
TOPICAL REVIEW

RECENT RESEARCH IN ECONOMIC DEMOGRAPHY RELATED TO LATIN AMERICA: A CRITICAL SURVEY AND AN AGENDA*

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THE POPULATION "EXPLOSION" IN LATIN AMERICA DURING THE PAST 25 YEARS HAS been followed by a veritable explosion of research into its origins, characteristics, and effects as seen from the points of view of many disciplines. Research on the economic determinants, concomitants, and consequences of population growth in Latin America has not been absent; but it has been notably less abundant than that pertaining, for example, to sociological dimensions of the phenomenon.

This dearth of research by economists reflects the complexity of the problem and the lack of scholars trained in both economics and demography, rather than the relative importance of the research for determining policy. The need for such policy-related research is clear. Navarrete (1967:11), for example, relates that a Latin American public health official voiced the opinion that population growth would bring his country great advantages over those nations which were growing more slowly and that the resultant development would lead to a reduction in fertility and the elimination of any population "problem." When asked what he proposed to do to house, educate, and employ the burgeoning population until such time as the problem was solved, he is said to have responded that he didn't really know but that he would leave it to the economists. The relative scarcity of research into economic-

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demographic interaction in Latin America is such that the confidence of that unnamed official may be sorely misplaced. For our understanding in this area is woefully inadequate, whether judged by comparison with our understanding of economic-demographic interaction in the more developed nations or by the more tangible criterion of the pressing need for the minimum information required for basic policy formulation.

It is the intent of this paper to review critically a specific subset of that literature in order to sketch the emerging profile of understanding of the economic dimensions of Latin American demographic phenomena. The review will emphasize the growing consensus that programs of population control may produce substantial economic benefits, but it will also note the weaknesses embodied in some of the premises upon which that consensus is based and the growing body of articulate criticism in Latin America. An attempt will also be made to identify the questions which must be answered if economic demography is to be a practical guide to policy. In addition, some of the more promising research efforts underway in Latin America are discussed.

The set of literature which the review covers is essentially that literature in English, Spanish, or Portuguese which explores theoretical or empirical aspects of the economic determinants of changes in mortality levels and fertility levels and the interrelationship between population growth and economic growth. Research reports which provide new data on fertility, mortality, and population growth for Latin American nations without explicitly analyzing economic-demographic hypotheses have been omitted. Also omitted intentionally from discussion here are studies which have been done by Latin Americans or which have appeared in Latin American publications but which deal with economic-demographic phenomena in a strictly theoretical fashion, without special reference to Latin America (for example, López Toro, 1969; Muhsam, 1970). Published reviews of economic-demographic conditions in Latin America (for example, Schultz, 1969a; Urquidi, 1967a, 1967b, 1969) which have been designed more to inform about prior research results than to suggest or evaluate new hypotheses are not reviewed here, although they are included in the bibliography. Finally, the extensive literature on spatial population distribution and migration is not considered here; those subjects represent a quite distinct and fairly easily separable set of research which merits separate complete review.¹

The set of studies which remains represents a rather large sample from the universe of original conceptual or empirical contributions to the delimited area of research during recent years. A large proportion of the research in this area consists of unpublished, specifically commissioned studies and narrowly-circulated conference papers. Studies or papers which may have been omitted erroneously are about equally likely to have been omitted because of inappropriate classification into one of the omitted subsets or because of this author's unawareness of the research. In either case it is apt to be the author's ignorance, and not an implication of unimportance, which has produced the omission.

The paper is divided into three parts. In the first part we consider the very meager information available on the relationship between economic variables and

mortality levels and mortality decline in Latin America. The second part covers aspects of the economic determinants of fertility in Latin America. And the third part explores the much more extensive research on the relationship between Latin American population growth and Latin American economic development.

