents to the McGill survey (classes of 2008–2018) were “very satisfied” or “somewhat satisfied” with their current jobs (Lee, 2020). Presented differently, however, these data illustrate that, in the latter two surveys, more than 20% of PhD graduates were not satisfied with their career trajectory or current job (UofA, 2019; Lee, 2020).

The UofA survey also asked PhDs whether their current job formally required that degree and found this to be the case for 60% of respondents (UofA, 2019). This metric is challenging to interpret, however, as there are many meaningful positions that benefit from a PhD, despite not formally requiring one. This may be why, in the McGill survey, a higher percentage of respondents (83%) reported they were “adequately qualified” for their job (Lee, 2020). This is confirmed by results from the NGS, which asked recent PhD graduates whether their current position required a PhD and whether they felt overqualified. NGS analysis by Desjardins and King (2011) that looked at the class of 2005 found that “overall, and for each field of study, fewer employed graduates reported being overqualified . . . than reported needing less than a doctorate degree to obtain their job.” In terms of numbers, the authors found that 19% of participants with PhDs felt overqualified in their current position. This was highest for those in engineering (28%) and lowest for those in life sciences (16%) (Desjardins & King, 2011). Similarly, 15% of respondents to the McGill survey reported feeling overqualified for their job (Lee, 2020). These data further illustrate there may be a significant number of PhD graduates who are potentially being underutilized in the labour market. Qualitative studies further demonstrate that some PhD graduates do not feel satisfied with their career trajectories following graduation (e.g., McAlpine & Emmioğlu, 2015; McAlpine & Austin, 2018).

5.5 Summary

The labour market outcomes of PhD graduates provide some evidence of the challenges they face in launching their careers. Employment figures reveal that, overall, Canadian PhD holders are doing well, with lower unemployment rates compared to almost all other levels of education. This is not the case for younger PhD graduates, however, as their unemployment rates are similar to or higher than those with bachelor’s or master’s degrees. Additionally, women with PhDs have higher unemployment rates than their male counterparts, and this holds across most disciplines.

An examination of Canadian earnings trajectories of the 2010 PhD cohort reveals that mean salaries vary considerably, with the highest earners making close to six figures more than those earning the least one year after graduation. While some PhDs are doing well economically, earnings for others are very low. In addition,

the gap between the lowest and highest earners grows from the first to the fifth year after graduation. There are also considerable differences based on discipline or field; business graduates earn the most by far, while the lowest earners are graduates from the sciences and the humanities, two fields that together make up just under a third of all PhD graduates.

For men with PhDs working full-time, the economic return of a PhD over a master's degree has been declining; furthermore, the return is lower and dropping more quickly for those under 40 years of age. In contrast, for women with PhDs working full-time, the economic return has been rising for the overall population and for those under 40. Having said this, the earnings of men are still considerably higher than those of women overall. Evidence suggests that there are no earnings differences between recent men and women PhD graduates who are working full-time; however, women with PhDs are more likely than men to have part-time employment or be unemployed.

International Mobility Among Canadian PhD Graduates

- 6.1 The Knowledge Economy and Its Impact on PhD Education
- 6.2 Canadian PhD Graduates on the Move
- 6.3 An Already-Mobile Cohort: International PhD Students at Canadian Institutions
- 6.4 Summary



Chapter Findings

- PhD graduates in Canada demonstrate similar international mobility as those in peer nations. The most common destination for graduates is the United States.
- PhDs without Canadian citizenship or permanent residency status are more likely to leave Canada following graduation. Those who wish to stay face obstacles related to immigration.
- Mobility is perceived as important for obtaining a tenure-track faculty position. Available data demonstrate that the primary motivations for mobility among PhD graduates who remain in academia are the prestige and outstanding faculty of international institutions, and the perception of improving their future career prospects, especially in Canada.
- There are limited data related to the mobility of PhD graduates from Canadian institutions who are working outside of academia, which makes it challenging to understand their motivations for leaving Canada.

Globalization has led to changes in the university environment in Canada and worldwide (Altbach, 2004; Forstorp & Mellström, 2018). These changes have brought the themes of mobility (of knowledge and individuals) and hierarchy (of institutions and countries) to the forefront of the discourse surrounding doctoral education and the labour market transition of PhDs (Jones & Gopaul, 2012). Graduates must be mindful that the production of PhDs occurs in a global environment, resulting in both challenges and opportunities.

Discussions about PhD graduates and the knowledge economy often invoke the terms brain drain or brain gain to describe the one-way migration of PhDs in a zero-sum game. The term international mobility presents an alternative and more comprehensive image for capturing the migration of PhDs and other highly skilled workers over extended periods. Studying this circulation can capture the diverse and nuanced consequences of migration over the long term. Some mobile PhDs may remain abroad their entire careers. Some may return to their home countries, having acquired new skills or knowledge, and having benefited from an expanded international network, which can be harnessed towards innovation both within academia and other employment sectors.

While the last two chapters focused on PhD graduates who have stayed in Canada, this chapter offers a review of the available evidence on those who are internationally mobile. This includes looking at domestic PhD graduates (those

who are Canadian citizens or landed immigrants) and also PhD graduates from Canadian institutions who were international students. Examining these issues addresses the third sub-question of the Sponsor's charge to the Panel, which inquires after the motivations behind the migration of PhD graduates in and out of Canada. The Panel notes that the majority of the evidence concerns the mobility of PhD graduates within academia and therefore Chapter 6 focuses primarily on this group. The motivations of internationally mobile PhD graduates from Canadian institutions who work outside of academia is an important knowledge gap that would benefit from additional study.

6.1 The Knowledge Economy and Its Impact on PhD Education

The emergence of the knowledge economy has resulted in a global competition for highly skilled workers. Among these are PhD graduates, particularly in STEM fields, whose training may be seen as advantageous in employment sectors linked to innovation. Maheu *et al.* (2014) argue that "doctoral attributes include coded skills and knowledge along with the intangible skills that facilitate exploitation of the knowledge produced across national and geographical boundaries." Moreover, research universities that train PhDs are seen as central institutions in the knowledge economy (Jones & Gopaul, 2012; Forstorp & Mellström, 2018).

Indeed, competition for knowledge workers was identified as a major policy issue in *The Fundamental Science Review*, which recommended increasing levels of international collaboration in research and the recruitment of talent from abroad to bolster Canada's capacity for innovation (Naylor *et al.*, 2017). This view is echoed in government documents such as *Building on Success: International Education Strategy 2019–2024*, which includes, as part of the introductory statement:

Today's global economy is changing rapidly and increasingly, employers are seeking new skills to meet these challenges. Expanding Canadians' access to higher education and skills training will strengthen Canada's workforce and create the conditions to compete successfully in global markets. Post-secondary education is vital for Canada's success as an innovative nation, and the need for global competencies, skills and networks has never been more important.

GC, 2019a

6.1.1 International Mobility Affects Research Partnerships and Trade

Several authors have argued that Canada has much to gain from international mobility, due in part to the increasingly international character of scientific research. From the academic perspective, studies have shown that, despite short-term drops in productivity, researchers who have worked abroad often produce more influential research and have greater international collaboration (Franzoni *et al.*, 2014). Indeed, the proportion of published research articles in *Nature* resulting from international collaboration rose from under 20% in 1990 to over 50% in 2019 (Monastersky & Van Noorden, 2019).

In an increasingly connected landscape for science and technology, cross-cutting problems beyond fundamental research are also occurring on a global scale. Bernstein (2013) comments that “young Canadians, like their counterparts elsewhere, are increasingly globally oriented . . . [and] are actively looking for opportunities that match their international and idealistic aspirations with practical problem solving.” Dufour (2012) argues that having mobile researchers exiting and entering Canada allows the country to better participate in international engagement or science diplomacy, which can be defined as “a problem-solving approach in the international realm, where it can be used as a tool to achieve better global governance” (Van Langenhove, 2016 as referenced in Ollivier-Mrejen *et al.*, 2018). Science diplomacy addresses complex global issues such as climate change (Ollivier-Mrejen *et al.*, 2018).

The notion that PhDs migrating out of Canada represents a lost investment or “brain drain” ignores those who have left and established themselves abroad but also remain connected with Canada. Similarly, Canada can act as a host for other diasporas, strengthening or establishing networks that can contribute positively to research and the economy (Dufour, 2012; Burns, 2013). Dufour (2012) contends that international mobility can allow Canada to exploit commercial partnership opportunities through networks of diasporas or entrepreneurial groups such as C100 (2019), a global community for Canadians working in tech that is headquartered in San Francisco. Ferreira and Klutsch (2018) even propose that international and inter-sectoral mobility be integrated into career development for scientists.

The geographical landscape of the global knowledge economy is also defined by knowledge clusters, consisting of both infrastructure and highly skilled personnel (Maheu *et al.*, 2014). These clusters reach beyond regional or national borders, and serve as poles or hubs that attract PhDs. In the U.S. municipalities of Brookline, MA, Palo Alto, CA, and Davis, CA, for example, where such centres (which include one or more prestigious research universities) are located, over 10% of inhabitants held PhDs according to 2012 U.S. Census Bureau data (Paton & Bell, 2019).

6.1.2 PhD Education Is Becoming a Global Priority

The new geography defined by the global knowledge economy has prompted changes to post-secondary education. This has led to a commodification of higher education. Forstorp and Mellström (2018) write that “[k]nowledge society discourse in the context of economic development . . . has implications for conceptions of knowledge, privileging knowledge as a commodity, with transferability and exchange value as its most useful dimensions.” The makeup of post-secondary education has over the years adapted to this reality through internationalization. PhDs are active participants in this phenomenon, which is underpinned by the premise that geographic mobility builds the professional, psychological, and creative repertoires of both students and researchers (Forstorp & Mellström, 2018).

Internationalization in post-secondary education can be defined as “the process of integrating international, intercultural and global dimensions and perspectives into the purpose, functions and delivery of education, and as such, it impacts upon the entire educational enterprise” (Ricketts & Humphries, 2015). A physical manifestation of this phenomenon has been the increasing number of international branch campuses for some universities (Mackie, 2019). In addition, even among institutions that forego geographical expansion, universities act to promote their brand internationally (Forstorp & Mellström, 2018) and highlight their place in the global marketplace of higher education (UofT News, 2019).

This movement has led Canadian universities to increase their focus on attracting top international students from abroad, but also to recruit PhD graduates as researchers and academic staff. As shown in Section 2.1.5, the number of international students enrolling in PhD programs at Canadian universities continues to grow. Similarly, there is international representation among faculty. A survey of English departments in Canada found that 59% of their faculty earned a PhD in Canada (Wood, 2017). Moreover, a quarter of those Canadian-trained faculty specialize in Canadian literature. The same trends were observed in history departments, where about half of the faculty were trained at Canadian universities, and just above half of these specialize in Canadian history (Wood, 2017). This suggests that Canadian-trained hires in those fields may be targeted for their specific Canada-centric areas of expertise.

Among Canadian social sciences departments, about one-quarter of the faculty in the three largest English-language institutions are Canadian-trained PhDs (Lachapelle & Burnett, 2018). There was a net decrease in the hiring of Canadian-trained faculty between 2007 and 2017 at these institutions, primarily to the benefit of faculty trained in the United States (Lachapelle & Burnett, 2018). In an earlier analysis of a group of 11,000 professors at 10 Canadian universities, Gingras

(2010) argued that institutional prestige had become tied to the proportion of internationally trained faculty.

These observations bring attention to an important point: while federal employment guidelines require that Canadian and permanent resident applicants be given priority consideration in hiring processes (GC, 2020b), training at Canadian institutions does not appear to provide a specific advantage to those seeking faculty positions domestically. PhDs are competing in a global employment market for a limited number of faculty positions. This underscores the reality that, for graduates who intend to remain in academia, being mobile is almost always an essential professional strategy.

6.1.3 Mobility Is Central to Academia

The possibility of a newly graduated PhD taking on a faculty appointment at their own institution is, generally speaking, uncommon. For one, the scarcity of tenure-track positions at Canadian universities is well known and such an opening may not exist (Section 4.1). Secondly, the training model of academia dictates that most graduates will have received training specifically in the areas of expertise in which the institution already employs a professor (i.e., the student's supervisor). In numerous disciplines, it is also customary to pursue postdoctoral research in order to bolster applications for academic positions, through the associated exposure to new networks and ideas, as well as stronger publication records. Taken together, mobility is often viewed as a necessary precondition for pursuing an academic career (Gopaul & Pifer, 2016). An example of a PhD graduate who found mobility essential for securing an academic appointment is given in PhD Pathway 10.



PHD PATHWAY 10

Kate Swanson, Assistant Professor, San Diego State University, United States (2014)*

Kate Swanson obtained her PhD at UofT's department of geography in 2005. In "Where Is Home? An Autoethnography of Academic Migration," Swanson describes the pathway leading to her current academic position in the United States, bringing to light many themes surrounding academic mobility.

Swanson took on a PDF appointment in Scotland following her PhD studies, after which she secured a tenure-track position at San Diego State University.

(Continues)

(Continued)

Her academic pathway brought her from her home in Southern Ontario to Ecuador (for fieldwork), to Scotland, and finally to the United States. Living in four different countries and eight different residences to follow academic opportunities affected Swanson's sense of home. In her own words, "my spatial imaginary of 'home' continues to shift as I move from place to place. As I relocate, I carry my cultural baggage and package it to create a representation of 'home'."

Moving to San Diego led Swanson to reflect on life as a Canadian based in the United States. She noted that "[g]rowing up in Canada, I never imagined that I would end up living in the United States. Even when my older brother, who is also an academic, secured a job at a private university in the US, it did not occur to me that this could be my path." Following a period of adjustment, where she felt conflicted by what she considers to be prejudices against the United States, she found herself settled and happy living in that country.

In Swanson's view, relocating to the United States should not have come as such a surprise, given the limited number of academic positions in Canada; the number of higher education institutions in the United States is far greater. Swanson distills the reality facing many academics by highlighting that, "[i]n academia, we often have little control over where we end up living. For junior scholars, going on the job market is exciting and terrifying, and almost feels like playing roulette."

(Swanson, 2014)

*As of 2020, Kate Swanson is a Full Professor in the Department of Geography at San Diego State University (SDSU, 2020).

It is known that there is a relationship between where one obtains a PhD and the probability of joining the professoriate, at least in some disciplines (Headworth & Freese, 2015; Albaugh, 2017; Nevin, 2019). Relatedly, there is an argument that PhDs from Canadian institutions may be well served in taking on employment at prestigious international institutions (e.g., as PDFs) to better position themselves in the future for permanent academic positions back in Canada. This issue has been cast as a form of cumulative advantage — in the global competition among research-intensive universities, prestige acts as a positive feedback (the so-called Matthew Effect) (Merton, 1988). In other words, institutions with high global rankings leverage prestige to attract greater resources than their competitors, leading to increased productivity, and resulting in even greater prestige.

