DETERMINANTS OF FERTILITY IN TWO CANADIAN POPULATIONS: A CAUSAL MODELLING APPROACH

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Résumé — A l'aide d'un modèle causal, nous déterminons que le désir d'avoir des enfants est surtout fonction de processus socio-psychologiques dans la famille, sujet à des contraintes socio-économiques. Trois processus socio-psychologiques sont considérés: un barème des objects modernes désirés, la satisfaction de vie et la communication entre époux, et les attitudes envers les enfants. Les variables socio-économiques comme l'éducation du mari, l'éducation de la femme et le revenu du ménage devraient influencer la fécondité par moyen de leur impact sur les processus socio- psychologiques dans la famille. Le modèle est examiné à l'aide de deux echantillons, à Cold Lake et Fort McMurray.

Abstract — A causal model is constructed to show that the demand for children is primarily a function of social psychological processes within the family, subject to certain socio-economic constraints. Three broad socio-psychological processes are posited as determinants of fertility. The first is the couples level of modern objects scale; the second is life satisfaction and the communication between the husband and wife; and the third is attitudes or tastes of family members towards children. Socio-economic variables, such as husband's education, wife's education and household income, are hypothesized to influence fertility through their impact on social psychological processes within the family. The proposed model is tested on two independent samples — one in Cold lake, the other in Fort McMurray — using a structural equation model by maximum likelihood methods.

Key Words — **fertility determinants, causal model, LISREL analysis, Bagozzi and Van Loo model**

Over the past several decades, research on the determinants of fertility has proliferated. Recent research has focused on factors affecting fertility levels and changes in less developed countries, especially with regards to the relative importance of socio-economic development and family planning programmes (Cutright and Kelly, 1981; Kelly and Cutright, 1980; Mauldin and Berelson, 1978; Tsui and Bogue, 1978). In addition, most of the research is based on aggregate rather than individual level data. In order to understand the complex phenomenon of fertility, data on various socio-economic and psychological factors are important at the individual level.

The complex nature of causation in fertility behaviour has motivated scholars from several disciplines to develop a comprehensive theoretical frame work with the inclusion of all relevant variables (Bullato and Lee, 1983; Davis and Blake, 1956; Freedman, 1962). Theories from economics, sociology and demography typically stress the constraining role of environment. In this approach households are hypothesized to choose a family size in response to price, income, norms or other social stimuli. On the other hand, theories from psychology begin with people's needs, motives or other mental events to model the primary antecedents of fertility (Bagozzi and Van Loo, 1978). Some psychological theories are concerned with the decision process itself or the rules governing it (for example, Fishbein, 1972; Hass, 1974), whereas others, while not explicitly concerned with this process, investigate individual preferences and values which are relevant if decisions are actually made (Hoffman and Hoffman, 1973). Among anthropological approaches, several discuss fertility determinants at the societal or cultural level with no references to couples making decisions; others focus specifically on these decisions (Bartlett, 1980; Hull, 1983).

A more general theory of fertility developed by Bagozzi and Van Loo (1978) claims that fertility is an outcome of two broad social processes within the family unit. The first hypothesizes that the shared, socially constructed attitudes of household members influence family size. The second posits that the social exchanges that transpire between husband and wife affect fertility. The theory views the social and economic variables as constraints on attitudes and on husband-and-wife interaction.

The general theory of fertility proposed by Bagozzi and Van Loo has certain theoretical and methodological benefits over the traditional approaches (Bagozzi and Van Loo, 1978b:317-318). According to Bagozzi and Van Loo (1980), "the theory makes no assumption that social or

economic behaviour can be reduced to the psychology of individuals but rather takes the husband-and-wife relationship as the unit of analysis. In this sense, the approach is more representative of interactionism and is a variant of social psychological theory. Specifically, as shown in Figure 1, the theory views fertility decisions as an outcome of social exchanges. The nature of these exchanges is represented by the degree of egalitarianism and social influence between husband and wife. Social and economic variables are then viewed as constraints on the husband's and wife's attitudes and their social exchanges. In this way, they constitute the setting or contingencies for fertility decisions". A detailed critical review of various economic and non-economic models of fertility is provided by Bagozzi and Van Loo (1978a). Comments on their review are provided by Kiser(1979), Leibenstein (1979), Namboodiri (1979), Scanzoni (1979) and Turchi (1979). Thus, theoretically the model incorporates the knowledge of both economic and non-economic aspects involved in making fertility decisions by the couples.

