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FERTILITY AND INCOME IN CANADA: A TIME SERIES AND CROSS SECTION ANALYSIS

BY

© NAMPERUMAL BASKARA RAO

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled FERTILITY AND INCOME IN CANADA: A TIME SERIES AND CROSS SECTION ANALYSIS submitted by Namperumal Baskara Rao in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

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ABSTRACT

The main objectives of the thesis are to examine: i) the relationship between fertility and income in Canada, as shown by time series and cross section data, ii) whether the income effect on fertility is similar in Quebec and Ontario with their proportions of Catholic and Protestant population respectively, and iii) the problems of interpreting the income-fertility relationship when we use different types of data such as, the time series, cross section, micro and macro data.

For the time series relationship, age specific fertility rates, lagged by one year, were regressed on personal per capita real income for the period 1926-64. Wherever necessary the original data were transformed in order to reduce autocorrelation. For the cross section relationship we used data on the number of unmarried children at home (below age 25) and the earnings of the head of the family.

During 1926-57, the time series relationship was positive, particularly among the younger age groups. The relationship was influenced by changes in the timing of births and in the completed family size among particular cohorts of women. We have examined certain factors that might have contributed to the negative relationship during 1958-64. The cross section data showed a weakening of the tradional inverse relationship (between family size and income) and a reversal to a positive relationship.

The positive time series relationship was less pronounced in Quebec as compared to Ontario. In 1961, the positive cross section relationship between family size and income was more consistent in Ontario than in Quebec.

We have examined briefly, in the light of specification bias and aggregation bias, certain problems that arise in the prediction of fertility using different types of data.

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INTRODUCTION

Fertility, in many of the industrialized countries, continued its long term decline till the late 1930's, reversed its trend and rose to new heights during the postwar period, and again started declining from the late 1950's. At the same time the trend in income levels in these countries generally showed a consistent rise up to about 1930, a steep decline during the depression period and a recovery thereafter. Though the relationship between fertility and income or socio-economic status in general was under investigation for a long time, the postwar 'baby boom' renewed the interest of several researchers to examine the factors that determine fertility.

Some studies using time series data examined the relationship over time, while others using cross section data analysed the relationship at particular points in time. Though these studies have definitely added to our knowledge about fertility, the estimated relationship between fertility and income is not very consistent and there are different interpretations of the relationship.

Most of the studies mentioned above are about United States and similar studies are very few in Canada. Given certain features which are characteristic of a pluralistic society, it will be of interest to examine the relationship between fertility and income in Canada. To what extent the economic factors influence fertility? Whether the nature of the response in fertility to the changes in the economic conditions differs among the Catholic and the Protestant populations? These are some of the problems that can be examined in Canada.

In statistical analysis, the data are organized in different ways. These differences are partly due to the availability of data and partly due to the convenience of analysis. For example, in time series analysis, per capita income and fertility rates (for the country as a whole or for the provinces) at specific points in time can be correlated. Countries or the provinces become the units of analysis in the time series relationship and the estimated relationship is relevant for a period of time. Another way of analysing the relationship between fertility and income is to use the cross section data which consist of the distribution of family size (or the number of children) according to the income of the families. From the cross section relationship we try to examine whether the rich have larger or smaller family size as compared to the poor. In the cross section data of the type mentioned above, individuals or families are the units of analysis and the relationship is relevant for a particular point in time. In the corss section relationship, the units of analysis can be geographical regions also. For example, fertility rates and per capita income in the various countries of the world can be correlated. These are a few instances of the several ways in which the relationship between fertility and income can be analysed using different types of data. The question is whether the units of analysis chosen and the type of data used, affect the magnitude and the direction of the relationship? Can we draw inferences, about individual behaviour, from the time series relationship? We may not be able to do an exhaustive analysis of these problems that arise from using the various types of data. However, we will examine a few problems that arise when we compare the time series relationship and the cross section relationship (using data on individuals or families).

No attempt has been made here to collect data through questionnaire. The idea is to profitably exploit the data easily accessible in Canada and gain as much knowledge as possible regarding the problems we have specified, so that our analysis may lead to a later more intensive study.

Researchers are aware that, with low and declining mortality in several countries, a study of the interrelationship between fertility on the one hand and the economic and social forces on the other is quite important. The implications of this relationship have to be taken into consideration, implicitly or explicitly, in the case of the economic development of the less developed countries, population policies etc. We expect that our study will be useful in this larger context also.

In Chapter I we have a review of some of the important studies along with the problems arising therefrom. Chapter II deals with the subject matter of our study and the general framework for analysis. We have discussed the statistical model and its assumptions in the third chapter. Chapter IV deals with the general trends in income, fertility and other related variables. Chapter V and VI deal with the time series and the cross section relationships respectively. In Chapter VII which is an extension of the preceding two chapters, we have discussed certain problems in interpreting the relationship, when we use different types of data, such as, cross section, time series, micro and macro data. In the final chapter we have tried to collect the main strands in our findings and discuss some of their implications as well as the possibilities for further research. We did some experimental calculation

in order to understand the relationship between income, unemployment rates, marriage rates and fertility. Secondly, fitting a trend line to the data on fertility and income needed some calculations. A brief description of the results of these initial experiments can be found in the appendices.

CHAPTER I

BACKGROUND

We will briefly review some important studies dealing with the socio-economic correlates of fertility. These studies differ with respect to the type of data used. Since these differences have certain implications for the findings, it will be useful to describe the different types of studies before proceeding with the review of the findings discussed in these studies.

Types of Studies

We can broadly divide the studies into the time series, cross section and the longtitudinal studies. In the cross section studies the estimated relationship is relevant for a particular point in time. In the case of the other two an element of time is involved, the relationship being relevant to a period of time.

In a way these differences are due to the type of data available to the investigator. To highlight these differences let us take some examples: 1) Sometimes the researcher collects data on, say, family size and income for a sample of people. He can have the data on the individuals cross classified by income and the number of children which will constitute his basic data. Here, the correspondence between income and the number of children is at the individual level ie, each individual takes certain values of income and family size. For purposes of analysis, the basic data are compressed into a more manageable form. Individuals

may be grouped into income intervals with mean family size for each interval. Generally, this grouping is done taking into consideration the homogeneity within the groups and the frequency distribution for both the variables. 2) In the second case the same data are collected by certain organizations and they are grouped and made available. That is, the researcher's data consist of individuals cross classified by the number of children and income intervals. Here also there is individual correspondence between the variables, but the homogeneity in the income intervals is not known to the researcher. 3) In another case the data are collected by different organizations and tabulated, e.g., total fertility rates or mean family size from the Vital Statistics Reports and income from the National Accounts Reports. These data may be at the same point in time and for the same geographical area (usually for a country or the provinces). However, the individual correspondence between the two variables is not explicit and the researcher has generally no knowledge about the frequency distribution, especially in the case of income. The data available to the researcher in (1) and (2) can be considered as micro data while the macro data refer that in (3). Generally the terms micro and macro are used to denote smaller and the larger groups respectively. What we want to emphasize is that in macro data the individual correspondence between the variables is very much blurred. Because of this lack of individual correspondence in the macro data, it is difficult to draw inferences, about individual behavior, from macro relationship. Sociologists have drawn attention to the lack of consistency between individual correlation (with individuals as units of analysis) and ecological correlation (with groups or geographical regions

as units of analysis). Similarly, economists through aggregation techniques, have analyzed the consistency (or the lacke of it) between the micro and macro relationships. In general, both sociologists and the economists face the same methodological problem: given macro observations can we draw inferences about or explain the behavior of the individual units.

In the cross section studies about fertility, both micro and macro data are used. In the time series studies macro data are used, while the longtitudinal studies use micro data. We may note that in a time series, the observations are not on the same group of persons. On the other hand, in the longitudinal studies, the observations are on the same group or cohort of persons. Longitudinal studies are specially designed to gather information on fertility, economic status, birth intervals etc., on the same cohort of women at subsequent points in time. Fertility data collected from the time series and longitudinal studies are analogous to period and cohort fertility respectively. Cohort fertility refers to the fertility of the same group of women (born or married during the same period) as they advance from one age group to another, while the period fertility refers to the fertility of different cohorts of women at the same points in time.

Both longitudinal and cohort models are designed to get data on the reproductive history of the same group of women. However, the data from the cohort model are retrospective in nature, while those from the longitudinal studies are prospective in nature. In longitudinal (or prospective) studies, the same women are interviewed at a few points in

time. In the cohort (retrospective) model, women aged 45 and above are asked to recollect the past events such as date of marriage, number of births etc., and these data constitute the reproductive history of that group of women.

Time Series Studies

Several time series studies have examined the relationship between the fluctuations in economic conditions and birth rates. The indicators of booms and depressions are several such as, real per capita income, unemployment rates, proportion of workers in non-agricultural occupations, index of industrial production, investment in housing and so on, the first two being more common. In some studies the above indicators are used collectively to identify the maxima and the minima in the economic cycles and in some others they are used separately. In 1906, Yule (1906: 88-132) found that birth rates were influenced by trade cycles directly and also indirectly through changes in the marriage rates. This was followed by the studies of Ogburn and Thomas (1922: 324-40), Hexter (1925: 125-38) and Thomas (1927: 97-103) who, while examining the impact of the economic changes on the social conditions, discussed the relationship between the birth rates and the economic fluctuations. From 1941 onwards there was a tendency for a more intensive analysis of the trends and fluctuations in births as influenced by marriages and economic conditions. In an important study, Galbraith and Thomas (1941: 465-76) found a high positive correlation between the employment conditions and births in United States during 1919-37. Similar findings were reported by Kirk (1942) for Germany, Kirk (1960) for United States,

and Silver (1966) for United Kingdom and Japan. Kirk's study (1960) showed evidence of a strong and positive relationship between fertility rates on the one hand and the economic factors such as, real per capita personal income, index of industrial production and employment conditions on the other. However, "the data of this study do not confirm the view that major changes in fertility are a function of business cycles. In other words, while the deviations from trend of fertility rates seem to move in the same direction as the trend deviations of economic indicators, the former series exhibits a distinctive character of its own, describing a trend in many respects quite independent of economic conditions. The surface waves are indeed much influenced by economic fluctuations, but the underlying tide appears to be an independent and surprisingly stable force" (Kirk, 1960: 254). That, fertility varies directly with economic fluctuations received further support from Becker (1960), Easterlin (1968) and Krotki (1968), the last mentioned author using Canadian data. Kiser et al (1968: 237-54) making use of refined measures like age-parity specific birth probabilities came to the same conclusion, though the relationship was not very strong. Basavarajappa (1971) using age-duration specific confinement rates for Australia found positive relationships during the inter war period and negative relationships for the post war period.

In these studies, the number and type of indices used to represent the variables, the statistical treatment of the time series data and the analytical approach to the problem differ, however, the common factor in all these studies is that they have tried to relate the variations

over time in fertility and economic conditions and most of them have shown a positive relationship.

Cross Section and the Longitudinal Studies

One cross section study (Charles 1948) using Canadian Census data showed that, with a few exceptions, higher income was associated with a smaller family size irrespective of ethnicity, education and place of residence. There are a good number of cross section studies using United States data from special surveys, censuses, and current population surveys. According to the Indianapolis study (Kiser and Whelpton, 1949),which was the earliest attempt to examine the socioeconomic correlates of fertility in a comprehensive manner, the relationship between the number of children ever born and the income of the husband was negative in the group with less than $3,000.00. However among the 'number and spacing planned' there was a consistent positive relationship, while the 'quasi planned' group showed an inverse relationship.

During the 1950's and later, a series of fertility studies were conducted in the United States. Out of these, the GAF (Growth of American Families) and the FGMA (Family Growth in Metropolitan America) studies are quite important. The GAF series (Freedman et al. 1959; Whelpton et al. 1966, and Ryder and Westoff, 1971) of studies were conducted in 1955, 1960 and 1965, and the main purpose of these studies was to gather data on the number of children expected in order to facilitate population forecast. The FGMA studies (Westoff et al. 1961; Westoff et al. 1963, and Bumpass and Westoff, 1970) focussed attention on the number of children desired (among women with two children), intervals between

births, success with family planning etc., and interviewed a panel of couples at subsequent points in time, ie., in 1957, 1960 and during 1963-67. The main purpose of these studies (FGMA) was to examine whether the number and spacing of children were due to explicit preferences on the part of women or due to certain accidental factors such as contraceptive failures, pregnancy wastage etc.

These studies (GAF and FGMA) did not find any significant and straightforward relationship between fertility and income. The relationship was generally inverse. However, there were quite a few exceptions. For example, the inverse relationship (between the number of pregnancies or the desired number of children on the one hand and income on the other) was generally weak, however, the inverse relationship was more pronounced among the Protestants than among the Catholics or Jews (Westoff et al. 1963; Bumpass and Westoff, 1970). Ryder and Westoff (1971) found that the expected number of children was smaller in the middle income group as compared to the low or the high income groups.

As mentioned earlier, the FGMA studies interviewed a panel of couples. These longitudinal studies examined the relationship between the changes in the couples' economic situation and the incidence of births during a time interval. In the FGMA's Phases I and II, the interviews were conducted in 1957 and 1960, and in 1959 there was a mild economic recession as a result of a steel strike. The authors (Westoff et al. 1963: 154-55) found that among the 33 families affected by the strike, fifty percent who reported the recession as severe did not have a single conception during the period of the study, and in all the seven

instances where conception took place the couples reported the effect of the recession as mild. Goldberg et al. (1959) reported that, while a mild recession did not affect the average expected family size, the timing of births seemed to respond to economic fluctuations ,for example, births were postponed when the economic conditions were not favourable.

In the cross section and longitudinal studies we have described, the data used are those on individuals or couples and comparison is made difficult due to certain differences in the indices, sample characteristics etc. Fertility may refer to completed family size, cumulative family size at specified ages, the total number of the ideal, desired or the expected number of children etc. Similarly income may mean husband's income, wife's or family income. Further, the relationship between fertility and income varies in certain subgroups of population classified by education, religion, colour and rural-urban place of residence. We could describe only the general findings, and what we understand from these studies is that the negative relation between fertility and income or socio-economic status was not as pronounced in the postwar periodsasit used to be, and certain subgroups had shown a tendency towards a positive relation in the more recent period. This is best described by Cho et al.:

> " The 1960 census data on current fertility by income provide ample evidence that the traditional inverse relationship between income and fertility has disappeared for the White population and is being modified for the Negro population. For the White population a new pattern of differential fertility by income appears to be emerging. . . . . Furthermore, we find the amazing results that fertility is positively related to income of husband; that controlling for education tends to increase the differentials, causing a sharper positive relation-

> ship; and that the positive relationship appears sharper in urbanized areas than in rural areas. Moreover, Negroes show an inverse relationship with reversal at the highest income, and in the urban areas there is evidence of a positive relationship at extremely low and high income levels. Finally, Northeastern Negroes show a fairly sharp, but not exactly consistent, positive relationship, while Southern Negroes show a sharp inverse relationship". (Cho et al. 1970: 280-81).

In the other cross section studies, several researchers used countries or other geographical areas, rather than individuals or couples, as the units of analysis. Blacker (1947: 88-102) and Davis (1949: 603-8) approached the problem from the point of view of Demographic Transition. Countries which have reached the low fertility stage are mostly those which are economically well developed, implying a negative relationship. Adelman (1963) fitting a regression equation for several countries found that the correlation between the age specific fertility rates and per capita income was positive when other variables like education, percent of labour force in non-agricultural employment, and population density were controlled. This finding has to be interpreted with some caution in view of the lack of homogeneity in the population on which the observations regarding certain variables are based (Janowitz, 1971). Heer (1965 and 1966) argues that the direct effect of economic development tend to increase fertility, while the indirect effects, through higher educational attainments and increasing net cost of children, tend to depress fertility. The combination of both these effects leads to a declining fertility along with economic development.

Economic Interpretation of Fertility and the Cost-Utility Model

The positive relationship as shown by the time series studies and a reversal from a negative to a positive relationship in the cross section studies using micro data, have led many researchers to question the theoretical basis of the traditional negative relationship. The main approach taken by them is to consider income in a relative rather than in an absolute sense and to analyse reproductive behavior within a cost-utility framework. That is, the effects of income and other variables are mediated through the costs and utilites of bearing and raising children and the response in fertility is a function of the net effects of these two forces, greater utility leading to larger family size and higher cost resulting in fewer number of children.

It was Leibenstein (1957: 159-65) who suggested that the cost-benefit framework, well known to the economists, might be useful to study the demographic-economic interrelationship. According to him, parents derive utility from children, in return for which they are prepared to incur some costs. The costs of children are direct and indirect. The direct costs are those expenditures on goods and services needed for children and the indirect costs are the opportunities foregone by resorting to raising children than to an alternative course of action. Cost and utility determine the number of children a couple would like to have. Becker and Easterlin, in their analysis of fertility used the cost-utility framework.

According to Becker (1960), the demand for children is the demand

for children of certain quaility. "Higher quality" children are those on whom additional expenditure is incurred and these children in turn yield additional utility to the parents. As in the purchase of consumer durables like cars, houses, etc., an increase in the long run income results in an increase in both quality and quantity of children, but the quantity elasticity is relatively small. According to Becker, the net cost of children "equals the present value of expected outlays plus the imputed value of the parents' services, minus the present value of the expected money return plus the imputed value of the child's services. If net costs were positive, children would be on balance a consumer durable and it would be necessary to assume that psychic income or utility was received from them. If net costs were negative, children would be a producer durable and pecuniary income would be received from them. Children of many qualities are usually available, and the quality selected by any family is determined by tastes, income, and price". (Becker, 1960: 213). Becker's formulation of the cost and utility of children is rather unrealistic. He has been criticised for not taking into consideration certain sociological factors that can restrict the parents' freedom to have children of certain quality (Duesenberry, 1960; Blake, 1968).

Continuing Becker's argument, the cost of children is the cost for children of given quality, and a rise in the expenditure on children is not necessarily a rise in the net cost, because quality also increases. What Becker means is that expenditures on children are not comparable unless they are standardized for differences in the quality. Further, cost is market determined like other goods, and if the rich have fewer

children it is because they choose higher quality children. Depending upon the extent of control over the number of children to be produced, couples will have additional children if the ratio of the expected utility to expected cost is greater for children than that for other goods and services. Using cross section and time series data Becker found a positive relationship between income and family size. Because of changes over time in child mortality, knowledge and use of contraceptives, cost of a given quality children, educational attainment, religiosity etc., Becker concludes, that "the negative correlation between the secular changes in fertility and income is not strong evidence against the hypothesis that an increase in income would cause an increase in fertility - tastes, costs and knowledge remaining constant" (Becker, 1960: 228).

Certain features of Becker's theoretical model and the empirical data he used to support his hypothesis were questioned. The main issue seems to be whether reproductive behavior is determined solely by the economic factors and to what extent the analogy between the demand for children and the demand for goods and services is valid. There does not seem to be as much freedom in choosing children as in consumer durables. Given the parents' social position in terms of occupation, income, education etc., the freedom to choose high quality or low quality children is often limited (Duesenberry, 1960: 233) and the way of life of the poor and the rich imposes certain social obligations as to what should be the standards of the children, the rich being subject to greater social pressures in this regard (Blake, 1968). Unlike in the case of consumer durables, the decision to have a child is not reversible

after the child is born (except in the case of adoption by another couple) and the parents cannot expect to maximise their utility even if the utility-cost ratio of children becomes unfavourable in comparison with alternative consumer durables (Blake, 1968; Spengler, 1960). All these arguments point out that in practice their are certain constraints largely sociological in nature which have to be taken into account.

We know that the industrialized countries experienced a secular decline in fertility. This consistent decline could not have taken place without an element of planning ie., without taking into consideration the advantages and disadvantages of having a smaller or larger family size and relating them to the potential improvements in the welfare of the family. There are social obligations of raising a family, becoming a parent etc., but these are quite likely to be re-interpreted in the light of economic and technological changes. So, "while the desire for offspring is clearly widespread and powerful, the fact that planning of families does occur suggests that a rational balancing of children against other sources of satisfaction also occurs" (Robinson, 1971: 20).

According to Easterlin (1968), in the United States, the long term movements in fertility were consistent with those of economic conditions. The per capita income in the United States was generally increasing continuously from the late 19th century up to about 1929. After a decline during 1929-34 the trend in income was again upward. Fertility of the white woman declined consistently from 1880 or so up to about 1937, the rate of decline being more rapid since 1922. From 1937 onwards

fertility started increasing continuously up to about 1959. In other words, during the past 100 years fertility and income moved in the same direction for about 30 years (1929-59) and for the rest of the period they moved in opposite directions. Why did fertility increase along with income during 1937-59 and not so during 1920's and several decades earlier? According to Easterlin (1968) the economic expansion and the increasing demand for labour before 1920 attracted a large number of immigrants. The competition in the labour market posed by the immigrants put an end to the optimistic economic outlook among the native population and thereby stifled a possible reaction in fertility. However, during World War II and later, the period of economic expansion, immigration was very much restricted thereby making economic opportunities easily available to the young entrants into the labour market which resulted in an acceleration of the rate of family formation and in higher fertility. The decline in fertility from the late 50's is attributed to the setback in relative income suffered by the young persons. That is, the recent cohorts born and raised during the period of economic expansion during the War and the immediate postwar period were accustomed to a high standard of living. The same cohorts, contrary to their high expectations, found that the economic conditions during the late 50's were not very favourable. So, high expectations on the one hand and relatively unfavourable economic conditions on the other, led to a decline in fertility.

Relative income generally refers to a person's aspired income in relation to his actual income. A person's aspired income may be determined by the environment in the parental home, peer group influence or by the status of those in similar age, occupational and educational categories.

The implication is that an actual income higher than the aspired level leads to a larger family size, while an actual income lower than the aspired level leads to fewer number of children. Apart from Easterlin (1968), Deborah Freedman (1963) and Freedman and Coombs (1966 a), among others, showed evidence in support of the hypothesis that fertility tends to be directly related to relative income rather than to absolute income.

Easterlin's arguments, though convincing, do not explain why fertility declined during 1920's while immigration was less and economic conditions favourable and secondly, the slower rate of increase in the income of the young people after 1960 was only temporary, however fertility continued to fall (Sweezy,1971).

Problem Areas

The survey of literature is by no means exhaustive. However, this gives us an idea about the theoretical problems involved in analysing the relationship and about the types of data and methods of analysis used to infer the relationship. The concept of relative income and the cost-utility approach have certainly been useful additions to our knowledge about fertility, though, as would be expected, there are some problems which remain unexplored and deserve further study.

Our knowledge about the actual relationship is in terms of the estimated relationship through certain statistical methods. Time series studies have generally correlated the deviations from trends. The type of trend fitted to the data and the resultant correlation of the residuals can very well change the magnitude and direction of the

relationship (Basavarajappa, 1971). Though the time series analysis is a complex one, there has been no discussion, except in one or two studies, about the extent of autocorrelation and its implications for the significance of the relationship.

Apart from the statistical techniques, the type of data used has also certain implications. Inferences are drawn, explicitly or implicitly, about the family's decision making process on the basis of the macro analysis. How far are these inferences meaningful? Closely related to the problem of consistency between the micro and the macro relationships, is the problem of the comparability of the time series and the cross section findings. In other words, from the time series relationship, can we predict the direction of the cross section relationship? It will be of interest to examine the reasons for the difference in the direction of the relationship between the time series and the cross section findings.

While both economic and sociological factors are admitted as having influence on fertility, the key issue seems to be the primacy of either of these two factors. It may not be possible to quantitatively determine the relative importance of these factors. What we can do is to examine how far a model of income-fertility relationship fits certain subgroups of population, differentiated by religion and ethnicity. In other words, we would like to know whether the income effect on fertility is invariant among groups differentiated by religion and ethnicity.

These are the major dimensions of the problem which we propose to inquire. Most of the studies reviewed in this chapter are for United

States. For Canada there are only a few studies dealing with the socio-economic correlates of fertility and the author is not aware of any study discussing the time series relationship between fertility and income. We expect that a time series and cross section analysis of the income-fertility relationship in Canada, incorporating some aspects of the problem mentioned above will be useful for further understanding of the reproductive behavior.

CHAPTER II

OBJECTIVES OF THE STUDY AND THE ANALYTICAL FRAMEWORK

In the previous chapter we gave a general idea of the main theme of our study. In the present chapter we will elaborate on the problem we intend to study and explore the general framework within which our analysis can be made meaningful.

