FERTILITY DECLINE IN CANADA, 1961 - 1970: AN ANALYSIS THROUGH FERTILITY TABLE APPROACH

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Social Scientists have evinced keen interest in the fertility decline in the North American Continent. Studies carried out in the U.S.A. (Ryder and Westoff, 1971), and Canada (Allingham, Balakrishnan, and Kantner, 1970) reveal the important role played by the pill in the decline of fertility during the late sixties. The decrease has been so significant that the U.S.A. fertility has already headed toward a ZPG. A recent press release claimed that Canada also is moving in a ZPG direction. The conclusion arrived at, for the press release, is based on the measure of total fertility. The present writers feel that the fertility decline as deduced from the changing total fertility rates is defective on account of methodological problems associated with the conventional measures of fertility. Furthermore, Canada has a large flow of immigrants and this also may influence the fertility rates. This paper attempts to remedy a major methodological problem of the conventional measures of natality by means of the fertility table technique. The different demographic components of Canadian fertility decline are also presented.

2. Methodological Problem of Conventional Fertility Measures

A rate is defined as the ratio of the frequency of occurrence of an event during the period (usually one year) under consideration to the appropriate population at risk. The computation of proper risk population is not always easy in view of the continuous nature of the occurrence of vital events. In mortality studies, proper exposure for the population under consideration is introduced. The present writers are of the opinion that the different conventional measures do not take cognisance of the correct woman years of exposure.

The core of the measurement problem lies in calculating the woman years of exposure. In the building of stochastic process models of fertility, the non-fertility period when a woman is pregnant, is taken care of (Dandekar, 1955; Singh, 1963, 1964, 1968, Singh & Bhattacharya, 1970. We believe that the non-fertile period has to be considered when any fertility measure is computed. All the females who give birth in one year may not beget children in the next year on account of biomedical reasons. While some bring forth issues, some others may not be exposed at all to the risk of child-bearing. Therefore, during the next year the woman years of exposure are bound to be less than those of the initial year assuming that there are no new entrants to the child-bearing span by means of immigration.

The importance of the point made here is further clarified by the following analysis. We make three assumptions.

1. A female who has been now delivered of a (live-birth) child would not conceive (beget) another child for at least two months after and shall be infertile for another 9 months if she conceives.
2. All live births are uniformally distributed over the 12 months of a year.
3. Females in the reproduction ages do not die. This "mortality-free" assumption can be dropped when mortality factor is incorporated into the fertility table idea proposed here.

Assumptions 1 and 2 are the crucial elements for the determination of the risk population. It has been estimated by medical researchers that a normal live birth is the outcome of 38 - 42 weeks of pregnancy. Also a female who has just given birth to a child, on an average, would not be able to conceive sometimes on account of bio-medical reasons (post partum amenorrhoea).

Consider year Z. The females who are delivered of babies in the first two months of Z may give birth to a child in any month of year Z + 1. In other words, they are exposed to the risk of bringing forth a child for 12 months as far as year Z + 1 is concerned. But the females who are responsible for live births in the months of March through December of year Z are exposed in year Z + 1 for 11, 10, 9, 8, 7, 6, 5, 4, 3 and 2 months respectively. Hence the total months of exposure to mothers of live birth's occurring in Z as far as year Z + 1 is concerned would be equal to

$$12 + 12 + 11 + 10 + \ldots\ldots + 2 = 89.$$

Months of non-exposure = 144 - 89 = 55

Thus it is clear that 55/144, that is 38.2 per cent of mothers in year Z are, on an average, not exposed to the risk of bringing forth a child in year Z + 1. The "reduction" to the risk population is considerable and has to be given its due. In section 3, we suggest the use of the life table approach as a solution to this methodological handicap.

3. Fertility Tables

Fertility tables, which are analogous to the life tables, are a way out of this methodological problem. If birth spacing data are available, the fertile life tables suggested by Pool and Wright (1969) can be fruitfully employed.

The following are the main functions of a fertility table:

q_x - Probability of a live-birth in year (x, x + 4) at the beginning of the age interval.

l_x - Number of females at risk of giving birth to at the beginning of the age interval (x, x + 4).

L_x - A first approximation of woman-years of exposure to the risk of a child birth in (x, x +4).

T_x - $\sum_{X=15}^{45} L_x$

E_x - T_x/l_x A first approximation of the expected years of exposure to the risk of child

birth in the reproductive span.

Y_x - The number of years the females who have births to are not at risk of giving birth to another child in (x, x + 4).

$Lx' = L_x - Y_x$ - A better approximation of the woman-years of exposure to the risk of child in (x, x + 4).