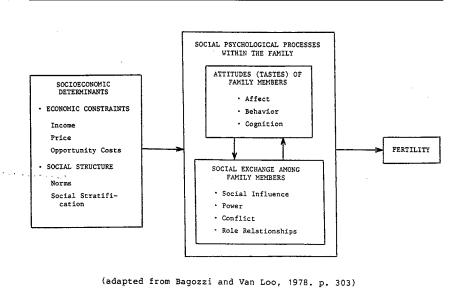(adapted from Bagozzi and Van Loo, 1978. p. 303)

FIGURE 1. AN OUTLINE OF THE THEORY

Methodologically the model has certain benefits over the traditional approaches, such as path analysis, in modeling causal relationship between the variables through latent concepts. Bagozzi and Van Loo adopt the linear structural relationship model, or LISREL, developed by Joreskog (1973, 1977, 1978) for testing their theoretical model. LISREL consists of the structural equation model and the measurement model. The structural equation model describes the theoretical causal relationships among the latent variables through a set of general linear equations. The measurement model, on the other hand, describes the measurement of the latent variables by the observable indicator variables and allows evaluation of the reliability of such measures.

The LISREL system overcomes some of the problems involved in employing such techniques as, correlation and regression analyses. According to Joreskog (1973), there are three difficulties associated with these techniques: namely (a) if there are errors of measurement in the independent variables, these errors will give rise to inconsistent regression estimates; (b) if the parameters in the structural equations and the parameters in the reduced form are not in a one-to-one correspondence, one or more of the parameters of structural equations may be overidentified or underidentified; and (c) since the regression technique is applied to each equation separately, one does not get an overall test of the entire causal structure. These difficulties are to a certain extent eliminated in LISREL analysis. In addition, the LISREL computer programme is extremely flexible in that it can accommodate virtually any type of causal model, efficient over variable sample sizes, and robust over nonnormality. The LISREL model makes allowances for structural errors, measurement errors, correlated errors of measurement, and models with reciprocal causation, as well as confirmatory factor analysis, longitudinal analysis, simulataneous analysis in several subpopulations, and covariance-structure analysis. Further, it also provides modification indices and partial derivatives that give some clue about the validity of the model structure. Above all, LISREL allows the use of multiple indicators for the estimation of theoretical variables and builds models closer to the real world.

However, despite the theoretical and methodological benefits over other models, Bagozzi and Van Loo's model is seldom used by social scientists in fertility analysis. Therefore, this paper attempts to develop a model similar to Bagozzi and Van Loo and test it through maximum likelihood method developed by Joreskog (1981). The model is tested in two Canadian populations, namely Fort McMurray and Cold Lake.

Since Fort McMurray is more homogenous than Cold Lake with regard to certain socio-economic and demographic characteristics, it will allow us to understand the role of socio-psychological factors under more controlled situations.

General Model

As shown in Figure 2, fertility is hypothesized to be a direct function of social-psychological process within the family and an indirect function of socio-economic constraints on family size.

Indirect influences of socio-economic determinants on fertility have been outlined by Easterlin (1969), Namboodiri (1972a, 1972b), Leibenstein (1974, 1975) and Turchi (1975) According to Bagozzi and Van Loo (1978), the socio-economic variables such as education, income, and occupational status serve not only as resources for families in the achievement of desired ends, but these factors "are also positional variables in the social structure" and affect decision making regarding family size. The family's socio-economic status also plays a role by forcing couples to make comparisons with others in their social class or desired social class and thus influences the couple to conform to a particular lifestyle. In other words, in order to maintain a particular social status, the family is forced to adopt particular type of consumption and family size. For example, there is more social pressure on families with a high socio-economic status to provide extensive child services and spend more on recreation and travel than there is on families of lower socio-economic status. These variables tend to have a negative influence on family size decision making.

The main social-psychological process within the family involves a decision regarding the family size. In general, the decision depends upon the needs of the husband and wife, life satisfaction, and communication or interaction between the two. For example, a couple satisfied with family life may prefer a smaller or larger family under a given socio-economic condition. A large number of studies have investigated the notion that fertility depends on the complex nature of relationship between husband and wife. Namboodiri (1972b), for example, has developed a causal model for explaining fertility as a by-product of interaction between husband and wife.

