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A MULTIVARIATE ANALYSIS OF 1971 CANADIAN CENSUS FERTILITY DATA

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Résumé — Bien que les données de recensement soient moins qu'adéquates pour l'analyse causale, cette étude essaie de mettre à l'épreuve un modèle de voie brute avec le nombre limité de variables disponibles dans les bandes d'échantillon d'un pour cent. En sélectionnant toutes les femmes déjà mariées âgées de 15 ans et plus, l'influence de divers facteurs sur les enfants déjà nés est examinée. Des caractères primaires attribuables comme la religion, l'éthnicité, et la nativité sont considérés comme des variables exogènes et les caractères acquis comme l'éducation, le revenu et la condition de travail, comme des variables endogènes. On a constaté que les caractères attribuables ont une influence considérable qui leur est propre sur la fécondité et sont plus importants dans le cas des femmes plus âgées. Dans le cas des femmes moins âgées, les caractères acquis ont plus d'importance en ce qui concerne la fécondité. Ceci peut indiquer une tendance où le comportement en fécondité est influencé moins par les valeurs et normes traditionnelles et davantage par les désirs individuels et les contraintes du revenu et les frais de la grossesse.

Abstract — Though census data are less than adequate for causal analysis, this paper attempts to test a crude path model with the limited number of variables available in the one per cent sample tapes. Selecting all ever-married women 15 years and older, the influence of various factors on children ever born are examined. Primary ascribed characteristics such as religion, ethnicity and nativity are treated as exogenous variables and achieved characteristics such as education, income and work status as endogenous variables. It is found that ascribed characteristics have a considerable influence of their own on fertility and are more important for older women. For younger women, achieved characteristics have greater significance on fertility. This may indicate a trend where fertility behaviour is less influenced by traditional values and norms and more by individual desires and constraints of income and costs of childbearing.

Key Words — **children ever born, socio-economic factors, multiple classification analysis, path diagrams**

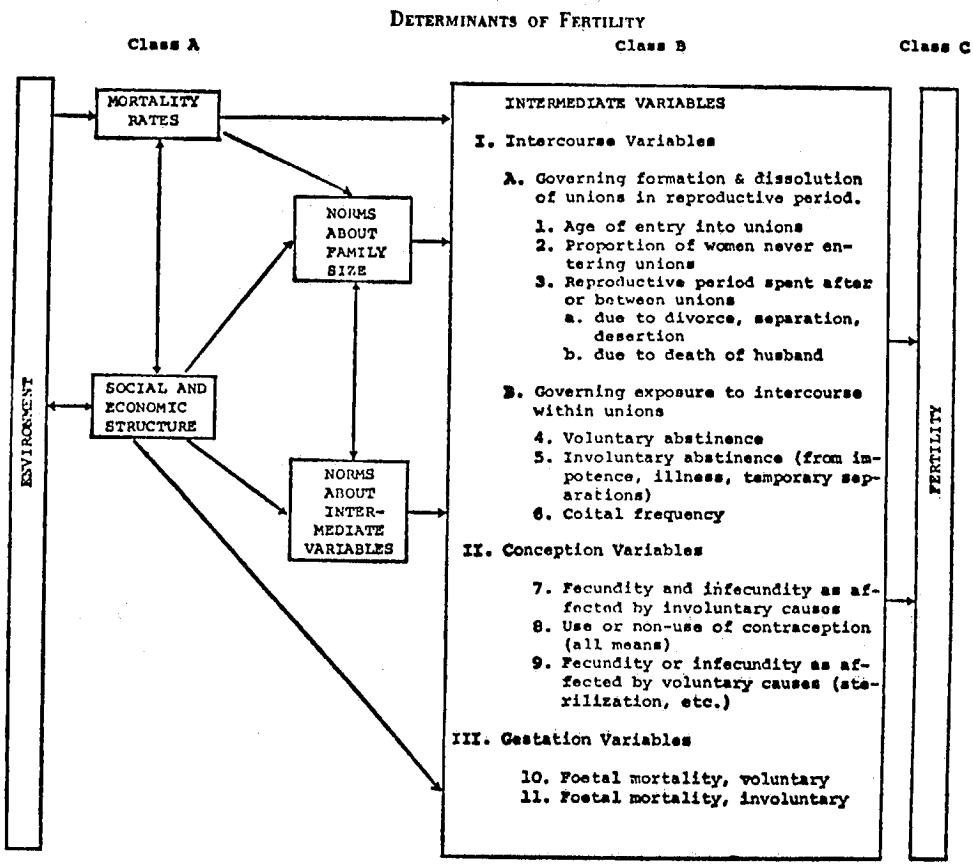
Introduction

Fertility trends in Canada have followed the patterns of most other industrialized countries in the last two decades. The baby boom of the fifties was followed by declining birth rates which are presently at all time lows. Though the advent of the pill and other effective contraception play a part, the major causes for the decline are to be found in basic social change such as liberalization of abortion laws, increasing secularization, changing roles of women, and higher educational attainment. The factors determining childbearing ideals and desires have probably undergone a shift in emphasis. This study is an attempt to investigate the relationship between fertility and other factors in Canada, using data collected in the 1971 census on children ever born to women, and other demographic and socio-economic characteristics.

The large number of antecedent factors, and the complex nature of causation in reproductive behaviour led to major attempts at developing frameworks which would encompass all relevant variables (Davis and Blake, 1956; Freedman, 1962). These attempts,

made almost two decades ago have served as starting points for the derivation and testing of a variety of specific hypotheses by later researchers. Davis and Blake (1956) provided a useful classification of *intermediate variables* which stand between social organization and social norms on the one hand and fertility on the other. These include variables such as age at entry into unions, extent of celibacy and periods of exposure to risk, contraceptive use, extent of infecundity and the practise of abortion. In their model the fertility of any social collectivity tends to correspond with a level prescribed by social norms. The effect of the intermediate variables is to produce the normative reproductive level. In a transitional society many of these variables take on a dynamic character. Freedman (1962) extended the taxonomy to variables which influence the intermediate variables. These included stratification variables such as occupation, income and education, family structure variables, technological factors, non-familial institutions and other characteristics of social and economic organizations.

A convenient visual representation of the taxonomy of determinants is provided by Yaukey (1969) and reproduced here (Figure 1). Yaukey points out that fertility research has focussed primarily on the relationships between Class A and Class C variables and



Source: Yaukey (1969), page 101.

FIGURE 1 DETERMINANTS OF FERTILITY

that what is needed is more research on the interrelationships between Class A and Class B variables and between Class B and Class C variables. Whatever the taxonomy, it is clear that a comprehensive framework for fertility research has to include four major factors: demographic and biological factors; psychological factors; contraceptive factors; and socio-economic structural factors. While recognizing the influence of this large number of factors, most studies understandably have concentrated on a very small part of the whole. Our own attempt will be determined on the basis of mainly demographic and socio-economic variables available in the census.

Societies differ in group structural characteristics such as religion, ethnicity, mother tongue, rural/urban composition, educational and labour force composition, occupational and income distributions. Membership along these characteristics place people in distinct social groups with different motives, aspirations, family size ideals and desires, norms and abilities to control fertility. While contraception is a means to an end, and many psychological factors are intermediate variables, these ascribed and achieved characteristics arising from membership in a society may well be treated as the basic independent or antecedent factors of reproductive behaviour.