Objectives

The subject matter of our study can be divided into three areas: the relationship between income and fertility in Canada as shown by the time series and the cross section data, the nature of this relationship in two provinces differentiated by religion and ethnicity and some of the methodological problems involved in the interpretation of the time series, cross section, micro and macro relationships.

Though the demographic features of Canada are generally similar to those of other developed countries, we find a few differences. For example, throughout the period 1921-65, the crude birth rate in Canada was higher than that of the United States, England and France, though the gap is narrowing in the more recent period. In 1965, Canada had the highest crude birth rate among the developed countries, exceeded only by Northern Ireland and New Zealand. Canadian population growth for a long time was sustained mostly by natural increase, and the annual rate of net immigration was negative throughout 1931-44 (Ryder, 1954). In the face of rapid industrialization, social differentiation

in terms of religion and ethnicity persists to certain extent. Hence, it will be of interest to study the trends and differentials in Canadian fertility.

The influence of religion and ethnicity on fertility is reinforced by region. Marked regional differences in fertility and marriage patterns were reported by Charles (1948). Similarly, we have evidence (Long, 1970; Krotki and LaPierre, 1968 a) for certain differences between the Catholic and the Protestant fertility trends during the past few decades. Though the birth rates in various provinces have started converging, the differences are not completely eliminated nor is the pattern of convergence similar. For example, the crude birth rate in Canada was 27.4 in 1921-25 and 27.5 in 1959, almost constant. On the other hand for the same period the birth rate in Quebec dropped from 35.5 to 28.5 while in Ontario it rose from 23.7 to 26.4. In 1926, total fertility rate in Quebec stood at 4307 per 1000 women as against 2730 in Ontario and in 1965 the positions are reversed with 2996 and 3125 for Quebec and Ontario respectively. The income levels are much lower in Quebec than in Ontario. During 1926-65, Quebec's per capita income was 23 to 33 per cent lower than that of Ontario. In Quebec 88 per cent of the population are Roman Catholics and 81 percent are of French origin, the corresponding figures are 30 and 10 respectively for Ontario. The question is whether the extent of the income effect on fertility will be similar in Ontario and Quebec. Is it possible that a population with an initial high fertility does not respond to the post war prosperity as effectively as that with a lower fertility to start with? These are some of the questions that remain to be answered.

Further, we would like to examine the implications of using certain types of data. Prediction of fertility as well as inferences based on different types of data can at times be misleading. We have discussed certain differences between the micro and the macro data in the previous chapter. The question is whether we can use the macro relationship to draw inferences about the individual behavior. For example, if a strong positive relationship is indicated by the macro (time series) data, can we expect a similar relationship at the household or family level. What if the increase in the aggregate income is mostly from the high income groups and the increase in fertility is from the poorer sections of the people who never experienced an increase in income?

Secondly, let us take the comparability of the time series and the cross section findings. Quite often the cross section regression coefficients are used to predict changes over time in fertility (Weintraub, 1962; Russet, 1964: 313-15). Similarly, a positive time series relationship between income and fertility is taken to mean that high income groups will have larger family size compared to the low income groups, at specific points in time. We will have to examine whether the direction of the relationship should necessarily be the same in time series and the cross section studies. In other words, can we predict, from the time series relationship, the direction of the cross section relationship?

We will hasten to add here that the consistency between micro and the macro relationships and that between time series and cross section

findings are rather complex and a sophisticated investigation of this problem seems to be confined mostly to econometricians. However, within the limitations imposed by the author's ability and the availability of data, an attempt will be made to examine this problem and to discuss certain implications for our understanding of the income-fertility relationship.

The Framework

We have seen in the previous chapter how the cost-utility approach has been used by some investigators. A set of factors affect both cost and utility and as a result we have three logical possibilities: the cost is equal to, less than or more than the utility. On the basis of these possibilities the consequences of certain courses of action can be examined. As applied to fertility analysis, most of the fertility differentials by income, rural-urban place of residence, education, occupation etc., become more meaningful if they are studied within the framework of cost and utility. Cost and utility can be considered as economic and non-economic in nature. By non-economic we mean those attitudes and activities that are not subject to measurement in terms of money.

To generalize, each course of action has a cost-utility aspect and the cost-utility ratio is evaluated in relation to similar ratios for other courses of action. The individual chooses that course of action which maximizes his utility. For example, under this assumption a parent has to evaluate the cost and utility of having a child in relation to that of other activities like the wife joining the labour

force, purchase of a house, going on a trip, etc. And if the parent decides to have a child it will be on the basis that the net utility from having a child is greater relative to those from the other competing activities. The capacity of a child to yield utilities is not invariant over time or among individuals. Social security arrangements can reduce the utility of a child as a potential source of security to the parents. In the case of a wife who is educated and employable, the opportunity cost - the benefits foregone as a result of raising children instead of, say, joining the labour force - will be higher than in the case of one who is not well educated and is not employable at a reasonable salary. Robinson's study (1971) contains a useful discussion of the various factors that influence cost and utility, the process of fixing the trade-off points and the applicability of this framework to reproductive behaviour.

A rational model of decision making, which is implied in the cost-utility framework, has been explained and understood in different ways and so a few observations are in order. The classical formulation of a rational model, implicitly or explicitly, involves certain assumptions. An individual has information about the number of alternative choices open to him, he is free to choose any one of them, he has knowledge about the nature of the outcome and the probability of a particular outcome resulting from a particular course of action and he is capable of ordering the payoffs and maximizing his utility. This approach is unrealistic since it imposes undue demands on the individual who is constrained by certain physiological and psychological limitations and so some modifications have been suggested (Simon, 1957: 241-56). One

such modification is to assume simple pay off functions. Instead of ordering the values of the pay offs ranging from -1 to +1, it is realistic to use values 1 or 0, ie., satisfactory or not satisfactory. Here, the evaluation process is less complicated and, using the analogy of a chess game, the player "instead of seeking for a 'best' move, needs only to look for a 'good' move" (Simon, 1957: 250). Secondly, the information gathering process, or the process of searching the desired outcome given certain courses of action, is in stages ie., the process may be crude to start with but may become more and more refined at successive attempts. Thirdly, the individual need not evaluate all the possible alternatives before making a choice, but they may be examined sequentially ie., the first satisfactory alternative is chosen. This modified model seems to be more suited for applicability to reproductive behavior.

From Himes (1963) we know that the desire to control conception is not new to the modern societies. Hawthorn (1970: 52-56) cites several studies to show that among the preindustrial populations, instances are not rare when people resorted to some sort of regulation of their number in relation to the available resources. In the recent period, the limitation and spacing of family size in order to achieve certain desired level of welfare, and the regularity and efficiency with which the family planning methods are used, presupposes an element of planning or an evaluation of the cost and benefit of having a specified number of children.

However, we would like to point out that, while comparing dif-

ferent classes of people or different societies, the framework is meaningful only in terms of the environment - social, psychological, economic, technological, etc. - in which the cost-utility functions take place. For example, there are differences in the nature of the interaction between husband and wife, in the normative patterns governing marriage and conception (Banks, 1954) and in the knowledge and availability of effective means to control conception. Because of this, the decision may be an elaborate process and precise in terms of the consequences or it may be vague or a trial and error process with unintended consequences. Again, in some societies or subgroups of population the utility or satisfaction attached to marriage and motherhood may be very high and the utility may almost be taken for granted, with the cost factor being very insignificant.

Variables and the Characteristics of Data

We have used mainly published data obtained from censuses, Vital Statistics Reports, National Accounts Reports, and Consumer Surveys. The national income figures are estimates, revised every now and then. We have used the revised figures. For the sake of accuracy and comparability of data we had to restrict our analysis for the period 1926-65. The variables used are personal per capita disposable income at constant prices and age specific fertility rates. For cross section data we are given only income intervals and mean number of children and sometimes only the number of unmarried children staying at home. There are some problems in interpreting these variables and we have discussed them in the sections on analysis.

There are a few reasons for using only income as an independent variable. Some initial experiments showed income to be a better predictor of fertility than unemployment rates. Further, using income and unemployment rates together we ran into the problem of multicollinearity. Cross section data contains only income and the number of children. In order to ensure comparability and discuss the problems related to the cross section and the time series findings we consider that income is more suitable than the other independent variables. Even though the regression equations contain only income and fertility, in our discussion, wherever possible we have considered other relevant variables.

Fertility is allowed to lag income by one year. This is a rough estimate (Kiser et al. 1968: 244-45) based on the Indianapolis survey data. Along with nine months of pregnancy, the time taken to conceive after stopping contraception is about four months. It implies that when the economic conditions improve the decision to have children is taken and births take place after approximately a year. This time lag is in a way arbitrary. It is relevant only to marital fertility. We have no clear idea about the time lag between marriage and conception or conception and marriage. Secondly,one can argue that the one year time lag will reflect only short term adjustments in fertility, if any, as a result of the changes in the economic conditions. We cannot deny the influence of long term effects. Changes in tastes and preferences are reflected only in the succeeding generations. Investigation of the lag structure, its persistence and change, over time, becomes a piece of research by itself.

Given the problem and the framework, the next step is how we propose to analyze the data. For a discussion of this we turn to the next chapter.

CHAPTER III

THE STATISTICAL MODEL

In the quantitative analysis of any relationship there are problems of bias and precision in the estimated parameters. A statistical model has to specify how these problems are to be treated. In this chapter we will discuss the statistical model used in our analysis and describe the techniques we have used to ensure that the important assumptions in the model are not violated.

The problems of bias and precision in the estimates are common to the time series and the cross section studies. However, certain assumptions are more likely to be violated in one type of study than in the other. A time series has a structure and dynamics of its own since the data are ordered in time. So, to study a single series or to explore the relationship between two or more series, the data are subjected to certain methods of analysis that are different from those used to examine cross section data. Before proceeding to a discussion of the model, we will briefly examine the nature of a time series and certain methods that are generally used for time series analysis.

Components of a Time Series

It is generally assumed that a time series consists of a trend, oscillations or cycles and random fluctuations. The trend is a 'long term smooth' movement in the series. Oscillations or cycles refer to the

wavelike movements around the trend. These movements measured from peak to peak or from trough to trough may have equal time durations and constant amplitudes or varying durations and amplitudes. In the former (equal time durations and constant amplitudes) the movements are periodic and they are strictly repeated through time. The term cycles, used in the literature can refer to periodic movements. However, it seems that generally the observed time series are not of the periodic (or cyclical) type (Kendall, 1946: 398). In the annual series, where the problem of seasonality does not arise, the term oscillation can be used to refer to those movements around the trend having varying time durations and amplitudes.

Correlation of Time Series

In the analysis of two or more annual series, trends and oscillations are separated and compared, with the emphasis being on the trend or the oscillation depending upon the purpose of investigation. In correlation analysis or in trying to examine the dependence of one series on the other, trend values are estimated and deviation of the observed values from the trend, expressed as per cent of the trend, are correlated. Moving averages of appropriate terms, straight line, second degree curve, log transformation are some of the techniques that are commonly used to estimate the trend values.

Correlation of time series, unadjusted for trend, is likely to reflect the joint influence of the trend and the oscillations. It is quite possible that the trends are correlated in one direction while the percentage deviations are correlated in the opposite direction . In

such cases using unadjusted data may not be very meaningful (Croxton and Cowden, 1955: 562-569). Another reason for removing the trend is that in the oscillations (using the turning points in the peaks and troughs), it is easier to identify the independent variable as it temporally precedes the dependent variable. To avoid spurious correlation is the major reason for the removal of the trend. For example, the variables X and Y may have no relationship or very weak relationship. But, a third variable, Z, may cause X and Y to vary together and as a result we may come up with a strong relationship between X and Y. For example, national income and the monetary value of consumption may increase over time along with prices and population. Several variables move over time and can disturb the relationship of X and Y. The smooth movement or the trend in the X or Y series is attributed to the influence of these disturbing variables which is sought to be removed by eliminating the trend. Very often the disturbing variables are unknown. When a trend line is fitted, the X or Y variable is expressed as a function of time, the term time implicitly referring to the influence of the disturbing variables. Lack of independence among the observations in a time series and the consequent violation of some of the assumptions (necessary for valid statistical inference) is yet another reason for removing the trend.

Problems in "detrending"

It may be seen from the previous paragraphs, that the distinction between trend and oscillation and the separation of these two, through certain statistical techniques, is to certain extent arbitrary especially when the purpose of the investigation is not to predict the values of a

variable using a single series, but to examine the relationship between two series. The process of fitting and removing the trend may be such as to eliminate part of the information contained in the original series, thereby obscuring the true relationship. Secondly, all time series relationships unadjusted for trend need not necessarily be spurious. Further, there seems to be no unique way to ensure that, through the removal of the trend, the problem of spurious correlation does not exist. As a matter of fact, it has been shown that the method of moving averages can produce artificial oscillations in a random series (Yule and Kendall, 1950: 630-631; Bird et al. 1965: 229-39) and these oscillations from two series may show high correlation with none in the original series. One of the reasons for "detrending", is the presence of autocorrelation among the original observations which in turn can affect the reliability of the correlation coefficients. The deviations from the trend or the new set of observations are supposed to be non-autocorrelated. However, the problem of autocorrelation can be tackled through proper specification in the regression equations.

Time as a Variable

An alternative method that is often suggested is to include time explicitly as a variable in the equation. The rationale for this method is that the coefficient of time in the regression equation is supposed to capture the influence of the unknown disturbing variables. In this partial time regression method, the partial correlation between X and Y is examined with time, representing the disturbing variables, kept constant. However, when we use either absolute deviations from the

trend or the paritial time regression method, the correlation between X and Y is the same (Frisch and Waugh, 1933: 337-401; Croxton and Cowden, 1955: 573-75). Further, when the independent variable and the disturbing variables are highly correlated, controlling for the latter as in the partial time regression, is not very meaningful. Again, if the coefficient of time is large and significant relative to that of the independent variable, it is hard to interpret, especially if the purpose of the study is more to understand the relationship than to predict.

These are only a few of the several methods available for the analysis of time series relationship. The individual trend deviation method is generally used in sociological research, while the partial time regression method is common in economic studies. It will need a more exhaustive study to evaluate the relative advantages and disadvantages of all the methods used in time series analysis and to determine, for a given set of variables, in which of these methods the estimated relationship will be closer to the true relationship. The relevance of these methods has to be viewed in the light of the purpose of the study, the type of data and the specification of the statistical model.

Trends in Income and Fertility

The two series used here are the annual data on personal per capita disposable income in constant dollars and age specific fertility rates for the period 1926-65. Personal disposable income equals personal income minus the direct taxes. The price indices, used to adjust the income figures, reflect the pure price changes as well as the changing

expenditure patterns within and between the major income groups. Fertility rates refer to the number of births per 1000 women in the reproductive age groups and they are available in the Vital Statistics Reports.

The income and the fertility series showed strong trends. It is difficult to say whether the trends observed in these variables are due to the inherent characteristics of these variables or due to the effects of external factors. It is quite likely that, along with income, changes in urbanization, educational attainment, the shift from a traditional to a more secular attitude might have influenced fertility. Unless the form of the relationship among these variables over time is known it is not possible to select the appropriate type of trend. A few generally used methods like the straight line, geometric trend (for income), and moving averages of various terms were tried. In most of the cases the fit was not good and secondly the residuals were autocorrelated. Hence, it was decided to use the original data and adjust for any extraneous influence through proper specification in the regression equation.

Specification of the Model

Form of the Regression Equation and the Basic Assumptions

The general form of the regression equation used in the analysis is as follows:

$$Y_i = \alpha + \beta X_i + U_i \quad \ldots \quad (1)$$

$E(Ui) = 0$, $E(Ui^2) = \sigma^2 U$ and $E(UiUi') = 0$ for $i \neq i'$

where X and Y are the independent and the dependent variables respectively,

'α' and 'β' are the population parameters. In a stochastic equation the assumption is that the value of Y cannot be predicted exactly. This implies that for each value of X there is a probability distribution of the values of Y. For repeated samples, a fixed value of X yields a distribution of Y values which cluster around the central value or the expected value of Y. The error term 'U' measures the deviation of the estimated Y from the expected Y value. Unlike X and Y, U is unknown and contains mostly random error.

In practice, the parameters 'α' and 'β' are estimated from data from a particular sample. The estimating equation can be expressed as:

$$Y_i = a + bX_i + e_i \qquad \ldots \qquad (2)$$

where, 'a', 'b' and 'e' are the estimators of 'a', 'β' and 'U'. The 'e' values are called the residuals or the deviations of the observed from the estimated Y values. We know that the sampling distribution of 'b' is centered around 'β'. The main problem in estimation is to examine to what extent 'b' deviates from 'β' and the extent of clustering of 'b's at 'β'. Since bias and precision of the estimates depend on the distributional properties of the error term 'U' and since 'U' is unknown, it is necessary to make certain assumptions regarding 'U' (Rao and Miller, 1971: 53-56). These assumptions enable us to establish the theoretical distribution of 'b's and to make certain probability statements regarding the precision of the estimates.

The assumptions of non-autocorrelation and homoscedasticity are important. This is because in the least square method, the parameters

are estimated by minimizing the sum of squared errors or the residuals and this is possible only when the covariance among the residuals (assumption of non-autocorrelation) is zero and when the variance of each residual is equal to one another (assumption of homoscedasticity or equal variance). In the absence of autocorrelation and heteroscedasticity the least square estimates yield the best linear unbiased estimates (Kane, 1968: 355-63).

Assumption of Non-autocorrelation in the Residuals

In a regression equation, fitted to a time series, first order autocorrelation is present when the residuals at time points t + 1, t + 2, t + 3 . . . etc. are dependent on those at t, t + 1, t + 2, etc. In positive autocorrelation, which is more common than the negative autocorrelation, there is an excessive bunching of residuals with similar signs, while in negative autocorrelation the plus and minus values of residuals alternate. In order to ensure that the estimated variance of 'b' is unbiased, it is necessary that autocorrelation be reduced to an insignificant level.

To know whether the autocorrelation is significant or not, a procedure known as the Durbin-Watson test is used and in case of significant autocorrelation certain adjustments are made in the data and a second regression equation is fitted to the adjusted data (Kane, 1968: 364-73). The Durbin-Watson test makes use of the 'd' statistic which can be expressed as:

$$d = \frac{\Sigma_{t=2}^{N} (e_t - e_{t-1})^2}{\Sigma_{t=1}^{N} e_t^{\,2}}$$

In time series data 'e_t' refers to the residuals at successive points in time. In case of positive autocorrelation ie., when the successive values of the residuals are algebraically close to one another, the first differences are small and so, the numerator in 'd' has a smaller value relative to the denominator, which results in a low 'd' value. When there is negative autocorrelation, the opposite is the case and the 'd' values are large. The theoretical 'd' values range from 0 to 4. When 'd' takes a value nearer to 2 there is no autocorrelation and the two extremes of 0 and 4 indicate positive and negative autocorrelation respectively. To test the significance of autocorrelation, the quantities 'd_l' and 'd_u', the lower and the upper bounds of the sampling distribution of 'd', are available (Durbin and Watson, 1951: 173-75). Under a chosen level of significance, using the number of the independent variables in the equation and the sample size, the quantities d_l and d_u can be read off the table (Durbin and Watson, 1951: 173-75). When positive autocorrelation is suspected, the hypothesis of positive autocorrelation can be rejected if $d > d_u$, cannot be rejected if $d < d_l$ and the test is inconclusive if $d_l < d < d_u$. Similarly for rejecting or not rejecting the hypothesis of negative autocorrelation we should have $(4-d) > d_u$ and $(4-d) < d_l$ respectively and the test is inconclusive otherwise.

Once the presence of autocorrelation is known the next problem

is how to reduce it to a tolerable level. Very often an investigation of the distribution of the residuals may reveal the sources of autocorrelation like the incorrect specification of the functional form of the equation, omission of a known independent variable etc., and in such cases necessary changes in the regression equation can be made. Sometimes, when these methods fail, the original data are transformed and a second regression equation is fitted to the transformed data which may reduce the autocorrelation.

The rationale behind this transformation of data is that the autocorrelated error terms consist of a random part and a systematic part and the latter is due to some unknown factors that result in autocorrelated error terms. Assuming that the error terms are generated by first order autoregressive scheme ie., the observations at successive time points are dependent only on the next preceding observations, the coefficient ρ is estimated in the following manner:

$$u_t = \rho\, u_{t-1} + v_t\,, \quad |\rho| \leq 1 \qquad \ldots \qquad (3)$$

$$E(V_t) = 0,\ E\,(V_t^2) = \sigma_v^2\,,\ E\,(V_t V_t^{'}) = 0 \text{ for } i \neq i^{'}$$

and,

$$\rho = \frac{\Sigma_{t=2}^{N}\ u_t\, u_{t-1}}{\Sigma_{t=2}^{N}\ u_{t-1}^{2}}$$

In practice ρ is estimated using the residuals assuming that the residuals are from the error distributions with the properties specified in (3). Using the ρ values, the original data can be transformed as

follows:

$$Y'_t = Y_t - \hat{\rho}\, Y_{t-1}$$

$$X'_t = X_t - \hat{\rho}\, X_{t-1} \quad \ldots \quad (4)$$

Using the transformed data (according to equation (4)) a second regression equation can be fitted:

$$Y'_t = a' + b'\, X'_t + v_t \quad \ldots \quad (5)$$

where,

$a' = a\,(1-\hat{\rho})$, and b' is an estimate of b.

The new set of residuals is again tested for the presence of autocorrelation.

Assumption of Homoscedasticity

Like the assumption of non-autocorrelation, the assumption of homoscedasticity (or equal variance) is also important to ensure precision in the estimates. The assumption of homoscedasticity requires that each of the error terms 'u_i' is from a distribution with zero mean and constant variance. In other words, since each X value has a distribution of Y values and a corresponding distribution of error terms, the variance or the dispersion in each of these error distributions should not increase or decrease with the X values. Detecting heteroscedasticity (or the absence of homoscedasticity) and adjusting for it through certain

statistical techniques poses some problems. Generally, Bartlett's test is used to detect heteroscedasticity and on the basis of the information gained from this test, the data are transformed (Kane, 1968). According to this test the sample is divided into 'k' independent subsamples, each subsample corresponding to each of the X values and the hypothesis of no difference in the variances of each of the subsamples, is tested using the Ch square values with k-1 degrees of freedom. In practice, the test becomes approximate since we use groups of X values as subsamples instead of treating each X value as a subsample. Further, when the number of observations is few, the degrees of freedom available are too small to make use of the Chi square table meaningfully.

Methods Used In Our Analysis to Ensure Non-autocorrelation and Homoscedasticity

To examine whether the residuals showed significant autocorrelation the Durbin-Watson test was used. Out of 21 regression equations using the time series data, 18 equations showed significant autocorrelation in the residuals. From the residuals of each of these 18 equations, the values of ρ were estimated (according to equation (3)). Using the ρ values, the original data were transformed according to equation (4). In the second set of regression equations there was no significant autocorrelation except in one (30-34 age group in Ontario). In other words in this particular case (30-34 age group in Ontario), the variance of the slopes may be underestimated and the hypothesis of $\beta = 0$ may be rejected more often than we should.

Due to fewer number of observations, we could not use Bartlett's

test to detect the presence of heteroscedasticity. We made use of a simpler method (Rao and Miller, 1971). This method makes use of the range in the residuals. The residuals are arranged in sequence according to, say, time or income which is supposed to have caused heteroscedasticity. If heteroscedasticity is not present, then the range - the difference between the maximum and the minimum - in the residuals will be approximately the same for different intervals of income or time. This method was used in our analysis and we found that the range in the residuals did not show wide variations according to the intervals of time or income.

