Fertility Control and Income Distribution in Developing Countries With National Family Planning Programmes

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Development policy, by and large, has emphasized economic transformation in the direction of sustained and rapid increases in the national product. In developing countries, however, the recent rapid economic gains have been unequally distributed among countries, regions within countries and socio-economic groups.[1] As a result of such economic inequality, development planners have increasingly questioned the validity of aggregate growth as the main objective of development strategy, thus turning their attention to social transformation in the direction of a more widespread access of the population to provisions of government goods, such as education, health services and adequate housing [35]. Such a development policy involves an interdisciplinary and comprehensive approach in which population policy has a significant role to play.

Past empirical studies show that rapid population growth, resulting from high fertility and improved mortality through the provision of public health and insecticidal services, has adversely affected national development. As a consequence, what population planning authorities are now attempting to bring under control is the birth rate [12].

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[1]For example, in India almost one half of the total population which is currently below the Government-designated poverty line has suffered a decline in its per capita income in the last two decades. On the other hand, over the same time period the average per capita income has substantially grown [46].

In the 1960's, government-sponsored family planning programmes were the main fertility control measure, although their effectiveness has been repeatedly questioned [11, 15]. In the recent past, population planners have begun to recognize the need for the integration of such family planning programmes with social and economic development planning schemes. In this context, further examination of the inter-action of national family planning programmes, demographic changes and socio-economic systems is needed to explore causational linkages and to measure the magnitude of inter-dependent impacts, for the purpose of population policy and planning. Along this line of policy interest, the distribution of income has emerged as a factor that needs to be considered as a planning variable in the evolution of population and development strategy. In addition, although the currently prevalent argument for a greater equality in income distribution heavily depends upon ethical and humanitarian consideration, a closer clarification of the inter-relationship between income distribution and fertility will further support cause for greater income equality on economic grounds as well.

It is important to note that income distribution includes a number of demographic factors, age, sex, and location being essentially its basic components. Furthermore, family formation, and life cycle behavioural changes, which are two other demographic factors, affect the distribution of household income. Migration, another crucial demographic factor, determines to a considerable extent, the pattern of the distribution of an economically-active population into different productive sectors and income categories [32].[2] Among these demographic factors, the present study focuses its analysis on the fertility-related demographic factors, in conjunction with the size distribution of income. Therefore, the primary purpose of this paper is to explore, by utilizing cross-sectional data for twenty developing countries with national family planning programmes around 1970, possible linkages between variations in income distribution and fertility changes through government family planning programmes within the framework of a simultaneous three-equation model. The data for this analysis are mainly drawn from statistics compiled by the United Nations, the World Bank and the Population Council.

REVIEW OF PREVIOUS EMPIRICAL STUDIES

There have been numerous empirical studies conducted with regard to the relationship of fertility and income [1,43]. However, most of these analyses have been based upon average values without taking into account dispersions of these variables.

In recent years, a very limited number of quantitative studies, examining the relationship of fertility and income distribution, has been available. Repetto [36] showed a strongly negative relationship between the distribution of income and fertility. He included, together with these two variables, other socio-economic variables such as income per capita, life expectancy, population density and newspaper circulation as a measure of effective literacy. The analysis was based on a single regression equation

[2]These demographic factors affecting income distribution are related to micro-level behaviour. In contrast, income distribution is, by and large, macro-oriented in nature. This difference in the nature of demographic factors and income distribution makes the interpretation of empirical analyses very difficult and ambiguous. For further discussion, *see* Rodger [42].

covering a sample of sixty-four countries, to which a step-wise multiple regression procedure was applied. In his other study [38], Repetto examined the interrelationship between fertility and income distribution, using a simultaneous equation system based upon aggregate data for sixty-eight countries both developing and developed. One of the findings shows that the impact of income distribution upon fertility is substantial. This study, however, suffers from the problem of model specification [8]. Furthermore, the role of family planning in the interactive process between fertility and income distribution is not explicitly described. Following his study discussed above, the same author [37] investigated non-linearity of the impact of changes in the relative income upon fertility, utilizing individual household data for Puerto Rico. He demonstrated that the relationship between income and fertility is non-linear so that changes in relative income positions affects fertility behaviour differently, depending upon income groups. This work differs from the author's previous work in the sense that it deals with micro-level data for a specific country. In place of fertility levels, Ahluwalia [3] regressed population growth rates together with several socio-economic variables on the variation in the income share of the three different income groups, by using inter-country data. The estimated regression equation shows that the growth of population is positively and significantly related to inequality as measured by the income share of the lowest forty percent. Most of these studies, however, suffer from problems of causation.

In addition to these simple analyses, there have recently been a few more complex analytical techniques incorporating a number of variables, which can be utilized for policy analysis. For instance, the Rodgers-Hopkins-Wery model, based on systems approaches, includes changing fertility and age-structure, labour supply, inter-sectoral labour mobility and inter-regional migration, consumption and saving patterns, household income distributions, etc. The model incorporates the direct and indirect effects of fertility control through chain causation and feedback [42]. The consequence of demographic change for income inequality in this model depends upon the source and nature of the change.