General Model

The model to be used in the current study is mainly determined by the type of data available on individual women in the one per cent public use sample tapes of the 1971 Canadian census. These are basically socio-economic characteristics and demographic variables such as age at time of the census and age at first marriage. The nature of census data does not enable one to test a complete causal model adequately. Most of the variables are measured at the time of the census only and do not refer to retrospective periods necessarily. Thus, type of residence, income and extent of work are specific to the time of census taking, whereas retrospective information on these variables would have been more important in establishing a cause-effect relation with fertility behaviour. In contrast religious or ethnic background rarely changes over one's life time.

Figure 2 is a schematic representation of the variables in a loosely arranged causal sequence using the information available from the census. The arrangement is based on the following logic. The exogenous variables on the left are largely ascribed characteristics, determined mainly before the beginning of adult life. While this is true of ethnicity, place of birth and mother tongue, religious affiliation may change though the probability is rather small. Type of residence is measured as of the census date and is only a crude approximation of life time or childhood experience of a rural or urban way of living. The model specifies that these ascribed variables not only influence achieved characteristics

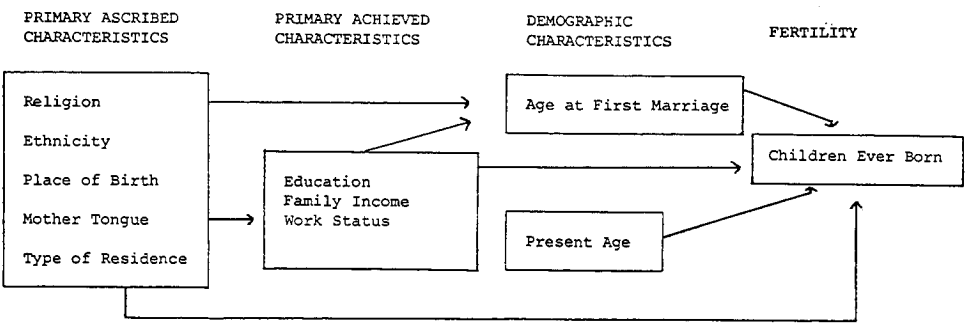


FIGURE 2 SCHEMATIC REPRESENTATION OF DETERMINANTS OF FERTILITY

shown in the next box, but also age at marriage, and children ever born directly. For example a woman's religious background can influence her education and age at marriage and also have a direct effect on her fertility behaviour (Goldscheider, 1971). Fertility differences by ethnicity, place of birth, mother tongue and type of residence, even when some of the other factors were controlled, are generally observed.

The achieved characteristics should not be strictly seen as *intermediate* variables comparable to the ones specified in the earlier conceptual schemes. They are rather seen as at least partially influenced by the designated exogenous variables. Our preliminary analysis has shown that these factors have strong relationships to fertility (Balakrishnan, Ebanks, and Grindstaff, 1979). Education and work experience are the two most important correlated variables with fertility, especially among younger women. Of course their relationships to childbearing are complex and operate in turn through other *intermediate* variables such as norms about family size, non-family-centred activities, life expectations and conflicting roles (Westoff and Ryder, 1977) — something that cannot be investigated with the census data. Thus these variables in the causal chain are missing. It is hypothesized that the achieved characteristics of education, income, and work status will have an independent effect on fertility beyond that which can be attributed to the ascribed characteristics such as religion, ethnicity and mother tongue. One should, however, emphasize that our interest is in explaining variations in fertility and not so much the variations in the so called achieved characteristics.

Age at marriage is shown as an *intervening* variable between the above mentioned factors and fertility. When present age is controlled, age at marriage has a very strong relationship to number of children ever born. The later the age at marriage the lower the fertility in general (Balakrishnan, Ebanks, and Grindstaff, 1979). This is not only due to shortened duration and such biological factors as lower fecundity at later ages, but common causal factors with fertility such as education, type of residence or work status.

Present age, the age at time of census, is an important independent variable as it has the highest association with fertility in many studies (Balakrishnan, Kantner and Allingham, 1975; Krishnan and Krotki, 1976; Henripin, 1972). It obviously is not dependent on any of the other characteristics. Its importance is more as a control variable in assessing the influence of other factors on fertility.

Specific Path Models

From the general schematic representation presented in Figure 2, more specific path models can be formulated. A more inclusive model is shown in Figure 3. The paths are hypothesized not only on what we already know from various other studies done in Canada and elsewhere but also from the insights gained from tabular analysis of the data. The direction of expected causations is indicated by the arrows. Thus age at first marriage is hypothesized to be influenced by religion, type of residence, ethnicity, mother tongue and education. Education is positively related to age at marriage. Rural persons marry somewhat earlier than their urban counterparts and French Canadians traditionally marry at a slightly later age than English Canadians.

All of the five ascribed characteristics are hypothesized to influence education. Certain religious groups may put a greater emphasis on education, such as certain Protestant sects or Jews. Education, especially at university level, may not have the same appeal to rural residents as urban residents. Nativity may be related because of differences in emphasis on the value of education in various cultures across the world. Ethnicity and mother tongue have also been found to be related to educational aspirations and achievement.

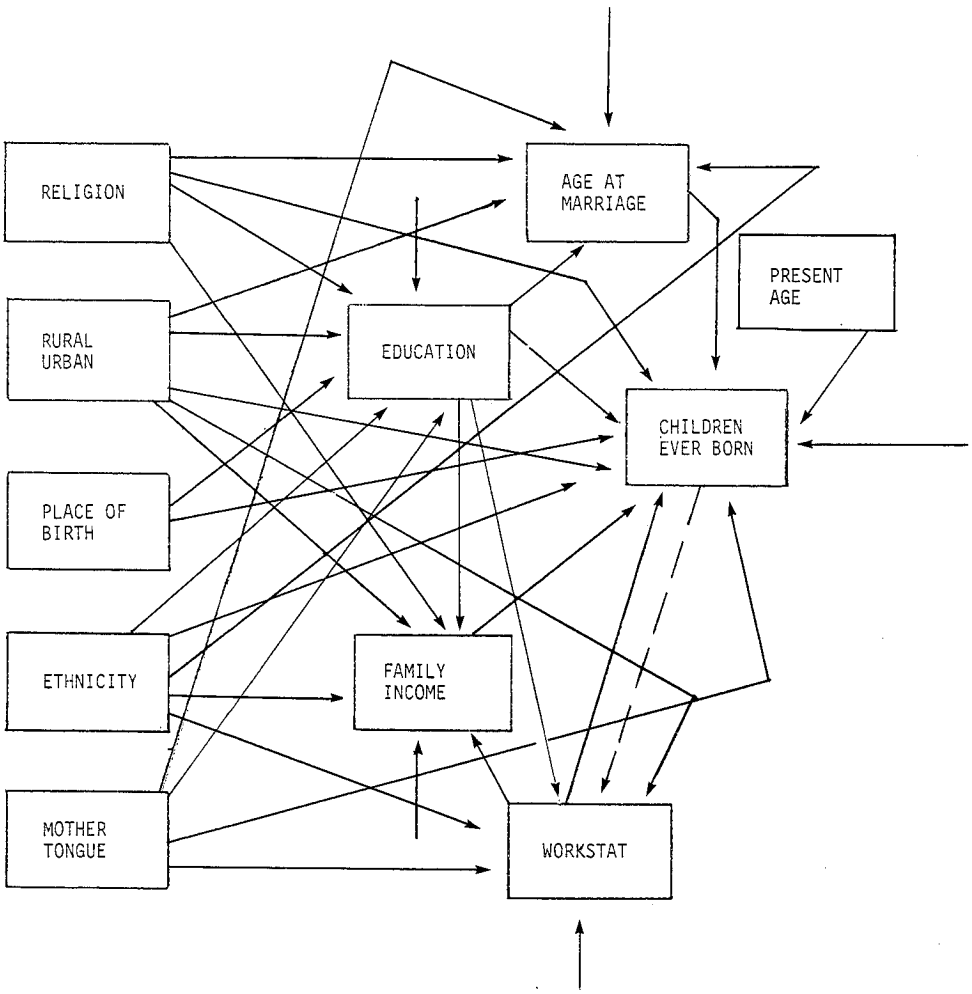


FIGURE 3 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

In the case of family income, wife's labour force participation, education and type of residence clearly should have a strong influence and to a lesser extent, it is hypothesized that religion and ethnicity may also influence family income. Wife's work experience is hypothesized to be largely influenced by type of residence and education and to a lesser degree by ethnicity and mother tongue.