1. ECONOMIC CONSIDERATIONS IN MORTALITY

The most neglected topic in the economic demography of Latin America has been the effect of economic variables on mortality levels and the change in those levels. The precipitate decline in mortality, unmatched by a comparable decline in fertility, is generally recognized as the principal direct cause of the sudden wave of increased population growth rates which has rolled across Latin America in the past 40 years. Analysis of the determinants of that mortality decline has been hindered until a few years ago by the nearly total absence of reliable mortality statistics. As recently as 1965, Somoza was led to suggest that data problems were of such magnitude that one had difficulty lending much credence to even the most elementary statistics on trends in mortality and life expectation for most of Latin America. The application of stable population theory by Arriaga (1968) to adjust census data and to generate life tables for various years for nine Latin American nations produced the earliest reliable estimates of the mortality decline and the first real opportunity to consider its economic determinants.

Working with those data, Arriaga and Davis (1969) concluded that although there appeared to be some correlation between the general level of economic development and mortality decline for those countries which experienced the decline prior to the 1930s, mortality has been "almost independent of economic development" for those nations to which the decline did not come until recently. Both the initial onset of the decline and the rate of decline appear to have been affected similarly. Certain nations, such as Brazil, Chile, Colombia, Costa Rica, Mexico, and Panama, had noticeably earlier mortality decline than the other nations for which Arriaga and Davis had data (the Dominican Republic, Guatemala, and Nicaragua). Although that first group of nations is hardly homogeneous by any other criterion, Arriaga and Davis suggest that their common early mortality decline was attributed to their relatively early ability to import public health assistance on the basis of their own economic growth. Mortality decline since World War II, however, appears to be much more closely related to the availability of public health services acquired through international programs of economic assistance and, hence, independent of (or in inverse relation to?) the level of economic development.

Differences in the time lags for reaching specific levels of life expectation suggest a similar picture of increasing rates of mortality decline independent of economic development. Whereas there existed a 54 year lag between the average year in which the first group of nations named above achieved a life expectancy at birth of 25 years (1860) and the average year for the same achievement in the second group (1914), there was only a nine year lag between their respective attainments of 50 year life expectancy (1951 versus 1960).

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Unfortunately, the number of nations and years for which Arriaga was able to construct life tables is too small for more extensive statistical analysis of the economic determinants of declining mortality. However, the economic concomitants of differential levels of life expectation have been explored in greater detail by Rao (1970). Rao chose ten social, health, and economic factors for a cross-section of eighteen Latin American nations and evaluated the extent to which they explain variation in five separate life expectancy measures (e^0_0 , ${}_5e_0$, ${}_{10}e_5$, ${}_{50}e_{15}$, e_5) for males and females separately. His economic variables (daily caloric intake, net national product (NNP) per capita, and percent of labor force in agriculture) had generally high and significant zero-order correlations with all the life-expectancy values in the cross section. Multiple regression analyses (with admitted problems in terms of degrees of freedom) indicated that the agricultural variable contributed little to reducing otherwise-unexplained variance and that caloric consumption and NNP had consistently significant coefficients only for e^0_0 and e_{65} . Rao interpreted this to mean that economic variables were more important in terms of their contribution to longevity and that they were relatively unimportant as contributors to decreased mortality during youth or working ages. For the the majority of the ten life expectancy dependent variables, the greatest proportion of the variance was explained by literacy, availability of hospital services, availability of medical personnel, daily caloric consumption, and per capita income.

