Population and Development: Threads of the Narrative

Literature review prepared as background for the Population and Development Working Group

Preliminary draft for comment

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Introduction

This paper reviews major lines of social science research that have sought to explain observed patterns of childbearing at the household level (particularly in developing countries), and the relationship between population growth and macroeconomic outcomes. It is intended as a background document for the Population and Development Working Group convened by the Center for Global Development.

For the sake of simplicity, diverse avenues of inquiry are aggregated into broad categories – for example, "How and why changes in child mortality affect fertility decisions." Because intellectual contributions do not always follow a logical sequence, or confine themselves to narrow questions, this categorization is imperfect, and loses some important nuances. However, this over-simplification does highlight which questions have been of most interest to the social science research community over the past 30 years or so, and how those questions have been conceptualized and investigated with available data.

The first part of the paper summarizes microeconomic research; the second part summarizes macroeconomic thinking; and the final section focuses on questions of particular concern to contemporary sub-Saharan African countries.

Microeconomic research

Nearly all classical representations of demographic transition depict the following chronological sequence: a fall in death rates, an ensuing period of natural population increase, a lagged decline of birth rates, and an eventual return to population equilibrium. (Cleland, 2001) Understanding the relationship between different phases and the implications of the Western experience for contemporary high-fertility societies make up the body of demographic transition theory.

In this section, the ways in which basic biological and behavioral determinants of fertility have been conceptualized and scrutinized are reviewed; followed by an examination of the causal link between mortality change and fertility change. Within the morality-fertility link, there exists a rich assortment of theories and sub-theories about the determinants of demand for the quantity and type (quality) of children.

1. Why do women have the number of children they do? Natural fertility and proximate determinants.

Natural fertility is defined as fertility that exists in absence of deliberate control through abortion or contraceptive practice. Reproduction is determined by biological factors, such as age, fecundability,[1] the time required for gestation, miscarriages, and postpartum amenorrhoea. Fertility also is recognized to be determined by socio-behavioral factors including marriage patterns, duration and intensity of breastfeeding (including its effect on the postpartum amenorrhoea period) and cultural/religious rules for sexual abstinence during certain periods.

Decomposing the factors affecting natural fertility does not establish whether reproductive behavior is socially or individually determined, and excludes consideration of the influence of how birth control. Davis and Blake (1956) developed an analytical framework identifying 11 intermediate determinants of fertility that affect the exposure of risk to contraception and the outcome of pregnancy. These variables were meant to capture any social, economic and environmental variable that could influence fertility. Bongaarts (1982) furthered this work by quantifying the effect of these intermediate variables on total fertility rate, collapsing them into seven proximate determinants of fertility[2], grouped into three categories: exposure factors, deliberate marital control, and natural marital control factors. Empirical evidence indicates that the factors having the strongest effect on levels and differentials of fertility are: proportions of women married (a measure of exposure to intercourse), contraceptive practices (a measure of exposure to conception), abortion and postpartum infecundability (duration of postpartum amenorrhoea being a measure of exposure to conception).

Where Bongaarts' model of proximate determinants analyzes fertility at the level of populations and societies, Hobcraft and Little (1984) employed an alternative way to assess the contribution of proximate determinants to fertility differentials. They developed an individual-level approach based on exposure analysis, calculating fecundity and fertility as the outcome of the fecundity-reducing effects associated with various stages of women's reproductive cycle.[3]

Bongaarts and Hobcraft and Little used different data sets from which to test their relative theories and estimate how much fertility reduction can be ascribed to the practice of induced abortion, making it difficult to compare the relative predictive power of both models. Reinis (1992) did a head-to-head comparison of the two estimation methods using the Shanghai World Fertility Survey data set, and concluded that under simulated

[1] The monthly probability of conception

[2] Any level of fertility in a population can be traced to variations in one or more of the following determinants: The proportion of women of reproductive age who are married, the use and effectiveness of contraception, induced abortion, postpartum infecundability (determined by the duration and intensity of breastfeeding), the frequency of intercourse, onset of permanent sterility (as related to menopause), miscarriages.

[3] States related to pregnancy, absence from sexual relations, contraceptive use, and post-pregnancy infecundability.

conditions, employing assumptions of random contraception use and induced abortion, both models performed well. The models did not perform as well when applied to real populations, because contraceptive use is an endogenous decision and pregnancies are not randomly aborted. Neither model performed well when women exercise stopping behavior once desired family size has been achieved, or when marriage is delayed. This last finding would imply that fertility behavior of non-married women is similar to that of married women.

Short of the extent to which fertility is constrained to behavioral and biological influences, these approaches do not capture how individual preferences drive reproductive behavior. Missing from these models are references to motivation, expectation, adaptation or social and cultural context that influence the demand for children and control of births.

2. How does change in mortality affect fertility preferences and behavior? Mortality decline as a prerequisite for reduced fertility.

If the demographic transition theory were a sufficient explanation of fertility change – with fertility falling after mortality – then couples' desired family size could be assumed to reflect a specific intended number of surviving children rather than a certain number of births. Thus, fertility would be considered to be a function of infant and child mortality in particular. Various mechanisms have been identified through which mortality may influence fertility behavior, acting at both micro and macro levels.[4] For example child mortality experience may shape reproductive behavior at the community level as it simultaneously impacts individual couples in their overall fertility differentials.

2.1 The child survival hypothesis, reduction of uncertainty hypothesis, and child replacement hypothesis

A reduction in child mortality necessarily increases the survival rates of children.[5] If couples have children to maximize the probability of ending up with a certain desired family size they must then control their number of births, or face too large a family size relative to their wishes. An excess in the number of living children (over the desired number) should trigger a reduction in fertility (Knodel and van de Walle, 1967; Scrimshaw, 1978; Preston, 1978).

Similarly, under conditions of high child mortality, couples may anticipate the loss of a child before it reaches adulthood. As an insurance strategy, parents may produce a larger number of children than would otherwise be desired to maximize

[4] The relationship between infant/child mortality and fertility is complex, because it is also possible to argue that high fertility rates tend to increase infant mortality rates in various ways including: rapid exhaustion of mother's physical endowments, shortening birth spacing, and requiring distribution of resources amongst greater number of small children (Lantz, Partin and Palloni, 1992).

[5] Decreases in child mortality are often attributed to the strength of improvements in health care, hygiene and material standards.

probability of a desired number of children surviving (Caine, 1983; Lloyd and Ivanov, 1988). A decrease in child mortality declines will reduce uncertainty, leading to a reduction in fertility as the number of surviving offspring becomes sufficiently predictable for families to start exercising reproductive planning strategies (Chowdhury, Khan, and Chen, 1976; Taylor, Newman and Kelly, 1976, McNicoll, 1986).

In less unpredictable environments, with lower mortality and with greater control over fertility, insurance strategies are supplanted with replacement strategies. To achieve a desired number of children, couples will try to replace lost children with further births (Palloni and Rafalimanana, 1999). But as mortality decreases, replacement will no longer be necessary, and fertility should decline. While high infant mortality has been argued to induce a replacement effect on the part of parents, the empirical evidence in support of this theory has been questionable. Some empirical evidence of the behavioral response to infant mortality has shown that parents who had lost a child were only 20-30 percent more likely to have another child than parents who had not lost a child (Preston, 1978).

Biological variables are also at play: Infant mortality has also been empirically shown to impact a woman's reproductive capacity, by curtailment of lactation, which in turn increases the median birth interval. A multi-country analysis concluded that the median birth interval is 60 percent longer if a child lives than if it dies in early infancy (Grummer-Strawn, Stupp and Mei, 1998).

2.2 Other effects of high mortality: Insurance against widowhood hypothesis

When mortality is high, there is a greater probability of being widowed at a young age. In societies where males are the main source of income generation, this may lead to economic hardships particularly for women, and endanger their survival (Jacobson, 1992). This can be averted if the woman has a sufficient number of children to maintain a reasonable standard of living. Children can therefore provide insurance against becoming a destitute widow. But as mortality decreases, there may be less need to rely on numerous children for an adequate level of support, and therefore less pressure to have many children to protect against future loss (Cain, 1990; van de Kaa, 1996; Portner, 2001).

2.3 Variance compensation hypothesis

This approach investigates the behavioral consequences of unpredictable variance in fertility outcomes, not the causes of that variance; i.e. the social, economic and fitness consequences when the resulting family size entails too few or too many surviving offspring (Leslie and Winterhalder, 2002). This model investigates how couples might adapt their reproductive strategy in the context of unpredictable family building (whether due to child survival, infecundability or social/environmental reasons), and the resulting implications on responses for fertility at the population level and for demographic transitions. Their more general approach can account for both excessive fertility (positive variance compensation) or reduced fertility (negative variance compensation),

which will affect subsequent fertility behavior.[6] This theory is complementary to the replacement population literature since replacement during the family building years will reduce unpredictable variance in the number of surviving offspring. They find that through its effects on fertility behavior, variance compensation has a direct bearing on birth spacing (and further maternal and child health issues) and completed fertility.

3. How to incorporate household preferences into a theory of fertility? New Household Economics.

When the demographic transition theory was first framed, aggregate connections between socio-economic and demographic developments could be traced, although testing of these relationships at the individual or household level was not implausible. Since that time, data collection techniques have improved and research methods have become more sophisticated, facilitating a more detailed investigation of the behavioral foundations of fertility outcomes.

The New Household Economics, inspired by the consumer choice theory, posited that rational, self-interested people will choose to consume those goods that yield them the greatest satisfaction – and that this notion could be extended to include motives for bearing and raising children. Under this framework, the changing balance between costs and benefits of childbearing drives parental demand for children and therefore the fundamental force propelling fertility decline. Children contribute to utility while they use scarce resources. The traditional budget constraint was modified to include unpaid labor that children provide to a household; the labor time of household members was measured as the wage they previously earned in the market or at an imputed wage based on potential earning capabilities (T.W. Schultz, 1974; Becker, 1981; Dasgupta, 1995).

The empirical findings did not reflect the predicted positive relationship between income and family size; therefore the model was adjusted to reflect both positive and negative consequences of increasing family size. The cost of children was reformulated to include value of the time spent in childcare by parents (opportunity cost), typically taken as the shadow price of women's time. Education and women's labor force participation were incorporated into the model to reflect their impact on fertility decisions as factors that influence opportunity cost of time.

An additional adjustment also was made to the parental utility function to capture the context in which parents were making fertility decisions. Given the high level of uncertainty regarding child survival to adulthood in conditions with high infant and child mortalities, the parental utility function was reformulated to refer to surviving children rather than total number of births. This is especially useful in consideration of the

[6] This is in contrast to the existing literature that focuses on mainly the negative consequences of having too few children when dealing with child mortality and family building. This tends to associate unpredictability with higher fertility- but this model emphasizes that either positive or negative variance compensation can occur depending on the specifiable circumstances.

motivation to have children as a means of old age income support (Ehrlich and Lui, 1991, 1997; T.P. Schultz, 2001).

4. What factors influence the demand for a given family size? The economic value of children.

Investing in children can be characterized as a type of intergenerational transfer because children can be thought of as inputs into the household production function that can produce additional household income (Cochrane, 1975; Dasgupta, 1995; Portner, 2001), old-age security (Ehrlich and Lui, 1991, 1997; T.P. Schultz, 1997), and emotional rewards (Weil, 1994; Stecklov, 1997). Children also can provide insurance against shortfalls in income under other circumstances in the absence of social safety nets (Robinson, 1997). Using this framework, parents demand is not just for children, but for child services – the flow of utilities produced for parents by their children.

4.1 Children providing services for current consumption

Children can work at home or as wage labor, and older children with their own households can remit money to their parents. In many less developed countries children begin to work a substantial number of hours per day from age of five or six (Dasgupta, 1993). If the household is in dire straits, the parents may actually sell their children as bonded labor (Portner, 2001).