Though present age may be correlated with some of the other variables it is obviously not dependent on them in any causal sequence. However, since its influence on fertility through marriage duration is overwhelming, it is important to introduce it into the model. The model is also tested separately for each age cohort. All the variables are hypothesized to affect children ever born with varying degrees of importance.

For simplicity we have treated the model as nonrecursive, something that can be questioned especially in the case of work status. Older women may go back to work after childbearing. While aware of this problem, due to the lack of specific work and reproductive history, it is impossible to investigate the work/fertility relationship in a cause/effect framework. The arrow in one direction only, from work status to children ever born, is justified under the assumption that work experience in 1970 to 1971 is likely to be correlated highly with earlier work experience. It is also felt that the path from work status to children ever born is more important than the reverse path. Our analysis is deficient to the extent this and other feedback loops are significant.

Data and Methods

The analysis in this paper is based on the one per cent sample tapes on individuals constructed from the 1971 Canadian census and hence is naturally restricted to the variables available in these tapes and to the limitations of these sample tapes. The variables selected are: age of woman, age at first marriage, children ever born, type of residence in 1971, place of birth, nativity or birthplace, ethnic background, mother tongue, religion, education, family income, and labour force participation. From the individual sample tapes, all the ever-married women 15 years or older were selected for study. There are 57,073 such women, a number large enough for most detailed analysis. Some limitations of the sample tapes are that they do not include Prince Edward Island, Yukon and Northwest Territories; little information on the husband is identifiable and data on child-spacing are not available.

Since the categorization of some of the variables in the sample tapes is different from that of the complete census and a few variables were specially recoded for this study, the categories used are shown below:

Education of Wife:	Below Grade 9, Grades 9-11, Grades 12-13, Some University
Mother Tongue:	English, French, Other
Place of Birth:	Native Born, Foreign Born
Ethnicity:	British, French, Other European, Other
Religion:	Catholic, Protestant, Other, None
Work Status:	Never Worked, Worked Before 1970, Worked in 1970 for 1-26 weeks, Worked in 1970 for 27-52 weeks, worked in 1971
Type of Residence:	Urban 30,000+; Urban <30,000; Rural-Nonfarm; Rural Farm
Family Income:	Less than $5,000; $5,000–$9,999; $10,000–$14,999; $15,000–$24,999; $25,000+

If children ever born is treated as the final dependent variable, all the other variables form the independent or antecedent variables. Preliminary tabular analyses showed that various levels of relationship exist between these independent variables and fertility. Our prime concern is in the assessment of the relative importance of these variables in the explanation of fertility. This is not an easy task as many of the independent variables are clearly correlated and may interact in ways that are not immediately obvious. Thus, spurious relationships may exist.

We have relied on the extensive use of the technique Multiple Classification Analysis (MCA) for examining the inter-relationships between several predictor variables and a

dependent variable within the context of an additive model. "The technique can handle predictors with no better than nominal measurement, and inter-relationships of any form among predictors or between a predictor and the dependent variable. The dependent variable, however, should be an interval scale (or a numerical variable) without extreme skewness, or a dichotomy" (Andrews *et al.*, 1969). Basically MCA is an extension of multiple regression analysis with dummy variables. The coefficients produced by MCA can be converted to coefficients obtained by multiple regression. However MCA is more convenient and easy to understand as the coefficients for all categories are obtained and expressed as deviations from the mean. In contrast, coefficients in dummy variable regression are deviations from the omitted variable.

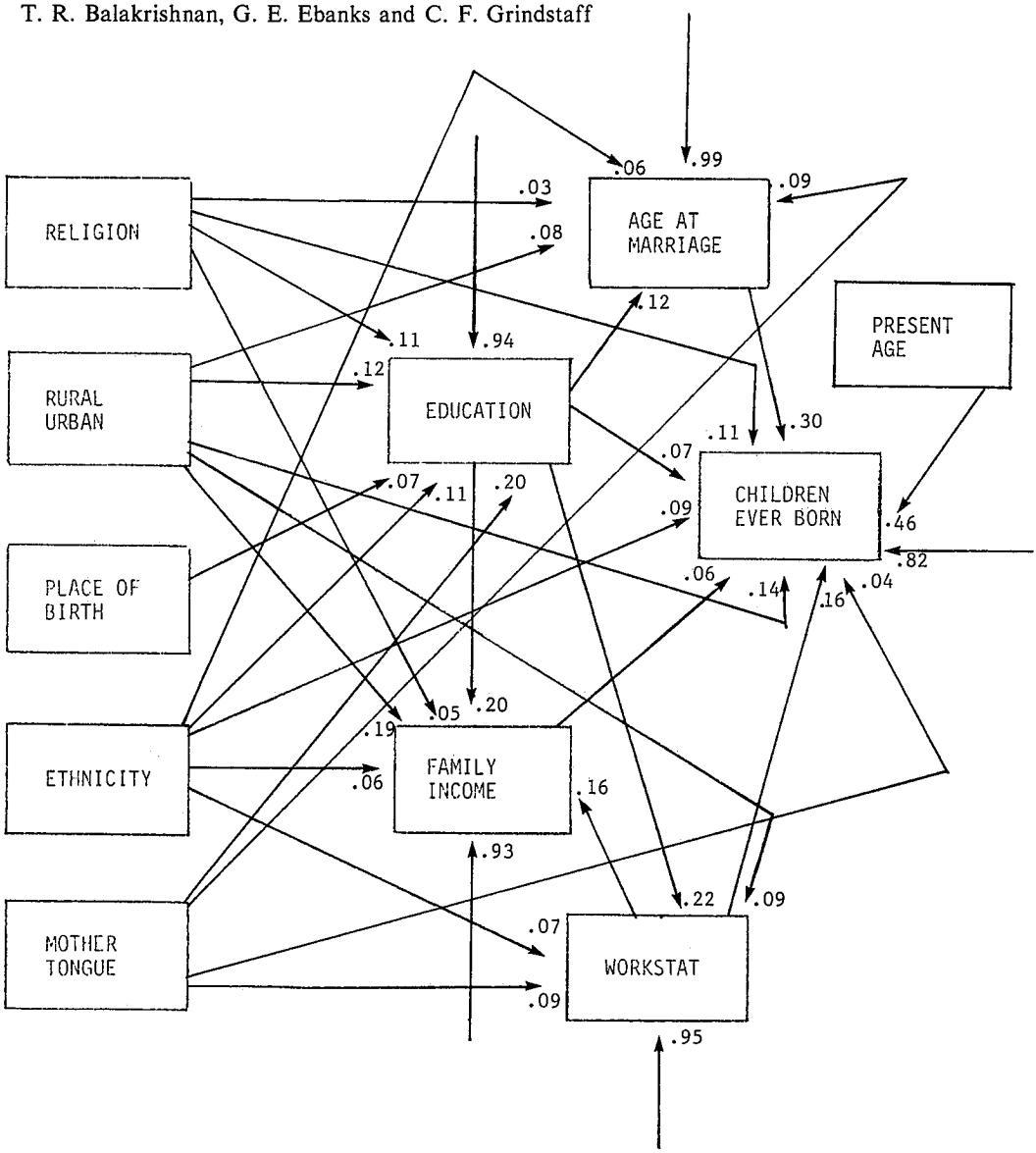
In addition to providing adjusted mean values on the dependent variable for each sub-class of an independent variable after controlling for all other independent variables, MCA output also presents a beta coefficient for each predictor. These beta coefficients indicate the relative importance of the various predictors in their joint explanation of the dependent variable.