Having to be mobile leads to a number of challenges for PhDs, and exacerbates certain issues relating to equity (Section 3.5). For one, persistent relocation can create personal challenges by requiring the repeated formation of social and professional networks (Gopaul & Pifer, 2016). Moreover, financial and personal conditions play a significant role in determining how “mobile” someone can be; single people with some financial means may be more easily prepared to move than those with partners or dependents, and/or with limited financial resources (Gopaul & Pifer, 2016; Acker & Hague, 2017). As explained by one respondent to the UBC survey of recent PhD graduates:

My postdoc ends this spring, at which time I am seeking contingent academic work, locally in the Vancouver area, due to my family commitments, and my partner’s job. Teaching part/time, I will likely have a much lower pay scale then what I have had with my postdoc funding. The SSHRC postdoc has been a wonderful opportunity for my research, art, and engaging international networks. I have several publications coming from my work now, as well as an expanded network in France. I would pursue a more secure academic position [sic], but it would mean uprooting life here. Many academics will do this, but my work unfolds in other ways.

Porter et al., 2017²⁹

Results from the UBC tracking study show that among PhDs, men are more likely than women to be working outside Canada, in both academia and the private sector (Porter et al., 2017). This holds true for Canadian citizens, permanent residents, and non-Canadians. For example, while over 60% of women in PDF positions were located in Canada, the same was true for less than 40% of men (Porter et al., 2017).

The requirement for mobility can also prove challenging for couples who both desire a career in academia. The limited number of academic positions creates a “two-body problem” whereby it is difficult for couples to find two desirable academic jobs in the same location (Wolf-Wendel et al., 2004; Schiebinger et al., 2008). The result is having to live apart or having one partner remain under- and unemployed. Acknowledging these challenges, many institutions, including those in Canada, have instituted mechanisms to enable spousal appointments under certain circumstances (CCA, 2012).

²⁹ Additional data and information from the UBC study (Porter et al., 2017) provided by Susan Porter are cited in several places in Chapter 6. This includes, but is not limited to, several quotes (including those in Box 6.1), as well as the data used to produce Figures 6.1 and 6.3.

6.2 Canadian PhD Graduates on the Move

The available data indicate that many PhD students who are Canadian citizens or permanent residents plan to explore international employment opportunities following graduation. The 2005–2006 Survey of Earned Doctorates (SED) found that approximately 21% of domestic PhD students intended to leave Canada following graduation (King *et al.*, 2008).

While it is challenging to accurately determine the number of graduates who act on their intentions to move to another country, some of the large-scale tracking studies (outlined in Box 4.1) shed light on the share of students who choose to migrate. The UofT study (classes of 2000–2015) found that 24% of PhD graduates who are Canadian citizens were working abroad (Reithmeier *et al.*, 2019). Similarly, results from the UBC study (classes of 2005–2013) show that 25% of those who are Canadian citizens were employed internationally (Porter *et al.*, 2017). Students from the earliest cohort in the UBC study were slightly less likely to be located outside Canada versus those from the latest cohort. This is ascribed to recent graduates departing Canada following graduation to pursue postdoctoral work on a temporary basis before returning home (Porter *et al.*, 2017). In the UofT and UBC studies, 44% and 45%³⁰ of graduates, respectively, who were permanent residents were working abroad (Porter *et al.*, 2017; Reithmeier *et al.*, 2019).

The data from the UBC study allow for a comparison between domestic PhD graduates who stay in Canada versus those who move abroad in terms of employment sector (domestic referring again here to Canadian citizens and permanent residents) (Figure 6.1). For this group, the proportion of PhDs working abroad in post-secondary education or private industry is slightly higher than that of PhDs working in those same sectors in Canada. Within the broad category of post-secondary education, the proportion of graduates employed as PDFs is twice as high among those living abroad compared to those living in Canada (12% versus 6%) (Porter *et al.*, 2017). In addition, the proportion of graduates employed in tenure-track positions is higher among those living abroad (33% versus 22%) (Porter *et al.*, 2017). On the other hand, a higher proportion of graduates who remained in Canada work in the public sector (Figure 6.1).

³⁰ In the UofT study, *permanent residents* referred to those who were so at graduation, while the same term referred to those who were so at admission in the UBC study (Porter *et al.*, 2017; Reithmeier *et al.*, 2019).

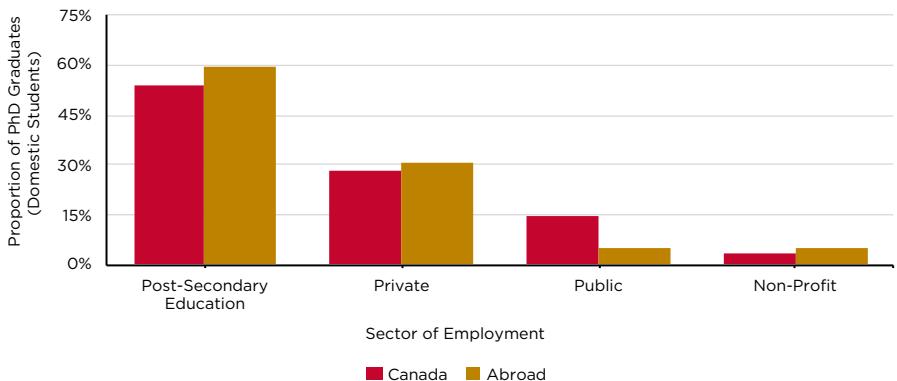
Data Source: Porter *et al.* (2017)

Figure 6.1 Employment Sector Breakdown of UBC PhD Graduates (Canadian Citizens and Permanent Residents), in Canada and Abroad

Domestic PhD graduates from UBC (classes of 2005-2013) who stay in Canada (red) are less likely to be working in post-secondary education or the private sector compared to those who move abroad (yellow). It is not known how many of those PhD graduates living abroad intend to return (or have since returned) to Canada. Additional data from the UBC survey used in this figure were provided by Susan Porter.

6.2.1 Graduates Perceive Greater Opportunities in the United States

While PhD graduates from Canadian institutions work in many countries, their main destination abroad is the United States. Evidence from the UofA, UBC, and UofT tracking surveys, as well as TRaCE, suggest that around a fifth of recent PhD graduates have moved to the United States for work, whether it be permanent or temporary (Porter *et al.*, 2017; Narayan, 2019; Reithmeier *et al.*, 2019; UofA, 2019). Boudarbat and Connolly (2013), analyzing data from the early 2000s, found that the likelihood of a PhD graduate from a Canadian university moving to the United States was 7 to 16 percentage points higher than it was for a bachelor's graduate. Among STEM graduates specifically, the United States is a popular destination for PhDs worldwide, though it is facing increasing competition from Australia and parts of Europe (Stephan *et al.*, 2016).

Due to the United States' close proximity to Canada, and its cultural and linguistic similarities, there are concerns about a "brain drain" to the south (e.g., Silcoff, 2018). Up until the graduating cohort of 2005, the NGS attempted to track

Canadian university graduates who had relocated to the United States, collecting follow-up data at two years and five years after graduation. Separate analyses of these data found that the overall number of Canadian graduates relocating to the United States on a permanent basis is relatively low, but the distribution did skew towards certain STEM fields, as well as towards those with higher degrees (Zhao *et al.*, 2000; Zarifa & Walters, 2008; Boudarbat & Connolly, 2013). For example, among the 2000 cohort, 11% of PhD graduates from Canadian institutions were living in the United States by the year 2005, versus 0.37% of college graduates (Boudarbat & Connolly, 2013).

Boudarbat and Connolly (2013) acknowledge that there are inherent limitations to the data due to non-responses. This makes it challenging to draw strong conclusions about motivations, or statistically significant factors underlying migration to the United States. PhDs made up a small sample within each survey, in spite of their overrepresentation among the respondents who had migrated. Qualitative evidence on this issue, however, brings certain recurring themes to the forefront. Namely, graduates recognize that the United States has both a larger job market and opportunities that do not exist in Canada. They also express conflicted feelings when faced with the prospect of relocating to the United States (Box 6.1).

Box 6.1 Canadian PhDs Are Conflicted About Migrating to the United States

“I tried to find a job in Canada as a scientist/academic and was unable after searching for jobs for 8 months. Once I looked at the US I was able to acquire many more job offers.”

“This is an absolute dream job. I am continuing the research that I started in my graduate studies. I am being groomed for a permanent position as the content expert in my field of research with the US Federal Government. I feel highly valued here. It disappoints me that jobs are scarce in Canada and that funding for new graduates is disappearing . . . It saddens me that I had to leave Canada to pursue meaningful work and now have no plans to return.”

“Although I would like to be employed in Canada, the science opportunities and the salaries in the US are much more reflective of the overall priority the US places on the value of science compared to previous Canadian governments and industry.”

(Porter *et al.*, 2017)

6.2.2 Graduates from Quebec Universities Demonstrate Different Patterns of Mobility

Quebec produces the second-highest number of PhD graduates in the country, with McGill University and the Université de Montréal being the second- and third-largest conferrers of PhDs in Canada (Looker, 2018). Results from TRaCE McGill (classes of 2008–2018) found that 34% of domestic PhD graduates from that English-language institution were working internationally (Lee, 2020). This percentage is higher than those in the UofT and UBC studies; however, this may be partially explained by the inclusion of more recent cohorts of graduates in the McGill study. The French-language survey of recent PhD graduates from Quebec institutions (classes of 2005–2015) by Bangali *et al.* (2019a) provides insight into that group's mobility, with 21% of the respondents working abroad. The largest employment sector for these respondents was the university or research environment, representing higher education but also other research-intensive, not-for-profit employers. Among 150 employed as university faculty, only a single respondent worked in Canada outside of Quebec. Approximately one-quarter of respondents worked in the for-profit private sector (Bangali *et al.*, 2019a). While 32% of respondents who were working internationally were located in the United States, the next most represented country of employment was France (15%). The total number of graduates working in la francophonie (OIF, 2019) beyond Canada is nearly half the number of those working within Canada but outside of Quebec (Bangali *et al.*, 2019b). This suggests that PhD graduates from Quebec institutions may preferentially explore opportunities in la francophonie if their native language is French.

6.2.3 International Comparisons Show Similar Trends

Much of the international evidence on PhD students and international mobility is based on studies and data from the European Union. The Panel notes that the experiences of PhD students in the European Union are different from those in Canada, given freedom of movement and the emphasis on stimulating mobility through standardization of higher education in E.U. countries (EHEA, 1999). In addition, the local context of the higher education system in many European countries differs greatly from Canada (e.g., language of instruction, number of PhD-granting institutions). However, while the European Union and Canada are not ideal objects of comparison, it is interesting to note that some of the international mobility trends seen in Canada are also evident in E.U. countries.

A Eurodocs survey polled 2,573 PhD students in 12 E.U. countries about their intentions to pursue opportunities abroad and found that the percentage of graduates who planned to leave their homeland varied substantially from country to country: graduates from Norway, Croatia, and Slovenia expressed the least

intention of leaving their home countries (21%), while those from Spain and France expressed the greatest (48% and 47% respectively) (Ateş *et al.*, 2010).

Another survey from the European Science Foundation (ESF) polled PhD graduates from universities or research institutes in several E.U. countries, as well as PDFs supported by the AXA research fund, in all disciplines from the 2010 to 2016 cohorts (Boman, 2017). The ESF survey found that 40% of respondents had worked in a foreign country for more than three months following completion of their degrees. Further, 34% of the mobile PhDs migrated to North America (Boman, 2017). This suggests that the mobility of these PhDs is not solely explained by E.U. freedom of movement. The survey also demonstrated that individual factors can affect someone's ability to explore opportunities abroad. For example, people between the age of 30 and 40 were the most mobile PhD graduates in the European Union (Boman, 2017), and both Canadian and E.U. data find that men are more likely than women to relocate following their studies (Boman, 2017; Porter *et al.*, 2017).

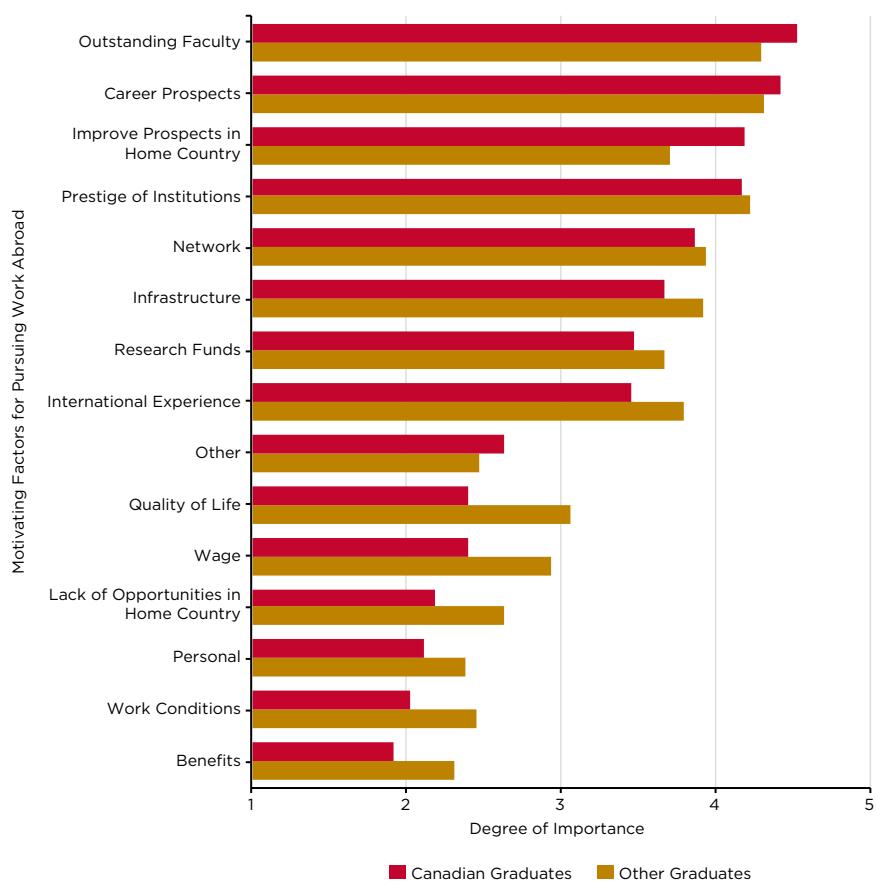
The ESF survey suggests that science and engineering PhDs are more mobile than those in other disciplines (Boman, 2017), while other evidence suggests the mobility of natural science PhD graduates has grown (Stephan *et al.*, 2015, 2016). A separate study of E.U. social sciences and humanities PhDs found that 23% of respondents in those fields also sought employment outside their country of origin after graduation (Reale *et al.*, 2019). These mobile graduates were more likely to be working in countries that had high R&D intensity (Reale *et al.*, 2019).

6.2.4 Mobile PhDs From Canada Have Similar Motivations as Those From Other Countries

There is a paucity of data on the motivations for, and barriers to, individual mobility in Canada (Ferreira & Klutsch, 2018). As such, the Panel analyzed publicly available data from a GlobSci survey, which investigated the mobility patterns and motivation of 47,304 researchers in the natural sciences (Franzoni *et al.*, 2012). This provides a starting point to understand the pull factors underlying relocation among Canadian PhD graduates versus those from other countries.

