WORLD EMPLOYMENT PROGRAMME
Population and Employment Project

Population and Employment
Working Paper No. 11

FERTILITY AND DESIRED FERTILITY:
LONGITUDINAL EVIDENCE FROM THAILAND

by

G.B. Rodgers
(with the collaboration of
Thienchay Kiranandana)

These working papers are issued to stimulate discussion and criticism. They should not be quoted without the permission of the author.

Copyright © International Labour Organisation
Geneva

February 1975

PREFACE

This paper arises out of a controversy on the application of the concept of "desired family size" to policy formulation, and in particular on its use in the BACHUE series of economic-demographic models developed within the I.L.O.'s Population and Employment Project. It cannot be said to have resolved the controversy, but perhaps represents a first step in its resolution.

The data base for this study was generously provided by the Institute of Population Studies, Chulalongkorn University, Bangkok, and much of the work of data organisation is due to Thienchay Kiranandana, formerly of this institute and now at Duke University, U.S.A. Helpful comments and suggestions on the work were provided at various stages by René Wéry, Richard Anker, John Knodel, Warren Robinson, T. Paul Schultz, Peter Peek and Mike Hopkins.

G.B. Rodgers

Table of Contents

	<u>Page</u>
I. Conceptual Framework	1
II. Empirical Tests of Attitudes to Family Size	6
a) Approach	6
b) Characteristics of base data	7
c) Error in attitudinal variables	13
d) Births, deaths and attitudes to family size	18
e) Desires for children and subsequent fertility	23
III. Desired Additional Children and Demographic Models	30
a) Behavioural functions for fertility and desired fertility	30
b) Physiological birth functions	37
c) Contraceptive acceptance	41
IV. Summary and Conclusions	45
Works cited	49
Appendix A	51

List of Tables

Table 1	- Desired additional children (D) by difference between 'ideal' and actual family size (E), 1969 and 1972. Absolute numbers and (in brackets) percentages.	9
Table 2	- Desired additional children (D) and difference between 'ideal' and actual family size (E), by parity and by age (non-negative E only).	10
Table 3	- $D_{72} = a + b \cdot D_{69} + c \cdot B + d \cdot M$. Coefficient estimates	14
Table 4	- $I_{72} = a + b \cdot I_{69} + c \cdot B + d \cdot M$. Coefficient estimates	15

.../..

<u>List of Tables</u> (continued)	<u>Page</u>
Table 5 - $(D_{72} - D_{69}) = a + b*B + c*M$. Coefficient estimates	21
Table 6 - $(I_{72} - I_{69}) = a + b*B + c*M$. Coefficient estimates	22
Table 7 - Fertility as a function of ideal or desired additional children	26
Table 8 - Behavioural fertility functions	34
Table 9 - Behavioural functions for desired additional children	35
Table 10 - Physiological birth functions	40
Table 11 - Contraceptive use functions	44

I. Conceptual Framework

The concepts of ideal or desired family size, although by no means uncontroversial, seem to be securely embedded in demographic analysis. Demographic surveys which do not collect information of this type are rare, and there is a widespread presumption that the attitudes of parents towards family size is of at least some assistance in understanding fertility¹. Such assistance can be provided in a number of ways. For instance, attitudes to fertility, regarded as intentions, or as a reflection of societal norms, can contribute to fertility projection at an aggregate level. This can be particularly important when fertility patterns are changing, as value reorientations or behavioural responses may be reflected in attitudes before behaviour itself starts to change². But implicit in the use of attitudinal variables for fertility analysis are two linked assumptions; firstly, that the "demand" for children is a meaningful concept; and secondly, that expressed attitudes are an adequate reflection of this demand.

The distinction between demand and supply functions for children is useful both conceptually and empirically. Behavioural analysis of the determinants of fertility, as proposed and developed by Becker (1960), Schultz (1969, 1974) and others, necessarily divides fertility into two components - that which is wanted, decided upon, and therefore responds to a number of elements in the household decision-making process; and a second component, positive or negative, which reflects the fact that fertility is not under total control. The first component can be regarded as a demand for children in relation to the variables entering into fertility decisions. Some would argue that fertility is generally not the result of a conscious decision under low education, low income conditions, and that this component is therefore not always meaningful;

¹ For a survey of the use of the ideal family size concept see Ware (1974).

² Though this too is not uncontroversial. See Ware, op. cit., p.14.

but given the extent to which actual fertility differs almost universally from the biological maximum¹, and given the rapidly accumulating evidence on the importance of behavioural factors² in fertility determination, this does not seem an acceptable argument - it denies the presence of even the limited reasoning required to link the relationship between intercourse and fertility with that between welfare and family size. However, few contraceptive techniques approach 100% effectiveness, and techniques for increasing fecundity are considerably weaker. Thus, even in societies where modern contraceptive use is widespread and education levels are high, fertility control is imperfect and demands are not necessarily satisfied precisely. The lower the level of control - and traditional contraceptive methods are in principle less efficient than modern - the larger will be the component of fertility which is due to factors outside the decision-making process.

Of course, the separate empirical identification of supply and demand relationships for children is not a realistic proposition, not least because the two are inter-dependent. But conceptually it makes sense to consider a desired component of fertility, which can be partly explained by socio-economic models based on the costs and benefits of children, some concept of the trade-off between quantity and quality, and a number of social variables; and an undesired component, which will vary with the use and effectiveness of contraception, education levels, age, biological factors, and so on.

Moreover, this distinction is of considerable significance in the more general context of population growth. As Blandy (1974), among others, has pointed out, current controversies on the adverse effects of population growth on economic development tend to ignore or undervalue the wishes of parents, who may indeed prefer larger numbers of children to increased income.

¹ See Clark (1967).

² See Schultz (1974).

When this is taken into account, it becomes difficult to find convincing reasons at the societal level for reducing fertility below existing desires of parents, except insofar as the future welfare of children is taken into account and compensating intergenerational income transfers can be arranged; in any case, existing demands for children constitute the baseline from which one operates. By contrast, unless there is a societal justification for population growth rates exceeding those implied by the wishes of parents, it is clearly in the interests of society to eliminate undesired births. For policy purposes, therefore, as well as for analytical purposes, a distinction between "wanted" and "unwanted" births is of great potential value.

The problem, however, comes when the attempt is made to separate "wanted" from "unwanted" births in empirical terms. While an abstract demand function for children is conceptually useful, the distinction between demand and supply, and therefore between wants, expectations and intentions is likely to be much less clear in the minds of those taking the decisions, especially when personal objectives are mingled with social norms, and when the decisions taken must relate to uncertain future rather than known present economic and social circumstances. Thus as family size increases, we may observe an increase in measures taken against conception which, analytically, might be associated with the achievement of a target family size. But in practice the increase in contraceptive measures can arise from a mixture of perception of social norms, vague subjective evaluation of the benefits and costs of children in economic and social terms, evaluation of the economic and subjective costs of contraception, and so on, all within a wider range of decisions on household issues in which different needs are felt and responded to with different intensities. The balance of these assessments is necessarily imprecise. Nevertheless, it is through this process that the controlled component of fertility is generated.

Clearly, unless only the results of this decision-making process are measured - i.e. births - a direct measurement of demand for children requires the expression of subjective preferences; but quite apart from the general unreliability of responses to attitudinal questions¹, it is difficult to ascertain precisely what subjective phenomena are measured by expressed attitudes. Responses to questions on, for example, ideal family size, can vary according to how they are phrased and their position in the interview². Broadly, 'ideal' family size questions are intended to give a picture of the societal norm; 'desired' or 'intended additional children', or similar questions, aim at intentions. But these are far from unambiguous. Immediate social and economic constraints are bound to affect responses on 'ideal' family size, even when they are specifically excluded (as in hypothetical questions, 'if you could start your married life again '); while conceptual distinctions between expectations and intentions, sometimes combined with ambiguity over whether births or surviving births are the object of the question, affect the reliability of more immediate questions on desires for children. Thus even if the concept of demand for children is analytically accepted, the extent to which this concept actually is reflected, through interviewee perceptions, in attitudinal data is a subject for empirical investigation, and one which is discussed at greater length in section II below.

If, despite these problems, measured attitudes to family size are meaningfully associated with subsequent demographic behaviour, analysis of a number of issues can be radically improved. In particular, if attitudes can be regarded as stable indicators of demand for children, behavioural analysis of

¹ See Lipton and Moore (1970).

² Namboodiri (1972) gives an example of this based on a survey in the United States.

fertility can concentrate on this variable, and overall births will then be determined by on the one hand attitudes, and on the other those variables which influence fertility control. In addition, demands for children should be a major influence on contraceptive acceptance. These issues are taken up in Section III.

The data base for this paper is the Longitudinal Study of Social, Economic and Demographic Change in Thailand, carried out over the period 1969 - 1973 by the Institute of Population studies, Chulalongkorn University, Bangkok. The methodology of their sample survey is described elsewhere¹, and some aspects of the data of particular relevance to this study are noted in Appendix A. For this analysis, a rural sample of women, married and with husbands present in 1969, has been taken. Observations on a maximum of 678 married women in the age range 15 - 44 were available for both 1969 and 1972; in practice, the number of observations for statistical analysis varied from 585 - 602 (including women reported pregnant in 1969) or 487 - 492 (excluding those reported pregnant), after exclusion of missing or erroneous data.

The major advantage of this data base for the present paper is its longitudinal nature - the same households were interviewed in both 1969 and 1972. Cross-sectional analyses of attitudinal variables in the first round of the longitudinal survey have already been carried out by Knodel and Prachuabmoh (1973) and by Prachuabmoh, Knodel and Alers (1973). They conclude that 'ideal family size' and 'desired additional children', although far from perfect, have some useful meaning. Here, by using the survey's longitudinal element we are able to go beyond this analysis, examining the responses of attitudinal variables to demographic occurrences, investigating the relationships between attitudes and subsequent fertility, and evaluating the potential role of attitudinal variables in models of household behaviour.

¹ Institute of Population Studies (1971).