MCA is not without its own limitations. Though the assumptions are less rigid compared to regression, it is still basically an additive model and interactions are ignored, unless specifically introduced. High multi-collinearity may distort the results to some extent. It is also sensitive to the number of categories and sample sizes and one has to be cautious in handling variables where nonresponse categories are high. However, given the various problems associated with census data, MCA may be one of the better methods available to us.

Our general approach is to use MCA two-fold: first, to estimate per cent of variance explained in children ever born and other *intermediate* variables and second, to fit the coefficients in the path models. The beta coefficients are used as path coefficients. R^2, which represents the proportion of variance explained in the MCA technique is used in the calculation of residual paths $\sqrt{1-R^2}$. To apply MCA technique, we had to assume that the intermediate variables are measured at the level of an interval scale. As education and family income are ordinal in nature with five or more categories it is assumed that the condition is not seriously violated. Treating work status as an interval scale variable is to some extent questionable. It is justified here under the premise that the five categories do form an ordinal scale in terms of work experience and comittment to work outside the home. However it is realized that the conditions of scaling are violated to a certain degree due to the limitations of data. We are not able to calculate the coefficients among the five exogenous variables, because they are categorical data. To this extent our path model is incomplete. However, it is not too consequential for our analysis which is basically focused on explaining variance in children ever born. Unlike multiple regression, all the beta coefficients in MCA are positive. Thus while they are good in comparing the relative importance of the predictors, they do not indicate their direction. Direction, however, is not meaningful for most of our categorical variables, and for the others, can be determined by looking at other features of the MCA such as adjusted deviations. It can be clearly seen that MCA is only a reasonable substitute in path analysis, which strictly requires that all variables be of an interval scale level of measurement.

Findings

A path diagram is shown as Figure 4 extending the MCA analysis to include education, family income, work status and age at marriage as intervening variables. The initial analysis is for all ever married women in the ages 15-59, which includes women in the reproductive ages as well as those who had completed their fertility up to 15 years previous.



All coefficients are statistically significant at the .001 level.

FIGURE 4 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS (EVER-MARRIED WOMEN AGED 15-59, CANADA)

Women above 60 years of age are excluded as their fertility took place in a much earlier period and some of the variables may not be relevant for them. Work status in the path model is a newly constructed variable, which combines the two variables, period last worked and number of weeks worked in 1970. Present age was introduced as a separate variable because of its overwhelming importance on children ever born.

Total variance explained for children ever born was 33.5 per cent. However, the beta coefficients show that most of this variance is due to age at marriage and present age.

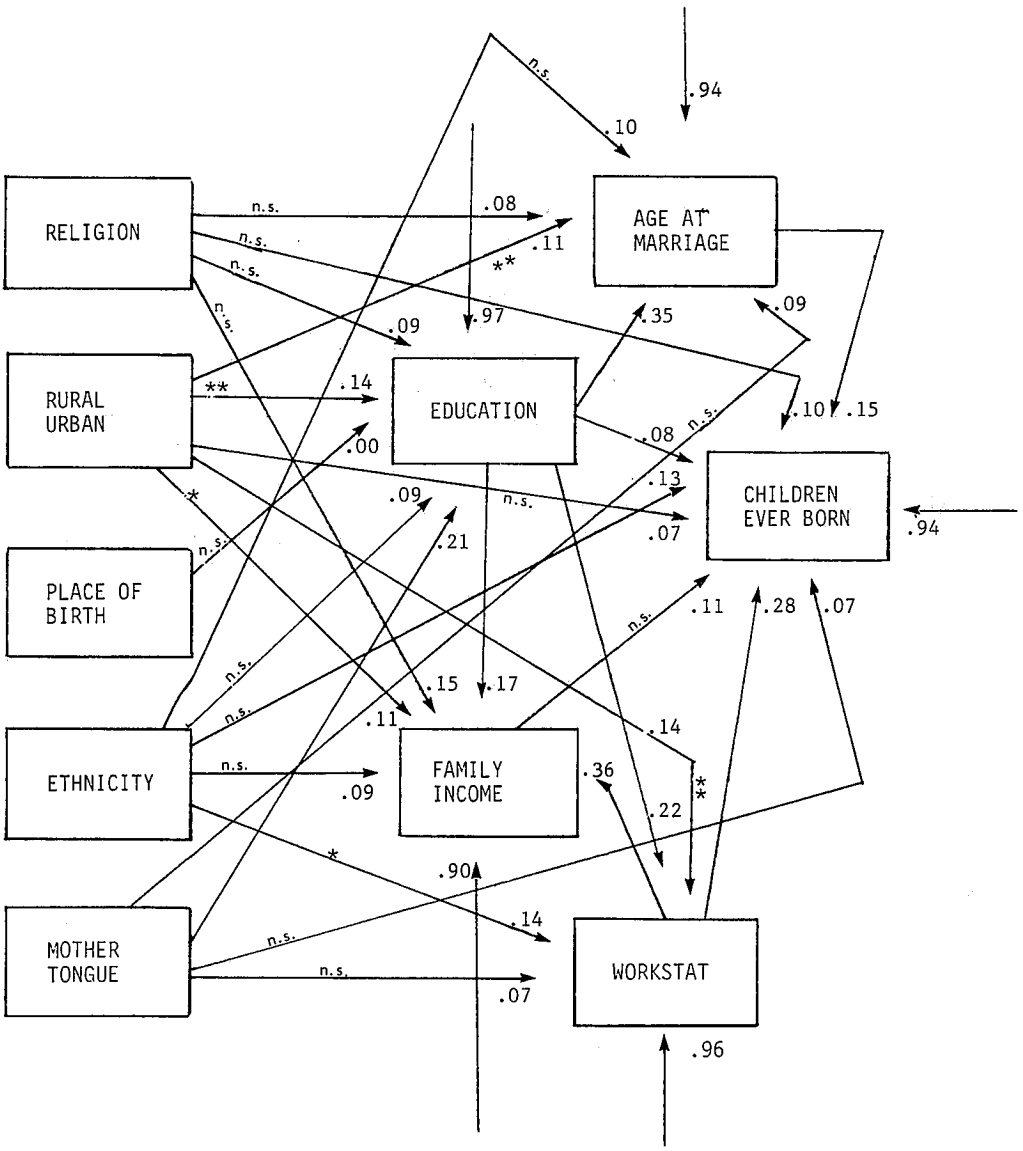
Among the other variables, the beta coefficients are relatively high for work status, religion, and type of residence. Ethnicity and education were less important and mother tongue the least.