Figure 6.2 looks at reasons why Canadian natural sciences PhDs choose to relocate, and compares this with natural sciences PhDs from other countries who do the same. These results indicate that Canadian PhDs sought opportunities abroad mainly because of the possibility of better career prospects and working with outstanding faculty. These are also the two main motivating factors for non-Canadian PhDs, a finding consistent with studies on E.U. PhD graduates not limited to those in the natural sciences (Ateş *et al.*, 2010; Boman, 2017). Overall, Figure 6.2 demonstrates that, for the most part, Canadian PhDs appear to share many of the same motivations as their international peers. Two exceptions were:

Canadian PhDs were more likely to say their motivation for mobility was the perception that an international position would improve their career prospects back home; and Canadian PhDs were less likely to identify a lack of professional opportunities in their home country as a motivator for relocating abroad.



Data Source: Franzoni et al. (2012)

Figure 6.2 Reported Motivating Factors for Pursuing Work Abroad Among Natural Sciences PhDs, Canadian Graduates Versus Other Graduates

Canadian PhD graduates (red) in the natural sciences have similar motivations for mobility as graduates from other countries (yellow). Graduates were asked to rank the importance of factors from low (1) to high (5) importance ($n = 214$ Canadian graduates, $n = 7,225$ other graduates). *Canadian PhD graduates* refers to those who were living in Canada at age 18 and who obtained their PhD in Canada.

The GlobSci survey also prompted respondents to report the perceived impact of their international experience. Canadians and non-Canadians responded similarly, noting enlargement of professional networks and exposure to new techniques as motivating factors for leaving their home countries (Franzoni *et al.*, 2012; Stephan *et al.*, 2015).

Though a sizeable fraction of PhDs leave Canada after graduation, research has indicated that many desire to return home eventually (King *et al.*, 2008; Franzoni *et al.*, 2012). The GlobSci survey found that respondents from Canada (35%) placed second, after those from Sweden (38%), in terms of intentions to return to their home country (Franzoni *et al.*, 2012). PhD Pathway 11 provides an example of a PhD who moved abroad for work, but returned to Canada after holding multiple positions in the United States.



PHD PATHWAY 11

Niem Huynh, Manager of Graduate Student Recruitment, Concordia University (2017)*

Niem Huynh obtained her PhD in geography from Wilfrid Laurier University, after which she searched for faculty positions. Huynh found a greater number of opportunities in the United States, and she secured a tenure-track position in Texas. In recalling her move, she writes: “Leaving Canada was a difficult decision, as everything I love, own, am acquainted with are deeply rooted in one geographic location, Toronto” (Huynh, 2014).

Huynh experienced personal and professional growth through her time in a new physical and cultural environment (Polk, 2017a). After only two years in her academic position, Huynh decided to take a risk, and pursued a new research opportunity at a non-profit organization. This required her to relocate once more, this time to Washington, D.C., where Huynh was afforded a platform for conducting research while engaging with a broader professional network within her field of geography (Polk, 2017a).

Huynh eventually returned to Canada, and leveraged this network to make professional contacts in the Montréal area (Polk, 2017a). These contacts allowed her to identify potential organizations to approach about employment opportunities. Following a number of information interviews, she obtained her position in graduate recruitment at Concordia University (Polk, 2017a).

*As of 2020, Niem Huynh is an Internship Coordinator and Mentor Coach at Concordia University (Huynh, 2020).

6.3 An Already-Mobile Cohort: International PhD Students at Canadian Institutions

The reputation of the Canadian post-secondary education system, along with the perception that Canada is safe, tolerant, and non-discriminatory, make the country an attractive destination for international PhD students (CBIE, 2018). Moreover, there has been an increased push from universities and policy-makers to advertise Canada as a destination of choice for international students (Ricketts & Humphries, 2015). Over the last two decades, the share of international students enrolled in PhD programs across Canada has risen to 29% (StatCan, 2016). These students represent an increasingly large cohort that may face challenges related to immigration laws during their studies (MRS, 2016). After graduation, the ability of these PhDs to remain in the country continues to depend on their immigration status.

The motivations of those who were international students (at the bachelor's, master's, and PhD levels) vary greatly depending on personal situations, as well as the social, economic, or political climate of their country of origin (Trevena, 2019). Some international PhDs express a sense of freedom associated with their mobility, and embrace the possibility of continuing to explore career opportunities abroad. For example, when asked about his plans following graduation from a UBC PhD program, one E.U. national in a STEM-based field said:

I do have the impression that the whole world is open to me/us in terms of, I can pretty much choose wherever I go next for a postdoc, and then, if there weren't family ties, for a following career. I have the impression that it's up to my decision where to go . . . So this is why globalization is really true for me in terms of the possibility to go anywhere and probably start work anywhere.

Phelps, 2013

Meanwhile, other PhDs wrestle with potentially limiting factors, including immigration policy, long-term career prospects, and family obligations:

Immigrating may be an option. I don't know. I may not consider just to live here forever because I'm the only child and I need to take care of my parents when they are old . . . So I may go back to [home country]. I haven't made the decision yet. I can also look for a job in a company in [home country] because there are a lot of biotech companies there . . . and they would like to have some people who got trained in Canada to work for their company . . . But I think I will apply for immigration because that way I

have more options. I can either stay here or go back . . . Maybe there will be more opportunities [in the United States] because there are more companies there but currently I like Vancouver so I would love to stay here.

Phelps, 2013

Other graduates may face unique political circumstances that can either prohibit their return or require it unconditionally. For example, as one UBC PhD graduate from the region of Central/South America commented:

I have to sign papers and guarantees that I'm going to come back to [home country] to my university and I have to continue teaching there. But here, many things are changing in my family, in my wife, in myself. I think we can see that there are very beautiful opportunities here in Canada . . . Every Latin American which is coming here, well the point of view are a little bit different. For example, if you compare somebody which is coming from Venezuela, or from Central America, from El Salvador . . . The economies of these countries are not doing very well and there are a lot of violence. But if you compare somebody from Argentina, or from Brazil, or from Chile, the conditions in this countries are right now much better so for us it's more complicated to take a decision to just [leave] our own countries and came here to start a new life here.

Phelps, 2013

The cross-border mobility of PhD students is a primary mechanism of internationalization, since they ultimately produce research, which is the main output of research universities (Cantwell *et al.*, 2018). This colours the relationship between international students and supervisors: students report a fear of losing their funding or visas, and also feel pressure to outwork domestic students (Cantwell *et al.*, 2018). Additionally, a global survey of PhD students found that those studying in Canada who were not raised in the country were more likely to report experiencing discrimination or harassment (30%) as compared to domestic students (21%) (Woolston, 2019).

Some of these issues become more acute for international PhDs who remain in the academy after graduation, particularly in the sciences. In a joint U.S.-U.K. study, double standards between domestic and international PhDs who become PDFs have been found to influence career outcomes (Cantwell & Lee, 2010). The study include interviews with administrators, PDFs, and faculty members in order to highlight prejudices affecting international PhDs hired into PDF positions. The professional experience of a PDF can be strongly linked to their ethnic background due to biases held by their supervisors (Cantwell & Lee, 2010).

6.3.1 International PhDs from Canadian Universities Are More Mobile Than Domestic PhDs

The 2005–2006 SED found that 31% of PhD graduates who began their program as a foreign or visa student expressed a desire to leave Canada following their studies, versus 17% of those who were Canadian by birth (King *et al.*, 2008).

Evidence suggests that, after graduation, international PhDs do leave Canada at a higher rate than Canadian citizens and landed immigrants. A UBC study found that 62% of its international PhD graduates appeared to be working abroad, while the same was true for 66% and 73% of international PhD graduates from McGill and UofT, respectively (Porter *et al.*, 2017; Reithmeier *et al.*, 2019; Lee, 2020).

Among UofT PhD graduates, this figure drops to 44% for permanent residents in Canada, and 24% for Canadian citizens (Reithmeier *et al.*, 2019).

International students studying in Canada have already made the decision to uproot themselves in order to pursue education and explore opportunities abroad, which increases mobility following graduation (Phelps, 2013). This is true for students in other countries as well. For instance, a recent E.U. study of social sciences and humanities PhDs found a strong correlation between moving to pursue doctoral studies and remaining mobile following graduation (Reale *et al.*, 2019).

There were substantial differences in employment sector for UBC's international PhD graduates depending on whether they remained in Canada or moved abroad (Figure 6.3). Compared to PhD graduates employed in Canada, a larger proportion of those employed abroad were working in post-secondary education, including as tenure-track faculty (39% versus 17%, not shown on figure) (Porter *et al.*, 2017).

With respect to the private sector, conversely, a larger proportion of international PhD graduates worked in that sector in Canada versus those living abroad.

International PhD graduates are inherently diverse. Several factors affect a graduate's decision to stay in Canada, and stay-rates show significant variation according to country of origin. The tracking study by UofT found, for instance, that 68% of American PhD graduates from UofT returned to the United States following their studies (Reithmeier, 2018). Similarly, 67% of Japanese graduates returned home, while 21% of Chinese graduates returned home versus 24% who chose to stay in Canada (Reithmeier, 2018). Overall, only graduates from Iran and India had a stay-rate of over 50% in Canada (Reithmeier *et al.*, 2019).³¹

The evidence on factors that drive international PhD students to be mobile immediately following graduation is limited, though the Panel presumes they are similar to those for domestic students (Figure 6.2). However, more research is needed to determine whether this presumption is accurate.

³¹ Additional data and information from the UofT study provided by Reinhart Reithmeier.

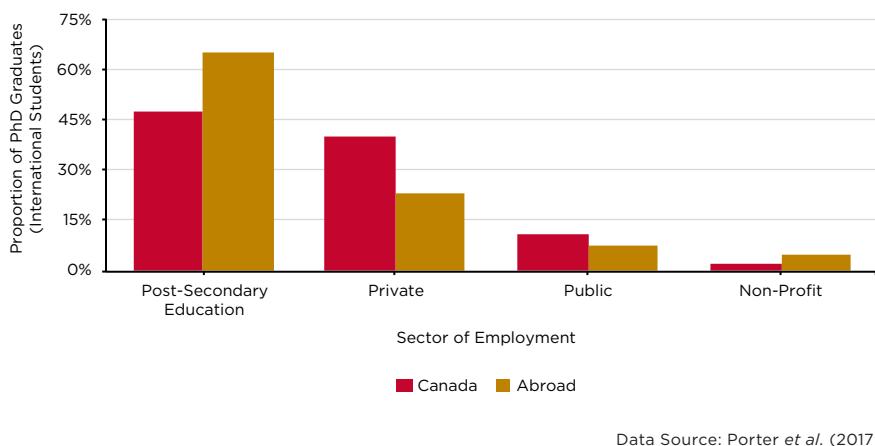


Figure 6.3 Employment Sector Breakdown of UBC PhDs (International Students) in Canada and Abroad

Among UBC's PhD graduates who were international students (classes of 2005-2013), those who remain in Canada (red) are significantly less likely to be working in post-secondary education, and significantly more likely to be working in the private sector, compared to those who move abroad (yellow). It is not known how many of those living abroad intend to, or have since, returned to Canada. Additional data from the UBC survey used in the figure were provided by Susan Porter.

6.3.2 Immigration Policy Offers Several Pathways for PhD Graduates to Stay in Canada

Phelps (2013) has noted that obtaining a PhD in Canada acts as a gateway to opportunities elsewhere following an international student's period of residency or citizenship. For those wishing to settle in Canada permanently, or to use Canada as a springboard for subsequent mobility, Canada's immigration policy becomes important. Approximately 60% of international students (non-PhD specific) intend to apply for permanent residency in Canada (CBIE, 2018), and a number of pathways exist for them to do so. These include:

Post-Graduation Work Permit Program (PGWPP): This program allows up to a three-year stay following graduation from an eligible Canadian institution. The PGWPP is not tied to any employer (GC, 2020c).

Canadian Experience Class (CEC): An immigration pathway that allows foreign graduates from Canadian universities (particularly those who participate in PGWPP) to remain in Canada, provided they have at least one year of work experience in Canada (GC, 2019f).

Express Entry, Federal Skilled Workers Program (FSW): While this program is not a pathway for immigration, it does allow those who qualify for the FSW, or for the other programs described above, to be given priority consideration based on their ability to meet educational criteria and other factors within the ranking system (Dam *et al.*, 2018; GC, 2019e).

Quebec does not participate in the Express Entry program, as it oversees its own immigration process. A temporary stay in Quebec can be obtained through the PGWPP, but permanent residency applications must occur through the Quebec Experience Program (PEQ) (Gov. of QC, 2019b). This program acts as a selection process for potential permanent residents, and requires the completion of tests pertaining to French language proficiency and, as of 2020, Quebec values (Gov. of QC, 2019a, 2020). Following the selection of candidates by the Quebec government, individuals must subsequently apply to the federal government for permanent residency (Gov. of QC, 2019a).

The international student share of permanent resident admissions in Canada has steadily dropped from 5% to 3% between 2007 and 2015, opposite to the observed trends in international student enrolment (Dam *et al.*, 2018). Some international respondents to the SPE survey, which included both PhD students and PDFs, reported that the immigration process was a challenge (SPE, 2019). This echoes results from the CGPSS, where 22% of respondents reported immigration laws or regulations as impeding their academic progress during their studies (MRS, 2016).

In a study evaluating public policy and international student recruitment, Sá and Sabzalieva (2018) suggest that federal policy is not the strongest factor influencing the recruitment and retention of international students. Comparing the policy and political environments in Australia, Canada, England, and the United States, the authors demonstrated how diverse policy approaches in these jurisdictions have nevertheless led to the steady enrolment of international students (not limited to PhDs). The relevant public policy actors in Canada affecting international graduates span multiple agencies and ministries. Indeed, in addition to the aforementioned process employed in Quebec, provinces and territories may offer their own pathways for immigration through Provincial Nominee Programs, which can play an important part in allowing PhD graduates to permanently settle in Canada (Sá & Sabzalieva, 2018).

In an assessment of the graduate retention strategies used in Canada and other peer nations (Australia, Ireland, the Netherlands, New Zealand, Sweden, the United Kingdom, and the United States), Trevena (2019) echoes the conclusion that policies alone are insufficient to explain the stay-rates of international graduates. Additional factors relating to language proficiency, length of time in country of study, as well as the economic, social, and political conditions in both country of

study and home country at the time of graduation, all play an important role in the retention of international PhD graduates from Canadian institutions (Trevena, 2019).

6.4 Summary

Like PhDs elsewhere, graduates trained in Canada are presented with the possibility, or in some cases the necessity, of seeking employment abroad following their studies. Recent surveys have shown the scale of participation in international mobility as well as the motivating factors in migration, revealing that Canada's PhD graduates demonstrate similar behaviour to those in peer nations. The most likely destination for Canadian PhDs is the United States. The main forces drawing PhD graduates away from Canada are the allure of prestigious institutions or researchers located internationally, as well as the possibility of improving career prospects either at home or abroad. These inferences are drawn from data specific to PhD graduates in the natural sciences, who tend to be more mobile than their peers in other disciplines. Many Canadian PhDs living abroad express a desire to return to Canada.

The number of PhD graduates from Canadian institutions who were international students has grown over the past decade, and this group faces distinct challenges related (but not limited) to immigration policy. This group is more likely to be in a STEM field (as compared to domestic students), which may contribute to both their increased mobility, as well as their propensity to be employed in the private sector if they choose to remain in Canada. A better understanding of this cohort hinges on the availability of more comprehensive data.