Measures of child labor-force participation appear to be positively correlated with birth rates (DaVanzo, 1971). Empirical evidence shows that post-primary schooling of the father affects male children's labor force participation, suggesting that when father's income earning potential is low, male child labor is attractive to the family (Sinha, 2003). In models that take fertility and child labor-force participation as endogenous, a positive relationship with size of land-holdings, agricultural productivity, child wage rates, and cropping patterns is found, and a negative relationship with child schooling is observed (Ehrlich and Lui, 1997; Sinha, 2003). The relationship between child labor and education has been viewed in the context of a tradeoff between child quantity and quality, and the economic consequences of quantity and quality choices that would impact parents' incentives for childbearing (Rosenzweig and Schultz, 1987; Ribero, 2000).

4.2 Children providing services for future consumption

It has been argued that the level of fertility at any stage of the economic development is determined primarily by the direction of intergenerational flows of wealth (Caldwell, 1982). A traditional society is characterized as flows from the younger to older generations, as a form of old-age security. But with economic and social changes, people's willingness to place extended family interests ahead of their own nuclear family is reduced, and may eventually reverse this flow. At a certain stage of the development process, instead of children contributing to parents, parents leave larger bequests or invest more in the human capital of children.

Urbanization has been offered as a possible reason for the transition to a nuclear family structure. Urbanization offers children better employment prospects, which improve their bargaining strength vis-à-vis parents. This lowers the return on children as investment, since they may be less likely to remit payments to support parents in their old age. Because all of these factors raise the cost of children, fertility should go down. But in transitional societies where the extended family has been a traditional system of support, the nuclearisation of the family without concurrent improvements of socio-economic infrastructure may influence parents to rely on a greater number of children to compensate for the probability that only some of their adult children will look out for the parents' financial security (Caldwell, 1976, 1982). A serious attempt was made to test Caldwell's wealth flow theory in rural Kenya, but the results did not corroborate the predicted theory (Dow, Archer, Khasiani and Kekovole, 1994).

Intergenerational transfers provide a mechanism for parents to smooth their consumption patterns in the absence of formal capital markets and social security systems that may otherwise preclude savings. Parents use children as a means to shift income from a period of certain income to future periods with uncertain income, to insure against possibility of income shocks.

Altruistic reasons for childbearing can be accommodated. By introducing a dynastic utility maximization to the parents' utility function, the model is modified to acknowledge that parents derive pleasure from their children and their future progeny. Dynastic implies that the present decision maker acts on the behalf of future generation by making bequests and investments in addition to current expenditures.

4.21 Children as insurance/old-age income security

Concentrating on parents' motive for childbearing as a means of old-age income support, the perception of the minimal number of children necessary to meet support needs will be a function of (a) the likelihood of children surviving to adulthood, (b) the potential support they can expect from their children, and (c) the availability of alternative means of support (Cain, 1983). The last is influenced by the availability of public support systems like a pay-as-you-go social security system or the accessibility to private capital markets. Capital markets are thought to provide better savings opportunities, which are then substitutes for intergenerational transfers.[7]

Evidence from a switching regression model on a Malaysian data set appears to support the old-age security hypothesis as motivation for parents who have not yet attained a sufficient number of children. However, the income effect associated with the provision of alternative means of old-age support generates an ambiguous effect on subsequent fertility (Jensen, 1990).

Cigno and Rosati (1992) also attempted to compare old-age self-interest to intergenerational altruism as incentives for childbearing through the impact of social

[7] Opponents argue that if children are desired for utility and annuity purposes, the wealth gained by the provision of an alternative annuity source will cause parents to choose more children for utility purposes.

security. Using a three-period overlapping generations framework, a model of old-age support was constructed whereby young working parents lend resources to their children at a given interest rate and then collect on these loans for old-age support. This is consistent with most microeconomic theories in less developed economies, which find that until children reach their teenage years, they represent a net economic loss to parents. The flow of resources appears to be from the parental generation to the younger generation, and is reversed only at later ages (Stecklov, 1997). Under a model of altruism, children's utility is specified as part of the parents' utility. The researchers find that greater access to capital markets or fully funded social security coverage exerts a negative effect on fertility in the self-interest model. However, in the altruistic model greater access to capital markets and social security benefits has a positive effect on fertility. Empirically, their Italian time-series data supports the self-interest model.

Children have three special properties when seen as a substitute for insurance. First, the expected net return of an additional child need not to be positive for risk-averse parents. It is assumed they will be willing to forego a certain amount of income to insure against risk of income loss in the future. This may explain why rational utility maximizing individuals choose to have more children, even though there may be a negative return associated with additional children. Second, children are a means of risk diversification, whose workload and consumption can be increased or decreased depending on the current level of parental resources. Finally, children are an incomplete form of insurance since observable characteristics like gender and ability cannot be known ex ante (Leslie and Dyson-Hudson, 1999). Survival uncertainty only adds to the risk and cost of childbearing (van de Kaa, 1996; Leslie and Winterhalder, 2002).

Uncertainty of future income due to adverse conditions enters into this framework. The standard model regresses fertility against present income levels, which treats children as standard normal consumption goods (Cochrane, 1975). This leads to the conclusion that people with more income will tend to have more children, implicitly assuming no variation in income across periods. Portner (2001) uses a stochastic dynamic process to demonstrate which factors influence number of optimal births. He uses education as a proxy for future income to see how uncertainty of income in future periods will influence a couple's demand for children. Given the inability to observe future income, education is used as a proxy for future income for three reasons. First, it is assumed that a more educated person will have a higher expected income. It is also assumed that higher educated individuals face less variation in income. Finally, education is taken to enable people with the ability to collect and process information, and take the steps necessary to prevent a low-income scenario (Sinha, 2003).

All of these reasons may also explain the observed inverse relationship between fertility and education. A mathematical solution is derived from Porter's model showing that the more risk-averse a household, the higher the likelihood of increased number of births. Even families who have relatively higher second-period income will tend to have a larger number of children if they faced a risk of zero or very low income in some periods. This may explain why two households with similar present income may have different expected income and therefore different number of children.

The survival probability of children influences the return on children. The substitution effect tends to raise the optimal number of births because survival probability is seen as less wastage of resources. The income effect, in contrast, predicts a lower number of optimal births because a higher expected number of survivors will lay claim to future resources. The more risk-averse a household, the more likely that the income effect will dominate the substitution effect, and reduced fertility is predicted. Therefore, the timing and number of births is dependent not only on a household's current income, but also perceptions of future income and the probability of child survival (Leslie and Dyson-Hudson, 1999; Leslie and Winterhalder, 2002).

Children can serve as an incomplete insurance good for patriarchal risk, also influencing fertility decisions (Cain, 1990). Women may face a high risk of widowhood, divorce, and abandonment, and consequently a loss of the main source of income. While in some societies extended families provide a safety net, in others, older children are relied on as a primary source of income support. In northern India, patriarchal risks and political deterioration, along with poor access to credit and weak interventions by the state, lead to a higher demand for sons. In contrast, in southern India, where the risk environment is more benign and access to substitutes easier, emphasis on sons is less (Cain, 1990).

Willis (1989) introduced the idea of imperfect annuity markets as an incentive for greater childbearing. In a perfect market, he hypothesized that survival risks could be pooled across individuals via life insurance or annuity contracts. Under imperfect markets, intergenerational transfers offer a partial substitute, and this reliance will result in increased fertility.

5. What is the tradeoff between children and other types of consumption? The opportunity cost of children.

The cost of children has also been treated as a function of parents' wage rate to analyze the time cost of rearing children (Eckstein and Wolpin, 1985). This model adequately generates a pattern of rising then falling fertility rate, under the assumption that per capita income rises continually as a result of human capital accumulation. Concentration on the relationship between fertility and the participation of women in the labor force was extended to include a shift of value systems that also may be driving the reduced demand for children.

5.1 Effect of women's value of time on childbearing decisions

Increases in the opportunity cost of women's time were predicted to have a negative substitution effect on the demand for children, while the increase in the value of men's time was predicted to have a positive income effect. Increases in real wages of women will therefore lead to a reduction in fertility while a rise in the real income of men should stimulate a couple to have more children. Higher market wages for women have

empirically been shown to result in less frequent marriage and lower fertility (T.P. Schultz, 1997; Ribero, 2000).

The link between a woman's education level and her ability to sustain a higher paying job also has been studied, especially in developed countries. More educated women should command higher market wages (Kremer and Chen, 2002; Hausmann and Szekely, 2004). If and when substitution effects outweighs income effects, more educated women should have fewer children. This is corroborated by empirical studies of the relation between education and fertility that have concluded that the mother's education has a significant impact on household fertility (Schultz, 1997; Sinha, 2003). A mother's schooling captures more than just her potential earnings; it also raises her non-market productivity. These effects are reflected in a reduction of child labor force participation (Rosenzweig and Evenson, 1977; Sinha 2003). Evidence from 15 Latin American countries indicates that mother's educational attainment plays an important predictive role in determining educational attainment of children- this process also depends on the potential return to the education in the labor market (Hausmann and Szekely, 2003).

The emphasis placed on the value of mothers' time reflects the long-held view that the social status and economic independence of women may be an important intervening factor between economic modernization and fertility decline. Cleland and Wilson (1987) note that the available evidence does not always show a negative relationship between gainful employment of females and fertility. In some cases, the more income earned by women for their family can better afford a household the resources to raise more children.

5.11 Women's autonomy and childbearing decisions

Autonomy is a standard concept used to capture the degree of access, control and independence women have in decision-making. Given the greater cost of childbearing for women one would expect women to opt for fewer children than men do.[8] Dyson and Moore found that women in southern India, who had greater autonomy than women in northern India, also had fewer children.[9] Other studies have substantiated the negative relationship between female autonomy and fertility rates (Sen, 1993; Cain, 1984).

Age at marriage and female secondary school education often proxy female autonomy, based on observations in developing countries of their strong positive

[8] Dasgupta illustrates an example from sub-Saharan Africa. Given a TFR of 6-8, and female life expectancy of 50 years, about half a woman's adult life is spent either carrying a child in her womb or breast-feeding it. Another high cost, often neglected in the literature, it the price of maternal mortality. In many third world countries, complications related to pregnancy constitute the largest single cause of death among women in their reproductive years.

[9] They found that in Northern India, rules of patrilineal descent, emphasis on strong filial relations, male control for property, and strong *purdah* dominate along with high fertility. This is in contrast to Southern India, characterized by strong male ties to their wife's relatives, women's defacto rights to inheritance and transferences of property rights, and endogamy (men settling in their wife's community) along with relatively much lower fertility rates.

relationships.[10] Though counterintuitive, female labor force participation is generally not taken as a proxy for level of autonomy. Though labor force participation may indicate a woman's economic power, it says nothing about how her income is distributed within the household. Neither is her participation indicative in the type of work in which she is partaking, under-remuneration of her productive work. Abadian (1996) uses age difference between spouses as a proxy in her study of female autonomy's impact on fertility, to capture the greater probability of widowhood borne by women who marry much older men. She also takes the age difference because if its ability to capture the distribution of intrahousehold power. The cross-country analysis finds a significant negative relationship between female autonomy and fertility.

5.2 Quantity-quality tradeoff

Children can be seen more as a capital good than a consumption good – they are relatively long-lived assets that produce a flow of services over time; they require an initial acquisition and periodic update costs. If children are assumed capital assets that produce a flow of services, the value of children is presumed to derive from the flow of services they produce, which is itself influenced by the underlying technology. A higher technology is represented by greater investment in each child – for example ensuring a proper education or better nourishment for stronger health. Given a set of resources, parents can choose to invest in many children with low resource investments per child, or they can invest in fewer children but with higher resource investments per child (Becker, 1981; Rosenzweig, 1990; T.P. Schultz, 2001).

5.21 Human capital investment in children

A parent can make many types of investment in a child: spending on current consumption, providing for their future consumption (bequests), or investing in their health and education. The last two are types of human capital investment in children, and are considered intergenerational transfers because, given constrained resources, parents must choose whether to invest more per child in the current period to ensure a greater payoff in future periods. The first systematic analysis of the quantity vs. quality interaction considered quality of children as measured by their human capital as a distinct choice variable for parents (Becker and Lewis, 1973).