CHAPTER IV

GENERAL TRENDS IN INCOME, FERTILITY AND RELATED VARIABLES

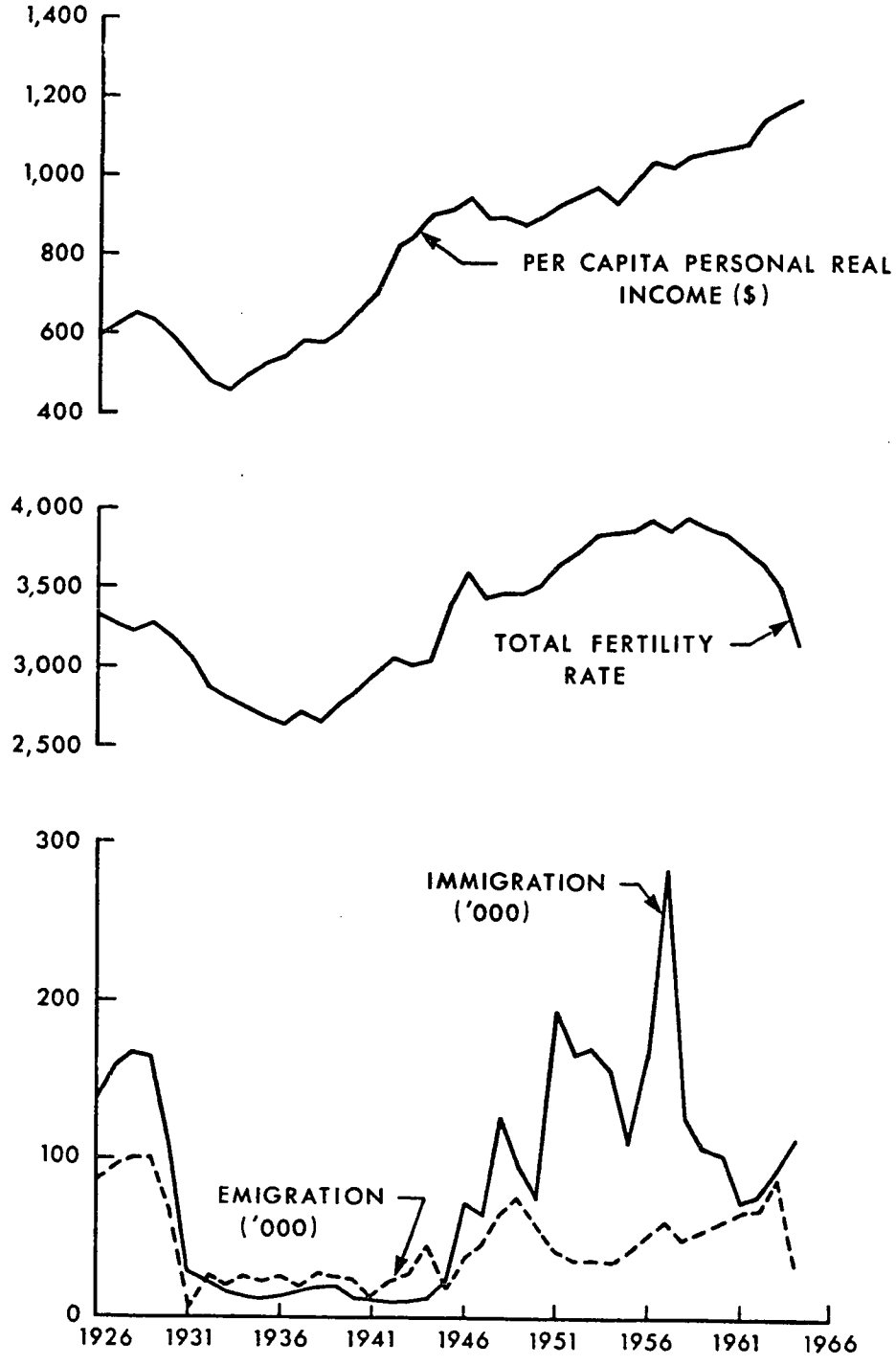
The period 1926-64 witnessed some important demographic and economic changes. The economy suffered a severe depression followed by a rapid recovery. Changes in the economy had their impact on marriages and fertility patterns. Fertility, after an initial decline, rose to high levels. Changes in fertility along with net immigration affect the age structure of the population, the size of the labour force etc., which in turn exert certain influence on the growth of the economy. Though we are interested mainly in analysing the effect of income on fertility, it is important to bear in mind that the economic and the demographic variables are interdependent. It is with this view that we describe, in the following sections, some of the major trends in income, fertility, immigration, age structure and labour force participation.

Income

Income, used in our analysis, refers to personal per capita disposable real income. GNP (Gross National Product), estimated in the National Accounts, Income & Expenditure Reports is the total value of goods and services produced during a period. Data on GNP and its complement GNE (Gross National Expenditure) are supplemented by data on sector accounts. In Canada, these sector accounts are: i) personal income & expenditure account, ii) government revenue and expenditure account, iii) business account and, iv) foreign account covering

FIGURE: 1

INCOME (1926-64), FERTILITY (1927-65) AND MIGRATION (1926-64): CANADA



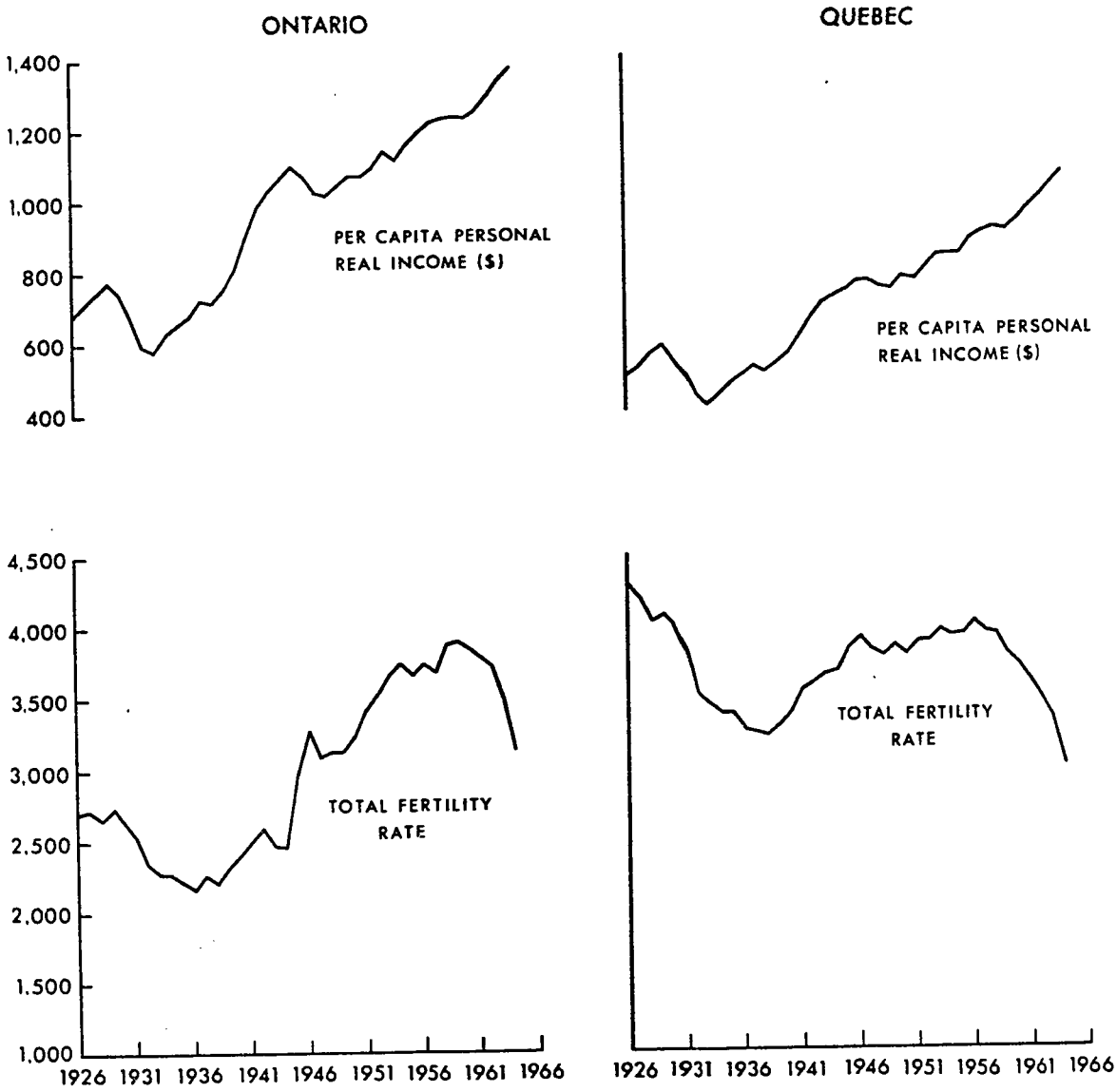
SOURCE: APPENDIX TABLE A.1

international current account transactions. Personal income includes not only the income that accrues to individuals and families, but also to the non-commercial institutions like, hospitals, universities, labour unions, fraternity societies etc. The major components of personal income are: i) wages, salaries and supplementary labour income, ii) military pay and allowance, iii) net income from the farm operators, iv) net income from non-farm unincorporated business, v) interest, dividends and net rental income and vi) transfer payments (e.g., family allowances, old age security fund payments, pensions to government employees etc.). Personal income minus the direct taxes equals the personal disposable income. Data on per capita personal disposable income, taken from the National Accounts, Income & Expenditure Reports, were deflated by price indices (1949 = 100).

In Canada, owing to the economic depression, income started declining consistently from 1928 reaching the lowest level in 1933. The period 1934-64 is generally one of rising income, the rate of increase being more spectacular during 1940-46. The average annual rate of growth in per capita real income was 6 per cent during 1940-46 and about 1.5 per cent in 1947-64. The income curves for Ontario and Quebec show similar effects of economic depression and prosperity. Throughout the period of our study, the income level in Quebec was lower than that in Ontario and this difference (absolute as well as percentage) was more pronounced during prosperous periods than during depression.

FIGURE: 2

INCOME (1926-64) AND FERTILITY (1927-65) ONTARIO AND QUEBEC



SOURCE: APPENDIX TABLES A.2 AND A.3

Total Fertility Rate

TFR (Total Fertility Rate) is the sum of the age specific fertility rates and is calculated as follows:

$$5 \sum_{i=1}^{7} (b_i / P_i)\, k$$

where, b_i = births that have occurred during a year to women of i th age group,

i = 15-19, 20-24 . . . 45-49.

p_i = number of women in the i th age group.

k = 1000

For a general understanding of the variations in fertility it is convenient to use broad time intervals. For Canada, 1931-41 and 1961-65 were periods of declining fertility, while 1941-51 and 1951-61 were periods of rising fertility. Quebec and Ontario showed some differences in fertility trends. In Quebec, the increase in fertility was significant only during 1941-51, the other three periods generally showing a decline. During the same period the rate of increase in Quebec was much less than that in Ontario. During 1937-59, the period of baby boom, TFR in Ontario rose by 75 per cent as against only 20 per cent in Quebec. For the country as a whole the increase during the same period was about 49 per cent. During 1951-61 while TFR rose by 16 per cent in Ontario, it declined by 2 per cent in Quebec. During the periods of declining fertility the rate of decline was greater in Quebec than in Ontario. As a result of this differential rates of

change during these years TFR in Quebec was 4 per cent less than that of Ontario in 1965 though it was 58 per cent higher in 1926.

Age Specific Fertility Rates and Order of Birth

Significant changes in the age pattern of fertility can be observed if we examine the age specific fertility rates which refer to the number of births that have occurred in a year to 1000 women in each of the relevant age groups. For the country as a whole, ASFR (Age Specific Fertility Rate) in age groups 40-44 and 45-49 continued to decline during 1931-65. During 1941-51 and 1951-61 the increase in fertility came from the 15-39 and the 15-29 age groups respectively. In Quebec the 15-34 age groups in 1941-51 and 15-24 age groups in 1951-61 contributed to the increase in births, all other age groups showing a decline. In Ontario on the other hand the increase in births was observed in all the age groups except the 45-49 in 1951-61. In general, after the period of economic depression, older age groups gained births slightly and as the years passed by, the younger age groups became more prominent in bearing children. The gain in births on the part of the older women could be attributed to the recovery of births postponed during unfavourable economic conditions. On the other hand, the gain in births on the part of the younger women was due to higher fertility as well as a shift towards a younger age at childbearing. During 1941-61, for marital fertility, the median age at childbearing in Canada declined from 23 to 22.

Order of birth statistics coupled with data on the mean number of children per family showed a tendency away from a very small or a very

large family size, the preference being for a medium size family. During 1941-61 the per cent of first and fifth and higher order births generally declined. On the other hand the per cent of births of second, third, and fourth order (combined) increased from 44 to 54. Similarly, the census data showed that during the same period the proportion of families without children, with one child as well as those with six children or more declined, while families with two to four children increased.

Marriages and Marital Fertility

Age specific fertility rates refer to the number of births per 1000 women of all marital status in each of the reproductive age groups. All the changes in ASFR cannot be attributed to fertility alone since a part of them can be due to changes in the proportion married in the respective age groups. For a better understanding of the changes in fertility we have to examine the trends in marriages and marital fertility.

The number of marriages per 1000 women of 15-44 age group declined from 32 in 1926 to a low of 27 in 1932. It increased thereafter reaching a high of 47 in 1942 and 1946. From 1946 onwards the marriage rate started declining consistently reaching about 35 in 1964. The median age at marriage (all marriages) for females declined from 23 in 1941 to 21 in 1961 and rose again to 23 in 1965.

TABLE 4.1 Per cent changes in age specific fertility rates and age specific marital fertility rates. Canada, Ontario and Quebec, 1931 - 1965.

	1931-41		1941-51		1951-61		1961-65	
Canada								
	ASFR	ASMFR	ASFR	ASMFR	ASFR	ASMFR	ASFR	ASMFR
15-19	+ 2.6	- 6.6	+56.7	+10.0	+21.0	+ 8.6	-15.3	-10.9
20-24	+ 0.9	- 4.9	+36.4	+ 3.0	+23.8	+ 6.8	-19.3	-17.9
25-29	- 8.7	- 7.7	+24.4	+ 4.3	+10.3	+ 3.0	-17.0	-17.9
30-34	-18.8	-12.5	+18.1	+ 6.7	+ 0.3	- 4.3	-17.6	-19.1
35-39	-22.4	-19.5	+ 8.1	+ 1.5	- 6.2	-10.6	-18.7	-20.0
40-44	-28.2	-25.9	- 2.2	- 5.9	- 7.8	-12.3	-22.8	-24.3
45-49	-32.7	-30.8	-16.2	-17.8	-22.6	-24.3	-16.7	-17.8
Ontario								
15-19	+ 3.1	-12.5	+63.3	+ 0.3	+15.5	+21.2	-16.1	-11.9
20-24	+ 4.5	- 8.8	+39.8	+ 6.3	+28.6	+13.5	-19.5	-18.4
25-29	- 5.4	- 9.1	+32.4	+12.4	+16.4	+ 9.6	-14.6	-14.9
30-34	-16.2	-15.4	+30.0	+17.8	+ 7.2	+ 2.6	-14.7	-15.9
35-39	-24.6	-23.7	+21.8	+14.1	+ 2.5	- 2.5	-15.0	-15.4
40-44	-33.7	-32.5	+ 9.9	+ 4.2	+ 4.3	+ 0.4	-18.7	-19.9
45-49	-50.0	-45.9	+10.5	nil	-15.8	-10.0	- 6.2	- 0.5
Quebec								
15-19	+ 4.9	- 3.0	+35.8	+ 4.3	+ 7.9	- 1.4	-16.2	- 7.4
20-24	+ 0.6	- 1.7	+27.8	- 5.7	+12.8	- 2.7	-15.2	-13.5
25-29	-10.5	- 6.0	+14.4	- 7.7	- 0.2	- 7.9	-17.1	-18.6
30-34	-19.1	-13.8	+ 8.2	- 4.6	- 8.4	-13.7	-22.1	-23.7
35-39	-26.0	-21.7	- 0.9	- 7.7	-15.0	-19.7	-23.4	-25.3
40-44	-30.0	-26.5	-12.6	-15.7	-15.6	-20.5	-28.4	-30.2
45-49	-30.1	-26.7	-27.7	-27.0	-23.4	-27.4	-25.0	-26.7

Source: Percentages calculated from the Vital Statistics Reports of the relevant years.

ASFR = Age Specific Fertility Rate; ASMFR = Age Specific Marital Fertility Rate.

Table 4.1 shows the per cent changes in age specific fertility rates and age specific marital fertility rates. Changes in age specific fertility rates reflect the weighted influence of changes in the proportion of women married and the changes in fertility (timing of births is another component). Let us suppose that marital fertility in an age group declines between two time points but the proportion married in this age group remains constant. In this case there will not be much difference between the rate of decline in age specific fertility rates and that in age specific marital fertility rates. If the proportion married also declines, then the rate of decline in age specific fertility rate will be greater than that in age specific marital fertility rate. Similarly, during periods of increasing marital fertility and rising proportion of married women, the rate of increase in age specific fertility rates will be relatively greater. Actually, marital fertility and the proportion married may change in opposite directions. It is the net effect of these changes that is reflected in the age specific fertility rates. The contribution (to age specific fertility rate) of changes in proportion married and in marital fertility can be called the marriage component and the fertility component respectively. In short, we are distinguishing the change in family size (among those already married) from the change in the number of births as a result of a greater proportion of women getting married and giving births.

During 1931-41 the decline in age specific fertility rates, with a few exceptions, was mostly due to the decline in marital fertility and this was more so in 1961-65. On the other hand, during 1941-51 and 1951-61,

especially in the former period, the marriage component was more important. In other words the rise in age specific fertility rates during 1941-61 was more due to a greater proportion of women marrying and giving births than to an increase in the family size of married women.

The relatively greater contribution of marital fertility to the decline in age specific fertility rates during 1931-41 and 1961-65 could be observed in Ontario and Quebec as well. During the 40's both age specific fertility rates and age specific marital fertility rates increased in Ontario in almost all the age groups. In Quebec on the other hand, during the same period age specific fertility rates increased in the 15-34 age groups while age specific marital fertility rates declined in all the age groups except in 15-19. During the 50's also the marriage component was more important in Quebec than in Ontario.

We may add here that the per cent increase or decrease as shown in the table is between certain specific points in time. For example, the decline in marital fertility in Quebec in almost all the age groups (in 1951-61) does not mean that marital fertility declined every year. Brief periods of increase are possible. Actually between 1951 and 1956 marital fertility in Quebec increased in the younger age groups even though a comparison of the 1951 and 1961 figures would indicate a decline.

In short, in Canada and the two provinces the decline in TFR was mainly due to the decline in marital fertility. During the 40's and the 50's, the periods of rising fertility, the contribution from the marriage component was quite substantial. Given this general pattern,

whatever increase in births which Quebec experienced was mostly due to an increasing proportion of women getting married and giving births. In other words the contribution of marital fertility to the baby boom was relatively less in Quebec.

Analysis of fertility trends in the United States has shown the significant role played by immigration in the relationship between fertility and economic conditions (Easterlin, 1968). The per capita GNP in the United States was generally increasing continuously from the late 19th century up to about 1929. After a decline during 1929-34 the trend was again upward. TFR for white women declined consistently from 1880 or so up to about 1937, the rate of decline being more rapid since 1922. From 1937 onwards fertility rose and after reaching a high level around 1959 started declining again. In other words during the past 100 years or so fertility and income moved in the same direction for about 30 years (1929-59) and for the rest of the period they moved in opposite directions. Why did fertility increase along with income during 1937-59 and not so during 1920's and several decades earlier? According to Easterlin (1968) the economic expansion and the increasing demand for labour before 1920 attracted a large number of immigrants. The competition in the labour market posed by the immigrants put an end to the optimistic economic outlook among the native population and thereby stifled a possible rise in fertility. During the post war economic expansion, however, immigration was very much restricted thereby making economic opportunities easily available to the young entrants into the labour market which in turn led to an acceleration in the rate of family formation and to higher fertility.

For Canada the available statistics on immigration and fertility do not enable us to do a detailed analysis of the role of immigration and its effects on the labour market and fertility. However, we can discuss briefly the general trends in immigration to this country and its possible impact on the labour market.

Immigration

The number of immigrants to this country varied from 105 to 167 thousand during 1926-30. Immigration declined considerably during depression and the war period. It increased substantially during the postwar period especially in the 50's. During 1951-59 the number of immigrants varied between 107 to 282 thousand. In 1957 about 282 thousand immigrants arrived which constituted the highest number since 1913. Emigration was slightly higher than immigration during the 30's and the 40's. It was more or less constant or increased slightly during the post war period. In general net immigration was quite high during the 50's.

Table 4.2 Percentage increase in population classified according to place of birth, Canada.

	Canada born	Foreign born	Total
1921-31	18.1	18.0	18.1
1831-41	17.6	-12.6	10.9
1941-51	25.9	2.1	21.8
1951-61	28.8	38.1	30.2

Source: 1961 Census of Canada, General Review, Native and Foreign born population, 7.1 - 7.

Though the immigrants consisted only about 16 per cent (1961) of the total population, they had quite a good share in the labour force because of their high labour force participation rates[1]. In 1961 post-war immigrants alone accounted for 12 per cent of the total labour force in Canada, while the prewar and postwar immigrants together constited about 21 per cent (Parai, 1965). The labour force participation rate in 1962 for both sexes was 65 per cent among the postwar immigrants as against 51 per cent for other Canadians (Canada born and prewar immigrants). During 1956-62 postwar immigrants accounted for more than one-third of the increase in labour force and about 40 per cent of the increase in employment opportunities (Canadian Statistical Review, Nov. 1962, p. iii). All these data seem to show that the influx of immigrants in the 50's could have, to a certain extent, affected adversely the employment opportunities available to the native population.

Age Composition and Labour Force

As a result of the increase in fertility there were substantial changes in the age distribution of the population. During 1941-61 the proportion of population aged 0-14 increased from about 28 to 34

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1 Labour force is composed of that portion of civilian non-institutional population 14 years of age and over who during a reference period are either employed or unemployed but looking for work. Participation rate refers to the proportion of the population 14 years of age and over who are in the labour force.

Table 4.3 Population in 0-14 and 65+ age groups as per cent of population in 15-64, Canada.

Year	Age Groups		
	0-14	65 +	0-14 and 65 +
1921	56.6	7.9	64.4
1931	50.3	8.8	59.2
1941	42.4	10.2	52.6
1951	49.0	12.5	61.5
1961	58.1	13.1	71.2

Source: 1961 Census of Canada, General Review, Age & Sex Composition, 7.1 - 4.

and consequently the 15-64 age group declined from 66 to 59 per cent. These changes in the age structure have certain implications for the labour force and the economic situation in general. The proportion of the population in 0-14 and 65+ age groups to the population in 15-64 age groups is one of the ways of indicating the dependency ratio since the young and the old have to 'depend' on the adult population in the working ages. During 1941-61 the dependency ratio increased from about 53 to 71. Most of this increase could be attributed to the rapid growth of the population in the 0-14 age group. It may be noted that all the persons in 15-65 age group do not belong to the labour force and out of those in labour force quite a few may be without jobs. Because of these factors the figures in Table 4.3 can be considered as the demographic dependency ratios (Krotki, 1968 b). The economic burden of a society will depend to a large extent on the

interaction between age structure and labour force participation of the population on the one hand and the demand for labour on the other.

Changes in fertility, age at childbearing and in marriage patterns leave their impact on the size and structure of the labour force as and when the birth cohorts reach specified age groups. This is particularly so in the case of female labour force. Apart from these demographic forces, the labour force is equally affected by certain socio-economic factors like the attitude towards work on the part of the female population, the extent of skills and education needed to qualify for employment, demand for labour etc. In their influence on the labour force, these demographic and economic factors may reinforce or counter-balance each other.

Between 1951 and 1961 the crude labour force participation rate (number of persons in labour force divided by the civilian population aged 14 years and above) for males declined from 84 to 81 per cent, while for females it increased from 24 to 29 per cent. For both sexes the rate increased from 24 to 29 per cent. For both sexes the rate increased slightly from 54 to 55 per cent. The crude participation rate can be considered as a weighted index of specific rates. The specific rates can be calculated with respect to age, marital status, presence of children of certain age etc. The proportions of population in the specified age, marital status categories etc. act as weights to the specific rates and thereby determine the overall or crude participation rate. Whether or not a married woman or a woman with

Table 4.4 Labour force participation rates by sex and selected age groups, Canada, 1951 and 1961.

