

## SENSITIVITY OF HOUSEHOLD AND FAMILY PROJECTIONS TO POPULATION GROWTH AND CHANGING AGE STRUCTURE

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*Résumé*—Ce document a pour objet d'étudier dans quelle mesure les projections de ménages et de familles subissent l'influence des diverses séries d'hypothèses sur lesquelles elles sont fondées. On s'aperçoit que la croissance démographique et les variations de la structure par âge sont les principaux facteurs de l'accroissement du nombre de ménages et de familles. D'autre part, la variation projetée de la répartition selon l'état matrimonial influe dans une certaine mesure sur le nombre futur de familles, mais très peu sur celui des ménages. Enfin, la variation projetée des taux de chefs de ménage a des répercussions appréciables sur le nombre de ménages, mais très peu d'effet sur le nombre futur de familles.

*Abstract*—The objective of this paper is to examine the "sensitivity" of household and family projections to the various sets of assumptions on which they are based. It is found that population growth and changing age structure make the largest contribution to the increase in the number of households and families. The projected changes in the marital status distribution have a certain effect on the future number of families but very little effect on the households. Lastly, the projected changes in headship rates make a substantial contribution to the resulting number of households but have little influence on the future number of families.

*Key words*—household projections, headship rate

### *I. Purpose*

Statistics Canada (1975b) has recently published household and family projections for Canada and the provinces to 2001. This paper summarizes the methodology used in these projections and examines the sensitivity of the various assumptions in the household and family projections. The assumptions considered here involve future population growth, marital status change and the proportions of household and family heads in the population. Although the projections are given by provinces and territories, this analysis will only concentrate on national results. For references to similar types of analyses on data from other countries see Bamas (1966), Kobrin (1973), Kono (1973), Parke and Grymes (1967), and the United Nations (1973a).

### *II. Methodology and Assumptions*

The number of households and families is governed largely by population size and by the passage of individuals through the life cycle. Methods of projecting households and families must, therefore, take into account changes in population size and structure. The headship rate method, which is adopted in the projections under review, achieves this objective by assigning to individuals various probabilities of being household or family heads. These probabilities are in turn determined by age, sex and marital status of the individual. The total number of households and families is then obtained by the application of these headship rates to the various population groups. This approach is recommended by the United Nations (1973b) and it has been used in Canada by Goracz (1969), and Kirkland (1971). For references to other methods used in Canada, see Illing (1964, 1967), Systems Research Group (1970), and Maki, et al., (1973).

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### 2.1 *Population assumptions*

The population projections used were taken from Statistics Canada (1974). These projections adopt a component method involving separate projections of mortality, fertility, internal migration and international migration. Since the emphasis here is on national results, it is not necessary to consider the assumptions used for internal migration. One mortality assumption is adopted for all projections; this involves the extrapolation of death rates specific for age, sex and cause of death. The mortality projections imply an increase in life expectancy at birth to reach 70.2 years for males and 78.4 years for females by 1986. Four series of population projections were used as input to the household and family projections (Statistics Canada, 1974, 1975a; Gnanasekaran, 1975):

Projection A: The total fertility rate is expected to reach 2.6 children per woman by 1985 and the net gain through international migration is set at 100,000 persons per year.

Projection B: Total fertility rate of 2.2 by 1985 and net gain of 60,000 through international migration.

Projection D: Total fertility rate of 1.8 by 1985 and net gain of 60,000 through international migration.

Projection E: Total fertility constant at the 1971 level of 2.19 children per woman and no international migration.

### 2.2 *Marital status assumptions*

The population projections described above are given by age and sex. For the purpose of household and family projections, these were further broken down into the following marital status categories: (a) single, (b) married spouse present, and (c) ever married spouse absent (separated, widowed and divorced). The main advantage of this grouping is that, according to the census definitions used until 1971, all married spouse present men are heads of families. A given age-sex group was first separated into single and ever married. The ever married group was then partitioned into spouse present and spouse absent.<sup>1</sup> Two assumptions were used to project these proportions:

Variable assumption: The proportions were projected with a modified exponential formula that extrapolated until 1986 the same rate of change as that observed between 1951 and 1971. The proportion married spouse present in the population aged 15 and over would change from 60.5 per cent in 1971 to 65.5 per cent by 1986. The various proportions are held constant for the period 1986-2001.

Constant assumption: The proportions in each age-sex group are held constant at their 1971 levels. Due to changing age structures, the proportion married spouse present would change from 60.5 per cent in 1971 to 63.5 per cent in 1986.