In terms of the net effect that mobile PhDs have for Canada, Reithmeier (2018) argues the results of UofT's PhD-tracking suggest there is a "brain-gain," while data in Stephan *et al.* (2015) (subject to limitations related to discipline) suggest Canada is losing PhDs and not attracting replacements from outside. The consequences of a positive or negative balance of migrating PhDs fail to paint the complete picture, however. PhD graduates may, for example, return to Canada following a period abroad and produce more influential research and have increased collaboration as a result of their mobility (Franzoni *et al.*, 2014), while those who stay abroad may act as positive ambassadors for Canada in their new countries.

Promising Programs and Approaches

- 7.1 Modernizing Program Design and Academic Culture
- 7.2 Improving Supervision and Mentorship
- 7.3 Transitional Initiatives
- 7.4 Policy Initiatives to Help Increase Non-Academic Receptor Capacity
- 7.5 Summary



Chapter Findings

- The purpose and design of some PhD programs are being rethought to better meet 21st-century needs.
- The supervision and mentorship of PhD students may be improved by supporting the development of faculty and using alternative mentorship approaches.
- Many Canadian universities have created professional development programs for PhD students that focus on building transferable skills to assist their transition to the labour market.
- Work-integrated learning programs create links between the private sector and academia while providing PhD students with non-academic work experience.
- Federal and provincial/territorial governments can use policy levers to encourage the growth of private-sector receptor capacity for PhDs in Canada.

As described in the previous chapters, the challenges faced by PhDs entering the labour market do not begin at graduation. Transitional challenges are often rooted in the graduate school experience itself; because of this, students may benefit from in-program training long before graduation. Post-graduation challenges may include a lack of receptor capacity, a PhD graduate's inability to communicate their skill set to hiring managers, or the absence of skills and knowledge of ways of working that are required by many employers (Chapter 4). Supporting the labour market transition of PhDs is a complex endeavour that no single actor can take responsibility for or address alone. Many stakeholders have a role to play, including governments, business and industry, university administrations and faculty, and students and alumni. This chapter highlights some of the promising practices and approaches currently being undertaken in Canada and in other countries to address these challenges. Some of these programs and approaches involve adding elements to current PhD programming, while others represent more wholesale shifts in PhD educational paradigms. While few evaluations have been conducted on the practices and approaches below, where available, the Panel drew on comments from evaluations in its analysis.

Examples of initiatives are illustrated in boxes and represent possible solutions to issues in the following key areas identified by the Panel:

- Program design and academic culture
- PhD supervision and mentorship
- Transitional initiatives
- Policies to directly increase receptor capacity outside of academia

7.1 Modernizing Program Design and Academic Culture

Academic culture has values and norms that PhD students internalize and adopt. There are benefits to academic culture; individuals with shared interests can ideally find a supportive community in which to collaborate and engage with new ideas. However, as discussed in Section 3.2, the prevailing academic culture is not always optimally oriented toward training students to thrive in careers that rely on different ways of thinking, approaching problems, or interacting with others. Academic culture can also affect students' well-being, and can exclude those who do not subscribe to the goals or values of the professoriate, or whose goals change. This can lead to challenges for graduates transitioning to the labour market outside academia in particular, who may feel they might not fit in a non-academic work environment, or who may perceive taking a job outside academia as a betrayal or a failure. The approaches and programs described throughout this section have evolved as a means to address some of the challenging aspects of academic culture, including the narrow and sometimes constraining visions of PhD education, and its potential negative impacts on PhD graduates.

7.1.1 Traditional PhD Models Are Being Reformed

A 2018 report by the U.S. National Academies of Sciences, Engineering, and Medicine called for a fundamental shift from the “current system that focuses primarily on the needs of institutions of higher education and those of the research enterprise itself to one that is *student-centered*, placing greater emphasis and focus on graduate students as individuals with diverse needs and challenges” (NASEM, 2018). Among other attributes, an ideal graduate education system would provide multiple opportunities for students to engage in interdisciplinary and transdisciplinary research, to consider the ethical impact of their work and its broader implications for society, and “to understand and grapple with differences of opinion, experiences, and ideas as part of their graduate education and training” (NASEM, 2018). The call to move toward a more student-centred approach to PhD education has been made by many over the last decade, and universities around the world are offering development opportunities to promote

these kinds of learning (Smith, 2015; Weisbuch & Cassuto, 2016; CAGS, 2018; Parry, 2020). Building 21 at McGill University is one example of such an opportunity (Box 7.1).

Box 7.1 Building 21 (B21), McGill University

B21 describes itself as “an experiment in a new way of learning that develops, nurtures and trains future-ready students.” Open to all McGill students, B21 encourages students with diverse interests and questions to engage with others beyond the disciplinary silos of academia. It “provides the experience of graduate learning in its purest and simplest form by removing the constraints, restrictions and limitations of programs” and offers a physical space for dialogue, creativity, exploration, and collaboration on new ideas without the expectation that the research must immediately lead to publishable results. Students selected for the B21 program are offered mentorship and access to learning technologies while they work on independent projects they themselves have proposed. Still in its early years, outcomes of the B21 program have yet to be evaluated by either internal or external reviewers.

(McGill University, n.d.)

Universities are also increasingly implementing and promoting more fundamental reforms in PhD programs, policies, and practices. Greater flexibility in the central components of doctoral study — research and dissertations — is slowly being permitted in some disciplines and universities in order to meet the needs of students and society, including potential employers (Gaudreau, 2018). For example, in disciplines where research is normally conducted by a single individual using a single approach, a student’s research may now include collaborative and interdisciplinary work that integrates multiple perspectives and ways of thinking. In disciplines where research is typically documented in a long, scholarly, single-authored dissertation intended for a limited academic readership, students are starting to embed creative or applied scholarly products that result from these expanded modes of research (Cassuto, 2015; Weisbuch & Cassuto, 2016). In other programs, students are allowed to substitute much of the dissertation with a variety of scholarly products capable of appealing to a range of audiences (MLA Task Force on Doctoral Study in Modern Language and Literature, 2014). In addition to helping change academic culture, in some cases, alternative forms of the dissertation may provide students with experience and opportunities

writing for audiences beyond academia. These reforms allow them to co-lead and participate in change for the public good, thereby not only enhancing competencies, but also addressing the deep-felt need of many students to make a more tangible difference in the world (IPLAI & McGill University, 2013; MLA Task Force on Doctoral Study in Modern Language and Literature, 2014; Manderson & Yachnin, 2016; Yachnin, 2016; Peker *et al.*, 2017; CAGS, 2018; Gaudreau, 2018; Parry, 2020).

While these approaches are attracting proponents, the number of PhD students encouraged or permitted to expand their research and dissertation in these ways is quite small (Weisbuch & Cassuto, 2016). In a nationwide consultation with the Canadian graduate community and other relevant stakeholders, CAGS found many participants excited about the prospect of change, as well as many with concerns (CAGS, 2018). Among the identified benefits were the potential social impacts resulting from the types of research proposed; improved opportunities for career preparation among students who might gain skills in collaboration and knowledge mobilization through a reimagined dissertation; and the development of graduates with the capacity to tackle complex challenges with transdisciplinary expertise and wider breadth of knowledge. Among the identified risks, respondents cited concerns that a revised PhD model could be subject to less rigour or less intellectual depth, or that examining or academic hiring committees might be skeptical of the knowledge base of those who have done non-traditional research. Some faculty members also expressed unease about supervising and evaluating a type of scholarship with which they themselves were unfamiliar (CAGS, 2018).

At UBC, the Public Scholars Initiative (PSI) was launched in 2015 to promote reimagined doctoral research and dissertations across all disciplines, and to test the viability of this approach for the academy (Box 7.2). Overall, PSI scholars have expressed appreciation for the opportunities to move beyond the typical academic understanding of how research can be conceptualized and conducted, as well as for the ability to create or deepen links and networks outside of academia — something that can help them eventually transition to the labour market (Peker *et al.*, 2017; UBC, n.d.-e).

Box 7.2 Public Scholars Initiative (PSI)

The PSI at UBC is an innovative approach that addresses the increasingly collaborative and transdisciplinary nature of scholarship. It is aimed at expanding PhD students' perspectives, thinking, and experience, preparing them for careers both inside and outside the academy, and enhancing the impact of their research (Peker *et al.*, 2017).

The PSI offers funding to PhD students in all disciplines for broadened, collaborative dissertation research, as well as academic support, professional development opportunities, and access to a network of students, academics, and professionals across disciplines and employment sectors. It encourages and supports PhD students and supervisors to conduct research that expands the boundaries of their discipline, and includes integrative, applied, and/or mobilized scholarship with partners primarily from outside the academy (including communities, government, the private sector, and NGOs) with the goal of making a tangible impact for these partners and society. The PSI anticipates that students will incorporate non-traditional research and products into their dissertations (e.g., interactive websites, policy papers, creative products, public communications) (UBC, n.d.-d). At the time of the program's launch, UBC's dissertation guidelines were altered, as were instructions to dissertation examiners (Peker *et al.*, 2017). As of 2019, there have been 184 participating students from all major disciplines, and over 30 students have graduated and have been employed in a variety of sectors (UBC, 2019; Porter, Forthcoming).

The PSI has been received favourably by academic supervisors and outside partners. Of 38 surveyed external partners, over 90% of respondents agreed or strongly agreed that collaboration with a PSI scholar benefited their organization and made a positive social contribution. In the words of one respondent, “[t]hese collaborations will help open new avenues of research, better understanding of field interventions and help further improve NGOs working in the field” (Peker *et al.*, 2017). Many faculty supervisors report that the PSI has had a positive benefit for their PhD students; however, some have been hesitant to support the incorporation of students' PSI-funded research in their dissertations out of a concern that certain parties (e.g., examiners or potential academic employers) may not value it (Peker *et al.*, 2017). As a model, the PSI is regarded as successful, and has contributed to an increased willingness to view PhD education differently (UK Council for Graduate Education, 2020).

7.1.2 Addressing Mental Health Issues by Changing Academic Culture

Even if vast structural changes to PhD programs were to be implemented, mental health issues among PhD students continue to be a concern. As discussed in Chapter 3, the culture of academia can negatively affect the mental health of PhD students, contributing to high incidences of depression and anxiety. New approaches to safeguard the mental health of graduate students are being increasingly discussed and implemented (Levecque *et al.*, 2017; Barreira *et al.*, 2018; Evans *et al.*, 2018; Flaherty, 2018; Jones & Oakley, 2018). For example, it has been recommended that faculty receive training to recognize the signs and symptoms of mental health issues so that they can either initiate conversations with their students or provide referrals to appropriate on-campus services (Evans *et al.*, 2018). It has also been suggested that universities establish guidelines intended to help students manage workload and promote work-life balance, as well as conduct a system-wide re-evaluation of funding for students and PDFs to alleviate the prevalence of anxiety surrounding finances and lack of job security (Levecque *et al.*, 2017; Jones & Oakley, 2018). One potential solution may be allowing graduate students who have taken medical leave (including for mental health reasons) to access accommodations, including a gradual return to work. Many such programs already exist for university faculty and staff across Canada (UVic, 2020; SFU, n.d.) and such a change would extend these employee rights to graduate students. Further, there has been a call to establish and/or expand on-campus mental health services or to publicize existing mental health services so that students can access professional care when needed (Barreira *et al.*, 2018; Evans *et al.*, 2018; Flaherty, 2018).

By addressing the culture of academia itself, it may then be possible to move the conversation forward from intervention to prevention. In an interview with *Inside Higher Ed*, Kaylynne Glover, a PhD student in biology at the University of Kentucky, and director of legislative affairs for the U.S.-based National Association of Graduate-Professional Students, stated that many of the mental health issues experienced by graduate students are rooted in “direct power relationships they have with their faculty advisors and supervisors.” She goes on to state that “the only way to fix that is by comprehensively addressing the nature of graduate school — of academia itself — and changing the culture” in an effort to promote work-life balance and healthy relationships between students and professors (Flaherty, 2018).

7.2 Improving Supervision and Mentorship

As the Panel noted in Section 3.3.1, sound academic supervision and quality mentorship are key indicators for success, both in terms of degree completion and in the post-graduation transition period. Improving academic supervision and mentorship may help change academic culture, and have direct benefits in terms of supporting PhD graduates as they move into the labour market.

7.2.1 An Approach to Academic Supervision to Support Student Development

While the value of PhD studies is being re-evaluated, the quality of academic supervision is also under scrutiny. There have been a number of suggestions on ways to improve the traditional model of a PhD education. For example, members of the Carnegie Foundation for the Advancement of Teaching suggest that students might benefit from having several supervisors rather than the traditional model in which a student is paired with one faculty member (Walker *et al.*, 2008). They write that “the multifaceted, integrative learning expected of today’s PhDs requires growth on a number of dimensions. It is rarely the case that one relationship can meet all those needs. Today’s students are thus best served by having several intellectual mentors” (Walker *et al.*, 2008). The authors go on to note that multiple supervisors would also benefit students by increasing their access to networks and future collaborators. Given the limitations of (almost) solely relying on one faculty member for a student’s supervision, CAGS has recommended that universities encourage a diversification of individuals on supervisory and/or examining committees to include, as appropriate, those from outside the academy (CAGS, 2018). The model of multiple supervisors is used in the United Kingdom, and its practice at the University of Edinburgh is highlighted below in Box 7.3. Potential benefits of multiple supervisors include a diversity of intellectual perspectives and expertise (McGill University, 2020). Research on the potential drawbacks of having multiple supervisors is limited; however, those identified include a “diffusion of responsibility” leading to a lack of overall leadership, the receipt of conflicting advice, and the management of multiple relationships and different personalities and leadership styles (Phillips & Pugh, 1987; Spooner-Lane *et al.*, 2007).

Box 7.3 Graduate Supervision at the University of Edinburgh

At the University of Edinburgh, every PhD student is supervised by at least two people, including a principal or lead supervisor, and either an assistant or co-supervisor (University of Edinburgh, 2019). While principal/lead supervisors remain the primary source of guidance for students, assistants or co-supervisors exist to support and complement that relationship. Co-supervisors are included as part of the supervisory team when a student's research has a clear, interdisciplinary perspective. In these cases, arrangements for supervision are organized between the lead and co-supervisor. Assistant supervisors, on the other hand, take on fewer responsibilities than lead supervisors, but may have closer day-to-day interactions with a student and provide complementary expertise to that of the supervisor. In addition to faculty, the University of Edinburgh recognizes expertise from non-commercial and non-degree awarding "associated institutions." Staff from such institutions are permitted to act in supervisory roles at any level, including that of principal supervisor. Once graduate supervisory teams are chosen, roles and responsibilities are clearly laid out for the benefit of both students and supervisors in a published Code of Practice (University of Edinburgh, 2019).

In some cases, the roles and responsibilities of academic supervisors are being reconsidered. As stated by members of Teaching Assistant and Graduate Student Advancement (TAGSA), "[t]he reconceptualization of graduate studies will not be possible without the reimaging of supervision" (Greene *et al.*, 2018). While many universities across Canada are implementing programs aimed at educating faculty on supervision and mentorship, TAGSA members point to the Program in Graduate Student Supervision at Memorial University of Newfoundland (Box 7.4) as an example that allows both new and seasoned faculty to reflect on their methods, "creat[ing] a growing community of practice that questions the assumptions about how faculty learn to supervise, and by extension, how graduate education needs to be reimagined" (Greene *et al.*, 2018).