Age Groups	Males		Females	
	1951	1961	1951	1961
14-19	53.5	40.5	33.4	31.7
20-24	94.0	94.2	48.5	50.4
25-34	98.1	98.0	25.1	28.9
35-44	98.5	98.0	22.1	30.8
45-54	96.5	96.4	21.0	32.5
14 +	84.1	80.8	24.2	29.1

Source: Denton & Ostry, Historical Estimates of the Canadian Labour Force, 1961 Census Monograph, DBS, 1967.

children should work is determined to a large extent by social customs, economic necessity, etc. The importance of demographic factors is through changes in the composition of the population (age, marital status etc.) which is considerably influenced by the past history of marriage and fertility.

During 1951-61 the participation rates for males declined to a considerable extent in the 14-19 age group. For females on the other hand the rates increased substantially, except in 14-19, in all the age groups especially in age groups 35-54. We may note that during the same period the population growth rate in the 20-24 age group compared to other age groups, was relatively less. Those aged 20-24 in 1961 and 1951 were born during 1937-41 and 1927-31 respectively. The low growth rate in 20-24 age group could be attributed mainly to the

relatively low fertility during 1937-41. The average TFR was about 2720 in 1937-41 as against 3262 in 1927-31. If the growth rate in this age group had been higher, perhaps the decline in the crude participation rate for males would have been negligible. And the crude participation rate for females would have been higher than the observed values since 20-24 was the age of maximum labour force participation for the females.

Further, given certain specific participation rates in each of the age-marital status categories, changes over time in the proportion of the single or married can affect the crude participation rate for women. In Canada, the participation rate was high among the single women (compared to the married) and in the younger age groups (compared to the older ones). A decline over time in growth rate of population single (in the young age groups) could result in a decline in the crude participation rates (all ages and marital status combined). During 1951-61 the proportion of the total female population that was single declined in the 20-24 age group, while that of the married increased in the same age group. In other words, the changes during 1951-61 in the demographic structure (decline in the proportion single in the young age groups) tended to have a depressing effect on the crude participation rates. However, the crude participation rate in Canada increased during 1951-61 in spite of the decline in proportion single. It increased because of a rise in the specific participation rates (participation rates in each of the age-marital status categories), especially among the married (Allingham, 1967). The increase in the specific participation rates may be due to certain socioeconomic factors.

We can briefly summarize our discussion in the present chapter. Personal per capita income fell to very low levels during the late 20's and the early 30's. After the depression, income rose steadily. The increase was quite impressive during 1940-46 and rather moderate in the postwar period. Total fertility rate, after a decline during the depression, rose sharply and reached unusual levels. However, since 1959 the decline in fertility was in sharp contrast to the continuing, though moderate, increase in income. Even though Quebec experienced the baby boom the increase in births was quite modest as compared to Ontario. We have also seen how the past history of fertility and marriage affect the age structure of the population, labour force participation etc. as and when the new cohorts reach specified age groups. Economic conditions influence and are in turn influenced by the demographic forces.

CHAPTER V

TIME SERIES RELATIONSHIP

In the present chapter we will be concerned with the interpretation of the relationship between fertility and income as shown by the time series data.

The pattern of variations in fertility and income described in the previous chapter shows that it will be more meaningful if the parameters of the relationship between income and fertility are estimated for certain subperiods separately, rather than for the whole period of 1926-1964. We may recall that income, used in the time series relationship, refers to the personal per capita disposable income at constant prices (1949=100). As mentioned in the previous chapter, total fertility rate started declining from 1959 onwards inspite of a rise in income. So, fitting a linear straight line regression equation for the entire postwar period would not be meaningful. Further, the war period is generally excluded from the study of the income - fertility relationship. Large scale enlistment in military service reduces the number of eligible males in the young adult age groups and the response in fertility (especially in the young age groups) might be different from what it would have been under normal circumstances. The feeling of psychological uncertainty, generally prevalent at times of war, can affect the motivation for family formation especially in the younger age groups. Because of these reasons we have split the period of our study into four subperiods: 1926-39, 1940-45, 1946-57 and 1958-64. Since fertility is

allowed to lag income by a year, the corresponding periods for fertility data are: 1927-40, 1941-46, 1947-58, and 1959-65.

Because of the limited number of observations in these sub-periods, we have fitted a single equation for the whole period using dummy variables in such a way as to estimate the parameters separately for each of the subperiods (Gujarati, 1969 and 1970). The estimating equation can be expressed as follows:

$$Y_{t+1} = a_0 + a_1 D_1 + a_2 D_2 + a_3 D_3 + b_1 X_t + b_2 X_t + b_3 X_t + b_4 X_t + e_t$$

where,

Y_t = Fertility rate (total fertility rate or age specific fertility rate)

D_1 = 1 for 1958-64
0 for other periods

D_2 = 1 for 1946-57
0 for other periods

D_3 = 1 for 1940-45
0 for other periods

X_t = Income for the four relevant periods
and

e_t = Residuals

a_0 takes the value of 1 for the entire period and this gives the intercept for the basic period, i.e., 1926-39. While the slopes are estimated directly,

the intercepts a_1, a_2, and a_3 are the differential intercepts with respect to the basic intercept, a_o. The estimated intercepts and slopes were obtained in the following manner:

1926-39 = $a_o + b_4X_t$ where, X_t takes the values during 1926-39.

1940-45 = $(a_o+a_3) + b_3X_t$ where, X_t takes the values during 1940-45.

1946-57 = $(a_o+a_2) + b_2X_t$ where, X_t takes the values during 1946-57.

1958-64 = $(a_o+a_1) + b_1X_t$ where, X_t takes the values during 1958-64.

While interpreting the relationship between fertility and income, it is necessary to bear in mind the distinction between the cohort fertility rate and the period (or calendar year) fertility rate. The period rate refers to fertility of different groups of women at a point in time, usually a year. Cohort measures, on the other hand, refer to fertility of the same group of women as they proceed through the childbearing years of life. So, cohort fertility rates are relevant for a period of about 30 or 35 years (from age 15-19 to 40-44 or 45-49), while the period rates are for specific points in time. Cohorts are generally identified by the year in which they were born or got married and they are known as birth cohorts and marriage cohorts respectively. Cohort fertility rates can be calculated from data on the reproductive history of women who are past their childbearing years. These data are collected from special surveys or censuses. In the absence of such data, age specific fertility rates from the Vital Statistics Reports are generally used to construct cohort fertility tables. For our analysis

we used data from the Vital Statistics Reports to construct cohort fertility tables.

Given a table of age specific fertility rates for, say, 35 years, with years for the rows and 7 age groups (15-19 . . . 45-49) for the columns, we can construct cohort fertility rates by reading the figures diagonally. For example, we start from age group 15-19 (left-top of the table), then proceed to age 20-24, five years later . . . etc., till we reach age 45-49 (right-bottom of the table). From these diagonal fertility rates we get the reproductive history of the same group of women and the sum of these rates is the completed family size or the mean number of children in the particular cohort of women. In the same table, figures in each of the seven columns in a year refer to the age specific fertility rates of different cohorts of women. When these rates are summed across the columns for each year we get the total fertility rate for the corresponding year. So, total fertility rates are period or calendar year rates. Age specific fertility rates are period rates if they are obtained for specific points in time and refer to the fertility levels among different cohorts of women at various stages of their reproductive period. Age specific fertility rates and total fertility rates used here for estimating the relationship with income, are period rates. In the remaining pages of the text, age specific fertility rates will mean period rates unless otherwise specified. Generally, cohort fertility rates are subject to certain errors due to mortality and migration in the particular cohorts of women. Bias due to mortality is less likely in the cohort fertility rates if they are calculated from the registration data (as in the Vital

Statistics Reports). Since we have used registration data for calculating cohort fertility rates the mortality effect will be negligible. Immigration can bias the cohort fertility rates if the immigrants are selective with respect to their fertility pattern and are a sizable proportion of the reproductive age groups. Detailed statistics on the fertility pattern of the immigrants are hard to obtain. Usually the fertility rates of the countries from where the migrants arrived are used to represent the fertility pattern of the migrants. Available data on the fertility rates of the foreign born in Canada are of this type. In 1961, in Canada, the age specific fertility rates of the foreign born were slightly lower than those of the native born (Kalbach, 1970: 106). In the same year, immigrants in the reproductive age groups constituted about 6 to 10 per cent of the total population in these age groups. Considering these factors the effect of immigration on cohort fertility rates may not be very significant.

Cohort fertility rates are useful in interpreting the effect of income on the age specific period fertility rates. Changes in the economic conditions may influence the age at childbearing as well as the completed family size. Births may be postponed in the early part of the reproductive period of a woman and recovered later without any significant change in the completed family size. Sometimes postponement of births, depending upon the age at which it takes place, may result in a smaller family size. Among particular cohorts of women, occurrence of births may tend to be concentrated more and more in the young reproductive ages, with or without any change in the completed family size. In short, whatever changes in fertility that take place in the early part

of the reproductive period of a cohort affect fertility in the older age groups. Unlike the period rates, the cohort rates can explicitly show the interrelationship among the age specific fertility rates. A detailed analysis of the cohort fertility in Canada is not attempted here. Wherever possible we have used cohort rates in order to illustrate the relationship between income and period fertility rates.

Table 5.1 Relationship between income and fertility rates, slope coefficients and correlations. Canada, Ontario & Quebec. 1926-64.

CANADA

Age Groups	1926-39		1940-45		1946-57		1958-64	
	b	r	b	r	b	r	b	r
15 - 19	.024** (.009)	.76	.012 (.008)	.54	.102** (.012)	.89	-.076** (.014)	-.97
20 - 24	.149** (.040)	.83	.062 (.041)	.33	.292** (.049)	.84	-.299** (.062)	-.90
25 - 29	.085* (.047	.51	.042 (.062)	.20	.136** (.057)	.80	-.274** (.084)	-.79
30 - 34	.027 (.036)	.24	.048 (.052)	.34	.056 (.043)	.44	-.173** (.069)	-.69
35 - 39	.008 (0.020)	.08	.051* (.030)	.79	.019 (.024)	.45	-.085** (.039)	-.70
40 - 44	.012 (.012)	.21	.010 (.017)	.45	-.003 (.014)	-.12	-.057** (.023)	-.92
15 - 49	1.342* (.773)	.52	.510 (1.153)	.14	2.318** (.942)	.78	-4.984** (1.526)	-.76

ONTARIO

15 - 19	.018 (.013)	.64	-.003 (.012)	-.13	.113** (.013)	.89	-.098** (.019)	-.93
20 - 24	.114** (.040)	.86	.054 (.038)	.37	.312** (.041)	.91	-.281** (.059)	-.93
25 - 29	.087** (.048)	.58	.099 (.071)	.34	.126** (.052)	.74	-.227** (.078)	-.85
30 - 34	.045 (.034)	.50	.234** (.115)	.72	.031 (.043)	.18	-.144** (.069)	-.73
35 - 39	.030** (.015)	.47	.126** (.061)	.78	.010 (.019)	.18	-.054* (.033)	-.55

Continued

Table 5.1 Continued:

Age Groups	1926-39		1940-45		1946-57		1958-64	
	b	r	b	r	b	r	b	r
ONTARIO								
40 - 44	.011 (.008)	.28	.007 (.006)	.18	.001 (.011)	.03	-.037** (.019)	-.86
15 - 49	1.559** (.796)	.61	2.501* (1.517)	.44	2.289** (.915)	.64	-4.525** (1.396)	-.87
QUEBEC								
15 - 19	.038** (.010)	.71	.017 (.015)	.47	.032** (.011)	.74	-.040** (.012)	-.90
20 - 24	.216** (.043)	.81	.092 (.084)	.41	.172** (.051)	.83	-.232** (.059)	-.86
25 - 29	.134** (.051)	.58	.025 (.122)	.11	.041 (.065)	.22	-.257** (.077)	-.83
30 - 34	.040 (.051)	.17	.116 (.100)	.64	.013 (.061)	.12	-.248** (.070)	-.88
35 - 39	.006 (.042)	.03	.079 (.093)	.65	-.033 (.053)	-.38	-.150** (.061)	-.86
40 - 44	.016 (.023)	.15	-.002 (.017)	-.05	-.078** (.031)	-.61	-.058* (.037)	-.91
15 - 49	2.200** (.795)	.54	1.322 (1.962)	.38	1.142 (1.030)	.51	-4.948** (1.209)	-.87

** = Significant at .01 level

* = Significant at .05 level

Source: Calculated from the Vital Statistics Reports & National Accounts, Income and Expenditure Reports.

Note:
a) The estimated relationship is based on transformed data (refer Chapter III) except: 15-19 age group, Canada.
15-19 & 20-24 age groups, Ontario.
b) In all cases positive autocorrelation is not significant either at 5% or 1% level, except in the 30-34 age group (Ontario) where the Durbin-Watson test is inconclusive (refer Chapter III).
c) Standard errors are given within parentheses.
d) Fertility is allowed to lag income by one year.

Table 5.1 shows the correlations and slope coefficients of the relationship between income and fertility. In 18 out of a total of 21 regression equations, transformed data were used (refer Chapter III). Transformation of data resulted in considerable reduction in the extent of positive autocorrelation. In all the 21 regression equations (using original as well as transformed data), except one there is no significant autocorrelation. In the 30-34 age group (Ontario) the Durbin-Watson test is inconclusive. That is, we are unable to decide whether or not the hypothesis of positive autocorrelation can be rejected. Hence in this particular age group (30-34 in Ontario) the variance of slopes may be underestimated and our hypothesis of $\beta = 0$ can be rejected more often than we should.

We may note that the fertility rates used in estimating the relationship include illegitimate births. Births were recored as illegitimate when the parents reported they were not married at the time of birth or registration. In Canada, the proportions of illegitimate births to total births varied between 3 to 4 during 1928-61. In the 15-19 age group the proportions were relatively high, varying between 16 to 19 during 1941-61. In the same age group, the trends in the fertility rate for all births and those in the illegitimate fertility rate were generally similar, at least up to 1961. In other words, exclusion of illegitimate births would not change the direction of the relationship between fertility and income in the 15-19 age group. In the other age groups illegitimate births were relatively less (about 1 to 5% of total births) and their effect on the relationship would not be significant.

The income effect on fertility is generally positive during 1926-57 and negative during 1958-64. Let us take the period 1926-57 and examine the relationship.

1926-57:

Age Pattern of Relationship

The age groups 15-29 are important for understanding the effect of income on fertility. These are the ages when people enter labour force, marry and start family formation. It is quite likely that fertility in these age groups are more sensitive, compared to the older age groups, to the changing economic conditions. During 1926-39 and 1946-57, a close relationship is indicated in the 15-29 age groups, particularly in 20-24. There are quite a few exceptions to this pattern of high correlations in the younger age groups (15-29) and we will examine them in the following paragraphs.

In Quebec, during 1946-57 income does not seem to have any effect on the fertility rates in the 25-29 age group, while the 40-44 age group shows a high negative correlation. Let us examine the negative correlation in the 40-44 age group. Women aged 40-44 during 1947, 1948 . . . 1958 started their reproductive period (age 15-19) during 1922, 1923 . . . 1933. At the time of the economic depression, these cohorts (40-44 in 1947-58) were in different stages of the reproductive period. Depending upon the age at which these cohorts faced economic depression, there was postponement of births and sometimes a decline in completed family size as well. We do not have data on the complete

reproductive history of all the cohorts. However, the available data show that there was a decline in the completed family size of the cohort of women who reached 40-44 during 1951-58. Among the cohorts who reached the 40-44 age group during 1951-58 (they were in the 15-19 age group during 1926-33), completed family size declined from 3315 (per 1000 women) to 3282 in Quebec, while in Ontario the family size increased from 2327 to 2581. In the same cohort (age 40-44 during 1951-58), fertility rates in Quebec declined in all the age groups except in 30-34 (corresponding to calendar years, 1941 to 1948). It is difficult to say whether the decline in fertility rates in Quebec was due to a preference for a smaller family size or a tendency against late childbearing. Whatever be the motive, the period fertility rates in Quebec in the 40-44 age group declined quite sharply during 1947-58 thereby resulting in a negative correlation with income. The rate of decline in the period rates in the 40-44 age group was lower in Canada and Ontario as compared to Quebec.

The lack of significant relationship in the 25-29 age group in Quebec (compared to Canada or Ontario) during 1946-57 could be due to a marked shift toward early childbearing. Among the cohorts of women aged 25-29 during 1947-53 (the same cohorts were in the 15-19 age group during 1937-43 and in 40-44 during 1962-68) the rate of increase over time in fertility rates in the 15-19 and the 20-24 age groups (compared to the 25-29 age group) was quite high in Quebec compared to Canada or Ontario. In other words, when the younger cohorts started replacing the older ones, births tended to be concentrated more and more in the younger age groups. This tendency for earlier childbearing could be observed in

Canada and the two provinces, however, it was more pronounced in Quebec than in either Canada or Ontario. With a greater proportion of births occurring in the 15-24 age groups and with no significant change in the completed family size of the same cohort (aged 25-29 during 1947-53 and 40-44 in 1962-68), there was no substantial increase in fertility in the 25-29 age group in Quebec. Presumably, these factors could have led to the lack of relationship between fertility and income (i.e., fertility in the 25-29 age group changed very little in spite of an increase in income) in the same age group in Quebec during 1947-58.

Coming back to Table 5.1, during 1940-45, the postive correlations are quite high and significant in the 30-39 age group in Ontario and the 35-39 age group in Canada. One would expect that an increase in income would generally result in an increase in births in the younger age groups (e.g., 15-29). However, the observed increase in births in the older groups (30-39 in Ontario and 35-39 in Canada) could probably be due to the recovery, during 1941-46, of births postponed at the time of economic depression. Empirical analysis of the postponement and recovery of births poses quite a few problems. How to distinguish births (in an age group) that are "recovered" from those that are the result of an "increase" in fertility? Generally, a decline in fertility in the younger age groups of a cohort followed by an increase in the older age groups can be interpreted as postponement and recovery of births respectively. We have to take into consideration the economic conditions during the prime childbearing years and the changes in the completed family size as well. Strictly speaking, the number of

Table 5.2 Per cent change per annum in fertility rates among the cohorts of women aged 35-39 during 1941-46, Canada, Ontario and Quebec.

	Age Groups				
	20-24	25-29	30-34	35-39	40-44
Canada	0.1 (1926-28)	-4.0 (1931-33)	-1.2 (1936-38)	1.9 (1941-43)	-0.9 (1946-48)
	-0.7 (1929-31)	-2.5 (1934-36)	-0.4 (1939-41)	2.5 (1944-46)	-1.8 (1949-51)
Ontario	2.2 (1926-28)	-4.6 (1931-33)	-0.6 (1936-38)	3.6 (1941-43)	0.7 (1946-48)
	0.3 (1929-31)	-2.4 (1934-36)	0.4 (1939-41)	3.7 (1944-46)	-0.6 (1949-51)
Quebec	-1.5 (1926-28)	-4.0 (1931-33)	-1.6 (1936-38)	1.0 (1941-43)	-1.7 (1946-48)
	-2.6 (1929-31)	-1.7 (1934-36)	-1.6 (1939-41)	1.6 (1944-46)	-2.8 (1949-51)

Source: Adapted from the Vital Statistics Reports.

Note: Years within parentheses refer to the period during which the cohorts of women were in specified age groups.

births recovered in an age group must be equal to or less than the number of births postponed in the preceding age groups. If recovery is complete, the completed family size of the cohort may not change much. In case of partial recovery, the completed family size may decline temporarily. There are certain situations when it is not easy to distinguish births that are postponed from those due to higher fertility. Let us suppose that the period fertility rates in the 25-29 age group increased by 10% between time 't-5' and 't'. Part of this increase could be because of the recovery of births postponed when the women were in the 20-24 age group five years earlier. Another part of the increase could be because the particular cohort of women (age 25-29) at time 't' desired to have a larger family size and to have it completed quite early as well. In such cases it is difficult to distinguish (without detailed estimates of the number of births the various cohorts of women would 'normally' have at specified ages) recovery of births from births due to earlier childbearing and births due to larger family size. We may also note that certain cohorts of women may have a smaller completed family size either due to a preference for small family size or due to partial recovery of births. So, the meaning of postponement and recovery of births is to be understood in the larger context of certain changes that take place in the economic conditions, family size preferences and in the timing of births among different cohorts of women.

We may add that postponement and recovery of births to be discussed in the succeeding paragraphs include the marriage as well as the fertility components. That is, in certain age groups, because of economic

Table 5.3 Per cent change per annum in fertility rates among the cohorts of women aged 30-34 during 1941-46, Ontario.

Age Groups					
15-19	20-24	25-29	30-34	35-39	40-44
4.7 (1926-28)	-5.5 (1931-33)	-0.2 (1936-38)	3.5 (1941-43)	0.5 (1946-48)	1.8 (1951-53)
2.4 (1929-31)	... (1934-36)	3.7 (1939-41)	5.1 (1944-46)	0.6 (1949-51)	1.8 (1954-56)

Source: Adapted from the Vital Statistics Reports.

Note: ' ... ' indicates that the change in fertility is less than 0.1 per cent. Years within parentheses refer to the period during which the cohorts were in specified age groups.

Table 5.4 Cumulative fertility rates (per 1000 women) among the cohorts of women aged 30-34 during 1941-46, Ontario.

Up to AGE						
19	152.0 (1926)	161.5 (1927)	166.5 (1928)	170.5 (1929)	179.0 (1930)	178.5 (1931)
24	789.5 (1931)	770.0 (1932)	729.5 (1933)	716.0 (1934)	734.5 (1935)	741.5 (1936)
29	1390.5 (1936)	1358.0 (1937)	1346.5 (1938)	1314.0 (1939)	1377.0 (1940)	1428.0 (1941)
34	1872.0 (1941)	1864.0 (1942)	1880.0 (1943)	1855.5 (1944)	1915.5 (1945)	2044.0 (1946)
39	2222.0 (1946)	2220.0 (1947)	2215.0 (1948)	2197.0 (1949)	2254.0 (1950)	2384.5 (1951)
44	2327.0 (1951)	2325.5 (1952)	2322.5 (1953)	2313.5 (1954)	2373.2 (1955)	2497.5 (1956)

Source: Adapted from the Vital Statistics Reports.
Note: Years within parentheses refer to the period during which the cohorts of women were in specified age groups.

conditions married women may postpone childbearing while the single women may postpone marriage (and consequently childbearing) to a later date. Available data do not permit us to examine these components separately.

Let us examine the evidence for recovery of births on the part of the women aged 35-39 (in Canada and Ontario) during 1941-46. Women aged 35-39 in 1941-46 were 30-34 in 1936-41, 25-29 in 1931-36 etc. Table 5.2 shows the changes in fertility rates in this cohort of women at various stages of the reproductive period. The periods, 1941-46, 1936-41 . . . and so on, are split into two: 1941-43 and 1944-46, 1936-38 and 1939-41 . . . etc. The rate of change refers to the per cent change in fertility over the preceding calendar years. In Canada and Ontario, the decline in fertility in the 25-29 age group (corresponding to calendar years 1931-36) and the 30-34 age group (in 1936-41) was followed by an increase in the 35-39 age group (1941-46). The increase in fertility in the 35-39 age group could not be due to a general rise in fertility. Because, the period fertility rates in the 35-39 age group declined consistently from 1926 to 1941. From 1947 onwards there was a decline except during 1950-55 when it increased slightly. The implication is that the increase in the period rates in the same age group during 1941-46 could be due to a recovery of births. So, the general trends in the period rates in the 35-39 age group, the reproductive history of the relevant cohorts of women and the unfavourable economic conditions during 1931-36 show that there was a recovery of births during 1941-46 on the part of women who reached age 35-39 by that time. The resultant increase in births (along with the increase in income)

could have contributed to the high correlation in the 35-39 age group during 1940-45 in Canada and Ontario. A comparison of the relative rates of change in fertility (Table 5.2) in Canada and the two provinces shows that the recovery of births was less pronounced in Quebec. Perhaps, in Quebec some of the women in the relevant cohorts preferred to have a smaller completed family size and so recovery of births was not necessary. It is difficult to compare the changes in the completed family size since we do not have data on fertility in the 15-19 age group for the same cohort (aged 35-39 in 1941-46). However, the cumulative fertility, from age 20 onwards and terminating at age 44, shows there was very little change in family size in Ontario. The annual rate of decline in the completed family size was about 1% in Canada and 2% in Quebec.

