

The Ph.D. Dilemma in Canada Revisited

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ABSTRACT

Growth of doctoral studies at Canadian universities in the last two decades has resulted in the more than 1,000 programs that are now offered. Not surprisingly, the output of Ph.D. graduates has increased 6 fold since the early sixties. But during the seventies, an imbalance between the rising supply of Ph.D. 's and the declining demand for them, particularly in higher education, became apparent. This paper traces historical trends in the employment of Canada's Ph.D. holders, and looks at their prospects for the future.

Traditionally, about 65% of doctoral graduates have entered educational occupations. Today, because of the youthful age structure, there are few retirements or deaths, and hence, the annual replacement demand is for only about 500 Ph.D. 's. But Canadian universities now confer around 2,000 doctorates each year (including returning Canadians from abroad).

Moreover, this imbalance is apt to persist. On the basis of the current enrolment of 13,000, the Ph.D. supply has been projected from 1977-78 to 1981-82 for 45 disciplines. Relating these supply estimates to the likely demand for university teachers reveals a potential surplus in almost every discipline. A cycle of shortage and surplus appears to have developed in some fields. These simulations have been derived from assumptions, which are outlined in two appendices and 26 supporting tables.

In addition, this paper also examines other features of the Ph.D. situation in Canada: a history of the growth of graduate education; variations in the ratio of Ph.D. enrolment to graduates in different disciplines; support programs for doctoral students, and the immigration of university teachers.

The information provides an overview of the many dimensions of the Ph.D. issue.

RESUME

Le Dilemme du doctorat au Canada, revu —

La croissance de l'intérêt pour les études au doctorat a été telle au cours des deux dernières décennies, que plus de 1,000 programmes sont présentement offerts dans les universités canadiennes. D'où la constatation que le nombre de détenteurs d'un doctorat soit six fois plus grand depuis les années 60. Toutefois, au cours des années 70, un déséquilibre s'est manifesté, surtout dans le domaine de l'enseignement supérieur, entre le nombre croissant

* The views expressed by the author are his own and not necessarily those of Statistics Canada.

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de diplômés d'un doctorat d'une part et la demande d'inscription à ce même niveau d'autre part. La présente étude veut tout à la fois tracer les tendances historiques en regard de l'utilisation des diplômés d'un doctorat des universités canadiennes et jeter un regard sur les perspectives d'avenir.

Traditionnellement, environ 65% des diplômés d'un doctorat s'orientaient vers des carrières dites pédagogiques. A l'heure actuelle, à cause du jeune âge du personnel enseignant, on y compte peu de retraités ou de gens qui décèdent, ce qui explique des demandes annuelles de seulement 500 nouveaux diplômés d'un doctorat pour remplir les postes existants. Toutefois, les universités canadiennes décernent actuellement environ 2,000 doctorats par an (y compris les canadiens qui reviennent d'un stage dans un autre pays).

D'ailleurs, il est à prévoir que ce déséquilibre aura tendance à se perpétuer. En se basant sur les 13,000 inscriptions actuelles à des programmes de doctorat, une projection a été faite de l'offre des candidats en regard des années 1977-78 à 1981-82, pour 45 disciplines. En juxtaposant ces projections de l'offre par rapport à la demande probable pour des enseignants universitaires, un surplus se révèle dans presque toutes les disciplines. Un cycle de pénurie et de surplus paraît s'être développé dans certaines disciplines. Ces simulations proviennent des hypothèses contenues dans deux appendices et vingt-six tableaux ci-annexés.

De plus, cette étude se penche également sur d'autres aspects de la situation des doctorats au Canada: une histoire de la croissance de l'enseignement supérieur; des écarts dans le rapport des inscriptions au doctorat dans de différentes disciplines; les programmes de soutien pour des candidats au doctorat et l'immigration d'enseignants universitaires.

Ces informations fournissent un aperçu général des dimensions multiples de l'utilité du doctorat au Canada.

INTRODUCTION

By 1971, the imbalance between the growing supply of Ph.D. graduates and the declining demand for them, particularly in the university sector, had become apparent. The Economic Council explored this issue in a report published in *Canadian Higher Education in the Seventies* in 1972.¹ The information available then was limited, but now many of the questions raised can be answered more authoritatively on the basis of recent data. The purpose of this report is to provide that data, and at the same time, discuss some of the issues.

This report is organized into four sections and two appendices.

The first section presents a statistical outline of the Ph.D. situation in Canada: the Ph.D. population, (e.g. employment sector, occupation, immigration status and university teachers' characteristics), degrees granted, and employment trends.

The second investigates the enrolment pattern of full-time and part-time doctoral students by field of study and legal residence status. It also gives, on a provincial basis, the number of Canada Student Loan Plan recipients, and the number of Canada Council Doctoral Fellows, by discipline.

¹ "The Ph.D. Dilemma in Canada: A Case Study". This study also provided a selected bibliography on the subject in the Canadian context, p. 128-131.

The third section deals with the structure of doctoral programs at Canadian universities, particularly the increasing number of graduate programs, and discusses the growth pattern for selected disciplines. In addition, Ph.D. enrolment is related to the number of degrees granted by discipline.

The last section focuses on the anticipated supply and demand of Ph.Ds in the university sector from 1977-78 to 1981-82.

THE PH.D. SITUATION: BASIC STATISTICS

Employment

The Highly Qualified Manpower Survey of 1973 presented, for the first time, an excellent overview of how Canada's Ph.D. population was employed.² By 1973, according to this survey, 27,410 residents of Canada had earned a doctorate. Of those who were part of the labour force, 64.8% were working in education (Table 1). The various levels of government employed 14.7% (11.7% in the federal government alone), and the industrial sector accounted for about 13.5%.

An occupational breakdown reflects this distribution of Ph.Ds among employment sectors. About half (50.8%) were university teachers, while other educational institutions employed 4.4% (Table 2). In addition, 4.7% were educational administrators. Chemists, geologists, engineers, and similar scientific occupations constituted a large component (20.9%). Another group (7.8%) functioned as administrators and managers in both government and industry.

Replacement

A unique characteristic of Canada's Ph.D. population is its relative youth. In the educational sector, two-thirds are younger than 44, and their average age has been estimated at 40. This means that for the next ten to fifteen years attrition due to retirement and death will be low. The current annual attrition rate, about 1.3%, opens about 500 replacement positions for Ph.Ds in all sectors of employment each year. However, around 2,000 Ph.Ds become available for employment annually, and demand in education and government is not expanding. The imbalance is apparent.

But the present age structure suggests a substantial replacement demand for Ph.Ds in 15 years, particularly in education. Since the average time to complete a Ph.D. is five years from the masters or equivalent level, the question of supply needs to be explored before the late eighties.

Citizenship

In the past, Canada has relied heavily on immigrants for highly qualified manpower: 57.6% of the 1973 Ph.D. population were immigrants. In addition, a large number of Canadians have obtained their degrees abroad. The 1973 survey showed that 31.9% of the Ph.D. population, including Canadian citizens and landed immigrants, completed their doctoral studies in the United States, and 22.9% in Europe (Table 3).

² Highlights of this information have been discussed in a separate article "Profile of Ph.Ds in Canada", *Canadian Statistical Review* (July 1976).

TABLE 1

EMPLOYMENT OF PH.DS BY INDUSTRIAL
SECTOR AND BY AGE, 1973

INDUSTRIAL SECTOR	YOUNGER THAN	34 - 44	OLDER THAN	NUMBER	PERCENT*
	34 %		44 %		
Primary industries (e.g., agriculture, mining)	19.6	37.1	43.3	485	(1.8)
Manufacturing	26.7	36.4	36.4	1,290	(4.9)
Service industries (e.g., transportation, trade, finance)	24.7	27.2	46.9	395	(1.5)
Education and related	24.1	43.0	33.0	17,120	(64.8)
Health and Welfare Services	21.5	39.0	39.5	1,000	(3.8)
Religious Organizations	1.6	18.5	79.8	620	(2.3)
Other Services (e.g., community, business, personal)	18.2	20.5	56.8	225	(0.8)
Business Management	26.0	35.4	39.0	1,290	(4.9)
Federal Administration	20.5	37.3	42.0	3,090	(11.7)
Provincial Administration	24.5	34.7	42.2	735	(2.8)
Municipal Administration	30.0	40.0	40.0	50	(0.2)
Industry as unspecified or undefined	41.7	29.2	29.2	120	(0.4)
TOTAL	23.1	39.1	37.8	26,405	(100.0)

* Percentage in brackets provide breakdown by industrial sector.

Source: Statistics Canada, unpublished data.

Examination of the country of birth of foreign-born Ph.Ds reveals that 25.0% came from the United Kingdom, 24.5% from the United States and a similar proportion from other European countries combined (Table 4). Almost 45% of them entered Canada between 1966 and June 1971.³

University Teachers

Historically, more than half of the Ph.Ds have been employed as university teachers. During the last 20 years, Canadian universities underwent remarkable growth. The number

³ The mailing list for the Highly Qualified Manpower Survey of 1973 was derived from the 1971 Census. Consequently, no one with a Ph.D. who immigrated to Canada between June 1971 and fall of 1973 was included.

TABLE 2

SELECTED OCCUPATIONS OF PH.DS BY SEX, 1973

SELECTED OCCUPATION	MALE	PER- CENT	FEMALE	PER- CENT	TOTAL	PER- CENT*
Government Administrators	455	94.8	20	5.2	480	(1.8)
General Managers and Senior Officers	580	100.0	--	0.0	580	(2.2)
Administrators in Teaching	1,175	94.4	65	5.6	1,245	(4.7)
Other Managers and Administrators	915	94.3	55	5.7	970	(3.8)
Chemists	1,490	94.6	90	5.4	1,575	(6.0)
Geologists	605	99.2	10	0.8	610	(2.3)
Agriculturists and Related	570	100.0	--	0.0	570	(2.1)
Other Natural Scientists	1,150	94.3	75	5.7	1,220	(4.6)
Engineers, Architects, System Analysts	1,490	96.1	60	3.9	1,550	(5.9)
Economists	185	94.9	5	5.1	195	(0.7)
Psychologists	295	80.8	65	19.2	365	(1.4)
Judges and Lawyers	115	92.0	10	8.0	125	(0.5)
Other Social Scientists	200	78.4	60	21.6	255	(1.0)
Ministers of Religion	570	96.6	20	0.0	590	(2.2)
University Teachers	12,155	90.5	1,270	9.5	13,425	(50.8)
Elementary and Secondary Teachers	260	82.5	55	17.5	315	(1.2)
Post-Secondary Non-University Teachers	410	82.0	90	18.0	500	(1.9)
Other Teachers and Related	225	67.2	110	32.8	335	(1.3)
Physicians and Surgeons	320	95.5	10	4.5	335	(1.3)
Dentists	20	100.0	--	0.0	25	(0.1)
Pharmacists	50	76.9	10	23.1	65	(0.2)
Other Health Occupations	50	90.9	5	9.1	55	(0.2)
Writers, Editors and Related Occupations	140	77.8	35	22.2	180	(0.7)
Clerical, and Service	105	95.5	10	4.5	110	(0.4)
Military and Policy Officers	160	97.0	5	3.0	165	(0.6)
Other Occupations	205	97.6	10	2.4	210	(0.8)
Not Stated	105	84.0	20	16.0	125	(0.5)
TOTAL	23,985		2,165	9.0	26,405	(100.0)

* Percentage in brackets provide breakdown by occupation.