Among the intervening variables we were able to explain only a small portion of variance, 13.7 per cent for family income, 9.0 per cent for work status and only 2.8 per cent in age at marriage. The inability to explain age at marriage is a surprising finding. This is due to the fact that only slight differences in mean age at marriage exist by socio-economic characteristics, and the within variance is far more important than between-group variance. Thus while age at marriage is important for fertility, trying to explain age at marriage by the so called structural variables is futile. When dealing with micro-data we find that variance explained is much lower than if we were dealing with aggregate data, a common finding in social science research. It is possible that the weakness of the model may be due to the fact that all the age cohorts are taken together and the beta coefficients and variance explained may vary for the different age groups.

Since it was seen that the explanatory power of the independent variables changes by age of women (Balakrishnan, Ebanks, and Grindstaff, 1979), the path model was separately applied to the different age cohorts. Figures 5-11 are for selected age groups. Before commenting on the models, it may be useful to look at variance explained in the intermediate variables and children ever born in these age-specific models (Table 1). Within each age category, except for 15-19, per cent of variance explained in children ever born is greater than that explained in the intermediate variables. Between the ages 20 to 35, thirty per cent or more of the variance is explained, whereas for the older age groups, the figure is in the low twenties. Variance explained in age at marriage decreases with age.

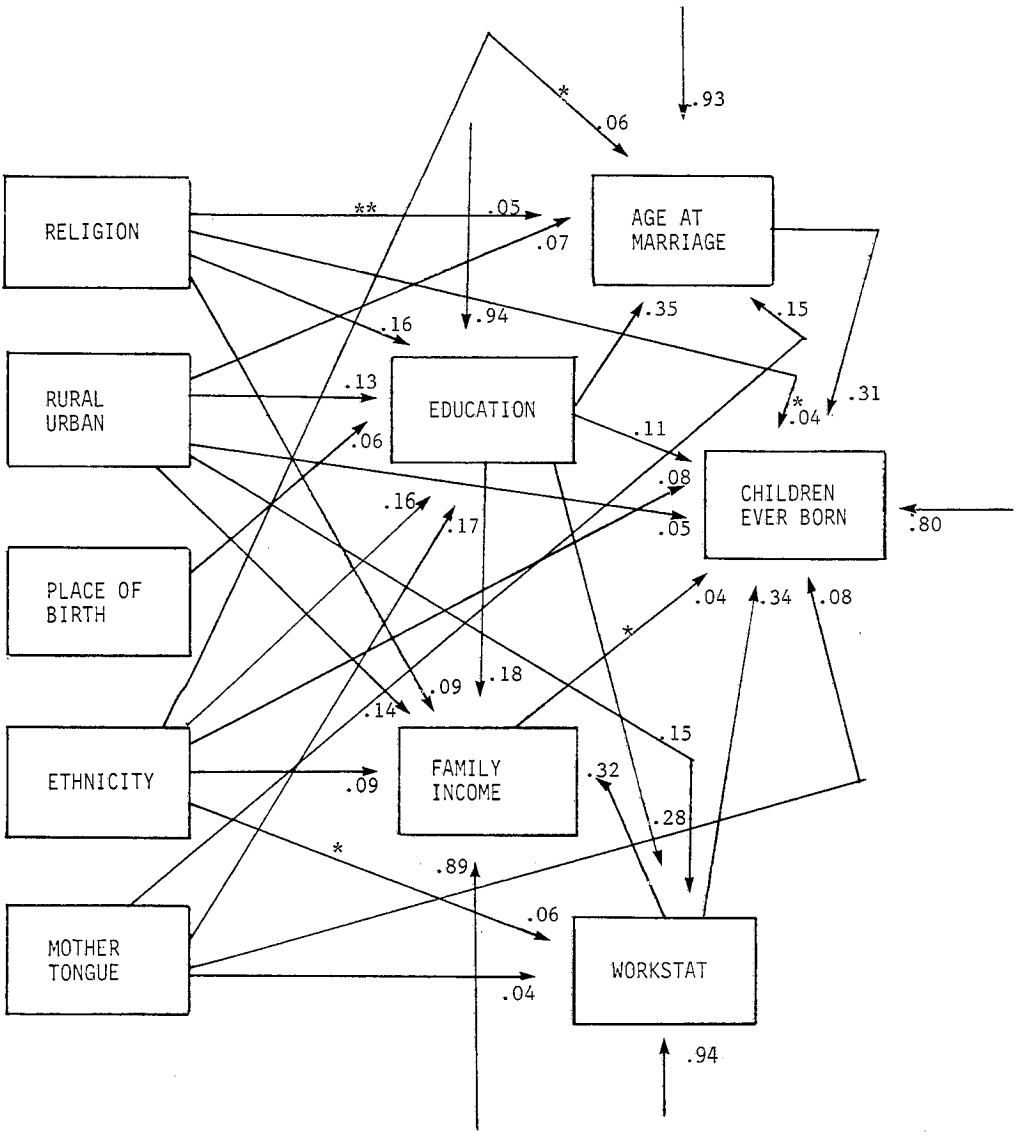
TABLE 1 PERCENT OF VARIANCE EXPLAINED IN INTERMEDIATE VARIABLES AND CHILDREN EVER BORN BY AGE COHORTS

Age Cohort	Age at Marriage	Education	Family Income	Work Status	Children Ever Born
15-19	12.2	5.6	19.0	7.0	12.6
20-24	14.2	11.3	20.6	11.5	35.8
25-29	11.1	11.3	19.7	10.0	36.5
30-34	9.0	11.5	16.7	8.0	29.0
35-39	6.0	13.6	18.0	8.0	22.9
40-44	5.2	13.6	14.7	7.2	21.2
45-49	3.6	14.6	12.7	10.0	20.6
50-54	3.8	14.9	13.0	8.7	22.9
55-59	4.4	12.6	13.5	8.2	24.1