Quantity and quality are jointly determined. Subject to a budget constraint, parents maximize their utility, which is a function of the number of children, quality of children and the consumption of all other commodities. The solution to this optimization problem explicitly shows that price of children increases as quality of children increases, and similarly that the cost of higher quality children increases as quantity of children increases. If income elasticity of demand for quality of children is higher than for quantity, fertility may be negatively correlated with income level, although both quantity

[10] While it is agreed that age at marriage and female secondary education are positively correlated with female autonomy, it has been argued that distinguishing between these two effects may be difficult since those women who would gain higher-level education would necessarily postpone marriage.

and quality are superior goods. It is noted that this model is static and therefore cannot be used to analyze dynamic interaction between quality and quantity of children.

Reasons for parents' increased investment in children has been analyzed to examine the shift from quantity to quality. Testing the observed child quantity-quality tradeoff is difficult because they are determined by the same process and household resource constraints. Rosenzweig and Schultz (1987) estimate the unanticipated variation in fertility on children's schooling attainment and birth weight in Malaysia. They find that unplanned births significantly reduce schooling attainment and birth weight of children. Empirical evidence has also shown a positive relationship between mother's schooling and a child's schooling (Ribero, 2000). Ribero indicates that children who lived with married mothers as opposed to children born out of wedlock have higher schooling achievement.[11]

Research on intra-household allocation decisions has also been shown to support the quantity/quality tradeoff. Empirical evidence indicates a negative effect of family size on children's scholastic performance (Hanushek, 1992). Concepts have been developed suggesting that birth order can influence intrahousehold allocation of resources, because birth order is the realization of fertility decisions. Portner and Ejrnaes (2004) suggest a model of sequential fertility decision: Couples decide whether to have a child, observe its genetic endowments, and then decide whether to have another. The model predicts that children with higher birth orders have an advantage over siblings of lower birth order. Data from the at Philippines demonstrated that birth order influences education attainment and time spent on school activities, and younger children receive more education.

6. What elements are missing from the microeconomic approach analyzing the demand for children?

This microeconomic approach includes not only the traditional independent variables of relative prices and income, but also the quality of children and budget constraints in terms of allocation of time and opportunity costs. This model links fertility decisions with other household decisions including labor force participation. The principal contribution of micro-economic theories lies in the theoretical perspectives on individual behavior as foundations of demographic phenomena, and particularly in the elaboration of the concepts of choice and motivation. But critiques have emerged.

The static nature of the new home economic approach assumes individual considerations and decision-making on the basis of observed behavioral outcomes. Economic theories applied in demographic studies fail to provide any deep conceptualization of the evolution of choice considerations, the role of the structure and substance of the social environment, and the interaction between context and agency.

[11] Children living with married mothers also fared better in school than children living with a divorced or an abandoned mother.

The framework has no room for changes in preferences, and assumes that couples have defined these preferences before marriage. Changes in behavior are attributed to variations in restrictions facing the decision-maker. In considering utility maximization, the underlying preference structure is not explicitly considered, and is assumed to be stable over time and identical across individuals and societies. In addition, the notion of child quality is also controversial, both in terms of conceptualization and in the inherent assumption that all children born in a family embody the same quality (Leslie and Winterhalder, 2002). Empirical findings show that the value of children may differ by order of birth and by gender (Portner and Ejrnaes, 2004; Dasgupta, 1995). Other critiques have focused on the assumption that couples decide on a utility-maximizing plan for childbearing at the beginning of a marriage, remarking that this seems impractical. Some critics have suggested that demand models as having no future, based on demographic developments around the world (Cleland and Wilson, 1987).

The microeconomic approach has focused on decision made by a single household; it has not studied in detail social mechanisms in which a myriad of individual household decisions lead to outcomes that are a collective failure (Dasgupta, 1995). This is considered a shortcoming, as is the neoclassical conception that household members all share common interests and work towards a common goal (Abadian, 1996).

The microeconomic literature has failed to explore which member in the household is actually making choice decisions. Household decisions would assume strong normative significance only if the underlying basis upon which they are made took each member's interests into reasonable account. But empirical findings have shown that intra-household allocations are often biased towards males over females and young over the elderly (Behrman, 1997; Abadian, 1996). Because gender inequities have been shown to prevail in education, food, and health-care allocations, it may be reasonable to extend that over fertility choices as well. This is supported by empirical evidence that women in developing countries often insure themselves against destitution with children, because they otherwise lack control over family income, access to productive resources or latitude to make decisions that determine their security (Dyson and Moore, 1983; Jacobson, 1992).

7. How and why do household preferences change?

Applying a life-cycle approach to fertility and accepting the possibility of shifts in preferences sought a more dynamic perspective to the new home economic theory formulation.

7.1 Easterlin and Crimmins' model for household decision-making

Supply side factors are missing from traditional decision-making models as influences on fertility decisions. Easterlin and Crimmins (1985) sought to correct for this by combining economic decision-making process with social and biological constraints, explicitly including supply, demand, and regulation variables. These include factors that

influence modernization (education, urbanization) and reflect cultural and genetic factors, and the proximate determinants that result in the observed number of children (demand for and costs of fertility regulation).[12] This approach allows for a more flexible model, and one with greater scope than the stricter traditional micro-economic approach.

This framework divides the demographic transition into five phases: Initially there is an excess demand for surviving children, because of high mortality rates. Declining infant mortality transforms this excess demand into excess supply. Excess supply is exacerbated by a reduction in the demand for children, given individuals' observation of a higher surviving number of children, which then motivates fertility-control behavior. Excess supply is gradually eliminated, the length of time dependent on the cost of fertility regulation. Finally, in the fifth phase, equilibrium between supply and demand for children is obtained.

Analysis of micro level data in Sri Lanka and Colombia, and macro-level data from Taiwan and a number of Indian states indicate that both supply and demand contributed to the motivation for birth control (van de Kaa, 1996). That work suggests that excess supply over demand may have been more important of the two in early stages of the fertility transition.

Bongaarts (1993) offers an alternative implementation of this supply-demand framework, restricting the discussion to a macro-level approach. Bongaarts' model measures actual fertility as a function of desired fertility, natural fertility and preference implementation. His model uses as total births rather than surviving children as the dependent variable, and his model is period- rather than cohort-based;[13] and relies on the degree of preference implementation. This last measure (degree of preference implementation) is the net result of a decision-making process in which couples weigh the cost of fertility regulation and the cost of unwanted childbearing. A consequence of taking total rather than surviving children as the dependent variable results in assuming that child mortality affects the demand for children rather than the supply. It is assumed that parents have a desired family size that they take based on previous child losses and risk of child mortality. Bongaarts finds that trends in fertility are largely due to changes in demand and preference implementation, the latter being more influential on fertility decline than changes in desired fertility.

7.11 Easterlin cycles

Criticisms of the Easterlin and Crimmins model include its inadequate reflection of the reasons for why demand for children declines, beyond an increase in the number of surviving children. This theory does not take into account how changes in relative prices

[12] Cost of fertility regulation is defined broadly to include economic, psychic, health, and social costs of acquiring and using contraception or abortion.

[13] Period-specific analysis is used to capture rapid recent changes in fertility behavior that are occurring in developing countries. A period-based model also avoids the complication of assuming fixed life cycle demand for children, which is important when considering the changing socio-economic conditions that lead couples to revise their demand for children.

may influence a couple's demand for children. It does not consider people's tastes and preferences for children, or shifts in their value systems. In answer, Easterlin proposed an extension, the Easterlin hypothesis, where he tried to incorporate these factors while still retaining a strong economic orientation.

The Easterlin hypothesis is a relative income theory of economic and demographic behavior. Easterlin maintains that a couple's preferences for goods other than children is determined while they are teenagers, and is conditioned by their parents' income at that time. This will constitute a minimum level standard of living that couples will strive to maintain before bearing children, but below which children will not be desired. This may even delay marriage, let alone childbirth. Therefore, if income is low relative to that minimum standard of living, family size will be restricted. Children are not seen as utility yielding until that minimum standard of living is achieved. But children will be desired if economic growth is occurring so that young couples are faced with incomes close to or exceeding their parents' incomes.

Easterlin posited that the economic and social fortunes of a cohort[14] tend to vary inversely with its relative size, because of the ensuing impact in labor markets that would subsequently determine the real wage. Any younger generation that exceeded its parents' generation in size would result in imperfect substitution between young and old workers. This would lead to a drop in the real wage of younger workers, who would be unable to sustain their parents' standard of living, and induce demographic adjustments like postponement of marriage and reproductive decisions. This may also contribute to higher female labor force participation as couples seek to maintain their relative economic status.

Testing of this theory has fallen into two main categories: The effects of relative cohort size on male relative income and the effects of changes of male income on fertility decisions. Most analysis has made use of the relative wages of US baby boomers, yielding ambiguous results in testing the relationship between relative cohort size and fertility (Macunovich, 2000). This model has also looks at how immigration can change the relative size of a cohort and therefore increase the labor supply in a market that may drive down wages, and how strong labor unions fighting to protect wages may increase unemployment and reduce people's ability to maintain a standard of living.

Easterlin's theory can be applied to developing countries by reformulating the imbalance in cohort size of a younger generation to the cohort size of an older generation to work through the family or village. For example, the division of intergenerational transfers, in the form of bequests (could be agricultural lands), to a larger number of offspring may be seen as reducing young people's relative income. Migration and mass exodus of peoples because war and poverty may also flood a country's relative cohort size, swamping labor markets, and reducing everyone's ability to maintain any kind of standard of living.

[14] Those individuals born in a given year.

Macunovich (2000) has posited that this theory may explain how a society with little or no control of fertility experiences a strong motivation for such control. She theorizes that after the initial decrease in child mortality, 15-20 years later the cohort size of individuals entering the labor market relative to prime-age adults should depress relative wages. Even in the case of poorly organized labor markets and large agrarian households, the division of land amongst larger number of surviving children will also depress earning potential of men relative to their material aspirations. This should eventually lead young couples to seek to delay marriage/fertility to maintain a higher disposable per capita income; the increase in relative cohort size which initiates the fertility transition. She cites 1999 UN data as evidence that 100 countries appear to not have decreased their fertility in response to a reduction in infant mortality, but decreased fertility only when that reduction resulted in a rise in the proportion of population aged 15-24 relative to those aged 25-59.

7.2 Household's response to family planning services

Family planning programs have manly focused on reducing excess supply of births, and helping families achieve a desired number of children. Some of the recent literature has tried to account for how exposure to family planning programs may influence household behavior, and whether it can affect demand for or quality of children. This exposure has been modeled as a reduction in the price of children because it lowers the fixed cost of raising children -- a cost that is independent of the level of child quality (Sinha, 2003). Taking household income as exogenous, parental utility is a function of number of children, child's school attendance, leisure and consumption of other goods. This model implicitly allows children to engage in economically productive activities by allowing parents to choose the allocation of child's time among school, work and leisure. The household demand framework predicts that exposure to family planning programs should result in lower fertility. Income effects associated with the price change induced by family programs is predicted to be large in low-income areas. Although not predicted by the model, empirical observation indicates that mother's exposure will increase child enrollment rate in school, a proxy for increasing quality of children, which in turn may induce decreased demand for quantity of children.

7.21 The Matlab experiment

The most notable controlled study examining the effects of family planning activities on contraceptive use and fertility was carried in the Matlab region of rural Bangladesh by the International Center for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). The Family Planning and Health Services Project (FPHSP) provided half the village in the region (the treatment area) with intensive family planning services (information and discussion of family planning needs, and provision of various contraceptive methods)[15], including visits every two weeks to each currently married, fecund woman by a resident project employee. The other half of the Matlab region (control area) received no additional family planning services beyond usual government services.

[15] Contraceptive methods included the pill, condoms, IUDs, injectables.