61

Data and Methodology

The data for the present study were obtained from two independent surveys conducted in Alberta; one in the Cold Lake region (n = 1207) and the other in Fort McMurray (n = 430). Both surveys were conducted in 1979 to study the social impact of developing natural resources in these communities. Details on the format of questions, procedures and cautions used in collecting the data are discussed in Gartrell *et al.*, (1980, 1981). The surveys used the dwelling unit as the primary sampling unit for systematic sub-sample drawn with sub-areas. The completion rate was 89 per cent for Fort McMurray and 82 per cent for Cold Lake region (Gartrell and Krahn, 1983). Discussion here will focus on the description of variables and their relationship to the proposed model. The proposed model is tested among the currently married women of reproductive ages (under 54 years old) and the resulting final sample is 229 for Fort McMurray and 409 for Cold Lake.

Selection of Variables

The theoretical links of socio-economic and psychological variables with fertility are well documented in the literature (see, for example; Bagozzi and Van Loo, 1978b, 1980; Goldberg, 1975; Hawthron, 1970), and therefore discussion here will be brief and focus more on the relevance of the indicators considered to measure the latent concepts for the study.

The ultimate endogenous variable for the study is total expected births. In fertility research, however, what should be the dependent variable is not always obvious — a measure of desired number of children, the total number of children expected, or a measure of difference between goals and behaviour (Goldberg, 1975). Several studies have used total expected births as a measure of fertility (Bagozzi and Van Loo, 1978b; Goldberg, 1975; Namboodiri, 1974). According to Goldberg, the expectation data "places the independent and dependent variables in proper time perspective ... have a greater real world base than questions with family size ideals or desires that contains substantial elements of fantasy, probably differing in form from one respondent to the next." In essence, total expected births in a cross-sectional survey contains retrospective information, that is, younger and older respondents report the total number of children they plan to have (in ad-

dition to the number of surviving children). Therefore, any observed difference in fertility among the respondents within the reproductive age can be attributed to various socio-economic and psychological factors. This is also one of the reasons for not using age as a control variable. However, this measure of fertility also suffers from a certain amount of response bias. For example, younger women may be likely to report socially acceptable family size as planned, while the older women may report their current family size as planned in order not to look ridiculous.

The independent variables such as husband's education, wife's education and household income are used as indicators of socioeconomic status. Education has different consequences for men and women with respect to fertility process and the roles they play in relation to that process (Cain and Weininger, 1973; Cochrane, 1979; Jayachandran, 1985; Janowitz, 1976; United Nations, 1983). Economists, however, treat husband's education as "permanent income" and wife's education as a proxy for "opportunity cost" in studying the role of these factors in fertility analysis. Although economic theories of fertility continue to show the relationship between full potential family income and fertility, researchers often conceptualize income with husband's earnings (Freedman and Thornton, 1982; Goldberg, 1975; Namboodiri, 1974). Husband's income is preferred over wife's income due to the direct positive effect of the former and the mixed effect of the latter. In other words, on the one hand, the wife's income increases the total family resources and thus may stimulate the taste for more children, but it also increases the opportunity costs involved in rearing and bearing children. However, due to lack of information to estimate husband's income, the present study uses household income. The author is aware of the fact that use of household income can cancel the opposite effects of husband's and wife's income. However, here its effect on fertility may be more like that of husband's income due to the relatively small contribution of wife's income to family income in these two primary resource communities.

The social-psychological processes within the family are considered as intervening or pre-determined and are measured as behavioural component of attitudes by the following four variables: (*a*) the modern objects scale, to assess how far the taste for material goods competes with children for the household's scarce resources (Bagozzi and Van Loo, 1978b; Freedman, 1975; Goldberg, 1975); (*b*) life satisfaction, to see how far the satisfaction in different areas of life by the couples increases or decreases the taste for children; (*c*) social exchange process, to under-

stand the role of interaction or communication between husband and wife in making fertility decisions, and (*d*) taste for children under given levels of socio-economic status, satisfaction in life, communication between husband and wife, and taste for modern goods.

Table 1 presents means and standard deviations for all variables in both samples. The proposed general model testing the theory is outlined in Figure 2. A definition of symbols used in the model is presented in Table 2. The model indicates that all the exogenous variables (HEDUC, WEDUC and HINCOME) have a direct influence on all of the intervening or predetermined variables. In other words, as socio-economic status increases, satisfaction in life, the relationship between husband and wife, modern objects and the approval of married couples not having children, increases. The hypothesis posited here is that, as attitude or tastes for children and social exchanges within the family become more modern, couples demand quality rather than quantity and thus reduce their family size.