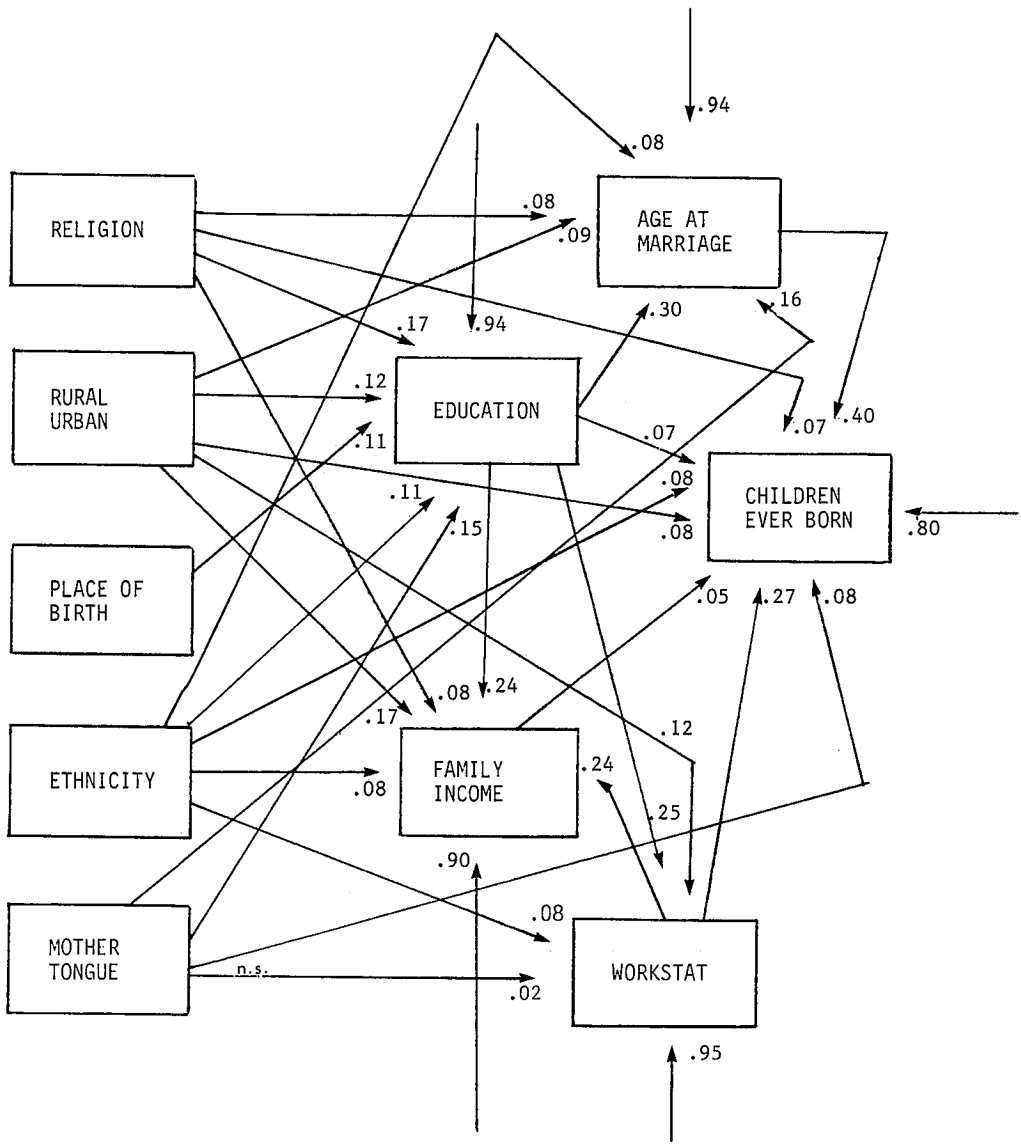
All coefficients are statistically significant at the .001 level except the ones shown, * = significant at .05 level; ** = significant at .01 level; and n.s. = not significant.

FIGURE 5 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS (EVER-MARRIED WOMEN AGED 15-19, CANADA)



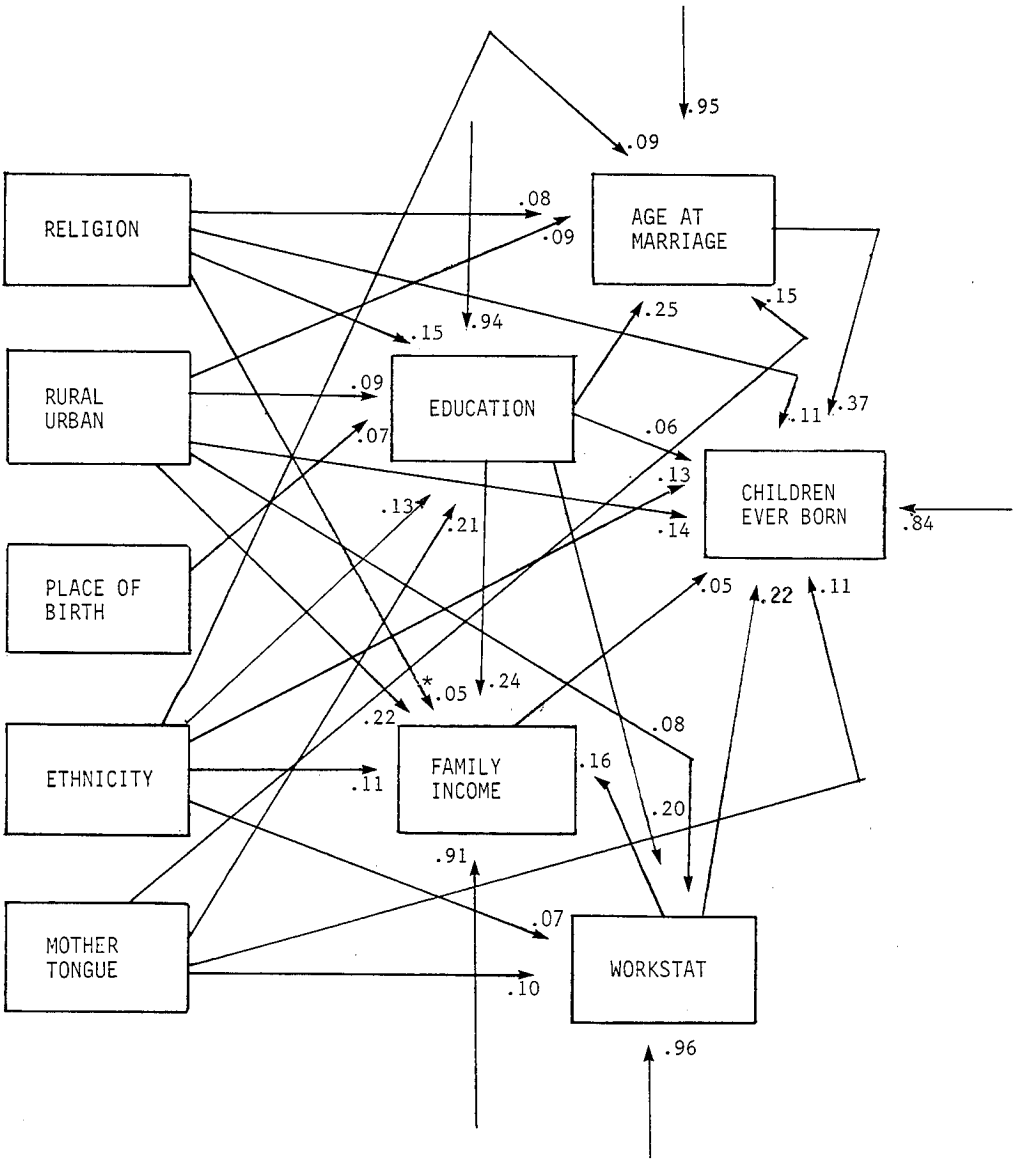
All coefficients are statistically significant at the .001 level except the ones shown, * = significant at .05 level; ** = significant at .01 level; and n.s. = not significant.

FIGURE 6 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS (EVER-MARRIED WOMEN AGED 20-24, CANADA)