THEORETICAL LINKAGES OF FERTILITY AND INCOME LEVELS AND DISTRIBUTION

Despite the fact that there are numerous differences in development stages, size, natural endowment, and cultural and traditional background, Kuznets has attempted to find certain regularities of income distribution patterns among both developed and developing countries [25]. In his pioneering study of income distribution, he has suggested a few hypotheses such as the so-called U-hypothesis which states that income distribution, although becoming more unequal in earlier stages, becomes more equal in later stages. Interestingly enough, a similar U-shaped relationship seems to be applicable to a change in fertility differentials in the process of demographic transition. There is considerable evidence that in Western European countries differences in fertility became larger during the first half of demographic transition, then shrank during the second half [45].

It should be emphasized, however, that analysis of the interrelationship between fertility and income distribution has been a comparatively neglected area of study and that empirical evidence has not been gathered sufficiently

to formulate a comprehensive theory with regard to the determination of interrelationships of these two variables.[3] Moreover, most of these limited empirical studies have drawn upon a set of variables which are inflicted with measurement problems, thus leading to ambiguous conclusions with various qualifications. In this section, therefore, taking account of the current state of empirical knowledge, we may have to be content with a *priori* consideration of several probable macor-oriented theoretical relationships between income distribution and fertility.

At present, most developing countries which are in dynamic dimensions of fertility changes are in the first half of demographic transition and modernization. In the context of these developing countries, we will first discuss the possible causational influences that variations in income distribution may have upon fertility changes.

There is an indication that economic considerations directly affect human reproductive behaviour [5, 29]. For illustrative purposes the Leibenstein 1957 fertility decision model can be utilized [26, 27]. This theoretical framework assumes that children are wanted for three different types of utility: comsumption utility; production (income) utility and security utility. At the same time, Leibenstein's theory assumes two different types of disutility: disutility from direct costs relating to food consumption, education, housing, etc; and disutility arising from indirect cost such as opportunity cost of having a child. Rational fertility decisions are a function of the balance of both marginal utilities and disutilities of an additional child.[4]

Let us apply this framework to different income groups in a society. For relatively higher income groups, because parents are usually well-educated, they tend to provide their children with an education of higher quality and at more advanced levels, consequently making the direct cost of the children higher and the production utility lower. Furthermore, women in these income groups tend to seek more working opportunities in order to increase a level of self-actualization. As there is a strong positive correlation between education achieved and income, the income foregone by these educated mothers for bringing up children is substantial. More importantly, the higher income groups tend to possess more modern consumer items and physical capital. Such higher aspirations for material possessions contribute to the reduction of the production and security utility of children. As a result of lower utilities and higher disutilities of children, higher income groups may want to have fewer births. Also, because higher income groups can have better access to modern health measures and a more satisfactory intake of food, infant mortality is controlled at a lower level [14]. Consequently, lowered infant mortality requires higher income groups to have fewer births to achieve their targeted number of living children. Conceivably, as the parents in these income groups are more likely to be exposed to modern values and norms through advanced

[3]In his recent work, Rodgers [42] attempted to synthesize both existing hypotheses and empirical findings related ro interrelationships of demographic factors and income distribution, suggesting a partial conceptual framework for income distribution analysis.

[4]In more developed countries, fertility behaviour can be considered within the Hicksian version of micro-economic framework formulated by Becker [6], in which children are viewed mainly as one of non-inferior consumer durable goods. The Becker model precludes the consideration of both security and production utilities.

education, they are more strongly motivated to accept family planning in order to achieve fewer births.

By contrast, lower income groups perceive both utility and disutility of a child in opposite directions. In developing countries, the bulk of lower income groups belongs to self-employed agricultural and informal sectors, where children have high production utility as unpaid family workers [28]. Also, children's security utility is higher for these lower income groups in that there is no proper social security system in most of the developing countries.[5] At the same time, lower income groups are characterized by lower educational levels and higher infant mortality, both of which are associated with lower family planning acceptance.

The above discussion leads us to the conclusion that because of differences in perceived utilities and disutilities of having children for different income groups, one observes a non-linear, most likely U-shaped, relationship between groups' incomes and their fertility. This implies that as the income of a certain lower income group increases, for instance, as a result of income transfers from higher income groups, the lower income group may adjust its reproductive behaviour, thus contributing to overall fertility reduction.

It should be noted, however, that although income distributional changes induced by intergroup income transfers may affect overall fertility levels because of this non-linearity effect, such changes are not the income distribution effect *per se*. What it actually involves, in contrast, is the following question: in what manner would an income group adjust its fertility, holding its income level constant, when the income distribution of its reference groups changed?

It is well-known that a production function contains four major inputs: land, capital, technology and labour. Land has been increasingly scarce in most developing countries as a result of recent rapid population growth. Also, its distribution is often skewed towards a handful of wealthy farmers. Capital acquisition is generally difficult because of the fragmentary development of capital markets. Even if available, lower income groups tend to have a less favourable credibility from the financial institutions. At the same time, these financial institutional constraints coupled with poor entrepreneurship due to low education, prevent the widespread adoption of new technologies among lower income groups. Among the conventional productive inputs, "labour" seems to be the factor most easily accessible and readily available to the lower income groups. It may be hypothesized, therefore, that upon perceiving their unfavourable relative income position, the lower income groups make an attempt to improve their economic status by having a larger number of their children mainly for income purposes.