II. Empirical Tests of Attitudes to Family Size

a) Approach

This section examines in some detail the characteristics and validity of two attitudinal variables measuring different aspects of demand for children: 'ideal family size' and 'additional number of children desired'. These variables cover slightly different concepts; 'ideal' relates to the number of children a woman would like to have if she could start her married life again; desired additional children refers to the present, and is probably more closely related to currently perceived costs and benefits of children. Two implications of this distinction for analysis can be drawn: firstly, 'desired additional children' may better reflect present objectives, and therefore link more closely to current fertility - the validity of this point will be investigated below; and secondly, parity stratification is necessary - and is used in this paper - where additional children is a component of the dependent variable. For comparability with more conventional age stratifications, however, we also stratify by age throughout the analysis in this section.

If the two attitudinal variables, ideal family size and desired additional children, are to be analytically useful, three criteria at least must be satisfied: (i) their measurement must be reasonably accurate; (ii) the attitudes expressed must respond to demographic occurrences within the household in a reasonably coherent and consistent way; and (iii) there must be some stable and identifiable relationships with subsequent demographic behaviour. To investigate the extent to which data from the Longitudinal Study of Thailand satisfy these criteria, we proceed as follows: basic characteristics of the data used are discussed in the next sub-section, (b).

In (c) the extent of error in the attitudinal variables used is examined; sub-section (d) covers the effects, over time, of births and deaths on attitudes to family size; and sub-section (e) takes a preliminary look at the relationship between attitudes to family size and subsequent fertility, prior to more extensive analysis reported in Section III.

b) Characteristics of base data

From the survey of Thailand described in Section I, the following data are used in this section:

- D_{69}, D_{72} : desired additional children in 1969, 1972
- I_{69}, I_{72} : ideal family size in 1969, 1972
- C_{69}, C_{72} : number of living children in 1969, 1972
- A_1 : age group of the woman concerned¹
- E_{69}, E_{72} : additional children required to reach ideal family size in 1969, 1972 (computed as $E_{69} = I_{69} - C_{69}$, $E_{72} = I_{72} - C_{72}$)²
- B : births between 1969 and 1972
- M : deaths of children between 1969 and 1972 (computed as $M = C_{69} + B - C_{72}$)²

Observations of married women aged 15 - 44 in 1969 were used, discarding non-responses and non-numeric answers to the variables D and I.³

¹ Coded 0 = 15-19; 1 = 20-24; 2 = 25-29; 3 = 30-34; 4 = 35-39; 5 = 40-44; all ages refer to 1969.

² As all children, whether or not at home, are included in C, this procedure is valid except insofar as it neglects adoptions (the latter are, however, rare).

³ These constituted from 2 to 15% of cases for the four variables concerned. Also excluded were those cases where husband or wife were sterilised, and a small number of 'Chinese' observations (2.6%). The latter were households where a Chinese language was spoken or the interviewer observed Chinese characteristics. Prachuabmoh et al (1973) have observed that the demographic attitudes and behaviour of the Chinese culture group in Thai society differ markedly from the rest of the population. However, in rural areas there were too few observations for behaviour differences to be analysed, and they have therefore been excluded from the sample.

For the sample as a whole, mean values for I_{69} and I_{72} were 3.96 and 4.22; for D_{69} and D_{72} the means were 0.92 and 0.62. As Table 1 shows, in both 1969 and 1972 there was a good measure of consistency between desires for additional children and the extra children required to reach ideal family size. In 94 and 95 per cent of cases where actual family size exceeded or equalled ideal, no more children were wanted; where ideal exceeded actual, on the other hand, between two-thirds and three-quarters of married women wanted more children. However, the data also support the hypothesis that, perhaps because of economic and social constraints, fewer children are desired than would be implied by the ideal. This is shown in Table 2; for the population as a whole, and excluding cases where family size already exceeds the ideal, the average value of D (desired additional) is only some two-thirds to three-quarters of that of E (ideal minus actual).¹ Moreover, a distinctive pattern by age and parity emerges; as age or parity increases, beyond a certain point the ratio of D to E starts to fall. This is true for age stratification in both 1969 and 1972 (the relationship is monotonic throughout the latter), and to a lesser extent for parity stratification in 1969. For younger women, the ideal can still be an objective; older women, on the other hand, perhaps take into account their own limited fertility potential when giving responses on number of additional children wanted, while ideal family size is not so constrained. Moreover, the economic constraints imposed by larger numbers of children may well reduce desires for more children more than it reduces 'ideals'. There is some support here for the argument that desired additional children will be more relevant to current fertility analysis than the difference between ideal and actual.

¹ It should be pointed out that D and E are not strictly comparable; the latter combines an ideal ("if you started your married life again") with reality, which is somewhat inconsistent. Our use of it here is primarily on the hypothesis that the 'ideal' is a social norm which conditions present behaviour even if it cannot be strictly regarded as a target.

Table 1

Desired additional children (D) by difference between
"ideal" and actual family size (E), 1969 and 1972.
Absolute numbers and (in brackets) percentages.

1969			
E ₆₉	D ₆₉		TOT
	0	>0	
<0	214 (94.3)	13 (5.7)	227 (100)
0	196 (94.2)	12 (5.8)	208 (100)
>0	88 (24.3)	274 (75.7)	362 (100)
TOT	498 (62.5)	299 (37.5)	797 (100.0)

1972			
E ₇₂	D ₇₂		TOT
	0	>0	
<0	221 (93.6)	15 (6.4)	236 (100)
0	189 (95.9)	8 (4.1)	197 (100)
>0	72 (31.6)	173 (68.4)	228 (100)
TOT	482 (71.1)	196 (28.9)	678 (100)

Table 2

Desired Additional children (D) and difference between "ideal" and actual family size (E), by₁ parity and by age (non-negative E only)¹

Subgroup ²	1969			1972		
	D ₆₉	E ₆₉	D ₆₉ /E ₆₉	D ₇₂	E ₇₂	D ₇₂ /E ₇₂
Total	1.22	1.61	0.76	0.90	1.31	0.69
C = 0	2.62	3.29	0.80	1.84	2.70	0.68
1	1.89	2.21	0.86	1.47	2.45	0.60
2	1.31	1.43	0.92	0.93	1.41	0.66
3	0.77	1.06	0.73	0.39	0.89	0.45
4	0.67	1.14	0.59	0.48	0.57	0.83
5	0.30	0.75	0.40	0.48	0.93	0.51
6	0.57	0.76	0.75	0.27	1.19	0.23
7	0.36	0.86	0.42	0.53	0.90	0.60
> 7	0	(0.40)	(0)	(0.33)	0.88	(0.38)
A ₁ = 0	2.40	3.14	0.77	1.82	1.91	0.95
1	1.88	2.17	0.87	1.35	1.65	0.82
2	1.54	1.71	0.90	0.86	1.06	0.82
3	0.89	1.11	0.80	0.60	0.94	0.64
4	0.61	1.20	0.51	0.71	1.42	0.50
5	0.47	1.01	0.47	0.53	1.41	0.38

¹ Figures in brackets based on 10 observations or less.

² C: presently living number of children; C₆₉ for 1969 data, C₇₂ for 1972 data.

A₁ : Age Group

Before turning to the reliability of D and I, a comment is required on the fertility and mortality variables. Mean fertility for the three years 1969 to 1972 is obtained from the 1972 pregnancy record, with a mean births per married women aged 15-44 of 0.64. Analysis by Knodel and Pitaktepsombati (1973) of similar data from the 1969 survey suggests that the information is of reasonable quality: if a bias is present, however, it is probably towards underestimation¹. The latter point is supported by reference to the mortality data, computed residually as $C_{69} + B - C_{72}$; such estimates are particularly liable to error, adding as they do the independent errors in three variables. However, this should not lead to biased results, and it is therefore a priori surprising that the mean mortality estimate obtained is virtually zero (0.01), with some 8.4% of observations negative.

Accurate data on the true mortality rate do not exist for rural Thailand, but approximate estimates can readily be made by using model life tables and applying them to the age-sex distribution of the children of the married women constituting the sample (which itself has to be estimated). A three year overall mortality rate of 6 to 6.5% was obtained in this way², corresponding to a value for our mortality

¹ On one comparison they suggest an underestimate in the survey of 8%, though they qualify this substantially.

² Estimates of the age-sex distribution of the population of Thailand were taken from Boonpratuang and Robinson (1973), mortality rates from Coale-Demeny model life tables (1966), level 17 (male), 18 (female), the levels being those used by Boonpratuang and Robinson. Alternative assumptions were made about the proportion of the population in each age group being offspring of women aged 15-44, whence the range from 6 to 6.5% in estimated crude mortality.

variable, M, of .215 to .235¹. An alternative approach is to use a question from the survey of 1969 on the total number of children of the interviewee who had died. The mean of this variable is about 0.7, compared with 3.61 living children, i.e. about 16%. This suggests a somewhat higher mortality rate², but it should be noted that the period covered includes - for some women - the 1950's and early 60's, when mortality was in fact higher.

One way to partly compensate for bias in the mortality estimates is to exclude observations where computed mortality is negative, and ipso facto erroneous. When this is done M rises to 0.148, births (B) increase by some 3% to 0.66, and the estimated number of children in 1972 falls by some 3% from 4.40 to 4.28. Estimated number of children on 1969 changes only marginally from 3.61 to 3.59. This suggests that births were somewhat, but not greatly underestimated, and that C₇₂ is biased more than C₆₉, though the reasons for this are obscure³. It seems reasonable to continue the analysis using only observations where mortality is non-negative; computed mortality is still about one-third less than that estimated above, but taking this step undoubtedly improves data quality sufficiently to outweigh any consequent new biases.

¹ $M = 3 \times \text{annual crude mortality rate for children of interviewees} \times \text{number of children in the family living in 1969}.$

² Cumulative mortality does not reach 16% until about age 30 in the life tables used above, whereas the mean age of all children in the sample is much lower; this method, if followed through, would therefore give higher values for the mortality variable, M.