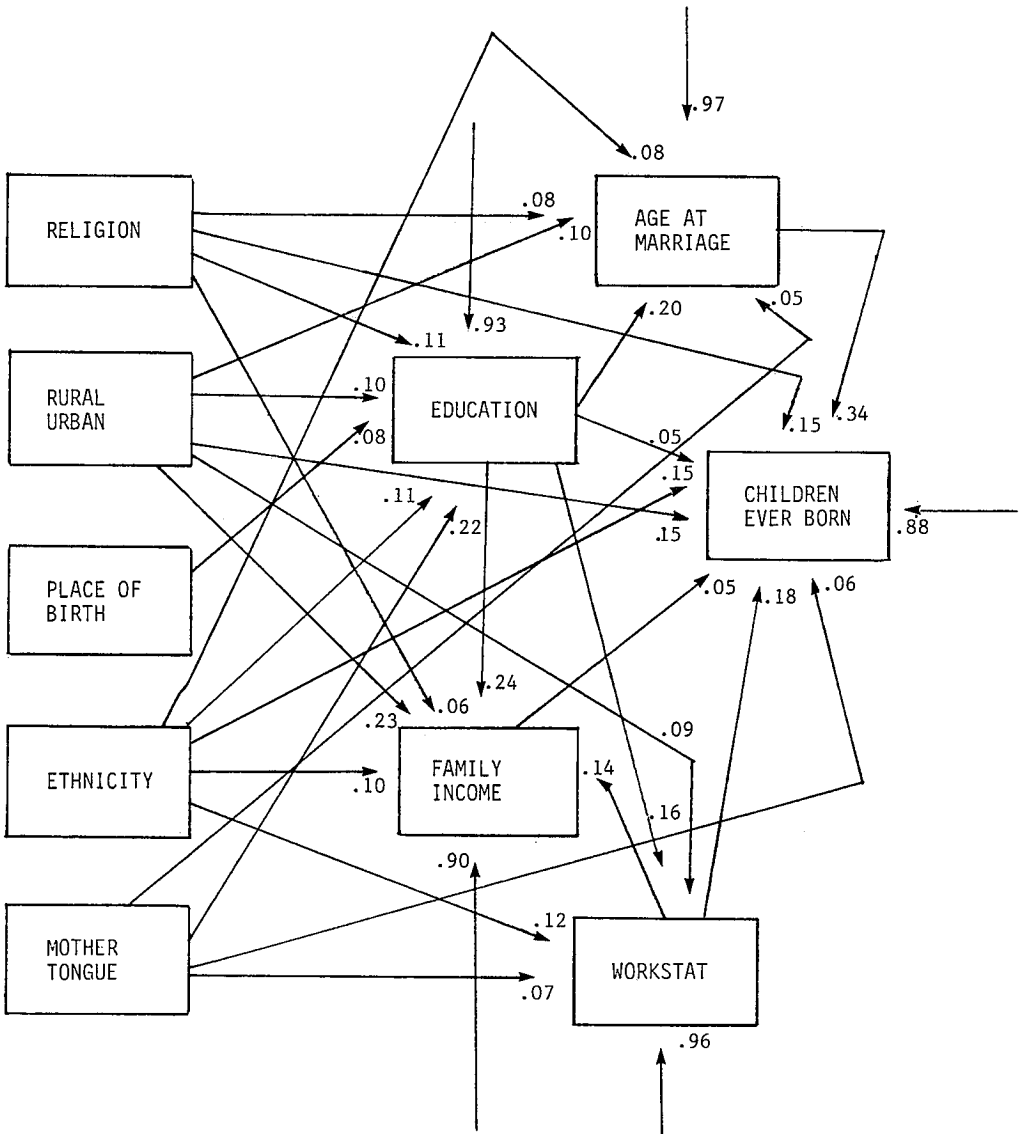
All coefficients are statistically significant at the .001 level except the ones shown, * = significant at .05 level; ** = significant at .01 level; and n.s. = not significant.

FIGURE 7 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS (EVER-MARRIED WOMEN AGED 25-29, CANADA)



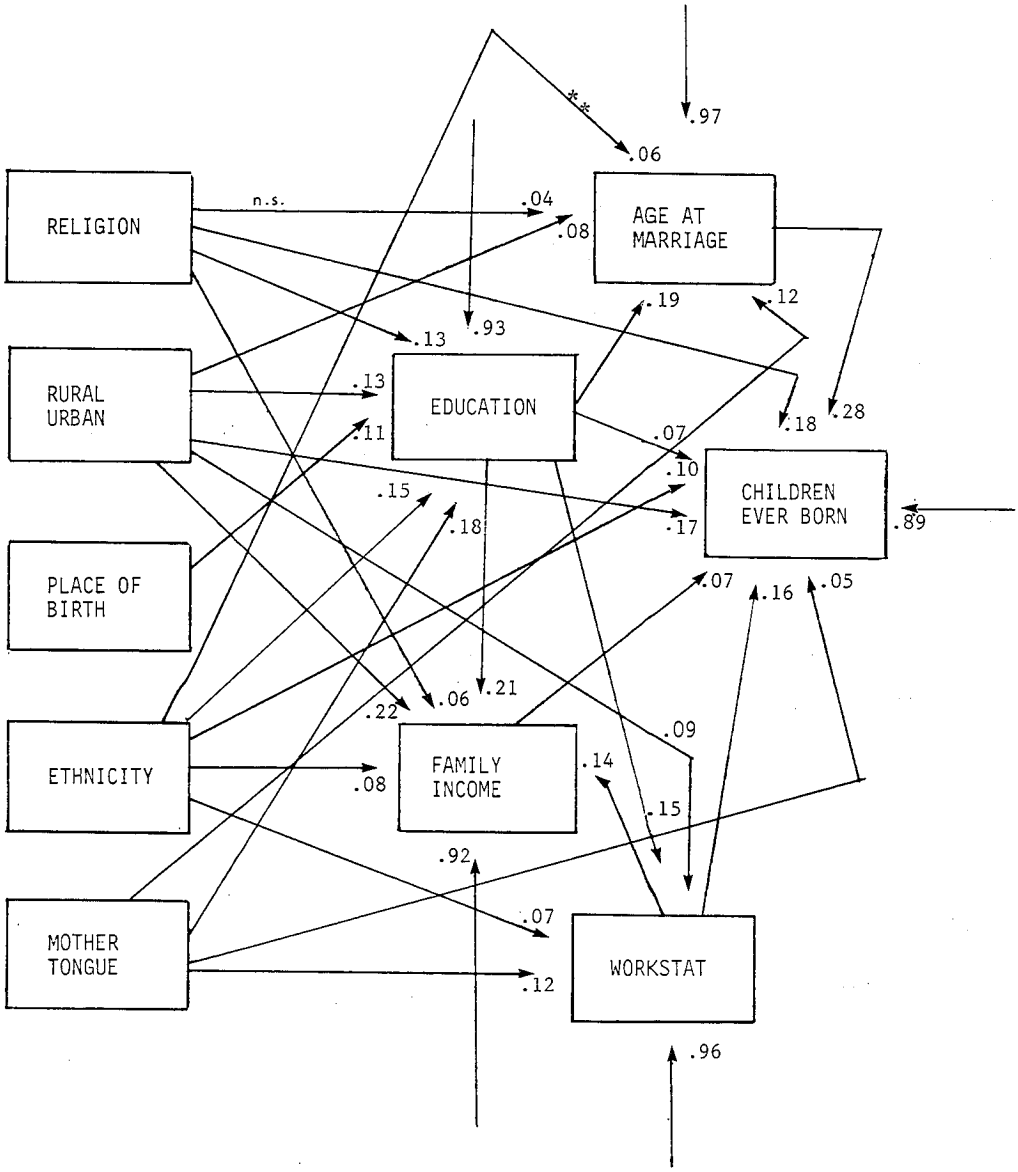
All coefficients are statistically significant at the .001 level except the ones shown, * = significant at .05 level; ** = significant at .01 level; and n.s. = sot significant.