During the same period (1940-45) the positive correlation in the 30-34 age group in Ontario is quite high and significant. Table 5.3 shows the rate of change in fertility among the cohort of women who reached age 30-34 in 1941-46. In the 20-24 age group there was a substantial decline in fertility during 1931-33, but not during 1934-36. While the increase of 3.5% in age 30-34 during 1941-43 could be interpreted as due to recovery of births, the increase of 5% during 1944-46 could be due to a general increase in fertility as well. Since we have data on fertility in the 15-19 age group for this cohort (age 30-34 in 1941-46) we can examine the changes in completed family size. The six columns of Table 5.4 refer to the family size up to specified age among the cohorts of women who reached age 30-34 in 1941, 1942, . . ., 1946. It can be seen that during 1941-44 the increase in births in the 30-34

age group did not alter the completed family size (corresponding to calendar years 1951-54). In 1945 and 1946, on the other hand, the increase in births in the same age group (30-34) could be due to a general rise in fertility since the completed family sizes of these cohorts (terminating reproduction in 1955 and 1956) increased to a certain extent. So, recovery of biths and to a certain extent, higher fertility could have led to the strong positive relationship in the 30-34 age group in Ontario during 1940-45.

During 1940-45, unlike in 1926-39 and 1946-57, fertility rates in the 15-29 age groups do not show any close relationship with income. Large scale enlistment of adult males into the armed forces and the psychological uncertainties about future could have discouraged any substantial increase in family formation and fertility in these young age groups. One might argue that during 1940-45, women in the younger age groups (15-24), who would have normally married and given births postponed these events to the postwar period because of the conditions prevalent at the time of war. Though this argument is quite convincing we would not be able to show from our data evidence for postponement of births and a later recovery. During the war period fertility fluctuated rather widely. Generally, there was no consistent decline in fertility. Secondly, fertility in the 20-29 age groups increased consistently up to 1959. Without an estimate of births which would have normally occurred among several cohorts of women at specific stages of the reproductive period, it would be rather difficult to separate births in the young age groups (20-29) that were recovered from those due to higher fertility (as a result of early childbearing or larger family size).

Postponement and recovery of births are different ways of interpreting the changes in the timing of births and in completed family size. Postponement and recovery may temporarily alter the age at childbearing among a few cohorts. However, when successive cohorts prefer to change their age pattern of childbearing as well as completed family size, changes in age at childbearing may continue for a longer time. Earlier (page 70), while discussing certain differences (between Ontario and Quebec) in the relationship between income and fertility during 1946-57, we briefly referred to the possible effect of changes in the timing of births and in completed family size on the age specific period fertility rates. It will be of interest to examine the separate influence of these two components, timing and family size, on the period fertility rates.

Changes in Completed Family Size and Timing of Births

Given a constant completed family size, changes in the age distribution of fertility rates can lead to an increase or a decrease in the average age at childbearing. We will be discussing mainly the latter since a decrease in the age at childbearing was a major feature of the fertility trends during the period of our study. Table 5.5 shows the fertility rates among four birth cohorts. Women born during 1907-11 reached the 15-19 age group in 1926 and the 40-44 age group in 1951. Similarly, those born during 1912-16, 1917-21 and 1922-26 were in the reproductive age groups (15-44) during 1931-56, 1936-61 and 1941-66 respectively. From the left to the right side of the table we proceed from the early to the more recent cohorts.

Table 5.5 Fertility rates (per 1000 women) in Canada, Ontario and Quebec: 1907-11, 1912-16, 1917-21 and 1922-26 cohorts.

Born during:	1907-11		1912-16		1917-21		1922-26	
In reproductive period during:	1926-51		1931-56		1936-61		1941-66	
	1907-11		1912-16		1917-21		1922-26	
Age Groups	ASFR	ASCFR	ASFR	ASCFR	ASFR	ASCFR	ASFR	ASCFR
				CANADA				
15-19	145.0	145.0	149.5	149.5	128.5	128.5	153.5	153.5
20-24	685.5	830.5	560.5	710.0	692.0	820.5	848.0	1001.5
25-29	721.5	1552.0	799.0	1509.0	957.0	1777.5	994.0	1995.5
30-34	611.5	2163.5	730.0	2239.0	722.5	2500.0	751.5	2747.0
35-39	465.5	2629.0	432.5	2671.5	448.0	2948.0	405.5	3152.0
40-44	154.5	2783.5	154.0	2825.5	142.5	3090.5	95.5	3248.0
				ONTARIO				
15-19	152.0	152.0	178.5	178.5	158.5	158.5	184.0	184.0
20-24	637.5	789.5	563.0	741.5	666.5	825.0	834.5	1018.5
25-29	601.0	1390.5	686.5	1428.0	848.5	1673.5	909.0	1927.5
30-34	481.5	1872.0	616.0	2044.0	626.0	2299.5	678.0	2605.5
35-39	350.0	2222.0	340.5	2384.5	366.0	2665.5	349.0	2954.5
40-44	105.0	2327.0	113.0	2497.5	109.5	2775.0	81.0	3035.5
				QUEBEC				
15-19	121.0	121.0	102.5	102.5	80.0	80.0	107.5	107.5
20-24	684.0	805.0	503.5	606.0	688.5	768.5	838.5	946.0
25-29	875.5	1680.5	949.5	1555.5	1078.0	1846.5	1086.5	2032.5
30-34	787.0	2467.5	878.5	2434.0	851.5	2698.0	842.5	2875.0
35-39	626.5	3094.0	566.5	3000.5	563.5	3261.5	481.5	3356.5
40-44	221.0	3315.0	208.5	3209.0	186.5	3448.0	111.0	3467.5

Source: Adapted from the Vital Statistics Reports.

Note: ASFR = Age specific fertility rates.
ASCFR = Age specific cumulative fertility rates.

In Canada and Ontario, women born during 1912-16 and later, and in Quebec those born in 1917-21 and later had larger completed family size as compared to the 1907-11 cohort. The rate of increase in the family size was quite high in Ontario. The increase in the completed family size of the 1922-26 cohort, compared to the 1907-11 cohort, was 17% in Canada, 30% in Ontario and 5% in Quebec. A major portion of the increase came from the 1917-21 cohort. The increase in the completed family size of the 1917-21 cohort over the 1907-11 cohort was 11% in Canada, 19% in Ontario and 4% in Quebec.

As we proceed from the early to the more recent cohorts, the rate of increase in fertility in the relatively younger age groups became more prominent. At the same time the rate of decline in fertility in the older age groups started increasing. The rates of increase in the younger age groups and of decline in the older age groups were generally higher in Quebec than in Ontario. For example, in Quebec, fertility rate in the 15-19 age group increased by 34% in the 1922-26 cohort compared to the 1917-21 cohort. For the same age group and cohort the increase in Ontario was about 16%. In the 40-44 age group of the 1922-26 cohort, fertility rate declined (compared to the same age group of the 1917-21 cohort) by 26% in Ontario as against 41% in Quebec. In the earlier section (pages 69, 70) we referred to the lack of relationship between income and fertility in the 25-29 age group and to the negative relationship in the 40-44 age group in Quebec during 1946-57. Due to the greater concentration of births in the younger age groups (particlularly in 15-19 and 20-24) fertility rates did not increase substantially in the 25-34 age groups and for the same reason

the rates declined quite rapidly in the 40-44 age group. Because of these changes in the age pattern of childbearing, in Quebec, there was no significant relationship between income and fertility in the 25-29 age group and there was a negative relationship in the 40-44 age group during 1946-57.

We may also note (Table 5.6) that the 1917-21 and 1922-26 cohorts (in Canada and the two provinces) completed a greater part of the family size in relatively younger age groups. For example, in Canada, in the 30-34 age group the family size of the 1907-11 cohort was 78% complete as against 85% in the 1922-26 cohort. In Ontario, for the same age group, family size was 80% complete in the 1907-11 cohort and it increased to 86% in the 1922-26 cohort. In Quebec, the increase was from 74% in the 1907-11 cohort to 83% in the 1922-26 cohort. It should be pointed out that in each of the four cohorts, the concentration of births in the younger age groups was greater in Ontario than in Quebec. For example, in the 1922-26 cohort 63% of the family size was completed by the time the women reached age 29, while it was 59% complete in Quebec at the same age. However, over time, the shift towards an early completion of family size was quite remarkable in Quebec. If this shift towards a younger age at childbearing in Quebec continues, the age distribution of fertility rates in Quebec may eventually become similar to that of Ontario.

We know that the distribution of fertility rates by age of mother is influenced by the changes in the completed family size as well as those in the timing of births. For example, a group of women may decide

Table 5.6 Indices of cumulative cohort fertility rates in Canada, Ontario and Quebec: 1907-11, 1912-16, 1917-21 and 1922-26 cohorts.

Cumulative fertility up to age 44= 100				
Cohorts of women born during:	1907-11	1912-16	1917-21	1922-26
In reproductive period (15-44) during:	1926-51	1931-56	1936-61	1941-66
Up to AGE	1907-11	1912-16	1917-21	1922-26
		CANADA		
19	5	5	4	5
24	30	25	27	31
29	56	53	58	61
34	78	79	81	85
39	94	95	95	97
44	100	100	100	100
		ONTARIO		
19	7	7	6	6
24	34	30	30	34
29	60	57	60	63
34	80	82	83	86
39	95	95	96	97
44	100	100	100	100
		QUEBEC		
19	4	3	2	3
24	24	19	22	27
29	51	48	54	59
34	74	76	78	83
39	93	94	95	97
44	100	100	100	100

Source: Adapted from the Vital Statistics Reports.

to have babies at shorter intervals without in any way changing the ultimate family size. Another group of women may increase the completed family size and also have shorter intervals between births. In the first group the effect of the change in the timing of births (or the age distribution of fertility rates) is clear, while in the second group the timing effect is combined with the family size effect. To separate these two components, timing and family size, one of them must be kept constant so that the effect of the other can be understood. In order to keep timing of births constant, the fertility rates of the cohorts of women born during 1912-16 and later were standardized on the basis of the age distribution of fertility rates in the 1907-11 cohort. That is, the proportional distribution of fertility rates by the age of the mother in the 1907-11 cohort was applied to the completed family size of the other three cohorts in order to get the standardized fertility rates for the 1912-16, 1917-21 and 1922-26 cohorts. Since the age distributions of fertility is kept constant, the differences in the standardized fertility rates among the 1912-16, 1917-21 and the 1922-26 cohorts would indicate the effect of the changing family size. On the other hand, among the same three cohorts, the deviations of the actual fertility rates from the standardized rates would reflect the changes in the timing of births.

It can be seen from Table 5.7 that, in terms of the effect on the period fertility rates, the timing component was generally more important than the family size component. For example, in Canada, fertility rate in the 25-29 age group of the 1922-26 cohort of women would have increased by 17% (compared to the 1907-11 cohort, same age

Table 5.7 Indices of cohort fertility rates (actual and standardized) in Canada, Ontario, and Quebec: 1907-11, 1912-16, 1917-21 and 1922-26 cohorts.

	Fertility rates in the 1907-11 cohort = 100						
Cohorts of women born during;	1907-11		1912-16		1917-21		1922-26
In reproductive period (15-44)during:	1907-11		1912-16		1917-21		1922-26
Age Groups		Actu -al	Stand -ardized	Actu -al	Stand -ardized	Actu -al	Stand -ardized
				CANADA			
15-19	100	103	101	89	111	106	117
20-24	100	82	101	101	111	124	117
25-29	100	111	101	133	111	138	117
30-34	100	119	101	118	111	123	117
35-39	100	93	101	96	111	87	117
40-44	100	100	101	92	111	62	117
				ONTARIO			
15-19	100	117	107	104	119	121	130
20-24	100	88	107	104	119	131	130
25-29	100	114	107	141	119	151	130
30-34	100	128	107	130	119	141	130
35-39	100	97	107	105	119	100	130
40-44	100	108	107	104	119	77	130
				QUEBEC			
15-19	100	85	97	66	104	89	105
20-24	100	74	97	101	104	123	105
25-29	100	108	97	123	104	124	105
30-34	100	112	97	108	104	107	105
35-39	100	90	97	90	104	77	105
40-44	100	94	97	84	104	50	105

Source: Calculated from the Vital Statistics Reports.

Note: Standardized fertility refers to the fertility rates which the 1912-16, 1917-21 and 1922-26 cohorts of women would have if they had the same age distribution of fertility rates as the 1907-11 cohort of women.

group), if the 1922-26 cohort had the same age distribution of fertility as the 1907-11 cohort. The increase of 17% was due to the increase in family size. However, the actual increase for the same cohort (1922-26) and the age group (25-29) was 38%. The balance of 21 percentage points (38 minus 17) could be attributed to the timing effect. Changes in timing may increase or reduce the fertility rates. In Canada, in the 40-44 age group fertility rate should have increased by 17% in the 1922-26 cohort (compared to the 1907-11 cohort) under the assumption of unchanging age (proportional) distribution of fertility rates. However, the fertility rate in the same age group and cohort (40-44, 1922-26 cohort) declined by 38%. Though the timing effect was more prominent than the family size effect in Canada and the two provinces, it was particularly so in Quebec especially in the 1922-26 cohort.

The effect of timing on the period fertility is more explicitly shown in Table 5.8. But for the effect of early childbearing, fertility rate in the 25-29 age group in 1951 would have been less by 18% in Canada, 16% in Ontario and 19% in Quebec. In the 20-24 age group (1946) because of the timing effect, fertility rate increased by 17% in Quebec, while the increase in Ontario was less than 1%. Again, due to early childbearing, fertility rate in the 40-44 age group (1966) was less by 52% in Quebec and by 41% in Ontario.

A few comments are in order regarding the relationship between fertility and income during 1926-57. The effect of income on the age specific fertility rates was to a large extent determined by the age at which particular cohorts of women found themselves at times of

Table 5.8 Acutal and standardized fertility rates (per 1000 women) in Canada, Ontario and Quebec: 1922-26 cohort.

Age groups & Years	Acutal	Standardized	Col.(1)-Col.(2)	Col.(3) as % of Col.(2)
	1	2	3	4
		CANADA		
15-19 (1941)	153.5	168.9	-15.4	-9.0
20-24 (1946)	848.0	800.0	48.0	6.0
25-29 (1951)	994.0	841.9	152.1	18.1
30-34 (1956)	751.5	713.6	37.9	5.3
35-39 (1961)	405.5	543.1	-137.6	-25.3
40-44 (1966)	95.5	180.3	-84.8	-47.0
		ONTARIO		
15-19 (1941)	184.0	198.3	-14.3	-7.2
20-24 (1946)	834.5	831.6	2.9	0.3
25-29 (1951)	909.0	784.0	124.0	15.9
30-34 (1956)	678.0	628.1	49.9	7.9
35-39 (1961)	349.0	456.6	-107.6	-23.6
40-44 (1966)	81.0	137.0	-56.0	-40.9
		QUEBEC		
15-19 (1941)	107.5	126.6	-19.1	-15.0
20-24 (1946)	838.5	715.4	123.1	17.2
25-29 (1951)	1086.5	915.8	170.7	18.6
30-34 (1956)	842.5	823.2	19.3	2.3
35-39 (1961)	481.5	655.3	-173.8	-26.5
40-44 (1966)	111.0	231.2	-120.2	-52.0

Source: Calculated from the Vital Statistics Reports.

Note: a) Standardized rates refer to the fertility rates the 1922-26 chohort of women would have if they had the same age distribution of fertility as the 1907-11 cohort.
b) Years within brackets indicate the time at which the cohort was in the specified age groups.

favourable or adverse economic conditions. The changes in fertility in that age group in turn led to certain adjustments in the fertility levels during the remaining years of the reproductive life. All these changes among different cohorts of women extending over a period of several years resulted in certain pattern of relationship between income and the period fertility rates.

Interpretation of the relationship between income and the period fertility rates becomes meaningful in the context of certain changes that take place in family size and the timing of births among the various cohorts of women. The interrelationship among the age specific fertility rates in a cohort of women is an important factor. Decisions regarding family size and birth intervals, taken during the early part of the reproductive period, leave their imprint on fertility levels in older age groups.

If the timing of births is constant, the movements in the period fertility rates will be same as those in cohort fertility rates. Late childbearing during a period of declining family size can exaggerate the decline in the total fertility rate so long as the tendency towards late childbearing continues. On the other hand, early childbearing during a period of a rising family size can exaggerate the increase in total fertility rate, again, so long as the shift towards an early childbearing continues. For Canada, due to the short period of our study, it is not possible to show to what extent the changes in timing exaggerated the decline in total fertility rate and the fertility rates in the younger age groups during the 1920's. However, we have shown how

during the 1940's, the increase in the period fertility rates in the younger age groups was exaggerated as a result of earlier childbearing. The extent of the relationship between income and the period fertility rates would have been different if, only family size had changed and not the age at childbearing. It is difficult to say categorically whether the income effect is greater on the timing of births or on the completed family size. During 1946-57, timing of births (or early childbearing) could have to certain extent contributed to the high correlations in the 15-19 and 20-24 age groups in Quebec (Table 5.1). But for the effect of timing, these correlations would, perhaps, have been lower and consequently the correlation between total fertility rate and income (in Quebec) during the same period would have also been lower than what it was. How much lower the correlations would have been is again a question that is difficult to answer. The rate of change in timing (or the extent of shift in births from one age group to another) and in the completed family size is an important factor in determining the separate influence of income on timing and family size. The age distribution of fertility rates at specific points in time is also an important factor. If the initial (1907-11 cohort) age distribution of fertility rates in Quebec had been similar to that of Ontario, it is rather doubtful whether the extent of the shift toward early childbearing in Quebec would have been as much as it was.

Finally, we may note that the fertility rates derived through the standardization procedures are hypothetical rates. When we standardize, the implicit assumpation is that the changes in completed family size do not interfere with the age at childbearing. In other words, we assume

that a constant age distribution of fertility would be maintained whatever be the degree of change in completed family size. In reality there may be a causal relationship (more due to social than biological factors) between the age at childbearing and the completed family size. Because of the interrelationship between timing and family size, the relationship between income, timing of births and completed family size becomes a multivariate relationship with a high degree of collinearity between timing and family size. In other words certain methodological problems arise if we try to examine the income effect on timing, controlling for family size or the income effect on family size, controlling for timing of births.

1958-64

The negative relationship during 1958-64 raises some doubts about the direction of the relationship in general between income and fertility. If income had a positive effect on fertility during 1926-57, why did fertility, especially in the younger age groups, decline since 1959 inspite of a continued increase in personal income? The decline in fertility after the late 50's can be interpreted in several ways. First, let us examine whether certain indicators other than personal income throw more light on the economic conditions during the late 50's and the early 60's.

General economic conditions during the postwar period.

Several studies point out that the growth rate in the Canadian economy since the middle of 1950 was not as impressive as during the

immediate postwar period (Economic Council of Canada, 1964; Walters, 1968 and Daly, 1964). "The slowdown in over-all economic growth from 1957 to date has been widely recognized (The year 1957 used as April 1957 was the peak of that business-cycle expansion and 1956-57 were high years in the ratio of investment to G.N.P.). In the six years since 1957, the growth has been less than in the six years before 1957 for the following Canadian series: G.N.P. (both in value and real terms); employment; railway traffic and consumer expenditure per person, in real terms " (Daly, 1964: 294).

The average unemployment rate in Canada, (per 100 persons in the labour force) among males (age 14 and above) increased from 3.2 in 1950-53 to 4.8 in 1954-57 and to 7.9 in 1958-61. Unemployment was quite high in the younger age groups. In the 14-19 age group, unemployment rate increased from 9.8 in 1954-57 to 15.9 in 1958-61. The increase in the 20-24 age group for the same periods was from 7.2 to 11.8.

Individual Income

One may argue that the movements in the aggregate variable like personal income can conceal the variations in individual income. That is, inspite of an increase in personal income, income among the individuals may have declined in certain age groups. Table 5.9 shows the individual income during 1951-65. The increase in income, for all age groups combined, was generally less during 1957-65 as compared to 1951-57. In the age group less than 25, income declined during 1957-65. Among males of the same age group income declined from $2082 in 1957 to $1676 in 1965, and for females from $1408 to $1226 during the same period.

The preceding paragraphs show that the economy was not buoyant during the late 50's and the early 60's. However, if we correlate unemployment rates and fertility rates, the relationship is positive which is hard to interpret.

Table 5.9 Non-farm median income of individuals, constant (1961) dollars, males and females by broad age groups, Canada, 1951-1965.

	Years					
Age groups & Sex:	1951	1954	1957	1959	1961	1965
Males:						
Less than 25	1459	1789	2082	1834	1814	1676
25-34	2986	3467	3838	3899	4141	4681
35-44	3331	3617	4059	4295	4641	5345
45-54	3150	3512	3902	3902	4212	4778
55-64	2592	2956	3308	3453	3657	3902
65 +	1098	1041	1208	1176	1286	1606
14 +	2664	2985	3359	3393	3631	3958
Females:						
Less than 25	1100	1231	1408	1313	1367	1226
25-34	1318	1543	1847	1956	1917	1865
35-44	1238	1432	1658	1729	1710	1741
45-54	1157	1035	1603	1683	1856	1714
55-64	781	851	1197	1306	1372	1337
65 +	691	783	790	805	816	865
14 +	946	993	1224	1242	1304	1272

Source: DBS, Income Distribution, Incomes of non-farm families and individuals Selected years, 1951-1965, 1969.

Concepts of Income

Relative Income and Permanent Income Hypotheses

It is generally argued that current income per se does not represent the income which an individual thinks is necessary to maintain and improve his standard of living. In order to explain the variations in fertility we can use an income concept other than current income. Two important concepts in this regard are permanent income (Friedman, 1957,) and relative income (Duesenberry, 1949). According to the permanent income hypothesis, current income consists of a permanent component and a transitory component. Transitory income would incude unexpected variations in income ('windfalls', lotteries etc.) while the permanent part consists of what the individual considers to be normal. Theoretically, permanent income would include the past, present and the future income of an individual. According to the relative income hypothesis, current income is meaningful only if it is related to the previous peak income reached by the individual. For example, an individual's consumption may vary with the ratio of his current income to his previous high income. That is, significant changes in consumption expenditure can be expected only when the current income deviates to a considerable extent from the previous high income. The hypotheses of permanent income and relative income originated in an attempt to explain the relationship between income, consumption and saving.

In the demographic studies, the definition and measurement of permanent income and relative income slightly differ from those in economic studies. Easterlin (1969) suggested the concept of potential

income. "The permanent income concept can be viewed as emphasizing that it is potential income flow through time that is pertinent to household decision-making, and that observed income may be an unreliable proxy for this. To minimize multiplication of concepts, I propose to embrace the permanent income notion in that of "potential" income. There is a second dimension to potential income, however. Even if there were no difference between prospective annual income and that currently observed, the potential income of a household would exceed its observed income, for the simple reason that typically money income is foregone in order to have time for other pursuits" (Easterlin 1969:129; Emphasis from the original).

Deborah Freedman (1963) measured relative income as the actual income of the husband relative to the income that might be expected on the basis of his occupation and age, and found that relative income was positively related to fertility. "There is evidence that the husband's income does make a difference over the longer childbearing period if it is considered in relation to the average income for the husband's occupational status and age. An income which is above the average for one's status is associated with more children, but being in a higher absolute income class means fewer children if the higher income is only what is usual for the husband's age and occupational status" (Deborah Freedman, 1963: 422).

Relative income can also be considered as current income relative to the desired standard of living. In order to examine the movements over time in the actual income of the young couples and in their desired

consumption level, Easterlin (1968: 123-28) used the ratio of the actual income of families with heads aged 14-24 (during 1953-62) and the income of the families with heads aged 35-44, five years earlier (during 1948-57). The young couples were assumed to have come from the families (heads aged 35-44, five years earlier) and so their (young couples) desired consumption level could be represented by the income of their parental families. It was found that this ratio declined during 1953-62 implying that the increase in the actual income among the young couples did not keep pace with the increase in their desired consumption level or standard of living. Since the actual income did not keep pace with the desired consumption level, it was argued that, fertility in the United States started declining from the middle of 1950's (Easterlin, 1968).