Source: Statistics Canada, unpublished data.

of full-time teachers increased sixfold, from less than 5,000 in 1956-57 to almost 30,000 in 1974-75 (Table 5). The most spectacular expansion took place in the social sciences, which grew from 931 to 9,863. In comparison, the physical and applied sciences increased from 1,491 to 6,637.

Between 1963-64 and 1972-73 the average annual increase in the number of university teachers was about 2,000, excluding the few hundred replacement positions that were filled. This meant that between 2,200 and 2,400 full-time teachers were hired each year, and approximately half had a Ph.D. Many of them were landed immigrants. According to immigration statistics, 17,713 immigrants whose intended occupation was university teaching were admitted to Canada between 1962 and 1974.⁴ Most came from the United

⁴ This refers to intention of immigrants, not positions obtained. There is another group of immigrants whose original intended occupation was not university teaching, but who were eventually employed by universities.

TABLE 3

GEOGRAPHIC ORIGIN OF PH.DS, 1973

	NUMBERS BY COUNTRY	NUMBERS BY REGION	PERCENT
Canada			
Atlantic Provinces	295 (2.5)		
Quebec	3,295 (28.4)		
Ontario	5,280 (45.5)		
Manitoba	370 (3.2)		
Saskatchewan	355 (3.1)		
Alberta	1,100 (9.5)		
British Columbia	900 (7.8)		
TOTAL, CANADA	(100.0)	11,595	42.4
United States		8,730	31.9
Europe			
Czechoslovakia	195 (3.1)		
France	815 (13.0)		
Germany	215 (3.4)		
Italy & Holy See	430 (6.9)		
Switzerland	170 (2.7)		
United Kingdom	3,820 (61.0)		
Others	615 (9.8)		
TOTAL, EUROPE		6,260	22.9
Australia & New Zealand		260	0.9
Asia (primarily India)		370	1.4
Other Countries (e.g., Africa, Latin America)		160	0.6
TOTAL, ALL COUNTRIES		27,410	100.0

Percentage in brackets provides regional breakdowns.

States (46.3%) and Great Britain (19.3%) (Table 6). Between 1972 and 1974, more than 1,200 immigrants whose intended occupation was university teaching entered the country each year, although the number of available positions had drastically declined. Unfortunately, information about the Ph.D. qualifications of landed immigrants who plan to teach at a university is not available. Table 7 shows characteristics such as average age and salary, proportion of females, and citizenship of university teachers in 1973-74. Faculties have been grouped into 47 disciplines under eight teaching fields. As an illustration, there were 1,465 (5.1%) faculty members teaching English; 1,229 (4.3%)

TABLE 4

FOREIGN BORN PH.DS BY COUNTRY OF BIRTH
AND PERIOD OF IMMIGRATION, 1973

	BEFORE 1955		1956-60		1961-65		1966-JUNE 1971		TOTAL NUMBER	PERCENT*
	NO.	%	NO.	%	NO.	%	NO.	%		
EUROPE										
United Kingdom	1,040	29.9	595	17.1	555	15.0	1,285	36.9	3,480	(25.0)
Germany	225	46.4	60	12.4	70	14.4	135	27.8	485	(3.5)
Soviet Union	335	77.9	30	7.0	15	3.5	50	11.6	430	(3.1)
Poland	225	63.4	40	11.3	20	5.6	70	19.7	355	(2.6)
France	85	27.0	20	6.3	75	23.8	125	39.7	315	(2.9)
Netherlands	145	56.9	60	23.5	45	17.6	15	5.9	255	(1.8)
Hungary	85	29.8	130	45.6	20	7.0	55	19.3	285	(2.0)
Czechoslovakia	70	21.5	5	1.5	10	3.1	225	69.2	325	(2.3)
Yugoslavia	60	57.1	5	4.8	15	14.3	20	19.0	105	(0.8)
Austria	70	66.7	10	9.5	10	9.5	15	14.3	105	(0.8)
Belgium	50	34.5	15	10.3	45	31.0	35	24.1	145	(1.0)
Greece	25	25.0	45	45.0	--	0.0	25	25.0	100	(0.7)
Spain & Portugal	10	10.0	15	15.0	25	25.0	50	50.0	100	(0.7)
Others: Europe	145	33.0	55	12.5	75	17.0	155	35.2	440	(3.2)
United States	435	12.7	220	6.4	600	17.6	2,110	61.8	3,415	(24.5)
India	60	5.7	95	9.0	250	23.8	665	62.4	1,050	(7.5)
China	80	16.7	50	10.4	125	26.0	215	44.8	480	(3.4)
Japan	25	18.5	--	0.0	25	18.5	80	59.3	135	(1.0)
Egypt & Libya	10	4.5	50	22.7	60	27.3	105	47.7	220	(1.6)
Other countries	60	10.3	75	12.9	140	24.1	295	50.9	580	(4.2)
TOTAL, ALL COUNTRIES	3,475	25.0	1,780	12.8	2,430	17.5	6,230	44.8	13,915	

*Percent in brackets show geographic distribution

psychology and 1,162 (3.5%) chemistry. Two-thirds were Canadian citizens, with some variations among disciplines; 13% were female, but women were concentrated in fine arts, modern languages, literature, education, social work, and household sciences.

The proportion who held a doctorate was 56.8% for all disciplines, with a high of 82.0% in the physical sciences.

Federal Government Employees

Traditionally, the federal government has also been a major employer of doctoral graduates. According to the Highly Qualified Manpower Survey, 3,090 Ph.Ds (11%) worked for the government in 1973. From Public Service Commission data it was possible to ascertain the length of employment and the discipline of study of the 2,293 hired under the Public Service Employment Act (Table 8).⁵

⁵ Since employees of a number of federal agencies such as the National Research Council, the Economic Council and crown corporations were not part of the "Data Stream" of the Commission, this figure underestimates the actual number of Ph.Ds in the public service. Moreover, some Ph.D.-holders in the government sector might not have identified themselves as such.

Table 5
Full Time University Teachers by Field of Study, 1956-57 to 1974-75

	Social Sciences	Increase over previous year	Humanities	Increase over previous year	Sub-total human sciences	Increase over previous year	Life Sciences	Increase over previous year	Physical and Applied Sciences	Increase over previous year	Sub- total Natural Sciences	Increase over previous year	Grand Total	Increase over previous year
1956-1957	931		1,181		2,112		1,370		1,491		2,861		4,973	
1957-1958*	1,028	97	1,280	99	2,308	196	1,275	- 95	1,565	74	2,840	- 21	5,148	175
1958-1959	1,126	98	1,380	100	2,506	198	1,181	- 94	1,638	73	2,819	- 21	5,325	177
1959-1960*	1,276	150	1,524	144	2,800	294	1,248	67	1,840	202	3,088	269	5,888	563
1960-1961	1,427	151	1,669	145	3,096	296	1,317	69	2,041	201	3,358	270	6,454	566
1961-1962*	1,630	203	1,878	209	3,508	412	1,432	115	2,232	191	3,664	306	7,172	718
1962-1963	1,834	204	2,087	209	3,921	413	1,546	114	2,423	191	3,969	305	7,890	718
1963-1964	2,210	376	2,484	397	4,694	773	1,740	194	2,691	268	4,431	462	9,125	1,235
1964-1965*	2,671	461	2,945	461	5,616	922	1,960	220	3,027	336	4,987	556	10,603	1,478
1965-1966	3,133	462	3,406	461	6,539	923	2,183	223	3,363	336	5,546	559	12,085	1,482
1966-1967*	3,904	771	3,994	588	7,898	1,359	2,651	468	3,843	480	6,494	948	14,392	2,307
1967-1968	4,676	772	4,583	589	9,259	1,361	3,121	470	4,323	480	7,444	950	16,703	2,311
1968-1969	5,424	748	5,073	490	10,497	1,238	3,596	475	4,771	448	8,367	923	18,864	2,161
1969-1970	6,430	1,006	5,850	777	12,280	1,783	4,087	491	5,472	701	9,559	1,192	21,839	2,975
1970-1971	7,528	1,098	6,626	776	14,154	1,874	4,789	702	5,661	189	10,450	891	24,604	2,765
1971-1972	8,598	1,070	6,972	346	15,570	1,416	5,244	455	6,149	488	11,393	943	26,963	2,359
1972-1973	8,846	248	7,138	166	15,984	414	5,493	249	6,393	244	11,886	493	27,870	907
1973-1974	9,257	411	7,048	- 90	16,305	321	5,834	341	6,400	7	12,234	348	28,539	669
1974-1975**	9,863	606	7,168	120	17,031	726	6,042	208	6,637	237	12,679	445	29,710	1,171

* Estimated.

** Includes for the first time Ryerson Polytechnical Institute with 623 faculty members, accounting for over 50% of the increase.

Source: Statistics Canada, unpublished data.