³ The questions were the same in both surveys. However, this is a happy conclusion as we stratify by C₆₉ in subsequent analysis and do not need to use C₇₂ again.

c) Error in attitudinal variables

The use of longitudinal data gives an unusually good opportunity to investigate the accuracy with which attitudes towards family size are measured. The same variables, desired additional children (D) and ideal family size (I), are measured with an interval of three years, and by relating values for these variables in 1972 to values for 1969, an estimate of reliability can be obtained. We postulate the following relationships:

$$D_{72} = a_1 + b_1 D_{69} + c_1 B + d_1 M + e_1 \quad \dots 1$$

$$I_{72} = a_2 + b_2 I_{69} + c_2 B + d_2 M + e_2 \quad \dots 2$$

Our expectations for the coefficients are as follows:
 a_1 and a_2 : close to zero; b_1 and b_2 : close to 1, except insofar as external factors have generated changes in preferences over the three years; we shall return to this below. The coefficients of B (births) and M (deaths) are included here only to remove their influence on changes in D and I.¹ They are analysed in the next section, and comments here are restricted to the coefficients a and b.

Estimates of the coefficients of equations 1 and 2 are given in Tables 3 and 4 respectively, stratified first by parity and secondly by age.

The coefficients b_1 (Table 3) and b_2 (Table 4), although generally significant and positive, are strikingly low, mostly around 0.4, with no clear pattern on either age or parity stratification. As we have already taken the influence of

¹ For D in particular they have to be present to allow for plausible changes in desired additional children with each child born; for I a priori reasons are weaker, but they are included for the sake of comparability.

Table 3

$D_{72} = a + b \cdot D_{69} + c \cdot B + d \cdot M$. Coefficient estimates

(standard errors in brackets)

Subgroups	a	b	c	d	R ²	N
Total	0.356	0.413** (0.029)	-0.162** (0.069)	0.187* (0.102)	0.256	602
$C_{69} = 0$	1.180	0.466** (0.108)	-0.674** (0.244)	0.227 (0.473)	0.365	43
1	1.398	0.288* (0.140)	-0.496+ (0.363)	0.919 (0.784)	0.105	78
2	0.541	0.373** (0.059)	-0.303* (0.175)	0.717* (0.324)	0.364	82
3	0.319	0.222** (0.052)	-0.184+ (0.115)	0.144 (0.199)	0.194	85
4	0.225	0.196** (0.071)	0.066 (0.173)	0.344+ (0.242)	0.115	85
5	0.173	0.477** (0.142)	-0.110 (0.135)	-0.121 (0.185)	0.155	71
6	0.045	0.002 (0.060)	0.038 (0.081)	0.479** (0.141)	0.172	66
7	-0.038	1.127** (0.331)	0.162 (0.211)	0.228 (0.283)	0.256	40
> 7	0.119	-0.119 (0.516)	-0.075 (0.114)	0.067 (0.103)	0.013	52
$A_1 = 0$	0.645	0.441** (0.128)	-0.084 (0.494)	0.530 (0.554)	0.450	20
1	1.215	0.379** (0.098)	-0.538* (0.320)	0.367 (0.584)	0.169	88
2	0.421	0.404** (0.052)	-0.384** (0.147)	1.233** (0.365)	0.400	112
3	0.441	0.252** (0.050)	-0.371** (0.098)	0.455** (0.142)	0.291	121
4	0.277	0.331** (0.091)	0.031 (0.138)	-0.106 (0.200)	0.096	140
5	0.209	0.355** (0.061)	-0.134 (0.130)	0.034 (0.128)	0.237	113

** indicates significance at the 1% level, * at the 5% level, and + at the 10% level (one-tail tests).

D_{69} , D_{72} : desired additional children in 1969, 1972

B : births from 1969 to 1972

M : deaths of children from 1969 to 1972

C_{69} : present living parity (1969)

A_1 : age group of woman

TABLE 4

$I_{72} = a + b \cdot I_{69} + c \cdot B + d \cdot M$. Coefficient estimates
(standard errors in brackets)

Subgroups	a	b	c	d	R ²	N
Total	2.325	0.426** (0.036)	0.250* (0.109)	-0.002 (0.165)	0.205	602
C ₆₉ = 0	1.526	0.322** (0.111)	0.495* (0.246)	-0.745+ (0.486)	0.278	43
1	2.105	0.409** (0.140)	0.291 (0.328)	0.437 (0.708)	0.128	78
2	1.907	0.392** (0.071)	0.503** (0.211)	-0.186 (0.390)	0.369	82
3	2.257	0.379** (0.074)	0.257+ (0.199)	-0.599* (0.344)	0.299	85
4	2.460	0.327** (0.077)	0.812** (0.274)	-0.341 (0.387)	0.286	85
5	3.052	0.384** (0.143)	0.347 (0.500)	-0.304 (0.684)	0.110	71
6	2.939	0.403** (0.104)	0.355 (0.341)	-0.258 (0.567)	0.244	66
7	2.805	0.458* (0.215)	-0.036 (0.665)	1.221+ (0.915)	0.180	40
> 7	3.834	0.147 (0.133)	0.192 (0.413)	0.134 (0.375)	0.038	52
A ₁ = 0	2.716	0.043 (0.155)	0.606 (0.577)	-0.432 (0.650)	0.150	20
1	2.417	0.324** (0.101)	0.314 (0.307)	-0.248 (0.562)	0.120	88
2	1.958	0.453** (0.067)	0.240 (0.210)	0.093 (0.532)	0.322	112
3	2.650	0.365** (0.066)	0.222 (0.181)	-0.592* (0.262)	0.255	121
4	2.448	0.388** (0.094)	0.532* (0.308)	0.289 (0.434)	0.156	140
5	2.317	0.473** (0.086)	0.581+ (0.359)	-0.046 (0.347)	0.262	113

** significant at 1%; * significant at 5%; + significant at 10%

I₆₉, I₇₂ : ideal family size in 1969, 1972

B : births from 1969 to 1972

M : deaths of children from 1969 to 1972

C₆₉ : present living parity (1969)

A₁ : age group of woman

demographic occurrences into account in equations 1 and 2, we must look elsewhere for the reasons for this substantial deviation from the predicted value. The most obvious possibility is that there has been a major shift in preferences between 1969 and 1972. Certainly, current contraceptive use rose from 5.6 per cent to 18.9 per cent over this period, and economic and social changes were occurring at an increasing pace (though rather less in rural Thailand, our data frame, than in urban areas). However, such shifts should show up not only in the estimated regression coefficients, but also in a difference between 1969 and 1972 in mean values for ideal family size, I , and for desired additional children, D . In fact, the mean ratio of I_{72} to I_{69} is 1.06, and the ratio of D_{72} to D_{69} is 0.68, both far above the estimated coefficients around 0.4. And when one uses estimated coefficients of births (B) and deaths (M) from Tables 3 and 4 to remove the influence of demographic occurrences over 1969-1972¹, these ratios are not greatly altered: I_{72}/I_{69} becomes 1.02, D_{72}/D_{69} becomes 0.74. A second possible reason for the coefficients deviating from 1 is that the whole sample is three years older, and age is likely to influence attitudes to family size². But here too, any effects should show up not only on estimated coefficients, but also on the ratio of the means. It seems that real factors cannot explain all the differences between the estimates of b_1 and b_2 and unity, for it is necessary to explain a rotation of the relationship - i.e. a change in the slope around - for ideal family size at least - a little changed mean.

However, this pattern can readily be explained if we assume that the variables D and I contain two components, one real (R) and one stochastic (S), the latter arising out of variation in interviewee or interviewer mood and receptivity, interview

¹ i.e. to D_{69} and I_{69} are added the mean number of births and deaths over 1969-1972, multiplied by their estimated coefficients from Tables 3 and 4 respectively (whole sample).

² This may explain the differences in ratios between D and I above.

surroundings, inadequate understanding or unfamiliarity with the concepts used, variation in interviewing techniques, and by no means least, impreciseness in the concepts themselves. Let us for the moment assume that the components R and S are independent, that S has zero mean (and therefore does not bias overall estimates of desired or ideal number of children) and that these properties hold between interviews at different points of time of the same persons as well as between different persons. Thus $I_{69} = I_{69,R} + I_{69,S}$ and similarly for I_{72} , D_{69} and D_{72} . Then in equations 1 and 2, the stochastic terms lead to bias in the estimates of b_1 and b_2 . It can be shown¹ that if b is the true coefficient and $\hat{b}$ that estimated, then an unbiased estimate of b is given by

$$b = (1 + (V_S/V_R)) \hat{b} \quad \dots 3$$

where V_S and V_R are the variances of the stochastic and real components respectively.

As we do not know the true value of b , equation 3 cannot directly give us the error variance of I and D . However, approximate estimates can be obtained by taking b as equal to the ratios of I_{72} to I_{69} and D_{72} to D_{69} , after allowing for the influence of demographic events in the intervening three year period, as computed above². This gives the ratio of 'stochastic' variance to 'true' variance as 0.79 in the case of desired additional children, and 1.39 for ideal family size. These figures cannot be regarded as precise, because of changes in I and D over the three years for which we have not accounted; however, it seems reasonable to conclude that (a) the stochastic variance is of the same order of magnitude as the true variance and (b) stochastic variation is less important for the desired additional children variable than for ideal family size.

¹ See Johnston (1972).

² This is equivalent to forcing the estimated relationship to pass through the origin.

