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THE AGING OF THE CANADIAN PROFESSORIATE A TECHNICAL NOTE

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THE AGING OF THE CANADIAN PROFESSORIATE A TECHNICAL NOTE

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MOSST

PREFACE TO SECOND DRAFT

The first draft of this paper, entitled "The Aging of the Canadian Professoriate -- is it a Problem?" has undergone the following modifications:

- provision of more details on the age projections to the year 2000, including: additional variants based on the assumption of rising student-teacher ratios; and statistical tables on the attrition assumptions. The reason for adding the other variants is to broaden the range of possible developments covered by the simulations

- deletion of the discussion and table dealing with turnover rates. It was decided to treat this subject more extensively in a separate note.

The helpful comments and suggestions by Dr. von Zur-Muehlen are gratefully acknowledged.

Introduction

Due to the expansion of the Canadian university system during the 1960s, a disproportionately large percentage of university teachers are now only at the beginning of their careers. This implies a very low rate of new job openings due to replacements over the next several decades. *Prima facie*, other factors could also be expected to contribute to the scarcity of new job openings. For example, the rate of increase in enrolment has begun to decline, and enrolment in absolute numbers is expected to actually decline from the mid-1980s or even earlier. Funding of research in the universities by the federal government has not grown in real terms during the first half of the 1970s, and while there has been recent growth, future rates of expansion of such funding are not likely to be as high as the rates during the 1960s.

According to a number of recently stated concerns, this could have serious implications. It is suggested that

the existing teaching staff has locked up the system in terms of employment opportunities, and in terms of promotions. It is also suggested that the rank structure could possibly become quite top-heavy, as pressures for promotion within the system mount. With a growing proportion of staff in senior positions, the costs per university teacher would also then rise more than would be the case under a more normal age and rank distribution of the staff.

Therefore, it is argued, the universities will be deprived of the normal inflows of new talent -- inflows that are considered essential for the creation of new ideas, challenging approaches, and the health of scientific progress. There is a perceived risk that potential researchers will be discouraged from enrolling in post-graduate studies, resulting in the loss of valuable talents. There could also be repercussions on the amount of scientific work carried out through thesis research.

Extending this reasoning to the 1990s, when enrolment is expected to rise again, and when the majority of the current university teachers begins to reach retirement age, a shortage

of suitable candidates for the emerging job openings may have to be met again by immigration. This situation could be aggravated by a dearth of Canadian graduates due to the shrinking size of the graduate programs during the draught years of the later 1980s.

This paper presents some further data on the aging trends of the Canadian professoriate. First, the median age and the age distributions to the year 2000 are calculated under two different assumptions about student participation rates, and two different assumptions about trends in student-teacher ratios. The results of these calculations illustrate the possible ranges in age trends and distributions, given the underlying assumptions. Second, some of the reasons for possible differences in age trends by discipline are discussed, based on demand estimates for graduates and teachers by discipline.

The empirical work underlying this paper was carried out with the help of the MOSST highly qualified manpower (HQM) model, a model designed to estimate future trends in the demand for the various categories of scientific and professional manpower[1]. Because the Canadian university

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[1] A forthcoming study by MOSST based on this model will deal with the demand for university graduates by discipline and by degree level.

professoriate constitutes the largest single group of researchers engaged in basic (or curiosity-oriented) research, the discussion in this paper is restricted to university teachers.

Age Estimate of University Teachers

The demand for university teachers is closely, though not entirely, dependent on the number of enrolled students. The number of university students rose at an almost uninterrupted pace from the beginning 1960s to the mid-1970s. The growth rates were particularly high from the mid - to the end-1960s.

The effect of the post-war birth wave on this expansion in enrolment was significant, but the major contributors were other factors, such as the increase in age-specific participation rates, the tremendous increase in the enrolment of women, and the growing popularity, by the population outside the traditional university ages, to pursue a degree on a part-time basis. Chart I illustrates the trends during that period. From 1963 to 1973, the annual

growth rate in enrolment was over 9.0 per cent. In actual numbers, on a full-time equivalent basis, enrolment rose from some 150,000 in 1963 to over 365,000 in 1973.

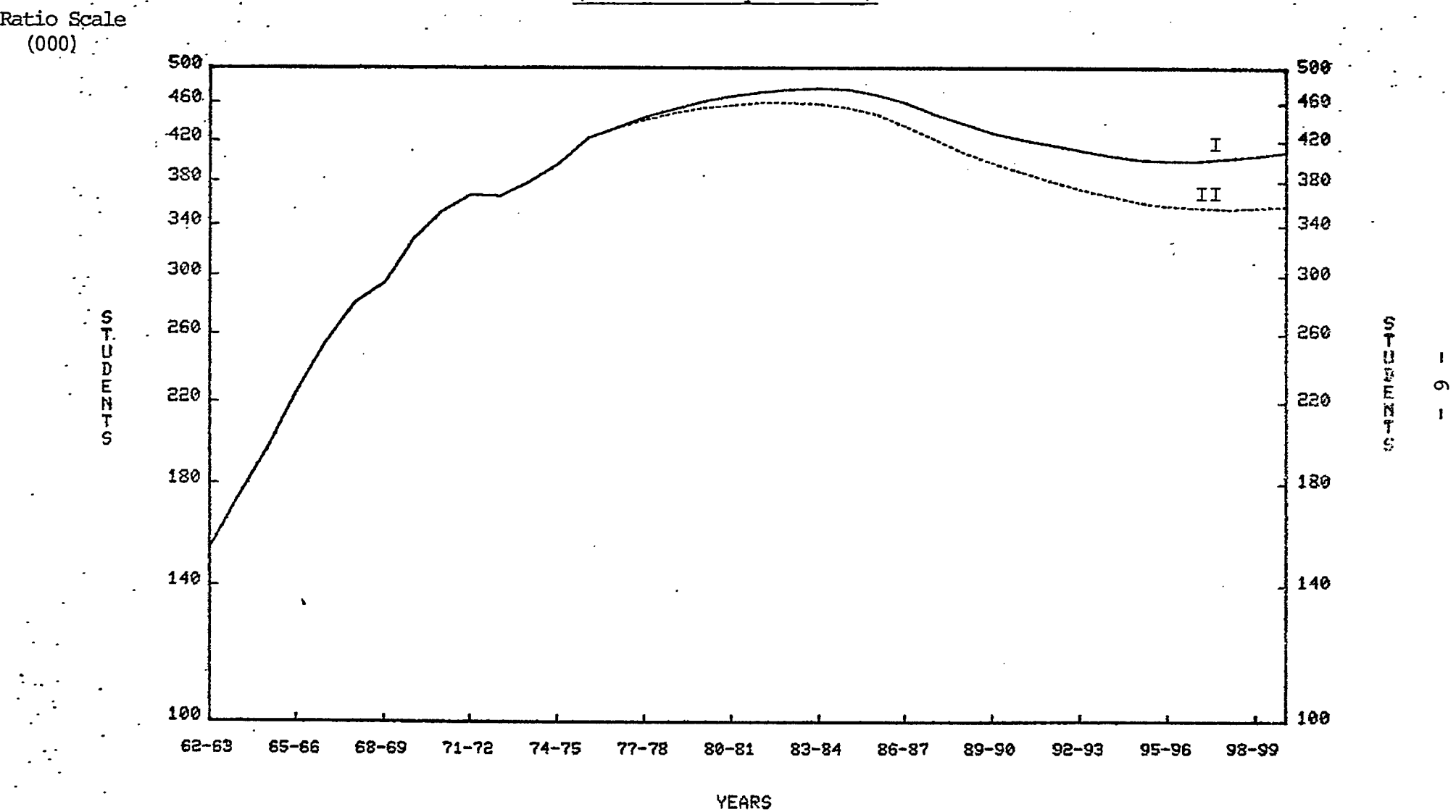
Enrolment has more or less ceased to expand in recent years, mainly because of a decline in male full-time participation rates, which were barely offset by further increases in female participation rates, and by growing part-time enrolment. Trends in enrolment for the remainder of the decade are shown in Chart 1. Two projections are provided: (1) the first (I) is based on constant participation rates while the second (II) assumes falling rates. Enrolment for I shows little or no further growth from now to the mid-1980s and begins to drop from then to the mid-1990s. Enrolment for II begins to decline a couple of years earlier, and remains below the level of I.