In the foregoing, the two effects of income distribution upon fertility have been analyzed, namely, the non-linearity effect and the perception effect. Now, let us discuss the possible influences that fertility changes may have upon variations in relative income shares. The following two different impacts of

[5]It should be noted that the strength of the old-age pension motive for having children is controversial [21, 30, 33, 41]. However, a recent study [5] suggests that security utility of children does not diminish until relatively late in the fertility transition.

fertility upon income distribution can be envisaged in the context of time sequences: immediate and lagged effects. The immediate effect is concerned with physical capital formation. Given income, a larger family consumes a greater amount of goods and services, leaving less savings and physical capital per worker. This negative dependency effect upon savings and physical capital formation is specifically pronounced in lower income groups. Because of their higher fertility, therefore, these lower income groups contribute to the worsening of overall income distribution in the short-run context.

The lagged effect, in contrast, is related to human capital formation. Higher fertility induces faster growth of labour force with a time lag. Lower income groups with higher fertility allocate virtually all of their limited resources to consumption, consequently equipping themselves with scarce human capital. Hence, the more pronounced fertility differentials the more conspicuous a dual quality of labour supply of skilled workers from low-fertility groups and unskilled from high-fertility groups. In less developed economies, the agricultural and informal sectors absorb excess labour of low quality. In more detail, the Fei-Ranis model shows that as economic development proceeds, such surplus labour is siphoned off from the traditional sectors by modern sectors at the wage rate prevailing at the traditional sectors [13]. This results in greater profits and savings in modern sectors, contributing to more concentrated income distribution in favour of the modern sector.

It is implausible, however, for any sole distribution theoretical model to be applicable to the economy as a whole. In the realm of economic theory, several income distribution theoretical frameworks have been developed, and each of them seems to have a certain degree of relevance to the context of current developing countries. For instance, once the surplus labour in traditional sectors is depleted by modern sectors, labour is likely to be mobile and its income responsive to an interplay of demand and supply in many parts of the traditional sector. In this case, the neoclassical case may be applicable to the labour market.[6] Let us consider a production function of a neoclassical type.[7] It is well-known in neoclassical economics that, resulting from a rise in fertility, an increase in labour supply relative to capital, lowers the labour share if the substitution of these two productive factors is inelastic. Empirically, this condition seems to be widely satisfied [19]. At the same time, higher fertility lowers the female labour participation rate, thus contributing to a rise in the labour share. This second mechanism, however, seems very limited, as compared to the first mechanism. Therefore, the overall effect of fertility upon labour shares may be considered to be negative.[8]

Besides these theories of factor shares, there are several other theories

[6]We should note that workers in traditional sectors are often self-employed and there is frequently no market demarcation between the returns to labour and capital.

[7]In spite of the fact that the theoretical relevance of the neoclassical framework has been questioned elsewhere [47], it still remains useful in relating fertility changes to income share variations.

[8]Nonetheless, the overall effect might yield an opposite result if the impact of fertility changes upon innovation is incorporated in the analysis [9]. If, in fact, higher fertility should induce labour-intensive bias in innovation, it may offset the negative effect of an increase in fertility on income shares. For simplification, however, the present study excludes this mechanism.

explaining factor incomes, which have been elaborated elsewhere [10, 23].[9] More importantly, in examining the link between factor incomes and household distribution of income, we must add the pattern of household asset ownership to the above mentioned theories of functional income distribution. However, the distribution of ownership of productive factors among households in each sector heavily depends upon historical background and institutional constraints rather than economic considerations. Because further analyses of this aspect seem to be deeply involved in the factors of political economy, we will not go into any further detail in this paper. In any case, the existing theories are indicative of the likelihood that high fertility adversely affects household income distribution in the short run, and in the long run, functional shares of income, and possibly, household income distribution as well.

We have thus far considered the interaction of income distribution and fertility in the context of developing countries ranging over the first half of modernization and demographic transition. Now, let us turn to the question of how fertility dispersion and income distribution interact with each other in the second half of the modernizing process? Limited theoretical as well as empirical work done in recent years suggests that both income concentration and fertility differentials become smaller towards the second half of modernization [2, 45]. Nevertheless, detailed discussion of this topic falls outside the scope of this paper.

In the above, we have focused upon a number of the interdependent relationships between fertility and income distribution, on the basis of speculative hypotheses and theoretical arguments. In view of such interdependent causational links, we will attempt to consider, in the following section, the inter relationships within the framework of an aggregate simultaneous equation system for further analysis.

THE MODEL

The model to be utilized in the present study consists of three functions: a family planning acceptance function; a crude birth rate function; and an income distribution function. The model includes nine variables, three endogenous and six exogenous. In model building, the selection of the endogenous and exogenous variables is always a difficult task. Because the majority of socio-economic and cultural variables are interdependent with each other to a varying degree, certain arbitrary considerations have been applied to the determination of both endogenous and exogenous variables. Furthermore, it should be noted that the model focuses upon fertility reduction due to the practice of modern contraceptives, thus precluding from its analysis the effect of traditional as well as non-contraceptive methods upon fertility changes.