The project began in October 1977, and by 1990, estimate placed contraceptive prevalence in the treatment area at 57 percent versus 27 percent in the control area (Pritchett, 1994). By 1990, total fertility in the treatment area had fallen by 25 percent compared to the control area (5.1 births compared to 6.7) (Foster and Roy, 1997). While Foster and Roy concluded by 1990 that the Matlab program had significantly raised completed years of schooling, Sinha found that by 1996 there was no significant impact on children's school enrollment.[16] She concluded that mother's exposure to the program had significant impact on boy's labor force participation. But the apparent success of this experiment masks the massive effort and cost required to influence fertility change. In fact the program expense makes its implementation on any national scale, in any low-income country, unlikely.[17]

Bongaarts (1993) concludes that family planning programs exert their strongest influence on fertility by increasing the level of implementation, but they also have an effect on desired fertility. Pritchett (1994) argues that while desire to regulate fertility may require a requisite level of contraception, that desire is not in itself influenced by access to contraception. A low level of desired fertility is sufficient and necessary to lower fertility. Instead Pritchett highlights how contraceptive practices have had important health benefits through better timing and spacing of births, which have improved both maternal and child health. Thus, because many couples in developing countries perceive they are better off with large families, the best way to reduce fertility is to change the economic and social conditions that make large families desirable.

Fertility has responded to a variety of initiatives, and the literature has also argued how contraception has enabled women to realize latent demand. In the Matlab experiment, family planning is shown to effectively help women realize their desired number of children by eliminating excess births. It appeared that such service were unknown and, once introduced, enabled couples to have two-thirds of the number of children they were having. The alternate explanation is that the program sent a strong signal that lower desired fertility is good, and therefore promoted its adoption as a social norm. But there is also the danger that contraception has been used to coerce women to limit their number of births, so that a decrease in fertility may not reflect a true reduction in desired number of children. The use of overt incentives and disincentives has been prevalent in parts of Asia (India, China and Indonesia), where it affects two-fifths of the world's population (Abadian, 1996). It is unclear how much of China's impressive drop in fertility rates is a function of compulsion, or its concurrent expansion of social and economic programs, like basic education and jobs for women.

[16] The author notes that this later finding could be attributed to school reforms introduced by the government in 1990.

[17] Pritchett states that taking into consideration only "core" costs averaged over $8 per women, which in Bangladesh is roughly about 5 percent of per capita GDP.

8. What is the sociological explanation for shifts in preference?

To help explain how fertility can remain high in the presence of strong family planning programs, theoreticians have sought to identify determinants of fertility decline in institutional factors; within this framework, changes in attitudes and aspirations, family size norms and in the acceptability of contraception will be the result, and not the cause, of fertility decline. In all cultures, procreation has strong religious and moral meanings, which may be extremely resistant to change.

In sociology, systems of value, beliefs and normative pressures have been used to explain reductions in moderate to high fertility. Caldwell (1982) believed that the limits of economic rational behavior are set by non-economic factors. The social conditions of society prevent fertility from falling below a set floor, even when it would be economically rational to do so, and likewise provides a ceiling when it would be rational to have more children. Ideas about intergenerational flows have been invoked to explain the observed demographic transition. In particular, as familial production has evolved into a capitalist and market-oriented mode of production, the intergenerational balance shifts. Intergenerational economic relations that favor older generations generally characterize familial production. Moving to a capitalistic mode of production may induce urbanization, and emphasizes the earning potential of the current generation, while promoting education and occupation (Ryder, 1983). This theory however, does not lend itself easily to empirical testing given the complexity in measuring intergenerational flows.

9. What is the diffusion of innovation explanation for shifts in preferences?

Diffusion and innovation – ideas about how new technologies or forms of behavior spread within a population – have also played roles in promoting fertility regulation. Dissemination of information at the household, community and government level are seen as fundamental influences on the cultural acceptance and use of contraceptives, which may have otherwise inhibited use. Direct support for family planning programs is still difficult to cite as a main pathway for decreased childbearing because fertility has also declined in those countries where government attitude has not been conducive to reproductive change.[18] But family planning programs can be a key factor in opening up otherwise culturally taboo areas, which facilitates the diffusion process of medical technology that then reduced childbearing. This non-linearity is difficult to capture in conventional quantitative analysis and regression models.

Diffusion also may explain why fertility reduction has been observed in societies still characterized as traditional – that is, had little in the way of economic improvement, generally considered a precursor for reducing demand for children in the demographic transition theory. With a diffusion process, the proportion of use of birth control may change substantially in a short period with little or no change in the usual indices of economic and social development (Retherford, 1985). Acceleration of acceptance occurs

[18] For example North Korea, Myanmar, Mongolia.

when opinion or religious leaders, or reference groups, sanction contraceptive use. Cleland and Wilson (1987) cite the absence of family limitation in its modern form, from traditional societies, as evidence that the spread of knowledge and ideas offers a better explanation for observed patterns of fertility change than structural determinism. It is difficult to determine whether the fertility change is the result of increased access to birth control services or the result of increased use of birth control from the spread of ideas and aspirations. But it seems plausible that access to birth control services is influential in controlling excess fertility while the spread of ideas and aspirations determines the level of controlled fertility. Pritchett's (1994) findings that desired family size is a principal determinant of fertility seems to corroborate the theory that ideas and aspirations are more influential in controlling fertility.[19]

Despite this theory's ability to explain observed changes in contemporary fertility decline, the innovation should be carefully specified. Fertility regulation has also been argued as an effective means for spacing births, not just a means to reduce fertility. The innovation may simply be masking sudden improvement in access or methods of birth control. Without proper specification, quantification of the effects of reduced fertility is difficult to discern.

10. What are the ideational and cultural change explanations for shift in preferences?

Communication and education, as mechanisms of innovation diffusion, alter the social and economic environments in which people initially make reproductive decisions. This plays a role in influencing motives, preferences, and family target sizes. In many developing countries, "marriage customs, family organizations, property systems, the means of attaining status, the systems of community reward and sanctions, and educational processes are organized in ways that promote nearly universal and fairly early marriage and high rates of marital reproduction. These institutions, customs, attitudes and beliefs are deeply rooted in long traditions."[20] In turn, social-economic development, education and prosperity stimulate the practice of contraception.

Ideational change is consistent with notions about how pre-transitional societies move from extended family structures to post-transitional societies, which favor nucleated families. It complements the autonomous shift in societies towards increased individualism, secularization and the progression toward greater tolerance of different forms of behavior. This theory has helped to explain the demographic transition experienced in Europe and other Westernized nations that have demonstrated an overwhelming preoccupation with self-fulfillment, personal freedom of choice and personal development. All of these may then be reflected in family formation, attitudes toward fertility regulation and motivation for parenthood. These shifts in value systems may not yet have taken root in developing countries, but may constitute an important consideration in the face of globalization and the spread of Western values.

[19] Other empirical studies have investigated the diffusion of birth control and found evidence in support of this theory (Casterline and Montgomery, 1993; Casterline and Rosero-Bixby, 1993).
[20] F.W. Notestein. (1983) Speech published in : *Population and Development Review*, 9(1): 345-360.

While some would argue this theory as a rebuttal to microeconomic theory (Cleland and Wilson, 1987), others would argue a synergy between economic and cultural factors; that ideational discussions should be a crucial addition to the micro-economic approach (Lesthaeghe, 1988). This has influenced Easterlin's life cycle model, as well as Retherford's (1985) theory of marital fertility.[21]

11. How might household preferences deviate from socially optimal fertility outcomes? Externalities

The concern of the consequences of high fertility can also be viewed in terms of systematic deviation between decisions that are privately optimal and decisions that are optimal at the societal level. This divergence between private and social costs may result in private decisions that lead to overly large numbers of children. The literature has discussed different incentives that may motivate childbearing, including quantity versus quality and improved life expectancy (whether because of improved environmental surroundings or improved access to medical services). But government provision of such services as education, health and housing may be ineffective in inducing lower fertility, though these services may address improving health outcomes and therefore increasing life expectancy. But when these services are provided free of cost, or at a highly subsidized rate, the private cost relative to the marginal social cost of that service to a family is reduced. As a result, the cost may not be properly internalized, and people will still choose to have a number of children that exceeds the social optimum.

Family structure can create an intra-family externality that leads to excessive fertility. When resources are pooled so that more than one family lives under a roof, for example a joint-family, generally it means that there are more people to help raise an individual family's children. Knowing that others will bear some of the cost of childrearing, the private cost to a family is reduced, and will therefore not constraint a couple's desire for more children. This tendency of having more children because relatives are sharing in the cost of childrearing has been observed in African societies (Dasgupta, 1995).

[21] Retherford proposed a theory that integrates the impact of development and mortality decline on the demand for children with the concepts of utility and costs used in the diffusion theory to explain rates of birth-control innovation. The underlying cause to reduced marital fertility is the declining demand for children, but it is the diffusion and acceptance of birth control methods that influences the rapidity and timing of fertility change. This model is important in that it explains fertility decline in contemporary populations where developmental factors have appeared only weakly related.

Macroeconomic Theory

From classical perspectives to modern theories linking population growth to economic growth and development, the major themes have remained the same. All have incorporated some aspect of scarcity of natural resources, capital market imperfections, and uncertainty in future income that may result in low-income growth, high fertility and poverty. They have also addressed the potential for technological innovation and investment in human capital to lift a country from an economy mired in poverty to a level of sustained, permanent income growth. The major trend in the literature has been the progressive development of a comprehensive dynamic paradigm that treats population, growth, and development as endogenously and simultaneously determined (Ehrlich and Lui, 1997).

1. Is there population equilibrium? The classical model of population growth

In the Malthusian theory, or classical model, of population growth, any improvement in a country's average standard of living will lead to more children being born and surviving to adulthood. This population growth will push living standards back to subsistence level as population growth places pressure on scarce resources- the population growth rate will eventually converge to an exogenously given growth rate of food supply. Mankind's biological capacity to reproduce is assumed to exceed its physical capacity to produce. Population is assumed to increase geometrically while food production increases arithmetically because of diminishing returns to a fixed factor in land. Eventually, growth in food supplies will not keep up with a burgeoning population, per capita food production will fall lead to a population existing at or slightly above the subsistence level. This low level equilibrium population trap is called the Malthusian trap, and considered the inducement for decreasing population growth until it returns to a sustainable equilibrium level. Short-term deviations from this equilibrium present themselves in children, who represent capital goods yielding future labor services (produced at constant cost) in this model. An increase for the demand for labor may result in a rise in the birth rate by generating a stream of expected returns in excess of costs (Ehrlich and Lui, 1997). The important conclusion is that long term income growth cannot be sustained. Increases in income per capita will trigger rapid population growth and population pressure will bring the model back into equilibrium.

Where Malthus failed to explicitly specify why food production can only increase arithmetically, David Ricardo justified this relationship on the basis of scarcity of land and the law of diminishing returns to labor and farming fixed land. John Stuart Mill (1965) further built on his predecessors' models by introducing a market wage rate. A market wage rate higher than the natural rate would induce an increase in population, discourage investment, and consequently reduce the demand for labor. This would eventually bring the market wage rate back to its natural rate and population would decline to its equilibrium level.

Regardless of further tweaking, the classical theory of population growth has had little success in explaining empirical evidence, mainly due to simplistic assumptions. The model assumes away the impact of technological progress in offsetting the growth-inhibiting forces of rapid population increases. Technological progress can augment the availability of land by raising its quality/productivity. Technological progress can also contribute to income growth, indicating that countries have the potential of escaping the Malthusian population trap.

The second criticism is the assumption that national rates of population increase are positively related to the level of national per capita income. Following this assumption, at relatively low levels of per capita income, population growth rates should increase with rising per capita income. Data on 76 countries in 1965 indicate that birth rates are negatively and significantly correlated with GNP per capita (Ehrlich and Liu, 1997). Aggregate income may not matter for population growth; rather, it may be how that income is distributed.