The number of full-time teaching positions is closely related to enrolment, but in the past it has also been affected by a decline in the student-teacher ratio. The number of teachers rose from about 9,500 in 1963 to almost 30,000 in 1973, or by some 12 per cent per annum on average,

CHART 1

UNIVERSITY ENROLMENT, 1962 - 2000

(Full time Equivalent)



SOURCE: Statistics Canada; and Estimates by MOSST (see Appendix for projection assumptions and method)

considerably faster than enrolment growth. About 25 per cent of the growth in the stock of teachers was due to a declining student-teacher ratio, with the remainder due to enrolment expansion.

For purposes of this simulation to 2000, two assumptions regarding the student-teacher ratio are made. The first is a constant ratio, and the second a ratio that rises by ten per cent over the projection period. Together with the two participation rate assumptions for enrolment, there are four possible combinations of assumptions for the required number of teachers:

A. constant participation rates, constant student-teacher ratio

B. falling participation rates, constant student-teacher ratio

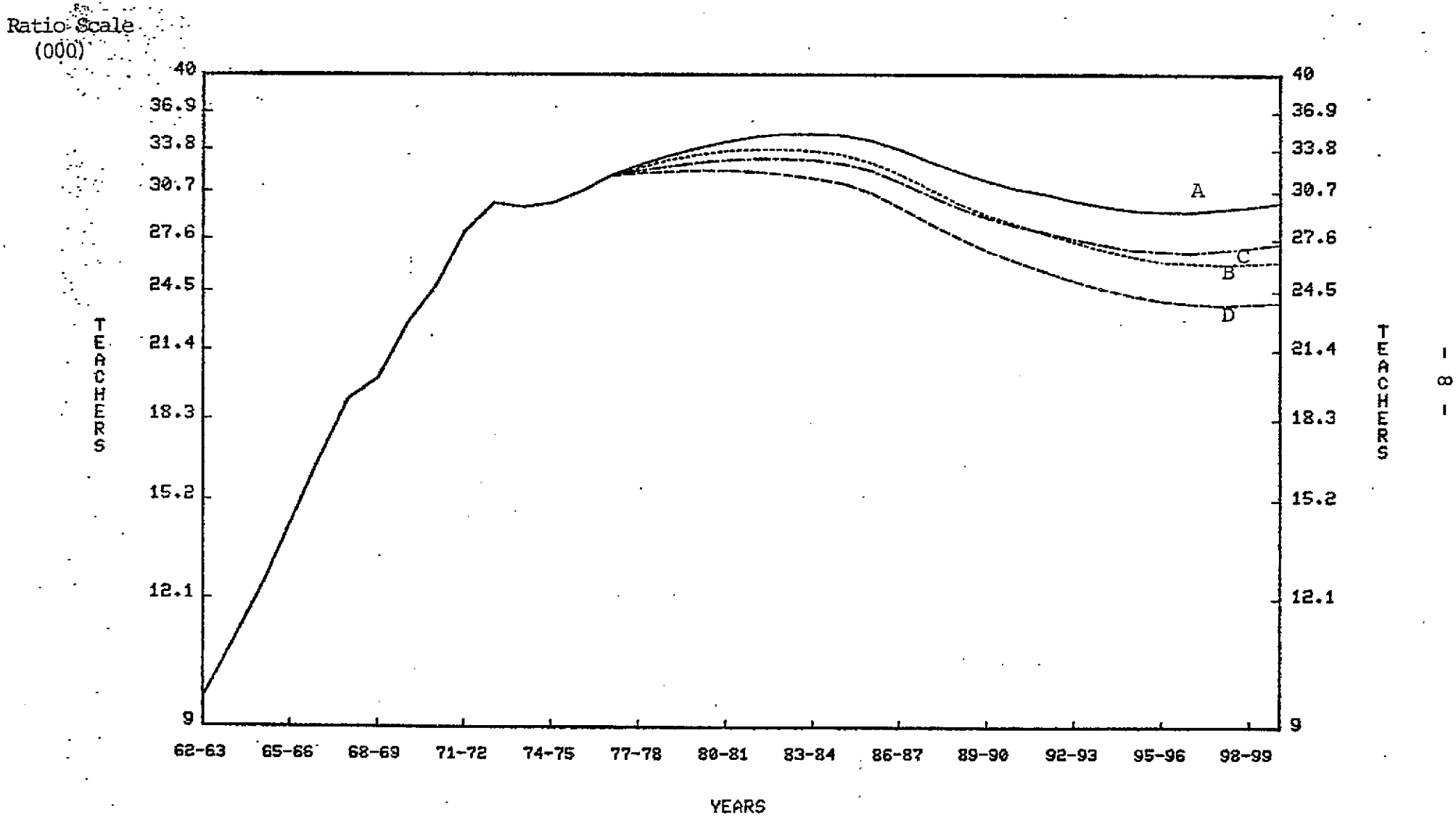
C. constant participation rates, rising student-teacher ratio

D. falling participation rates, rising student-teacher ratio

Chart 2 shows the growth in the stock of teachers from now to 2000 under these four assumptions. Projection A (high) and Projection D (low) bracket the range of growth

CHART 2

NUMBER OF FULL-TIME UNIVERSITY TEACHERS, 1962 - 2000



SOURCE: Based on data from Statistics Canada; and estimates by MOSST (see Appendix for

that is implied by the above assumptions. Assuming no change in participation rates and in the student-teacher ratio from the current level, the stock of teachers rises to about 35,000 by the mid-1980s, and then begins to fall until it reaches just over 29,000 by the mid-1990s (Projection A). Assuming a decline in participation rates and a rise in the student-teacher ratio, the stock of teachers rises to a little over 32,000 by the early 1980s, and then falls to about 24,000 by the mid-1990s (Projection D). The other two trends (B and C) fall between A and D.

The effect of the growth rate changes is reflected in the changing age structure of the stock of teachers. In computing future age changes, account is taken of attrition, not only of the initial stock but also of new entrants each year over the projection period[1].

Table 1 summarizes the median ages of the professoriate for the years to 2000, under the four basic assumptions. With assumption A, the median age rises from 39.4 years in 1975 to 47.8 years in 2000. The rate of increase varies

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[1] See the Appendix to this paper for a description of the method.

TABLE 1

MEDIAN AGE OF UNIVERSITY TEACHERS, 1975 - 2000

	Projection A	Projection B	Projection C	Projection D
	(Years)			
1975	39.4	39.4	39.4	39.4
1980	40.8	41.0	41.3	41.5
1985	43.4	44.0	44.2	44.8
1990	47.0	47.8	47.9	48.7
1995	48.0	50.0	49.8	51.2
2000	47.8	49.1	48.5	49.9

SOURCE: Estimates by MOSST

however: for the five 5-year periods from 1975 - 2000, the average annual increases are 0.3, 0.5, 0.7, 0.2 and -0.4 years.

Under Projection D, the median age rises from 39.4 in 1975 to 51.2 in 1995, and then begins to decline again. The average annual increases for the five sub-periods are 0.4, 0.7, 0.8, 0.5 and -0.3 years.