The Family Planning Acceptance Equation

A number of past studies have explored likely links between contraceptive acceptance (AR) and other variables [15, 44]. In this paper, family planning acceptance refers to all modern contraceptive

[9] In some parts of the informal sector where wages are determined as residuals, the neo-Keynesian type of theory may be more desirable. On the other hand, modern sectors appear to call for different distribution theories such as the bargaining theory which is applicable to part of the modern sector and theory of degree of monopoly, to another part.

methods in government family planning programmes and is measured by the number of contraceptive acceptors per 100 married women. In respect to explanatory variables affecting the acceptance of modern contraceptive methods, a variety of socio-economic factors can be listed down. Following the theoretical framework discussed in the previous section, the average income for each income group (YP) and its distribution (YD) are considered as primary explanatory variables. As explained earlier, there exists a non-linear or U-shaped relationship between groups' average income and fertility. In developing countries with national family planning programmes, a similar U-shaped relationship between groups' average income and family planning acceptance can be observed. Moreover, fertility behaviour is affected not only by differences in incomes *among* various income groups but also by those *within* income groups. At a level of a group's average income, fertility may be lower if the variance in the distribution of income is higher. The rationale for this relationship is that due to the non-linearity between fertility and income within each group, households with income below the group average have higher fertility than those with incomes at the same distance above the average. In addition to the non-linearity of income, the effect of income distribution *per se* upon family planning acceptance may be observed when a certain income group perceives changes in the pattern of income distribution in its reference groups, with its group income unchanged. In order to capture these effects, the family planning acceptance equation is specified as follows:

$$AR = a_0 + a_1\ YP + a_2\ YP^2 + a_3\ YD$$

Because this model utilizes intercountry data, YP is measured by per capita income in each developing country and YD, by the Gini coefficient of household income.

As discussed in the previous theoretical section, the above-specified equation is incomplete in accounting for variations in family planning acceptance. Evidently, family planning programme performance is heavily dependent upon its programme effort. In a recent study on the impact of family planning programme effort and socio-economic conditions upon contraceptive use, Freedman and Berelson [16] have demonstrated, based upon 46 countries with national family planning programmes, that both social setting and programme effort have a strong positive correlation with family planning programme acceptance. Although programme effort appears to be closely associated with socio-economic conditions in the reduction of fertility, the former also has a substantial *independent* effect on the performance of family planning programmes. For this reason, family planning programme setting scores (PE) which have been measured by Freedman and Berelson are included in this equation as an explanatory variable.

The use of contraceptives is correlated with other socio-economic, bio-social and social structural variables. As far socio-economic variables, working wives, for instance, tend to have fewer births due to the higher opportunity cost. At the same time, working women tend to postpone their age at marriage, consequently contributing to lower fertility. These two mechanisms can be measured by the level of female labour force participation (WLF). In any empirical study on the socio-economic theory of fertility, education is an essential explanatory variable. Parents' educational level is related to the degree of their exposure to modern values and norms favourable to the use of modern contraceptives. Secondly, well-educated parents are more likely to

provide their children with advanced education, thus limiting their family size through the use of contraceptives. Thirdly, as higher female education levels increase the opportunity cost of wives' not participating in the labour force, females at child-bearing age tend to use contraceptives. Furthermore, if parents provide their children with higher education, it will lead to higher direct as well as indirect costs of having children.

In as far as bio-social variables are concerned, life expectancy at birth seems to be one of the proper variables for consideration. It is generally agreed that increases in life expectancy at birth imply higher survivorship probabilities of children, thus motivating parents to reduce the number of actual births needed to achieve their targeted family size. However, whether or not this replacement mechanism operates depends upon how speedily parents perceive such changes in survivorship [39]. Moreover, longer life expectancy contributes to a decrease in the dissolution of marriage by death. This effect, of course, works against fertility reduction.

As suggested in past studies [15], the acceptance of cntraceptives is also affected by social structural and environmental characteristics. We should consider a variety of community-level variables such as community health levels and facilities, community educational facilities and community agricultural and industrial development.

Although inclusion of these additional variables is motivated by theoretical considerations, it is difficult to assume that these explanatory variables are independent of each other. In fact, our preliminary computations have shown that most of the variables are very closely correlated with the level of income, its distribution, and family planning programme effort. Because of the problem of multi-collinearity, all but women's labour force participation have been eliminated from the ultimate specification of the equation. Thus, the effect of these excluded variables is indirectly represented by the variables retained in the equation.

The Crude Birth Rate Equation

$$CBR = A(AR)$$

Because of the unavailability of proper data for the measurement of distribution in fertility, the crude birth rate (CBR) will be employed as a proxy for the variance of fertility. As discussed elsewhere [7, 38], developing countries amidst demographic transition seem to have both higher levels and larger dispersions of fertility because of widening differences in response to modernization by different socio-economic classes. In this context, it appears acceptable to relate a higher level of fertility to a larger dispersion of fertility. In the model of this paper, therefore, the crude birth rate is assumed to reflect the level of fertility *explicitly* and the dispersion of fertility *implicitly*.