The preceding paragraphs show that the measurement of permanent income and relative income depends to a considerable extent on the type of data available. Permanent income, strictly speaking, would be a weighted combination of an individual's past, present and expected income in the future. From the time series data there seems to be no way of estimating future income. For our purposes, permanent income was estimated (using the time series data on personal income) as a weighted average of the past and present income, the weights declining as one proceeds from present to past. Current income (at time 't') received a weight of 30%, the previous year's income a weight of 25%, and the preceding 3 years received weights of 20%, 15% and 10% respectively. Different weighting procedures were also tried. Whatever be the weights used the estimated relationship between permanent income and fertility was

negative during 1958-64. Similarly, relative income (measured as the ratio of current year's personal income to the highest level of income during the preceding 5 or 10 years) did not change the negative relationship for the same period. Let us examine other factors which could have led to the negative relationship during 1958-64.

Utility Function

Income Effect and Substitution Effect

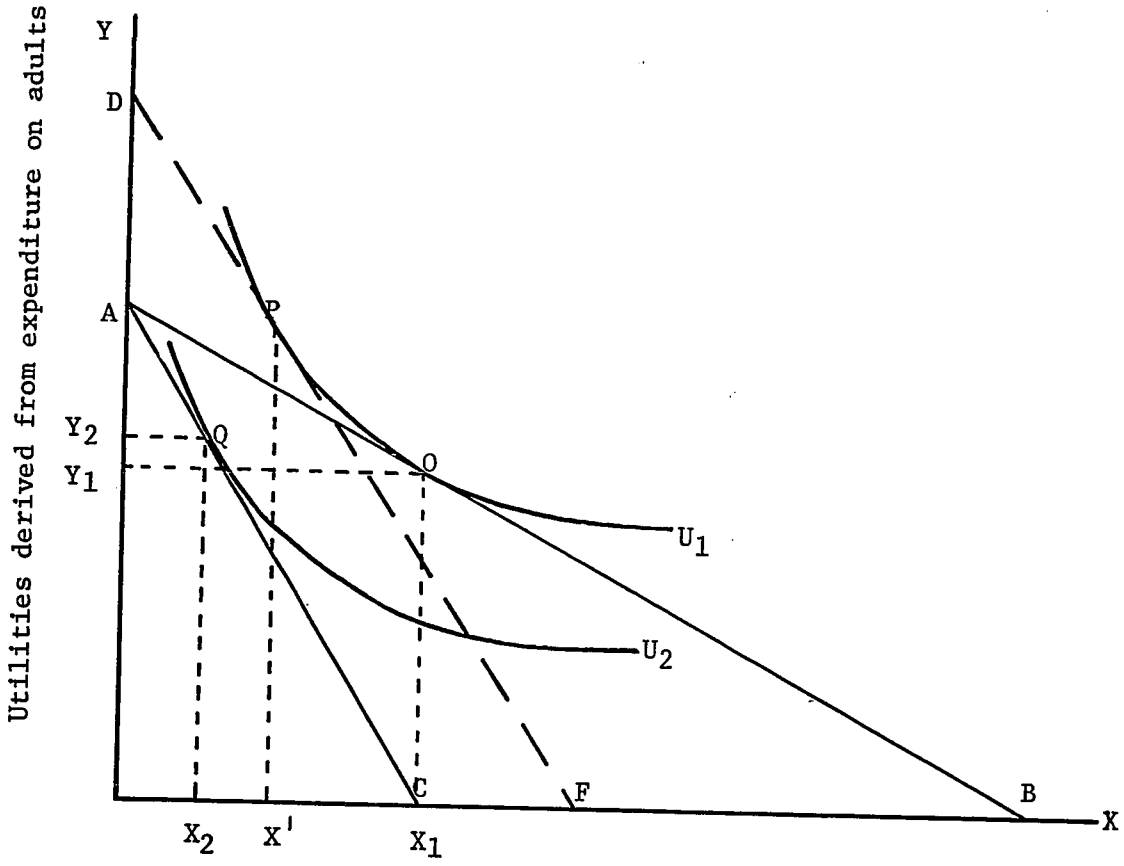
We may note that the decisions regarding family size are taken at the individual or family level. One can think of several variables that are quite likely to influence the number of children a family desires to have. Education, religion, labour force participation of wife are some of these variables. For example, the direct effect of income of the wife may affect fertility positively, while the opportunity cost of a child (the amount of income foregone by the wife as a result of allotting her time to child care rather than to earning income) may discourage fertility (Mincer, 1963). The overall effect of income on family size may be positive or negative depending upon which of these two forces (positive influence of income and the negative effect of opportunity cost) predominates. Opportunity cost can vary according to the educational level of wife, child care facilities etc. The point is that the complex ways in which fertility interacts with several other variables at the micro or household level may not always show up in the aggregate data. We do not propose to examine here all the variables that influence the decision to have an additional child. Let us take two variables, income and the prices of the commodities and examine how they can influence, at

the micro level, the cost and benefit of having a child.

Quite a few studies have pointed out that the addition of a child results in certain changes in the expenditure pattern of the family (Nicholson, 1949; Henderson, 1949 and 1950). Henderson (1949) examined the changes in the expenditure pattern as a result of the addition of two children to a childless family. Compared to the childless family, expenditure on standard food items in the two child family increased by about 10 to 20%, while expenditure on luxury items and on adult clothing declined to a certain extent. These changes in the expenditure pattern as a result of the addition of two children differed to a certain extent according to the economic status of the families- low, middle and upper income groups. What is important is that given certain constraints imposed by income and prices, certain adjustments take place in the family budget because of the addition of a child. The basis for these adjustments are the utility or satisfaction derived from the alternative ways of spending the money, given certain tastes and preferences on the part of the family. If X and Y are two commodities, an individual may choose a particular combination of these two commodities (say, 3 units of X and 7 units of Y etc.) such that his total satisfaction is maximum. Changes in the price of X (with respect to Y) can reduce the total satisfaction till a new combination of Xand Y, at the new price level, is chosen which again ensures maximum satisfaction to the individual.

Let us suppose that the total expenditure of a family consists of two parts: Y or expenditure on adults and X or the expenditure on children. In other words, Y and X refer to baskets of goods and services at certain

Figure 3.
Hypothetical representation of expenditure on children & adults - Income effect & Substitution effect



Source: Adapted from Leftwich, R.H., The Price System and Resource Allocation, 1962

prices consumed by the adults and children respectively. Utility or satisfaction is derived by the parents by allotting a part of their income on Y and the other part on X. Changes in income and the prices of X and Y can modify the utility derived from Xand Y. For example, the prices of the goods that go into X may increase (relative to Y). So, even with an increase in income, parents may have to allot a greater proportion of their income on X than on Y. If they are not willing to do so, the motivation to have an additional child will be negligible (assuming, of course, that there is no intention on the part of the parents to reduce the expenditure per child or to lower their own standard of living).

The effect of the changes in income and prices on X and Y can be diagramatically represented (Figure 3). For the sake of simplicity we will treat Xand Y as two commodities. However, the real meaning of X and Y explained in the previous paragraph has to be borne in mind. X and Y may be consumed in different combinations ie., 4 units of X and 10 units of Y, 6 units of X and 7 units of Y . . . etc. Each of these combinations yields the same total satisfaction to the consumer or the family. A set of these combinations is represented by the indifference curve (U_1 and U_2 in Figure 3) and it is a matter of indifference to the consumer as to which combination is used, since each combination yields the same satisfaction. The indifference curve is a theoretical representation of the tastes and preferences of the consumer. The curve slopes downwards because, when the quantity of one commodity increases, the quantity of the other has to be reduced if the total satisfaction is to remain the same. The amount of Y the consumer is willing to give

up in order to have an additional unit of Xis defined as the marginal rate of substitution of X for Y (MRSxy). As one moves along the indifference curve to the right, X increases and Y decreases. Under these conditions the marginal rate of substitution of X for Y will decrease. That is, when the consumer has less of Y and more of X, he may not be willing to part with Y for the sake of an additional unit of X. If one moves along the curve to the left the quantity of Y increases and X decreases. Under these conditions, MRSxy will increase i.e., the consumer has more of Y and so he will be willing to part with Y for the sake of X. Because of this relationship between the quantities of X and Y and the marginal rate of substitution of one for the other, the indifference curve is convex to the origin. The degree of convexity will be greater if X and Y are poor substitutes, and lesser if X and Y are good substitutes.

Given the income of a consumer, which of the several possible combinations of Xand Y (represented by the indifference curve) the consumer will actually choose depends on the prices of the commodities. If his income is Z_1 and the price of X is p_{x1} and of Y is p_{y1},

the ratio: $\frac{Z_1 / p_{y1}}{Z_1 / p_{x1}} = \frac{p_{x1}}{p_{y1}}$, is indicated by the budget line (line AB in the figure). The consumer can spend all his income on Y (Z_1 / p_{y1} or point A in the figure) or on X (Z_1 / p_{x1} or point B in the figure). Between these two extremes he can purchase various combinations of the commodities X and Y. Given the budget line, the particular combination which yields maximum satisfaction is indicated by the point at which the budget line is just tangent to the indifference curve. In Figure 3, the

point at which AB line is just tangent to the curve U_1 is O. The quantities purchased are X_1 and Y_1.

Let us suppose that the price of X increases from p_{x1} to p_{x2}. That is, the price of X relative to Y is higher than before. Because of this price increase, the budget line is rotated clockwise, with A (Z_1/p_{y1}) as the focal point, till it cuts the X axis at C (ie., Z_1/p_{x2}). The new line AC is steeper than the previous budget line AB. The new point of maximization is at Q and X_2 and Y_2 quantities will be purchased. The quantity of Xis reduced and that of Y is increased. As a result of the price rise in X, consumer's real income decreases and the curve U_2 yields less total satisfaction than U_1.

Suppose that the consumer's real income is increased to compensate for the loss in purchasing power as a result of a rise in the price of X. The "compensating increase in income" will move the budget line parallel to itself i.e., to DF. The new budget line DF is tangent to U_1 at P, the point of maximum satisfaction. The quantity of X purchased is reduced from X_1 to X'.The combination of X and Y at point P yields the same total satisfaction as the combination at O.

The movement from O to P (and the reduction in the quantity from X_1 to X') refers to the substitution effect which results from the change in the price of X relative to the price of Y. The income effect can be determined by assuming no compensating variation in income. The movement from P to Q (and the reduction in the quantity from X' to X_2) refers to the income effect.

What is important is the changes in the relative price. The prices of two commodities, for example, can go up, but the price of one commodity may increase faster than the other. The total price index that is generally used to deflate income (as in the case of personal income in our analysis) refers to the change, over time, in the prices of all commodities combined. Actually the price index of a single commodity may increase faster than the total price index. In Canada, for example, between 1950 and 1961 the total price index (1949 = 100) increased from 103 to 129. During the same period, however, the price index for health care increased much faster i.e. from 102 to 160, the price index for transportation increased from 105 to 141, and shelter, from 106 to 145. If the price index of certain commodities and services consumed by children (e.g., medical care, education etc.) increases faster than the total price index, the couples may have to spend a greater proportion of their income on their children inspite of an increase in real income. An increase in the expenditure or cost of children, other things being equal, may weaken the motivation to have an additional child. Historically, both income and the cost of raising children might have gone up. But the question is whether the cost of children increased faster than income, especially since the late 1950's? If it did, the decline in fertility since the late 50's could be attributed partly to the higher cost of raising children. Available data do not permit us to examine this problem.

In order to understand the substitution effect (described in the preceding paragraphs), a knowledge of the tastes and preferences for children relative to those for other goods and services will be necessary

(Easterlin, 1969; Robinson, 1971). The emphasis is on the relative preferences than on absolute preferences. 'Tastes are not "either-or", but "more or less. Typically, households do not want either A or B. Rather they desire both A and B, and a certain combination of less A and more B may leave them just as satisfied as an alternative of more A and less B. The subjective rate at which a household is willing to "trade-off" A for B (technically, the marginal rate of substitution) is variable, but the important point is that such subjective trade-offs do exist, and hence even a household with a strong B-bias may, if the terms of trade are favourable, give up some B for A and consider itself better off' (Easterlin, 1969: 134).

We may not be able to construct a detailed preference schedule (or indifference curve) based on the individual's preferences for certain number of children, compared to his preferences for certain competing goods. We may not know exactly how much of the various goods and services an individual will be prepared to give up for the sake of an additional child. However, there are a few factors let us call these Y factors) such as, travel, leisure, summer home, etc., which may constitute an important part of an individual's standard of living. It may be that the individual, after a family of certain size is reached, will not be prepared to forego these Y factors for the sake of an additional child. In other words, the rate of substitution of X (children) for Y (material goods) can decrease rapidly after a certain point is reached. Due to sociological factors these preferences may differ among individuals and vary over time. These differences in the preference schedules and the extent to which certain goods and services serve as substitutes for

children can be understood only through special studies of consumer behaviour.

We can briefly summarize what we discussed in this chapter. Fertility rates during 1926-57 varied directly with per capita personal income. There was an increase in the completed family size of the recent cohorts (i.e., those born during 1912-16 and later). The increase in the completed family size was less in Quebec as compared to Ontario or the country as a whole. In Canada and the two provinces, as the younger cohorts started replacing the older ones, early childbearing became more prominent and this was particularly so in Quebec. It appears that the positive correlations during 1946-57 in Canada and both the provinces would have been somewhat lower had there been no timing effect (or early childbearing). With the available data it is difficult to explain satisfactorily the negative relationship between fertility and income during 1958-64. Historically, in the developed countries, fertility rates generally declined along with economic development. We are aware that the rise in fertility during the 1940's would not have continued indefinitely without endangering the standard of living. But what exactly caused the fertility rates to decline since the late 50's is difficult to determine. It may be that the effect of certain variables on fertility, operating at the micro or household level, did not show up in the aggregate data used in our analysis. We discussed some possible ways in which the decision making process at the household level can be examined. Changes over time in the cost of children (relative to changes in income), the extent to which certain factors such as, travel, leisure, summer home etc., (which may constitute an important part of the standard of living) serve as

substitutes for children, are some of the variables that require further study.

CHAPTER VI

CROSS SECTION RELATIONSHIP

In the present chapter we will examine the relationship between income and fertility as shown by the cross section data. The cross section data used here are from the censuses. The basic data consist of the number of wage earning families cross classified by the number of children (less than age 25, unmarried and staying at home at the time of enumeration), income (wages and salaries) and the age of head. We will briefly discuss some of the problems that arise from the way in which these variables are defined in the census.

Measurement of Income and Family Size in Census

A family consists of husband and wife with or without unmarried children living in the same dwelling, or a parent living with unmarried children. Further, a man or woman having guardianship of a child or ward and living in the same dwelling is also considered a family. This definition of a family was first adopted in 1941 and retained in the subsequent censuses. In 1961, most of the families were husband and wife families, i.e., families in which the husband and wife were living together at the time of census enumeration. Out of about 4.1 million families enumerated in 1961, about 3.8 million or nine-tenths were husband and wife families (1961 Census of Canada, 7.2-1, p. 4). In 1941 and 1951 , "normal families" (same as the husband and wife families) constituted about 88% and 90% respectively of the total number of families (1951 Census of Canada, v.10, p. 319).

Since our data cover only the wage earning families (those families with heads as wage earners) income used in our analysis refers to wages and salaries. As a result, families whose heads were employers or workers on own account status, such as, the professionals, businessmen, farmers, etc. will be excluded. In Canada, the proportion of wage earning families to the total number of families (families with all sources of income) was about 50% in 1941 and 66% in 1961. In other words, the number of families for whom data on the number of children cross classified by earnings are available, constitute about one-half to two-thirds of the total number of families. Due to certain reasons, to be discussed later, we have included for our analysis only those wage earning families whose heads were below age 45. This will further reduce the size of the population under study. For example, in Canada, the total number of families in 1961 was about 4.1 million, while the tables (number of children and earnings) used in our analysis are based on 1.7 million families (i.e., wage earning families with heads below age 45) or about 43% of the total number of families. In 1941, the proportion of wage earning families with heads below age 45 was about 28% in Canada. In Ontario, the tabulation (number of children and earnings) is based on 32% of the total number of families in 1941 and on 45% in 1961. The corresponding figures for Quebec are 33% and 43% in 1941 and 1961 respectively. It is not known exactly how many of these families (wage earning families with heads below age 45) are husband and wife families. Among the families with all sources of income, nine-tenths are husband and wife families. We presume that in the wage earning families also about 90% will be of husband and wife

families.

The term, family size, used by demographers refers to the number of children ever born or those living at the time of interview or enumeration. But, from the census data we could get only the number of children under age 25, unmarried and staying at home at the time of census enumeration.

Table 6.1 Number of children (per 1000 families) and income among the wage earning families with the age of head below 45 years, Canada, 1941.

Income ($)	Children born to mothers & living	Children less than age 25, unmarried & staying at home
<450	2160	2107
450-949	1881	1849
950-1449	1737	1723
1450-1949	1706	1704
1950-2949	1648	1656
2950-3949	1602	1625
3950-4949	1689	1719
4950 +	1788	1837
All income groups	1815	1796

Source: Census of Canada, 1941, v.5, Table 27.

Note: a) Income refers to wages and salaries
b) For income intervals $1950 and above, the number of children in col. 2 is greater than that in col. 1. This is found in the original.

Only for 1941 (not for 1951 & 1961) we have data on the number of families cross classified by income (wages and salaries) and the number of children living. For the sake of comparability, for all the three years we have used the number of children staying at home which will differ from the actual family size, especially when the head of the family is older (e.g., 45-64, 65+). However, this difference can be reduced if we ignore those families where the age of head is 45+. Secondly, what is of interest to us is that the difference between these two concepts of family size should not change the direction of the income-fertility relationship. From Table 6.1 we can see that the relationship between family size and income is generally the same whether we use the number of children living or the number of unmarried children below age 25 and staying at home.

We can briefly summarize the limitations of the data used in this chapter. Our discussion of the cross section relationship between the number of children and earnings (or income) is based on about 30 to 45% of the total number of families. Excluded are those families with sources of income other than wages and salaries (e.g., income from business, profession etc.) and those wage earning families with heads aged 45 and above. Secondly, the number of children will mean the number of unmarried children aged less than 25 and staying at home. This is not strictly equivalent to the concept of family size used in demographic studies i.e., the total number of children ever born or living. However, the 1941 data show that the difference between the number of children living and the number of unmarried children less than age 25, is not very significant when we consider only families with heads aged less than

45. We may note that the income-fertility relationship discussed in the present chapter will be biased if the relationship in the excluded families (those with sources of income other than wages and salaries) is different from that of the included families (whose source of income is wages and salaries).

Differentials in Family Size by Income

In cross section data, the differences in family size according to the level of income are generally called family size (or fertility) differentials by income. Family size may decrease consistently along with an increase in income i.e., the poor have larger family size than the rich. Given this negative relationship, the difference in family size between the rich and the poor can be called negative differential. The negative differential may decrease or increase over time. A second pattern is when both income and family size increase consistently ie, the rich have larger family size than the poor. Given this positive relationship, the difference in family size between the high and the low income groups can be called positive differential. Like the negative differential, positive differential can change over time or differ among certain subgroups of population classified by occupation, education, etc. That is, the positive (or negative) relationship between income and family size may be more pronounced in, say, higher educational categories than in the lower educational categories, in white collar occupations as compared to the blue collar occupations etc.

Sometimes family size may decrease from the low to the middle income groups and increase from the middle to the high income groups.

This pattern of relationship gives an 'U' shaped curve, that is, when income is plotted on the X-axis and family size on the y-axis, the resultant distribution will form an 'U' shaped curve. Instances of 'U' shaped relationship are not rare in demographic literature, especially in studies on postwar fertility in the United States. Using data on the number of children ever born, Cho et al.(1970) found some evidence for an 'U' shaped relationship. "For whites in the age group 35-39 years, on the whole, there is an inverse relation of income of husband to fertility. The exceptions are reversals that occur for the lowest and the three extremely high income categories, forming a weakened U-shaped curve. But the fertility of the very poor is significantly higher than that of the rich. For the age group 40-44 years, the pattern is similar: consistent inverse relationships appear for those who have family incomes of $2,000- $2,999 up to $5,000 - $6,999, and then a positive relationship appears for the higher family income categories. Nevertheless, the poor are substantially more fertile than the rich" (Cho et al., 1970: 267-268).

Table 6.2 shows the distribution of mean family size according to income intervals in Canada for the years 1941, 1951 and 1961. In 1941 and 1951 the relationship was generally in the inverse direction, that is, family size decreased along with an increase in income. However, this negative relationship existed only up to certain levels of income. This is not strictly an 'U' shaped distribution since the increase in family size could be observed only in the highest or the highest two income groups. The data for 1961 on the other hand showed

Table 6.2 Number of children (per 1000 families) and income among the wage earning families with the age of head less than 45, Canada, 1941, 1951, and 1961.

1941		1951		1961	
Income ($)	No. of children	Income ($)	No. of children	Income ($)	No. of children
< 450	2107	< 500	1983	< 2000	2320
450-949	1849	500-999	2102	2000-2999	2140
950-1449	1723	1000-1499	2008	3000-3999	2140
1450-1949	1704	1500-1999	1816	4000-4999	2192
1950-2949	1656	2000-2499	1767	5000-5999	2242
2950-3949	1625	2500-2999	1775	6000-6999	2267
3950-4949	1719	3000-3999	1767	7000-9999	2337
4950 +	1837	4000-5999	1766	10,000 +	2565
		6000 +	1912		
All income groups	1796		1822		2207

Source: Census of Canada for the years 1941 (v.5, table 27), 1951 (v.3, table 140) and 1961 (v.2, pt. I, table 88).

Note: Income refers to wages and salaries.

Children are those below age 25, unmarried and staying at home at the time of enumeration.

a positive relationship if we exclude the income group of less than $2000 dollars. In general we can say that during 1941-61 there was a shift from a negative to a positive relationship.

This change in the direction of the relationship does not seem to be due to the different method of measuring the family size. We have seen before (Table 6.1) that even if we use the total number of children living (instead of the number of unmarried children staying at home), the relationship is negative in 1941. Evidence from other studies (Henripin, 1968: 278-279) shows that the relationship is positive in 1961.

Table 6.3 Indices of variations in the number of live born children among married women according to husband's income and the age of woman, Canada, 1961.

(Average number of children in income group $ 5000-7000 = 100)

Income ($)	Age Groups 25-29	35-39	45-49
< 1000	82	102	117
1000-3000	85	90	98
3000-5000	89	96	94
5000-7000	100	100	100
7000-10,000	112	108	102
10,000 +	121	128	104

Source: J. Henripin, Trends and Factors of Fertility in Canada, 1972: 278-279.

" It seems clear enough that, generally speaking, a positive relationship is being developed between fertility and income. This is already the prevailing relationship amongst young urban couples in Canada today. We have also shown that when one nullifies the influence exercised by other factors which usually vary at the same time as income (schooling, for instance), the positive effect of income on fertility is a good deal more generalized than would seem at first sight" (Henripin, 1972: 291).

Since age is an important factor in the relationship between income and family size, we can examine the relationship according to the age of head and this is shown in Table 6.4. In the 35-44 age group, the family size (for all income groups) in Canada declined from 2413 in 1951 to 2306 in 1961. Women aged 35-39 and 40-44 in 1951 were born during 1912-16 and 1907-1911 respectively. Those in 35-39 and 40-44 age groups in 1941 were born during 1902-1906 and 1897-1901 respectively. Since fertility rates declined from 1926 to the middle of the 1930's, the older cohorts i.e.,the 1902-1906 and 1897-1901 (aged 35-39 and 40-44 in 1941) had larger family size as compared to the younger cohorts i.e., the 1912-16 and 1907-11 cohorts (aged 35-39 and 40-44 in 1951). The revival in fertility started in the 1912-16 cohort. Inspite of this revival, fertility rates in specified age groups in the 1912-16 cohorts did not reach the fertility levels of the older cohorts (i.e. 1902-1906 and 1897-1901 cohorts) at comparable age groups. In short, the impact of the baby boom was not sufficiently reflected in the fertility levels of the 1907-11 and the 1912-16 cohorts, particularly in the case of the 1907-11 cohort.