The age structure for the years 1975-2000 is provided in Table 2, which shows the percentage distribution of the stock of teachers by 5-year age groups under the four assumptions. With the anticipated decline in enrolment, the required stock of teachers falls and, as a consequence the share of the younger ages in the total stock diminishes. This feature is common to the four alternatives, which differ from each other only by degree. The lower the teacher requirements implied by a particular assumption, the larger the shortfall of the younger age groups in the age pyramids up to the beginning of the 1990s. The age pyramids are shaped over time by the base-year age distribution, the change in the stock required, and the replacement needs due to attrition. During some periods,

TABLE 2

PERCENTAGE AGE DISTRIBUTION OF UNIVERSITY TEACHERS, 1975 - 2000

	1974-75[1]	1979-80	1984-85	1989-90	1994-95	1999-2000
			PROJECTION A			
UNDER 26	0.9	0.8	0.4	0.2	0.7	1.1
26 - 30	10.6	16.1	9.9	2.0	8.9	17.8
31 - 35	23.8	13.5	18.2	11.2	3.4	12.0
36 - 40	20.9	20.3	12.5	19.4	11.2	2.7
41 - 45	16.3	17.8	19.1	13.2	20.0	10.4
46 - 50	11.8	13.8	16.6	20.4	13.5	18.9
51 - 55	8.0	9.8	12.7	17.5	20.6	12.5
56 - 60	4.8	5.8	7.8	11.5	15.2	16.5
61 +	2.5	2.2	3.0	4.7	6.6	8.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
			PROJECTION B			
UNDER 26	0.9	0.7	0.3	0.1	0.6	1.1
26 - 30	10.6	14.9	8.0	0.6	7.8	17.7
31 - 35	23.8	13.6	16.9	8.7	1.6	11.0
36 - 40	20.9	20.7	13.0	18.5	8.8	1.1
41 - 45	16.3	18.1	19.9	14.1	19.5	8.3
46 - 50	11.8	14.0	17.4	21.9	14.8	18.9
51 - 55	8.0	10.0	13.3	18.7	22.8	14.1
56 - 60	4.8	5.9	8.1	12.3	16.8	18.7
61 +	2.5	2.3	3.1	5.0	7.3	9.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

(Cont'd)

TABLE 2 (Concl'd)

PERCENTAGE AGE DISTRIBUTION OF UNIVERSITY TEACHERS, 1975 - 2000

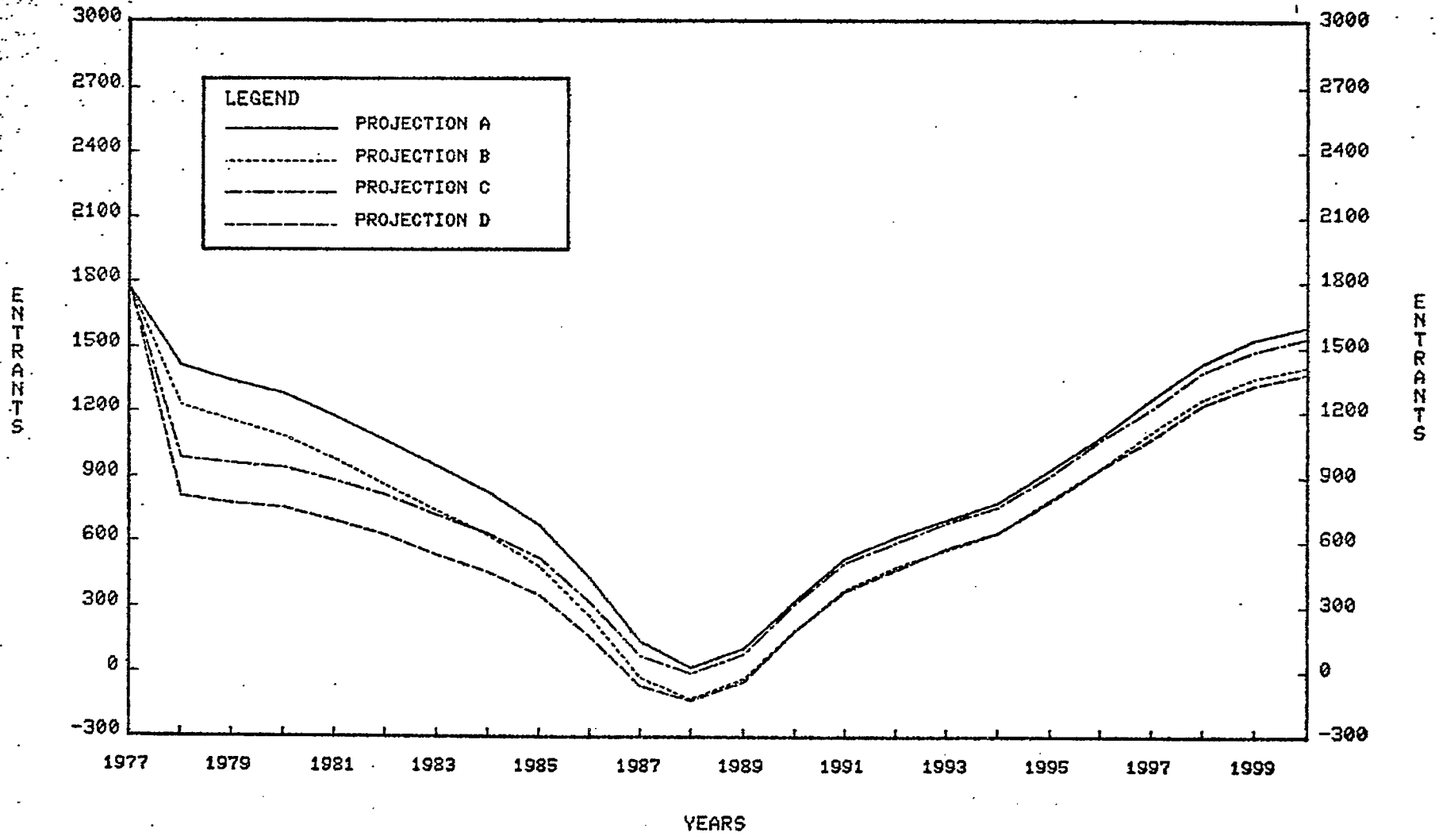
	1974-75[1]	1979-80	1984-85	1989-90	1994-95	1999-2000
UNDER 26			PROJECTION C			
UNDER 26	0.9	0.6	0.3	0.2	0.7	1.2
26 - 30	10.6	13.6	7.9	1.5	9.5	18.9
31 - 35	23.8	13.8	15.5	8.8	3.0	12.8
36 - 40	20.9	21.0	13.1	16.7	8.8	2.2
41 - 45	16.3	18.4	20.4	14.2	17.2	8.0
46 - 50	11.8	14.3	17.7	22.1	14.6	16.2
51 - 55	8.0	10.1	13.5	18.9	22.5	13.6
56 - 60	4.8	6.0	8.3	12.5	16.7	18.1
61 +	2.5	2.3	3.2	5.1	7.2	8.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
			PROJECTION D			
UNDER 26	0.9	0.5	0.2	0.1	0.7	1.2
26 - 30	10.6	12.3	6.0	0.4	8.4	18.9
31 - 35	23.8	13.9	14.0	6.3	1.6	11.9
36 - 40	20.9	21.4	13.7	15.4	6.1	1.2
41 - 45	16.3	18.7	21.3	15.1	16.2	5.6
46 - 50	11.8	14.5	18.6	23.7	15.9	15.7
51 - 55	8.0	10.3	14.2	20.3	24.8	15.2
56 - 60	4.8	6.1	8.7	13.4	18.3	20.4
61 +	2.5	2.3	3.4	5.4	7.9	10.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE: Estimates by MOSST (see Appendix Table 3)

Chart 3

NEW ENTRANTS - FULL-TIME UNIVERSITY TEACHERS

(Annual Number, 1977 - 2000)



NOTE: Includes requirements due to changes in stock and replacement

SOURCE: Estimates by MOSST (see Appendix for assumptions and method).

the inflows due to replacement need are diminished, and in some cases entirely eliminated, by declines in the needed stocks (see Chart 2 for stock changes). In fact, under assumption D, for the last part of the 1980s, the attrition is not sufficient to reduce the stock to the desired level.

The annual inflows of required teachers under the four basic assumptions are portrayed in Chart 3. In this Chart, inflows are defined as the sum of stock changes plus replacements due to attrition (deaths, emigrants, net withdrawals above age 55).

Demand estimates by discipline

Many faculties are not significantly affected by trends in the 18-24 population but rather by economic and technological requirements, or by general social demands such as health care requirements of an aging population. To determine which faculties are not likely to experience the kind of slowdown that is generally anticipated for the university system, the relationship between demand and supply on the market for the graduates of the various faculties is

examined below. Demand projections are available from a recent simulation (June 24, 1977) of the MOSST highly qualified manpower demand model. The model calculates occupational requirements based on econometric projections of the industrial structure of output and employment, and on demographic, social and public policy factors. Replacement demands due to attrition are also taken into account. The occupational gross requirements (due to growth and replacement needs) are then linked to the educational system by means of transition probabilities which take account of educational upgrading and inter-disciplinary mobility (c.f., a graduate in medicine working in the occupation hospital administrator, etc.)[1].