These conclusions are of some significance. In all surveys, errors are expected, but it is generally assumed that their variance is small relative to that of the true value of the variable under consideration. For responses on concrete questions such as births and family size, this may be reasonable - even in the case noted above, where computed mortality data were suspect, the errors required to produce poor computed residuals are small, and even a standard deviation of error of one child in reported family size - intuitively an extreme case - would result in a ratio of error to true variance of only 0.16. For births, misreporting is probably somewhat more likely, and it is unfortunate that in the data available we have no direct check on fertility; but here too error variances of the same order of magnitude as the true variance seem out of the question. Thus we can conclude that errors in attitudinal variables in the Longitudinal Study of Thailand were greater, and probably considerably greater than in any corresponding factual information. Moreover, this conclusion is reached without reference to two further factors: (a) it is probable that for any given individual, errors will be positively correlated between time periods: and (b) the question of bias has been neglected. Both of these factors add to the unreliability of attitudinal data.

d) Births, deaths and attitudes to family size

Although we can infer from the above discussion that the attitudinal variables discussed will not be very efficient in behavioural analysis, this does not preclude their use in behavioural models if they respond coherently and consistently to demographic occurrences. To test this response, relationships of the following form have been estimated:

$$(D_{72} - D_{69}) = a_1 + b_1 * B + c_1 * M + e_1 \quad \dots 4$$

$$(I_{72} - I_{69}) = a_2 + b_2 * B + a_2 * M + e_2 \quad \dots 5$$

i.e. the relationships between changes in attitudes and demographic occurrences. Our expectations for the coefficients are as follows:

- a_1, a_2 : no expectations; they may pick up the effects of secular changes in I and D;
- b_1 : negative, and close to -1 if desires for additional children consistently reflect a target family size;
- b_2 : zero if ideal family size is unaffected by parity, but positive if (as observed by a number of writers) the ideal rises to accommodate present parity;
- c_1 : positive, by the reverse argument to b_1 ; full "replacement" would imply +1;
- c_2 : zero or negative by the reverse argument to b_2 .

Results are reported in Tables 5 and 6¹. In the case of desired additional children (Table 5), the overall effect of births is generally negative, highly significant for the sample as a whole, and for some subgroups. However, the coefficient b_1 is considerably less than 1, indicating an increase in the family size target with each birth². Moreover, there is a distinct pattern by age and parity. The absolute size of the coefficient, starting close to -1, drops unevenly but sharply as parity increases, to marginal insignificance

¹ The coefficients of B and M reported in Tables 3 and 4 are dangerous to interpret in this context because of the difference in dependent variable, and also because of possible colinearity between B and D_{69} or I_{69} .

² Note that we assume the error on this variable to be much less than on the attitudinal variables, following our discussion above.

with 3 children and total insignificance with 5 or more children. It seems reasonable to interpret this pattern as reflecting a much clearer conceptualisation of desired additional children at lower parities. With larger families, the effects of additional children are proportionately less, and the targets implied by responses on desired additional children have less behavioural significance. The pattern by age is less clear, although a tendency for the coefficient of births to decline in absolute magnitude with age (the first age group excepted) is also present here.

Despite problems in its estimation, discussed above, the mortality variable is marginally significant with the expected sign for the sample as a whole, although the coefficient is fairly low¹. There is relatively little significance across the parity and age stratifications, but the sign is only twice negative, strongly suggesting that the replacement effect is present. There is some suggestion in the results that the replacement effect is strongest with parities of 2 or 3, or in the 25-29 age group; however, the lack of significance makes this conclusion tentative.

The constant is small for the sample as a whole, and varies inconsistently in sign between subgroups; there is little support here for a hypothesis of secular changes.

Table 6 gives the corresponding results for change in ideal family size. Not a single coefficient is significant at 5% across all sub-groups, giving some support to the view that 'ideal family size' is largely independent of family demographic history. However, 14 coefficients of the birth variable are

¹ This may be partly due to error; however, offsetting underestimation of c due to error there is overestimation due to a probable downward bias in M (see discussion above).

TABLE 5

$(D_{72} - D_{69}) = a + b \cdot B + c \cdot M$. Coefficient estimates
(Standard error in brackets)

Subgroup	a	b	c	R ²	N
Total	0.029	-0.440** (0.088)	0.271* (0.133)	0.043	602
C ₆₉ = 0	-0.167	-0.920** (0.300)	0.356 (0.594)	0.192	43
1	0.162	-0.453 (0.419)	0.083 (0.884)	0.016	78
2	0.166	-0.734** (0.263)	0.692+ (0.502)	0.101	82
3	-0.133	-0.323+ (0.221)	0.446 (0.380)	0.037	85
4	-0.068	-0.331 (0.270)	0.312 (0.385)	0.027	85
5	0.100	-0.152 (0.147)	-0.116 (0.201)	0.025	71
6	-0.197	-0.105 (0.186)	0.056 (0.321)	0.005	66
7	-0.018	0.150 (0.206)	0.228 (0.279)	0.032	40
> 7	0.081	-0.049 (0.118)	0.070 (0.106)	0.009	52
A ₁ = 0	-0.685	-0.190 (0.710)	0.520 (0.797)	0.046	20
1	0.401	-0.760* (0.385)	-0.091 (0.701)	0.052	88
2	-0.102	-0.596** (0.215)	1.220* (0.539)	0.091	112
3	0.019	-0.481** (0.166)	0.373+ (0.240)	0.084	121
4	0.002	0.005 (0.163)	0.063 (0.235)	0.001	140
5	0.040	-0.230 (0.183)	0.124 (0.180)	0.014	113

** significant at 1%; * at 5%; + at 10%.

D₆₉, D₇₂ : desired additional children, 1969, 1972

B : births from 1969 to 1972

M : deaths of children from 1969 to 1972

C₆₉ : present living parity (1969)

A₁ : age group of woman

Table 6

$(I_{72} - I_{69}) = a + b*B + c*M$ Coefficient estimator
(standard errors in brackets)

Subgroups	a	b	c	R ²	N
Total	0.148	0.118 (0.130)	-0.011 (0.197)	0.001	602
C ₆₉ = 0	-0.681	0.354 (0.338)	-0.497 (0.669)	0.032	43
1	0.339	0.338 (0.362)	-0.200 (0.765)	0.012	78
2	0.210	0.042 (0.281)	-0.025 (0.538)	0.000	82
3	-0.006	0.119 (0.269)	-0.179 (0.463)	0.004	85
4	-0.358	0.483 (0.377)	-0.248 (0.538)	0.023	85
5	0.550	0.171 (0.559)	-0.075 (0.765)	0.001	71
6	0.518	-0.195 (0.401)	-0.646 (0.691)	0.019	66
7	0.509	0.160 (0.707)	0.745 (0.958)	0.018	40
> 7	-0.154	-0.270 (0.549)	0.625 (0.496)	0.032	52
A ₁ = 0	-0.936	0.833 (1.025)	0.013 (1.150)	0.046	20
1	0.255	0.279 (0.377)	-0.649 (0.687)	0.013	88
2	0.081	0.105 (0.264)	-0.598 (0.665)	0.008	112
3	0.312	0.051 (0.241)	-0.490 ⁺ (0.349)	0.017	121
4	0.017	0.033 (0.340)	0.755 ⁺ (0.488)	0.017	140
5	0.130	0.150 (0.406)	0.085 (0.400)	0.003	113

** significant at 1%; * at 5%; + at 10%.

I₆₉, I₇₂ : ideal family size, 1969, 1972

B : births from 1969 to 1972

M : deaths of children from 1969 to 1972

C₆₉ : present living parity (1969)

A₁ : age group of woman

positive out of 16, suggesting that some effect may nevertheless be present, but that stochastic variation in the dependent variable is too large for it to be identified statistically. If this is correct, the order of magnitude of the effect on ideal family size would appear to average about 0.1 per birth with a rather larger effect at lower ages and parities.

Any relationship with mortality is weaker still. 11 coefficients out of 16 are negative, the sign suggested by the hypothesis advanced above, but it is equally plausible to interpret the results as indicating no relationship.

e) Desires for children and subsequent fertility

The results of sub-section (d) indicate a response of attitudinal variables to demographic events which broadly conforms to the directions predicted by an assumption of rational behaviour. In this section, we investigate the reverse relationship - whether fertility in the interval 1969 to 1972 has any relationship to the attitudes expressed at the beginning of the period.

The precise relationship between desired additional children in 1969 and fertility over 1969-1972 depends not only on the extent to which desires are translated into practice, but also on the extent of and reasons for child spacing; only a proportion of desired additional births will in fact be observed in the period 1969-1972, and this both weakens and modifies the observed relationship, the former because variation in timing introduces a new and as yet unexplained element, and the latter because the larger the number of additional children wanted, the smaller the proportion which can be born in the three-year period - i.e. the relationship will be non-linear.

The following formulations of the relationship with births over 1969-1972 (B) were tested, using as alternative independent

variables ideal additional number of children¹ (E_{69}) and desired additional number of children (D_{69})

$$B = a_1 + b_1 * E_{69} \quad \dots 6a$$

$$B = a_2 + b_2 * D_{69} \quad \dots 6b$$

$$B = a_3 + b_3 * f(E_{69}) \quad \dots 7a$$

$$B = a_4 + b_4 * f(D_{69}) \quad \dots 7b$$

where $f(X)$ is as follows:

$$f(X) = 0 \text{ where } X < 0$$

$$f(X) = X \text{ where } 0 \leq X \leq 2$$

$$f(X) = 2.8 \text{ for } X = 3$$

$$f(X) = 3.3 \text{ for } X = 4$$

$$f(X) = 3.5 \text{ for } X = 5$$

The formulation in equations 6a and 6b is linear, including, for E_{69} , negative values. The logic for equations 7a and 7b is that the probability of giving birth rises linearly with desired additional family size up to a certain level; the impact of the second additional desired child is likely to be as large as that of the first, since the time interval to the first additional child is likely to be shortened if a second is wanted (thus bringing more first births within the three-year time span), and it is also not exceptional to have two births in three years. Similar arguments apply, but somewhat weakened, to the third additional child desired; i.e. we consider that biological constraints on fertility have some effect, but that the predominant factor is the reduction in

¹ As noted above, this variable is built from disparate components; ideal additional number of children should be read as equivalent to ideal minus actual family size, which is theoretically a rather different concept.

child spacing interval; taking these factors intuitively into account, the effect of the third additional child is assumed to be only 0.8 times that of the second. By extension of this argument, the fourth and fifth additional children wanted are taken to have respectively 0.5 and 0.2 times the impact of the second, and larger additional numbers desired are assumed to have no impact on fertility in the short term. The precise form of this function is partly intuitive, and partly arbitrary; however it is worth noting that it produced a slightly better fit than either of two alternatives, (a) a similar form with declines in birth probability commencing only at level 4 for desired additional children; and (b) a logarithmic form.