Let us return to the discussion of the changes in fertility differentials by income in Canada during 1941-61. In the age group 35-44, the relationship was negative in all the three years, 1941, 1951 and 1961. A consistent negative relationship will indicate a monotonic decrease in family size as one proceeds from the lowest to the highest income group. Negative relationship was consistent in 1941 and 1961 with the exception of the highest one or two income groups. In both the years the lowest income group had the largest family size. In 1951, however, the negative relationship was consistent only in the middle categories i.e., from the 500-999 dollar group to the 4000-5999 dollar group. In other words the lowest income group did not have the largest family size. Comparing the extent of the relationship during 1941-61 is made difficult due to the lack of consistency in the relationship, especially in 1951. One way of comparing the extent of the negative relationship is to take the range of the difference between the smallest and the largest family size. If we take broad income groups (i.e., low, middle and high income groups), the largest family size can be observed in the low income group (though not in the lowest income group as in 1951) and the smallest family size, in the high income group (though not in the highest income group). A narrowing of the range (or the difference between the largest and the smallest family size) will roughly indicate a weakening of the negative relationship. Using the indices given in Table 6.4 we can examine the changes in the range of the negative differentials during 1941-61.

In the 35-44 age group the range between the smallest and the largest family size was 38 points (100 minus 62) in 1941. This range

Table 6.4 Number of children (per 1000 families) and indices of family size according to income and age of head, wage earning families, Canada, 1941, 1951 and 1961.

Family size in the lowest income group = 100

1941

Income ($)	Age < 35		Age 35-44	
< 450	1506	100	2938	100
450-949	1305	87	2661	91
950-1449	1182	78	2417	82
1450-1949	1169	78	2190	75
1950-2949	1134	75	1969	67
2950-3949	1115	74	1810	62
3950-4949	1204	80	1850	63
4950 +	1369	91	1938	66
All income groups	1259		2413	

1951

Income ($)	Age < 35		Age 35-44	
< 500	1494	100	2671	100
500-999	1598	107	2819	106
1000-1449	1541	103	2695	101
1500-1999	1398	94	2464	92
2000-2499	1400	94	2305	86
2500-2999	1422	95	2225	83
3000-3999	1427	96	2098	79
4000-5999	1455	97	1949	73
6000 +	1614	108	2005	75
All income groups	1437		2306	

1961

Income ($)	Age < 25		Age 25-34		Age < 35		Age 35-44	
< 2000	947	100	2109	100	1793	100	3111	100
2000-2999	882	93	1982	94	1692	94	2854	92
3000-3999	896	95	1932	92	1713	96	2747	88
4000-4999	943	100	1948	92	1818	101	2654	85
5000-5999	954	101	1972	94	1896	106	2606	84
6000-6999	957	101	1982	94	1934	108	2554	82
7000-9999	1037	110	2042	97	2012	112	2543	82
10,000 +	1114	118	2230	106	2211	123	2679	86
All income groups	917		1971		1792		2706	

Source: Census of Canada for the years 1941 (v.5, Table 27), 1951 (v.3, Table 140) and 1961 (v.2, pt. I, Table 88)

Note: Income refers to wages and salaries.
Children are those less than age 25, unmarried and staying at home at the time of enumeration.

was reduced to 33 points (106 minus 73) in 1951 and finally to 18 points (100 minus 82) in 1961. In other words, during 1941-61, though the low income groups continued to have a larger family size than the high income groups, the extent of the difference between these two extremes had narrowed to a certain extent.

In the age group below 35 years in Canada, the negative relationship in 1941 changed into a positive relationship in 1951. In 1941, family size decreased consistently from the lowest income group up to the 2950-3949 dollar income group. However, in 1951 for income intervals 1500 dollar and upwards, family size increased consistently. In 1961 also the positive relationship was quite consistent with the exception of the lowest income group.

At each point in time, the negative relationship was less pronounced in the younger age groups compared to the older age groups (as in 1941) or the negative relationship in the older age groups changed to a positive relationship in the younger age groups (as in 1951 and 1961). In 1961, the change from a negative to a positive relationship was quite prominent if we compare the distribution of family size by income intervals in the fage groups 35-44, 25-34 and the group below age 25. In the youngest age group, family size, with the exception of the lowest income group, increased consistently along with income. In the same year, family size of the highest income group was less than that of the lowest income group by 14% in the 35-44 age group. On the other hand, in the group below age 25, the highest income group's family size was about 18% larger than that of the lowest income group.

Table 6.5 Number of children (per 1000 families) and indices of family size according to income and age of head, wage earning families, Ontario, 1941 and 1961.

Family size in the lowest income group = 100

1941

Income ($)	Age < 35		Age 35-44	
< 450	1360	100	2481	100
450-949	1026	89	2273	92
950-1449	1109	82	2114	85
1450-1949	1146	84	2021	81
1950-2949	1110	82	1843	74
2950-3949	1087	80	1716	69
3950-4949	1159	85	1764	71
4950 +	1315	97	1904	77
All income groups	1161		2093	

1961

Income ($)	Age < 25		Age 25-34		Age < 35		Age 35-44	
< 2000	938	100	1870	100	1596	100	2546	100
2000-2999	901	96	1854	99	1579	99	2414	95
3000-3999	911	97	1853	99	1653	102	2438	96
4000-4999	941	100	1890	101	1759	110	2432	96
5000-5999	954	102	1930	103	1856	116	2443	96
6000-6999	928	99	1940	104	1984	119	2425	95
7000-9999	1037	111	2012	108	1986	124	2435	96
10,000 +	1111	118	2199	118	2182	137	2603	102
All income groups	924		1890		1725		2438	

Source: Census of Canada for the years 1941 (v.5, Table 57), 1951 (v. 3, Table 140) and 1961 (v.2, pt.I, Table 88)

Note: Income refers to wages and salaries.
Children are those less than age 25, unmarried and staying at home at the time of enumeration.

Table 6.6 Number of children (per 1000 families) and indices of family size according to income and age of head, wage earning families, Quebec, 1941 and 1961.

Family size in the lowest income group = 100

1941

Income ($)	Age < 35		Age 35-44	
< 450	1643	100	3415	100
450-949	1425	87	3159	93
950-1449	1361	83	3051	89
1450-1949	1311	80	2819	82
1950-2949	1215	74	2409	71
2950-3949	1112	68	2058	60
3950-4949	1324	81	2039	60
4950 +	1497	91	2033	60
All income groups	1415		2990	

1961

Income ($)	Age < 25		Age 25-34		Age < 35		Age 35-44	
< 2000	849	100	2102	100	1830	100	3478	100
2000-2999	800	94	1971	94	1722	94	3183	92
3000-3999	808	95	1946	93	1752	96	3069	88
4000-4999	823	97	1952	93	1832	100	3008	86
5000-5999	821	97	1937	92	1862	102	2937	84
6000-6999	840	99	1896	90	1854	101	2761	79
7000-9999	884	104	1973	94	1946	106	2644	76
10,000 +	818	96	2171	103	2153	118	2731	79
All income groups	818		1962		1795		3027	

Source: Census of Canada for the years 1941 (v.5, Table 27), 1951 (v.3, Table 140) and 1961 (v.2, pt. I, Table 88)

Note: Income refers to wages and salaries.
Children are those less than age 25, unmarried and staying at home at the time of enumeration.

In short during the period 1941-61, as the new cohorts started replacing the older ones, there was a weakening of the negative relationship as well as a reversal to a positive relationship.

We may note that the family size in the younger age groups (< 25 and 25-34) cannot be treated as completed family size. One may argue that the birth intervals are shorter for the high income groups (compared to the low income groups) thereby showing a positive relationship in the younger age groups. However, during the remaining period of the reproductive life (35-44) the family size of the poor may increase faster than that of the rich. Consequently, the relationship between income and completed family size may become inverse. The question is whether the birth intervals are longer among the poor as compared to the rich. Available evidence (Freedman and Coombs, 1966 b) show that among the American couples, the interval between births is generally longer among the high income groups as compared to the low income groups. If this finding is true of the Canadian childbearing pattern, the positive relationship shown by our data is quite likely to be maintained till the family size is completed. A similar view was expressed by Henripin (1972) who, in his study of Canadian fertility, found that the positive relationship was more consistent among women aged 25-29 as compared to those in the 35-39 and 45-49 age groups especially in the 45-49 age group. "The positive part played by income in encouraging fertility might be thought of as affecting the younger generation more particularly. This may be the case but a certain reservation should be formulated: it may be that lower income couples are more fertile than are high income couples, after the age of 40, thus compen-

sating at least partially for their sub-fertility prior to the age of 40. This would mean that the former would space out the birth of their children more, but would bear them over a longer period of time. This is rather improbable and would run counter to the results of a survey recently conducted by Ronald Freedman and Lolagene Coombs, among American couples. According to the survey, low income couples do not space out the births of their children as do couples with higher incomes. Moreover, it should be remembered that the twelve odd years of fertility left on the average to couples where the wife is between the ages of 35 and 40 do not readily compensate for the differences in fertility noted amongst women under the age of 40. The hypothesis stating that the positive part played by income is a good deal more notable amongst recent generations thus seems more than plausible" (Henripin, 1972 : 277-280).

Ontario and Quebec (Tables 6.5 and 6.6) generally followed the national pattern i.e., a weakening of the negative relationship and a reversal to a positive relationship. In Quebec, though the negative relationship weakened during 1941-61, the shift towards a positive relationship was not as pronounced as in Ontario. In Ontario, on the other hand, the weakening of the negative relationship as well as the shift towards a positive relationship was more prominent compared to either Canada or Quebec. In the 35-44 age group, in 1941, the relationship was negative in Canada and the two provinces. In 1961, in the same age group, the lowest income group continued to have the largest family size in both Canada and Quebec, however, in Ontario, it was the highest income group that had the largest family size. Again,

in the age group below 35 years in 1961, the family size of the highest income group was larger than that of the lowest income group by about 37% in Ontario, and the corresponding figures for Canada and Quebec were 23% and 18% respectively.

It is hard to explain the reasons for the weakening of the negative relationship and the emergence of a positive relationship. Banks (1954), in his study of the fertility decline among the English middle classes in the 1870's, observed that high motivation for a small family size was common among those families who aspired to reach the living standards set by the elites or the high income groups. In other words, the gap between the actual and the aspired levels of income served as a constraint or a check against having a larger family size. It follows that a narrowing of the gap between the actual and the aspired levels of income (or a reduction in the inequality of income) can weaken the motivation for a small family size, especially among the middle income groups. The question is whether the weakening of the negative relationship in Canada in the 35-44 age group during 1941-61 could be attributed to a reduction in the inequality of income. To answer this question we should know the rate of increase over time in income and in fertility in different income groups. Available evidence indicates that earnings (wages and salaries) were more equally distributed in 1951 than in 1930-31 (Goldberg and Podoluk, 1957: 1963). Income distributions during the postwar and prewar periods are not comparable. However, the general indications are that the lower and the lower-middle income groups had a greater share (compared to the upper income groups) of the increase in the aggregate income during

Table 6.7 Percentage distribution of wages and salaries, wage and salary earning families, Canada, 1930-31 and 1951.

Quintiles	Percentage share of wages and salaries	
	1930-31	1951
Lowest quintile	5.3	8.0
Second quintile	11.3	13.9
Third quintile	17.3	17.9
Fourth quintile	23.5	22.6
Highest quintile	42.6	37.5

Source: Simon A. Goldberg and Jenny R. Podoluk, "Income size and Distribution Statistics in Canada", Income and Wealth, Series VI, 1957, p. 163.

1941-51. We do not know whether the increase in fertility during the baby boom was higher in the middle income group, compared to the low and the high income groups. However, it is possible that with the reduction in the inequality of income during 1931-51, the gap between the actual and the aspired living standards was reduced and as a consequence, the middle income groups started having larger family size compared to what they used to have in the past. In other words, when the income differences among the income groups are reduced, family size in these income groups may also tend to converge thereby reducing the negative fertility differential. The arguement regarding the reduction in the inequality of income and its possible effect on family size can, perhaps,

explain the weakening of the negative relationship, but not the emergence of a positive relationship.

One of the explanations for the emergence of the positive relationship, often cited in demographic literature, is that the poor had large family size in the past not because they wanted it but because of inadequate knowledge about effective family planning methods. And once knowledge about contraception spreads to the low income groups also there is every chance of a positive relationship emerging. "The postwar diminishing of fertility differentials between socioeconomic groups may reflect decreasing differences between such groups with respect to the adoption of family limitation. It has seemed plausible as one aspect of the transition from a rural to an urban society that the effective use of methods to regulate conception would spread from higher - status to lower-status groups and from city to country. There is evidence that all major sectors of our population are being drawn toward a single urbanized society in which information and standards of behavior are quickly communicated throughout the social system. The eventual result of such developments may be that all major groups will adopt effective means for limiting family size, which will bring a large reduction of the fertility differentials that have been common in the Western world for more than a century. In the United States as in some European cities traditional fertility differences may be reversed, with higher-income groups having more children than lower-income groups because they can afford more children without sacrificing the other amenities of urban life" (Freedman et al. 1959: 101-102).

Cho et al. (1970) also found evidence for the reversal of the traditional inverse relationship in their study of the variations in fertility (completed family size as well as age specific fertility rates) with respect to income, education, rural-urban residence etc. "For the total population of native white women, we found the amazing results: fertility was directly related to income of husband; when controlled for education, differentials tended to increase, thereby showing a sharper direct relationship; and the positive relationship is sharper in urbanized areas than in rural areas. For the total Negro population, there was an inverse relationship with reversal at the highest income; and, in urban areas, there was evidence of a slight positive relationship for extremely low and high income groups, Northeastern Negroes showed a rather sharp (although not consistent) positive relationship, whereas Souther Negroes showed a sharp inverse relationship" (Cho et al. 1970: 293). These observations make it clear that the shift from an inverse to a positive relationship seems to start in particular segments of the population (e.g., Whites, urban population) and spreads to other segments of the population (e.g. Negroes, rural population). Differential access to contraceptive knowledge and service, changes in the economic value of children and in the relative economic cost of children etc. are some of the factors which, according to the authors (Cho et al. 1970), led to a change from the traditional inverse relationship to an "U" shaped curve and then to the positive relationship.

We can briefly summarize our findings in this chapter. We tried to analyze the differences in fmaily size according to the income

classes. Because of the lack of detailed statistics on family size and income, we had to use wages and earnings of the heads of the families (wage earning families) as a proxy for income. And for family size, we used the indicator, the number of unmarried children (among the wage earning families) less than age 25 and staying at home at the time of census enumeration, instead of the number of children ever born or living. Further, we could study the relationship between income and family size only in broad age groups. However, we found certain pattern in the relationship between income and family size during 1941-61. In Canada and the two provinces, there was a tendency for a weakening of the negative relationship as well as a shift toward a positive relationship. In 1961, the positive relationship was more consistent in the younger age groups as compared to the older age groups. The weakening of the inverse relationship and the emergence of a positive relationship was quite prominent in Ontario as compared to Canada or Quebec. These findings are in accord with those in the previous studies (Freedman et al. 1959; Cho et al. 1970). Spread of contraceptive knowledge and practice among the low income groups, changes in the cost of raising children (the increase in cost of children making it difficult for the poor to have a larger family size than the rich) are some of the factors that might have led to the reversal of the negative relationship.

C H A P T E R V I I

TIME SERIES, CROSS SECTION, MICRO AND MACRO RELATIONSHIPS: CERTAIN PROBLEMS OF INTERPRETATION

In the present chapter we will discuss a few problems of interpretation (of the relationship) that arise with different types of data.

In the preceding two chapters we discussed the relationship between income and fertility as shown respectively by the time series and the cross section data. The time series relationship was positive during 1926-57, and negative during 1958-64, while the cross section relationship changed from a negative to a positive relationship (although the relationship was not very consistent) during 1941-61. In other words the direction of the relationship was not the same in the cross section and the time series studies. Instances of positive time series relationship and negative cross section relationship were observed in previous studies as well (refer Chapter I). In the United States, in quite a few studies with different types of data, the direction of the relationship between fertility and income (or socio-economic status) was not the same: i) historically, in the United States as well as in other industrialized countries, fertility declined along with economic development implying thereby a negative long-term relationship between income and fertility; ii) time series studies generally showed a positive relationship between fertility and income (or other indicators of economic conditions); iii) cross section studies (using countries as units of

analysis or using data on individuals collected through sample surveys) generally showed an inverse relationship between fertility and income. We may note that the shift from a negative to a positive relationship, observed in the United States (Cho et al. 1970) is of recent origin. During 1935-40 there was an inverse relationship between fertility and socio-economic status, during 1945-50 the extent of the inverse relationship was very much reduced and in 1955-60 positive relationship became more prominent (Cho et al. 1970; 244-285).

Thomas drew attention to the difference in the direction of the relationship, when she observed, "With a more rapid pace of industrialization, improved transportation and communication, and urbanization, the sharp secular decline that occurred in births or fertility rates reflects primarily the operation of the neo-Malthusian preventive check. There is, moreover, evidence that the spread of small-family system, through effective use of contraception or other means of birth control, proceeded until very recent years from the more favored economic and social classes through the middle classes and penetrated much more slowly into the lower ecnomic and social ranges of the population. Thus, both secularly and structurally there has been a negative relationship between married fertility (or size of family) and income or level of living. At the same time, however, in most highly industrialized areas, positive relationships between business cycles and birth or general fertility rates have been observed, with a lag of a year or more" (Thomas, 1960: 258-259). The question is whether the cross section and time series data should show the same direction of relationship between fertility and income.

Closely related to the problem of discrepancy between the time series and cross section relationship, is the problem of consistency between the individual and the aggregate relationships. Decisions regarding family size are taken by individual households or families. Given certain relationship between macro variables such as, per capita income and mean family size during a period, the question is what can we say about the family decisions regarding fertility and income. If, for example, a doubling of per capita income results in a 50% increase in fertility (at the aggregate level), can we say that the individual family size on an average will increase by 50% if the income of the husband or of the family doubles? The problem here is essentially one of establishing consistency between the micro and the macro functional relationships.

Secondly, in economic studies, the difference in the elasticities of expenditure estimated from the cross section and the time series data is sometimes attributed to aggregation bias. In the words of Haavelmo, 'The elasticities of expenditure (for a group of consumer goods or for all consumer goods) with respect to income, as obtained from family-budget data, frequently differ quite considerably from those obtained from time series of per capita income and per capita expenditure (eliminating effects of changes in prices). Several explanations have been offered. They seem to run along two different lines, one leading to the conclusion that the problem is "merely a problem of aggregation", another to the somewhat negative result that cross section studies " have no meaning" ' (Haavelmo, 1947: 335).

We will not be able to discuss in detail all the aspects of the problems mentioned in the preceding paragraphs. We will point out a few situations where problems of interpretation of the relationship could arise when different types of data are used. The following paragraphs are intended to serve as a context or a framework within which the findings discussed in the preceding two chapters are to be understood.

Cross Section and Time Series Relationships: Specification Bias as a Result of Excluding an Independent Variable

Cross section and the time series relationships can be in opposite directions due to the omission of a relevant independent variable from the regression equations. Let us assume that fertility is influenced by both income and education. Using deviations from the mean, the true relationship can be expressed as:

$$y = \beta_1 x_1 + \beta_2 x_2 \quad \ldots \quad (6)$$

where,

y = Fertility (family size or total fertility rate)

x_1 = Income

x_2 = Education (number of years of schooling)

While estimating the relationship let education (x_2) be omitted. As a result we have:

$$y = b x_1 \quad \ldots \quad (7)$$

and $$b = \Sigma x_1 y / \Sigma x_1^2 \quad \ldots \quad (8)$$

Since y is influenced by both x_1 and x_2 we substitute (6) for y in (8):

$$b = (\beta_1 \Sigma x_1^2 + \beta_2 \Sigma x_1 x_2) / \Sigma x_1^2$$

$$= \beta_1 + \beta_2 \cdot \Sigma x_1 x_2 / \Sigma x_1^2 \quad \ldots \quad (9)$$

The bias in "b" as a result of excluding x_2 is given by the terms other than β_1 in (9). β_2 is a measure of the effect of the left out variable x_2 on the dependent variable y and $\Sigma x_1 x_2 / \Sigma x_1^2$ (which we will denote as auxiliary coefficient) refers to the comovements of the excluded and the included independent variables. In other words, when education is omitted, income captures the influence of education (on fertility) and the extent of this influence is determined by the auxiliary coefficient. If for example, income and education are unrelated (zero auxiliary coefficient) there is no bias in "b". Given certain relationship between education and income, in (7) we have the unconditional effect of income on fertility i.e., the direct as well as the indirect effect of income (through education) on fertility. In (6) on the other hand β_1 measures the conditional effect of income, that is, the effect of income on fertility given that education (x_2) is held constant.

We may note that the sign of "b" depends on the relative size and sign of the quantity $\beta_2 \cdot \alpha$, where, $\alpha = \Sigma x_1 x_2 / \Sigma x_1^2$ that is the auxiliary coefficient. Let us suppose that in (6) the effect of income on fertility is positive while that of education is negative. While estimating the income effect, we exclude, and equation (7) is fitted to time series and the cross section data. The cross section data consist of income inter-

vals and family size for each interval, while the time series data consist of average income and family size for a period of time. We know that education (number of years of schooling) influences fertility and income. In the cross section data (as compared to the time series data) the variability in education is likely to be greater. When the individuals or the families are classified according to income, it is quite likely that the mean number of years of schooling is greater in the high income groups than in the low income groups. In other words, the classification of individuals by income brings out the variability in education or the number of years of schooling. In time series data, on the other hand, the variability in the mean number of years of schooling (along with an increase in income over time) will be less. Because of this difference in the extent of variability, the auxiliary coefficient,'α' will be larger in cross section data. Given a positive income effect (+ β_1) and a negative effect ($-\beta_2$), a larger value of 'α' in cross section can result in 'b' having a negative sign in cross section and a positive sign in the time series relationship.

There are certain situations where specifying a relationship is more difficult in time series data than in cross section data. Instead of education we can consider other variables, such as, the opportunity cost of bearing and rearing children. Let us suppose that a woman who is capable of earning, say, \$5000 is less inclined to have an additional child compared to the other who can earn only \$ 500. In addition to this, the probability of having an additional child may be low in a family where the husband's income is low and the wife is capable of contributing substantially to the family income. In other words, the effect of opportunity cost (in our example the potential income of wife

may be more salient when the husband's income is less than what the couple would like to have. Specifying this relationship between fertility, opportunity cost and husband's income will be less difficult in the case of cross section data. In time series, with only per capita income (and not the distribution of families by income), it is difficult to specify this relationship and consequently some of the theoretically relevant variables have to be ignored.

We are not suggesting here any hypothesis regarding the relationship between fertility, income, education, opportunity cost etc., nor do we maintain that the income-fertility relationship is always negative in cross section and positive in time series data. What we have tried to show is that the way in which certain variables are operationalized (or quantified) may be such that the cross section and time series findings may not be consistent with respect to the magnitude and direction of relationship.

Before proceeding to the next section we may add that even if income is the only variable influencing fertility, the cross section and the time series studies need not necessarily show the same direction of relationship. For example, in cross section data the relationship will be negative if the poor have higher elasticity of demand for children as compared to the rich. Given a unit increase in income, the family size of the low income families will increase faster than that of the higher income families. So, at a point in time the poor will have a larger family size than the rich. The continuation of this negative relationship at successive points in time will depend on the

on the extent of the difference (between the rich and the poor) in elasticity and in the rate of increase in income over time. Similarly, if the high income families have higher elasticity of demand for children and an equal or higher rate of increase in income (compared to the poor) cross section relationship will be positive at successive points in time.

A time series relationship can be fitted to the mean values of income and family size at various points in time. We can see that there need be no correspondence between the slopes of the cross section and the time series equation. $\bar{x}$ and $\bar{y}$ can vary together over time, but at each point in time family size can be larger or smaller in the high or low income groups. Positive time series relationship per se does not indicate that high income groups have large family size. If the contributions to mean income are mainly from the rich and the contributions to the mean family size are mainly from the poor, negative cross section and a positive time series relationships are quite likely. Conversely, a negative time series relationship does not necessarily mean that the poor have large family size. What seems to be important is, given certain change in income, whether the rich and the poor experience differential rates of change in family size. These differential rates of change can be examined only in a longitudinal model, a model which combines the features of both time series and cross section data.