Theoretically, fertility is regulated not only through contraception, but also through other intermediate variables such as factors affecting exposure to intercourse (*e.g.* age at marriage and dissolution of unions) and gestation and successful parturition [15]. Nevertheless, it should be stressed that the model focuses its analysis upon fertility reduction only through the use of

all family planning methods offered in national government programmes. The equation, therefore, includes one explanatory variable (AR) representing the acceptance rate of all programme methods.

The Income Distribution Equation

$$YD=f\ (YG+YP+LT+CBR)$$

Several possible explanatory variables can be considered for this equation. These variables include the rate of economic growth (YG), per capita income (PY), the level of literacy (LT), and the crude birth rate (CBR). Economic growth has been one of the common targets in planning strategy. There is an optimistic view that rapid economic growth lends itself to reducing the size of residual population to be absorbed into the traditional sector and making this absorption easier, thus generating an increase in relative equality. In contrast, a pessimistic view is that fast economic growth promotes economic concentration and often worsens not only the relative but also the absolute position of low income groups. This unfavourable effect makes the usual twin objectives of development planning mutually inconsistent.

Per capita income is a comprehensive index for the level of economic development. As hypothesized by Kuznets, there is a U-shaped relationship between income distribution and per capita income changes. His study has demonstrated that the U-shaped pattern has its turning point between US$ 400-500 [25]. In order to reflect this non-linearity, the equation is expressed in terms of a quadratic function.

Furthermore, literacy facilitates an adoption of advanced technologies in production processes, which in turn affects income distribution [24]. Because there is no available data relevant to the measurement of the skewness of literacy patterns, it is assumed that higher literacy implies greater equality in the development of literacy. Literacy levels are proxied by the amount of newspaper circulation per 1,000 persons. This approximation has been justified elsewhere [36]

It has been pointed out earlier that higher fertility worsens income distribution in both short and long-run perspectives. The long-run effect, however, poses some statistical difficulties. First, although the appropriate length of a time lag must be selected, the average age of entry into the labour force varies considerably from country to country. Secondly, not many fertility measures are available in developing countries. Perhaps, the CBR measure may be the most widely available for low-income countries. Nevertheless, as it dates back, it is more likely that the data becomes increasingly difficult to obtain and its statistical precision, more dubious. For these reasons, any specific variable representing the lagged effect is excluded from this equation. However, in most of the countries included in this study, CBR is very high with its mean value being 40.55 and the relatively small standard deviation, as shown in Appendix A. It may be sensible, therefore, to assume that except for a very few countries, crude birth rates in 1970 are not far from those in the 1950's and 1960's. Henceforth, the lagged effect may be captured considerably by crude birth rates in 1970. In this regard, exclusion of the variable for the lagged effect from this equation may not lead to serious specification errors.

Table 1

Estimated Regression Model
(Second-stage Results)

(*i*) Family planning acceptance equation:

$$AR = 10.31 - \underset{(0.0002)}{0.0011\ PY^2} + \underset{(0.038)}{0.212\ PY} + \underset{(0.073)}{0.261\ PE} - \underset{(8.48)}{30.08\ YD} + \underset{(0.025)}{0.117\ WLF} \qquad \bar{R}^2 = 0.958$$

(*ii*) Crude birth rate equation:

$$CBR = 47.26 = \underset{(0.133)}{1.111\ AR} \qquad \bar{R}^2 = 0.785$$

(*iii*) Income distribution equation:

$$YD = -0.229 - \underset{(0.00001)}{0.00002\ PY^2} + \underset{(0.0017)}{0.0046\ PY} + \underset{(0.0055)}{0.0062\ YG} + \underset{(0.0032)}{0.0143\ CBR} - \underset{(0.00050)}{0.00003\ LT} \qquad \bar{R}^2 = 0.723$$

study, therefore, fall below this turning point. Next, family planning programme setting scores are positively related to contraceptive acceptance. This indicates that family planning performance is directly influenced by its programme effort. As expected, women's labour force participation is positively correlated to contraceptive acceptance. Moreover, the income distribution variable has a negative coefficient, which means that if equality in income distribution increases, contraceptive acceptance increases and *vice versa*.

Looking at the crude birth rate equation, we note that the coefficient conforms to a *priori* expectations. Contraceptive acceptance is negatively correlated to the crude birth rate.

The income distribution equation has tested Kuznets' U-shaped hypothesis, by incorporating the squared term of per capita income. As expected, the coefficients of both terms for per capita income have shown correct signs, confirming the validity of the hypothesis. However, it should be noted that in this study the turning point of the relationship between income and income distribution is in the vicinity of US$ 1,150 instead of US$ 400-500 as suggested

by Kuznets.[11] This equation has also proven that economic growth rates are positively related to the Gini coefficient. This implies that faster economic growth induces greater inequality in income distribution, thus being compatible with the pessimistic view mentioned earlier. This result contradicts one of the earlier findings [3]. Also, the crude birth rate is related positively to the Gini coefficient. This shows that both higher levels and, implicitly, larger dispersions of fertility aggravate income distribution. Furthermore, the estimated equation shows that literacy as a pre-requisite for the diffusion and adoption of advanced technologies contributes to the reduction of income inequality.