Box 7.4 Program in Graduate Student Supervision (PGSS)

The PGSS at Memorial University of Newfoundland is led by professionals in education, career services, and administration, and was designed to prepare faculty to take on (or to improve) academic supervision. PGSS recognizes research that shows that “[t]he relationship between student and supervisor is one of the most important factors influencing graduate student retention, persistence and graduate outcomes” (MUN, 2019a). The program uses an evidence-based curriculum to introduce new and existing faculty to models of supervision, and it encourages participants to reflect on their own practice as graduate supervisors (Greene *et al.*, 2018). Relying on the latest literature from the field of education, PGSS explores a number of key topic areas, including cross-cultural supervision. The university offers PGSS in collaboration with its Centre for Innovation in Teaching and Learning and the department of graduate studies (Greene *et al.*, 2018). What began as a program for the faculty of one university is now pan-Canadian, attracting professors from across the country for its nine-week in-person or online program (MUN, 2019a).

Beyond training and guidelines, tools to support meaningful conversations can benefit the student-supervisor relationship. As explained by Walker *et al.* (2008), “a shared understanding of what is expected goes a long way toward reducing the potential for misunderstanding, abuse, or simply slipping through the cracks.” A program that uses conversational prompts to guide student-supervisor dialogue, and that provides a clear set of identified goals and timelines, can create a shared vision among departments, faculty, and students on necessary aspects of the student-mentor relationship. In many Canadian universities, student-supervisor expectations are presented in writing and sometimes signed by both parties (Galt, 2013). An existing tool currently being promoted by CIHR is Individual Development Plans (IDPs) (Box 7.5). According to CIHR (2019), IDPs have the potential to help students consider career options early in their studies, while providing guidance to supervisors in initiating conversations that move beyond research subject matter and into career transitions. Furthermore, the use of IDPs in academia may help prepare students for non-academic workplaces, where IDPs or personal development plans are sometimes used to guide career conversations and planning (Jacobson, 2020).

Box 7.5 Individual Development Plans (IDPs)

An IDP is “a tool that supports graduate students and PDFs in actively preparing for the career(s) of their choice by exploring career paths, establishing career goals, and identifying skill gaps, culminating in an action plan to achieve their career goal(s)” (CIHR, 2019). IDPs include several stages with questions and answers that promote conversations on career paths between students and supervisors. For example, in the first stage, Self-Assessment, the students might ask “Am I developing a variety of competencies across research, communication and transferable skills?” In turn, the mentor asks, “What resources, opportunities and networks could be valuable in my trainee’s development? Can I facilitate access to them? If not, who could?” (CIHR, 2019). The stages following Self-Assessment include Career Exploration, Goal Determination, Plan Development, Plan Refinement, and Implementation.

The effectiveness of IDPs remains under review. According to CIHR, they have been found to lead to a number of benefits, including improved career outcomes, higher productivity and publication rates, the management of expectations, and better relations between students and supervisors (CIHR, 2019). However, recent studies also indicate that IDPs may only be as effective as the faculty leading them. A 2016 survey of 663 PhD students in the sciences from 98 U.S. universities found that students deemed the practice most effective when the tool was completed with a supervisor “with whom they have a positive relationship,” or among students who were already “confident about their career plans and who took advantage of other career development resources at their institution” (Vanderford *et al.*, 2018). The authors of the survey recommended that more research be done to determine the effectiveness of IDPs, as well as any unintended negative consequences related to their use (Vanderford *et al.*, 2018). Additionally, the Council of Graduate Schools found that there are limitations that reduce the potential effectiveness of IDPs in STEM-related programs in the United States, including funding, staff availability, limited faculty knowledge of non-academic careers, a lack of student interest and participation in non-mandatory career programs, and a lack of faculty support for students who profess an interest in non-academic careers (Denecke *et al.*, 2017).

7.2.2 Alumni Engagement: An Untapped Resource

In the Panel's view, alumni represent another underutilized but potentially important resource for providing mentorship to PhD students. PhD graduates who have launched successful careers outside of academia can show students the advantage of having an advanced degree in a variety of prospective careers, and the multiple pathways to success. Alumni can be a valuable source of mentorship and networking opportunities (Yachnin, 2020). Creating linkages between alumni and PhD students may include inviting the former to department events to give students a chance to hear their stories, interact with them, and forge connections. Another approach, undertaken by TRaCE, is posting alumni stories online, highlighting the varied career paths of PhD graduates across Canada, and allowing students to connect with graduates through a web-based mentoring community (TRaCE, 2019a; Yachnin, 2019).

In order to advance career opportunities for PhDs, doctoral programs bear some responsibility to inform students of potential challenges and opportunities; otherwise, as stated by McAlpine and Emmioğlu (2015), “leaving opportunity structures unexamined during the doctorate does a disservice to the investment that students and their supervisors make in advancing students’ research capabilities.” Among the steps described by McAlpine and Emmioğlu (2015) to improve the flow of information supplied by PhD programs are:

1. Provide PhD applicants with information on the positions held by PhD alumni.
2. Ensure the institution, not necessarily the supervisor, provides both career advice and training for non-academic careers during the degree.
3. Hold career panels in which alumni describe their career trajectories, including how personal circumstances have influenced their decisions.
4. Ensure students are introduced to accounts of the extended academic career trajectories now required to be competitive.

A study by O'Meara *et al.* (2014) of 884 PhD students in STEM departments at two major U.S. research universities found that, when implementing some of the steps described above, the overall result is an improvement in students' sense of agency over their career advancement. At the universities included in the study, a variety of career paths were routinely encouraged and legitimized by academic departments, faculty, and graduate student associations, through sponsored speaker series that hosted PhD graduates employed in industry, government, public policy, and K-12 education (often alumni or faculty colleagues). In addition, students often had opportunities to engage informally with the speakers (e.g., lunches, dinners) and ask questions about the content of their work, work-life balance, salary, and other benefits. Often, these meetings occurred without

faculty, and, in the opinion of the students, afforded them the freedom to openly discuss and compare academic and non-academic career choices. Students interviewed as part of the study described these learning and networking opportunities as “valuable,” “beneficial,” and “enlightening” (O’Meara *et al.*, 2014). For example, Ron, a PhD student in astronomy, noted “I think that it has been pretty valuable for a lot of us, in also realizing if you don’t get an academic position that’s not the end of the world. There are a lot of other things happening” (O’Meara *et al.*, 2014). Another interviewee noted the benefits of working in a department and among faculty that welcomed and encouraged other career paths, making it easier for her to realize her strengths and desired goal of pursuing a career in K-12 education. These results are important because, as stated by the authors, “agency in career advancement is important to students’ motivation, completion, and career placement.” They go on to note that “[e]ncouraging departments to consider the ways in which they support graduate student agency in career advancement does not diminish the role graduate students themselves play as agents who need to plan, navigate, and negotiate their own careers;” rather, it helps to support the creation of an environment that empowers students to recognize and assume their own agency. As an added benefit, even with limited funding or operating under financial constraints, university departments and faculties have the potential to be influential in supporting career advancement among PhD students, by reaching out to graduate alumni (O’Meara *et al.*, 2014).

7.3 Transitional Initiatives

While changing academic culture and improving student-supervisor relationships can indirectly ease the labour market transition for PhD graduates, there are also opportunities to directly support those making this transition. Transitional programs can help PhD students or recent graduates develop essential skills required by employers and/or create links between non-academic sectors and PhD students or graduates. Described below are a number of programs developed by funding agencies, not-for-profit organizations, and university departments to ease this academia-to-labour-market transition by enhancing professional development through specialized programs and courses, as well as through opportunities for work-integrated learning.

7.3.1 Graduate Programming Can Play a Role in Career Development

University departments and faculties have a considerable role to play in creating positive career outcomes for their PhD graduates. Part of the response to the ongoing discussion about improving career outcomes for PhDs has been the creation by Canadian universities of professional development programs administered by graduate faculties (Lypka & Mota, 2017).

In addition to providing skills and information, improved graduate programming in both departments and faculties can help break the stigma or isolation that students may feel as they cope with the idea that the positions they have worked toward may not be forthcoming, and that life plans may have to change (Bowness, 2015). These programs normalize the idea of alternative careers and provide a gathering place for students facing the same challenges (Bowness, 2015).

While PhD students consistently communicate a desire for career preparation, it is worth noting that studies also show that students “rarely engage in career-seeking strategies” (McAlpine & Austin, 2018). Reasons for this may vary, but could include over-confidence in one’s ability to secure employment, a lack of time to undertake extra-curricular non-academic work, and discouragement from academic supervisors (Thiry *et al.*, 2015; McAlpine & Amundsen, 2016).

7.3.2 Professional Development Programs Can Support the Labour Market Transition

As discussed in Chapter 4, some private sector employers in Canada believe that PhDs lack certain skills needed to ensure success in the non-academic workforce. At the same time, some graduates may have relevant skills that they are unaware of or are unable to communicate to non-academic employers. Most Canadian universities are working to address the development of what are often termed “soft skills;” these programs are often led by graduate schools in partnership with other university services (Jones, 2018).

Professional development programs typically focus on building skills beyond the academic skills considered to be fundamental to the PhD. Non-academic professional skills are generally transferable skills and competencies that relate to “a student’s ability to present himself or herself professionally and to integrate quickly into complex workplace environments after graduation” (Rose, 2012). It should be noted that most of these skills (e.g., project management, communication) are just as valuable to those pursuing an academic career. While professional development programs are increasingly commonplace at Canadian universities, for the most part they are not a mandatory requirement for obtaining a PhD, and it therefore remains up to individual students to opt in and fit them

into their existing schedule (Lypka & Mota, 2017). Furthermore, limited evidence from Australia indicates that, while professional development programs do assist in overall career outcomes, they do not necessarily shorten the distance between graduation and the attainment of full-time employment (Jackson & Michelson, 2015).

In addition to university-wide professional development programs, many departments have established their own professional development initiatives targeting the specific skill sets and potential career paths open to students in those particular fields (Box 7.6).

Box 7.6 A Professional Development Course in UofT's Biochemistry Department

The biochemistry department in UofT's Faculty of Medicine offers a graduate course in professional development with the aim of providing students the skill set needed for success in academic and non-academic careers in biomedicine. The course is mandatory and graded, and students are required to participate in class, prepare written assignments, and give oral presentations. The course also includes panel discussions with guest speakers from a range of sectors, including law, research ethics, management consulting, science writing, government, and industry. This course is available in addition to other projects set up by UofT's Graduate Professional Skills Program, which provides support through voluntary initiatives.

(UofT, 2019b)

Faculties at some universities have developed diploma programs aimed at creating industry-specific skills among students and recent graduates. For example, the Graduate Diploma in Pharmaceutical & Healthcare Management and Innovation at Queen's University is offered to recent PhD graduates, among others. The program relies on coursework as well as practical experience in an effort to increase the skills of those seeking careers in the pharmaceutical or other health-related industries. These experiences are intended to make graduates more competitive in pursuing career opportunities in the labour market (Queen's University, n.d.-b).

In addition to universities, Canada's funding agencies recognize the need for professional training that is collaborative, interdisciplinary, and that can extend beyond the professoriate. In response to this need, the Collaborative Research and Training Experience (CREATE) program was introduced by NSERC in 2014

(Box 7.7). This program is designed to support the development of new researchers by “improving training in areas such as professional skills, communication and collaboration, as well as providing experience relevant to both academic and non-academic research environments” (NSERC, 2019b).

Box 7.7 The Collaborative Research and Training Experience (CREATE)

The CREATE program offers grants for up to six years to teams of established researchers who commit to working with highly qualified students and PDFs, facilitating their training, and preparing them for employment in industry, government, non-government organizations and/or academia. While funded by NSERC, the CREATE program promotes collaboration with disciplines outside of the sciences and engineering, including those disciplines covered by SSHRC and CIHR. In addition to the regular stream, CREATE also offers an industrial stream that places qualified candidates in Canadian firms in order to develop the skills needed for labour transition, as well as an international program — jointly funded by NSERC and Deutsche Forschungsgemeinschaft — that facilitates an exchange between German and Canadian researchers (NSERC, 2019b).

An evaluation of the CREATE program in 2016 deemed it too early to assess long-term outcomes (including employment outcomes), as no grant had been fully completed at the time of evaluation; however, PhD students participating in the program did report that their training emphasized the “development of research protocol/methods, knowledge translation/mobilization, multidisciplinary/interdisciplinary research, strategic planning/advice, and digital activities” (Circum Network Inc, 2016). The evaluation also showed that, as part of their program, CREATE participants were offered a variety of training opportunities through conferences, internships, guest lectures, and research activities with organizations outside the university. Finally, the early evaluation showed that the CREATE program provided an avenue to employment by broadening the training of participants, noting that “[i]mportant from the trainees’ point of view, was their development of collegial and professional networks, including contacts with industry or other sector representatives” (Circum Network Inc, 2016).

7.3.3 Work-Integrated Learning Shows Promise

Work-integrated learning (WIL) is the process by which students learn through a combination of experience in both educational and workplace settings (Billett, 2011). WIL provides students with an opportunity to combine theory with practice, and can include training, a structured work experience, and institutional partnerships that benefit both the employer and employee (i.e., student) (HEQCO, 2016). WIL learning can ease PhD graduates' transition to the labour market and accelerate their career. There are a number of university- or department-specific co-op programs across Canada seeking to create industry links and provide work experience for PhD students. These include programs in the arts and humanities that are not generally associated with the private sector. For example, the Arts Co-op program at UBC is open to English and history PhD students, offering them opportunities to gain relevant experience in their fields outside of academia, while also earning income that may be needed for graduate studies (Box 7.8) (UBC, n.d.-a). WIL, however, is still rare among Canadian PhD programs. In some peer countries, a co-op element in a PhD program is much more common. For example, in the Netherlands, more than two-thirds of PhD students complete an internship as part of their studies. The same is true for 55%, 30%, and 23% of PhD students in Germany, Spain, and the United Kingdom, respectively (Charbonneau, 2011).

Box 7.8 Arts Co-op Program at UBC

In 2013, the Arts Co-op program at UBC was launched in conjunction with the department of English and was expanded in 2016-2017 to include the department of History (UBC, n.d.-b). The program provides interested PhD students with opportunities for professional growth in a variety of workplaces beyond academia. As noted by Elizabeth Hodgson, the program's co-founder and faculty advisor, “[w]e wanted co-op because its programs integrate career-training in the world students are already inhabiting. We wanted co-op because it has an experienced staff who know employers and how to work with them to generate decently paid positions for doctoral students. And we wanted co-op because they take seriously the coaching, reflection, and feedback necessary for real career development” (Wood, 2019).

Participating students alternate between academic semesters and placements in paid, degree-relevant positions in order to gain experience in, and knowledge of, a variety of potential career paths. Co-op coordinators work with employers to find or develop quality positions for students in for-profit, not-for-profit, and government sectors.

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Over the course of three four-month work terms, students gain useful insight into careers while developing a professional network (UBC, n.d.-a). Using their research and communications skills, students have undertaken work in academic administration, public relations, curriculum development, and project management (UBC, n.d.-a). In the past five years, the Arts Co-op program has experienced a 20 to 25% enrolment rate among PhD students (Wood, 2019).