The Problem of Aggregation

Let us suppose that each individual's (or couple's) family size

(Y_i) is a linear function of income (X_i). For a group of individuals and over a specified period of time we have a set of such relationships and they can be expressed as follows:

$$\begin{aligned} Y_i &= a_i + b_i X_i \\ &\vdots \\ Y_N &= a_N + b_N X_N \end{aligned} \qquad \ldots \qquad (10)$$

where,

Y = Family size

X = Income

i = 1, 2, . . . N individuals or observations

t = 1, 2, . . . T years. For the sake of simplicity the subscript 't' is omitted.

The macro relationship for the same N individuals is:

$$Y_t = a + b X_t \qquad \ldots \qquad (11)$$

where,

Y = family size at the aggregate level

X = Income

t = 1, 2, . . . T years

The dependent macro variable, Y, can be predicted in two ways: a) from equation 11, let us call this Y', or b) estimate the dependent variable from the micro equation (equation 10) and aggregate them to get the macro dependent variable which can be denoted as Y''. The criterion of con-

sistency requires that the predicted dependent variables Y' and Y'' should be equal. 'Consistency means that a knowledge of the "macro-relation" . . . and of the values of the aggregate independent variable would lead to the same value of the aggregate dependent variable as a knowledge of the micro-relations and the values of the individual independent variables' (Green, 1964: 35). For consistent relationship (in terms of the predicted macro dependent variable) between these two equations (equations 10 and 11), we would expect that the macro intercept 'a' will equal the sum of the micro intercepts 'a_i' and the macro slope will equal the mean of the micro slopes. The difference, if any between 'a' and '$\Sigma\, a_i$' and that between 'b' and '$\sum_i b_i \cdot I/N$', is attributed to aggregation bias. In other words, because of the aggregation bias in the estimated parameters the predicted macro dependent variables Y' and Y'' can differ.

If we are given the micro functions there are certain ways in which these micro functions can be aggregated such that the macro parameters 'a' and 'b' are free from the aggregation bias (Brown 1970: 145-161). In practice we rarely have sufficient knowledge about the individual functions. We are given, for example, aggregate values of X and Y for several points in time. In other words we fit an equation to aggregate values rather than aggregating the individual functions. In such cases the estimated parameters can be biased. This aggregation bias in the parameters can be expressed, following Allen (1956: 694-722), as

$$a = \sum_i a_i + \sum_i b_i A_i = \sum_i a_i + N \text{ cov } (b_i A_i) \quad . \ . \ . \quad (12)$$

$$b = \sum_i b_i B_i = \bar{b} + N \text{ cov } (b_i B_i) \quad . \ . \ . \quad (13)$$

where,

i) $\bar{b} = \sum_i b_i \cdot I/N$

ii) A_i and B_i are from the auxiliary equation:

$$X_{it} = A_i B_i X_t$$

where,

a) $i = 1, 2, \ldots N$ individuals.

b) $t = 1, 2, \ldots T$ years.

c) X_i= Individual income.

and d) $X_t = \sum_i X_{it}$.

In equations 12 and 13, the non-corresponding terms, cov($b_i A_i$) and cov ($b_i B_i$) contribute to the aggregation bias. To eliminate aggregation bias either of two conditions is necessary. One is that the income distribution is constant over time i.e., the proportionate changes over time in X_t are the same for X_i ($i = 1, 2 \ldots N$).The alternative condition which is quite unlikely, is that the micro slopes, b_is, are all equal. Generally, systematic changes in income (e.g., income changes widely among certain subgroups of population having atypical elasticity of demand for children) can result in an under - or over estimation of the macro slope, as compared to the mean of the micro slopes.

To summarize our discussion in this chapter, the cross section and the time series relationships (between fertility and income) can be

in opposite direction due to the misspecification (i.e., omission of an independent variable from the equation) of the equation. Secondly, even if we assume that only income (and no other variable) influences fertility, the cross section and the time series relationships need not necessarily be in the same direction. Cross section relationship (distribution of family size according to income intervals) at specific points in time can be considered as a function of the rates of change, in the past, in family size and income among the rich and the poor. On the other hand the time series relationship perse does not indicate whether the rich and the poor experience differential rates of change in family size and income. So, from the time series relationship alone it is difficult to predict the direction of the cross section relationship. Thirdly, due to aggregation bias the macro slope can over- or under estimate the mean of the micro slopes. As a result, certain problems of inference arise when the levels of explanation are different from the levels of observations (Goldscheider, 1971: 31). Decisions regarding family size are taken at the household or family level. However, from the macro (time series) relationship alone, it is rather difficult to understand the motives behind certain changes in the individual family size on an average (particularly during 1958-64 for which the time series data showed a negative relationship between fertility and income). Further, there can be large differences in the predicted family size (using micro or macro data) or fertility, if the aggregation bias is substantial.

If the micro relationship is considered the theoretical or true relationship, cross section and time series analyses constitute different approaches that are available for understanding the individual or

micro relationship. How to combine different sources of data in such a way that the true relationship can be identified, is really a problem. ' In fact the three basic problems that econometricians have recently faced - the identification problem, the aggregation problem, and the relationship of cross section and time series data - are all illustrations of one single problem which still awaits adequate formulation: the problem of combining different kinds of knowledge and different sources of data in a manner which is consistent as well as efficient' (Chipman, 1957: 234-35).

CHAPTER VIII

SUMMARY AND IMPLICATIONS

We can briefly summarize the discussion so far and examine the implications of this study for the understanding of the reproductive behaviour.

A cost-utility model seems to be a useful framework for investigating the relationship between fertility and socioeconomic factors. However, the classical formulation of rational behaviour, implied in the cost-utility model, prescribes certain assumptions which are extremely unrealistic. Following Simon (1957) we have suggested certain modifications. An individual may not be able to order the expected pay offs (from his decision) from - 1 to + 1, but he will be able to choose a favourable course of action as against an unfavourable one. Secondly, the process of searching for a desired outcome, given several courses of action, is crude to start with but may become more and more refined at successive attempts. Thirdly, the individual need not examine all the possible alternatives before making a choice, but they may be examined sequentially i.e., the first satisfactory alternative may be chosen.

Cost and utility are considered as both economic and non-ecnomic in nature. Decisions regarding family size are generally based on the process of comparing the cost and the utility of bearing and rearing children. The main advantage of this model is that it serves as a link between family decisions on the one hand and certain global variables

like urbanization, industrialization etc. on the other. These variables have certain effects on the cost and utility of having children which in turn influence the decisions regarding the number of children a family can have. Fertility differentials by income, education, occupation, rural-urban residence etc. are more meaningful if they are examined within this framework.

Even the modified model may not give a good "fit" to all types of individual behaviour. While comparing different classes of people or different societies, the cost-utility framework is meaningful only in terms of the social, psychological, economic and technological environment prevalent among people at specific points in time. Preindustrial societies used different methods to keep the population size within certain limits (Douglas, 1966). Pelly Bay Eskimos practised female infanticide and the Nambudiri Brahmins of India allowed only their eldest sons to marry. From a modern man's point of view, these methods of controlling population are by no means the best or the most efficient, but they seem to have served certain functions to the society in keeping with the technology and the value systems prevalent at that point in time. We may note that the Pelly Bay Eskimos tried to control their population for the sake of physical survival, while the Nambudiri Brahmins did so in order to maintain certain social and economic advantage. The relative advantages and disadvantages of taking certain course of action are perceived in the context of certain factors like physical survival, social status and prestige, scope for social and economic mobility etc. which vary from time to time and differ among individuals. The cost-utility model will break down if changes in these factors are

not taken into consideration.

The major findings of our study can be broadly divided into three parts. First, we examined the relationship between fertility and income in Canada using both time series and cross section data. Secondly, we have shown certain similarities and differences in the income-fertility relationships in Ontario and Quebec. These two provinces differ from each other with respect to religion, ethnicity and standard of living. Thirdly, we discussed some methodolgical problems that arise in comparing the time series, cross section, micro and the macro relationships.

During 1926-65 there were significant changes in fertility and family formation in Canada. After a decline till about 1936, fertility rates (especially in the younger age groups) started picking up and reached high levels. This spurt in births, generally called the baby boom, lasted for about two decades. After 1959, fertility rates started declining.

For the time series relationship, fertility rates, lagged by one year, were regressed on personal per capita real income. During 1926-57 the relationship was generally positive. The younger age groups (15-29) showed high positive correlations during 1926-39 and 1946-57, but not during 1940-45. During 1940-45, the 35-39 age group in Canada and Ontario showed high positive correlation which could be attributed to the recovery of births (and the consequent increase in births during a period of rising income) postponed at the time of depression. There was an increase in the completed family size of the recent cohorts (i.e. those born during 1912 - 16 and later). In Canada and the two provinces, when the younger

cohorts started replacing the older ones, early childbearing became more prominent. During 1958-64 the relationship between fertility and income was negative. With the available data it is difficult to explain this negative relationship. It may be that the effect of certain variables on fertility, operating at the micro or household level, did not show up in the aggregate data used in our analysis. We discussed some possible ways in which the decision making process at the household level can be examined. Changes over time in the cost of children (relative to changes in income), the extent to which certain factors such as, travel, leisure, summer home etc. (which may constitute an important part of the standard living) serve as substitutes for children, are some of the variables that require further study.

For analysing the cross section relationship we used the census data on the number of unmarried children (less than age 25) staying at home, and the earnings of the family. During 1941-61 there was a tendency towards a shift from a negative to a positive relationship between family size and income.

Many of the findings for the country as a whole are applicable to Ontario and Quebec as well. However, there are certain differences between these two provinces in fertility trends and in the extent of the income effect on fertility. In 1926, total fertility rate in Quebec was about 58% higher than that of Ontario, but in 1965 it was 4% less. The increase in births during the period of the baby boom was quite substantial in Ontario as compared to Quebec. For example, during 1937-59, total fertility rate in Ontario rose by about 75% as

against 20% in Quebec. Similarly, the increase in the completed family size of particular cohorts was quite substantial in Ontario, while it was relatively less in Quebec. For example, the increase in the completed family size of the 1917-21 cohort (compared to that of the 1907-11 cohort) was 19% in Ontario and 4% in Quebec. In each of the four cohorts (1907-11, 1912-16, 1917-21 and 1922-26) the concentration of births in the younger age groups was greater in Ontario than in Quebec. However, over time (1922-26 cohorts compared to the 1907-11 cohort) the shift towards a younger age at childbearing was relatively more prominent in Quebec than in Ontario. The cross section data showed that there was a weakening of the negative relationship between family size and income, in Ontario and Quebec. However, the shift towards a positive relationship was more pronounced in Ontario than in Quebec.

We discussed some problems in interpreting the relationship, that arise with different types of data. Time series and the cross section relationships can be in opposite direction due to specification bias (i.e., omission of a relevant independent variable from the regression equations). If we consider only income and fertility, the direction of the relationship in the cross section and time series studies need not necessarily be the same. The cross section relationship (distribution of families according to income and family size) at specific points in time, can be considered as the function of the rates of change in the past in income and family size among the rich and the poor. Time series relationship (using mean income and mean family size) shows the relative changes in income and family size for the total population, and not the differential rates of change in

income and family size for the rich and the poor. So it is difficult to predict the cross section relationship from time series relationship or vice versa.

Decisions regarding family size are taken at the individual or family level. But from the macro (time series) relationship alone, it is difficult to understand the whole complex of motives behind certain changes in the individual family size on an average. There can be large differences in the predicted family size (using micro and macro data) if the aggregation bias is substantial. For example, we may find (from the macro relationship) that the family size increases by 50% if the per capita income doubles. However, it does not necessarily follow that the individual family size on an average will increase by 50% if the income of the husband or of the family doubles.

If the individual relationship (i.e., the way in which the decision regarding family size at the household level is influenced by certain variables) is considered as the theoretical or true relationship, cross section and time series analyses constitute different approaches that are available for understanding the individual relationship. How to combine different sources of data in such a way that the true relationship can be identified is really a problem (Chipman, 1957).

We will make a few observations regarding the implications of this study for our understanding of the reproductive behaviour and for further research.

It seems that it is not always safe to predict the future trends in fertility on the basis of the macro time series relationship. For example, if we had used the relationship between fertility and income during 1946 - 57 in order to predict fertility rates in the 1960's, we would have been wrong. Similar arguement applies to other variables as well. It is believed that with increasing urbanization and industrialization, fertility should decrease in the underdeveloped countries. The implicit assumption here is that urbanization or industrialization induce changes in the expected direction in a number of intermediate variables which in turn bring pressure on individual families to reduce the family size. The complex of motives that determine the individual family size cannot be understood adequately from the aggregate relationship alone. Whether it is prediction or explanation, the assumption of a direct relationship between the macro and the micro variables may not be always valid. We do not argue that only micro variables are useful. The point we want to stress is that there are certain problems, that arise out of the type of data used and the nature of our explanation and which we have to take into consideration while predicting or explaining certain phenomena. These problems are best described by Goldscheider, "When we make macro-observations and employ macroexplanations, we often fail to make empirical connections between what is observed and the interpretation of these observations; when observations and explanations remain at the micro level, we often fail to note the larger implications of our analysis; when macro-observations are tied to micro explanation, we often end up unduely stretching an index; when micro-observations and macroexplanations are combined, we often

falsely concretize our concepts. When the level of observation is different from the level of explanation, we also fail to establish logical connections between what we observe and how it is explained" (1971: 160-61).

The change from a negative to a positive relationship between income and family size as indicated by the cross section data is interesting. Cho et al. (1970), in their study of differential fertility in the United States, found certain pattern in the shift towards a positive relationship. For example, positive relationship was more pronounced among the White population as compared to the Negroes and in the urban areas as compared to the rural areas. It is suggested by the authors that these patterns of differential fertility are in a way related to the stages in demographic transition reached by a population at certain points in time. In the early transitional population (high fertility and declining mortality) one could expect an incipient form of inverse relationship between fertility and socioeconomic status. At this stage, urbanization and industrialization were slowly changing the traditional social structure. Literacry was improving and access to contraceptive knowledge was limited to a small section of the population. Children might still be a source of future income. The late transitional population (declining fertility and low mortality) was characterised by continued progress in literacy and education, increasing female participation in the labour force, rising per capita income, greater access to contraceptive knowledge etc. As a result, the economic value of children and the ability to "afford" them would differ among the various subgroups of population. Consequently, the inverse

relationship may give way to a "U" shaped relationship. That is, high and low income groups would have larger family size as compared to the middle income groups. In the post-transitional population (low fertility and low mortality) children, as a result of more expensive and longer periods of education, lose much of their economic utility to the parents and become "consumer goods". This may lead to a direct relationship between family size and socioeconomic status.

While discussing the more consistent positive relationship among the Whites as compared to the Negroes, the authors aboserve, "In terms of the distance travelled toward the completion of the demographic transition, the American Negro population has yet to go a substantial distance; therefore, it still shows, to a large extent, the famili inverse relationship between economic status and fertility, although the reversals of the inverse relationship can be seen in urban areas. Nevertheless, as Negroes improve their standard of living and become more urban, it is very likely that they will show a pattern of differential fertility similar to that of White fertility differentials in the recent period" (Cho et al.1970: 284-85).

What is important here is not exactly the stages in demographic transition, but the changes over time and differnces (among subgroups of a population) in various factors like the economic utility and cost of children, prevalence of higher standard of living, scope for social and economic mobility etc. We observed (Chapter VI) that in Ontario the positive relationship was more consistent among the younger cohorts as compared to the older ones. The shift towards a postive relationship

was not as pronounced in Quebec as in Ontario. Perhaps, in due course, a consistent positive relationship may emerge in Quebec as well. It would be of interest to see whether a similar pattern can be observed in the case of fertility differentials by occupation, education and by rural-urban residence. Using census data we can examine whether the variations in differential fertility among certain provinces and over time follow any pattern.

Not much is known about the short term and the long term effect of income on fertility. Generally, it is assumed that fertility at time 't' is influenced by income at time 't-1'. It is quite likely that fertility is influenced by income at time t-1, t-2, t-3, . . . etc. This can be expressed as follows:

$$Y_t = \alpha_1 X_{t-1} + \alpha_2 X_{t-2} \cdots \alpha_h X_{t-h}$$

'Y' may be considered as fertility and 'X' as income. The value of the coefficient 'α' at time t-1, t-2, . . . etc. may decline over time and reach zero beyond certain number of years. These coefficients can be considered as the short term effect of income on fertility. However, fertility at time 't' is subject to the long run (sum of the short run coefficients 'α_r' for r years) effect of changes in income. In other words, the decisions regarding family size at a point in time are influenced by changes in income during the 'r' years.

Some of the reasons for these lagged reactions (of fertility to the changes in the economic conditions) are the imperfect knowledge

of the economic situation and the psychological inertia on the part of the people. For example, it may take some time for a rise in the gross national income or industrial production before its effect is felt on the standard of living of the individuals or families. Further, the realization of a higher standard of living or better economic condition may not necessarily lead to an immediate adjustment in family size. The usual assumption of one year lag for fertility takes into consideration only the gestation period and the time taken to conceive. But, the decision regarding a change in family size certainly involves an element of time. These decisions may not follow immediately the change in the economic conditions. The couple may decide to wait and see.

Continued prosperity may be perceived by the couples as an indicator of a probable increase in future income which can be an important element in the decisions regarding the size of the family. On the other hand, a sudden rise in income in a particular year may not lead to such an optimism. Perception of the changes in the economic conditions and the time taken to react to these changes may very well vary from one population to another and among different cohorts. The lag structure or the time profile of the reaction coefficients can also differ according to the order of birth. First births, as compared to higher order births, may respond more readily to short term changes in income. In a way the distributed lag analysis can add a new dimension to the relationship between income and fertility.

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APPENDIX A

Table A1 Personal per capita real income (1926-64), total fertility rate (1927-65) and migration (1926-64), Canada.

Year	Income ($)	Total fertility rate	Immig-ration ('000)	Emigr-ation ('000)
1926	593	3319	136	87
1927	620	3294	159	95
1928	649	3217	167	100
1929	636	3282	165	101
1930	594	3200	105	66
1931	533	3084	28	14
1932	476	2864	21	27
1933	452	2803	14	20
1934	497	2755	12	25
1935	521	2696	11	22
1936	536	2646	12	25
1937	583	2701	15	20
1938	576	2654	17	26
1939	606	2766	17	24
1940	658	2832	11	22
1941	707	2964	9	12
1942	828	3041	8	22
1943	848	3010	9	28
1944	904	3018	13	45
1945	915	3374	23	17
1946	933	3595	72	38
1947	896	3441	64	46
1948	895	3456	125	66
1949	881	3455	95	77
1950	895	3503	74	59
1951	927	3641	194	42
1952	950	3721	164	36
1953	974	3828	169	36
1954	937	3831	154	35
1955	980	3858	110	40
1956	1038	3925	165	51
1957	1026	3880	282	60
1958	1046	3935	125	49
1959	1055	3895	107	54
1960	1069	3840	104	61
1961	1079	3756	72	65
1962	1135	3669	75	68
1963	1168	3502	93	88
1964	1193	3145	113	32

Source : DBS, Vital Statistics Reports & National Accounts Reports
Dpt. of Citizenship & Immigration, Immigration Statistics

Table A2 Personal per capita real income (1926-64) and total fertility rate (1927-65), Ontario.

Year	Income ($)	Total fertility rate
1926	676	2702
1927	712	2704
1928	749	2667
1929	777	2748
1930	733	2648
1931	682	2530
1932	598	2369
1933	578	2286
1934	631	2276
1935	659	2219
1936	672	2161
1937	729	2273
1938	717	2202
1939	750	2316
1940	826	2403
1941	911	2505
1942	982	2591
1943	1034	2474
1944	1057	2469
1945	1092	2970
1946	1062	3277
1947	1028	3097
1948	1019	3110
1949	1041	3111
1950	1072	3222
1951	1073	3406
1952	1097	3539
1953	1134	3667
1954	1110	3732
1955	1156	3657
1956	1191	3714
1957	1213	3680
1958	1227	3773
1959	1234	3793
1960	1236	3742
1961	1251	3689
1962	1294	3618
1963	1343	3475
1964	1374	3125

Source : DBS, Vital Statistics Reports & National Accounts Reports.

Table A3 Personal per capita real income (1926-64) and total fertility rate (1927-65), Quebec.

Year	Income ($)	Total fertility rate
1926	504	4266
1927	527	4195
1928	558	4010
1929	580	4059
1930	544	4001
1931	508	3804
1932	446	3502
1933	424	3441
1934	459	3369
1935	472	3364
1936	493	3268
1937	526	3261
1938	511	3211
1939	529	3287
1940	561	3389
1941	609	3529
1942	664	3571
1943	706	3643
1944	719	3666
1945	735	3832
1946	758	3896
1947	762	3805
1948	753	3797
1949	741	3812
1950	769	3775
1951	766	3861
1952	791	3877
1953	833	3944
1954	833	3904
1955	833	3904
1956	877	4001
1957	887	3938
1958	902	3928
1959	905	3764
1960	921	3700
1961	962	3578
1962	996	3473
1963	1018	3333
1964	1062	2996

Source : DBS, Vital Statistics Reports & National Accounts Reports.

APPENDIX B

A. Fertility,Marriage, Income and Unemployment

The influence of income on fertility may be direct, or indirect through the changes in the proportion married. In Chapter IV, we mentioned that the change in age specific fertility rates consists of two components: fertility component (i.e., change in age specific marital fertility) and the marriage component (change in the age specific fertility rate due to the changes in the proportion of women getting married and giving birth). The influence of income on the fertility and the marriage components can be called the direct and indirect effects of income on fertility respectively.

Generally, the direct and the indirect effects of income are examined through partial correlations, i.e., what is the effect of income, for example, on fertility, controlled for marriage. Ideally it would be desirable to calculate two sets of correlation: i) income and age specific marital fertility, ii) income and age specific fertility. A comparison of these two sets of correlation can reveal the possible influence of income on the fertility and the marriage components separately. In Canada, data on age specific marital fertility rates for single years are not available except for 1961 and later. As an alternative, an index of marriage was used in the equation along with fertility and income. So, the equation consisted of three variables: total fertility rates, per capita personal income and marriage rates (number of marriages per 1000 women in the 15-44 age group). The correlation between total fertility rate and the marriage rate was about + 0.12 and the correlation between income and marriage rate was + 0.41. The coefficient of determination was 0.72 for income and fertility, and it increased to 0.78 when the third variable, marriage rates was included. In other words, the

gain in the explained variation was very little by including the marriage rates.

However, the low correlation between fertility and marriage rate does not mean that marriage does not influence fertility. The low correlation could be due to the type of indicator used for marriage. We used the number of marriages per 1000 women of all marital status (single, married, widowed, and the divorced). Perhaps the number of marriages per 1000 single women would have been more meaningful. Secondly, the relationship between marriage and fertility need not necessarily show up when we correlate the time series of fertility and marriage rates. In the time series correlation, fertility at time 't' is considered to be related to marriages that took place at 't' or 't-1'. However, fertility rate at 't' can be influenced by marriages that took place before 't-1' ie., t-2, t-3 . . . etc. In a statistical sense, the variable, marriage rate did not serve any useful function in the regression equation and so it was dropped.

Similarly, income could explain a greater proportion of variation in fertility than unemployment rates. The coefficient of determination was 0.72 for income and fertility, and it increased to 0.79 when unemployment rates were included.

Changing the period of analysis (separate equation for the prewar and the postwar periods) or using different indicators (like age at marriage instead of marriage rates) did not change the relationship very much. So, it was decided to use only income as the independent variable.

B. Fitting a Trend Line

When the purpose of fitting a trend line is to isolate the cycles or oscillations, the fitted trend line should pass through the center of the cycles (Yule and Kendall, 1950). Following Kirk (1960), we assumed that national income grows at a constant rate of increase. So, a straight line to the logarithm of per capita income can be fitted. For our data a straight line to the logarithm of per capita income gave a reasonably good fit. However, for fertility data it was difficult to select a good trend. Second degree curve and moving averages (3, 5, and 7 year moving averages) gave a trend that was so close to the original data that by eliminating the trend most of the variations in the original data would have been eliminated. The trend line fitted through a 15 year moving average was slightly better. But in the case of the 15 year moving average we would be losing 14 observations. Further, the deviations from the fitted trend showed significant autocorrelation. Hence it was decided to use the original data in the equation and transform the data, wherever necessary, in order to reduce the extent of autocorrelation.

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