Table 6

Immigrants to Canada by Country of Last Permanent Residence and Intended Occupation: "University Teaching", 1962 to 1974

	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	Total 1962 to 1974
Great Britain Per Cent	95 24.4	160 29.7	195 29.0	271 25.0	353 25.0	457 23.6	545 23.9	499 20.8	284 15.1	143 10.5	117 11.3	155 10.5	140 11.7	3,414 19.3
France Per Cent	25 6.4	30 5.6	27 4.0	42 3.9	69 4.9	81 4.1	87 3.8	90 3.8	105 5.5	77 5.7	73 7.2	94 6.3	86 7.2	886 5.0
Other Western European Countries Per Cent	41 10.5	39 7.2	58 8.6	77 7.1	97 6.9	142 7.2	175 7.7	157 6.5	155 8.2	61 4.5	75 7.3	96 6.5	92 7.7	1,265 7.1
India, Pakistan Per Cent	14 3.6	38 7.1	31 4.6	81 7.5	86 6.1	131 6.6	99 4.3	177 7.4	120 6.4	87 6.4	54 5.2	89 6.0	56 4.7	1,063 6.0
Other Asia Per Cent	4 1.0	14 2.6	6 0.9	27 2.5	49 3.5	89 4.5	124 5.4	128 5.3	166 8.8	80 5.9	53 5.1	180 12.2	113 9.4	1,033 5.8
United States Per Cent	174 44.6	208 38.6	267 39.7	477 44.0	615 43.6	857 43.2	1,013 44.4	1,040 43.4	918 48.7	774 57.0	556 53.9	708 47.8	588 49.1	8,195 46.3
All other countries Per Cent	37 9.5	50 9.3	88 13.1	109 10.1	141 10.0	229 11.5	237 10.4	307 12.8	138 7.3	136 10.0	103 10.0	159 10.7	123 10.2	1,857 10.5
TOTAL	390	539	672	1,084	1,410	1,986	2,280	2,398	1,886	1,358	1,031	1,481	1,198	17,713

Source: Department of Manpower and Immigration, unpublished Data.

Table 7
 Characteristics of University Teachers by Discipline, 1973-74

Discipline	Number	Percent	Percentage with Doctorate	Average Age	Average Salary \$	Percentage Canadian Citizen	Percentage Female
Physical Education	632	2.2	29.3	—	15,659	—	—
Education	2,050	7.2	43.5	—	18,255	—	—
Sub-total Education	2,682	9.4	40.1	40.6	17,632	76.3	21.3
Music	425	1.5	22.8	—	15,670	—	—
Fine & Applied Arts	623	2.2	15.9	—	15,408	—	—
Sub-total fine Arts	1,048	3.7	18.7	39.9	15,513	59.6	18.7
Classics	269	1.0	62.0	41.5	17,826	—	14.9
History	1,037	3.6	68.0	39.4	17,320	66.2	7.8
Library and Records Science	93	0.3	23.9	44.8	18,314	—	50.0
Mass Media Studies	83	0.3	17.7	40.7	16,829	—	5.0
English	1,465	5.1	60.7	40.6	16,814	59.4	20.2
French	776	2.7	47.8	40.4	16,099	63.1	28.6
German	224	0.8	72.3	41.3	16,597	—	23.0
Spanish	156	0.6	52.3	40.6	15,738	—	28.1
Other Modern Languages	667	2.3	49.9	40.2	16,581	—	19.9
Philosophy	693	2.5	67.0	39.9	17,934	59.4	5.4
Religious Studies	537	1.9	60.1	43.0	16,436	—	4.7
Sub-total Humanities	6,000	21.0	58.9	40.5	16,904	62.1	16.6
Anthropology	331	1.2	61.8	38.6	16,834	41.0	17.8
Area Studies	119	0.4	62.8	—	17,701	—	—
Commerce, Business Administration	1,051	3.7	39.1	37.4	17,727	72.1	4.6
Economics	904	3.1	63.8	38.3	18,563	63.3	4.2
Geography	609	2.1	66.7	37.4	17,250	53.7	3.6
Law	504	1.8	16.5	35.5	19,007	77.1	5.4
Political Science	691	2.4	58.6	38.0	17,736	64.4	7.4
Psychology	1,229	4.3	77.0	37.2	17,173	58.2	15.9
Social Work	289	1.0	23.4	42.6	17,917	81.3	33.2
Sociology	848	3.0	55.7	38.1	16,491	55.5	14.7
Sub-total Social Sciences	6,575	23.0	55.4	37.9	17,607	62.3	10.2

Table 7 (con't)
 Characteristics of University Teachers by Discipline, 1973-74

Discipline	Number	Percent	Percentage with Doctorate	Average Age	Average Salary \$	Percentage Canadian Citizen	Percentage Female
Agriculture	412	1.5	79.8	43.4	19,797	80.8	3.0
Biology	697	2.4	83.1	40.6	18,767	65.8	10.5
Botany	191	0.7	89.2	40.6	18,367	—	11.9
Household Science & Related	238	0.8	38.9	41.0	16,087	—	77.8
Veterinary Medicine & Sciences	135	0.5	40.7	37.2	17,567	—	5.0
Zoology	315	1.1	89.2	40.1	18,391	61.4	8.7
Sub-total Biological Sciences	1,988	7.0	76.1	40.8	18,468	69.6	15.7
Architecture	188	0.7	7.7	40.1	17,474	—	3.8
Chemical Engineering	241	0.8	87.2	40.5	20,231	—	0.4
Civil Engineering	444	1.6	57.8	41.1	19,512	—	0.4
Electrical Engineering	286	1.0	72.7	40.2	19,600	—	0.7
Mechanical Engineering	331	1.1	63.6	40.9	19,629	—	0.3
Mining Engineering	109	0.4	72.6	41.3	19,943	—	0.9
Forestry	81	0.3	50.6	40.2	18,434	—	0.3
Other Applied Sciences	502	1.7	—	—	—	—	—
Sub-total Applied Sciences	2,182	7.6	59.7	40.6	19,175	72.3	0.7
Dentistry	260	0.9	18.7	41.4	22,201	—	9.2
Medicine	3,032	10.6	42.7	41.8	21,745	—	11.1
Nursing	431	1.5	3.9	39.1	13,333	—	98.7
Pharmacy	143	0.5	79.6	40.8	18,873	—	10.2
Sub-total Health Professions	3,846	13.5	38.2	41.4	20,764	73.4	20.6
Mathematics	1,315	3.9	78.2	37.8	18,016	57.3	5.3
Chemistry	1,162	3.5	90.3	39.9	19,449	66.4	5.7
Geology and Related	516	1.5	86.9	40.1	19,108	66.4	1.4
Physics	1,124	3.9	86.6	38.6	18,383	69.3	3.0
Sub-total Physical Sciences	4,218	14.8	82.0	38.9	18,618	63.2	4.1
GRAND TOTAL	28,539	100.0	56.8	40.0	18,369	66.3	13.0

Table 8

Employment of Ph.Ds by Year of Appointment and Discipline in Federal Departments under the Public Service Employment Act*, 1940 to 1972

	Before 1940	1940-49	1950-54	1954-59	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	Total
Humanities	5	14	15	14	2	1	3	4	1	3	3	4	3	11	7	7	12	109
Social Sciences																		
Economics	—	3	10	11	2	3	3	1	4	3	2	8	10	4	14	15	11	104
Sociology & Anthropolgy	1	1	—	1	2	1	—	1	1	1	1	3	2	2	4	2	2	25
Political Science	1	2	3	3	1	—	1	—	1	1	3	1	1	2	1	—	—	21
Psychology	—	1	2	—	—	—	—	—	1	—	1	1	2	3	3	1	—	15
Sub-total Human Sciences	7	21	30	29	7	5	7	6	8	8	10	17	18	22	29	25	25	274
Agricultural & Biological Sciences	26	135	136	120	21	21	30	12	28	54	66	57	49	31	25	23	13	847
Engineering	1	4	1	9	3	5	4	2	6	9	9	6	9	7	8	4	5	92
Physical Sciences																		
Chemistry	3	24	34	31	9	5	7	4	12	28	16	28	24	24	19	13	4	285
Geology & Related	1	20	34	24	9	10	11	4	9	15	10	20	9	14	6	10	9	215
Mathematics & Physics	1	9	16	9	7	2	2	5	5	5	8	8	9	13	17	6	5	127
Health Sciences																		
Dentistry	—	1	2	3	2	1	2	1	1	3	3	2	3	2	2	1	—	29
Medicine	—	16	20	32	2	5	7	6	4	8	12	5	5	6	6	3	3	140
Veterinary	10	44	61	41	7	10	7	8	13	10	14	8	18	16	8	4	4	263
Sub-total Natural Sciences	42	253	304	269	60	59	70	42	78	133	138	134	126	113	91	64	43	2,019
Grand Total	49	274	334	298	67	64	77	48	86	141	148	151	144	135	120	89	68	2,293

* Excludes National Research Council, Defense Research Board and all crown corporations.

Source: Adapted from a Table prepared by Dr. Valerie Sonnenfeld from unpublished Public Service Commission data.

During the sixties, about 100 Ph.Ds joined the federal public service annually. The number fell to 89 in 1971, and 68 in 1972.

In 1972, the overwhelming majority of the Ph.Ds employed by the government had obtained their degrees in the natural sciences: 2,019 (88%). The humanities and social sciences accounted for the remaining 12%.

Table 9 shows employment sectors of Ph.Ds immediately after graduation. In the early seventies, a very small percentage of the graduates in the humanities were employed by government. The percentage in the social sciences was somewhat higher, mainly due to economists. Fewer than 15% of the physical and applied scientists, who represented the largest group of Ph.Ds produced, joined the government during these years.

Unemployment – Under – utilization

Table 9 also shows the unemployment rate of Ph.Ds by field of study. The rates indicate that only a small number are actually unemployed; a more critical question is whether they obtain positions in which their training is effectively utilized. By virtue of their education, aptitude and motivation, Ph.D. graduates are able to displace masters and bachelors degree-holders. Under-utilization is more the issue than unemployment.

This topic has not received the attention it deserves. In recent years, one-third of the Ph.D. graduates in the natural sciences have continued their training as post-doctorals. It has been estimated that between 2,000 and 3,000 Ph.Ds are now engaged in post-doctoral studies, many of them in a kind of holding pattern, since viable employment opportunities are scarce.

Degrees

From 1960-61 to 1973-74, Canadian universities awarded 14,280 Ph.Ds, 60% of them between 1969-70 and 1973-74. The annual number increased from 300 during the early sixties, to almost 2,000 in the early seventies.

Table 10 shows the number of doctoral degrees awarded between 1960-61 and 1973-74 by broad field of study, and Table 11 gives the same information for selected disciplines. For the 14-year period, annual Ph.D. output in education increased from 7 to 120, and in engineering from 19 to 300. The number of Ph.Ds in mathematics rose from 10 to 150, and in psychology, from 20 to 150. It should also be remembered that in those years, a large number of Canadians obtained doctoral degrees abroad, particularly in the human sciences, and most of them returned to Canada.

During the sixties, almost three-quarters of the Ph.Ds awarded by Canadian universities were in the natural sciences, but this proportion has declined to two-thirds. The humanities and social sciences represent only 33% of Ph.D. output, although close to 60% of doctoral enrolment. This reflects a longer completion time, and a higher withdrawal rate.