2. Can aggregate income grow unconstrained by population growth? The neo-classical model

In very basic growth models, as in microeconomic theory, people make consumption and saving decisions. Savings are translated into investment, which enables the capital stock of the economy to grow. This growth in capital in turn determines the growth rate of national income, via the capital-output ratio. To the extent that population growth increases while all other parameters remain constant, population growth has a negative impact on growth of per capita income. But this simplistic version takes the capital-output ratio to be exogenous, implying that population growth has no direct effect on growth of income.[22]

In 1956 there was renewed interest in population growth theories, with the emergence of Solow's neoclassical growth model. Based on an aggregate production-function characterized by constant returns to scale and diminishing returns to scale in factors of production, output is produced by the stocks of physical capital and labor. The model was eventually extended to include human capital stock, encompassing health and education. This equation is transformed into growth rate terms to focus on flows of observable production factors. Steady-state income growth is derived from manipulating the aggregate production function, and is independent of the rate of savings and the rate of population growth. This model implies population neutralism – population is irrelevant to long-term income growth because it is determined exogenously from the model. Likewise, an increase in income will not feedback into population growth, so that the latter will not constraint income growth. In the short run population growth will dilute the capital available per worker, but this effect is temporary.

[22] Keynes (1937) suggested the importance of population growth to sustain investment and aggregate demand.

This model departs from classical theory of population and growth by no longer taking fixed land as a production constraint or limiting factor to production. This departure allows for an output growth beyond subsistence level. Long-term growth is explained by an exogenous technological factor, also called the Solow residual. It drives persistent income growth beyond its factors of production, and explains why income growth can match or surpass population growth.

A country's income growth to its steady state level is achieved through increases in capital accumulation that enhances the capital-labor ratio, defined as labor productivity. Increased capital accumulation is achieved though higher investment, which in a closed economy is derived from national savings. Therefore, higher labor productivity is achieved with a higher savings rate or a reduction in population growth, until the steady state level of growth is achieved. Both of these factors operated in six economies of East Asia,[23] where savings rate increased from 10-20 percent of gross domestic product in 1960, to 40-60 percent by 1990. Though more varied, these countries have also experienced sharp declines in their population growth rates relative to labor force growth rates (Lee, Mason and Miller, 2003).

2.1 How does population change influence savings and wealth? Life-cycle framework

Drawing from earlier works of Tobin (1967) and Modigliani (1954), researchers have developed a life-cycle framework that explores the impact of population change on savings and wealth. As discussed in the review of microeconomic thinking, individuals prefer to smooth their consumption over their lifetime, and will insure against life-cycle variation in individual productivity with savings. In the absence of formal savings infrastructure, or where there are inadequate resources that preclude savings, children may be used as a substitute. When incorporated into the neoclassical framework, the impact of population growth on steady state level of income depends on whether the former increases or decreases the savings rate.

Lee, Mason and Miller (2000) consider adults' wealth accumulation as they enter the workforce. Savings is thought to be concentrated among the working-age population that results in wealth accumulation, while the retired dissave, drawing down their wealth.[24] Allowances for bequests are made in this framework, assuming that risk-averse individuals may over-accumulate wealth to insure against uncertainty.[25] Wealth profiles tend to increase with age, over an individuals lifetime, and the extent to which it declines in the elderly is still debated (Lee, Mason and Miller, 2003).

Faster population growth should therefore lower the aggregate rate of savings, since population growth eats at aggregate income. Higher fertility shifts the age structure of the population toward a very young age and therefore increases the dependency ratio

[23] Indonesia, Japan, South Korea, Singapore, Taiwan and Thailand
[24] This may not be immediate since the recently retired may still live off the interest of the wealth they have accumulated.
[25] Uncertainty can be with regards to future income streams and future consumption needs.

in families. Children represent a net cost[26] to parents until they reach an age where they can produce; they represent higher consumption during a parent's working-age period, reducing the amount that can be saved. Less wealth is accumulated to support retirement, decreasing consumption in future periods as well. In developing countries this tends to lower the savings ability of families, who focus on current consumption and rely on children to provide the family's future consumption. Children will then be expected to support their parents as well as their own family's needs, further drawing down their wealth accumulation and decreasing the amount saved. With less savings there is less investment in capital and countries get caught in a poverty trap with no other recourse to improve investment in capital accumulation.

While public pay-as-you-go systems have been argued to reduce the incentive of parents to have children for old-age income support, and therefore reduce fertility, they will not in themselves improve capital formation. What was previously a private transfer, from children to their parents, will become a public transfer, from working-age people to the retired. Private pension funds on the other hand, allow workers to develop and grow their wealth accumulation, which translates into higher savings and increased holdings in capital. Rather than relying on transfers from either the government or their children, individuals grow their own wealth affording them greater lifetime consumption, sufficient to sustain themselves in retirement in future periods and support a family in current periods. There is still a role for government in deepening financial markets so individuals can save on their own, or sponsoring mandatory saving/retirement programs as has been done in Malaysia and Singapore.

With the neoclassical approach, it is not possible to analyze determinants of technological advance, given its independence from the decisions made by economic agents. It also fails to explain large differences in Solow residuals across countries with similar technologies. Neoclassical models of economic growth are also uninformative on the possible influence of economic conditions on demographic variables. Population growth is taken as exogenous to income growth, which is assumed to be influenced solely by growth in capital accumulation and/or change in technology. The magnitude of population growth determines the level of per capita income, not its steady state growth. The micro-economic literature has pursued a more complete treatment of population growth as an endogenous variable.

2.2 How can population change influence the pace of economic growth? Convergence patterns

Convergence-pattern studies extend the neo-classical approach, exploring the relationship between the level of economic development and economic growth. They focus on the rate of labor productivity growth: the rate at which countries shift from their current level of labor productivity to their steady state equilibrium level. A large gap between current and steady state equilibrium levels of labor productivity indicates gaps in other factors of production, such as capital accumulation and technology. In open

[26] Parents will therefore have an incentive to reduce the amount they expend per child, resulting in less probability of investing in their children's education and therefore human capital accumulation.

economies with trade and foreign investment, capital is thought to flow from areas with high capital-labor ratios to areas with lower capital-labor ratios. This flow of investment will allow lower productivity countries to catch up to countries that have already reached their steady state equilibrium levels, and hence all countries should converge to zero steady state income growth. Low-income countries with less capital should therefore grow at a faster rate than high-income countries that already have high capital-labor.

This conclusion is subject to many restrictive assumptions, including perfect factor mobility, identical resource endowment and identical aggregate production functions across countries. These assumptions therefore lead to the prediction that all countries will converge to the same long-term level of labor productivity. More importantly, evidence shows positive rather than negative correlations between labor productivity and the level of growth (Kelley and Schmidt, 2003). Thus, the model has been modified to predict conditional convergence among economies that display similar initial endowments and parameters.

Demography has been added to convergence analysis to see how population changes can impact the pace of economic growth. Various specifications have analyzed certain aspects of the demographic transition on convergence rates (Kelley-Schmidt, 1994, 1995; Bloom and Williamson, 1998; Bloom, Canning and Malaney, 1998). Kelley and Schmidt (2003) build on an earlier core economic and political model of economic growth presented by Barro (1997) to evaluate the merit of various alternative specifications. The main finding of interest from Barro's core model is that growth rate of output per capita is positively related to a lower total fertility rate. This demographic variable captures the reduced capital-shallowing impact, and the resource cost of raising children versus savings impact, of high youth dependency. Kelley and Schmidt's results support the theory that declines in mortality and fertility have improved the pace of economic growth, each contributing roughly 22 percent to changes in output growth, from 1960-1995.

3. What is the relationship between population growth and long-term income growth? Endogenous growth theories

3.1 New growth theory

The poor performance of neoclassical theories in explaining long-term economic growth, outside of external technological shocks or improvements, and the prediction that all countries will converge to zero growth, led to the development of new growth theory. The new growth theory provides a theoretical framework for analyzing endogenous growth determined by the system governing the production process, rather than by forces outside the system. This model seeks to explain the factors that determine the size of the Solow residual. Income growth is taken to be a consequence of long-run equilibrium.

The aggregate production function is characterized by increasing rather than constant returns to scale. The restriction of diminishing returns to capital investment is

discarded because investment in human capital is taken to generate externalities and productivity improvements, which offsets diminishing returns. Human capital is the engine for growth in this model, taking per capita income as an endogenous variable. When parents choose quality over quantity of children by investing in children's human capital, they raise the level and long-run rate of per capita income growth while lowering fertility. The net result is sustained long-term income growth and reduced population growth. National growth rates depend on national savings rates and level of technology, the latter that is a function of investment in human capital.

The implication of this model is that without complimentary investment in human capital, infrastructure, and research and development; high foreign capital investment will not lead to improved capital-labor ratios. Society as a whole suffers when there is less education because technological change is an endogenous outcome of public and private investment in human capital. The country will be stuck in with a low capital-labor ratio and therefore reduced income growth and remain in a poverty trap.

Countries may be unable to mobilize private investment in education or infrastructure if individuals do not perceive a personal gain from the positive externalities created by their investments; therefore the free market leads to a sub-optimal level of complementary capital. Government can improve the efficiency of resource allocation given that the high social benefits, by providing public goods and promoting education. This public provision creates an externality that once internalized by the household, may lead it to make decisions that further their private benefit rather than the social benefit.

This model is intended to understand sources of long-term income growth, and as a result neglects the impact of factors on short- and medium-term growth. It does not address low rates of labor-intensive utilization when capital is scarce and working-age population is high. It does not look at incentive factors that may lead to sub-optimal accumulation of human capital and low savings rates. The model is also constrained by its assumption that all sectors of the economy are identical and symmetrical, therefore cannot address growth-generating reallocation of labor and capital during the process of structural change (Naqvi, 1996: 977). Finally, empirical studies of the predictive values of endogenous growth theories offer limited support of this model. In fact, there is evidence that the disparity between rich and poor countries is widening (Prescott, 1998; Temple, 1999).

3.2 Multiple equilibria

Diversity of growth has been addressed in the literature using multiple equilibria models. Theories developed which focused on the failure of individuals to coordinate their behavior to lead to an outcome that would benefit all agents. Instead, their inability to coordinate results in an outcome that leaves all agents worse off, producing a collective failure. In this model there are several equilibrium points, describing various levels of economic development. In the situation of collective failure, agents are stuck in a poverty trap, and though undesirable, it is an equilibrium, characterized by low average income or growth. To move from this point to a higher development equilibrium, agents

as a collective must choose to invest their resources to further a common goal. Sometimes it takes action by one firm or worker to increase the incentives for other agents to take similar action. But complementarities often involve investments whose return depends on other similar investments being made by other agents. Once an economy settles on a low equilibrium, a "big push" in initial conditions or parametric changes is needed to move the economy to a higher steady state. Therefore, countries with similar technology and initial endowments of capital and labor can end in different stages of economic and demographic development.

Taking from microeconomic theory, in the absence of higher skilled jobs that pay better wages, individuals will not have an incentive for education. Extended further, without a higher expected income in future periods, parents who rely on their children as a source of old age income support will not have the incentive to expend resources in educating children. They will still choose to have more rather than better "quality" children, which in turn will drain from parental savings- this will eventually impede the aggregate capital accumulation required to provide jobs that would reward greater skills.

More directly, the problem of high fertility can be summarized as a coordination failure: Fertility decisions need to be coordinated across families; if the average fertility rate declines, all are better off. But any one family will be worse off being the only family with fewer children. This helps incorporate the role that society plays in the diffusion process and dissemination of information. As society as a whole changes preferences towards smaller families, then agents will coordinate their actions and all will be better off.

In multiple equilibria models, the equilibrium that countries will converge is dependent on initial conditions rather than on underlying parameters of the model. An example of this can be seen when women earn higher wages (Galor and Weil, 1993). From microeconomic theory, if higher wages increase the opportunity cost of time to women more than household income, women will have fewer children. Lower fertility will raise the level of labor productivity, by raising the capital-labor ratio. On the assumption that physical capital is more complementary to women's labor input than to men's, women's wage rate will increase relative to that of men. The resulting inference is that countries with high level of initial capital will converge to high income-level equilibrium with low fertility and high relative wages for women. Countries with low levels of initial capital will get stuck in a low-income equilibrium with high fertility and low wages for women.

Recent models have moved to analyze the role of government in facilitating the coordination problem. Government policy is understood to be endogenous to the under-developed economy, whose policies could help move an economy to a preferred equilibrium or mire an economy in a bad equilibrium for many years.