The results (Table 7) support the hypothesis that ideal and desired numbers of additional children are both reflected in subsequent fertility. For the sample as a whole, the coefficients of both D and E are positive and highly significant. For the parity and age stratifications, significance varies substantially, but this is probably a stochastic phenomenon and the general tendency is towards a positive sign, with the exception of the highest parity and age groups. A tendency for attitudes to have the least effect on behaviour at higher ages and parities would certainly be consistent with the results presented in section (d), where it was found that the effect of behaviour on attitudes was least in these groups. However, the results of Table 7 are insufficiently strong for this to be more than suggested.

A number of comments should be made on these results. Firstly, the use of the non-linear function generally improves the fit as measured by R^2 , supporting the broad hypothesis underlying the specification of this function (without necessarily validating its precise shape). Moreover, the coefficients are considerably raised by the use of the non-linear function. Secondly, the large error components of D and E, identified in section (c),

Table 7

Fertility as a Function of Ideal or Desired Additional Children

Regression coefficients with standard errors in brackets

Group	Linear: $B = a + b \cdot E_{69}, D_{69}$				Non-Linear: $B = a + b \cdot f(E_{69}), f(D_{69})^1$			
	Constant	Independent variables		R^2	Constant	Independent variables		R^2
		E_{69}	D_{69}			E_{69}	D_{69}	
Total	0.690 0.635	0.042** (0.010) -	- 0.070** (0.017)	0.032 0.030	0.608 0.616	0.100** (0.022) -	- 0.112** (0.024)	0.033 0.036
$C_{69} = 0$	0.764 0.675	0.072 (0.069) -	- 0.115* (0.067)	0.023 0.061	0.387 0.473	0.236+ (0.147) -	- 0.232* (0.107)	0.054 0.094
$C_{69} = 1$	0.742 0.724	-0.004 (0.044) -	- 0.005 (0.040)	0.000 0.000	0.730 0.699	0.002 (0.068) -	- 0.022 (0.059)	0.000 0.002
$C_{69} = 2$	0.667 0.692	0.064* (0.034) -	- 0.055+ (0.035)	0.045 0.031	0.613 0.673	0.128* (0.057) -	- 0.096 (0.060)	0.059 0.032
$C_{69} = 3$	0.721 0.722	0.003 (0.042) -	- 0.003 (0.050)	0.000 0.000	0.695 0.724	0.035 (0.074) -	- 0.000 (0.081)	0.003 0.000
$C_{69} = 4$	0.616 0.584	0.032 (0.030) -	- 0.075* (0.044)	0.013 0.035	0.550 0.567	0.122* (0.061) -	- 0.131* (0.070)	0.048 0.041

Table 7 (cont'd.)

Group	Constant	E ₆₉	D ₆₉	R ²	Constant	E ₆₉	D ₆₉	R ²	N
C ₆₉ = 5	0.608 0.545	0.040 (0.032) -	- 0.142 (0.111)	0.022 0.023	0.570 0.545	0.022 (0.077) -	- 0.145 (0.114)	0.001 0.023	71
C ₆₉ = 6	0.850 0.669	0.102** (0.030) -	- 0.130+ (0.096)	0.129 0.031	0.671 0.665	0.163+ (0.124) -	- 0.148+ (0.103)	0.029 0.035	60
C ₆₉ = 7	0.548 0.593	-0.008 (0.047) -	- -0.229 (0.250)	0.001 0.021	0.575 0.593	-0.026 (0.172) -	- -0.229 (0.250)	0.001 0.021	42
C ₆₉ > 7	0.646 0.588	0.019 (0.042) -	- -0.588 (0.705)	0.004 0.014	0.600 0.588	-0.300 (0.250) -	- -0.588 (0.705)	0.028 0.014	52
A _L = 0	1.030 1.014	0.019 (0.053) -	- 0.029 (0.055)	0.006 0.014	0.900 0.941	0.082 (0.108) -	- 0.077 (0.092)	0.028 0.033	22
A = 1	0.912 0.916	0.045+ (0.033) -	- 0.047+ (0.035)	0.021 0.021	0.803 0.833	0.117* (0.053) -	- 0.118* (0.051)	0.055 0.061	86
A _L = 2	0.800 0.788	0.029 (0.026) -	- 0.035 (0.032)	0.011 0.010	0.763 0.775	0.062 (0.051) -	- 0.058 (0.053)	0.013 0.010	114

Table 7 (cont'd.)

Group	Constant	E ₆₉	D ₆₉	R ²	Constant	E ₆₉	D ₆₉	R ²	N
A ₁ = 3	0.721	-0.001 (0.031)	-	0.000	0.720	0.002 (0.062)	-	0.000	104
	0.715	-	0.009 (0.048)	0.000	0.727	-	-0.010 (0.062)	0.000	
A ₁ = 4	0.551	-0.005 (0.019)	-	0.001	0.579	-0.044 (0.051)	-	0.005	146
	0.560	-	-0.014 (0.055)	0.000	0.556	-	-0.003 (0.063)	0.000	
A ₁ = 5	0.425	0.006 (0.018)	-	0.001	0.408	0.023 (0.065)	-	0.001	113
	0.409	-	0.024 (0.050)	0.002	0.420	-	-0.018 (0.085)	0.000	

** significant at 1%; * at 5%; + at 10%.

1 For definition of f see equations 7a and 7b and associated text.

B : births from 1969 to 1972

E₆₉ : ideal family size minus actual family size, 1969

D₆₉ : desired additional children, 1969

C₆₉ : present living parity, 1969

A₁ : age group of woman.

will cause the coefficients of these variables to be underestimated by of the order of 50 per cent, probably somewhat less for D and somewhat more for E. This suggests that for the sample as a whole, around 20 per cent of desired or ideal additional children result in births in a three-year period (using the non-linear formulation to discount the influence of large numbers of desired additional children).¹ Thirdly, the constant is large, and the level of explanation, as measured by R^2 , is low. The implication to be drawn is that even after taking into account errors in E and D, the component of fertility which is not related to expressed desires for children is more important than the component which can be causally associated with E and D. This may be due to inability to control fertility, or it may indicate that expressed attitudes are only partially relevant. Fourthly, and somewhat surprisingly, there is little difference in significance between E and D in explaining fertility. Our discussion above suggested that desired additional children would be a better explanatory variable than ideal minus actual family size. The fact that this is not so indicates that either variable might be used in a wider fertility model.

¹ It is proposed to re-estimate these functions subsequently using generalised least squares and an estimate of the error variance.

III. Desired Additional Children and Demographic Models

In this section some possible roles for the variable 'desired additional children'¹ in demographic models are studied, with the aid of the Thai data described and used above. Firstly, the validity and effectiveness of behavioural explanations of desired additional children are investigated, comparing results with those obtained where fertility is the dependent variable. Secondly, we study the role of desired additional children in a physiological fertility model where demands for children are separated from the ability to control fertility. And thirdly, we test the usefulness of desired additional children in a model of contraceptive acceptance.

a) Behavioural functions for fertility and desired fertility

The economic model of fertility determination is now well established in the literature², and we shall not develop the theory here. Broadly, fertility is seen as part of a household decision-making process in which the allocation of household resources, including income and time, to different ends, including child-raising, is determined; within this framework, alternative economically based models of fertility responding to different household characteristics and environments can readily be established. However, at the base of such models is the concept of births as a consciously determined phenomenon; that is, the level of fertility is a result of demand for children. Thus a behavioural model of fertility constitutes a good base for the testing of the relevance of expressed desires for children, since the most direct impact of behavioural relationships should be on demands for children - the impact on births should in general be less because of imperfect control over fertility.

¹ We restrict analysis to this variable rather than continuing to also cover ideal family size. In addition, we stratify only by parity in this section.

² See the supplement of the Journal of Political Economy, March/April, 1973 for extensive analysis of such models.

Unfortunately, the Longitudinal Survey of Thailand covers only some of the variables required for an economic analysis of fertility; in particular, wage and income data are lacking, as is detailed information on the disposition of time within the household. Moreover, a rural sample is not the most favourable for analysis of this type, because socio-economic variation tends to be less. However, a partial model has been formulated and is reported below.

Two alternative dependent variables are used, births from 1969 to 1972 (B), and desired additional children in 1969 (D_{69}), using the non-linear form developed in Section II (e). The following explanatory variables are used:

- (i) A_{69} : age in 1969; although not theoretically a component of the fertility model, this variable may have behavioural as well as physiological implications;
- (ii) E_w^1 : education of the woman concerned. As this is positively related to the opportunity cost of the woman's time - i.e. a positive wage-education relationship is expected - we expect increased education to be associated with lower fertility or desired additional children;
- (iii) E_h : education of the husband or household head. This variable serves as a rather poor proxy for income; its sign is indeterminate a priori, but its effect is likely to be at least less negative than that of the woman's education²;
- (iv) L : female labour force participation outside the home. This variable can be expected to be negatively associated with fertility, in so far as labour force participation is incompatible with child-raising;
- (v) K : domestic employment opportunities, as measured by the occupation of the head

¹ Takes the value 1 if at least 4 years of primary school completed, zero otherwise.

² See Schultz (1974), p.14.

of the household; this should have a positive impact on fertility, both through making child-raising compatible with economic activity, and through raising the returns to "investment" in children, where opportunities exist for children to contribute to household income from a young age;

- (vi) T : average mortality levels (% per year), among children aged 1-14, in the province of residence of the interviewee. This variable is used as an indicator of expected mortality because it seems to be the most reliable mortality information available at the province level, although still far from perfect. Although in theory the sign of this variable is indeterminate, in practice experience in other developing countries suggests that the impact of mortality on fertility is positive, implying that the price elasticity of demand for children is low¹;
- (vii) X : expectation of education costs of children measured by the percentage of all children aged 11 to 13 attending school in the mother's province of residence (1970). We expect a negative relationship between this variable and fertility if these costs are taken into account in the fertility decision.

The variables measuring labour force participation and domestic employment opportunities proved to be insignificant throughout, and have been dropped from the analysis. This leaves the following functions to be estimated:

$$B = a_0 + a_1 * A_{69} + a_2 * E_w + a_3 * E_h + a_4 * X + a_5 * T + e \quad \dots 8$$

$$D_{69} = b_0 + b_1 * A_{69} + b_2 * E_w + b_3 * E_h + b_4 * X + b_5 * T + e \quad \dots 9$$

¹ See Schultz (1974), p.16.