Between 1964-65 and 1971-72, 10,876 new university positions, in addition to replacements, were created in the humanities and social sciences. But Canada produced only 2,627 Ph.Ds in these fields, including foreign students who returned home and graduates who might have accepted employment in industry and government. It is obvious, therefore, that there was a substantial scarcity of teachers with a Ph.D. Universities' short-term remedies were to hire landed immigrants, and lower the formal teaching qualifications. These practices had two results: 1) the proportion of foreign-

Table 9
 Employment Sector of Ph.Ds Immediately after Graduation from Canadian Universities
 by Field of Study, 1970-71 to 1974-75
 (in percent)

	Humanities					Social Sciences				
	1970-71	1971-72	1972-73	1973-74	1974-75	1970-71	1971-72	1972-73	1973-74	1974-75
University Teaching	84.8	83.5	70.2	66.1	52.6	74.3	63.3	59.2	51.9	51.9
Industry	—	—	—	0.8	3.6	1.6	1.6	4.7	3.8	5.3
Government	1.9	1.7	4.9	5.5	5.8	9.3	7.6	15.4	14.6	19.0
Private Research Institutes	1.9	1.1	2.7	2.0	4.5	2.7	4.0	3.0	6.6	5.5
Other (mostly in the educational sector)	5.1	9.7	13.8	18.9	19.4	9.8	20.7	14.5	20.3	6.3
Unemployed	6.3	4.0	8.4	6.7	8.1	2.2	2.8	3.2	2.7	2.9
Total Number	158	176	225	254	222	183	251	338	364	416
Number in Post Doctoral Studies*	4	3	5	4	4	14	11	12	16	20

* Those Ph.D. graduates who were pursuing post doctoral studies have been excluded from the percentage distribution.

Source: Adapted from data of the Canadian Association of Graduate Schools.

Table 9 (cont'd)
 Employment Sector of Ph.Ds Immediately after Graduation from Canadian Universities
 by Field of Study, 1970-71 to 1974-75
 (in Percent)

	Life Sciences					Physical and Applied Sciences				
	1970-71	1971-72	1972-73	1973-74	1974-75	1970-71	1971-72	1972-73	1973-74	1974-75
University Teaching	46.5	40.0	40.7	28.2	27.3	41.0	38.8	33.1	31.4	31.3
Industry	8.8	6.3	5.9	9.2	11.2	22.7	25.7	29.2	30.4	22.2
Government	22.3	18.0	18.6	30.1	21.5	14.7	12.9	13.2	14.3	14.8
Private Research Institutes	5.3	9.8	16.6	14.5	18.5	1.9	4.8	9.2	10.2	12.5
Other (mostly in the educa- tion sector)	9.4	21.0	12.2	15.3	14.1	9.1	10.9	11.3	9.1	11.7
Unemployed	7.6	4.9	5.9	2.7	7.3	10.5	6.9	4.0	4.6	7.4
Total Number	170	205	253	262	205	427	420	469	461	351
Number in Post Doctoral Studies*	126	131	160	152	99	232	249	277	244	164

* Those Ph.D. graduates who were pursuing post doctoral studies have been excluded from the percentage distribution.

Source: Adapted from data of the Canadian Association of Graduate Schools

Table 10

Doctoral Degrees Awarded by Field of Study, 1960-61 to 1973-74

	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
Humanities	57	42	57	52	74	87	94	96	119	157	188	208	231	235
Social Sciences	41	35	39	56	56	70	78	134	157	166	229	231	291	290
Education	7	17	12	13	22	25	39	73	60	78	77	109	123	120
Sub-total Human Sciences	105	94	108	121	152	182	211	303	336	401	494	548	645	645
Percentage Human Sciences*	(34)	(29)	(26)	(25)	(27)	(26)	(27)	(30)	(30)	(29)	(30)	(32)	(33)	(33)
Agriculture and Biological Sciences	57	67	100	99	97	125	115	154	173	235	276	240	249	250
Engineering and applied Sciences	19	20	26	46	45	83	105	103	168	188	225	261	300	300
Health Professions and Occupations	24	25	30	31	44	46	50	58	56	95	102	151	180	185
Mathematics and Physical Sciences	101	115	157	184	228	260	298	388	375	456	528	524	558	560
Sub-total Natural Sciences	201	227	313	360	414	514	568	703	772	974	1,131	1,176	1,287	1,295
Percentage Natural Sciences*	(66)	(71)	(74)	(75)	(73)	(74)	(73)	(70)	(70)	(71)	(70)	(68)	(67)	(67)
Grand Total	306	321	421	481	566	696	779	1,006	1,108	1,375	1,625	1,724	1,932	1,940

* Percentage breakdown between Human Sciences and Natural Sciences in brackets.

Source: Statistics Canada.

Table 11
 Doctoral Degrees Awarded By Selected Disciplines, 1960-61 to 1972-73

	Fine Arts	Economics & Business	Geography	Political Science	Psychology	Social Work	Agriculture	Medecine	Mathematics	Chemistry & Physics
1960-61	—	10	2	2	25	—	6	23	8	81
1961-62	—	5	3	1	20	1	16	25	10	93
1962-63	—	6	3	2	24	1	17	30	6	135
1963-64	2	7	3	2	35	—	17	27	21	142
1964-65	1	12	5	—	31	3	11	41	28	159
1965-66	1	14	3	5	44	—	16	40	34	177
1966-67	2	10	8	1	47	—	14	46	43	203
1967-68	—	20	10	10	82	3	15	52	49	276
1968-69	—	21	13	8	98	2	27	50	53	282
1969-70	3	15	14	18	86	2	60	87	61	332
1970-71	6	28	18	21	119	1	46	95	85	369
1971-72	6	27	22	31	109	1	52	134	97	356
1972-73	5	49	24	20	121	6	64	163	113	375
Total	26	224	128	121	841	20	361	813	608	2,980

Source: Statistics Canada

TABLE 12

FULL AND PART-TIME DOCTORAL STUDENT ENROLMENT
BY FIELD OF STUDY, 1969-70 TO 1975-76

ACADEMIC YEAR	HUMAN SCIENCES				NATURAL SCIENCES				TOTAL
	HUMANITIES	SOCIAL SCIENCES	SUB- TOTAL	ANNUAL PERCENTAGE CHANGE	PHYSICAL & APPLIED SCIENCES	BIOLOGICAL SCIENCES & HEALTH PROFESSIONS	SUB- TOTAL	ANNUAL PERCENTAGE CHANGE	
1969-70	2,779 (23.8)	2,852 (24.4)	5,631 (48.2)		3,915 (33.8)	2,101 (18.0)	6,016 (51.8)		11,649
				14.2				6.1	
1970-71	3,088 (24.1)	3,345 (26.1)	6,433 (50.2)		4,182 (32.6)	2,199 (17.2)	6,381 (49.8)		12,814
				7.9				-3.0	
1971-72	3,263 (24.6)	3,827 (28.8)	7,090 (53.4)		4,066 (30.6)	2,122 (16.0)	6,188 (46.6)		13,278
				6.5				-6.5	
1972-73	3,379 (25.4)	4,169 (31.3)	7,548 (56.7)		3,845 (28.8)	1,938 (14.5)	5,783 (43.3)		13,331
				2.9				-7.5	
1973-74	3,401 (25.9)	4,369 (33.3)	7,770 (59.2)		3,541 (27.0)	1,810 (13.8)	5,351 (40.8)		13,121
				2.1				4.2	
1974-75	3,295 (25.2)	4,640 (35.5)	7,935 (60.8)		3,352 (25.7)	1,774 (13.6)	5,126 (39.3)		13,061
				3.6				-0.3	
1975-76	3,288 (24.7)	4,934 (37.0)	8,222 (61.7)		3,284 (24.6)	1,826 (13.7)	5,110 (38.3)		13,332

*Figures in brackets indicate the percentage by field of study.

Source: Adapted from the Canadian Association of Graduate Schools data.

born university teachers increased rapidly for a number of years, a situation which had implications for Canada's cultural identity, and 2) some who were hired might have been better suited to other activities.

PH.D. ENROLMENT AND GOVERNMENT ASSISTANCE

Numbers

Doctoral enrolment trends form the basis of the future supply of Ph.Ds. In the early seventies, about 13,000 full- and part-time students were enrolled at Canadian universities. Unlike the sixties when enrolment increased rapidly each year, between 1970-71 and 1974-75 it levelled off but increased in 1975-76. The proportion of part-time doctoral students rose from 19.7% of full-time enrolment in 1969-70 to 33.6% in 1975-76.

There was a marked shift during the early seventies from the natural sciences to the humanities and social sciences. In 1969-70, the former accounted for 51.8% of all doctoral students, but the percentage declined to 38.3% in 1975-76 (Table 12). Conversely, the humanities and social sciences increased from 48.2% to 61.7%. In absolute numbers, enrolment in the physical and applied sciences fell from 3,915 to 3,284, whereas it rose from 2,852 to 4,934 in the social sciences, and has remained constant in the humanities and life sciences.

Geographic Location

Another important feature of Canadian doctoral enrolment is the fact that more than 50% of it is in Ontario universities. The University of Toronto alone enrolled more than 20% of all doctoral students (Table 13).

Citizenship

Expansion of Canadian graduate education at the doctoral level was achieved, to a large extent, with foreign-born graduate students frequently taught by foreign-born faculty. A large percentage of full-time doctoral students are non-Canadian (Table 14). In 1972-73, landed immigrants accounted for almost one-third, while another 15% were foreign students. Table 15 shows that Americans were the largest single group from abroad, constituting 12.6% of all enrolment, with a high of 22.7% in the humanities and a low of 2.6% in engineering. In contrast, doctoral students from Asian countries made up 13.3%, with a low of 2.7% in the humanities and a high of 32.5% in engineering.

Government Assistance

A possible contributing factor for the increased number of foreign-born doctoral students was the formula financing scheme in some provinces, which allocated funds to universities on a per-capita of enrolment basis. By 1975-76, Ontario universities were receiving about \$12,000 a year from the provincial government, for each Ph.D. student, in addition to tuition fees. Thus, it was in the universities' interest to expand doctoral enrolment. Moreover, there were support programs for graduate students.