4. How does fertility influence income growth? Endogenous fertility growth models (EFGM)

4.1 Endogenizing fertility choice

Standard growth models ignore fertility as a choice variable, omitting an important source of income growth variation across countries. Heterogeneity in preference for children, quantity and quality, are assumed exogenous; these models investigate the role population growth, instead of incorporating the source of that growth, on economic growth. EFGMs link fertility choices and economic growth by endogenizing both variables, including the assumption that the relative number of young imposes a productivity cost or dependency effect on the economy (Ahituv, 2001). The EFGMs take savings and reproductive decisions to be taken simultaneously, therefore variation in investment and fertility rates are generated by human decisions, not necessarily by exogenous shocks.

Barro and Becker (1989) generate a multiple equilibria solution by introducing the negative income effect (opportunity time cost of rearing children) of fertility into a standard neoclassical growth model. A country can be shown to converge to a high or low steady state level of income. In their framework, altruistic parents choose family size along with consumption and intergenerational transfer decisions. More specifically the parents' utility function depends on their consumption and the number and utility associated with each child. The steady-state rate of population growth is positively related to the degree of altruism toward children and the steady-state long-term interest rate, but negatively related to the rate of growth between generations in per capita consumption.

4.2 A dynastic family model

Becker, Murphy and Tamura [BMT] (1990) have a comprehensive model of endogenous population and economic growth that explains different features of the demographic transition as well as incorporate explicit micro-foundations. This model addresses the importance of the quantity-quality tradeoff, and how investment in education can drive economic growth. As with standard optimization models, there is a dynasty head who is assumed to maximize a dynastic utility function which incorporates the utility of parents and each child. Making time spent on investing in children's human capital a choice variable for parents endogenizes growth in per capita income. As with all endogenous growth theories, human capital is the engine of growth in this model. Fertility is endogenized by making number of children in a family another choice variable. The rates of return in investment for quantity of children and their human capital is a function of the head's level of endowed human capital and the chosen number of children.

The resulting solution indicates that the optimal number of children is a decreasing function of the head of family's endowed level of human capital. The rate of return in investment in human capital is then a decreasing function of the number of

children. The model can therefore arrive at one of three steady state equilibria, two of which are stable. There is an intermediate, but unstable state of development, defined by a threshold level of initial human capital endowment from where an economy can either spiral into a Malthusian poverty trap or grow. If the initial level of endowed human capital is below the threshold, the economy will converge to a Malthusian trap with a high fertility rate and a low level of human capital and income. The result is zero income growth. If the initial level of human capital endowment is higher than the threshold, then investment in human capital becomes more worthwhile and the economy will rest at a stable state of persistent growth.

Under the same objective function and production technology, an economy converges depending on the initial human capital of the dynasty head. No explicit analytical solution exists for the transition paths of human capital formulation or fertility – only comparisons of fertility levels in two steady states. There is no story explaining how a country can move from a lower to higher steady state. Finally the behavioral implication of the BMT model fails to adequately model all components of the demographic transition, namely the role of mortality. Variations have be extended to incorporate childhood longevity to the BMT model (Meltzer, 1995); a higher longevity always leads to an increase in the optimal number of children because in this version, the rate of investment in a child's human capital is independent of its longevity.

4.3 Family model incorporating optimal intergenerational transfers

Ehrlich and Lui [EL] (1991) tried to address some of the concerns by building on the BMT model, and incorporating implicit contracts between parents and children. The EL introduces a three-period overlapping generations component to the BMT optimization problem to further explain a parent's motive for investing in a child's human capital. Intergenerational transfers are a third choice variable for parents, apart from investment in children's human capital and number of children. The rate of return to parents is determine by life expectancy of both parents and children, their time preference, technology of producing human capital and the optimal rate at which children compensate their parents for the investment in them (Ehrlich and Lui, 1997).

Therefore, although an economy may be stuck in a low-level equilibrium trap, an exogenous increase in young or old age longevity (i.e. prolonged life expectancy), the rate of return for both quantity and quality of children is raised by a reduction in child mortality or advances in educational technology. Any one of these may suffice as a one-time "big push" necessary to trigger a take-off toward stable and perpetual income growth. Though level of income may increase, which may induce fertility also to increase, eventually the increased cost of human capital should raise the cost of childrearing sufficient to decrease fertility as the economy converges to a higher equilibrium. It also can be argued that as productivity of investment in children increases, there will be less need to have a greater quantity of children to support parents in their old age.

Empirical evidence demonstrates that young-age longevity enhances the economy's growth rate by a larger percentage than old-age longevity (Ehrlich and Lui, 1991). This suggests that simply lowering fertility may result in an aging of the population, which lowers the economy's long-term rate of growth.

Most of these models conclude that level of educational attainment and national wealth account for most of the cross-country fertility variation. But the estimation methods employed by these studies have been unable to control for effects of omitted variables and errors in measurement, many of their results subject to unobserved heterogeneity bias. Ahituv (2001) uses panel data with annual observations from 1960 to 1989 from 114 countries. This robust data allows for analysis of variation within countries, and he is able to correct for unobserved country-specific components. A more significant negative relationship is found between fertility and productivity than when these unobserved components are allowed to downward bias the cross-sectional estimates. He concludes that the children-dependency effect is the main demographic factor that keeps countries with high fertility rates poor. Other important determinants include education gap between men and women, and life expectancy.

5. How does population change influence output growth? Age structure analysis

Empirical evidence over the last four decades indicates that the relationship between population growth and output growth has changed. In the 1960s and 1970s, no statistically significant relationship was found. In the 1980s, a large, negative and statistically significant relationship was found between population and output growth, but this relationship was also found to vary with a country's level of economic development. Though the overall net demographic relationship was negative during the 1980s; developing countries exhibited a negative relationship between population and output growth while developed countries showed a positive relationship (Kelley and Schmidt, 1994).

Absolute population size may have a more modest macroeconomic impact than does the composition of age structures. Previous studies have neglected to explicitly take into account the patterns of birth and death rate changes over time. The economic-growth impact of a new birth varies over the lifetime of that individual. The initial impact is negative during child-rearing years, positive during an individual's labor productive years, and generally negative during retirement. These offsetting effects of a positive labor force versus a negative dependent population may then mask the impact of overall population growth and its timing on economic growth. The age structure of a population is therefore consequential for its economic performance: Young people tend to be net consumers while working-age people tend to be net producers and savers. As a result, large youth and elderly cohorts are thought to retard the pace of economic growth, while large working-age populations should increase its pace.[27]

[27] Adam Smith argued that population growth makes for larger markets, which features greater scope for specialization, and so promotes productivity growth.

All of the economic models mentioned in this section consider some variation of the age structure analysis, including the dependency burdens of younger and elderly cohorts. While these models sacrifice the true depth of population dynamics, they do look at aspects of the impact of big youth cohorts on low savings, low investment, and slow educational capital deepening. The neoclassical model looks at savings patterns over the lifetime of an individual, while endogenous growth theories incorporate intergenerational transfers and parents' motivation to raise children as a function of income earning potential of both parent and prospective child.

The demographic transition begins as societies experience declining mortality rates, especially infant and child.[28] The increase in survival rates of children increases the youth population and induces parents to limit childbearing. Eventually this adjustment results in stable population growth. Once this steady state has been achieved, the growth rate of the workforce equals the population growth rate (Bloom and Canning, 2004). There is a lag in adjustment in parental behavior, and this surge in youth population will enter the labor force as fertility declines. The proportion of economically productive individuals to total population will rise until the offsetting decline in fertility reduces the surge of individuals entering the labor force. Williamson (2003) indicates that this demographic "bonus" may or may not be realized; the resulting growth potential depends on features of the social, economic and political environment.

An increase in longevity may be insufficient to induce a reduction in fertility. Sub-Saharan Africa has recorded impressive increases in life expectancy over the last 50 years, but fertility still remains high and incomes stagnant (Bloom and Canning, 2003). High desired fertility persists amongst conditions of low income and low female education rates, creating high youth dependency rates. A poverty trap is created whereby the high dependency burden lowers rates of savings, capital accumulation, and school enrollment.

Explicitly, age-structure analysis on economic growth can work through three mechanisms: labor-market effect, effect on savings and capital accumulation, and the effect on educational enrollment and human capital (Bloom and Canning, 2003).[29] Labor market effects have been analyzed using the dependency ratio, which looks at the growth rate of working-age population against that of total population (Kelley and Schmidt, 1995; Bloom and Williamson, 1998; Bloom, Canning and Malaney, 1999; Bloom and Canning, 2003). The impact of demographic change may be to increase labor supply but how well this extra supply of workers is put to productive employment depends on the economic system and policy environment (Bloom and Canning, 2004). There is a

[28] Debate exists as to whether the initial trigger of the demographic transition in developing countries derived from exogenous or endogenous sources. Exogenous supply-side theories focus on the role that diffusion of medical technology and health investments have played in improving survival rates, therefore influencing the supply of existing children. Endogenous demand-side theories focus on how improvements in agricultural productive technology and trade in food can raise nutrition and lower infant mortality, thereby triggering the demographic transition (Williamson, 2003).

[29] Age distribution may also have a significant relationship with technological development. If a new technology demands a new training profile in the basic formal education system, it will not have its full breakthrough until sufficient numbers of young people have been trained to use it.

possible generational crowding effect, where a large cohort entering the labor market may affect relative wages and individual labor supply (Easterlin and Crimmins, 1985).

Bloom and Williamson (1998) investigate the impact of the working age population on economic growth using a sample of 78 countries. Williamson summarizes the results as follows: Economic growth will slow when the growth rate of the working-age population is less than that of the population as a whole, and will accelerate when the rate of growth of the working-age population exceeds the growth rate of population. Reductions in the dependency ratio lead to a larger effect on income growth than suggested by the accounting effect of neo-classical models.[30] Bloom, Canning and Malaney (1999) show that reductions in dependency ratios still have a pronounced impact on economic growth, even after accounting for reverse causality of economic growth on age structure.

The savings and capital accumulation mechanism by which age structure impacts economic growth is not as clear-cut as the labor market effect. Higher savings do not necessarily translate into higher local investment. Even when markets are opened to international capital markets, one assumes that investment will flow where it finds the highest return. However, markets do not always operate perfectly, so this assumption does not always hold true. The relationship between age structure and aggregate savings instead looks at changes of income distribution between generations. Expected economic growth should raise the lifetime expected income of younger generations relative to older ones, thus influencing other consumption and investment decisions. An increase in life expectancy should increase the number of years an individual can work, if it indicates that the overall health of the population has improved. A healthier population would result in a more productive labor force (Strauss and Thomas, 1998). There will also be a greater need to fund retirement income if life expectancy rises (Lee, Mason and Miller, 2001). Both factors would induce higher savings.

Williamson and Higgins use the overlapping generations model to capture the dynamic aspects of the life-cycle framework, analyzing pooled cross-section, time series aggregate data. They conclude that changes in age structure produce a very large swing in savings, and their estimates track the actual gross savings rate of Taiwan from 1950-1995 (Lee, Mason and Miller, 2003). Empirically, however, there has yet to be clear specification or identification in modeling and testing the relationship of age structure on investment and savings decisions. The precise mechanisms by which demographic and other influence these relationships are incompletely understood.

Finally, the impact of demographic changes on education has been explored in various sections of this paper. The impact of high youth dependency on parents' ability to save and finance their children's education has been investigated deeply in the micro-economic literature. This has been investigated in terms of the smaller family size effect on school enrollments (Rosenzweig and Schultz, 1987; Rosenzweig, 1990; Hanushek,

[30] The accounting effect assumes that age-specific behavior remains unchanged as the age structure evolves (Bloom and Canning, 2004). While this type of analysis predicts reduction in welfare, it disregards the corresponding behavioral adjustments that will take place.

1992), and the impact that longer life expectancy plays in increasing the returns to education sought (Meltzer, 1995). Both of these relationships have been shown to have a strong positive predictive relationship on education.

These three mechanisms suggest that population growth from lower mortality has different economic impacts than will growth due to higher fertility. A reduction in mortality rates will have a positive impact on economic growth by increasing the labor force per capita, generating higher savings rates and increasing the return on education. In contrast, high fertility will depress per capita income growth, savings rate and educational enrollment by increasing the youth dependency ratio.