While the future supply trends by faculty are not quantifiable to the same extent, certain inferences can nevertheless be made, based on past and current capacities of the various faculties. It is a well-known fact that enrolments in some faculties are highly controlled

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[1] See the Appendix for a reference to the methodology.

-- either by virtue of actual limitations in the number of available study places, or by virtue of strict academic admission requirements -- but that enrolments in many other disciplines have been allowed to grow in line with public demand. To the controlled[1] group belong such faculties as medicine, dentistry and some of the other health fields, and to a certain extent such fields as engineering, some of the more mathematically-oriented natural sciences, some of the life sciences, and one or two of the fields from the social sciences where graduates face institutional labour market entry restrictions. A review of the available information on graduates by major field of study indicates that the current "over-production" of university graduates is concentrated in the uncontrolled study fields, while the production of graduates is more or less in line with the labour market requirements in the controlled fields.

The projections presented here show occupational demands by category (Chart 3) and the consequent educational requirements by major field of study to 1985 (Chart 4). With the exception of demand for occupations in the education

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[1] The terms "controlled" and "uncontrolled" should only be taken as approximations and as convenient short-hand expressions that are reflective of admissions policies.

sector, there appears to be no weakness in the underlying medium-term demand growth for highly qualified manpower in relation to general economic and population growth. If the close relationship between capacity and demand that currently prevails in the controlled university fields persists into the future -- and there is no reason to assume that it will not -- then labour market conditions for highly qualified manpower will continue to determine the growth of enrolment and teachers of such faculties, at least in the medium term.

As far as the "uncontrolled" fields are concerned, not all of their graduates are now obtaining highly qualified manpower jobs. With a slowdown in enrolment growth, and thereafter a decline in enrolment to the mid-1990s, there will be relatively fewer graduates, and a larger proportion of such graduates should obtain highly qualified manpower jobs, according to the demand projections, even though not all may be able to find such jobs[1]. Nevertheless, as growth of enrolment declines,

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[1] However, new graduates may also have to compete for jobs with graduates from previous years who are still searching for HQM employment.

and later as absolute numbers of the enrolled decline, the demand for university teachers may be diminished in the uncontrolled sector. This may be the case despite the fact that there is no major downward shift in the demand for graduates from such faculties, basically because the demand for teachers is not determined by the demand for students who are able to obtain highly qualified manpower jobs, but by the total number of students that are enrolled in that discipline. (See Chart 6 for a schematic illustration).

Chart 4 (p. 20 - 22) shows the projected demand growth for various categories of highly qualified manpower in relation to the growth of projected total employment and the growth of the 18-24 population. The chart indicates that the demand for such manpower is (a) independent of the growth of the 18-24 population; and (b) higher than the growth of total employment, with the exception of the teaching occupations. The demand for health occupations grows also somewhat less than employment as a whole, basically in response to budget restraints and the maintenance, as opposed to the further extension, of health services after a decade of very rapid growth.

CHART 4

INDEX (1976=100)

ESTIMATE OF DEMAND FOR HIGHLY QUALIFIED MANPOWER OCCUPATIONS

INDEX (1976=100)

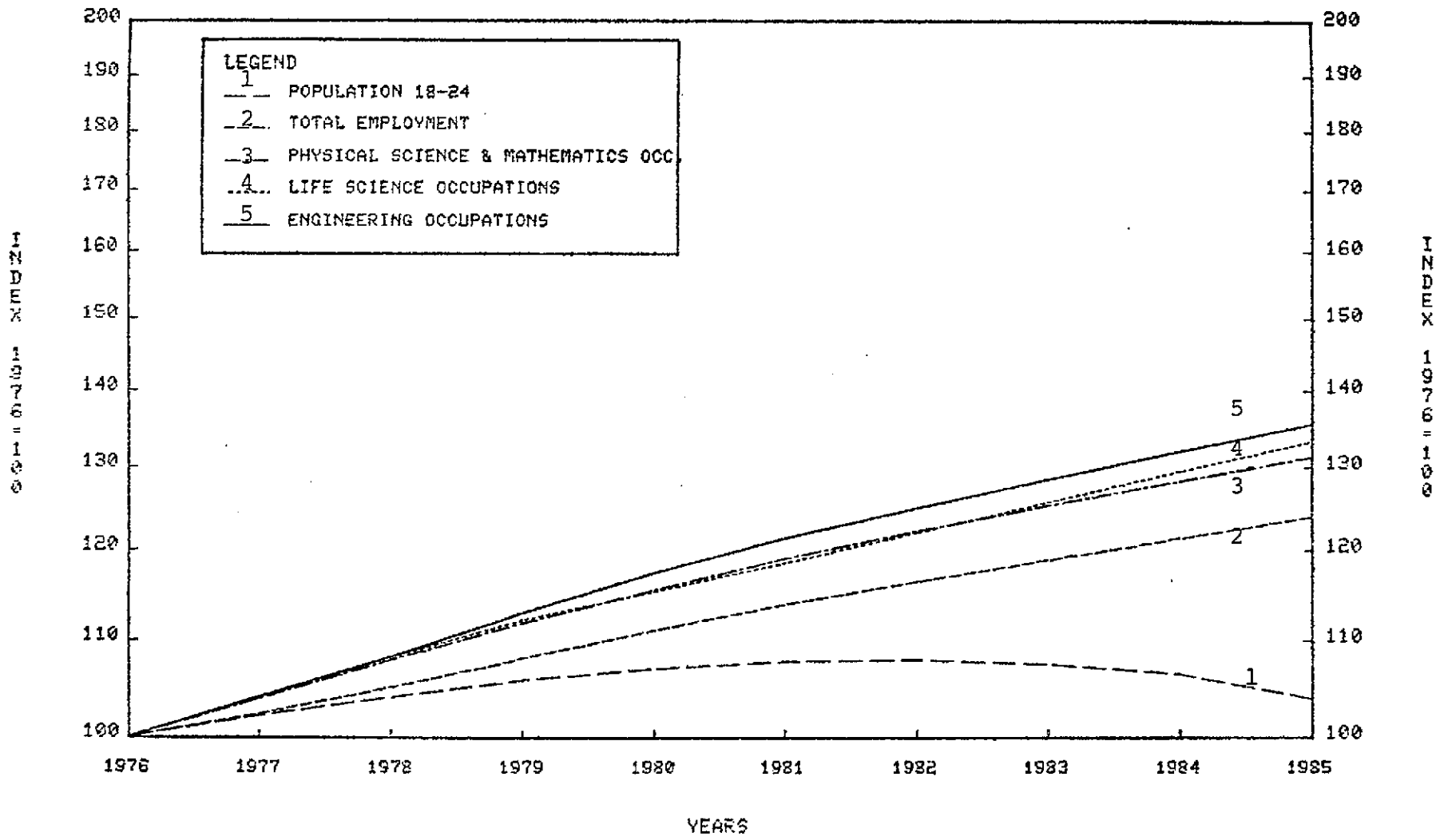


CHART 4 (cont'd)