Most doctoral students at Canadian universities have been supported by federal or provincial government fellowships, by teaching or research assistantships and scholarships

TABLE 13

FULL AND PART-TIME DOCTORAL ENROLMENT AT FIVE SELECTED
UNIVERSITIES* 1968-69 TO 1975-76

YEAR	ALBERTA	BRITISH COLUMBIA	MCGILL	MONTREAL	TORONTO	SUB- TOTAL	OTHER 22 UNIVERSITIES	TOTAL
1968-69	808 (8.4)	882 (9.2)	1,016 (10.6)	763 (7.9)	1,817 (18.9)	5,286 (55.0)	4,318 (45.0)	9,604
1969-70	961 (8.2)	1,015 (8.7)	1,327 (11.4)	883 (7.6)	2,290 (19.6)	6,476 (55.5)	5,201 (44.5)	11,677
1970-71	1,074 (8.4)	1,079 (8.4)	1,325 (10.3)	973 (7.6)	2,550 (19.9)	7,001 (54.6)	5,813 (45.4)	12,814
1971-72	1,077 (8.1)	1,061 (8.0)	1,314 (9.9)	1,000 (7.5)	2,647 (20.0)	7,099 (53.5)	6,169 (46.5)	13,268
1972-73	1,019 (7.6)	1,024 (7.7)	1,239 (9.3)	1,116 (8.4)	2,700 (20.3)	7,098 (53.2)	6,233 (46.8)	13,331
1973-74	942 (7.2)	948 (7.2)	1,202 (9.2)	1,174 (9.0)	2,724 (20.8)	6,990 (53.3)	6,131 (46.7)	13,121
1974-75	910 (7.0)	891 (6.8)	1,128 (8.6)	1,174 (9.0)	2,854 (21.9)	6,957 (53.3)	6,104 (46.7)	13,061
1975-76	895 (6.7)	836 (6.3)	1,082 (8.1)	1,372 (10.3)	2,821 (21.2)	7,006 (52.6)	6,326 (47.4)	13,332

*Figures in brackets indicate percentage distribution.

Source: Adapted from the Canadian Association of Graduate Schools data.

Table 14

CITIZENSHIP AND IMMIGRATION STATUS OF FULL-TIME MASTERS AND PH.D.
STUDENTS BY FIELD OF STUDY, 1972-1973
(in percent)

Field of Study	CANADIAN CITIZEN		LANDED IMMIGRANT		FOREIGN STUDENTS		NON-CANADIAN STATUS NOT REPORTED		TOTAL *	
	MASTERS	PH.D.	MASTERS	PH.D.	MASTERS	PH.D.	MASTERS	PH.D.	MASTERS	PH.D.
Education	81.1	69.9	12.1	20.7	6.3	8.6	0.7	0.8	1,468	618
Fine & Applied Arts	80.2	75.9	14.3	22.2	3.6	1.9	-	-	217	54
Humanities	73.4	56.4	12.6	30.0	12.9	10.9	1.1	2.9	3,114	1,777
Social Sciences	77.5	59.9	11.6	27.9	9.6	11.0	1.3	1.2	5,826	1,919
Agriculture & Biological Sciences	76.2	53.0	12.4	31.6	8.8	12.8	1.6	2.6	969	830
Engineering	51.5	33.8	28.2	43.3	18.8	19.7	1.5	3.2	1,759	1,043
Health Professions and Occupations	75.5	61.3	19.0	29.6	5.3	7.9	0.2	1.2	485	432
Mathematics and Physical Sciences	64.6	45.4	20.6	40.9	12.7	12.3	2.1	1.4	1,598	1,852
TOTAL	72.6	53.0	15.1	32.9	11.0	12.1	1.3	2.0	15,114	8,395

* The legal status of graduate students was available for only about 80% of the master's and doctoral students.

Source: Statistics Canada, unpublished data.

Table 15

CITIZENSHIP OF FULL-TIME PH.D. STUDENTS BY COUNTRY AND
FIELD OF STUDY, 1972-1973
(in percent)

FIELD OF STUDY	CANADA	UNITED STATES	UNITED KINGDOM	FRANCE & OTHER EUROPEAN	CARIBBEAN	CENTRAL & SOUTH AMERICA	AFRICA	SOUTH PACIFIC	ASIA	TOTAL * NUMBER
Education	70.5	10.8	3.6	2.1	0.8	0.2	2.4	3.9	5.7	614
Humanities	57.2	22.7	6.8	5.7	1.0	0.6	1.4	1.9	2.7	1,751
Social Sciences	60.9	15.9	6.2	4.9	0.5	0.3	2.7	1.9	6.8	1,888
Agriculture and Biological Sciences	53.9	12.0	8.2	4.2	0.7	0.6	2.7	2.6	15.2	817
Engineering	34.7	2.6	4.2	10.1	0.3	2.0	11.8	1.8	32.5	1,017
Health Professions and Occupations	61.6	4.8	3.6	7.4	1.4	1.5	1.1	1.7	17.0	927
Mathematics and Physical Sciences	46.8	8.0	9.6	7.0	0.6	1.5	2.0	2.8	21.7	1,798
TOTAL	53.8	12.6	6.9	5.9	0.7	0.9	3.5	2.4	13.3	8,442

* The information was available for about 80% of the full-time doctoral students.

Source: Statistics Canada, unpublished data.

from the universities, or by student loans. It has been estimated that 50% to 75% of doctoral students in the physical and applied sciences have obtained funding through National Research Council grants. (The exact number is difficult to determine because National Research Council support could consist of either direct fellowships to students, or research grants provided to universities or individual faculty members, which enable them to hire doctoral students as research assistants.) Consequently, in most of the natural sciences doctoral students have experienced little difficulty obtaining financial support to cover their living and transportation expenses. By contrast, only one-third of the full-time doctoral students in the humanities and social sciences have been supported by the Canada Council. Others have received fellowships from the provinces, or have benefited from the federal Canada Student Loan Plan.

The Canada Council increased the number of fellowships in the humanities and social sciences from 426 in 1965-66 to a high of 2,456 in 1970-71; they declined to 1,387 by 1975-76. Table 16 shows the number of Canada Council doctoral fellowships by discipline between 1965-66 and 1975-76. An estimated one-third of the full-time doctoral students at Canadian universities were benefiting each year from the Council's Program.

The federal Canada Student Loan Plan has made it possible for doctoral students to borrow interest-free \$1,000 to \$1,800 annually (up to a present maximum of \$9,800), depending on the province (excluding Quebec), and the year the loan was granted. The percentage who have done so is comparatively low. As an illustration, during the late sixties and early seventies, there were about 10,000 full-time doctoral students at Canadian universities each year, out of which only a few hundred took advantage of the Canada Student Loan Plan. Table 17 gives the number of Canada Student Loan Plan certificates issued, by province: a total of 373 in 1964-65 which increased to 3,238 in 1974-75. The majority, 3 035, went to Ontario residents. The number of certificates in Ontario had risen from 504 in 1971-72 to 2,177 the next year, reflecting a change in the Ontario Student Assistance Program so that it consisted of an \$800 loan and a grant of up to \$600.

The Canada Student Loan Plan also offered financial assistance for doctoral studies abroad. In 1967-68, of the 593 recipients, 29.7% were studying in the United States, 10.6% in the United Kingdom, and 3% in other countries (Table 18). Six years later, in 1973-74, the number of loan recipients had increased to 2,656. However, of the 2,451 studying in Canada, 2,275 were in Ontario. Studies abroad had declined: 4.2% in the United States, 2.2% in the United Kingdom, and 1.3% in other countries.

Since most doctoral students receive financial assistance from universities and federal and provincial sources, their main economic contribution to their education consists of foregone income.

DOCTORAL PROGRAMS

Historical Development

At present, 34 universities offer Ph.D. programs, most of which were created during the sixties and early seventies. This is a considerable change from 1944-45 when only five

TABLE 16
Canada Council Doctoral Fellowship Holders
By Discipline, 1965-66 to 1975-76

	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
Administrative Studies (1)	-	-	-	-	23	26	31	24	18	24	12
Business Administration	-	-	-	-	59	64	68	47	36	29	21
Anthropology (Archaeology)	9	36	55	79	86	99	96	90	75	76	74
Economics	53	125	181	234	207	215	182	135	113	95	79
Education (2)	-	-	-	-	58	92	93	137	157	144	152
Fine Arts	19	34	53	59	65	77	88	71	58	64	48
Geography & Demography	13	31	47	69	54	63	56	46	36	35	30
History	68	132	230	303	272	257	261	214	175	149	125
Classics	13	42	45	48	44	43	33	22	18	19	18
English	52	113	211	321	323	313	286	204	173	136	124
French	41	68	115	152	144	138	112	91	74	60	49
German	6	9	27	40	36	34	29	19	18	21	19
Other Foreign Languages	10	20	39	56	76	79	86	69	59	54	56
Law	3	14	27	51	48	40	26	34	34	31	34
Linguistics	4	26	41	69	82	68	66	44	42	33	35
Mathematics	2	2	12	16	36	44	44	32	27	19	14
Philosophy	32	84	151	219	190	183	170	117	100	81	86
Political Science	37	99	154	184	183	194	183	153	133	122	103
Psychology	25	29	51	110	122	167	200	183	175	170	173
Religious Studies (3)	-	-	-	-	50	55	58	43	40	31	26
Social Work	-	-	-	-	2	4	5	3	3	-	1
Sociology	39	85	115	176	163	165	166	133	120	102	78
Other (4)	-	-	-	-	45	36	56	44	38	39	30
TOTAL	426	949	1,554	2,183	2,368	2,456	2,395	1,955	1,722	1,534	1,387

* Between 1957-58 and 1964-65 a total of only 1,318 predoctoral fellowships were granted: 97 in 1957-58; 110 in 1958-59; 121 in 1959-60; 133 in 1960-61; 169 in 1961-62; 184 in 1962-63; 216 in 1963-64; 288 in 1964-65.

(1) Prior to 1969-70, Public Administration was included in Political Science and Business; and Administration often under Economics.

(2) Prior to 1969-70, Education was included in Psychology.

(3) Prior to 1969-70, Religious Studies were included in Philosophy.

(4) This category includes areas such as Urban and Regional Studies, Communication Studies, Criminology, Information Sciences, and Interdisciplinary subjects.

Source: Annual Reports of the Canada Council.

Table 17

Canada Student Loan Plan Certificates for Doctoral Students by Province, 1964-65 to 1974-75

	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75
Newfoundland	2	5	5	8	11	11	7	7	10	5	3
Prince Edward Island	1	3	3	1	2	—	2	6	6	2	3
Nova Scotia	23	19	9	24	22	32	29	40	27	45	20
New Brunswick	8	13	19	26	12	18	11	10	10	6	10
Ontario	244	208	127	258	162	185	348	504	2,177	2,472	3,035
Manitoba	14	20	34	32	24	35	35	32	36	28	55
Saskatchewan	9	23	23	28	24	30	29	16	28	10	17
Alberta	22	51	71	83	106	132	115	84	63	23	31
British Columbia	50	98	112	133	91	95	118	72	50	65	64
Total	373	440	403	593	454	538	694	771	2,407	2,656	3,238

Note: The province of Quebec does not participate in the Canada Student Loan Plan, but has its own student assistance program.