Although one is led to suspect that the statistical problems not discussed by Rao (particularly multicollinearity among his independent variables) reduce the trustworthiness of his results, his study represents a distinctive advance in the analysis of mortality in Latin America. Such a cross-section approach would seem to offer the possibility of considering numerous additional questions which are relevant to economic policy, as the data became available. Research on policy with respect to mortality seems to have been hindered by the moral imperatives which make it virtually inconceivable that a government would choose any policy other than the most rapid reduction in mortality which is possible. Yet most policies to reduce mortality require developmental resources, physical, human, and financial, which have an undeniable opportunity cost in terms of alternative objectives within the society. Much additional research is needed on the relationship between alternative programs of public health investment and the returns to such in the form of decreased mortality. Further research is needed on the incidence of mortality within nations in response to questions of both efficiency and equity. To what extent, for example, does a relationship exist between income distribution and life expectancy in the Latin American nations? To the extent that such a relationship is established, greater urgency may be lent to the goal of more equitable distribution of the benefits of development. To what extent does a significant variation exist in mortality across subnational regions? If such differences exist, as they most certainly do, then policies influencing population redistribution must take into consideration the implied differences in lifetime productivity. Though mortality may not be a dominant feature of the interpersonal distribution of income or

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the interregional distribution of productivity, to ignore the possibility is to invite misinterpretation of the phenomena.

2. ECONOMIC CONSIDERATIONS IN FERTILITY

Sustained high and, in some cases, rising levels of fertility have combined with Latin America's unprecedented mortality decline to produce the rates of population growth characterized as "explosive." The analysis of economic dimensions of those fertility levels has taken place in two chronologically overlapping phases. The first phase consisted of the application of concepts of "demographic transition" to suggest that temporary bursts of population growth were not surprising in the aftermath of mortality decline, and that birth rates would fall in due course. As evidence became available that birth rates were not falling and that population growth appeared more-than-temporary, detailed analyses of the determinants of fertility on a country-by-country basis began. These studies have tended to borrow from microeconomic theorizing in the United States. Data limitations, especially the lack of usable economic data in the many fertility surveys conducted over recent years, still hinder additional study. And many questions remain unanswered.

The concepts of "demographic transition" are principally inductive and have been drawn from retrospective analysis of the reduction in mortality in various European nations in the last century, followed by reductions in birth rates after surprisingly similar intervals (cf. Heer, 1966). The experience of Latin American nations, as it has become known, appears to elude simple transference of the concept. Heer and Turner (1965) were among the first to discover, in a cross section of 318 communities, that in Latin America rapid increases in the standard of living were associated with increases, not decreases, in fertility in at least the short term. Collver (1965) applied European lags between mortality decline and fertility decline, and noted that Chile, Venezuela, and Mexico were among the most highly developed nations in Latin America but that they possessed birth rates which were declining "very late." Gendell (1967) noted similar phenomena in Brazil over the entire 40-year period from 1920 to 1960. Despite pronounced differences in fertility by residential location and by socioeconomic status and despite substantial migration and increases in levels of income for most of the population over that period, fertility in Brazil, according to Gendell, remained at a high level throughout the interval. Kirk (1971) has noted that birth rates do appear to be declining now in a wide spectrum of less-developed nations, including several in Latin America. More importantly, he notes, the rate at which the transition is being made is increasing dramatically. That is, the number of years it takes a nation to decline from birth rates in excess of 35 per thousand to rates below 20 per thousand is decreasing. The later the onset of fertility decline, the more rapid, it appears, is the rate of decline. Miró and Mertens (1968) drew from CELADE (Centro Latino-Americano de Demografía) fertility studies in seven urban areas and three rural areas of Latin America to demonstrate that rural areas had substantially higher levels of fertility than urban areas. This evidence, together with evidence of rapid urbanization, has led to the emergence of an approach to

demographic transition found in Singer (1970). Singer suggests that the population boom may be viewed as a temporary phenomenon which will resolve itself as processes of urbanization increase the proportion of the population in the low-fertility urban population and decrease the proportion in the high-fertility rural population.