Bloom and Canning (2004) analyze the impact of all three mechanisms on economic growth for a panel of countries observed every five years from 1960 to 1995. Average total years of schooling and life expectancy were used to proxy the health of the workforce, and in turn the quality of labor. The case of Ireland demonstrates a country with a rapidly falling birth rate that led to a fall in youth dependency and an increase in share of working-age people from 1950-2000.[31] Coinciding with and attributed to this decline was a boost in economic growth from 1990-2000. But to harness the potential productivity potential associated with the swell in labor supply, appropriate policies are also needed. Otherwise excess labor supply can result in unemployment and ultimately lead to a poverty trap.

The case with the East Asian economies demonstrates that rapid economic growth was associated with factor inputs rather than with improvements in total factor productivity (Bloom and Canning, 2003). The driving forces behind the growth of these inputs seems to be increasing savings and investment, because these countries saw a concurrent surge in economic growth. These can be attributed to higher life expectancy, but the authors note the importance of strong financial incentives and institutions to facilitate savings for retirement.

6. How do changes in population size influence the distribution of poverty and income inequality?

It matters whether higher fertility is occurring in urban or rural settings. One could argue that there is a more negative impact of having a growing young rural population than a growing urban one. The negative consequences on fertility response may be less in an urban setting than in a rural setting. In urban settings there is less room for expansion, and less ties to extended communities that would otherwise facilitate cost sharing in childrearing. The tendency to have extended families in rural agricultural settings is much higher, as is the likelihood of less exposure to new ideas, education and access to public services. Exploitation of the commons and rent-seeking activities of natural resources are also easier in rural areas since there are fewer restrictions and less oversight, resulting in a situation where the private cost of childrearing is much lower

[31] The period of 1980-2000 saw a substantial increase in female labor force participation rates also contributing to the higher ratio of working-age people.

than the social cost. This may bias fertility upward in rural rather than urban settings. Feedback effects may also operate; poverty may increase resource degradation by causing people to consider a shorter time horizon when making their decisions (Pender, 2003; Abernathy, 2002). This shows that population growth, without a parallel increase in capital, can result in both poverty and a less equal distribution of income in a society. A decline in average resources per person increases competition, which in resource-constrained economies can eventually lead to less equitable distributions of resources and wealth.

Population growth can have a negative impact on poverty, as the impact of size and composition of the population changes is also felt at the household level. Income and resource distribution within a household will vary as the number of members contributing to this common pool enter or exit their labor-productive years, and as the number of young and elderly dependents change. This will therefore influence the amount of consumption a household can finance, and therefore their level of poverty. Demographic shifts also can worsen societal income inequality if the population growth among the poor is disproportionately larger.

Most theories that focus on incentives for large family size emphasize households constrained by income decisions. Households in poverty are more likely to view children as consumption or capital goods, and may have motives other than altruism in childbearing. It is also likely that the poor have less access to good health care, and face greater health risks. High child mortality may result in large numbers of closely spaced births, to increase the likelihood of attaining desired number of surviving children.

The microeconomic section covers the various rational motives for poorer households to attach higher value to the benefits from children rather than their costs. Households with more money can better afford to send their children to school, raising the cost of childrearing and biasing fertility downwards. Hausmann and Szekely (2003) argue that the opportunity cost of work for the market versus housework changes very drastically along the income distribution, explaining different choices made by these households. If these conclusions are true, than poorer households would have higher fertility rates than the rich, and rapid population growth will have a disproportionately heavy impact on those in poverty.[32]

6.1 Influence of changes in age-structure on poverty and income inequality

Eastwood and Lipton (2003) investigate how changing age-structures can affect the incidence of poverty through the distribution of consumption and income (CI) and through the efficiency with which the poor convert CI into well being. They show that the distribution effect is as large as the negative growth effect of high fertility on a nation's incidence of poverty (Eastwood and Lipton, 1999). They use cross-national regressions

[32] Economies of scale for enlarged families have been discussed within a household in the microeconomic literature -- but these are probably offset by the diseconomies from infection and competing claims on limited resources like adequate nutrition to sustain health and ensure passage into adulthood.

for 45 developing and transitional economies to conclude that fertility increases absolute poverty. Direct analysis of the ability of those in poverty to convert CI into well being is difficult, but household-based analyses demonstrate how rationality may prompt different responses to fertility based on income levels. As with other age-distribution analyses, growth in CI per EA is derived from increased savings, which generates extra capital. Regressive redistribution of income between the non-poor and the poor can push those who are slightly above or on the poverty line below it; this increases the incidence of poverty and overall poverty inequality.

7. How can cumulative causality and endogeneity be accounted for? Systems approach

Just as demographic change may have an impact on economic growth, economic variables may have an impact on demography: cumulative causality. Once the demographic transition has been triggered and demographic changes give way to economic and income growth, the wealth effect creates a positive feedback between economic growth and demographic change. This is an issue of endogeneity, the problem of attributing economic growth to factors that are themselves endogenously determined within the model. Though it is generally taken as a technical problem that complicates the estimation and isolation of each effect more difficult, there is also a conceptual dimension -- advising policy prescriptions for individual causal links has little value without looking at the broad sent of effect and cross-effects.

Cumulative causality can be explored by a model in which demographic factors can affect economic growth, and income levels can have an impact on demographic variables (Ahituv, 2001). Generally, instrumental variables are used to isolate individual causal effects. But Bloom and Canning (2003) suggest a systems approach for analyzing demographic shifts on economic growth, to model the process of transitioning from an underdeveloped to developed economy. This model also provides a foundation for linking microeconomic decisions with macroeconomic processes. The process of economic development is likely to change the marginal benefits and costs for micro investments related to population change as well as other micro investments such as in human, physical and financial resources (Behrman, 2003).

The system focuses on the interaction between capital accumulation, economic growth and demographic change – all endogenous to the system. Demography has a direct and indirect influence on output, through effects on labor supply and capital accumulation respectively. Income levels and capital stock have effects on fertility and mortality. Finally capital accumulation has a positive effect on income growth, which in turn induces further capital accumulation through savings. Any exogenous change to the system, such as the introduction of family planning programs, will have repercussions on all endogenous variables in the system. These interventions serve to shift the age structure of the population as discussed, which will affect income directly through changes in labor supply and dependency ratios. This will also indirectly influence income through the capital-to-labor ratio, which will also influence capital accumulation, future income growth and demographic changes. Other possible external influences on

population include contraceptive technology, climate, geography and environmental policy. Exogenous shocks that influence capital include changes in government savings rates, world interest rates and rates of time preferences; exogenous shocks to income include technological change, terms of trade, geographic barriers to trade and climate (Bloom and Canning, 2003).

Eastwood and Lipton (2003) suggest that demographic variables should be added to the analysis of the cumulative impact of growth, reduction of inequality, poverty reduction, greater economic openness, and provision of basic social services. Fertility reduction will strengthen the positive feedback among the relationships of these variables. This systems approach may also explain increased poverty inequality as countries transition to developed economies. The rate at and extent to which the poor will experience exogenous shocks will vary against those individuals who can better afford to adapt to changing environments and technology. Education plays a big role in the rate of diffusion and adoption of innovation, as discussed in the micro section. This predisposes those who are above the poverty line and in a position to capitalize already faster than those below the poverty line, possibly increasing the disparity between both groups.

African Context

1. What have the fertility trends been in Africa?

This paper has discussed major microeconomic and macroeconomic theories about fertility and economic development, focusing on current developing and transitional economies. We now turn to work specifically on sub-Saharan Africa.

In most countries of sub-Saharan Africa, despite improvements in child and infant mortality rates, fertility rates and large family sizes have persisted. Constraints on premarital and extramarital sexual relations are weaker in Africa than in Asia or Latin America (Caldwell et al., 1992). The HIV/AIDS epidemics are depleting the working age population in several countries, while the dependency burden of a younger youth cohort has not decreased. As a result, the average age of the population has remained low, as has the proportion of working-age population. At the beginning of the twenty-first century, about one out of every four people in sub-Saharan Africa was 10 to 19 years old (Population Division, Department of Economics and Social Affairs of United Nations Secretariat, 1999).

Cohen (1998) reports that at the time of his study, 14 East African countries had total fertility rates that ranged from 4 children per woman in Zimbabwe to 6.9 children per woman in Uganda. Among 14 West African countries, he found that estimated total fertility rates ranged from 4.5 births per woman in Ghana to 7.4 births per woman in Niger. Since then, in most countries in Africa for which there is available data, fertility has been declining over the last two decades (Mboup and Saha, 1998). In Western, Eastern, Central and Southern Africa, Garenne and Joseph (2002) identify evidence of fertility decline in urban areas, and in many rural areas. They find a common pattern of an early urban fertility decline followed a decade later by fertility decline in rural areas. Evidence of recent declines is strongest in East and Southern Africa – declines in fertility have cut across almost all socioeconomic and demographic subgroups (Cohen, 1998).

Sub-Saharan Africa has led other regions in levels of fertility, with an estimated level of about 6 children per woman. Some countries have seen total fertility rates that have fallen below 5 children per woman; Botswana recorded 4.4 in 1995-2000, Kenya recorded 4.6 in 1998, South Africa recorded 3.1 in 1995-2000, and Swaziland recorded 4.8 in 1995-2000. As many as 16 countries in the region however recorded constant or increasing levels of fertility (UN, 2000). Five countries in particular have had fairly constant birth rates since the 1950s; Burundi has a total fertility rate of 6.8, Mali at 7.1, Somalia at 7.2, Togo at 6.6 and Uganda at 6.9 children per woman. The remaining 11 countries have actually experienced a rise in total fertility between the 1950s and 1990s: Angola from 6.4 to 7.2, Chad from 5.8 to 6.6, Congo from 5.7 to 6.3, Democratic Republic of Congo from 6 to 6.7, Equatorial Guinea from 5 to 5.9, Gabon from 4.1 to 5.2, Guinea Bissau from 5.1 to 6, Liberia from 6.3 to 6.8, Malawi from 6.8 to 7.2, Mozambique from 6.2 to 6.5 and Sierra Leone from 6.1 to 6.5 children per woman (Ntozi, 2002).

2. How have intergenerational transfers influenced reproductive behavior in different types of societies in Africa?

Redistribution of resources within a society is an important aspect of economic development because of its effect on the productive employment of capital. This includes the transfer of resources across age groups, from economically productive agents to dependent populations, whether facilitated by a social system or within a family. When the shape of the economic life cycle changes, it alters the dependent life stages, as well as the institutional context of transfers used to fund varying stages of dependency. Finally as the population ages structure changes in many transitional economies, the relative weightings of dependency versus productivity are also altered.

2.1 Hunter-Gatherer/Nomadic Clans

Many agrarian and nomadic societies still rely on traditional methods of intergenerational transfers. This, in turn, influences other behavioral and consumption decisions. Studies of contemporary nomadic/hunter-gatherer groups describe them as heavily investing in children (Kaplan and Robeson, 2002; Kaplan, 1994). People produce resources in excess of their consumption into old age, transferring the surplus to their children and grandchildren. No stage of the life cycle that corresponds to retirement as found in agrarian or industrial societies, and all transfers of food are strongly downward, from older to younger persons. The group can decide to eliminate elderly who become dependent, or children whose father had died (Lee, 2003).

These groups share resources within smaller kinships of related families, i.e. three or four family households living in clusters. This horizontal redistribution acts as a form of insurance, protecting against random variations in foraging for food. Childrearing is also a broadly shared responsibility between families as well as within families. In fact, the average infant in an Efe hunter-gatherer group is cared for by 11 people in addition to its parents (Ivey, 2000). As a result, demographic changes are the consequence of internal decisions about fertility made within units of the group.