Source: Department of Finance

Table 18

Canada Student Loan Plan Doctoral Student Recipients by Province or Country of Study, 1964-65 to 1974-75

	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75
Newfoundland	—	1	1	1	—	1	—	2	4	7	12
Prince Edward Island	—	—	1	—	—	—	—	—	1	—	—
Nova Scotia	20	12	7	10	8	13	11	19	21	38	13
New Brunswick	2	10	8	9	5	6	4	6	5	5	4
Quebec*	10	11	12	10	9	12	9	11	38	51	88
Ontario	208	131	81	180	105	125	295	392	1,992	2,275	2,739
Manitoba	2	5	9	10	5	12	14	15	22	7	46
Saskatchewan	5	5	7	12	2	3	7	7	8	5	8
Alberta	13	24	32	46	63	80	70	53	61	31	39
British Columbia	6	48	51	58	32	34	69	41	27	32	19
Sub-Total - CANADA	266	247	209	336	229	286	479	546	2,179	2,451	2,968
United States	64	150	143	176	157	169	140	141	129	112	149
United Kingdom	17	29	32	63	52	65	60	62	65	59	61
Other	6	14	19	18	16	18	15	22	34	34	60
Total	373	440	403	593	454	538	694	771	2,407	2,656	3,238

* Quebec is not participating in the Canada Student Loan Plan

Source: Department of Finance

Table 19

Number of Canadian Universities Offering Master's
and Doctoral Degree Programs, 1944-45 to 1974-75

	<u>Master's degree</u>	<u>Doctor of Philosophy</u>
1944-45	17	5
1946-47	18	7
1950-51	22	13
1954-55	23	13
1958-59	28	16
1962-63	31	19
1966-67	38	24
1970-71	45	30
1974-75	52	34

Source: Association of Universities and
Colleges of Canada

Canadian universities had doctoral programs (Table 19).⁶ During the fifties there was little expansion, and fewer than 300 Ph.Ds were granted each year, most of them in the natural sciences.

The sixties was an era of dramatic increase in the number of doctoral programs. According to the Handbook of the Association of Universities and Colleges, in 1970, 851 different doctoral programs were in operation at 30 universities. By 1974 the number had increased to 1,146 (in addition to 2,000 masters programs), many of which have small enrolments (Table 20). Every province but Prince Edward Island, developed its own programs, without national planning or co-ordination.

Thus, 26 universities have doctoral programs in chemistry, 18 in English literature, 19 in history, 15 in geography, and 12 in sociology. Considering the many options in each discipline, the number of courses is very large.

This is illustrated by a subject like English Literature in which a student can specialize in areas ranging from Medieval studies to modern drama or poetry.

Chemistry, too, is divided into many sub-groups within the major branches. Although some specialties are in demand, a substantial number of doctorates are still produced in

⁶ Some of these graduate programs are given in affiliation with other universities.

Table 20

Number of Doctoral Programs at Canadian
Universities by Discipline, 1974-75

<u>Discipline</u>	<u>Number</u>
<u>Humanities</u>	
Fine and Applied Arts	18
Classics	5
History	30
English	16
French	9
German	8
Spanish	5
Other Modern Languages	11
Philosophy	21
Religious Studies	26
Other humanities	12
Sub-Total Humanities	131
<u>Social Sciences</u>	
Archaeology	7
Anthropology	8
Area Studies	45
Commerce and Business Administration	23
Economics	19
Education	84
Geography	27
Law	6
Political Science	19
Psychology	27
Social Work	4
Sociology	13
Sub-Total Social Sciences	282
<u>Biological Sciences</u>	
Agriculture	67
Biology	62
Botany	26
Household Science and related	12
Veterinary Medicine and Science	15
Zoology	8
Other Biological Sciences	14
Sub-Total Biological Sciences	204

Table 20 (con't)

<u>Discipline</u>	<u>Number</u>
<u>Applied Sciences</u>	
Architecture	1
Chemical Engineering	21
Civil Engineering	17
Electrical Engineering	20
Mechanical Engineering	18
Mining Engineering	5
Forestry	33
Other Engineering and Applied Sciences	101
Sub-Total Applied Sciences	216
<u>Medical Sciences</u>	
Dentistry	6
Medicine	84
Pharmacy	10
Other Medical Sciences	30
Sub-Total Medical Sciences	130
<u>Physical Sciences</u>	
Mathematics	25
Chemistry	26
Geology and related	15
Physics	46
Other Physical Sciences	5
Sub-total Physical Sciences	117
GRAND TOTAL	<u>1,146</u>

other disciplines where demand is subsiding. Therefore, shortages and surpluses can exist within one discipline. Since, for economic, political and structural reasons, Canada's chemical industry will not expand substantially, the question of how many universities should offer doctoral programs in chemistry has been raised.

A similar situation seems to have developed in engineering. Altogether, there are 216 different doctoral programs, including 21 in chemical engineering, 17 in civil, 20 in electrical and 18 in mechanical. Because Canadian industry has not hired many engineering Ph.Ds, positions are scarce; for lack of employment opportunities, some students have undertaken post-doctoral studies.

In the past, most Ph.Ds were employed in the university sector and others joined the

Table 21

RATIO BETWEEN PH.D. ENROLMENT AND PH.D.
AWARDS BY FIELD OF STUDY,
1969-70 TO 1974-75 (in percent)

	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	SIX YEAR AVERAGE	TOTAL DEGREES GRANTED
Education	11.6	8.3	11.0	9.9	10.8	7.8	9.9	599
Humanities	4.8	4.8	6.2	7.7	7.9	8.9	6.7	1,248
Social Sciences	7.4	6.2	7.1	7.2	8.6	8.5	7.5	1,355
Biological Sciences	12.9	16.6	17.2	20.3	22.2	20.4	18.3	1,117
Applied Sciences	12.0	16.6	16.3	20.6	23.2	23.3	18.7	1,455
Health Occupations	15.3	17.6	21.0	25.0	28.1	23.0	21.7	1,176
Physical Sciences	15.1	15.3	20.1	19.6	24.3	21.3	19.3	2,933
ALL FIELDS	10.5	11.0	12.7	13.4	15.0	13.8	12.7	9,883

Source: Derived from the Canadian Association of Graduate Schools' data.

government. The number of openings in these areas has diminished in recent years, and indications are that future job prospects are less than promising.

The present saturation of universities and government is particularly critical for humanities and most social science Ph.D.s; up to 90% of them were traditionally employed in these sectors, although actual numbers are small. Yet, in 1974-75, there were 131 different doctoral programs in the humanities and 282 in the social sciences.

The Ratio of Degrees to Enrolment

As a measure of output, the ratio of Ph.D.s granted to total enrolment for a six-year period has been estimated by field of study. To overcome the effect of yearly fluctuations, these calculations were based on a six-year average. Table 21 shows that about 20% of Ph.D. students have graduated each year in the natural sciences, compared with only 6.7% in the humanities and 7.5% in the social sciences.

In chemistry, for example, 23.3% received doctorates each year compared with 5.2% in political science and 5.5% in sociology (Table 22). Expressed differently, it would take a cohort of 100 chemistry doctoral students slightly more than four years to graduate, whereas similar cohorts in political science and sociology would take about 20 years. In absolute numbers, 204 Ph.D.s in chemistry were awarded each year between 1969-70 and 1975-76, but only 23 in political science and 20 in sociology.

A number of illustrations are of interest. Cumulatively, for a seven year period, there were 4,797 Ph.D. students in physics and 958 degrees were granted — 137 (20.0%) each year. Enrolment in English was greater — 5,630 students — but only 409 Ph.D.s or 58 (7.3%) a year were granted.

The ratio of enrolment to Ph.D. awards in most of the humanities and social sciences requires thoughtful analysis. More careful selection of students might lessen the drop-out rate (50%) and reduce the length of time for completion of a doctorate. Although the formal requirement from masters or equivalent standing to a Ph.D. is two to three years, the normal time is five years. By contrast, in most sciences the actual length of study is three years, with a withdrawal rate of less than 25%.

Differences in Ph.D. productivity have been attributed to the less formal structure of the humanities and social sciences, greater emphasis on the dissertation, and the newness of many doctoral programs. Whatever the reason, there is a need for change. From a student's point of view, an indefinite period of study is frustrating and costly, and from society's vantage point, it is also expensive. As previously mentioned, most provinces pay universities more than \$10,000 annually for each Ph.D. student.

But the small number of doctorates conferred in most of the humanities and social sciences in relation to Ph.D. enrolment in those disciplines may have been a blessing in disguise for the seventies. Otherwise, the number of Ph.D.s seeking employment would have been even larger.

The Irregular Supply of Ph.D.s

A cycle of shortage and surplus in the supply of Ph.D.s appears to be developing in some disciplines. In 1973-74 and 1974-75, fewer new doctoral students registered, than there were Ph.D.s granted. Only 1,545 new doctoral students enrolled in 1973-74, whereas 1,940 degrees were awarded. The figures for 1974-75 were 1,793 new students and

Table 22

RATIO BETWEEN PH.D. ENROLMENT AND PH.D. AWARDS BY
SELECTED DISCIPLINES, 1969-70 to 1975-76

	Seven Years TOTAL ENROLMENT	Seven Years TOTAL DEGREES GRANTED	PERCENTAGE	AVERAGE ANNUAL NUMBER OF DEGREES GRANTED
Classics	596	54	9.1	8
History	4,503	350	7.8	50
English	5,630	409	7.3	58
French	2,657	164	6.2	23
Modern Languages & Literature	2,327	159	6.8	23
Philosophy	3,247	254	7.8	36
Religious Studies	1,419	117	8.2	17
Anthropology & Archaeology	1,379	78	5.6	11
Commerce, Business Administration	646	55	8.5	8
Economics	2,395	150	6.3	21
Geography	1,744	168	9.6	24
Law	459	45	9.8	6
Political Science	3,093	161	5.2	23
Psychology	7,635	803	10.5	115
Sociology	2,570	141	5.5	20
Medicine	5,015	1,051	21.0	150
Pharmacy	823	193	23.5	28
Mathematics	4,479	664	14.8	95
Chemistry	6,111	1,425	23.3	204
Geology	1,694	256	15.1	37
Physics	4,797	958	20.0	137
ALL DISCIPLINES*	90,669	11,708	12.9	1,673

Source: Derived from the Canadian Association of Graduate Schools' data.