FIGURE 8 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS (EVER-MARRIED WOMEN AGED 30-34, CANADA)



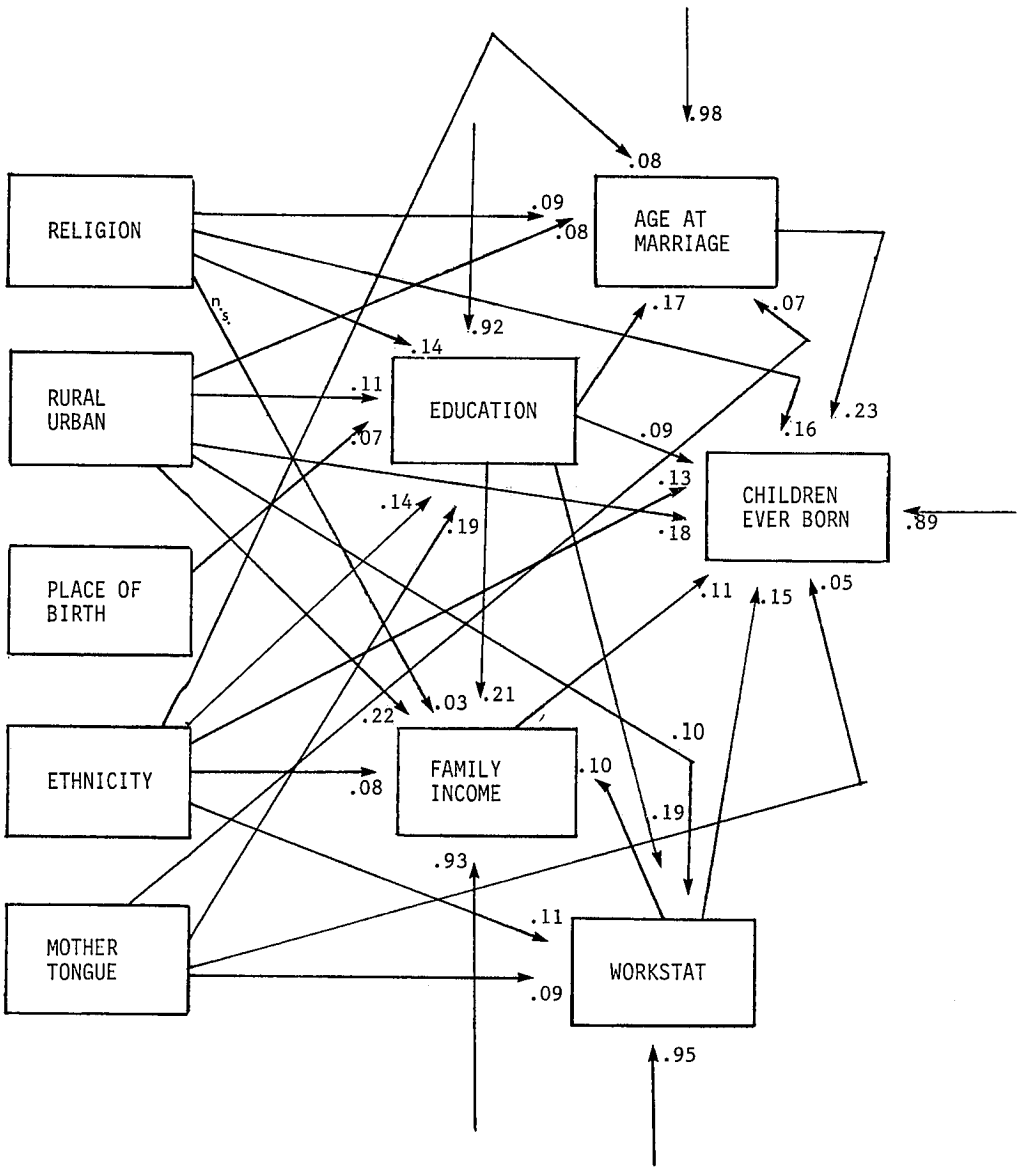
All coefficients are statistically significant at the .001 level except the ones shown, * = significant at .05 level; ** = significant at .01 level; and n.s. = not significant.

FIGURE 9 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS (EVER-MARRIED WOMEN AGED 35-39, CANADA)



All coefficients are statistically significant at the .001 level except the ones shown, * = significant at .05 level; ** = significant at .01 level; and n.s. = not significant.

FIGURE 10 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS (EVER-MARRIED WOMEN AGED 40-44, CANADA)



All coefficients are statistically significant at the .001 level except the ones shown, * = significant at .05 level; ** = significant at .01 level and n.s. = not significant.

FIGURE 11 PATH DIAGRAM OF CHILDREN EVER BORN AND OTHER SOCIO-ECONOMIC AND DEMOGRAPHIC CHARACTERISTICS (EVER-MARRIED WOMEN AGED 45-49, CANADA)

Up to age 30 we are able to explain more than ten per cent of the variance in age at marriage whereas it is very low among the older women. Percent of variance explained in education varies within a narrow range of 11-15 per cent among all the age groups except the youngest ages 15-19. This is understandable as in this age group fewer women are likely to have more than high school education. Variance explained in family income is somewhat higher in the younger age categories, around 20 per cent, than among the older women. We are not able to explain much of the variance in work status, generally lower than ten per cent. Differences among age categories are small.

The path diagrams for the various age cohorts shown in Figures 5 through 11 reveal certain salient features. The overall explanatory power of the path model is weakest for the youngest age group of women 15-19. This is to be expected since apart from a small sample size, these women are likely to be married very recently and have only a small number of children. The mean number of children is only 0.61 with a high proportion childless. The residual path is high at 0.94. Work status has the highest beta coefficient of 0.28 with age at marriage second at 0.15.

For the next two age groups, 20-24 and 25-29, the beta coefficients and variance explained are higher in comparison to all other ages. Work status and age at marriage have the two highest beta coefficients on children ever born. Path coefficients for age at marriage are consistently high for all the age groups, though a slight decrease for the older age cohorts can be noticed. Path coefficients from work status to children ever born decrease in a linear fashion from a high of 0.34 for 20-24 age category to 0.11 for the 55-59 age class. Path coefficient from education to children ever born decreases with age. Educational level among older women is generally lower and probably did not have the same effect on fertility in the past when most of their children were born. Among younger women, not only is there a greater variation by education, but education influences their family size norms, contraceptive use and work experience in a way as to affect their reproductive behaviour as never before.

Path coefficients from religion to children ever born are significant and increase with age. From a low of 0.04 for the 20-24 age group it increases to 0.18 for the 40-44 age group and seems to indicate the decreasing influence of religion on fertility. It is somewhat higher for the 15-19 age group at 0.10, but we are discounting its importance due to the small size and the very short fertility experience of this group.

Path coefficients from type of residence to children ever born are significant for all the age cohorts emphasizing the relative importance of this variable. The values however increase with age, from 0.07 for 15-19 and 0.05 for 20-24 to 0.19 for the 45-49 age category. A conclusion is that fertility differentials purely attributable to rural/urban residence are probably lower for the younger women compared to older women who have completed their childbearing by 1971. The pattern of ethnicity to fertility is similar to that of type of residence with decreasing importance for younger women.

In spite of considering a large number of variables, we are able to explain only about 25 to 30 per cent of the variance in children ever born. In summary, the amount of variance explained is as much as could be expected based on past experience in working with this type of data and this particular methodology. This low proportion of explained variance is due to a plethora of factors, some of which are the following: fertility is a complex variable associated with variables not easily measured; there are many explanatory factors not included in the census; and we are dealing with individual rather than aggregate data.

Summary and Conclusions

Though census data are less than adequate for causal analysis, this paper attempted to test a crude path model with the limited number of variables available in the individual sample tapes. Primary ascribed characteristics such as religion, ethnicity and nativity were treated as exogenous variables and achieved characteristics such as education, income and work status as endogenous variables. It was found that ascribed characteristics have a considerable influence of their own on fertility and were more important for older women. For younger women, achieved characteristics had greater significance for fertility. This may indicate a trend where fertility behaviour is less influenced by traditional values and norms and more by individual desires and constraints of income and costs of childbearing.

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