### 2.3 *Headship rate assumptions*

The last set of assumptions concerns the evolution of the proportion of household and family heads in the various age, sex and marital status groups. For the purpose of projections, it is worth distinguishing three non-overlapping types of heads: heads of primary families, heads of secondary families and heads of non-family households.<sup>2</sup> These were taken into account to provide a constraining value to the number of heads (all types combined) in the given population groups. Three assumptions were developed in regard to headship rate:

High assumption: The headship rates, in each age, sex and marital status group, were extrapolated until 1986 at the same rate of change as that observed between 1961 and 1971. The proportion of household heads in the population aged 15 years and over would change from 39.9 per cent in 1971 to 45.5 per cent in 1986. The proportions are held constant for the period 1986-2001.

Low assumption: The future change in headship rates was expected to be equivalent to the observed change between 1951 and 1971. By 1986, there would be 44.9 per cent household heads in the population aged 15 and over.

Constant assumption: The headship rates are held constant at their 1971 levels. Due to changing age

structure, the proportion of heads would change from 39.9 per cent in 1971 to 41.8 per cent by 1986. The results of the constant assumption are lower than those of the low assumption.

### *III. Effects of the Assumptions*

Through introducing alternative combinations of the various assumptions, it is now possible to examine the sensitivity of these assumptions in the household and family projections. It is noted that Statistics Canada (1975b) published four principal series of projections. The reader is referred to the original publication for detailed tables and analyses of the results of these four series.

#### *3.1 Effect of varying the population assumptions*

The effects of population change can best be illustrated under conditions of constant marital status and constant headship. It is seen from Table 1 that an addition of from 1,929,500 to 2,405,300 households is expected in the period 1971-1986, solely as a result of changes in the size and age structure of the Canadian population. The population aged 15 and over would increase by 25.6 per cent in the period 1971-1986 under conditions of no international migration (Projection E) or by 33.5 per cent under the assumption of 100,000 net immigrants per year (Projection A). In spite of fixed rates, the number of households would increase over this period by 31.8 per cent (Projection E) or 39.7 per cent (Projection A) while the number of families would increase by 31.5 per cent or 39.9 per cent respectively. The households and families would increase faster than the population aged 15 and over because of the changing age distribution of the adult population. In particular, this period until 1986 will see the large post-war generations arrive at the prime ages for marriage and household formation.

Though population growth makes a very strong contribution to household and family growth, it is also seen from Table 1 that the differential outcomes of the various population assumptions are relatively small at the national level. Discounting the purely analytic assumption of zero international migration (Projection E), the three other projections yield results for 1986 that vary by a range of only 197,400 households and 172,800 families. These figures represent a range of about two per cent. These observations indicate that a large part of the future growth of households and families is inherent in the simple dynamics of the age distribution of the existing population. Stated differently, the fertility component, which is the most volatile element in population projections at the national level, only starts to introduce uncertainty into the household and family projections in the longer term.

#### *3.2 Effect of varying the headship assumptions*

Table 2 illustrates the effect of varying the headship rate assumptions under conditions of constant marital status applied to Projection D. For the period 1971-1986, the high headship assumption yields an increase of 47.7 per cent in the number of households. The increase is 36.4 per cent when the constant headship rates are applied. The difference between these two figures (11.3) is attributable to the increase in headship rates under the high assumption. In other words, 24 per cent (11.3/47.7) of the increase in total households from 1971 to 1986 under the high headship assumption arises from the projected changes in headship rates, and the remainder from changes in the base population during the period.<sup>3</sup> Over the longer term, 1971-2001, only 16 per cent of the increase in households can be attributed to projected changes in headship rates. This smaller share is naturally a function of the fact that headship rates are held constant during the latter part of the projection period.

The contribution of changing headship rates is found to be far less important for families than for households. The increase in families over the period 1971-1986 varies only from 35.8 per cent to 36.8 per cent under the different headship assumptions. Under the high assumption, less than one per cent of the increase in families between 1971 and 1986 can be attributed to

TABLE 1. EFFECT OF THE POPULATION ASSUMPTIONS ON THE  
NUMBER OF HOUSEHOLDS AND FAMILIES, CANADA, 1971-2001

(Assuming constant marital status and constant headship rates)

Projection No.	Population assumption		In thousands		Per cent increase	
	Fertility	International migration	1971	1986	1971- 1986	1986- 2001
H O U S E H O L D S						
A	High	100,000	6,062.8	8,468.1	39.7	25.9
B	Medium	60,000	6,062.8	8,279.4	36.6	21.9
D	Low	60,000	6,062.8	8,270.7	36.4	20.4
E	Constant	0	6,062.8	7,992.3	31.8	17.4
F A M I L I E S						
A	High	100,000	5,070.7	7,091.8	39.9	24.9
B	Medium	60,000	5,070.7	6,923.8	36.5	20.8
D	Low	60,000	5,070.7	6,919.0	36.5	19.4
E	Constant	0	5,070.7	6,667.0	31.5	16.4

Note: Includes collective households.