* Includes other disciplines not identified.

1,900 Ph.D.s granted (Table 23). Consequently, taking the drop-out rate for new students into account, there will be a substantial decline in the number of degrees conferred three to five years hence. Chemistry exemplifies this boom or bust cycle. For seven years Canadian universities awarded an annual average of 204 Ph.D.s, but in 1973-74 only 57 students enrolled; 103 in 1974-75 and 83 in 1975-76. Thus, a substantial decline in Ph.D.s is likely in three years. However, in 1975-76 the number of new doctoral students

Table 23
New Doctoral Students as a Percentage of Doctoral
Enrolment, 1973-74 to 1975-76

	1973-74			1974-75			1975-76		
	Enrolment*	New Students	%	Enrolment*	New Students	%	Enrolment*	New Students	%
EDUCATION	1,205	139	11.5	1,298	145	11.2	1,335	264	19.8
Fine Arts	92	8	8.7	92	3	3.3	147	18	12.2
Classics	81	7	8.6	65	6	9.2	68	10	14.7
History	677	59	8.7	657	71	10.8	645	92	14.3
English	875	98	11.2	853	113	13.2	816	152	18.6
French	362	24	6.6	344	34	9.9	357	37	10.4
Library Science	10	5	50.0	7	1	14.3	10	2	20.0
Modern Languages and Literature	442	30	6.8	404	31	7.7	400	46	11.5
Philosophy	470	42	8.5	460	61	13.3	453	56	12.4
Religious Studies	204	14	6.9	197	15	7.6	193	21	10.9
Other	20	5	25.0	32	3	9.4	75	6	8.0
HUMANITIES (Total)	3,233	290	8.4	3,111	338	10.9	3,164	440	13.9
Anthropology and Archaeology	198	19	9.6	214	30	14.0	258	23	8.9
Area Studies	198	14	7.1	210	29	13.8	178	17	9.6
Commerce, Business Administration	99	9	9.1	112	27	24.1	114	29	25.4
Economics	377	61	16.2	404	82	20.3	429	97	22.6
Geography	244	39	16.0	250	33	13.2	229	55	24.0
Law	60	2	3.3	67	11	16.4	63	7	11.1
Political Science	486	74	15.2	509	82	16.1	522	78	14.9
Psychology	1,153	139	12.1	1,217	195	16.0	1,326	294	22.2
Social Work	37	7	18.9	40	5	12.5	45	7	15.6
Sociology	421	51	12.1	421	61	14.5	449	77	17.1
Other	50	9	18.0	73	21	28.8	0	26	-
SOCIAL SCIENCES	3,323	424	12.8	3,517	576	16.4	3,613	710	19.7

Source: Derived from the Canadian Association of Graduate Schools' data.

* Both full and part-time doctoral students.

Table 23 (cont'd)

New Doctoral Students as a Percentage of Doctoral
Enrolment, 1973-74 to 1975-76

	1973-74			1974-75			1975-76		
	Enrolment*	New Students	%	Enrolment*	New Students	%	Enrolment*	New Students	%
BIOLOGICAL SCIENCES	923	139	15.1	1,000	142	14.2	1,087	224	20.6
APPLIED SCIENCES	1,263	150	11.9	1,158	132	11.8	1,267	165	13.0
Dentistry	10	1	10.0	12	1	8.3	12	2	16.7
Medicine	695	101	14.5	644	110	17.1	675	144	21.3
Pharmacy	101	9	8.9	91	14	15.4	91	25	27.5
Other	40	5	45.5	27	6	22.2	30	7	23.3
HEALTH SCIENCES	846	116	13.7	774	131	16.9	808	178	22.0
Mathematics	621	102	16.4	571	85	14.9	580	113	19.5
Chemistry	760	57	7.5	716	103	14.4	663	83	12.5
Geology	255	50	19.6	260	45	17.3	277	45	16.2
Physics	641	66	10.3	589	55	9.3	512	64	12.5
Other	51	12	23.5	67	36	53.7	26	20	76.9
PHYSICAL SCIENCES	2,328	287	12.3	2,203	324	14.6	2,058	325	15.8
TOTAL	13,121	1,545	11.8	13,061	1,793	13.7	13,332	2,306	17.3

Source: Derived from the Canadian Association of Graduate Schools' data.

* Both full and part-time doctoral students.

has increased to 2,306 or 17.3% of the total doctoral enrolment with considerable variations by discipline.

To this point, discussion has dwelt only on supply. Graduate students in chemistry, as in many other disciplines, have reacted to current diminishing employment opportunities by not continuing to the doctoral level, although information about the demand in three to five years is imperfect. This may be a wise course of action for individual students, but collectively, it creates recurring imbalances.

Universities might consider establishing ratios of the number of new Ph.D. students to the total enrolled. In 1973-74, this ratio was 11.8%, 13.7% in 1975-76 for all fields, but varied among disciplines. The problem is to determine the ideal ratio, taking both supply and demand into consideration. The next section simulates anticipated supply and demand for Ph.D.s for university teaching from 1977-78 to 1981-82.

PH.D. SUPPLY AND DEMAND IN THE UNIVERSITY SECTOR

The demand for Ph.D.s in the next five years is difficult to predict. It has been estimated that only 1.3% to 1.5% of the present 35,000 Ph.D. positions will have to be replaced each year — fewer than 500 annually for the next few years. This means that one out of four of the 2,000 new Ph.D.s produced each year will be absorbed as replacements for Ph.D. holders who retire, die, or withdraw for health reasons.

Historically, education and government have employed about 85% of the Ph.D.s in Canada. The present economic climate indicates that those two sectors will utilize a much reduced number of Ph.D.s. Austerity measures instituted by the federal and provincial governments will decrease employment opportunities in the public sector. The combination of financial constraints and demographic trends have the same effect on university teaching positions. Demographic patterns indicate that in a few years, the source population for post-secondary students (18-24 years old) will drop from 3.3 million to 2.7 million, and universities will have to anticipate a decline in enrolment, provided that the participation rate for post-secondary education does not change markedly.

A model, described in Appendices A and B,* simulates the supply and demand for Ph.D.s in universities. After adjustments for other employment possibilities the balance is considered a potential surplus.

The model treats each of the 42 discipline categories separately, and assumes that there is no substitutability among them. For example, a deficit in dentistry cannot be filled by a surplus in pharmacy. Tables 24 and 25 summarize the supply and demand pattern of Ph.D.s by discipline for university teaching, and serve as a basis for a five-year projection.

For most disciplines, the surplus is small in absolute numbers, but large in percentage terms. For example, there is a supply of 12 Ph.D.s in classics and a demand for 6, creating a surplus of 6 persons, but this means 50.0% under-utilization.

Between 1977-78 and 1981-82 there will be a cumulative surplus of 3,230 Ph.D.s, 1,780 in the natural sciences and 1,250 in the humanities and social sciences (Table 26). Only in the health sciences do supply and demand seem to balance more. Nevertheless,

* Copies of the Appendices are available from the Editor.

Table 24

Supply of Ph.D.s for University Teaching by Discipline, 1976-77

Ph.D. enrolment	Less Foreign Students		Withdrawal rate		Length of Study until graduation		
	in percent	balance	in percent	balance	years	Degree granted each year	
Humanities							
Fine & Applied Arts	147	5	140	60	56	5	11
Classics	68	10	61	30	43	5	9
History	605	10	544	40	326	5	65
English	816	10	734	55	330	5	66
French	357	10	321	55	144	5	29
Other Modern Languages and linguistics	472	10	431	60	172	5	34
Philosophy	453	10	408	45	224	5	45
Religious Studies	193	10	174	45	96	5	19
Others	50	10	45	45	25	5	5
Sub-total Humanities	3,161		2,858		1,416	5	283
Social Sciences							
Anthropology	218	10	196	50	98	5	20
Archaeology	40	10	36	50	18	5	4
Area Studies	210	10	189	50	94	5	19
Business Administration	114	10	103	50	51	5	10
Economics	429	10	386	50	193	5	39
Education	1,335	5	1,268	60	507	5	101
Geography	229	10	206	40	124	5	25
Law	63	10	57	50	29	5	6
Political Science	522	10	470	65	164	5	33
Psychology	1,326	10	1,193	45	656	5	131
Social Work	45	10	41	50	21	5	4
Sociology	449	10	404	65	141	5	28
Other	113	10	102	50	51	5	10
Sub-total Social Sciences	5,093		4,651		2,147	5	430
Applied Sciences							
Architecture	41	15	37	50	17	3	6
Chemical Engineering	187	15	159	15	135	3	45
Civil Engineering	195	15	166	15	141	3	47
Electrical Engineering	322	15	274	15	233	3	78

Table 24

Supply of Ph.D.s for University Teaching by Discipline, 1976-77 (cont'd)

	Ph.D. enrolment	Less Foreign Students		Withdrawal rate		Length of Study until graduation	
		in percent	balance	in percent	balance	years	Degree granted each year
Mechanical Engineering	177	15	150	15	128	3	43
Mining	111	15	94	15	80	3	27
Forestry	54	15	46	40	28	3	9
Other	134	15	114	50	57	3	19
Sub-Total Applied Sciences	1,221		1,040		819	3	274
Biological Sciences							
Agriculture	94	10	85	20	68	3	23
Biology	310	10	279	50	139	3	46
Botany	200	10	180	10	162	3	54
Veterinary Medicine	74	10	67	20	54	3	18
Zoology	240	10	216	20	173	3	58
Other	70	10	63	20	50	3	17
Sub-Total Biological Sciences	988		890		646	3	216
Health Sciences							
Dentistry	12	10	11	20	9	3	3
Medicine	668	10	601	25	451	3	150
Pharmacy	91	10	82	20	66	3	22
Other	40	10	36	20	29	3	10
Sub-Total Health Sciences	811		730		555	3	185
Physical Sciences Mathematics and related	570	15	484	35	315	3	105
Chemistry	663	15	564	15	479	3	160
Geology	277	15	235	50	117	3	39
Physics	512	15	435	30	305	3	102
Other	36	15	31	50	15	3	5
Sub-Total Physical Sciences	2,058		1,749		1,231	3	411
TOTAL	13,344		11,918		6,814		1,799

Supply of Ph.D.s for University Teaching by Discipline, 1976-77 (cont'd)