Frustration with the imprecision of such "macroeconomic" approaches for explaining and predicting changing fertility was one of the stimuli which led to the growth of "microeconomic" approaches to fertility and to the subsequent application of those theories in studies of economic factors in fertility in Latin America. The microeconomic approach sought to derive a better understanding of the relationship between changes in the level of fertility and changes in economic conditions by approaching the decision to bear children as a basically rational decision made by families in response to specific culturally-determined attitudes toward children. It was believed that if the family planning decisions of individuals in different socioeconomic situations could be deduced, then the fertility implications of changing socioeconomic conditions might be derived with greater accuracy than by cross-section analysis of overall development and birth rate trends. But the microeconomic approach has encountered mounting objections as economists have attempted to introduce increasing rigor into the analysis at the cost of some intuitive appeal. Tractable static economic models are cumbersome when applied to this inherently dynamic phenomenon. In its most reasonable form, seen in early work by Becker (1960) and in Schultz (1967), the microeconomic approach to fertility suggests that the frequency of births in a population can be understood from three factors: a family-size goal, the incidence of infant mortality, and the uncertainty of the family formation process where deaths, births, dissolution, and remarriage are unpredictable.

The family-size goal, Schultz suggests (1969: 8), is determined by family analysis of the benefits of having children versus the costs to the family of those children. Benefits include not only the value to the parents of the children themselves, but also their value as potential contributors to family resources. In less-developed (especially agricultural) societies the resource value of children appears to begin much earlier than in urban or more-developed nations. The costs of having children include the opportunity cost of parents' time (the income foregone by either parent because of child-care obligations) and the direct pecuniary costs of feeding, clothing, sheltering, and educating children to whatever extent is culturally considered appropriate.

The influence of infant mortality is seen in family planning in terms of the attempt by parents to compensate for expected infant mortality by seeking the number of births which will give the the desired number of children who survive. The uncertainty associated with other dimensions of the family formation process, such as premature parent death, dissolution of a parental union, and the uncertainty of remarriage, may combine to produce an increase in the desired number of births or a decrease in the spacing of births with a resultant increase in the total number of children.

Two applications of this approach have been made in Latin America, the first by Schultz (1969) for Colombia, and the second by Da Vanzo (1972) for Chile.²

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Schultz studied cross-section variance in "surviving fertility" for a set of 131 Colombian *municipios*. Schultz used estimates of crude birth rate derived from child/woman and child/population ratios as indicators of surviving fertility in each municipio. The "surviving fertility" measure was used to adjust for a real variation in death rates in data on simple population increase. As independent variables derived from the family planning model, he chose (1) the female labor force participation rate as a proxy for women's opportunity wage, (2) school attendance rates of children and educational attainment levels of adults as measures of the costs of rearing children, (3) annual growth of real wages as a measure of increasing living standards, and (4) the proportion of adult women married or living in consensual unions as an intermediate cause of interregional variation in fertility.

Schultz found, using ordinary least squares techniques, that variation in the educational variables explains about 22% in the cross-section variance but that more of the other variables add significantly to the proportion explained at a .05 level of significance, although the *a priori* signs were correct. His results imply that a doubling in the school attendance rate would be associated with a 5% reduction in surviving fertility. As the proportion of adults with some schooling increased from 62% to 74%, there would be an expected additional decrease of 1% in fertility.

The Schultz study suffered from a number of defects, which he admitted. The relationships which determine female participation in the labor force, the formation and dissolution of marriages, and the number of children born are not independent of one another. These variables are determined by similar cultural and economic factors and, to some extent, jointly determine one another. The single equation model adopted by Schultz ignores much of this simultaneity and implicitly assumes that the various explanatory variables are independent of one another. Furthermore, it was not possible to include a measure of relative infant mortality in the Colombia study, for lack of data. The "surviving fertility" measure, the participation rates in lieu of female wages, and the absence of child economic activity information may have introduced misspecification or spurious variation which reduced the real explanatory power of the postulated variables.