ESTIMATE OF DEMAND FOR HIGHLY QUALIFIED MANPOWER OCCUPATIONS

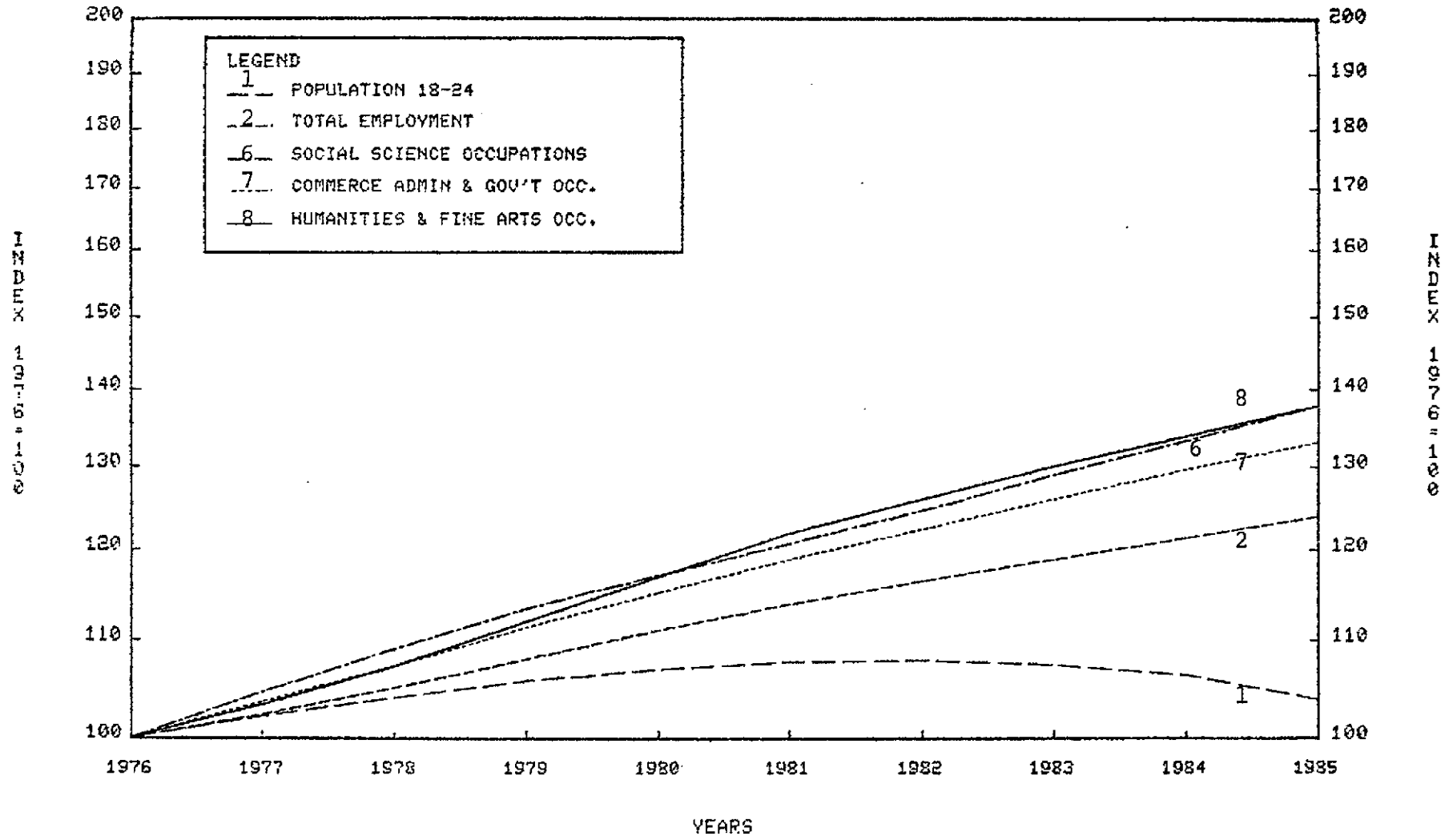


CHART 4 (concl'd)

INDEX (1976=100)

ESTIMATE OF DEMAND FOR HIGHLY QUALIFIED MANPOWER OCCUPATIONS

INDEX (1976=100)