$T'_x = \sum_{X=15}^{45} (L_x - Y_x)$

$E'_x = T'_x / l_x$ - A better approximation of the expected years of exposure to the risk of child birth in the reprodctive span years lost due to child birth at age X.

$E_x - E'_x$ - Years lost due to child birth at age x.

T.F.R., or expected family size at age x --- $(E_x - E'_x)$ 12/11.

4. Fertility Tables for Canada 1961 - 1970

Fertility tables for the 1961 - 70 decade are presented in appendix (tables A - 1 to A - 5). The age-specific fertility rates are used as probabilities; no conversion of M_x's into q_x's as done if life table construction was performed. The synthetic and the period TFR's for the decade under review are shown in Table 1.

4.1 Virtual Fertility Decline

The decennial decline in TFR as measured by Statistics Canada estimates is 1,529 births per 1,000 woman, while the fertility table approach reveals a decline of 1,464 births. Thus for every 1,000 women in the reproductive span overestimates of 65 births over the decade is noted by Statistics Canada by employing a conventional measure of fertility. It is worthwhile to point out that, from 1961 through 1964, the fertility table values are lower than the period TFR, in 1965 they are almost identical, and from 1966 onwards the period rates are lower than the fertility table ones. Since the fertility table rates are synthetic values, they look like cohort rates. The convergence and divergence of period and cohort rates have been noted for Canada (Henripin, 1972). It seems to the present authors that, however synthetic, the fertility table rates convey the behavior of cohort rates. A detailed study of this problem is being undertaken.

4.2 Immigration Component

Immigrant females of reproductive age-groups in Canada constitute 1 to 3 per cent of the total Canadian females of reproductive ages.

The impact of immigration on Canadian fertility needs to be probed into. Economic insecurity, problems related with assimilation in the host community etc. all lead to postponement of births. We suggest two models to study the effect of immigration on the conventionally computed TFR.

Assumption 1: Immigrant females in the reproductive age group are not likely to give birth to a child in the first year of this stay in Canada.

Assumption 2: Immigrant females in the reproductive age group are not likely to give birth to a child in the first two years of their stay in Canada.

From the data available on immigration by age and month of arrival (Statistics Canada publications Vital Statistics 1961 through 1970), one can develop estimates of the TFR under assumptions 1 and 2. These are presented in Table 1. The first type of assumption yields a TFR of 3,874 in 1961 and 2,344 in 1970 for the non-immigrant Canadian population. The ten-year decline works out at 1,530 births per 1,000 women which is not far apart from that given by the difference in period TFR values. Under assumption 2, the decline in 1962 - 70 is 1,444 births per 1,000 women, showing that the immigrant component leads to a superficial reduction of 85 births per 1,000 women. The realistic situation may be somewhere between those referred to by assumptions 1 and 2. Hence, on an average, a superficial reduction of about 43 births per 1,000 women is the effect of immigration on Canadian fertility decline during the period 1961 - 70.

Conclusion

This analysis of fertility decline done here for Canada reveals that the overall decrease in the decade 1961 - 70 as portrayed by changing TFR is exaggerated by about 65 births per 1,000 women. If immigration component is built into the study, the superficiality of the decline is further increased. Overestimates of total fertility rate are in direct conflict with the claims by some that Canada is close enough to achieve zero population growth.

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Data Sources

Statistics Canada. (1972) Vital Statistics 1970.

OTTAWA: Information Canada

APPENDIX

Due to the limitations of space, fertility tables for 1961, 1963, 1965, 1967 and 1970 are selected.

Table 1 Total Fertility Rates Canada: 1961 - 1970

YEAR	TFR STAT CANADA	FERTILITY TABLE TFR	TFR IMMIGRATION 1	UNDER ASSUMPTION 2
1961	3840	3801	3874	
1962	3756	3721	3791	3827
1963	3669	3639	3710	3745
1964	3502	3482	3544	3583
1965	3145	3146	3193	3232
1966	2812	2827	2867	2911
1967	2586	2606	2646	2698
1968	2441	2466	2488	2546
1969	2388	2412	2428	2522
1970	2311	2337	2344	2383