The study of fertility conducted by Da Vanzo (1972) not only improved the specification of these variables, it also provided the most statistically sophisticated analysis of economic fertility in Latin America to date. Da Vanzo utilized data on urban and rural areas of each of the 25 Chilean provinces to estimate by two-stage least squares an 8-equation model of female labor force participation, marital status, and fertility decisions for each of 9 age cohorts of women. The need for a simultaneous equation model is based upon the reasoning that female wages, child economic activity, child schooling, female labor force participation rate, and ultimately, birth rates are not phenomena which can be separated into a single stream of sequential causation. Rather they are jointly determined in the real world in complex interrelationship with one another. The simultaneous equation model was developed by Da Vanzo from the traditional literature on female labor force participation and from the fertility approach of Schultz. A complete description of the model would

be too lengthy here, but the eight jointly dependent variables were: female labor force participation, female wage, proportion currently legally married, proportion consensually married, proportion separated, fertility, child labor force participation, and child school attendance. Each dependent variable was expressed as a linear function of other variables, which were either given by data from outside the model (exogenous) or estimated by other equations within the model (endogenous). Fertility, for example, was estimated as a function of four exogenous variables (proportion consensually married, male wages, infant mortality rates, and a binary urban-rural dummy) and four endogenous variables (proportion legally married, child labor force participation, child school attendance, and female wages).

Da Vanzo found that her age-specific fertility equations explained from 82% to 91% of the variance (for ordinary least squares estimates) across the fifty areas in children-ever-born to women of the specified age. For almost every age cohort the proportions legally and consensually married were the most significant variables for explaining fertility, and legally married women tended to be associated more strongly with high fertility than consensually married. This result followed Da Vanzo's expectation that the greater social amenities payable to legitimate children and possibly greater frequency of sexual contact would lead to high fertility in legal marriages, and it runs counter to the sketchy evidence reported by Stycos (1968) that fertility was higher among consensually married women. Child labor force participation and child school attendance (entered separately due to strong negative correlation between them) appear to support the hypothesis that the costs and benefits of a child influence the number of children parents desire. Although the elasticities are not given, the reported results support the notion that increased schooling opportunities or increased resistance to child labor will decrease the desirable number of children and, hence, decrease the birth rate. The female wage variable had the expected sign in all of the estimated equations, and its level of significance was generally higher for older cohorts (though never significant at .05), perhaps indicating greater influence after first children. Male wages demonstrated a positive effect upon fertility for all but the youngest age groups. Infant mortality, finally, had a strong direct relationship to fertility for all but the two youngest age groups.

The findings of Da Vanzo's research bring us full circle to the question of overall and specific influences of development on fertility. When changes in female wages and female participation are controlled for (she reports), simple increases in income levels are associated with increased fertility. To the extent, however, that development provides greater opportunity for female education, fertility may be expected to be reduced. Increased female education in the Da Vanzo model appears to raise female wages and to induce women not only to postpone or reject marriage but also to desire fewer children. Those wages, the opportunity costs of bearing and raising children, appear to overcome the increase in desired family size attributable to higher income.

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The policy implications are clear. Policies designed to eliminate the gap between male and female educational opportunity or to diminish sex-discrimination in hiring appear likely to reduce fertility. Reduction in infant mortality also appears to reduce fertility, but Da Vanzo questions whether one can expect the effect to be felt over any short period. A broader implication appears to be that increased income levels unaccompanied by social change, such as that suggested with respect to female education and employment, may not decrease fertility.

The possibility of generalizing from Da Vanzo's results may be questioned on several grounds. Chile has long been recognized as one of the least sexist of the Latin American nations. Woman's suffrage came early there, and female participation in industry and politics has traditionally been greater there than in most of Latin America. What significance does the Da Vanzo model have for a nation with substantially different cultural underpinnings? Fragmentary evidence is available from Bolivia. A large sample survey of fertility in the departments of La Paz, Cochabamba, and Santa Cruz (*Centro de Estudios de Población y Familia*, 1970) found a strong inverse relation between years of education and live births. Women without any education had 77% more live births than those of comparable age with secondary education or more. But female participation rates showed mixed relationships to fertility. Those women who worked either at home or away were found to have generally greater numbers of live births than those who did not work, except in urban La Paz. It was suggested in the study that this perverse effect of female participation may be attributable to the fact that women with many children have greater need to work than those with few. The statistical analysis was too elementary to permit testing that hypothesis. Stycos (1968) found little evidence of the inverse relationship between education and fertility, and he suggested that fertility was clearly higher in consensually married women.