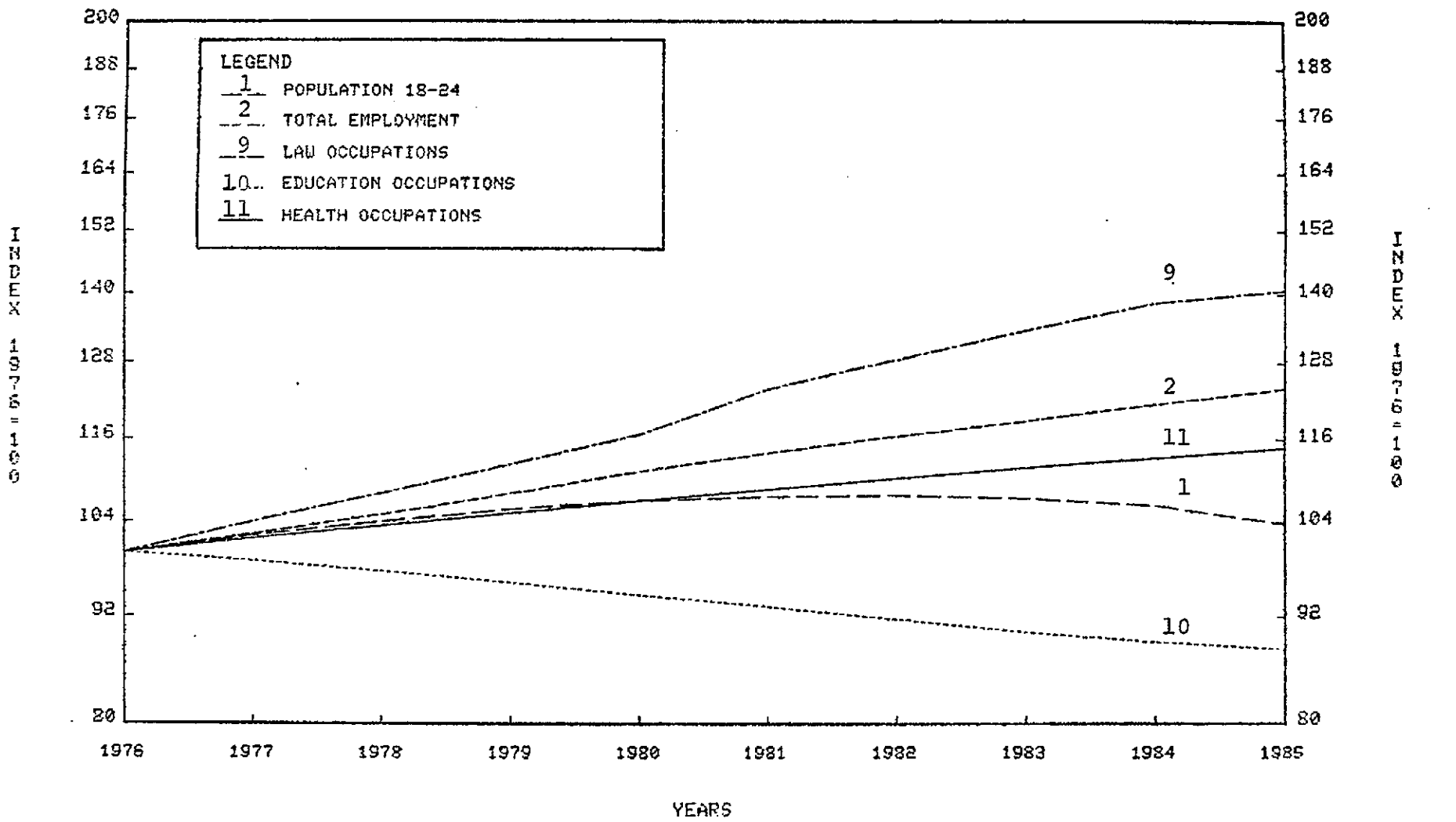


CHART 5

DEMAND FOR UNIVERSITY GRADUATES BY FIELD OF STUDY

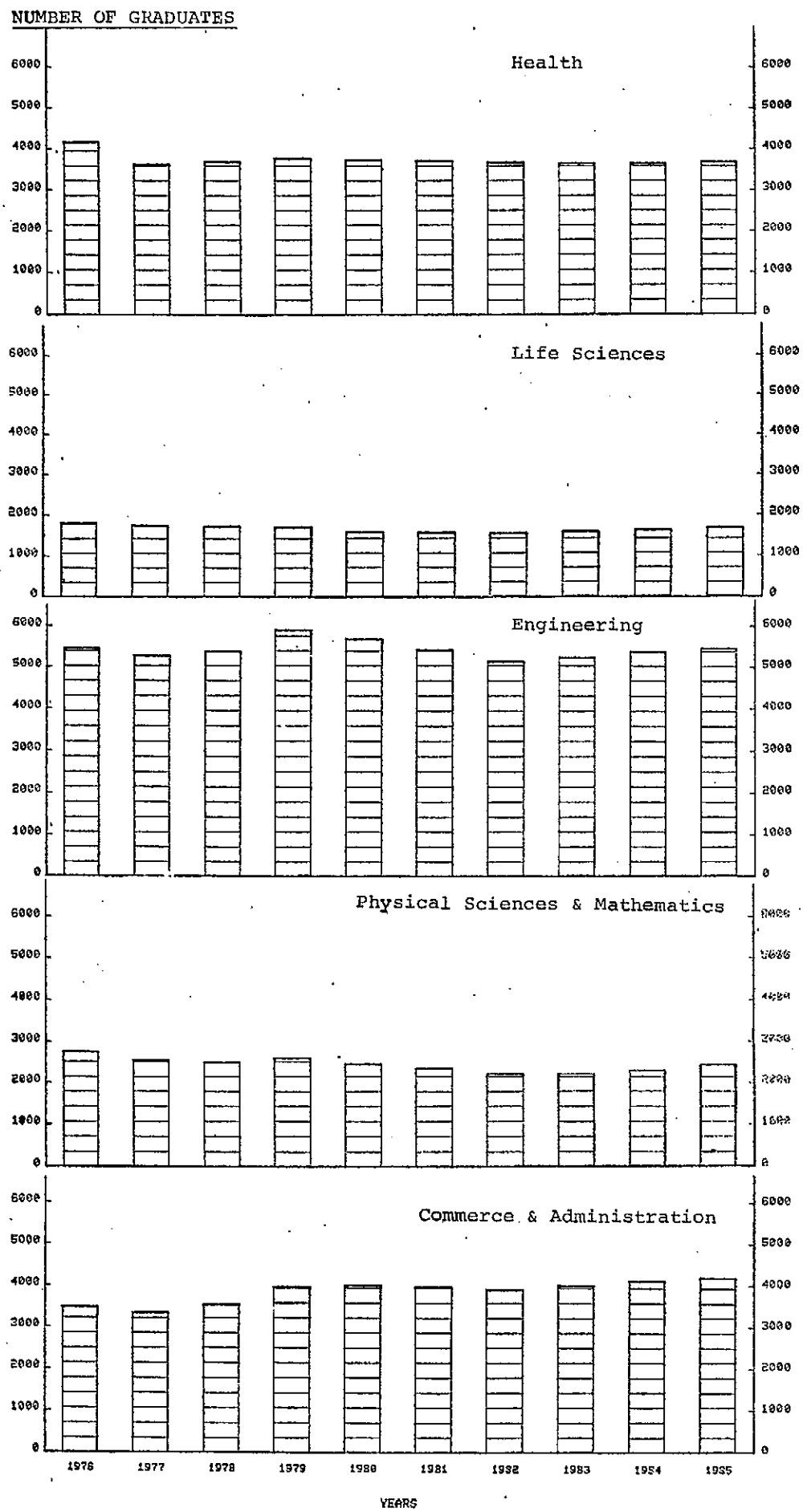
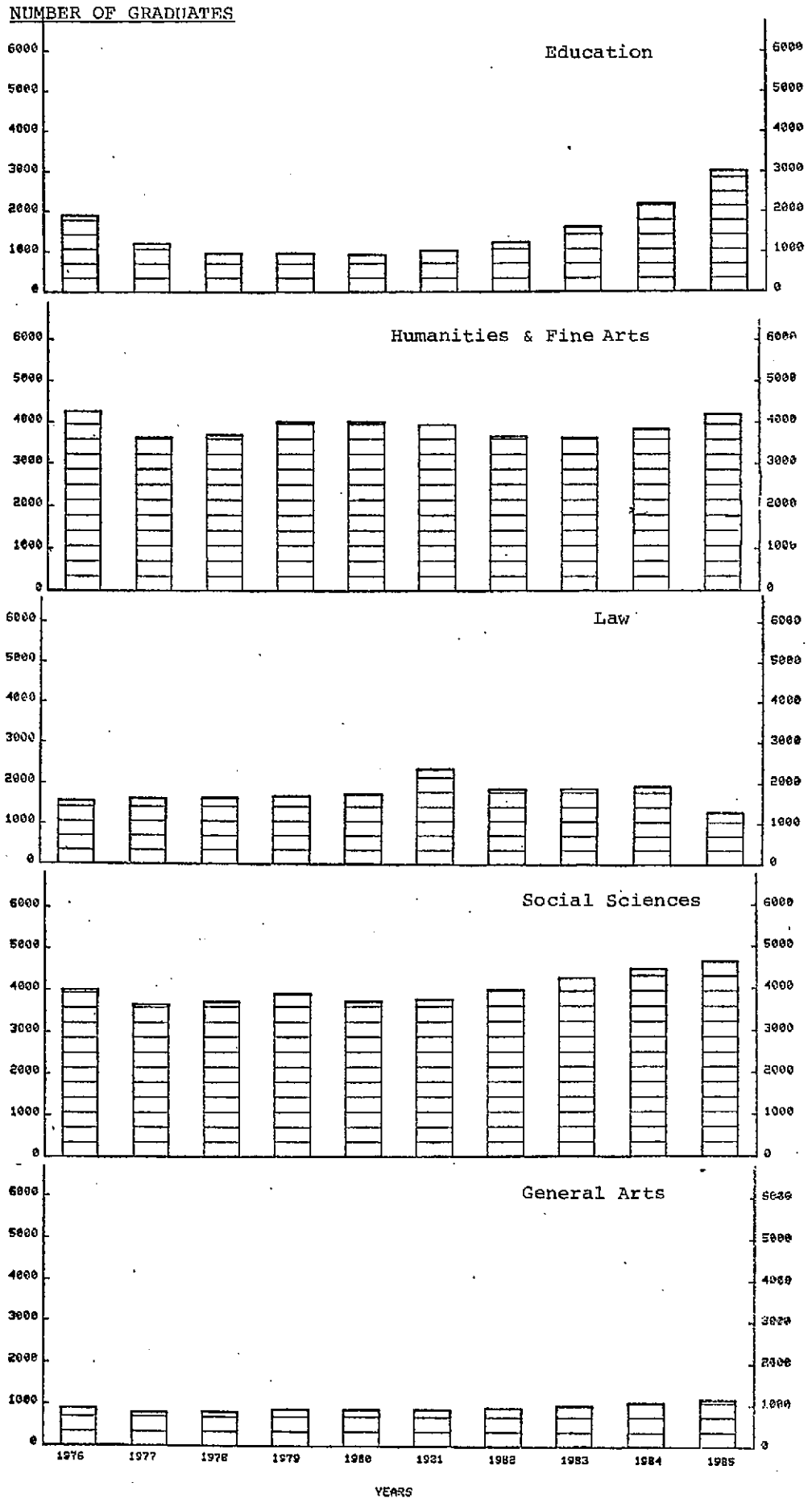


CHART 5 (concl'd)

DEMAND FOR UNIVERSITY GRADUATES BY FIELD OF STUDY

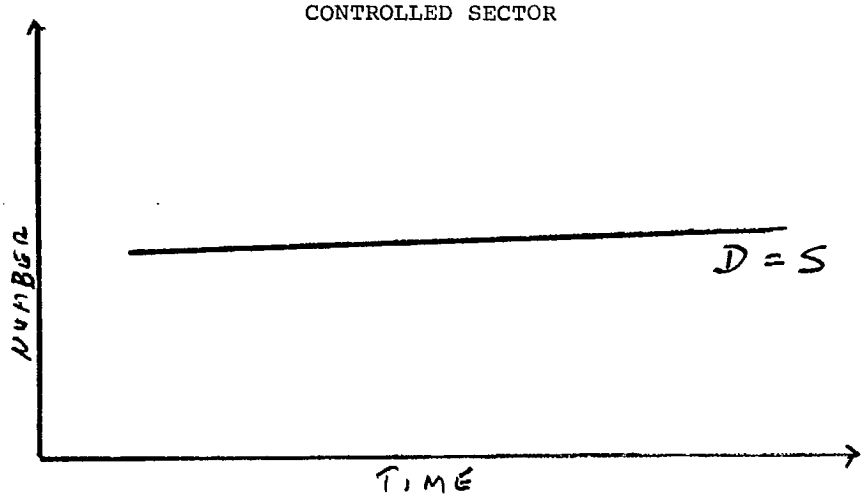


SOURCE: Estimates by MOSST, based on June 24, 1977 solution of the HQM model.