In order to estimate the parameters in Figure 2, a LISREL program

TABLE 1. MEANS AND STANDARD DEVIATIONS FOR ALL
VARIABLES IN BOTH THE SAMPLES

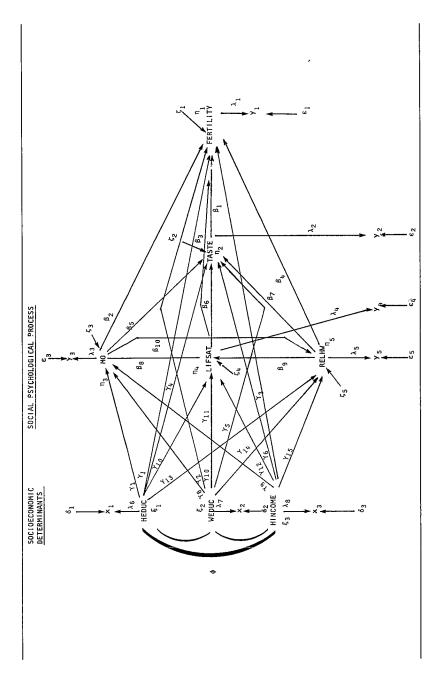| VARIABLE	FORT McMURRAY		COLD LAKE	
	MEAN	STDDEV	MEAN	STDDEV
Fertility	2.20	1.78	2.72	2.22
Taste for children	4.64	1.78	4.29	1.80
Modern objects scale	4.55	2.25	5.86	2.36
Life satisfaction	28.20	3.96	28.85	4.04
Relationship between husband and wife	8.64	3.02	7.83	3.02
Husband's education	12.34	2.95	11.06	3.57
Wife's education	11.82	2.69	11.01	2.95
Household income	2.47	1.52	1.91	1.27

TABLE 2. DEFINITION OF SYMBOLS USED IN FIGURE 2

ξ_1 = husband's education(HEDUC)
   X_1 = husband's completed years of education

ξ_2 = wife's education (WEUDC)
   X_2 = wife's completed years of education

ξ_3 = household income (HINCOME)
   X_3 = family income, total income from all sources of all
   family members in the household (divided by 10000)

η_1 = fertility
   Y_1 = the total number of children the respondent is plan
   to have (in addition to the number of surviving children)

η_2 = taste for children (TASTE)
   Y_2= do the respondent approve or disapprove of a married
   couple not bearing or rearing children (strongly
   disapprove = 1 ... strongly approve = 7)[1]

η_3 = modern objects scale (MO)
   Y_3 = possession of a dishwasher, microwave oven,
   automatic washer, dryer, freezer, color Tv, gas barbecue,
   skis etc.

η_4 = satisfaction in life (LIFSAT)
   Y_4 = respondents satisfaction with the family life,
   friends, neighborhoods, etc (very dissatisfied = 1 ...
   very satisfied = 7)

η_5 = the social exchange processes or interaction
   between husband and wife (RELHW)
   Y_5 = a) spouse disagreement about house keeping,work
   schedules,spending money, and visiting or writing
   relatives (never = 1 ... very often = 5)
   b) husbandwife communication; discussion about work
   (jobs,housework), and sharing personal problems
   (never = 5 ... very often = 1)[2]

λs (lambda) = structural coefficients relating unobserved or
   theoretical variables to observed variables

ϕs (phi) = covariance of the exogenous theoritical variables
   ξ_1, ξ_2, and ξ_3.

Σs (gamma) = structural coefficients relating exogenous,
   theoretical variables (ξs) to the endogenous variables
   (ηs)

βs (Beta) = structural coefficients relating the endogenous
   theoretical variables

δs and ϵs (delta and epsilon) = measurment errors in observed
   variables, X and Y, respectively

ζs (zeta) = errors of prediction.

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[1] Higher scores on this would indicate the higher degree of
approval for married couples not bearing or rearing children.
[2] Higher scores on these indicators would mean greater
disagreement and poor communication between husband and wife

FIGURE 2. PROPOSED MODEL FOR THE DETERMINANTS OF FERTILITY

(version V, 1981) provided by Joreskog and Sorbom is used. The LISREL program uses the full information maximum likelihood procedure to get the estimates. The procedure for estimating the parameters is discussed in the Appendix.

Findings

The test of proposed model in Figure 2 shows perfect fit of observed data with theoretical model in Fort McMurray (X^2 = 0.01; df = 7; p = 1.000; *GFI* = 1.000 ; R^2 = 0.212) and Cold Lake (X^2 = 0.27; df = 7; p = 1.000; *GFI* = 1.000; R^2 = 0.522).