Sources: *Census of Canada, 1971*, Vol. 2.1-12, Table 85.  
Statistics Canada, 1975b: 85-86.

TABLE 2. EFFECT OF HEADSHIP RATE ASSUMPTIONS ON THE  
NUMBER OF HOUSEHOLDS AND FAMILIES, CANADA, 1971-2001  
(Assuming Projection D and constant marital status)

Headship Rate Assumption	In thousands			Per cent increase	
	1971	1986	2001	1971- 1986	1986- 2001
<u>H O U S E H O L D S</u>					
High	6,062.8	8,955.1	10,710.6	47.7	19.6
Low	6,062.8	8,826.7	10,582.5	45.6	19.9
Constant	6,062.8	8,270.7	9,955.3	36.4	20.4
<u>F A M I L I E S</u>					
High	5,070.7	6,936.8	8,267.2	36.8	19.2
Low	5,070.7	6,886.3	8,211.3	35.8	19.2
Constant	5,070.7	6,919.0	8,259.6	36.5	19.4

Note: Includes collective households

Sources: Same as Table 1

changing headship rates. More generally, it can be noted that, once age, sex, and marital status are controlled, family headship rates have remained rather stable over time. While people may be forming families at slightly younger ages, there is also more dissolution of families either through marital separations or through the departure of children in the case of lone parents.

### 3.3 *Effect of varying the marital status assumptions*

The contribution of the marital status assumptions to the future growth of households and families can be measured by comparing the results under the condition of constant headship rates applied to a single population projection. Table 3 shows that the increase in households is almost the same under the two marital status assumptions. The projected marital status change until 1986 can account for only four per cent of the growth in households over this period. For families, the projected increase would be 36.5 per cent under constant marital status or 41 per cent under variable marital status. That is, 11 per cent (4.5/41) of the latter increase can be attributed to changing marital status. It is quite reasonable that marital status assumptions would have more effect on the number of families. An increase in the proportion married spouse present will necessarily increase the number of families in the population. However, it need not increase the number of households since the single and ever married spouse absent populations also make strong contributions to the total number of household heads.

TABLE 3. EFFECT OF MARITAL STATUS ASSUMPTIONS ON THE  
NUMBER OF HOUSEHOLDS AND FAMILIES, CANADA, 1971-2001

(Assuming Projection D and constant headship rates)

Headship Rate Assumption	In thousands			Per cent increase	
	1971	1986	2001	1971- 1986	1986- 2001
<u>H O U S E H O L D S</u>					
Variable	6,062.8	8,374.1	9,978.1	38.1	19.2
Constant	6,062.8	8,270.7	9,955.3	36.4	20.4
<u>F A M I L I E S</u>					
Variable	5,070.7	7,148.3	8,465.3	41.0	18.4
Constant	5,070.7	6,919.0	8,259.6	36.5	19.4

Note: Includes collective households

Sources: Same as Table 1

*3.4 Effect of the joint variation of headship and marital status assumptions*

Table 4 gives the results of all possible combinations of the headship rate and marital status assumptions under one population projection. In 1986, the combination of high headship with variable marital status yields 9,012,600 households, an increase of 48.7 per cent for a 15-year period. The combination of constant headship and constant marital status results in 8,270,700 households by 1986 or an increase of 36.4 per cent. Thus, the 1986 results differ by a range of 741,900 households. The attribution of this difference to marital status and headship cannot be clearly resolved since it depends on which factor is considered first. Taking an average of the two possible solutions, it is seen that 11 per cent of the difference is accounted for by variations in the marital status assumptions and 89 per cent to headship rate assumptions.<sup>4</sup>

For families, the range between the high and constant combinations amounts to 239,300 units in 1986. Of this difference, 94 per cent is due to marital status variation and 6 per cent to headship rate variation. This once again shows that the marital status assumptions are more important for the number of families than for the number of households.