Results are given in Tables 8 and 9. The age variable is significant and negative for all birth functions; a tendency in the same direction for the desired additional children functions is much weaker, with the exception of the whole sample regressions. A reasonable interpretation of this would be that for births, the relationship reflects largely a physiological effect both within each parity stratum and for the sample as a whole. The same is not true for desired additional children; although age has a strong effect in the whole sample, and more significant than that for births, this is greatly weakened with parity stratification, indicating that the bulk of the true relationship is in fact with parity.

The female education variable, E_w , is generally negative and often significant for both births and desired additional children. The level of significance tends to be somewhat higher for desired additional children, in conformity with our suggestion, above, that the effects on desires will generally exceed those on practice - i.e. births. Because of the different coverage and units of the dependent variables we cannot directly compare the coefficients; however, for the sample as a whole the difference between more and less educated women is some 30 per cent of the mean value of D_{69} , and 18% of the standard deviation, as compared with only 12 per cent of the mean value or standard deviation of B.

The husband's education, E_h , usually has, as anticipated, a less negative effect than wife's education. However, for both birth and desired additional children functions, its effect is generally not significant and varies in sign.

The last two variables, children's education (X) and mortality (M) raise problems because they are defined at the province level and are inter-correlated. Children's education is generally negatively related to births, with a fair degree

Table 8

Behavioural Fertility Functions

$$B = a_0 + a_1 * A_{69} + a_2 * E_w + a_3 * E_h + a_4 * X + a_5 * T$$

(standard errors in brackets)

Subgroup	a_0	a_1	a_2	a_3	a_4	a_5	R^2	N
Total	1.953	-0.030** (0.004)	-0.084+ (0.060)	0.016 (0.063)	-0.052** (0.020)	-	.12	587
"	1.600	-0.031** (0.004)	-0.085+ (0.060)	0.027 (0.064)	-	0.032 (0.030)	.11	587
"	2.269	-0.031** (0.004)	-0.082+ (0.060)	0.013 (0.063)	-0.077** (0.029)	-0.053 (0.043)	.12	587
$C_{69} = 0$	6.764	-0.094** (0.021)	-0.564+ (0.400)	0.166 (0.366)	-0.200+ (0.119)	-0.584** (0.186)	.48	38
$C_{69} = 1$	1.689	-0.036** (0.010)	-0.178 (0.200)	0.245 (0.203)	0.021 (0.075)	-0.049 (0.116)	.17	78
$C_{69} = 2$	3.397	-0.045** (0.012)	0.045 (0.177)	0.168 (0.190)	-0.183* (0.081)	-0.193+ (0.129)	.23	79
$C_{69} = 3$	3.082	-0.036** (0.015)	-0.273+ (0.164)	-0.261 (0.205)	-0.233* (0.108)	0.047 (0.122)	.23	76
$C_{69} = 4$	2.096	-0.033** (0.013)	0.046 (0.166)	-0.022 (0.169)	-0.097 (0.077)	0.022 (0.114)	.12	85
$C_{69} = 5$	1.609	-0.026* (0.015)	-0.168 (0.148)	0.170 (0.170)	0.026 (0.075)	-0.080 (0.119)	.09	70
$C_{69} = 6$	4.874	-0.071** (0.023)	-0.213+ (0.164)	0.201 (0.171)	-0.203* (0.086)	-0.151 (0.141)	.27	60
$C_{69} = 7$	4.373	-0.052* (0.025)	0.051 (0.192)	-0.296+ (0.196)	-0.197+ (0.138)	-0.229+ (0.141)	.18	43
$C_{69} > 7$	2.411	-0.056+ (0.035)	0.036 (0.207)	-0.205 (0.189)	-0.027 (0.104)	0.174 (0.186)	.15	58

** significant at 1%, * at 5%, + at 10%

B : births from 1969 to 1972

A_{69} : age of woman in 1969

E_w : education of woman; dummy variable: 1 = primary completed

E_h : education of husband; dummy variable: 1 = primary completed

X : education of children (macro variable) (divided by 10 to aid in presentation)

T : child mortality (macro variable)

C_{69} : present living parity

Table 9

Behavioural Functions for Desired Additional Children

$$D_{69} = a_0 + a_1 * A_{69} + a_2 * E_w + a_3 * E_h + a_4 * X + a_5 * T$$

(standard errors in brackets)

Subgroup	a_0	a_1	a_2	a_3	a_4	a_5	R^2	N
Total	3.362	-0.067** (0.006)	-0.208* (0.097)	-0.099 (0.103)	-0.056* (0.032)	-	.19	587
"	2.747	-0.067** (0.006)	-0.212* (0.097)	-0.091 (0.103)	-	0.096* (0.048)	.19	587
"	2.923	-0.067** (0.006)	-0.211* (0.097)	-0.094 (0.103)	-0.020 (0.046)	0.074 (0.070)	.19	587
$C_{69} = 0$	2.141	-0.033 (0.036)	-0.527 (0.677)	0.938 ⁺ (0.619)	-0.016 (0.202)	0.215 (0.314)	.23	38
$C_{69} = 1$	-1.695	0.012 (0.021)	-0.254 (0.413)	0.201 (0.420)	0.189 (0.155)	0.581** (0.239)	.11	78
$C_{69} = 2$	2.827	-0.037* (0.022)	-0.432 ⁺ (0.324)	-1.280** (0.348)	0.018 (0.148)	0.130 (0.236)	.30	79
$C_{69} = 3$	1.020	-0.010 (0.023)	0.079 (0.262)	-0.098 (0.326)	-0.067 (0.173)	0.064 (0.195)	.02	76
$C_{69} = 4$	4.448	-0.042* (0.020)	-0.603** (0.251)	0.301 (0.256)	-0.235* (0.117)	-0.345* (0.173)	.14	85
$C_{69} = 5$	1.075	-0.011 (0.017)	-0.114 (0.168)	-0.193 (0.192)	-0.044 (0.085)	-0.007 (0.134)	.05	70
$C_{69} = 6$	1.848	-0.051 ⁺ (0.032)	-0.381* (0.225)	0.075 (0.235)	-0.017 (0.118)	0.193 (0.194)	.11	60
$C_{69} = 7$	0.277	0.001 (0.017)	-0.209 ⁺ (0.126)	-0.041 (0.128)	-0.017 (0.091)	-0.004 (0.093)	.10	43
$C_{69} > 7$	-0.076	0.002 (0.007)	-0.051 (0.042)	0.045 (0.038)	0.003 (0.021)	-0.005 (0.038)	.05	58

** significant at 1%, * at 5%, + at 10%

D_{69} : desired additional children, 1969

A_{69} : age of woman in 1969

E_w : education of woman; dummy variable: 1 = primary completed

E_h : education of husband; dummy variable: 1 = primary completed

X : education of children (macro variable) (divided by 10 to aid in presentation)

T : child mortality (macro variable)

C_{69} : present living parity

of significance; this is true whether or not the mortality variable is included. For desired additional children, on the other hand, the variable is generally insignificant, and varies in sign if the mortality variable is included; without the mortality variable it is significant for the sample as a whole, and although generally insignificant across the parity stratification, it is consistently negative except for the highest parity group.¹ The mortality variable, by contrast, has a less strong effect. In the fertility functions it tends to have a weak negative effect if the children's education variable is included, a weak positive effect if it is not; in the desired additional children functions it has a generally positive effect taken alone, significant for the sample as a whole, but a rather weaker and somewhat inconsistent effect when the education variable is included.

For these two variables, then multicollinearity makes interpretation difficult - they are moreover collinear with other variables such as urbanisation. However, it seems reasonable to conclude that children's education has a more significant effect on births than on desired additional children. This may largely be the result of stochastic variation in D_{69} - it is worth noting that when the mortality variable is excluded in the sample as a whole, the estimated coefficient of child's education is very similar for both D_{69} and B. The mortality variable has a generally positive effect only when taken alone; it is then more significant for D_{69} . But for D_{69} multicollinearity makes the separation of the effects of E and M difficult, while in the case of B, the effects of children's education predominate.

¹ For economy of exposition, results where either mortality or children's education are excluded are given only for the sample as a whole in Tables 8 and 9.

Over-all, there is not a great deal of difference in general performance between the birth and desired additional children functions. Although within sub-groups, the birth functions tend to have a higher R^2 , this can be largely traced to non-behavioural effects of age. The desired additional children function does better on female education; the birth function is superior for child education. The results for mortality are ambiguous, and the effects of husband's education are generally insignificant. These results are rather weak; but the inference can still legitimately be made that the desired additional children function does not in this case add significantly to our understanding of or ability to estimate fertility relationships. For it to do so, better results would be required on the desired additional children function than on the birth function, to compensate for the loss in efficiency arising from the addition of a new variable intervening between fertility and its objective determinants.¹ The reason why results with desired additional children are not superior to those for births is probably largely to be found in the inaccuracy with which the former variable is measured - it seems from the functions estimated that the variable itself is meaningful and that hypotheses arising out of the economic model of fertility can as reasonably be tested on this variable as on fertility.

b) Physiological birth functions

One of the basic fertility models for which attitudinal variables are potentially most useful involves the distinction between wanted and unwanted children. Desires for children are transformed into births, but via a process over which control is imperfect. Thus natural fecundity and sterility, contraceptive use, social constraints on frequency of intercourse,

¹ The point can of course be legitimately made that with a wider (longitudinal) data source, a more exhaustive test of attitudinal variables might not confirm this conclusion; we are necessarily restricted by the data base.

infant mortality and so on, all have additional effects on fertility. Here we test a model of this type, using the 'desires for additional children' variable analysed above. Births from 1969 to 1972 (B) are taken as a function of:

- (i) D_{69} : additional children wanted in 1969 using the non-linear form $f(D)$ described in II(e) to avoid the effects of large values;
- (ii) U : current or past contraceptive use; although contraceptive use in 1969 alone (U_{69}) is a plausible variable, the dramatic rise in contraceptive take-up from 1969 to 1972¹ makes it seem more reasonable to use a composite variable for 1969 and 1972 (U_{70}) to capture some of the effect of increasing contraceptive dissemination on births over the three-year period²;
- (iii) A_{69} : age, to allow for decreasing fecundity;
- (iv) $(D_{69} * E)^3$: an interaction term, desired additional children times education level of the woman to allow for differential effects of desire for children at different educational levels.