However, since there were many insignificant paths, the parameters for the final causal models were estimated with the inclusion of significant paths in both the samples. Tables 3 and 4 provide indirect and total effects of exogenous and and endogenous variables for the models.

Endogenous Variables

Findings from Fort McMurray demonstrate that, with the exception of life satisfaction, variables within the social-psychological processes of the family have a significant influence on fertility. The lack of significant influence of LIFSAT could be partially due to population composition or misspecification of the variable in the model. A recent study by Gartrell (1982) has shown that Fort McMurray residents who were male, young and recent migrants reported the lowest satisfaction. Since the population is composed of a higher proportion of males and young adults, we could expect, in general, lower satisfaction. The observed negative influence of RELHW on LIFSAT is supported by an earlier study (Krahn *et al.*, 1981). The modern objects scale (MO) has a positive influence on fertility. This supports, to some extent, the economist's point of view that children are considered to be "normal goods" and an increase in income leads couples to maximize utility by "consuming" more children, just as they increase their consumption of other goods (Freedman and Thornton, 1982). The standardized coefficients given in Table 5 show that MO (0.250) has the strongest influence on fertility, followed by RELHW (-0.151) and TASTE (-0.095).

Findings from the Cold Lake region, on the other hand, shows that all the variables, except RELHW in the social- psychological processes,

TABLE 3. INDIRECT AND TOTAL EFFECTS OF ENDOGENOUS AND EXOGENOUS VARIABLES FOR THE FORT McMURRAY MODEL

	TASTE		MO		LIFSAT		RELHW		HEDUC		WEDUC		HINCOME	
	IN	TE	IN	TE	IN	TE	IN	TE	IN	TE	IN	TE	IN	TE
FERTILITY		-.089		.207				-.093		-.088		-.151	.006	.006
TASTE														.177
MO														.270
LIFSAT				.269				-.239					-.014	-.014
RELHW													.362	.362

TABLE 4. INDIRECT AND TOTAL EFFECTS OF ENDOGENOUS AND EXOGENOUS VARIABLES FOR THE COLD LAKE MODEL

	TASTE		MO		LIFSAT		RELHW		HEDUC		WEDUC		HINCOME	
	IN	TE	IN	TE	IN	TE	IN	TE	IN	TE	IN	TE	IN	TE
FERTILITY		-.136	.023	.188	.005	.005	-.003	-.003	-.008	-.139	.013	-.216	.133	.133
TASTE	-.009	-.174				-.035	.022	.022		.061	-.018	.080	-.163	.165
MO												.148		.941
LIFSAT				.153				-.614			-.175	-.175	.246	.246
RELHW				-.176							-.026	.322	-.166	-.166

TABLE 5. STANDARDIZED COEFFICIENTS, DISTURBANCE TERMS AND DEGREE OF DETERMINANCY FOR THE FORT McMURRAY MODEL

	FERTILITY	TASTE	MO	LIFSAT	RELHW	HEDUC	WEDUC	HINCOME
STANDARDIZED COEFFICIENTS								
FERTILITY		-0.095	0.250		-0.151	-0.155	-0.227	
TASTE								0.149
MO								0.200
LIFSAT			0.141		-0.169			
RELHW								0.199
R²	0.193	0.029	0.047	0.048	0.045			
DISTURBANCE TERMS, VARIANCE AND COVARIANCES								
PSI (ψ)	1.886	2.614	3.293	11.911	5.967			
TE ($\theta\epsilon$)	0.260	0.299	0.384	1.238	1.103			
TD ($\theta\delta$)						0.819	0.591	0.211

have a significant influence on fertility. RELHW influences fertility indirectly through LIFSAT and TASTE. In addition, variables within social psychological processes have a significant influence on each other in contrast to the Fort McMurray data. Once again, the positive influence of MO on fertility and negative influence on TASTE supports the "new home economics" points of view made earlier. The standardized coefficients given in Table 6 show that MO (0.164) has the strongest influence on fertility, followed by TASTE (-0.107).
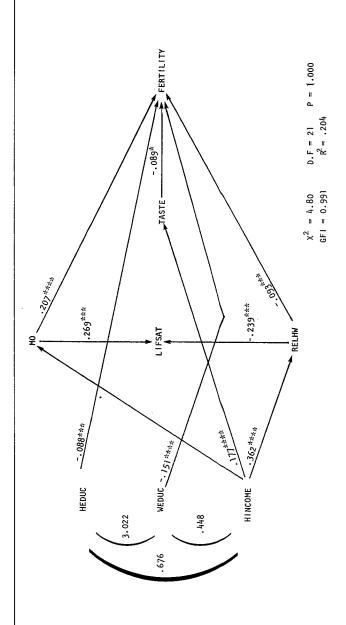
In sum, social-psychological variables within the family are more significantly related to each other in determining fertility in the Cold Lake model than in the Fort McMurray model. In both communities, LIFSAT has no significant direct influence on fertility. Even the indirect influence of LIFSAT on fertility is rather weak (0.005) in Cold Lake, which leads us to question the validity of the indicators used to measure this concept.