2.2 Agricultural Societies

Some of these hunter-gathering groups have evolved into agricultural societies, where property rights of land, dwelling and livestock ownership have been established. The elderly have a substantial source of patriarchal power since ownership is primarily in their name. There is a life-cycle stage of retirement in these types of agrarian communities, but elders are still important contributors in terms of childcare, managerial skills, specialized knowledge and various other home production tasks that enable adult children to earn the livelihood. Resources are transferred from adult children to elders, as well as to younger children (Stecklov, 1997). But because elders share in the burden of raising younger children, the opportunity cost of childrearing is reduced. In surveys administered to agricultural populations in low-income countries, people list support of old age as a leading reason for having children (Lee, 2003). Empirical evidence from Côte D'Ivoire indicates that the net direction of transfers in agricultural societies to be

strongly downward – from older to younger persons, and this is attributed to the very young age distribution of these populations (Stecklov, 1997).

Public transfers to the elderly are largely limited to civil servants and the military. As a result high fertility is a rational response by parents to existing conditions in developing countries as long as children make net economic supporters instead of net economic burdens (Caldwell, 1982). Stecklov also suggests that if high fertility is the result of parental need for old-age security, then government expansion of social insurance programs is likely to improve welfare and lead to a decline in fertility.

3.How have the institutions of marriage and polygyny influenced reproductive behavior?

The historical roots of African marriage systems in sub-Saharan Africa began with low population density, when women were valued for their productive and reproductive capabilities. Bridewealth – payment from the husband's family to the bride's family – resulted from the demand for female labor. This eventually led to polygyny, as a way for men to increase their female labor supply and their progeny. Males increase their reproductive success substantially by increasing their number of wives, mistresses or concubines (Bergstrom, 1994). In many African societies, this instilled social and ethical acceptance that men needed more than one wife, and by extension more sexual relations, and also placed a high value on greater fertility (Orubuloye et al., 1997). This ethic persisted even after Eurasian colonialists and schools set forth a system of monogamous marriage – traditional views towards marriage, sexual relations and fertility have prevailed despite sanctions against polygyny and bridewealth by many modern African governments. Bergstrom (1994) states that 45 to 55 percent of women living in the Sahel region of Africa live in polygynous households, compared to 25 to 35 percent of women living in polygynous households in West, Central and East Africa. He postulates a model of polygyny based on a desire to increase one's number of offspring subject to scarce resources, to capture the mixed agricultural and pastoral societies of Africa.

The fundamental rule of marriage is that no individual is allowed to marry another from a related clan. This enables marriage as an institution to facilitate exchange of reciprocal gifts in a traditional society. Men move from their own network into new ones by way of marriage, which increases their access to resources but also their obligations to others in their newfound network. This has been strengthened by urbanization in Africa, which has resulted in large migrant populations in cities throughout that region of the world- community-based networks play an important role in matching workers to firms in African cities (Luke and Munshi, 2003).

Marriage is associated with entry into the wife's network in Africa, which brings increased benefits and responsibilities. Networks help provide accommodation, credit, job assistance in a city, plus help in sending remittances back to rural homes. Luke and Munshi (2003) found that marriage significantly increases employment, income and remittances among the migrants in their sample of Luo, an ethnic group in Kenya. A

closer look finds that high ability individuals are deferring entry into marriage in the city, to avoid the progressive ability-tax that is imposed on them by entering into a network. They predict that should trends continue, as the economy improves and returns to individual ability grow (despite a necessary improvement in ability), that more individuals will opt out of marriage so as to not bear the cost of subsidizing the network.

Therefore, the active practice of polygyny is resulting in higher fertility per married man, because there are more women to carry his child. Despite improvements in education, medical technology, and urbanization, traditional values sanction polygyny, and each of the wives is expected to bear children because of the high cultural value placed on fertility.

4. What role has adolescent fertility played in overall fertility levels?

Median age of women at first birth in Africa is approximately two years younger than it is in North Africa, Asia or Latin America (Cohen, 1998). African countries have relatively high rates of adolescent fertility rates.

Differences in teenage fertility are in part attributed to differences in average age of marriage, but this is not true in all countries. Cohen states a median age of 14.9 at first marriage in Niger in 1993, and 19.5 years in Burundi. This trend is improving, with many countries showing later ages at first marriage, which are significantly correlated with urban residence and educational attainment (Cohen, 1998). Surveys indicate that despite the increase in age at first marriage in many countries, adolescents are still bearing a disproportionate number of children; many are unmarried.

5. How has contraceptive use influenced reproductive behavior? Birth Spacing

Caldwell et al. (1992) find that modern contraceptive is used to improve the spacing rather than prevention of births, more so in Africa than anywhere else in the world. Breastfeeding delays pregnancy by postponing the return of ovulation, therefore its length of time can be extended to exert some control over the timing of the next birth. Women in Africa are replacing traditional spacing practices such as prolonged breastfeeding and postpartum abstinence with contraception, so the increased use of contraception may not be resulting in declining fertility as has been observed in other parts of the world. Prolonged breastfeeding often is used not only to space children, but also as a means to reduce the incidence of infant mortality.

Lindstrom and Berhanu (2000) investigated the effects of breastfeeding on birth spacing in Ethiopia to determine the efficacy of this method in reducing the risk of infant and child mortality given that this country faces very scarce resources. This is important because it is believed that closely spaced births will reduce the birth weight of children, predisposing them to greater probabilities of morbidity and mortality; deplete or impair the mother's production of milk; deplete maternal health; and given all of these factors,

increase amount of resources required for medical treatment. They find that despite that breastfeeding often is extended into the third and fourth years of life in Ethiopia, infant and child mortalities are still very high.[33] It is also believed that breastfeeding is carried out for longer periods of time given scarcity of adequate weaning foods. This might then indicate that despite increased contraceptive prevalence and family planning programs, prolonged breastfeeding will continue in order to provide nourishment for infants. But the authors find that sustained breastfeeding beyond the age of two is associated with significantly higher child mortality, especially if breastfeeding is carried at age three and beyond. They postulate that failure to introduce adequate food supplements to breast milk at older ages may retard child development and increase risk of mortality, especially given the resource deprivation in Ethiopia. So for those cases where breastfeeding is used to space births, as has been documented in many parts of Africa (Cohen, 1998); contraception may indirectly help reduce fertility by increasing birth intervals but reducing infant mortality associated with increased dependence on breast milk, therefore increasing number of surviving offspring.

6. HIV/AIDS epidemic

6.1 What have the HIV/AIDS trends been in Africa?

Almost 70 percent of adults and 80 percent of children living with HIV in the world reside in Africa. Africa had also seen 75 percent of AIDS-related deaths in the world by end of 2000 (UNAIDS/WHO, 2000).

Caldwell et al. (1994) cite numerous studies from countries throughout sub-Saharan Africa that describe a traditional sexual culture characterized by substantial permissiveness and the absence of punishment for extra-marital relations. The main mode of transmission is heterosexual – most of the HIV infected adults are women, forming roughly 55 percent of the total, indicating that the potential impact of this epidemic on fertility could be significant (Ntozi, 2002).

In the 1980s and early 1990s the epidemic was experienced mostly in Eastern and Central Africa, where HIV prevalence of women attending antenatal clinics were as high as 30 percent in some sites in Uganda. On average, prevalence ranges from 5 to 15 percent in both Central and Eastern Africa. Since the late 1990s the epidemic has increased in Southern African countries, with high prevalence recorded at 35.6 percent in Botswana, 23.6 percent in Lesotho, 16 percent in Malawi, 13.2 percent in Mozambique, 19.5 percent in Namibia, 19.9 percent in South Africa, 25.3 percent in Swaziland, 20 percent in Zambia, and 25.1 percent in Zimbabwe (Ntozi, 2002).

[33] The proximate determinants of infant and child mortality in Ethiopia have been well researched; breastfeeding is but one of many factors that is contributing to persistent rates of infant and child mortalities.

6.2 Impact of HIV/AID on reproductive behavior

HIV/AIDS has led to fertility declines in many countries where the disease is highly prevalent. HIV/AIDS influences fertility of individual women through biological and proximate determinants of fertility. These include marriage, contraception, pregnancy, abortion, breastfeeding, postpartum abstinence, pathological sterility and natural fecundity. HIV/AIDS induces sterility, increases fetal mortality and can decrease frequency of sexual intercourse and production of spermatozoa (De Vincenzi et al, 1997; Thackway et al, 1997; D'Ubaldo, 1998). In countries like Uganda and those in Southern Africa, seroprevalence among women in their reproductive ages is 25 percent, and HIV/AIDS is causing an estimated 20 percent reduction in fertility (Garenne and Joseph, 2002). Examples of sites in Tanzania and Zambia indicate that fertility has declined in populations hard hit by HIV/AIDS epidemic – but it takes long durations of high HIV/AIDS prevalence to reduce fertility at a national scale (Ntozi, 2002).

HIV/AIDS is influencing marital practices, although the effect is difficult to generalize from setting to setting. Gregson et al. (1998) found that personal risk perception is associated with non-marriage in Zimbabwe – young women who felt at risk because many close associations were dying of AIDS were less likely to enter into long-term or cohabitating union. Luke and Munshi (2003) find that in their sample population from Kenya, marriage significantly increased the probability of men entering into risky sexual relations.[34] Their risk of contracting HIV is much higher, as is the probability of their passing it on to female partners – once they contract HIV, their fertility opportunities are altered, whether by choice or because of the onset of sterility. For the same population in Kenya, Okeyo and Allen (1994) found high levels of widowhood, but reduced widow remarriage rates. Where a male relative of the late husband used to marry the widow, that practice has been discouraged for fear of spreading the HIV infection. As a result widows cannot find sexual partners, and this limits their ability to continue producing children. A similar phenomenon was observed in Uganda, where the proportion of widows not remarried in their prime reproductive years rose from 59 percent among the 20-24 year olds to about 70 percent among the 25-29 and 30-34 year olds (Ntozi, 1997).

HIV/AIDS is also influencing pregnancy. Studies in Côte D'Ivoire and Uganda have indicated that HIV infected women have fewer pregnancies than HIV negative women (Ntozi, 2002). Gray et al. (1998) find in the Rakai district of Uganda, that in all age groups from 15-40, the pregnancy rate of HIV positive women was lower than of HIV negative women with overall rate of 13.4 percent and 21.4 percent, respectively. This might be due in part to less coital frequencies noted amongst HIV positive women. In this study it was also found that the pregnancy rate was significantly lower in women who exhibited AIDS symptoms at 7.5 percent than those who were seropositive, but without symptoms, at 14.3 percent. Logistic regression analysis estimated a 77 percent compared to 51 percent reduction in pregnancy risk for women with symptomatic HIV versus women who had symptom free HIV. Finally Gray et al. also find that HIV

[34] The authors defines an individual as risky if he matched with casual partners or commercial sex workers a few times a week or a few times a month in the previous year of data collection.

infection also influenced abortion practices – 18.5 percent of 130 pregnancies in HIV infected women ended in abortion compared to a 12.2 percent of 861 pregnancies in HIV negative women.

While these and other studies have focused on the biological and behavioral effects of HIV/AIDS on proximate determinants of fertility in individual women, few studies have linked the epidemic with fertility of populations at macro-levels. Isolating the impact of HIV/AIDS from other proximate factors of fertility is difficult in itself because HIV/AIDS influences those proximate factors. In most countries the fertility transition was underway before the acknowledged onset of HIV/AIDS, so to distinguish the increased use in contraception as a proximate determinant of fertility or in response to fear of contracting HIV/AIDS is difficult. For the impact to be felt, the prevalence of the disease has to be high in the region of 20 percent and sustained over about a decade or more (Ntozi, 2002). While some countries are expected to reach that stage, few have thus far, making observation and concrete predictions indeterminate.

It also is difficult to establish fertility and sexual behavior patterns for asymptomatic women with HIV/AIDS. Most countries severely affected by HIV/AIDS do not have enough equipment to test and advise women of their status unless they seek such services. But many in the population do not seek such services unless their conditions have advance to symptomatic stages, whether for fear of knowing or having others know of their condition.

Finally, it is too soon to tell how increased infant mortality will influence reproductive behavior. While the need to replace dead children may exert an upward pressure on fertility and challenge the influence of family planning programs, changes in sexual behavior like delayed first marriage and safer sexual relations may naturally curtail high fertility trends in certain regions of Africa.

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