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Max Von Zur-Muehlen

	Returning Canadians			Sub- Total	Total Canadian and Foreign	Less already employed		University teaching	
	United States	United Kingdom	other countries			in percent	balance	in percent	balance
Humanities									
Fine & Applied Arts	5	2	4	11	22	15	19	90	17
Classics	2	3	1	6	15	15	13	90	12
History	8	4	4	16	81	15	69	90	62
English	6	5	2	13	79	15	67	90	60
French	2	1	4	7	36	15	31	90	28
Other Modern Languages and linguistics	3	1	4	8	42	15	36	90	32
Philosophy	5	6	8	19	64	15	54	90	49
Religious Studies	1	1	2	4	23	15	20	90	18
Others	2	1	1	4	9	15	8	90	7
Sub-Total Humanities	34	24	30	88	371	15	317		285
Social Sciences									
Anthropology	-	-	-	20	20	15	17	75	13
Archaeology	3	2	2	7	11	15	9	75	8
Area Studies	3	2	1	6	25	15	21	75	16
Business Administration	9	0	0	9	19	15	16	75	12
Economics	10	7	2	19	58	15	47	50	24
Education	15	3	2	20	121	15	103	50	52
Geography	3	2	3	8	33	15	28	75	21
Law	2	2	1	5	11	15	9	50	4
Political Science	5	5	6	16	49	15	42	75	32
Psychology	15	3	2	20	151	15	128	50	64
Social Work	1	1	1	3	7	15	6	75	4
Sociology	5	4	4	13	41	15	35	75	26
Other	3	1	1	5	15	15	13	75	10
Sub-Total Social Sciences	74	32	25	131	561		474		286
Applied Sciences									
Architecture	1	2	3	6	12	5	11	50	6
Chemical Engineering	3	3	0	6	51	5	48	50	24
Civil Engineering	3	3	0	6	53	5	50	50	25
Electrical Engineering	5	5	1	11	89	5	85	50	42

Table 24
Supply of Ph.D.s for University Teaching by Discipline, 1976-77 (cont'd)

	Returning Canadians			Sub- Total	Total Canadian and Foreign	Less already employed		University teaching	
	United States	United Kingdom	other countries			in percent	balance	in percent	balance
Mechanical Engineering	3	3	0	6	49	5	47	50	24
Mining	3	2	0	5	32	5	30	50	15
Forestry	1	1	1	3	12	5	11	50	6
Other	2	3	3	8	27	5	26	50	13
Sub-Total Applied Sciences	21	22	8	51	325		308		155
Biological Sciences									
Agriculture	6	1	1	8	31	5	29	50	14
Biology	5	3	1	9	55	5	52	50	26
Botany	8	3	1	12	66	5	63	50	32
Veterinary Medicine	3	1	1	5	23	5	22	50	11
Zoology	8	3	1	12	70	5	66	50	33
Other	2	3	1	6	23	5	22	50	11
Sub-Total Biological Sciences	32	14	6	52	268		254		127
Health Sciences									
Dentistry	1	1	1	3	6	5	6	50	3
Medicine	7	1	1	9	159	5	151	50	76
Pharmacy	2	1	1	4	26	5	25	50	12
Other	2	0	0	2	12	5	11	50	6
Sub-Total Health Sciences	12	3	3	18	203		193		97
Physical Sciences Mathematics and related	12	2	2	16	121	5	115	50	58
Chemistry	10	5	5	20	180	5	171	40	86
Geology	8	3	2	13	52	5	49	50	24
Physics	13	6	10	29	131	5	124	50	62
Other	5	2	2	9	14	5	13	50	6
Sub-Total Physical Sciences	48	18	21	87	498		472		236
TOTAL	221	113	93	427	2,226		2,018		1,186

Table 25
Demand and Supply of University Teachers with a Doctorate Degree, 1977-78

	New Growth	Replacement	New Total	Proportion with Doctorate	Effective Demand	Potential Supply	Surplus (+) Demand (-)	Percentage under-utilized
Education	44	29	73	50	40	52	+ 12	23.1
Fine and Applied Arts	18	12	30	50	19	17	- 2	
Classics	4	3	7	80	6	12	+ 6	50.0
History	16	10	26	80	21	62	+ 41	66.1
English	21	14	35	80	28	60	+ 32	53.3
French	12	8	20	80	16	28	+ 12	42.8
Other Modern Languages	15	11	26	80	21	32	+ 11	34.4
Philosophy	11	7	18	80	14	49	+ 35	71.4
Religious Studies	9	6	15	80	12	18	+ 6	33.3
Sub-Total Humanities	88	59	147	-	118	261	+143	54.8
Anthropology	5	4	9	75	7	21	+ 14	66.7
Area Studies	2	1	3	75	2	16	+ 14	87.5
Commerce, Business Administration	18	12	30	75	22	12	- 10	
Economics	14	10	24	75	24	32	+ 8	25.0
Geography	9	6	15	75	11	21	+ 10	47.6
Law	8	5	13	75	10	4	- 6	
Political Science	10	7	17	75	13	32	+ 19	59.4
Psychology	19	13	32	80	26	64	+ 38	59.4
Social Work	5	3	8	50	4	4	-	-
Sociology	13	9	22	75	16	26	+ 10	38.5
Sub-Total Social Sciences	103	70	173	-	135	232	+ 97	41.8
TOTAL HUMAN SCIENCES	253	170	423	80	312	562	250	44.5
Agriculture	5	4	9	80	7	14	+ 7	50.0
Biology	11	7	18	80	14	26	+ 12	46.2
Botany	3	2	5	80	4	32	+ 28	87.5
Veterinary Medicine	3	2	5	80	4	11	+ 7	63.6
Zoology	6	4	10	80	8	33	+ 25	75.8
Sub-Total Biological Sciences	28	19	47	-	37	116	+ 79	64.6

Table 25
Demand and Supply of University Teachers with a Doctorate Degree, 1977-78 (cont'd)

	New Growth	Replacement	New Total	Proportion with Doctorate	Effective Demand	Potential Supply	Supply (+) Demand (-)	Percentage under-utilized
Architecture	3	2	5	50	2	6	+ 4	66.7
Chemical Engineering	4	2	6	75	4	24	+ 20	83.3
Civil Engineering	6	4	10	75	8	25	+ 17	68.0
Electrical Engineering	6	4	10	75	8	42	+ 14	33.3
Mechanical Engineering	5	3	8	75	6	24	+ 18	75.0
Mining Engineering	2	1	3	75	2	15	+ 13	86.7
Forestry	2	2	4	75	3	6	+ 3	50.0
Other Applied Sciences	6	4	10	75	8	13	+ 5	38.5
Sub-Total Applied Sciences	34	22	56	-	41	155	+114	73.5
Dentistry	4	3	7	75	5	3	- 2	
Medicine	45	30	75	75	56	76	+ 20	26.3
Pharmacy	2	2	4	85	3	12	+ 9	75.0
Sub-Total Health Professions	51	35	86	-	64	91	+ 27	29.7
Mathematics and related	19	13	32	75	24	58	+ 34	58.6
Chemistry	17	11	28	90	25	86	+ 61	70.9
Geology and Related	8	5	13	90	12	24	+ 12	50.0
Physics	22	15	37	90	33	62	+ 29	46.8
Sub-Total Physical Sciences	66	44	110	-	94	230	136	59.1
TOTAL NATURAL SCIENCES	179	120	299	80	236	592	352	59.4
GRAND TOTAL *	446	300	746	-	560	1,194	+602	50.4

* Grand total includes demand and supply information for the "other" disciplines not identified.

Table 26

Supply and Demand of University Teachers with a Ph.D. Degree by Teaching Field, 1977-78 to 1981-82

	1977-78			1978-79			1979-80			1980-81			1981-82		
	Supply	Demand	Surplus(+) or Deficit(-)	Supply	Demand	Surplus(+) or Deficit(-)	Supply	Demand	Surplus(+) or Deficit(-)	Supply	Demand	Surplus(+) or Deficit(-)	Supply	Demand	Surplus(+) or Deficit(-)
Humanities	278	137	+141	278	137	+141	278	137	+141	278	137	+141	278	137	+141
Social Sciences	284	175	+109	284	175	+109	284	175	+109	284	175	+109	284	175	+109
Sub-Total Human Sciences	562	312	+250	562	312	+250	562	312	+250	562	312	+250	562	312	+250
Applied Sciences	155	41	+114	155	41	+114	155	41	+114	155	41	+114	155	41	+114
Biological Sciences	116	37	+ 79	116	37	+ 79	116	37	+ 79	116	37	+ 79	116	37	+ 79
Health Sciences	91	64	+ 27	91	64	+ 27	91	64	+ 27	91	64	+ 27	91	64	+ 27
Physical Sciences	230	94	+136	230	94	+136	230	94	+136	230	94	+136	230	94	+136
Sub-Total Natural Scs.	592	236	+356	592	236	+356	592	236	+356	592	236	+356	592	236	+356
GRAND TOTAL	1,194	548	+646	1,194	548	+646	1,194	548	+646	1,194	548	+646	1,194	548	+646

if some of the assumptions underlying the model change, the situation could be different. For example, universities simply might not hire new faculty although an increase in enrolment over the next few years is likely. Or, to economize, they might fill positions that become vacant through retirement and death with graduate students and part-time teachers. This is appealing for universities whose financial resources have been reduced in relative terms. It is even more attractive in view of the fact that as they acquire seniority, faculty move into higher ranks with higher salaries, compared to those of lecturers and assistant professors. As another economy measure, provincial governments and universities might consider a slight increase in the student-teacher ratio which would mean a substantial saving of positions each year.

The future prospect is that few teachers will be employed in relation to the total. This could have serious implications for the quality of university education in Canada. During the sixties, universities had to rely on less than fully-trained personnel to meet the growing demand, many of whom are still employed. Now when there is an adequate supply of Ph.D.s, even the best experience difficulty obtaining university positions. Without suitable employment it is difficult for them to keep abreast of research in their field, and there is a danger that their training may become obsolete.

The supply of Ph.D.s, at least for the next five years, can be projected more accurately because doctoral students now enrolled will still be in the system. Nevertheless, particularly at the discipline level, the figures are meant to indicate the magnitude of the problem rather than to predict precise numerical values. From a policy point of view this exercise should be regarded as only one type of analysis, which needs to be supplemented by information from other sources and judgmental considerations.

This simulation seems to indicate that the employment opportunities in the university sector for the next five years will be limited and many Ph.D. holders will have to pursue other career alternatives. This scenario does not only provide challenges for the individual Ph.D. recipient, but also to the universities as well as government and industry. They will have to develop new avenues of employment for this group of highly-skilled and motivated young Ph.D. holders.⁷

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