For many students, these experiences have proven to be helpful and eye-opening. As noted by an early participant in the English co-op program, “[t]he breadth of experience [my co-op] position provided was extremely useful” as it required him “to think more generally, working as part of a team on a very diverse array of tasks and projects” (UBC, n.d.-a). Jonathan Newell said that he eagerly enrolled in the co-op program, noting that it “was a balm for the anxieties of precarity and the looming potential of unemployment” (Wood, 2019). Newell acknowledges that the co-op never replaced his desire to teach (he works as an instructor at Langara College), but it did show him that he had career alternatives he might pursue whenever he wished (Wood, 2019).

Programs and organizations that use WIL to give students and PDFs work placements, such as Mitacs (Box 7.9), have been credited with helping PhDs develop useful skills that are highly desired by employers, shaping the careers and research interests of students, exposing students to employment opportunities they may not have considered, developing important networks, and ultimately launching careers (Mitacs, 2019a). Data from Mitacs indicate that those who have participated in the program have been highly satisfied with the overall experience (Mitacs, 2019a). While there is awareness about the benefits of giving students a chance to interact with industry and learn about broader career possibilities, the number of available internships remains small relative to the number of PhD students (Mitacs, 2019a).

The Science to Business Network (S2BN) is another initiative assisting PhD students in their career transition by improving linkages with the private sector (S2BN, 2019). Focusing on STEM students, S2BN has several chapters across the country, and organizes networking events and career-development workshops for graduate students with the aim of creating partnerships between academia and industry (S2BN, 2019). In a 2015 review of collaborative PhD programs between European universities and industrial partners, it was noted that the success of programs joining academic and industrial partners was predicated on careful

planning among stakeholders, and that “[i]n this process, striking a balance between academic and business priorities and needs is essential, but the long-term goal is to develop mutual trust between the partners and to strive for sustainable relationships” (Borrell-Damian *et al.*, 2015).

Box 7.9 Mitacs

In Canada, the largest organization that facilitates direct linkages between students and non-academic sectors is Mitacs. Mitacs is a pan-Canadian organization that supports innovation and research in Canada by matching academics and graduate students with partners in government and industry. Over the last 20 years, through its various programs, Mitacs has supported over 20,000 research internships, provided career training to over 33,000 students and PDFs, and has worked with over 60 universities, 4,000 companies, and both federal and provincial governments (Mitacs, 2019b). The program operates across most of the country, with PhD students and PDFs holding Mitacs fellowships in every province each year since 2014 (Mitacs, 2019a).

The number of PhD students and PDFs participating in Mitacs programs has been steadily growing: in 2012, there were just over 510, which grew to about 850 by 2015, and reached more than 1,500 in 2018 (Mitacs, 2019a). While the majority of fellowships (84%) are held by PhD students and PDFs in STEM fields (engineering and life sciences in particular), Mitacs also works with social sciences, arts, humanities, and business PhD graduates (Mitacs, 2019a).

Mitacs Accelerate, the organization’s flagship program, links industry and the not-for-profit sector with PDFs and students at all levels through research projects that are supported by an academic supervisor at a post-secondary institution (Mitacs, 2019a). While the standard Accelerate “unit” is four months, units can be stacked for longer projects. In 2018-2019, there were over 6,500 Accelerate internship units distributed across the country (this number includes college students and master’s students, in addition to PhD students and PDFs) (Mitacs, 2019a).

The Mitacs Elevate program specifically focuses on PDFs (Mitacs, 2019a). The two-year research management fellowship also includes an employer and academic supervisor, and is based on an approved research project. Elevate fellows split their time between a university-based research team and their partner organization (Mitacs, 2020b).

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The Elevate fellowships also include a “professional-development curriculum” intended to provide training in research management. There were over 200 Elevate fellowships in 2018-2019 (Mitacs, 2019a).

Mitacs surveys show that partner organizations have gone on to hire Mitacs fellows. Long-term surveys indicate that 40% of Elevate partner organizations have hired at least one former Mitacs fellow, while recent data from the Accelerate program show that a quarter of employers have hired or plan to hire their interns (Mitacs, 2019a).

7.3.4 EDI is an Important Consideration in Transition Initiatives

As noted in Section 3.5, EDI is a growing focus in higher education as a diverse PhD student population and an equitable and inclusive environment brings substantial benefits. In order to retain and graduate more students from underrepresented groups, a number of solutions have been suggested, including strengthening mentoring and advising. For example, Universities Canada recommends EDI training for teaching assistants and new graduate student supervisors (UC, 2019). A potential way to ensure that faculty commit to this role would be for universities to reward teaching and supervision as part of the tenure process — a move that would require the support of university and departmental leadership (Tapia & Johnson, 2009). In an effort to promote EDI on Canadian campuses, in 2019, the federal government launched Dimensions, a voluntary pilot program aimed at increasing EDI and supporting equitable access to funding and research opportunities, and embedding EDI principles in research design and practices (GC, 2019b). While Dimensions is modelled on the U.K.-based Athena SWAN Charter, in which universities were asked to commit to gender parity on campus within the STEM fields, Dimensions goes beyond by promoting EDI across disciplines and including all underrepresented groups within its charter (Shen, 2019).

As universities seek to recruit, retain, and support underrepresented students, a number of promising programs have also emerged to ease these students’ transition to the labour market. Taking into account the specific needs of students with disabilities, the Paul Menton Centre (PMC) at Carleton University, for instance, has long been a recognized leader in promoting accessibility in every aspect of student life (Carleton University, 2019c; UC, 2019). While not a PhD-specific program, PMC offers employment services to disabled students through the Research, Education, Accessibility and Design (READ) and Accessible Career Transitions (ACT) initiatives. These programs offer individualized and ongoing support to prepare participants for all aspects of their labour transition, including

skills development, networking, and interview preparation (Carleton University, 2019a, 2019b). Outside Canada, the National GEM Consortium in the United States has successfully focused on the recruitment of underrepresented minorities in the STEM fields (Box 7.10). By offering financial and networking support, the program has an established record of supporting academic to career transitions (Leggon & Pearson, 2009; GEM, n.d.).

Box 7.10 National GEM Consortium

In order to keep underrepresented students active in the STEM fields, there is a recognized need for financial, academic, professional, and social supports. These include facilitating the creation of professional and social networks and offering experiences that bridge the transition from student to employee. The National GEM Consortium in the United States provides a model of how to successfully create links between academia and industry for underrepresented students in the sciences and engineering. Black, Native American, and Latinx GEM fellows receive the financial support to complete their studies, as well as internship opportunities with top employers. According to GEM Fellow Zakiah Robinson, the sustained financial support brought her the peace of mind of not having to worry about money while pursuing her PhD in chemistry, and her internship at DOW Chemical gave her the opportunity to do “real research that advanced the company’s goals” while also providing her with a lifelong mentor (Parks, 2005).

The GEM Consortium includes 94 universities and corporations, and its Fellows graduate from top universities with marketable skills and a competitive advantage as they enter the labour force. More than 3,000 GEM graduates (including 200 PhDs) have entered the labour force as researchers, academics, entrepreneurs, and business leaders, with more than 80% of program participants going on to accept full-time offers with their sponsoring agency (Leggon & Pearson, 2009; GEM, n.d.).

In addition to supporting the career transitions of underrepresented students, universities have also recognized the need to support these students while on campus. For example, programs such as Supporting Aboriginal Graduate Enhancement (SAGE) provide early support to Indigenous students in master’s and PhD programs (Box 7.11).

Box 7.11 Supporting Aboriginal Graduate Enhancement (SAGE)

SAGE is part of an initiative that was created to provide mentorship services to Indigenous graduate students across British Columbia's post-secondary institutions. While the program's mission is increasing Indigenous representation on campus, it recognizes that this alone is not enough, and that students must be supported after enrolment. In this regard, the SAGE program "support[s] the academic success and cultural affirmation of students by linking their academic graduate research with culturally-informed mentors, including faculty, knowledge keepers, alumni, and SAGE Coordinators" (UBC Office of Indigenous Education, n.d.). While the SAGE program began in British Columbia, it has since been adopted in other institutions in Canada (e.g., University of Manitoba, UofT) (Longman, 2019; UofT Centre for Indigenous Studies, n.d.).

7.4 Policy Initiatives to Help Increase Non-Academic Receptor Capacity

A key challenge facing PhD graduates seeking employment outside of academia is the number of available, meaningful positions that make use of PhDs. Federal and provincial/territorial governments, along with professional and/or academic organizations, can help address this challenge by increasing private, public, and not-for-profit sector receptor capacity. Similar to transitional initiatives, programs to increase receptor capacity yield benefits partially by demonstrating to employers the advantage of hiring PhDs. A number of public policy measures and other organizational initiatives have already been undertaken in an effort to work toward the goal of increasing non-academic capacity, some of which are highlighted below.

7.4.1 Entrepreneurship Can Support Innovation

As noted at the start of Chapter 4, PhD graduates are immersed in original research during their studies in such a way that it changes the way they "think and solve problems" (Naylor *et al.*, 2017). These creative problem-solving skills make them uniquely suited to be innovators (Naylor *et al.*, 2017). Entrepreneurship provides a mechanism for PhDs to leverage their ability to innovate and, in the process, create receptor capacity for themselves (and possibly other PhDs). Several programs across the country aim to support the entrepreneurial efforts of people

in Canada, including those with PhDs. There were 146 start-up assistance organizations (SAOs) in Canada run by governments, universities, private companies, and not-for-profits (e.g., hospitals) in 2015 (DEEP Centre, 2015). Of these, 29 are accelerators that provide seed funding and offer time-limited technical expertise and mentorship to support “high-potential firms.” Another 79 are incubators that target entrepreneurs in the early stages, provide support for a longer period of time, and offer a “broader suite of services in terms of access to physical space and mentorship” (DEEP Centre, 2015). The remaining SAOs are commercialization organizations or hubs. SAOs tend to be concentrated in the provinces that hold Canada’s largest cities, with almost all housed in Ontario (41%), British Columbia (19%), Quebec (17%), or Alberta (10%) (DEEP Centre, 2015).

Assessing the effectiveness of Canada’s SAOs in supporting innovation is difficult as there is no standardization of reporting activities and outcomes. This means different SAOs are aggregating data over different time periods and using different definitions for key terms (e.g., job creation). Despite these challenges, there is evidence that Canada’s SAOs are having an impact. Statistics from 20 of Canada’s accelerators and incubators indicate they have helped about 3,500 clients with an average investment of about \$500,000 each, leading to the creation of 10,000 jobs (noting that there is no standard measure of what is considered a job created) (DEEP Centre, 2015). DEEP Centre (2015) also found that traditional accelerators had the highest “per-company follow up investments” (compared to other SAOs) while traditional incubators created the most jobs. One SAO that is gaining attention for its approach to encouraging entrepreneurship is the Creative Destruction Lab (CDL) (Box 7.12).

Box 7.12 The Creative Destruction Lab (CDL)

The CDL is a key accelerator that supports entrepreneurial efforts in Canada (DEEP Centre, 2015; CCA, 2018). It began at UofT’s Rotman School of Management in 2012, and has expanded to four other locations across Canada (Vancouver, Calgary, Montréal, and Halifax) and three internationally (Atlanta, Oxford, and Paris) (CDL, n.d.-a). The CDL provides several different dimensions of support to promising entrepreneurs. This includes connecting them with experienced professionals who provide guidance on how to navigate the challenges in moving from pre-investment through to product development and revenue generation; accounting and legal services; and access to different financing opportunities (e.g., institutional and private investors) (CCA, 2018; CDL, n.d.-a).

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DEEP Centre (2015) found that the CDL “dwarf[ed]” all other accelerators in terms of capital raised, while Silcoff (2017) estimates that graduates of CDL were valued at more than \$600M as of 2017.

While the CDL is not specifically aimed at PhDs, “some of CDL’s most impressive alumni are graduate students who used their research to found a company” (CDL, n.d.-b). Examples include PhD graduates from engineering, physics, biology, and political science (CDL, n.d.-b).

7.4.2 Pathways and Partnerships can be Created with the Public and Not-for-Profit Sectors

As noted in Section 4.2, the public sector is an important employer of PhDs in Canada. Several programs exist with the aim of attracting highly educated people interested in launching careers in the public service. For example, the Government of Canada’s Recruitment of Policy Leaders program is an annual campaign to recruit master’s and PhD graduates into mid- to senior-level policy roles (Public Service Commission of Canada, 2019). The program is highly competitive. During the 2017–2018 campaign, a total of 1,633 people applied, of which 21 were hired (Public Service Commission of Canada, 2019). Data indicate that the program is viewed favourably by both senior policy executives and program alumni, and that it has been successful in attracting qualified candidates who subsequently advance their career within the public service (Public Service Commission of Canada, 2019). In addition to Recruitment of Policy Leaders, a number of federal departments host their own separate recruitment programs (e.g., Natural Resources Canada’s Policy Analyst Recruitment and Development Program and the Department of National Defence’s Policy Officer Recruitment Programme). The Canadian Science Policy Fellowship (CSPF) administered by Mitacs has also been created to attract PhDs from all disciplines (Mitacs, 2020a). The CSPF offers 12-month positions to PhDs within participating federal and provincial government offices. It is a mutually beneficial program, in that it exposes governments to the latest academic research and expertise, and increases the capacity of these organizations to respond to emerging policy issues. In turn, PhDs have the chance to expand their skill sets in the field of policy development, gain relevant workplace experience, and build professional networks outside of academia (Mitacs, 2020a).

As discussed in Chapter 6, many PhD graduates, particularly in STEM fields, express a strong interest in pursuing opportunities abroad. Programs that enable participation in international policy can provide opportunities in the public

service while also establishing links between Canada and other countries. For example, the Science Diplomacy post-doctoral fellowship is a pilot program designed to offer internships for PhDs within Quebec government offices abroad. These internships, currently based in Germany and the United Kingdom, afford PhDs the opportunity to promote international research collaborations and support graduates in developing skills related to the development of partnerships across borders (Gov. of QC, 2018).

While the not-for-profit sector holds opportunities for PhDs, there are very few existing programs that support their transition into these areas, or help potential employers realize the benefits of hiring PhD graduates. In the Panel's view, cultural and media institutions, philanthropic organizations, and advocacy groups all stand to benefit from the diversity of skills offered by PhDs. However, many organizations do not realize this, nor do many graduates know how their skill sets could be advantageous to these organizations. Without opportunities to connect PhD students and graduates with the not-for-profit sector, this lack of awareness will stay in place. In the United States, the Mellon/American Council of Learned Societies (ACLS) Public Fellows Competition has worked to bridge this knowledge gap (Box 7.13).

Box 7.13 Mellon/American Council Learned Societies (ACLS) Public Fellows Program

The Mellon/ACLS Public Fellows Program "promotes the visibility and value of the humanities PhD beyond the academy by offering opportunities for PhDs to contribute to the public good while gaining career-building experience" through two-year paid placements (ACLS, 2019). Beginning in 2011, this program has grown steadily each year in the number of positions offered to PhDs from the humanities and social sciences. Host organizations must apply to participate in the program, demonstrating a commitment to mentorship and an ability to offer "a substantive portfolio of assignments that will foster the fellow's professional development" (ACLS, 2020). Selected organizations have included museums and archives, public radio and other media outlets, cultural and human rights organizations, among many others. To be selected for the program, fellows must undergo a rigorous application and interview process. Once selected, the fellows benefit from a number of professional growth opportunities provided by ACLS, in addition to the work placements (ACLS, 2019).