So far we have examined each structural equation rather than the model as a whole. By transforming these structural equations into a reduced form, the crude birth rate equation, for instance, is traced back to all predetermined variables. The income distribution is also expressed in terms of these predetermined variables. Most importantly, it should be stressed that the reduced form of the model, therefore, includes both direct and indirect influences of predetermined variables.

By utilizing the reduced form coefficients and the means of variables, we can compute elasticity multipliers, as shown in Table 2.[12] It is clear from Table 2 that family planning programme effort has the strongest influence on the number of contraceptive acceptors. This result is in agreement with the finding obtained earlier [16] that programme effort has a singificant relation to acceptance rates and that its correlation with programme acceptance is even stronger than socio-economic setting variables. The programme effort variable also affects substantially both the crude birth rate and income distribution in a favourable direction. Table 2 also indicates that women's labour force participation contributes to greater family planning acceptance,

Table 2

Elasticity Multipliers

	Exogenous variables				
Endogenous variables	PY	PE	YG	WLF	LT
Family planning acceptance	0.423	1.001	−0.338	0.675	0.016
Crude birth rate	−0.096	−0.159	0.073	−0.112	−0.003
Income distribution	0.136	−0.193	0.136	−0.130	−0.006

[11]Although Kuznets referred to per capita income in 1965 constant US dollars, our estimate is based upon per capita income in 1970 current US dollars. However, the difference in such data base fails to account for the entire difference between Kuznets' result and our estimate.

[12]Elasticity multipliers have been used elsewhere. For detailed discussion, *see* [4, 19, 20].

lower crude birth rates and greater equality in income distribution on the order of considerable magnitude. By contrast, literacy generates a marginal impact on all of the policy objective variables. Interestingly enough, the rate of economic growth adversely affects the number of contraceptive acceptors and the crude birth rate through the effect of income distribution. Most importantly, per capita income has a considerable magnitude of an impact multiplier upon contraceptive acceptance and income distribution. Although this factor boosts the crude birth rate through the income distribution equation, it is overwhelmed by its impact on contraceptive acceptance. Perhaps, it can be also noted that the per capita income elasticity with respect to family planning acceptance directly computed from the structural equation (*i*) in Table 1 is +0.780, which is 83 percent larger than the per capita income elasticity derived from the reduced form. When indirect effects are taken into consideration, the impact of economic development proxied by per capita income upon family planning acceptance and the crude birth rate becomes less influential.

CONCLUSIONS

This simultaneous three-equation model has shown several important interactive links between income distribution and fertility through government family planning programmes as the sole fertility regulation means. One of the primary findings of this study is that in developing countries economic development affects both on family planning performance and fertility in two opposite directions. First, higher levels and faster rates of economic development induce greater inequality of income, which in turn aggravates family planning acceptance and crude birth rates (the income distribution effect). Secondly and conversely, economic development contributes favourably to higher contraceptive acceptance rates through changes in the utility and disutility of having large-sized families (the family planning effect). In this model, the income distribution effect is slightly dominated by the family planning effect. This, in turn, leads to an overall positive impact of economic development upon fertility. This favourable effect will be stronger if income distribution is well-controlled. The model has also shown that the negative effect of income inequality in the early part of economic development can be reduced by manipulating policy measures such as the family planning programme effort, women's labour force participation and the general level of literacy. These policy tools reinforce the positive effect of economic development upon contraceptive acceptance and fertility.[13] These results seem to suggest that policy makers and planners should consider the minimization of the skewness of income distribution when fertility reduction and rapid economic development are simultaneously included in their policy and planning objectives. Perhaps, as a partial solution to the problem, rapid economic development policies in favour of modern industrialization should be accompanied by appropriate employment policies for both urban and rural sectors, with a view to alleviating the deterioration of income distribution. This solution seems to be in line with one of the new directions in development strategies discussed in one of the recent studies [34].

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[13]The development factors such as women's labour force participation and literacy levels will additionally contribute to lowering fertility through non-contraceptive means, *e.g.* rising age at marriage. However, these policy possibilities fall outside the main interest of this study.

Finally, the results and their policy implications discussed above must be qualified in a few respects. First, a considerably more refined model is required to assure the validity of the findings and policy considerations. Secondly, the model faces some recognized data deficiencies and limitations. Thirdly, the basic assumption which underlies cross-sectional studies is that the cross-sectional relationship can be generalized to change over time. This assumption should be tested with time-series data when such data are compiled. Despite these difficulties and qualifications, this model has produced a number of interesting policy implications relevant to developing countries with national family planning programmes.