TABLE 6. STANDARDIZED COEFFICIENTS, DISTURBANCE TERMS AND DEGREE OF DETERMINANCY FOR THE COLD LAKE MODEL

	FERTILITY	TASTE	MO	LIFSAT	RELHW	HEDUC	WEDUC	HINCOME
STANDARDIZED COEFFICIENTS								
FERTILITY		-0.107	0.164			-0.218	-0.289	
TASTE			-0.207	-0.079		0.128	0.157	0.197
MO							0.189	0.449
LIFSAT			0.086		-0.472			
RELHW			0.128				0.322	
R²	0.228	0.120	0.307	0.231	0.091			
DISTURBANCE TERMS, VARIANCE AND COVARIANCES								
PSI (ψ)	3.768	2.673	3.334	11.790	8.254			
TE (θε)	0.151	0.337	0.535	1.516	1.602			
TD (θδ)						0.137	0.866	0.122

Exogenous Variables

The model for Fort McMurray (Figure 3) shows that both husband's and wife's education have a significant direct influence on fertility. HINCOME has an influence on fertility only through social-psychological processes within the family. However, the positive influences of HINCOME on TASTE and RELHW are unexpected. This tells us in simple terms that an increase in household income would likely to reduce the taste for children and communication or interaction between husband and wife. If Becker's (1960) hypothesis that a rise in income would increase both the quantity and "quality" of children desired is correct, then we should expect a negative influence of HINCOME on TASTE. Although, the indirect effect of HINCOME on fertility is positive and weak, such a finding in cross-sectional data, according to Becker, could be due to variation in contraceptive use across income groups, with the greater ability of high income couples to plan effectively being responsible for their lower fertility. The positive influence of HINCOME on
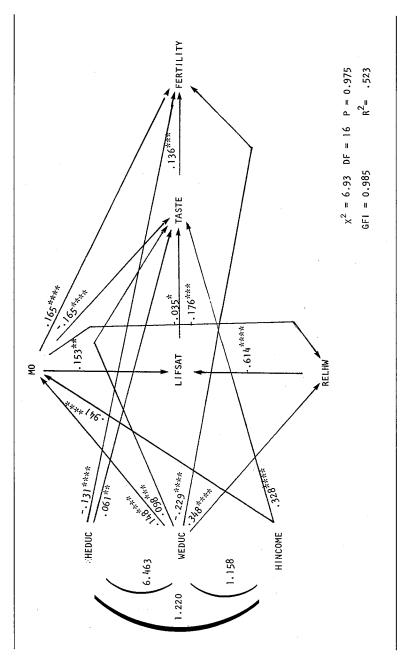
FIGURE 3. FINDINGS FOR FORT McMURRAY AND THE MODEL FOR FIGURE 2

Note: The level of statistical significance of each estimate under the one tailed t-test is
indicated by ****,***,**, and * for one, two, five and ten per cent levels respectively.

$X^2 = 4.80$ D.F = 21   P = 1.000
GFI = 0.991 $R^2 = .204$

RELHW reflects the general lifestyle of this population. Residents of Fort McMurray reported a higher incidence of drinking and smoking and an increase in health problems (Gartrell, 1982). In other words, an increase in income results in an increase of taste for modern goods, but decreases the relationship between husband and wife.

The socio-economic variables in Figure 4 for the Cold Lake region demonstrate that both husband's and wife's education have a significant direct influence on fertility. Though both HEDUC and WEDUC have significant impact on some of the socio-psychological variables within the family, their indirect influence is negligible. The impact of HINCOME on fertility is also indirect (0.133) rather than direct. All three variables (HEDUC, WEDUC and HINCOME) have a significant direct influence on TASTE. An interesting finding is that despite a strong correlation between HINCOME and MO ($r = 0.476$), these variables have opposite effects on TASTE in the presence of other variables in the causal system. However, the indirect effect of HINCOME on TASTE (-0.163) is negative, which further supports Becker's points of view mentioned earlier. Surprisingly, wife's education (WEDUC) has a significant positive influence on RELHW. In general, one would expect better communication or interaction between husband and wife with the increase in wife's education, that is reflected to some extent in its indirect effect. This requires some explanation. Women with a higher education may be frustrated with life due to lack of job opportunities for them in these communities. This, in turn, would result in familial disruption. The indirect and total effects of exogenous variables given in Table 3 show a better picture of the influence of these variables on fertility through social-psychological processes.