Source: Vital Statistics, 1970 Ottawa: Information Canada.
FERTILITY TABLES

Table A1 Fertility Table for Canada Females 1961

AGE GROUP	qx	lx	Lx	Tx	Ex	L'x	T'x	E'x	T.F.R.
15 - 19	.058200	100000.0	491723.9	3369349.	33.69	466683.	3052567.	30.526	3.801
20 - 24	.233600	97941.6	466379.2	2877625.	28.78	371051.	2585884.	25.859	3.501
25 - 29	.219200	92220.6	462913.4	2411245.	24.11	374127.	2214832.	22.148	2.357
30 - 34	.144900	92665.1	472893.2	1948331.	19.48	412936.	1840705.	18.407	1.292
35 - 39	.081100	95027.7	483707.0	1475437.	14.75	449382.	1427768.	14.278	0.572
40 - 44	.028500	97154.7	493098.5	991730.	9.92	480802.	978386.	9.784	0.160
45 - 49	.002400	98981.3	498635.6	498631.	4.99	497588.	497584.	4.976	0.013

Table A2 Fertility Table for Canada Females 1963

AGE GROUP	qx	lx	Lx	Tx	Ex	L'x	T'x	E'x	T.F.R.
15 - 19	.053100	100000.0	492438.9	3374912.	33.75	469559.	3071636.	30.716	3.639
20 - 24	.226000	98118.6	467509.9	2882473.	28.82	375060.	2602077.	26.021	3.365
25 - 29	.210600	92454.6	464218.2	2414963.	24.15	378674.	2227017.	22.270	2.255
30 - 34	.140300	92932.5	473752.4	1950744.	19.51	415593.	1848342.	18.483	1.229
35 - 39	.075800	95177.9	484578.2	1476991.	14.77	452439.	1432748.	14.327	0.531
40 - 44	.025900	97335.7	493645.2	992413.	9.92	482458.	980309.	9.803	0.145
45 - 49	.002100	99073.4	498770.7	498768.	4.99	497854.	497851.	4.979	0.011

Table A3 Fertility Table for Canada Females 1965

AGE GROUP	qx	lx	Lx	Tx	Ex	L'x	T'x	E'x	T.F.R.
15 - 19	.049300	100000.0	492972.7	3391858.	33.92	471707.	3129656.	31.297	3.146
20 - 24	.188600	98250.8	472450.6	2898885.	28.99	394485.	2657948.	26.579	2.891
25 - 29	.181900	93623.7	468981.7	2426434.	24.26	394338.	226346.3	22.635	1.956
30 - 34	.119400	93836.3	477386.3	1957452.	19.57	427511.	1869125.	18.691	1.060
35 - 39	.065900	95866.6	486610.9	1480065.	14.80	458552.	1441613.	14.416	0.461
40 - 44	.022000	97675.6	494534.9	993454.	9.93	485015.	983061.	9.831	0.125
45 - 49	.002000	99211.8	498923.6	498919.	4.99	498050.	498046.	4.980	0.010

Table A4 Fertility Table for Canada Females 1967

AGE GROUP	qx	lx	Lx	Tx	Ex	L'x	T'x	E'x	T.F.R.
15 - 19	.045200	100000.0	493550.1	3410413.	34.10	474030.	3193214.	31.932	2.606
20 - 24	.161100	98394.0	476189.4	2916862.	29.17	409065.	2719183.	27.192	2.372
25 - 29	.151400	95402.3	473783.3	2440672.	24.41	411019.	2310118.	23.101	1.567
30 - 34	.091400	94816.2	482099.2	1966888.	19.67	443543.	1899099.	18.991	0.813
35 - 39	.050600	96804.9	489652.2	1484788.	14.85	467973.	1455555.	14.556	0.351
40 - 44	.015900	98205.6	495928.9	995136.	9.95	489029.	987582.	9.876	0.091
45 - 49	.001500	99429.1	499212.6	499207.	4.99	498557.	498553.	4.986	0.008

Table A5 Fertility Table for Canada Females 1970

AGE GROUP	qx	lx	Lx	Tx	Ex	L'x	T'x	E'x	T.F.R.
15 - 19	.43400	100000.0	493803.9	3419672.	34.20	475052.	3224959.	32.250	2.337
20 - 24	.142100	98456.9	478770.3	2925868.	29.26	419241.	2749907.	27.499	2.112
25 - 29	.145600	95119.1	475132.7	2447097.	24.47	414601.	2330665.	23.307	1.397
30 - 34	.080700	95004.9	483739.4	1971964.	19.72	449581.	1916064.	19.161	0.671
35 - 39	.038500	97168.3	491703.4	1488224.	14.88	475139.	1466482.	14.665	0.261
40 - 44	.011000	98628.8	497049.9	996521.	9.97	492266.	991343.	9.913	0.062
45 - 49	.000900	99604.3	499474.4	499471.	4.99	499081.	499077.	4.991	0.005