Appendix A

Data Matrix

	Acceptance rate (AR)[1]	Crude birth rate (CBR)[3]	Gini coefficient (YD)[2]	Programme setting score (PE)[1]	Annual percent increase in GDP (YG)[4]	Per capita income (in US 10 dollars) (PY)[4]	Square of per capita income (PY)[2]	Women's labour force participation rate (WLF)[5]	Newspaper circulation per 1,000 inhabitants (LT)[6]
Chile	7.9	26	0.496	16	3.5	63.2	3,994	13.3	89
Columbia	13.0	45	0.546	16	5.7	40.9	1,673	15.4	109
Costa Rica	18.2	34	0.440	21	5.1	58.4	3,411	12.1	101
Dominican Rep.	4.0	49	0.485	14	5.0	38.9	1,513	15.9	36
Ecuador	3.5	45	0.670	6	5.6	27.6	762	12.7	41
Egypt	3.7	37	0.424	8	3.6	21.6	467	4.0	22
El Salvador	4.0	42	0.463	13	5.7	29.4	864	21.5	103
Honduras	6.1	49	0.613	7	4.9	27.8	773	7.8	42
India	2.6	42	0.472	19	4.8	9.4	88	11.9	16
Kenya	2.0	48	0.610	6	7.3	15.1	228	50.0	14
Malaysia (West)	4.0	38	0.510	18	5.8	34.7	1,204	20.9	65
Mexico	3.2	43	0.571	4	7.1	71.7	5,141	10.2	116
Pakistan	1.0	48	0.332	8.	5.5	14.5	210	5.5	18
Philippines	11.2	45	0.488	16	4.8	25.7	660	21.3	13
South Korea	13.4	28	0.369	24	12.2	26.5	702	26.6	138
Sri Lanka	8.0	30	0.367	12	6.2	17.5	306	13.1	49
Thailand	9.5	43	0.550	11	8.4	19.7	388	46.0	24
Tunisia	5.2	38	0.500	12	3.6	24.5	600	12.9	16
Turkey	0.9	40	0.558	6	6.6	32.8	1,076	33.4	41
Venezuela	6.5	41	0.602	7	4.0	108.3	11,729	12.6	93

Source: [16, 22, 31].

United Nations. *Population and Vital Statistics Report, Series A.* Vol. 25, No. 2. 1973.
ILO. *ILO Yearbook.* 1972, 1974 and 1975.
UNESCO. *Statistical Yearbook.* 1974.

Appendix B

Zero-Order Correlation Coefficients, Mean and Standard Deviation

Variable	Mean	Standard deviation	AR	CBR	YD	PY	PY^2	PE	YG	WLF	LT
AR	6.10	4.37	1.00								
CBR	40.55	6.80	−0.46	1.00							
YD	0.50	0.09	−0.25	0.45	1.00						
PY	35.41	23.74	0.20	−0.17	0.31	1.00					
PY^2	1,789.45	2,704.95	0.13	−0.12	0.30	0.96	1.00				
PE	12.20	5.70	0.64	−0.50	−0.51	−0.10	−0.17	1.00			
YG	5.77	1.98	0.25	−0.15	−0.14	−0.22	−0.23	0.22	1.00		
WLF	18.36	12.31	0.02	0.10	0.27	−0.24	−0.22	−0.02	0.56	1.00	
LT	57.30	40.66	0.42	−0.44	−0.06	0.60	0.48	0.34	0.36	−0.13	1.00

REFERENCES

1. Adelman, Irma. "An Econometric Analysis of Population Growth." *American Economic Review.* Vol. 52, June 1963. pp. 314-39.
2. ————————and Cynthia Morris. *Economic Growth and Social Equity in Developing Countries.* Stanford University Press. 1973.
3. Ahluwalia, Montek S. "Income Inequality: Some Dimensions of the Problem." in *Redistribution with Growth.* (Chenery *et al.*). Chapter 1. 1974. pp. 3-37.
4. Anker, Richard. "An Analysis of Fertility Differentials in Developing Countries." *The Review of Economics and Statistics.* Vol. LX, No. 4. February 1978. pp. 58-69.
5. Arnold, Fred and Chintana Pejaranonda. *Economic Factors in Family Size Decisions in Thailand.* Survey of Fertility in Thailand. Report No. 2.
6. Becker, Gary S. "An Economic Analysis of Fertility." *Demographic and Economic Change in Developed Countries.* Published for the National Bureau of Economic Research by the Princeton University Press. 1960. pp. 209-31.
7. Bhattacharyya, Amit K. "Income Inequality and Fertility: A Comparative View." *Population Studies.* Vol. XXIX, No. 1. March 1975. pp. 5-19.
8. Birdsall, Nancy. "Analytical Approaches to the Relationship of Population Growth and Development." *Population and Development Review.* Vol. 3, No. 4. December 1977. pp. 63-102.
9. Boserup, E. *The Conditions of Agricultural Growth.* London: Allen and Unwin. 1965.
10. Cline, William R. "Distribution and Development." *Journal of Development Economics.* Vol. 1 (1975). pp. 359-400.
11. Davis, Kingsley. "Population Policy: Will Current Programme Succeed?" *Science.* Vol. 158, (1967). pp. 730-39.
12. Demeny, Paul. "The Economics of Population Control." *Rapid Population Growth.* Published for the National Academy of Sciences by the Johns Hopkins Press. 1971. pp. 199-221.
13. Fei, J. and G. Ranis. *Development of the Labour Surplus Economy: Theory and Policy.* Irwin. 1964.
14. Fredericksen, H. "Determinants and Consequences of Mortality and Fertility Trends." *Public Health Reports.* Vol. 81. 1966. pp. 715-28.
15. Freedman, Ronald. "Applications of the Behavioral Sciences to Family Planning Programmes." *Studies in Family Planning.* No. 23. October 1967. pp. 5-9.
16. ————————and Bernard Berelson. "The Record of Family Planning Programmes." *Studies in Family Planning.* Vol. 7, No. 1. January 1976. pp. 1-40.