In sum, socio-economic variables in both communities show significant direct influences on fertility. Most of the variables in Cold Lake, in comparision to Fort McMurray, exert an indirect influence on fertility. Further, the variance explained in fertility by exogenous and endogenous variables are 20.4 per cent and 52.8 per cent for Fort McMurray and Cold Lake respectively. The chi-square value and Goodness of Fit Index (GFI) suggest an excellent fit of the models. However, the large amount of measurement errors in LIFSAT (1.516, 1.238) and RELHW (1.602, 1.103) indicate the problems involved in measuring these concepts by their respective indicators.

In general, the educational status of husband and wife have a significant influence on fertility. The significant influence of HEDUC and WEDUC on TASTE in the Cold Lake model suggests that as the educa-

FIGURE 4. FINDINGS FOR COLD LAKE AND THE MODEL FOR FIGURE 2

tional status of the couples increases, they tend to substitute goods for children. In both communities, HINCOME influences fertility only through social-psychological processes within the family. The significant impact of HINCOME on MO and TASTE suggests that an increase in income is likely to increase the taste for children and modern goods. Which is consistent with Becker's point of view that an increase in income results in the increase of consumption power of couples for goods and children. However, the total effect of HINCOME on TASTE in Cold Lake is reduced by the presence of MO, LIFSAT and RELHW. As shown in Figure 4, LIFSAT is not directly influenced by any of the exogenous variables. On the contrary, the relationship between husband and wife (RELHW) is influenced directly by WEDUC in Cold Lake and HIN-COME in Fort McMurray, both exogenous variables. The latter findings are contradictory to the general expectation and suggest that an increase in WEDUC and HINCOME is likely to increase disagreement between husband and wife, and reduce the communication between them.

Discussion and Conclusions

The causal model proposed here, that is, fertility is a direct function of social-psychological factors constrained by socio-economic variables, holds true to a greater extent in Cold Lake than in Fort McMurray. In both populations, the socio-economic factors (except HINCOME) seem to play a dominant role in explaining fertility. These findings are supported by other recent Canadian studies (Balakrishnan *et al.*, 1975; Lapierre-Adamcyk, 1979; Vlassoff and Gartrell, 1982). The present study, however, does not support findings that socioeconomic variables are less effective in explaining fertility in Canada (Lapierre-Adamcyk, 1979) and that the direct effect of differences in development (for example, HEDUC, WEDUC and MO) on fertility will be small.

In general, fertility is influenced by HINCOME through social-psycholgical processes within the family. The indirect influence of husband's and wife's education are negligible in Cold Lake despite their significant influence on social-psychological variables. There are a number of plausible explanations for this finding. First, the population of Fort McMurray is quite young, highly mobile and economically motivated (Krahn, *et al.*, 1981; Vlassoff and Gartrell, 1982) compared to the Cold Lake region. Also, Fort McMurray posseses a high level of family and community satisfaction (Vlassoff and Gartrell, 1982).

Therefore, one could understand the weaker role of socio-psychological factors, due to smaller variation, in explaining fertility. Second, the poor performance of socio-psychological factors even in a heterogenous population like Cold Lake shows that the indicators (modern objects, life satisfaction, taste and relationship between husband and wife) do not seem to capture the realm of social-psychological processes, in contrast to many researcher's expectations. Third, the large amount of structural and measurement errors indicate the omission of important variables (for example, duration of marriage), as well as discrepancies in measuring the concepts by the proposed indicators (Bagozzi and Van Loo, 1978; Goldberg, 1975; Namboodiri, 1972a; Turchi, 1975).

The explained variance (R^2) obtained for the models is comparatively larger than those found by other researchers for similar models at the individual level (Bagozzi and Van Loo, 1978; Goldberg, 1975; Willis, 1973).