7.5 Summary

While the examples provided above are not exhaustive, the Panel believes that they illustrate the types of initiatives that could help PhDs overcome challenges as they enter the labour market. These programs focus on adapting PhD programs to a changing labour market, providing training in academic mentorship and supervision, and offering guidance on the academic-to-labour-market transition. Importantly, most of these programs engage students before graduation, in anticipation of their entry into the labour market. Moreover, the programs do not just target students and supervisors, but recognize that there is a need to approach this issue in a systemic way that includes several stakeholders: policy-makers; private sector leaders; and university staff, administrators, and faculty.

Many more promising approaches exist in Canada and internationally beyond those highlighted in this chapter. However, even with the growth of such programs, more can be done. While small, successful programs are crucial to transformation, their effectiveness to create systemic change depends on their widespread use. Furthermore, broad evaluations of programs and their impacts could lead to improvements that would guide the way forward in developing and investing in initiatives that promise to help the widest array of students. The challenges faced by PhD graduates are diverse, and require a range of initiatives to overcome them. By taking a holistic approach, PhD graduates may experience greater success in entering a labour market that has the motivation and the receptor capacity to absorb them, and that allows them to contribute their unique skill sets to Canada's economy.

Conclusion

- 8.1 Addressing the Charge
- 8.2 Knowledge Gaps
- 8.3 Panel Reflections

In recent years, an increasing number of people have graduated with PhDs in Canada, partly as a consequence of investments in research at universities, and partly because of efforts to increase Canada's supply of HQP. At the same time, PhDs are facing challenges with entering the labour market following graduation. There has been a stagnation or decline in the number of tenure-track academic positions for new graduates, but no evidence of greater uptake of PhD graduates into meaningful positions outside of academia. A lack of demand specifically for PhD graduates from employers, among other factors, is contributing to the underutilization of PhDs in the workforce. This has given rise to important questions for both students and Canadian society about the value of PhD training investments and about how to optimize students' education and experiences to ensure their potential contributions can best be realized in the Canadian economy.

Understanding the challenges faced by recent PhD graduates is not an easy endeavour. There is no single source of data that tracks all recent graduates across Canada on an ongoing basis. By reviewing a range of economic data sets and tracking studies, however, the Panel was able to examine the sectors that employ PhD graduates, unemployment statistics, and the average levels of compensation. The data allow for comparisons among disciplines or fields of study, as well as comparisons with other levels of education. Taken as an aggregate, PhDs experience lower levels of unemployment and higher earnings than peers with other credentials. Having said this, the data demonstrate that the younger cohorts of PhD graduates are not experiencing the same benefits in terms of employment. Furthermore, the economic return of obtaining a PhD compared to a master's is lower for those under 40 compared to the overall population.

The aggregate data mask important differences in the outcomes of PhDs in the labour market. When data on discipline and gender are considered, a range of experiences is revealed. Men with PhDs earn more than women across all disciplines, although there is evidence that the salary differential has narrowed for recent graduates who are employed full-time. In addition, women with PhDs are more likely than men to be working part-time, and unemployment rates are higher for women across most disciplines. There are also substantial differences in earnings in the first five years post-graduation linked to discipline or field; graduates in business have the highest earnings by some margin while those in the humanities and sciences have the lowest earnings. Additionally, while PhD and master's graduates in the sciences have earnings that are approximately equal for the first five years after graduation, for all other disciplines, PhD graduates have higher earnings.

Labour market indicators are important but tell only part of the story, since they cannot convey the range of experiences and emotions felt by graduates making the transition from studies to career. The Panel, therefore, chose to look at a range

of data sources and other evidence, including personal narratives, in order to provide the most comprehensive account of the challenges facing PhD graduates entering the labour market; at the same time, Panel members recognize there are many gaps in knowledge. In developing this report, the Panel hoped to convey the multiplicity of pathways and outcomes by drawing on diverse sources of quantitative and qualitative evidence. This evidence enabled the Panel to address the charge, outlined below, and to identify the key knowledge gaps that remain (Section 8.2).

8.1 Addressing the Charge

What are the main challenges that PhD students in Canada face in transitioning to the labour market, and how do these differ by field of study?

A central challenge faced by all PhDs is that the number of PhDs graduating from Canadian universities each year has consistently increased over the past two decades, but the availability of career positions, whether in academic or other sectors, has not kept pace. While the obstacles facing the transition of PhD graduates into various sectors are many, and vary as a function of discipline of study, there are some common themes. These common challenges are discussed here, with some differences among disciplines noted in the answers to the sub-questions.

A common challenge faced by many PhD graduates is the academic culture of the research environment at post-secondary institutions. Academic culture can promote a community for people with shared interests, enabling them to collaborate, to learn, and to develop and share new ideas. At the same time, it can contribute to challenges faced by people during and after their PhD training, particularly for those who do not want to stay in academia, or for those who feel as if they have “failed” in a broad sense if they do not succeed in reaching their desired academic career.

The PhD remains the primary pathway toward the academic professoriate in many disciplines, and traditionally, PhD programs have followed a model in which one generation of faculty trains the next. A PhD student’s supervisor plays a significant role in guiding them toward academic success, but also in shaping expectations and career ambitions. Supervisors have, for the most part, been trained by other professors with limited experience outside of academia. As such, they may be ill-prepared or even reluctant to prepare their students for careers in other sectors, which may demand different skill sets and different ways of approaching research and scholarship. Furthermore, supervisors may, either intentionally or unintentionally, project the view that the path they took

themselves (i.e., joining the professoriate) is the ideal. To counter this, many graduate departments in Canadian universities are offering training that teaches faculty various models of academic supervision, and guides them in improving their practice. One such example at Memorial University of Newfoundland is highlighted in Box 7.4 of this report. Furthermore, tools such as IDPs (Box 7.5) have been created in an effort to encourage and direct early conversations between supervisors and students relating to career plans.

Additional challenges facing PhDs are financial support and guidelines for time to completion, along with access to career development resources, which vary among institutions and departments. The result is that the experiences of PhDs transitioning to the labour market can be diverse. For example, depending on a student's financial situation, they may have limited professional mobility and be more inclined to accept temporary work. In general, the transition to the labour market occurs abruptly, and can involve a disruption of identity compounded with a period of underemployment or precarious employment. As such, as suggested in Chapter 7, many of the promising approaches for facilitating the career transitions for PhDs come into play long before graduation.

For international students enrolled in PhD programs at Canadian universities, other challenges have been identified, namely immigration and the resources needed to navigate the Canadian system. Access to Canadian funding for PDF positions can be challenging for international students, which can leave them disadvantaged and increasingly reliant on the funds of the principal investigator if they wish to remain in the academic labour market. It will be important to consider the unique needs of international students because they constitute a significant, and growing, portion of PhDs graduating from Canadian institutions.

What unique challenges do PhD graduates working in Canada face in launching their careers in academia?

Obtaining a PhD is a necessary step towards entering the professoriate in many disciplines, and a majority of PhD students in Canada express a desire to follow this path. However, the number of tenure-stream professors in Canada has been almost constant since 2009, with a declining number of assistant professor positions, which are almost always the first tenure-track position for new faculty. The combination of increased PhD production and declining numbers of new tenure-track professor positions has led to greater competition for fewer jobs. Furthermore, academia is an international labour market, and Canadian graduates are competing with graduates from all over the world for a diminishing number of positions. Looking forward, it is unlikely that the receptor capacity for tenure-track positions in Canada will grow in the foreseeable future, although some turnover will occur as senior professors decide to retire.

The challenge facing PhD graduates is not simply too few tenure-track positions, but also a belief that there are few meaningful jobs outside of academia where they would “fit in.” Academic culture can promote the idea that any career other than a tenure-track position for PhD graduates is a failure, and that seeking work outside academia is a betrayal of graduates’ and faculty ideals. This may be one reason that, in spite of the stagnant numbers of tenure-track positions, evidence suggests that approximately half of recent PhD graduates are working in higher education in one capacity or another. While some of these graduates are in meaningful long-term positions (e.g., administration, lab management), many hold temporary transitional roles that are not usually considered end-points in a career.

Research suggests that, three years after graduation, PhDs from most disciplines are more likely to be in precarious transitional roles (e.g., sessional instructor, PDF) than in tenure-track professor or researcher positions. Some PhD graduates take on consecutive transitional contracts at universities hoping to increase their chances of obtaining a tenure-track position, while others choose this route so that they can stay in academia, because they lack knowledge about employment elsewhere, or because they do not have the time or resources to seek alternative employment. In the sciences, PDF positions have previously been seen as a direct step towards a tenure-track position; however, most PDFs in Canada will not become professors. Evidence shows that PhD graduates in the sciences are most likely of all disciplines to be in transitional positions three years after graduation, and least likely to be full-time professors. The probability that a humanities or fine arts PhD will be in a transitional role three years after graduation is also high, while their probability of being a full-time professor is low. This is likely related to the rate at which humanities PhD graduates take on sessional positions. While there are no definitive data on exactly how many people in Canada are sessional instructors, the increased use of sessional instructors for undergraduate teaching, particularly in the humanities, suggests the numbers are on the rise. Evidence also indicates that, for many PhDs in such positions, this work is their primary form of income. Consecutive transitional positions may be associated with feelings of job insecurity, which is known to be correlated with the symptoms of chronic mental stress (e.g., depression, anxiety), physical health problems, and poorer self-rated health.

What unique challenges do PhD graduates working in Canada face in launching their careers outside academia?

Outside of academia, PhD graduates in Canada are finding employment in the private, public, and not-for-profit sectors as researchers, scientists, analysts, and managers among many other positions. Some, but not all, of these jobs require and/or benefit from a PhD. The increasing number of PhD graduates from

Canadian institutions represents an opportunity for growth in their employment in non-academic sectors, but evidence suggests these sectors are not capitalizing on this opportunity.

Private industry is the largest sector of employment for PhDs outside of academia; about one fifth to one quarter of recent graduates are working for private companies. There are significant differences based on discipline, however. Engineering graduates are more likely to find positions within the private sector by some margin, while humanities graduates are least likely.

R&D both inside and outside the academy enables innovation and supports the Canadian economy. While there are a significant number of PhD graduates working in R&D, not all research personnel have (or require) a PhD, nor do all PhDs working in the private sector work in R&D. Having said this, private sector R&D capacity is related to the overall private sector capacity for employing PhDs in Canada. Compared to the OECD average, Canada invests less money in R&D overall, and a significantly smaller proportion is done by industry and government in this country, while a larger proportion is done by academia. The difference is even more striking when comparing Canada to the United States. Additionally, the per capita number of researchers employed in Canada has been shrinking since 2010, but increasing in the United States and the OECD overall. Canada's unique R&D environment, which is smaller and relatively more heavily concentrated in universities compared to many of its peers, demonstrates that Canadian industry does not create the same pull for PhD graduates in comparison with other OECD countries.

A key obstacle facing PhD graduates transitioning out of academia is a lack of awareness about opportunities in other sectors, and on how best to pursue them. Many PhD graduates complete their studies without having learned the skill of networking or having formed any non-academic networks despite their importance for finding employment. Additionally, while PhD students graduate with a clear sense of the knowledge they have created and gained, they have less awareness of the skills they have acquired in the process, or how to communicate those skills to employers.

PhD graduates are also challenged by the fact that some private sector employers do not perceive any benefits in hiring them, believing that they come from “another world” and that they lack certain essential professional skills. This may be reflective of a skills mismatch in which PhDs have specialized knowledge but are seen by some employers as lacking adaptability as well as certain communication and teamwork skills. PhD graduates may also be lacking the abilities increasingly needed for 21st-century work, such as collaborating with

diverse actors and incorporating multiple perspectives from different disciplines and sectors.

Numerous programs have been developed that seek to address the disconnect between non-academic employers and PhDs. Among these are transitional initiatives that teach PhD students or recent graduates the essential skills desired by employers, or that create links between non-academic sectors and PhD students. The latter type of program can help create receptor capacity by demonstrating to employers that there are benefits to hiring PhD graduates. Many of these programs, such as the Arts Co-op program at UBC, are administered by the universities themselves, while others, such as Mitacs and the CREATE program, are being developed by government and non-government organizations.

Beyond these programs, there are also efforts underway to reinvent the PhD itself by rethinking its purpose and design in order to develop graduates who are better prepared to tackle 21st-century problems. For example, the Public Scholars Initiative (PSI) at UBC encourages students and faculty to engage in research that includes applied and/or mobilized scholarship with partners primarily from outside the university (e.g., communities, the private sector); the PSI's goal is to make a tangible impact for these partners, for students, and for society. In redesigning the PhD, universities may change the types of students drawn to PhD programs, reaching those who may not quite fit into traditional academic culture. This can also support EDI at universities by welcoming, and appealing to, people with a wider variety of experiences and backgrounds.

What are the key motivations behind the migration of PhD graduates in and out of Canada? Is brain circulation simply a feature of a highly globalized, knowledge-based economy, or is it caused by a lack of opportunities for PhD graduates?

Canada finds itself embedded in the global circulation of PhDs. Many Canadian post-secondary institutions are highly ranked globally, and the country benefits from a high quality of life and an overall favourable international reputation. For PhDs, this means that Canada can be seen as a place of choice for relocation; in addition, the strength of Canadian institutions creates an advantage for their graduates who are exploring opportunities at other prestigious research centres abroad.

Universities are becoming increasingly internationalized and this, combined with limited available full-time academic positions, has led to mobility being viewed as a requirement for PhDs seeking to remain in academia. In this respect, it is unsurprising to note that the majority of mobile PhDs identified in survey data are PDFs. For these individuals, the prestige of international institutions and faculty play a role in drawing them abroad following graduation, as they seek to maximize their chances of obtaining an academic position either back in Canada

or elsewhere. That being said, Canadian PhDs generally express a strong desire to return to Canada, should suitable employment opportunities become available.

International students graduating with PhDs from Canadian institutions also participate in global mobility, and are more mobile than their domestic (Canadian or landed immigrant) counterparts. This can be explained by the interplay of several factors: immigration barriers; a tendency for people who relocate for their studies to remain mobile (for numerous reasons); and a greater likelihood for international students to be in STEM fields (STEM graduates being more mobile) compared to domestic students. While evidence is not definitive, international PhD graduates from Canadian institutions who elect to stay in Canada tend to have lower earnings than domestic PhD graduates; data also suggest that those with the lowest earnings may therefore be choosing to leave.

The extent to which PhD graduates, whether international or domestic, leave Canada due to lack of opportunities could not be determined based on available data; however, qualitative evidence, based on narrative sources and quotes from interviews, does cite lack of opportunities as motivating factors for migrating, often to the United States.

8.2 Knowledge Gaps

The preceding chapters have made clear that significant data gaps prevent a fuller understanding of the paths taken by PhDs as they enter the labour market, and the challenges they face when beginning their careers. While data exist related to labour market outcomes of PhD graduates in general, data gaps make it challenging to conclusively answer some important questions, including where PhDs are employed (location and sector), how many are in transitional roles, and the average length of time it takes to launch a career post-graduation.