17. Gaulde, J. "Capital-labour Substitution Possibilities: A Review of Empirical Evidence." *Technology and Employment in Industry*. edited by A.D. Bhalla. ILO. 1975. pp. 35-58.

18. Goldberger, Arthur. *Econometric Theory*. New York: Wiley. 1964.

19. Gregory, Paul; John M. Campbell and Benjamin Cheng. "A Simultaneous Equation Model of Birth Rates in the United States." *Review of Economics and Statistics*. Vol. 54, No. 4. November 1972. pp. 344-80.

20. ————. "Cost-inclusive Simultaneous Equation Model of Birth Rates." *Econometrica*. Vol. 40, No. 4. July 1972. pp. 681-87.

21. Hohm, Charles F. "Social Security and Fertility: An International Perspective." *Demography*. Vol. 12, No. 4. 1975. pp. 629-44.

22. Jain, Shail and A.E. Tiemann. *Size Distribution of Income: Compilation of Data*. World Bank. Discussion Paper No. 4. Washington. D.C. 1973.

23. Knight, J.B. "Explaining Income Distribution in Less Developed Countries: A Framework and An Agenda." *Oxford Bulletin of Economics and Statistics*. Vol. 38, No. 3. August 1976. pp. 161-77.

24. Kocher, James E. *Rural Development, Income Distribution, and Fertility Decline*. The Population Council. 1973.

25. Kuznets, Simon. "Economic Growth and Income Inequality." *American Economic Review*. Vol. 45, No. 1. March 1965. pp. 1-28.

26. Leibenstein, Harvey. *Economic Backwardness and Economic Growth*. New York: Wiley and Sons. 1957.

27. ————. "An Interpretation of the Economic Theory of Fertility." *Journal of Economic Literature*. Vol. XIL, No. 2. June 1974. pp. 457-79.

28. Mamdani, Mahmood. "The Myth of Population Control." *Monthly Review Press*. 1972.

29. Mueller, Eva. "Economic Motives for Family Limitation." *Population Studies*. Vol. 26, No. 3. pp. 383-403.

30. Neher, Philip A. "Peasants, Procreation, and Pensions." *American Economic Review*. Vol. 61, No. 3. Part I. June 1971. pp. 380-89.

31. Nortman, Dorothy. "Population and Family Planning Programmes: A Factbook. *Reports on Population/Family Planning*. The Population Council. 1970, 1971, 1972, 1973, 1974 and 1975.

32. Oberai, A.S. "Migration, Unemployment and the Urban Labour Market: A Case Study of the Sudan." *International Labour Review*. Vol. 115, No. 2. March-April 1977. pp. 221-33.

33. Ohlin, Goran. "Population Pressure and Alternative Investments." *International Population Conference Proceedings*. London. Vol. III, International Union for the Scientific Study of Population. 1969. pp. 1703-28.

34. Oshima, Harry T. "Review Article: New Directions in Development Strategies." *Economic Develoment and Cultural Change*. Vol. 25, No. 3. April 1977. pp. 555-87.

35. Portes, Alegjandro. "On the Sociology of National Development: Theories and Issues." *American Journal of Sociology*. July 1972. pp. 55-85.

36. Repetto, Robert. "The Relationship of the Size Distribution of Income to Fertility, and the Implications for Development Policy." *Population Policies and Economic Development*. World Bank Staff Report. 1974. pp. 141-48.

37. ————. "Inequality and the Birth Rate in Puerto Rico: Evidence from Household Census Data." Center for Population Studies. Harvard University, Research Paper No. 14. (Mimeo). June 1976.

38. ———— "The Interaction of Fertility and Size Distribution of Income." (Mimeo), 1974.

39. Retherford, Robert. "The Influence of Child Mortality on Fertility: A Review of Mechanisms." *Seminar on Infant Mortality in Relation to the Level of Fertility*. CICRED. 1975. pp. 65-86.

40. Richardson, D.H. and R.J. Rohr. "Distribution of a Structural-t-Statistic for the Case of Two Included Endogenous Variables." *Journal of the American Statistical Association*. Vol. 66, No. 334. June 1971. pp. 375-82.

41. Robinson, Warren. "Peasants, Procreation, and Pensions: Comment." *American Economic Review*. Vol. 62. December 1972. pp. 977-78.

42. Rodgers, Gerry B. "Demographic Determinants of the Distribution of Income." *World Development*. Vol. 6, No. 3. March 1978. pp. 305-18.

43. Simon, Julian L. *The Effects of Income on Fertility*. Carolina Population Center. 1974.

44. Som, Ranjan K. "Effects of Economic, Social and Demographic Factors on Fertility and Mortality Levels: Intercountry Studies." *Population Bulletin of the United Nations*. No. 9. 1977. pp. 12-20.

45. United Nations. "The Determinants and Consequences of Population Trends." Department of Economic and Social Affairs. *Population Studies*. No. 50, Vol. 1. 1973.

46. ————. *Journal of Development Planning*. No. 11. New York. 1977. pp. 1-43.

47. Wan, Henry Y. *Economic Growth*. Cornell University. 1971.