It is worth noticing that under assumptions of high or low headship, the projected households for the year 2001 would be higher under an assumption of constant marital status than under a variable pattern of marital status change. That is, a higher proportion of married spouse present would result in a lower number of households. To explain this surprising result, it must be noted that a high proportion of the population in the married category implies an equal number of spouses who are not subject to being household heads. Thus, under the conditions of the relatively high headship rates projected for 2001, a larger proportion

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TABLE 4. JOINT EFFECT OF THE MARITAL STATUS AND HEADSHIP ASSUMPTIONS ON THE NUMBER OF HOUSEHOLDS AND FAMILIES, CANADA, 1971-2001

(Assuming Projection D)

Headship Rate and Marital Status Assumptions	In Thousands			Per cent increase	
	1971	1986	2001	1971- 1986	1986- 2001
<u>H O U S E H O L D S</u>					
Headship rates High					
Marital status:					
Variable	6,062.8	9,012.6	10,663.2	48.7	18.3
Constant	6,062.8	8,955.1	10,710.6	47.7	19.6
Headship rates Low					
Marital status:					
Variable	6,062.8	8,896.8	10,553.1	46.7	18.6
Constant	6,062.8	8,826.7	10,582.5	45.6	19.9
Headship rates Constant					
Marital status:					
Variable	6,062.8	8,374.1	9,978.1	38.1	19.2
Constant	6,062.8	8,270.7	9,955.3	36.4	20.4
<u>F A M I L I E S</u>					
Headship rates High					
Marital status:					
Variable	5,070.7	7,158.3	8,459.8	41.2	18.2
Constant	5,070.7	6,936.8	8,267.2	36.8	19.2
Headship rates Low					
Marital status:					
Variable	5,070.7	7,111.2	8,411.2	40.2	18.3
Constant	5,070.7	6,886.3	8,211.3	35.8	19.2
Headship rates Constant					
Marital status:					
Variable	5,070.7	7,148.3	8,465.3	41.0	18.4
Constant	5,070.7	6,919.0	8,259.6	36.5	19.4

Note: Includes collective households.

Source: Same as Table 1

unmarried would result in a larger number of households. This result does not hold true for families. Under all headship assumptions, the lower the proportion married, the lower the number of families.

#### *IV. Conclusions*

Under the conditions of no international migration, a constant marital status distribution and constant proportions of heads in the various population groups, there would be a net increase of 1,929,500 households and 1,596,300 families in Canada during the period 1971-1986. This increase is thus inherent in the current age structure which will see the movement of the large post-war generations through the prime ages for marriage and household formation during the period until 1986. If international migration is set at a net gain of 100,000 persons per year, there would be an increase of 2,405,300 households and 2,021,100 families in the same 15-year period. Assuming 100,000 net immigrants plus a continuation of the recent change in marital status distribution and in headship rates, the net increase over this period would be 3,171,000 households and 2,270,300 families (Projection 1 in Statistics Canada, 1975b). These latter increases of 52.3 per cent in households and 44.8 per cent in families are considerably higher than the 28.9 per cent growth projected for the population under the highest assumptions.

It is found that household and family projections are most sensitive to population growth and changing age structure. Even under conditions of rapid change in the headship rates, this population factor accounts for 75 per cent of the change in households and 89 per cent of the change in families until 1986 (using Projection D). The marital status assumption accounts for three per cent of the increase in households and 10 per cent of the increase in families. Lastly, the headship assumption can be held responsible for 22 per cent of the household increase but only one per cent of the family increase. Thus the household projections are sensitive to the headship assumptions but not to the marital status assumptions. On the other hand, the family projections are sensitive to the marital status assumptions but not to the headship assumptions.

#### *Footnotes*

- 1 Other methods could have been used for projecting marital status, for instance, the component method suggested by Spohr (1973) or the cohort method proposed by Hocking (1958) and Pressat (1959). However, the work of Calot, et al., (1970) indicates that the simple extrapolation of proportions can produce adequate results.
- 2 A primary family is a family where the family head is also a household head. A secondary family is one where the family head is not a household head. A non-family household is a household of which the head is not the head of a family. Note also that households are here defined to include both private and collective households.
- 3 It can be noted that Parke and Grymes (1967:446-447) obtained very similar results for the United States. Over the projection period 1966-1985, 24 per cent of the increase under the high assumption can be attributed to changes in headship rates.
- 4 These results are again very similar to those obtained by Parke and Grymes (1967:450) for the United States.

#### *Disclaimer*

The author alone is responsible for the views expressed in this paper.

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