One key gap is detailed data on the employment of PhDs in Canada, including sector-specific information. The number of PhD graduates in transitional positions and the nature of jobs outside of higher education are particular blind spots. For example, no data are available on the number of PDFs in Canada or the number of Canadian PDFs abroad. Similarly, there are no definitive data on the number of sessional appointments in Canada. Little is also known about exactly what types of jobs PhDs hold outside of higher education, how these differ by discipline, PhDs' satisfaction with these jobs, and how these jobs link to their degrees, if at all.

A greater understanding of the trajectories taken by PhDs requires longitudinal data that follow the same individuals over time. The NGS provides a useful snapshot three years after graduation (when many PhDs may still be in a transition period); however, these cohorts are not monitored beyond this point.

The results from the ELMLP can provide insight, and this platform will be able to provide more information as more cohorts are tracked and for longer periods. As discussed in Chapter 5, at the time of this report's publication, the longest trajectory available in the ELMLP was five years (for the 2010 cohort), but evidence indicates that the transition period to the labour market takes longer for some PhD graduates. Longer-term data would also help determine if labour market advantages emerge later in a person's career (e.g., higher returns to experience related to having a PhD). Supporting qualitative evidence is also required to fully understand the particular challenges faced by PhD graduates entering the labour market, and to better understand non-quantitative measures of success (e.g., enjoyment in a career, having a position that utilizes skills).

There is a particular need for information related to PhD graduates from Canadian universities who leave the country, particularly those who work in the private sector. The ELMLP data do not include this information, since these individuals do not have Canadian earnings and therefore do not file Canadian tax returns. Evidence related to the motivations driving mobility, along with employment information (e.g., sector of employment, permanent or contract position) would be particularly relevant for this group. Similarly, data limitations exist for international PhDs; the Citizenship and Immigration Canada evaluation of the 2009–2014 federal international student program identified a need to collect data on international PhDs specific to level of study (GC, 2015).

Lastly, there is a need for information and data related to PhD students and graduates from underrepresented groups. While some research and data consider differences between the experiences of men and women, there is limited information related to other elements of diversity. This includes a lack of data related to students from racialized students, Indigenous students, LGBTQ+ students, and students with disabilities. Without reliable information, it is challenging to develop effective policies and solutions to problems that these particular groups of students face, or to effectively work towards EDI.

In an effort to increase data collection, many universities have begun to monitor their own alumni (e.g. McGill, UofT, UBC, and UofA). These studies have provided useful evidence throughout this report. Other surveys provided important insight, particularly in relation to mobility. The Panel recognizes that there are limitations with these data, however, that make it challenging to draw general conclusions. For instance, these surveys do not poll the Canadian PhD graduate population comprehensively, but look only at specific universities (Porter *et al.*, 2017; Reithmeier *et al.*, 2019; UofA, 2019; Lee, 2020), specific disciplines (Franzoni *et al.*, 2012; TRaCE, 2016; Narayan, 2019), or provinces (Bangali *et al.*, 2019a).

Moving forward, Canada can learn from comprehensive surveys carried out in other jurisdictions (Boman, 2017; NSF, 2017, 2018), or those that are being initiated (Hancock *et al.*, 2019) for guidance on how to fill these data gaps. The Panel highlights that there are tremendous opportunities for future research to improve understanding of the experiences and labour market outcomes of PhDs graduating from Canadian universities.

8.3 Panel Reflections

PhD graduates in Canada are increasingly facing significant challenges as they enter the labour market following graduation. The labour market transition of these highly qualified individuals can be difficult and is a growing concern for universities, employers, funders, governments, graduates themselves, and the public. PhD graduates have high expectations of themselves and what they can accomplish; they want to make a difference. At the same time, many recent graduates find themselves unprepared for the workforce, or in a state of precarious employment without job security or prospects for a viable career that draws on their education and experience.

The PhD is usually a necessary credential for an academic position and, in many disciplines, PhD programs are typically designed to produce the next generation of professors. The Panel recognizes, however, that PhDs also benefit Canadian society and the economy more broadly; this can be enhanced by integrating PhDs more effectively into different sectors of the Canadian labour market. It is widely recognized that, in order to keep pace with peer countries, the Canadian economy needs to shift towards a greater concentration of knowledge-based companies that depend on a highly skilled and innovative workforce and support current and emerging industries. Canada's population of PhDs already has many of the skills needed to support this transition to a robust and resilient knowledge economy. They can be better prepared to do so if their capabilities are further enriched before they graduate, and if they are employed in jobs where they can apply their training and continue to develop their expertise.

The Panel found that the challenges faced by PhD graduates as they enter the workforce can be attributed to a range of factors. These include a misalignment of PhDs' own expectations with the realities facing them upon graduation. In addition, supervisors, graduate programs, funders, and universities are generally not oriented to supporting students' development of the full breadth of competencies and mindsets relevant to diverse careers. Organizations outside of academia that employ (or could employ) PhDs often do not recognize the value of the degree, though there are programs in place and under development to provide opportunities to facilitate such labour market transitions. The interconnectedness

of PhDs with the labour market system means that all of these players have a role in addressing the challenges facing PhDs as they launch their careers.

Panel members appreciated the opportunity to work collaboratively on this important issue, and have benefited from the diverse perspectives around the table. Throughout their work on this report, Panel members were motivated by a double duty of care. First is a responsibility for the advancement of young researchers who complete PhD programs across the country and in all the academic disciplines. Having invested four or more years to earn their PhDs, these graduates have merited a real shot at remunerative, worthwhile, and fulfilling careers. The second duty of care is to the advancement of society, the economy, and the natural environment. If they can develop their careers, Canada's PhD graduates have the expertise, knowledge, and drive to contribute significantly to the social, economic, and environmental health of Canada and the world.

The Panel believes there is a great deal of promise for the future. The growing knowledge economy demands a highly skilled and creative workforce and the PhDs graduating from Canadian institutions can play a key role in tackling the challenges facing Canada in the 21st century. Many PhD graduates are already making an impact across multiple sectors of the Canadian economy. There are promising practices within and outside of universities that promote a more student-centric approach to PhD education, considering both students' innate abilities and their career aspirations. Some of these practices support the development of transferable skills needed in the workforce; others are rethinking the nature of the PhD itself to enhance its relevance and better serve a more diverse pool of students and the evolving needs of society. Work-integrated learning programs are building skills and knowledge and also creating links between industry and academia. These and other promising approaches are important, but more widespread action would be beneficial. Programs, both large- and small-scale, and both pan-Canadian and local, can adapt to meet the present and future needs of graduates and Canada more broadly. It is hoped that this report will be a catalyst to help accelerate the initiatives and good work that are underway across Canada to address the challenges facing PhDs as they move into the labour market following graduation.

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Appendix

Here, the Panel provides further details on the methodology underlying its estimated returns to a PhD (Section 5.3). The foundation of the analysis is a conventional human capital earnings function:

$$\ln Earnings_i = \alpha_0 + \alpha_1 EXP_i + \alpha_2 EXP_i^2 \beta_1 EDI_i + \cdots + \beta_M Masters_i + \beta_{PhD} PHD_i + \gamma X_i + \varepsilon_i$$

This function relates the dependent variable, the natural logarithm of annual earnings, $\ln Earnings_i$, for individual i , to key human capital factors, notably experience and education. Given the logarithmic functional form, the coefficients can be (approximately) interpreted as the percentage rate of return to a given variable.¹ The key variables (regressors) are:

- Experience, or more accurately, potential labour market experience (EXP_i): As true labour market experience is not measured in the census, it is proxied by an individual's current age minus their age when they finished school (years of schooling plus five years). The specification includes the quadratic (squared) term EXP_i^2 to account for the fact that earnings grow with each year of work experience, but at a decreasing rate (i.e., earnings grow most quickly at the beginning of an individual's career). As is common, in this specification we restrict the returns to experience to be independent of the level of education.
- Education indicators: These are indicator (dummy) variables (e.g., EDI_i) that indicate an individual's highest degree (e.g., high school diploma, bachelor's, MBA), with master's and PhD represented by $Masters_i$ and PHD_i . The coefficients on these variables, β_M and β_{PhD} , capture the rate of return to that degree relative to our baseline category, a bachelor's degree.
- Other variables, observable and unobservable: The Panel employed a relatively sparse specification in order to estimate overall differences by degree type. The only additional controls included (X_i) are indicators for province/territory of residence. Finally, note that ε_i captures the unobserved determinants of earnings in this model.

The regression was estimated by Ordinary Least Squares (OLS), separately for men and women, and by census year. The model was also estimated on a subsample restricted to early career university graduates: those having at least a bachelor's degree and who are under 40 years of age. This enabled the returns to experience to be more specifically estimated on a sample of younger workers, earlier in their

¹ A difference in log earnings less than 0.20 is closely approximated by the corresponding percentage difference. For larger log differences, the corresponding percentage difference is higher (e.g., for 0.20 it is 22%, for 0.30 it is 35%, and for 0.40 it is 49%).

working careers. Finally, all samples are restricted to those who worked full year, full time in the reporting period (the year before the census).

Rather than report all of the individual coefficients (e.g., experience, education dummies), the Panel reports “packages” of these coefficients, combined into more meaningful magnitudes. These magnitudes, in turn, are the basis of the figures in Section 5.3. The Panel notes these estimates can only be interpreted as causal under the assumption that there are no systematically unobservable differences between PhDs and non-PhDs that would be reflected in differences in earnings.

The values reported are:

- *The economic return of a PhD*, defined as how much higher (or lower) earnings are for PhD graduates versus master’s graduates (excluding MBAs). The values (differences in log earnings) can be interpreted approximately as the proportionate difference in earnings between a PhD and a master’s graduate at any given level of experience.
- *The opportunity cost* of a PhD in terms of foregone labour market earnings. This value is based on estimated returns to experience, and on the assumption that a PhD takes five years to complete. In short, a master’s degree holder could gain five years’ work experience, or earn a PhD while gaining no labour market experience. This approach underestimates the opportunity costs of acquiring a PhD among the significant number of students who take longer than five years to complete their degree (Section 2.1.2).
- *The net return in the first year* is the difference in earnings between a new PhD graduate and a master’s graduate with five years’ experience. In other words, it is the economic return, minus the opportunity cost (in the first year following a PhD). Because earnings will grow faster at the beginning of a career, the master’s graduate will benefit from their head-start, but this benefit will fade as the PhD graduate accumulates experience. A negative value means that the earnings of a PhD one year after graduation are lower than a master’s graduate with five years’ work experience. In Figures 5.6 and 5.7, this is the difference in log earnings at the beginning of the comparison between master’s and PhD graduates.
- *The years to catch up*. In order to estimate the speed at which the earnings of PhDs will grow relative to those of master’s graduates, the Panel also calculated the number of years of experience it will take before PhD earnings surpass master’s earnings. If the PhD graduate starts out ahead of the master’s graduate, this number will be negative. Larger positive numbers indicate that it will take several years of work experience for the PhD to make up for the lost experience while earning their degree, combined with a relatively low return to the PhD. This magnitude is captured in Figures 5.6

and 5.7 by the point where the difference in master's and PhD earnings crosses zero.

The values of these magnitudes and their standard errors are listed in Tables A.1 (for men) and A.2 (for women). Also included in Tables A.1 and A.2 are the sample sizes analyzed and the percentage of these samples with master's degrees and PhDs.

Table A.1 Economic Returns, Opportunity Costs, and Net Return of a PhD versus a Master's, Men (Regression Table)

Census Year	Full Population			University Graduates Under 40		
	2006	2011	2016	2006	2011	2016
Percentage with a Master's Degree	4.8%	5.8%	6.0%	16.3%	17.7%	18.6%
Percentage with a PhD	1.2%	1.4%	1.2%	2.5%	2.5%	2.4%
Economic Return of a PhD	0.256* (0.024)	0.241* (0.025)	0.212* (0.023)	0.332* (0.043)	0.267* (0.060)	0.141* (0.051)
Opportunity Cost of a PhD	0.249* (0.005)	0.241* (0.006)	0.243* (0.005)	0.533* (0.064)	0.486* (0.065)	0.447* (0.064)
Net Return of a PhD After First Year of Work	0.008 (0.025)	.0005 (0.0257)	-0.031 (0.024)	-0.201* (0.073)	-0.219* (0.073)	-0.306* (0.085)
Years for PhD to Catch Up to Master's Holder	- 1.0 (3.3)	-0.1 (3.5)	4.2 (3.2)	7.8* (1.8)	10.1* (2.6)	16.1* (2.7)
Sample Size	112,886	114,269	112,717	10,491	11,863	12,610

Data Source: Panel analysis of PUMF data for the 2006 and 2016 Canadian censuses, and the 2011 National Household Survey

* Indicates statistically significant at the 5% level. Standard errors are reported in parentheses.

Table A.2 Economic Returns, Opportunity Costs, and Net Return of a PhD Versus a Master's, Women (Regression Table)

Census Year	Full Population			University Graduates Under 40		
	2006	2011	2016	2006	2011	2016
Percentage with a Master's Degree	4.6%	5.8%	6.9%	14.4%	15.9%	17.9%
Percentage with a PhD	0.6%	0.7%	0.8%	1.4%	1.5%	1.5%
Economic Return of a PhD	0.150* (0.032)	0.225* (0.034)	0.283* (0.027)	0.126* (0.059)	0.200* (0.067)	0.197* (0.055)
Opportunity Cost of a PhD	0.204* (0.005)	0.209* (0.005)	0.201* (0.005)	0.245* (0.063)	0.215* (0.064)	0.166* (0.053)
Net Return of a PhD After First Year of Work	-0.054* (0.033)	0.0163 (0.0345)	0.082* (0.027)	-0.119 (0.085)	-0.015 (0.087)	0.032 (0.074)
Years for PhD to Catch Up to Master's Holder	9.3* (5.6)	-2.8 (6.0)	-14.9* (5.0)	14.9* (7.5)	3.2 (16.4)	-24.4 (121.5)
Sample Size	84,590	90,428	89,957	10,049	12,612	13,820

Data Source: Panel analysis of PUMF data for the 2006 and 2016 Canadian censuses, and the 2011 National Household Survey

* Indicates statistically significant at the 5% level. Standard errors are reported in parentheses.

CCA Reports of Interest

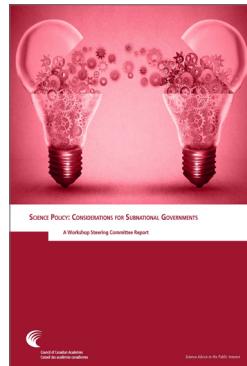
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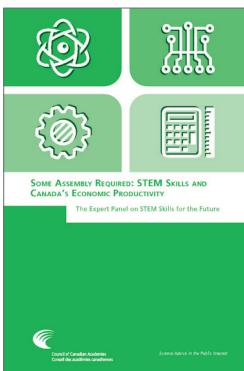
Competing in a Global Innovation Economy: The Current State of R&D in Canada (2018)



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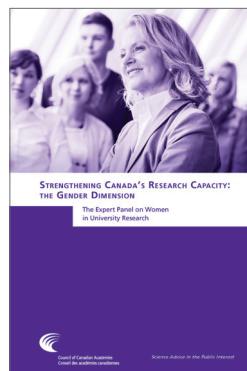
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