Finally, given the complex nature of the fertility phenomenon, people often respond differently, based on their socio-economic and cultural background. The present study suggests that socio-economic variables continue to play a dominant role in explaining fertility; however, the role of social-psychological processes is not captured by the present study. The variables used to measure the social-psychological processes within the family often remain at the theoretical level and are not empirically tested by researchers. The theoretical model tested by Bagozzi and Van Loo using data from two developing societies, however, shows the inefficiency of social-psychological factors in determining fertility. The findings of the present study, based on data from two communities in a developed society, further supports Bagozzi and Van Loo's assertion. In developed societies, one would expect social-psychological factors (life satisfaction and interaction or communication between husband and wife) to play a dominant role due to universal education and low level of income inequalities. But that does not seem to hold true. A major problem is the large amount of error involved in measuring the concepts. This leads us to question the role and validity of social-psychological factors in fertility analysis. However, a study without sociopsychological factors both in theory and empirical work may lead to a distorted view of the fertility process (Turchi, 1975). Therefore, more concrete measures must be developed in order to understand the degree of interaction and communication between husband and wife in explaining the fertility phenomenon. Further, the big task facing social scientists is to identify

the threshold level for the social-psychological factors influencing fertility under different stages of transition.

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APPENDIX

Estimation Procedure

The system of equations for the proposed model of Figure 2 include structural and measurement model equations.

The structural equations are:

$$
\begin{bmatrix} \text{FERTILITY} \\ \text{TASTE} \\ \text{MO} \\ \text{LIFSAT} \\ \text{RELHW} \end{bmatrix} =
\begin{bmatrix} 0 & \beta_1 & \beta_2 & \beta_3 & \beta_4 \\ 0 & 0 & \beta_5 & \beta_6 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \beta_7 & 0 & \beta_8 \\ 0 & 0 & \beta_9 & 0 & 0 \end{bmatrix}
\begin{bmatrix} \text{FERTILITY} \\ \text{TASTE} \\ \text{MO} \\ \text{LIFSAT} \\ \text{RELHW} \end{bmatrix} +
\begin{bmatrix} \gamma_1 & \gamma_2 & \gamma_3 \\ \gamma_4 & \gamma_5 & \gamma_6 \\ \gamma_7 & \gamma_8 & \gamma_9 \\ \gamma_{10} & \gamma_{11} & \gamma_{12} \\ \gamma_{13} & \gamma_{14} & \gamma_{15} \end{bmatrix}
\begin{bmatrix} \text{HEDUC} \\ \text{WEDUC} \\ \text{HINCOME} \end{bmatrix} +
\begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \\ \zeta_5 \end{bmatrix}
$$

The Measurment equations are:

$$
\begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \end{bmatrix} =
\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}
\begin{bmatrix} \text{FERTILITY} \\ \text{TASTE} \\ \text{MO} \\ \text{LIFSAT} \\ \text{RELHW} \end{bmatrix} +
\begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \end{bmatrix}
$$

and

$$
\begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} =
\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}
\begin{bmatrix} \text{HEDUC} \\ \text{WEDUC} \\ \text{HINCOME} \end{bmatrix} +
\begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{bmatrix}
$$

The lambda(λ) coefficients are fixed at 1.0 in order to facilitate the interpretations by ensuring that the concepts have same units of measurement as the indicators. The error variances for the exogenous (δ) and endogenous (ε) variables are estimated by substracting reliability coefficients from 1 and multiplying by the variance of the respective indicators in order to get the portion of true and error variance components of the total variance of the indicators. The covariance matrix for the exogenous

concepts (ϕ) and error variances for the endogenous concepts (ψ) are left free for the LISREL program to estimate.

The LISREL program finds maximum likelihood parameter estimates by minimizing the following function:

$$F = log|\Sigma| + tr(S\Sigma^I) - log\ |S| - (p+q)$$

Where

Σ is the covariance matrix among all the observed indicators, that is implied by our estimated model,

S is the actual observed covariance among the indicators,

p and q are indicators of exogenous and endogenous variables respectively.

The goodness of fit of the model is assessed by likelihood ratio χ^2 test. The null hypothesis is tested against the most general hypothesis the Σ is unconstrained. The probability level of χ^2 is the probability of obtaining a χ^2 value larger than the value actually obtained given that the model is correct. The degrees of freedom for χ^2 is

$$df = 1/2K(K+1) - t$$

Where K is the number of variables analyzed and t is the total number of parameters estimated. The degrees of freedom is important to assess the fit of the model, since the χ^2 measure is sensitive to sample size. The goodness of fit index (GFI), on the other hand, is independent of sample size and relatively robust against departures from normality and therefore useful to assess the fit of the model in general.