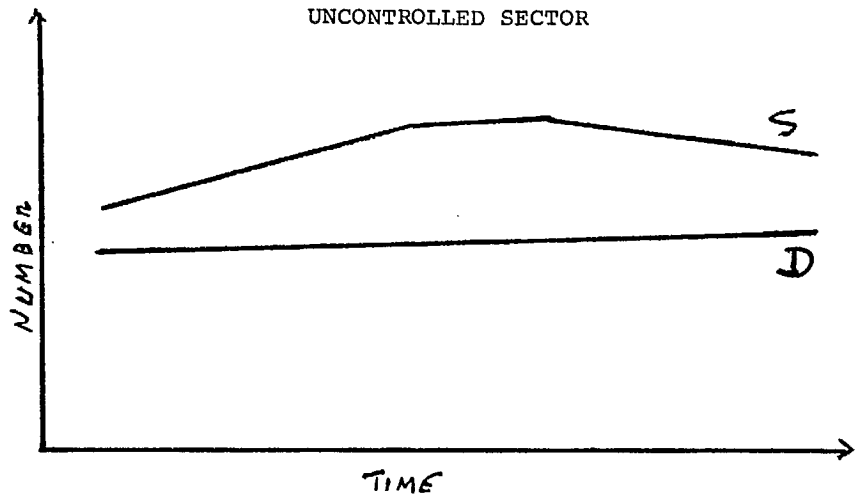
CHART 6

Schematic Illustration
DEMAND AND SUPPLY OF GRADUATES, BY SECTOR

CONTROLLED SECTOR



UNCONTROLLED SECTOR



S = Enrolments, Graduates. This is the factor determining the demand for university teachers.

D = Demand for university graduates in highly qualified manpower jobs.

Chart 5 (p. 23 - 24) shows the annual numbers of university graduates in the various major fields of study who will be required to fill the emerging highly qualified manpower jobs. As noted, the number of such jobs is estimated on the basis of the growth in the occupational stocks (as shown in Chart 4), replacement trends, educational upgrading and interdisciplinary shifts.

Conclusions

This note presents the age structure implications for the stock of the Canadian professoriate to the year 2000, under four basic assumptions regarding enrolment rates and student-teacher ratios. Given the assumptions, the four simulations indicate the possible range of the emerging age structures, All variants confirm the same underlying pattern, and differ from each other only by degree. Other things being equal, changes in student enrolments and student-teacher ratios of the order of magnitude used in these simulations do not appear to be sufficient to significantly affect the indicated pattern in the age structure.

The impact on the age structure is likely to be not equal for all disciplines. It is suggested that the extent to which various disciplines will be affected depends not only on the degree to which enrolments fluctuate in line with demographic changes, but also on many other factors. Several disciplines have controlled admissions, and reduce the chances of producing over-supplies of graduates. Their supply capacity is also more in balance with the labour market and is governed not by demographic enrolment volatility, but by the demands of society and industry. Research is necessary to identify such disciplines in greater detail, and to determine if they are likely to continue to be able to maintain their research capacity and absorb new researchers more adequately than other disciplines.

APPENDIX

Enrolment Projections

Future enrolment is based on estimates of the size and changing composition of the potential university age population (15 years and over) and base-year age-specific propensities to attend university. The propensities by single-year of age are derived from base-year enrolments and age distributions obtained through the Post-Secondary Student Survey of 1975, for the following types of enrolment: full-time undergraduate; part-time undergraduate; full-time post-graduate; part-time post-graduate. The demographic projections by single year of age are based on "Projection C" by Statistics Canada.

For each type of enrolment, the following approach is used:

$$r_i = E_o d_i \; / \; P_{o,i} \qquad i = 15,16,17.....50^{+}$$

where r_i is the propensity of persons of age "i" to attend university

E_o is enrolment in the base year 0

d_i is the proportion of enrolments of persons of age "i"

and $P_{o,i}$ is the population of age "i" in the base period 0

Thus enrolment in a particular type of program is

$$E_t = \sum_i r_i \; P_{it} \qquad \text{for all } t \text{ to } 2000$$

The enrolment estimates for the various types of programs are added together on the basis of weights, i.e., 3.75 part-time undergraduate, or 2.5 part-time post-graduate students, are assumed to be the equivalent of one full-time student.

Projection A assumes constant (1975) participation rates (d_i) to 2000.

Projection B assumes that full-time rates will decline by 10 per cent, and part-time rates by 25 per cent to the year 2000.

Projection of the Demand for University Teachers

The stock of teachers required to 2000 is related to the projected enrolments by means of a constant student-teacher ratio:

$$UT_t = S^{-1} E_t$$

where UT_t is the stock of university professors required in year t

and S is the base year student-teacher ratio.

Under the high assumption, the student-teacher ratio is assumed to remain constant at the current level. Under the low growth assumption, the ratio is assumed to rise by 10 per cent, with half of the rise over the first five years of the projection period, and the balance over the following years to 2000.

The method for estimating replacement demand due to attrition is taken from the MOSST highly qualified manpower demand model. There, the existing stocks in the base period 0 are subjected to the risks of mortality, withdrawal and emigration appropriate to their age, sex and occupation. The decrease this causes in the overall stock level by occupation is the demand due to attrition at the beginning of period 1. Algebraically this can be expressed in the following way:

$$D^k_{R_1} = \sum_i \sum_j S^k_{ijo} \; (dij) \; (rij^k) \; E^k_{ij}$$

where $D^k_{R_1}$ is the replacement demand in the kth occupation in period 1

S^k_{ijo} is the stock in the kth occupation of age i and sex j in the base period 0

d_{ij} represents the mortality rate of persons of age i and sex j

r^k_{ij} is the withdrawal rate of persons in the kth occupation of age i and sex j

E^k_{ij} is the number of emigrants from the kth occupation of age i and sex j

The new entrants by single years of age, sex and occupation in period 1 are added to the age, sex and occupation-specific stocks remaining from period 0. The age distribution

for new university teachers is assumed to be in the range of 25-30 years[1]. These new stocks are, in turn, subjected to the various risks of attrition, producing estimates of replacement demanded by each occupation in period 2. The process is reiterated to the end of the projection period.

Withdrawal rates are derived for those aged 55 and over, using a method similar to that by which working life tables are calculated. Participation rates by single years of age and sex are calculated by standardizing the base-year stock numbers to the base-year population by single years of age and sex. These rates are applied to the respective age and sex groups of a stationary population[2] to obtain the number of persons from a specific cohort who are in an occupation at each successive age. The difference in the stock of age i and the stock of age $i + 1$ is assumed to be due to the effects of mortality, withdrawal and emigration:

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[1] Replacements on account of attrition (i.e. death, emigration, and net withdrawals over 55 years of age) are assumed to be in the 25-30 year range. Withdrawals and accessions at ages below 55 are assumed to cancel out, and have no net effect on the age structure.

[2] The stationary population comprises the number of persons who will be alive and in Canada at different ages out of an original group of 100,000 born alive. In practice, two stationary populations are calculated - one for males and one for females. They are computed using mortality rates and emigration estimates consistent with the assumptions of the attrition model.

$$S^{k}_{i}+1,\ j,\ t+1 = S_{ijt}(1 - dij)(1 - r^{k}_{ij})-E^{k}_{ij}$$

Given the stock estimates derived from the "participation rates" and the stationary population, the above equation can be solved for r^{k}_{ij}, the retirement rate. Further, in the case of university teachers, 65 is generally the compulsory retirement age.

The mortality rates used in this simulation are given in Appendix Table 1. The withdrawal rates calculated by the above method are shown in Appendix Table 2. In the absence of data on emigration, it was assumed that the annual emigration of university teachers is equivalent to three-quarters of one percent of the base-year stock (1971). This is the estimated percentage of emigration for the entire stock of HQM, based on Canadian emigration data and U.S. immigration records for the years 1971 and 1975. In the case of the university teachers, the possibility has been raised that this assumption may be an underestimate due to the fact that returning teachers of U.S. origin are not counted as immigrants by the United States.