Thus: $B = a_0 + a_1 * D_{69} + a_2 * U_{70} + a_3 * A_{69} + a_4 (D_{69} * E) + e \dots 10$

¹ In the case of this sub-sample, which excludes women reported pregnant in 1969, from 8.5 to 22.4 per cent.

² The variable used takes the value 2 if contraceptives have been used by 1969, 1 if they have been used by 1972 but not by 1969, and 0 otherwise. Comparison with a model using 1969 alone indicates that use of this composite variable improves the results, although only slightly.

³ The education variable is a dummy for completed at least four years of primary education (or not); there was insufficient variation in educational level to distinguish other categories - tests using observations with secondary education separately were inconclusive because of an insufficient number of observations.

Expectations for the coefficients are:

a_1 : positive (cf Table 7)

a_2 : negative

a_3 : negative

a_4 : no expectation - interactions between D,U,A and E
could lead to this variable having either sign.

Results are given in Table 10. In general they support the model, although as usual significance is not high. The coefficients of "desired additional children" are generally positive, with the exception of the two highest parity groups, as in Table 7, and with weak significance for the sample as a whole. However, the level of significance and the absolute size of the coefficients are both smaller than in Table 7, a phenomenon which can be partly traced to collinearity between age and desires for children for any given parity. The contraceptive use variable is highly significant for the sample as a whole, with a negative effect on births. Within sub-groups its effect varies, with the maximum negative effect at parities 3 and 4, and negative impact at higher parities, but a non-significant positive effect at parities 1 and 2. This suggests an acceptable modification to our hypothesis - at lower parities, contraceptive use is related primarily to short-term child spacing, and has little effect on three-year fertility, with the possible exception of parity zero, as a longer interval might be expected before the first birth than between births. For parities 3 and above, the use of contraceptives more unambiguously reflects an attempt to reduce fertility. The age variable is negative as expected, even within parity groups, always significant and highly significant up to parity 4, and for the sample as a whole. As noted above, this variable may well pick up some effects on

Table 10

Physiological Birth Functions

$$B = a_0 + a_1 * D_{69} + a_2 * U_{70} + a_3 * A_{69} + a_4 (D_{69} * E)$$

(standard errors in brackets)

Subgroup	a_0	a_1	a_2	a_3	a_4	R^2	N
Total	1.549	0.051 ⁺ (0.036)	-0.145** (0.046)	-0.028** (0.004)	-0.065 ⁺ (0.042)	.13	492
$C_{69} = 0$	2.368	0.104 (0.163)	-0.211 (0.337)	-0.062** (0.019)	-0.117 (0.141)	.39	32
$C_{69} = 1$	1.580	0.014 (0.099)	0.030 (0.130)	-0.037** (0.010)	-0.018 (0.096)	.20	61
$C_{69} = 2$	1.703	0.051 (0.067)	0.017 (0.144)	-0.041** (0.012)	0.062 (0.085)	.24	70
$C_{69} = 3$	1.937	0.074 (0.115)	-0.311** (0.113)	-0.039** (0.014)	-0.115 (0.145)	.21	64
$C_{69} = 4$	1.767	0.074 (0.074)	-0.276** (0.101)	-0.035** (0.013)	-0.025 (0.132)	.20	69
$C_{69} = 5$	1.297	0.285* (0.138)	-0.080 (0.122)	-0.022 ⁺ (0.016)	-0.300 ⁺ (0.219)	.12	60
$C_{69} = 6$	3.149	0.115 (0.116)	-0.154 (0.148)	-0.065* (0.027)	-0.073 (0.217)	.17	47
$C_{69} = 7$	2.131	-0.194 (0.233)	-0.205 ⁺ (0.147)	-0.040 ⁺ (0.025)	Z	.13	38
$C_{69} > 7$	3.095	-0.429 (0.643)	-0.025 (0.238)	-0.065* (0.037)	Z	.08	51

** significant at 1%; * at 5%; + at 10%

Z indicates no variation in the variable.

B = births from 1969 to 1972

D_{69} = desired additional children, 1969

U_{70} = contraceptive use 1969-72 (composite variable)

A_{69} = age in 1969

E = education of woman

fertility of decline in desired additional children with age, but the predominant effect is doubtless physiological. Finally, the interaction term tends to be negative, but its significance is very weak. It is, however, retained because its inclusion is considered to improve the specification of the equation.

Over-all, if our hypothesis is that births arise out of demand for children and the ability to control reproduction, then these data give very much greater weight to the question of control. Of course this does not necessarily imply that demands for children are unimportant - it may well be that, as argued above, expressed desires do not measure these demands very well. Moreover, an important point to take into account is that the degree of control, as measured by contraceptive use, may well be influenced by demand for children; we turn to this next.

c) Contraceptive acceptance

A key variable in the physiological birth functions is the use of contraceptives, as measured by the composite variable U_{70} . Here we test a model of the determinants of this variable. It would, of course, be possible to take a simpler variable such as current use of contraceptives as dependent, but the composite variable is used because it is consistent with the model in Section II(b) above, takes three values rather than two and thereby avoids statistical problems of dummy dependent variables, and also encompasses much more variation than contraceptive use in 1969 alone.

Four variables are taken as influencing the use of contraceptives:

- (i) D_{69} : desire for additional children in 1969. Where this is positive, we expect contraceptive use to be less; as the number of desired additional children rises, the influence on contraceptive use declines sharply - given a positive demand for children, contraceptive use should be

affected only by child spacing, a factor which becomes rapidly less important as the number of additional children increases. In the model the non-linear form incorporated is that used for the effects of ¹desired additional children on births;

- (ii) A_{69} : age will affect the use of contraceptives negatively in two ways; firstly, it will reflect resistance to new methods among older women; and secondly, it will reflect increasing sterility, making the use of contraceptive methods redundant;
- (iii) E_w ² : education of the woman can be expected to positively affect the use of contraception, both by increasing awareness of its availability and usefulness, and by increasing receptivity to change;
- (iv) F_{70} : the spread of family planning programmes should increase awareness of and responsiveness to contraception. As a proxy for this variable, we use the cumulative number of family planning acceptors within the official programme to 1970 in the province where each interviewee lives,³ divided by the married female population, aged 15 to 49, in that province, and expressed as a percentage.

This gives the following linear model:

$$U_{70} = a_0 + a_1 * D_{69} + a_2 * A_{69} + a_3 * E_w + a_4 * F_{70} + e \quad \dots ll$$

¹ A form using a dummy variable was also used but did not improve the results.

² Defined as a dummy variable, completed at least four years schooling (or not).

³ Source: Thai National Family Planning Programme.

Results are given in Table 11. For the sample as a whole, all variables are significant with the predicted signs, although the over-all level of explanation is fairly low. Within the parity stratification, none of the variables are entirely consistent, but over-all each tends to repeat the pattern for the sample as a whole, without strongly indicating any variation with parity. The desire for additional children is, surprisingly, the least consistent variable; however, it tends to be positive, attaining maximum significance at parities 1 and 2; interestingly these are precisely those parities where the effects of contraceptive use on births is least (Table 10). Above we argued that this was probably because of the effects of child spacing; since the form of D_{69} allows for the effects of child spacing, the results are consistent. The frequent significance of the family planning variable is not necessarily to be interpreted as confirming the effectiveness of the government family planning extension programme. In practice, the extension of family planning by province is highly correlated with the degree of urbanisation of that province (incidentally, an interesting comment on the programme itself). Thus this variable may well also be picking up the effects of proximity of urban centres; although the family planning programmes probably contributes, we cannot identify the extent to which it contributes because of multicollinearity when an urbanisation variable is introduced.

Table 11

Contraceptive Use Functions

$$U_{70} = a_0 + a_1 * D_{69} + a_2 * A_{69} + a_3 * E_w + a_4 * F_{70}$$

(standard errors in brackets)

Subgroup	a_0	a_1	a_2	a_3	a_4	R^2	N
Total	0.625	-0.091** (0.025)	-0.129** (0.040)	0.123* (0.056)	0.081** (0.023)	.08	487
$C_{69} = 0$	0.335	0.021 (0.076)	-0.108 (0.127)	-0.039 (0.258)	0.075 (0.058)	.14	27
$C_{69} = 1$	0.732	-0.153** (0.057)	-0.070 (0.104)	-0.119 (0.191)	0.087+ (0.066)	.15	61
$C_{69} = 2$	0.631	-0.082+ (0.050)	-0.170* (0.101)	0.211+ (0.143)	-0.019 (0.051)	.14	69
$C_{69} = 3$	0.882	0.093 (0.089)	-0.306* (0.163)	0.152 (0.162)	0.397** (0.123)	.18	64
$C_{69} = 4$	1.168	-0.094 (0.077)	-0.335* (0.147)	0.259+ (0.160)	0.222** (0.078)	.23	69
$C_{69} = 5$	0.654	-0.107 (0.126)	-0.111 (0.178)	0.177 (0.161)	-0.019 (0.059)	.05	60
$C_{69} = 6$	0.938	-0.055 (0.110)	-0.199 (0.301)	0.009 (0.209)	0.180* (0.085)	.11	48
$C_{69} = 7$	-0.537	0.119 (0.257)	0.076 (0.276)	0.540** (0.201)	0.196* (0.101)	.27	37
$C_{69} > 7$	2.711	-0.155 (0.388)	-0.653** (0.197)	0.015 (0.110)	0.058+ (0.036)	.23	52

** significant at 1%; * at 5%; + at 10%

U_{70} = contraceptive use 1969-72; takes the value 2 if
contraceptives have been used by 1969, 1 if
contraceptives have been used by 1972, and zero
otherwise.