Conversion of occupational into educational requirements

The MOSST model first estimates occupational trends, which are then related to educational requirements by field of study. This involves the folloiwng basic steps starting with:

- a column vector e_t of employment by industry (IND) in year t, estimated by the CANDIDE econometric model

$$e_t = \{e_{1t}, e_{2t}, \ldots e_{IND,t}\} \quad t = 1971 \text{ to } 1985$$

- a matrix [1] of coefficients P representing the distribution of occupations within each industry in a given year t

$$P_t = [P_{ij}] \qquad i = 1,2,\ldots,K;\ j = 1,2,\ldots,IND$$

where K is the number of occupations,

$$\sum_{i=1}^{K} pij = 1 \qquad \text{for all } j \ ,$$

and $0 \leq pij \quad 1 \qquad$ for all i,j

- a column vector a_t of attrition by occupation in year t

$$a_t = \{a_{1t}, a_{2t}, \ldots, a_{Kt}\} \qquad t = 1971 \text{ to } 1984$$

- a vector g_t of the proportion of jobs in each occupation to be filled by university graduates in year t

$$g_t = (g_{1t}, g_{2t}, \ldots, g_{Kt}) \qquad t = 1972 \text{ to } 1985$$

- an array N representing the distribution of educational backgrounds, classified into the major fields of study and degreee level within each occupation in a given year t

$$N_t = [n_{ijl}] \qquad i = 1,2,\ldots, K;\ j = 1,2,\ldots,FOS$$

$$l = \text{BA, MA, PHD}$$

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(1) See footnote next page

where *FOS* is the number of fields of study.

The demand for university graduates by field of study in year t is thus written as

$$D_t = \left[P_t e_t - P_{t-1} e_{t-1} \; a_{t-1}\right]' \quad Z_t N_t$$

where Z_t is a diagonal matrix of the vector g_t.

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[1] For the health and education occupations, the coefficients are estimated on the basis of socio-demographic factors; certain other occupational trends, such as those for lawyers, architects, veterinarians, etc., are related to the demand determinants that are appropriate for these occupations. A full account of the method is provided in the forthcoming MOSST study on "The Demand for University Graduates to 1985".

APPENDIX TABLE 1

MORTALITY RATES BY AGE AND SEX

AGE	MALE	FEMALE	AGE	MALE	FEMALE
15	0.0010551	0.0004580	51	0.0084061	0.0044027
16	0.0012734	0.0005153	52	0.0092659	0.0048106
17	0.0014462	0.0005549	53	0.0101672	0.0052408
18	0.0015776	0.0005722	54	0.0111092	0.0056927
19	0.0016911	0.0005754	55	0.0121282	0.0061791
20	0.0017810	0.0005715	56	0.0132603	0.0067124
21	0.0018411	0.0005674	57	0.0145417	0.0073051
22	0.0018657	0.0005701	58	0.0159649	0.0079349
23	0.0018340	0.0005774	59	0.0175060	0.0085933
24	0.0017500	0.0005849	60	0.0191759	0.0093140
25	0.0016447	0.0005956	61	0.0209856	0.0101308
26	0.0015492	0.0006125	62	0.0229460	0.0110771
27	0.0014944	0.0006387	63	0.0250341	0.0121218
28	0.0014816	0.0006743	64	0.0272425	0.0132426
29	0.0014901	0.0007173	65	0.0296059	0.0144861
30	0.0015181	0.0007675	66	0.0321591	0.0158991
31	0.0015636	0.0008250	67	0.0349367	0.0175285
32	0.0016246	0.0008897	68	0.0378967	0.0193194
33	0.0016949	0.0009598	69	0.0410161	0.0212406
34	0.0017758	0.0010351	70	0.0443578	0.0233744
35	0.0018766	0.0011187	71	0.0479848	0.0258029
36	0.0020070	0.0012136	72	0.0519601	0.0286081
37	0.0021764	0.0013229	73	0.0562097	0.0317094
38	0.0023866	0.0014473	74	0.0606918	0.0350519
39	0.0026315	0.0015846	75	0.0655171	0.0387569
40	0.0029081	0.0017340	76	0.0707965	0.0429456
41	0.0032136	0.0018943	77	0.0766410	0.0477393
42	0.0035452	0.0020646	78	0.0829766	0.0530571
43	0.0038886	0.0022372	79	0.0897294	0.0588182
44	0.0042458	0.0024130	80	0.0970103	0.0651438
45	0.0046380	0.0026031	81	0.1049301	0.0721552
46	0.0050865	0.0028188	82	0.1135998	0.0799737
47	0.0056127	0.0030712	83	0.1229454	0.0885183
48	0.0062159	0.0033602	84	0.1328930	0.0977083
49	0.0068820	0.0036780	85	0.1435535	0.1076649
50	0.0076117	0.0040254			

SOURCE: Statistics Canada, Life Tables, Canada and The Provinces, 1970-1972 Catalogue No. 84-532

APPENDIX TABLE 2

ESTIMATED WITHDRAWAL RATES
UNIVERSITY TEACHERS
(per 1000)

AGE	MEN	Women
55	25	5
56	24	19
57	37	28
58	46	48
59	55	65
60	76	55
61	103	85
62	125	121
63	155	152
64	188	163
65	1,000	1,000

SOURCE: See description of method above

APPENDIX TABLE 3

ESTIMATE OF NUMBER OF UNIVERSITY TEACHERS, 1975 - 2000

	1974-75[1]	1979-80	1984-85	1989-90	1994-95	1999-2000
PROJECTION A						
UNDER 26	278	271	139	62	194	341
26 - 30	3,175	5,466	3,466	614	2,625	5,333
31 - 35	7,141	4,574	6,353	3,512	987	3,611
36 - 40	6,245	6,892	4,352	6,113	3,300	800
41 - 45	4,883	6,025	6,661	4,163	5,898	3,124
46 - 50	3,526	4,681	5,795	6,414	3,983	5,678
51 - 55	2,403	3,321	4,425	5,488	6,078	3,762
56 - 60	1,441	1,955	2,714	3,616	4,493	4,952
61 +	750	753	1,050	1,463	1,942	2,419
TOTAL	29,959	33,938	34,953	31,444	29,500	30,020
PROJECTION B						
UNDER 26	278	228	97	30	162	299
26 - 30	3,175	4,968	2,683	169	2,055	4,634
31 - 35	7,141	4,550	5,652	2,546	423	2,875
36 - 40	6,245	6,892	4,328	5,391	2,341	297
41 - 45	4,883	6,025	6,661	4,117	5,180	2,175
46 - 50	3,526	4,681	5,795	6,380	3,934	4,965
51 - 55	2,403	3,321	4,425	5,459	6,039	3,707
56 - 60	1,441	1,955	2,714	3,597	4,464	4,910
61 +	750	753	1,050	1,455	1,929	2,398
TOTAL	29,959	33,373	33,404	29,144	26,528	26,260

(Cont'd)

APPENDIX TABLE 3 (Concl'd)

ESTIMATE OF NUMBER OF UNIVERSITY TEACHERS, 1975 - 2000

	1974-75[1]	1979-80	1984-85	1989-90	1994-95	1999-2000
PROJECTION C						
UNDER 26	278	196	105	59	189	329
26 - 30	3,175	4,442	2,596	446	2,553	5,165
31 - 35	7,141	4,517	5,055	2,562	797	3,511
36 - 40	6,245	6,892	4,296	4,826	2,359	612
41 - 45	4,883	6,025	6,661	4,106	4,629	2,198
46 - 50	3,526	4,681	5,795	6,412	3,928	4,438
51 - 55	2,403	3,321	4,425	5,486	6,076	3,708
56 - 60	1,441	1,955	2,714	3,615	4,492	4,951
61 +	750	753	1,050	1,462	1,941	2,418
TOTAL	29,959	32,782	32,696	28,975	26,965	27,330
PROJECTION D						
UNDER 26	278	155	67	30	160	290
26 - 30	3,175	3,961	1,878	107	2,033	4,517
31 - 35	7,141	4,494	4,385	1,680	389	2,834
36 - 40	6,245	6,892	4,273	4,133	1,481	282
41 - 45	4,883	6,025	6,661	4,053	3,935	1,329
46 - 50	3,526	4,681	5,795	6,365	3,866	3,747
51 - 55	2,403	3,321	4,425	5,446	6,016	3,637
56 - 60	1,441	1,955	2,714	3,589	4,447	4,886
61 +	750	753	1,050	1,452	1,922	2,387
TOTAL	29,959	32,237	31,246	26,855	24,248	23,907

[1] Total, and distribution, is based on data from the Full-Time University Teachers File, Statistics Canada

SOURCE: Estimates by MOSST (see notes on method and assumptions above)