D_{69} = desired additional children, 1969

A_{69} = age of woman in 1969 (divided by 10)

E_w = education of woman

F_{70} = family planning extension (macro variable)
(divided by 10)

IV. Summary and Conclusions

In this paper we have used data from Thailand to investigate the validity and usefulness in fertility analysis of two attitudinal variables, ideal family size and desired additional children. First, the relationship between these variables was studied, and it was found that there is a general tendency to want less additional children than the ideal would imply. A tentative investigation of the accuracy of measurement of the attitudinal variables concluded that errors were indeed large, and that the error variance was of the same order of magnitude as the true variance. There was some evidence that desired additional children was measured more accurately than ideal family size. The responsiveness of these variables, over time, to demographic occurrences was then investigated. If attitudes are fixed, desired additional children should change with births and deaths, while ideal family size should not. The results showed desired additional children responding much more than ideal family size; but responsiveness was far from complete, in the sense that for each additional child born, the number of additional children was reduced by less than 1 - around a half for the sample as a whole, more at lower parities, less at higher parities. The response to child deaths, although significant, was smaller still. Ideal family size was, as expected, relatively stable. However, there was some weak evidence for a small rise in ideal family size with each birth¹.

The main rationale for studying attitudes to fertility is their use as predictors. Investigating the extent to which desired additional children and ideal minus actual family size are reflected in subsequent fertility, we find that there is a relation, although it is rather weak. Surprisingly, both attitudinal variables are equally viable. After allowing for errors

¹ This is consistent with Knodel and Prachuabmoh's (1973) cross-sectional result that there is some tendency to rationalise existing family size in ideal family size.

of measurement, some 10-12% of desired or ideal additional children result in births in a three-year period; after discounting the influence of large numbers of additional children wanted, this rises to around 20%.

The use of attitudinal variables in demographic models was then studied. A comparison of desired additional children and of births as dependent variables in a behavioural model suggested that overall there was little to choose for power between the two formulations. However, as in theory, desires for children should be more closely related than fertility to the variables involved in household-decision making, this implies that the attitudinal formulation is ultimately less efficient in fertility analysis. A fertility function distinguishing on the one hand desires for additional children, and on the other hand control over fertility or physiological limitations on fertility (as proxies for wanted and unwanted components of fertility) produced the expected results, with fertility broadly positively related to desires and negatively to control (contraceptive use) and age. However the positive effect of desired additional children was weak. Finally, the role of desires for additional children in contraceptive take-up was investigated in the context of a general contraceptive use function. The expected relation is again confirmed - contraceptive use is more likely where no more children are wanted - but this is not dominant in the determination of contraceptive take-up. This result confirms that reached in a bivariate analysis by Knodel and Prachuabmoh (1973).

The specificity of this study should be emphasised - results relate only to one particular longitudinal survey of rural Thailand. However, conclusions can be drawn which have relevance for the study and use of attitudinal variables in fertility analysis elsewhere. Firstly, both attitudinal variables studied

clearly were at least partly valid, in that they measured something which was subsequently partially reflected in objective phenomena - i.e. births - and which was responsive in a sensible and predictable way to demographic events in the past. However, there was considerable inaccuracy in their measurement, which necessarily reduces the value of this validity. Secondly, the use of attitudinal variables in a model of fertility which differentiates demand for children from fertility control, while supporting the general hypotheses on which such a model is built, did not add significantly at the empirical level to our understanding of the determination of fertility. The desire for additional children is not obviously superior to births as a dependent variable; and while desire for additional children is a significant determinant of births in a wider birth function, its explanatory power is limited. If our overall understanding of the relationship between fertility and its economic and social environment is to have increased, these relationships need to be strong, in order to compensate for the loss of efficiency which the introduction of the intermediate attitudinal variable implies. This was not the case in our analysis, and the independent use of demand for children does not therefore significantly improve on the explanatory power of a model relating fertility to socio-economic variables directly.

This is a rather disappointing result; as indicated in Section I, there are theoretical and practical reasons for preferring a formulation in which demand and supply of children are distinguished. The fact that these theoretical reasons do not have an empirical counterpart can be at least partly traced to the inadequacy of 'desired additional children' as a measure of demand for children. It is of course arguable that this inadequacy may be specific to the Thai data base used, and also that a wider specification of a behavioural fertility model, using data not available in the Thai survey, might improve the results; this however remains to be tested.

Although the conclusion regarding the issue of attitudinal variables in a wider fertility model must be at least tentatively negative, the analysis suggests that the variable 'desired additional children' nevertheless has some empirical value. Firstly, it seems to have at least limited short-term predictive value; secondly it is relevant to the analysis of contraceptive acceptance; and thirdly its introduction assists in understanding the nature of the decision-making process - i.e. it is a variable of psychological and sociological value. Thus even though this paper does not support the direct introduction of the desired number of children into a behavioural fertility model, attitudinal variables clearly have a role to play in the wider field of demographic analysis.

Works cited

1. Becker, G.S., "An Economic Analysis of Fertility" in Demographic and Economic Change in Developed Countries, National Bureau of Economic Research (Princeton U.P., 1960).
2. Blandy, R.J., "The Welfare Analysis of Fertility Reduction", Economic Journal (March 1974).
3. Boonpratuang, Chet, and Robinson, W.C., An Estimate of the Age and Sex Distribution of the Thai Population in 1970 (Thai National Economic and Social Development Board, mimeo, May 1973).
4. Clark, C., Population Growth and Land Use (Macmillan, 1967).
5. Coale, A. and Demeny, P., Regional Model Life Tables and Stable Population Models (Princeton, 1965).
6. Institute of Population Studies, Chulalongkorn University, Bangkok, The Methodology of the Longitudinal Study of Social, Economic and Demographic Change, Research Report No.6 (Bangkok, December 1971).
7. Johnston, J., Econometric Methods (Tokyo, McGraw Hill Kogakusha, 1972), 2nd edn.
8. Knodel, J. and Pichit Pitaktepsombati, "Thailand: Fertility and Family Planning Among Rural and Urban Women", Studies in Family Planning (Population Council, September 1973).
9. Knodel, J. and Visid Prachuabmoh, "Ideal Family Size In Thailand: Are the Responses Meaningful", Demography (November 1973).
10. Lipton, M. and Moore, M., The Methodology of Village Studies in Less Developed Countries, Institute of Development Studies Discussion Paper 10 (University of Sussex, mimeo, June 1972).

11. Namboodiri, N.K., "Some Observations on the Economic Framework for Fertility Analysis", Population Studies, vol. xxvi, no. 2 (July 1972), pp. 185-206.
12. Prachuabmoh, Visid, Knodel, J. and Alers, J.O., Preference for Sons, Desire for Additional Children and Family Planning in Thailand (Bangkok, Institute of Population Studies, Chulalongkorn University, mimeo, July 1973).
13. Thailand, Ministry of Public Health, National Family Planning Programme, Monthly Report of National Family Planning Programme (Bangkok, series up to January 1973).
14. Thailand, National Statistical Office, 1970 Population and Housing Census (Bangkok, 1973), Changwat series.
15. Schultz, T.P., "An Economic Model of Family Planning and Fertility", Journal of Political Economy, vol.77, no. 2 (March/April, 1969), pp. 153-180.
16. -----, Fertility Determinants: A Theory, Evidence and an Application to Policy Evaluation (Santa Monica, California; Rand Corporation, January 1974).
17. Ware, H., Ideal Family Size, World Fertility Survey Occasional Papers, No.13 (October 1974).

Appendix A

Data

The data base for this study is a special sample of the Longitudinal Study of Social, Economic and Demographic Change in Thailand, carried out by the Institute of Population Studies, Chulalongkorn University, Bangkok.¹ The survey contains a wealth of information, and only a limited selection of economic and demographic variables has been made. The survey covered rural areas in 1969 and 1972, interviewing the same individuals at both dates, and urban areas in 1970 and 1973. For this study, only the rural sample has been taken, as data processing for the urban sample was incomplete at the time the work was carried out. The coverage of Thailand is almost complete, only certain ethnically distinct and border areas having been omitted from the sampling frame. The sample size for the rural sample for 1969 was 1476 households, covering 2609 individuals interviewed, including 1367 currently married women (i.e. excluding female household heads) and 127 female household heads. Of these 1494 individuals, 1193 were recontacted in 1972, and this forms the basic sample for the study. After excluding female household heads and others without husbands present in 1969 or 1972, and all those aged 45 or over, 710 observations remain. The difference between this figure and the 678 quoted in Section I is due to the exclusion from the analysis of a small number of individuals who had been sterilised, or whose husbands had been sterilised; and the exclusion of a small ethnic Chinese group (see comment on p. 7 above). For analytical purposes, some 57 observations where computed mortality was negative were eliminated (see comment on p.12), and for certain purposes 101 observations of women reported pregnant in 1969 were deleted. This left a sample size of 621 observations including pregnant women

¹ Thanks are due to Dr. Visid Prachuabmoh for permitting access to these data for this study.

and 520 excluding them. The difference between these figures and the actual sample sizes of 585 to 602, or (excluding pregnant women) 487-492 reported in Tables 3-11, is due to the deletion of any observations with missing values for one of the variables under consideration.

The survey was undertaken in 15 changwats (provinces) of Thailand. In order to complement the data available from the survey, a number of variables were defined at the province level, and data on them obtained from other sources. The following have been reported: (i) the mean mortality rate for children aged 1-14 in the province (about 1970); source: official registration records and the Census of Thailand, 1970. Mortality data for ages 1-14, although evidently still incomplete, seem to be more accurate than infant mortality data. (ii) the proportion of children aged 11-13 attending school in the province (1970); source: Census of Thailand, 1970. (iii) female family planning acceptors as a proportion of all married women aged 15-49 in the province (about 1970); source: Thailand, Ministry of Health (1973); Census of Thailand, 1970. This is a rather poor proxy for the extent and intensity of family planning services.

A number of other province level variables were used, including indices of urbanisation and of female labour force participation. However, results including these variables have not been reported, primarily because of very high levels of multi-collinearity.