The problem is clear. If one wishes to know what effect alternative forms of economic development will have on fertility, it will be necessary to determine specific effects under each of broadly varying sets of cultural conditions. There is reason to believe, furthermore, that economic development will effect fertility in ways which vary with structural differences in the economy at the beginning of the process *and* with the specific patterns or strategies utilized. Is it not likely that a society which begins from a fundamentally agricultural economy and develops in terms of expanding and modernizing agriculture will encounter different fertility consequences than one which begins from the same base and proceeds to industrialize and urbanize? And what of an economy which develops by diversifying production from high income enclave exports to more broadly-based domestic industrial production, with all the distributive implications which that may carry? But both Venezuela and Bolivia could be associated with that last pattern. The other cultural and economic differences between them are so great that the fertility implications of their superficially similar development pattern must certainly be different.

The approach which is needed is a set of models of fertility behavior consider-

ably more complex than that of Da Vanzo. The models would need to be sensitive to alternative patterns of structural change in output under alternative development strategies, alternative patterns of government expenditure, and alternative patterns of final consumption. They would need to include a larger set of endogenous variables such as both male and female wages, rural-urban location, and female participation rates. For most complete analysis, they should then be made operational as a submodel within a general equilibrium model of growth and development.

Even so, additional questions would remain about Latin American fertility. How, for example, do the economic variables affect aggregate fertility? Are there changes in spacing or timing as well as changes in desired family size? If the changes can be identified in detail, what kind of policy is likely to be most effective in reducing fertility, assuming that such a decision has been reached. And, finally, can Kirk's "new" demographic transition be explained across nations and through time by differences in the patterns of economic development which have characterized the "late starters"?

3. POPULATION GROWTH AND ECONOMIC DEVELOPMENT

The interrelationship of high rates of population growth and historically low rates of economic growth continues to pose the most fundamental questions for economic demographers in Latin America. The largely pronatalist policies of the 1940s and 1950s yielded somewhat during the early 1960s to the growing body of literature, generally not specifically related to Latin America, which could find little positive to say for high rates of population growth. The gradual application of those approaches to Latin America undermined pronatalist attitudes. The highly abstract level of the analytical arguments and empirical models and the overwhelming recent growth of the Mexican and Brazilian economies, in the presence of rapid population growth, have combined with skepticism of models developed in the advanced capitalist countries to produce a renewed questioning of the appropriateness of antinatalist policy.³

The theoretical literature identifies a somewhat asymmetric set of economic advantages and disadvantages of either larger or more rapidly growing populations. The asymmetry enters because advantages are generally associated with larger populations and disadvantages are attributed to rapid rates of growth.⁴ The role of savings is, ironically, important to both cases.

Large populations tend to be associated with the potential for economies of scale in the production of consumer goods, capital goods, and some government services. The constant increase in demand from growing populations is seen as a stimulus to investment and to the resultant growth through windfall profits to producers (Hirschman, 1958). If one is concerned with decreasing returns to labor inputs (as the argument below will be), Clark (1967) argued that one need only find a combination of economies of scale and capital-augmenting technological change to offset the decreases. The very pressure upon resources created by large populations, furthermore, may induce the technological adaptation needed to sustain

the standard of living (Boserup, 1965; López Toro, 1970). And in the Latin American context, population growth may permit a nation to produce efficiently for a domestic market, reducing thereby the need to depend upon specialized and unstable export markets for principal stimuli to development (Singer 1971).

With respect to savings, the pronatalist case suggests several routes to higher savings through higher birth rates. If larger populations are accomplished through larger families,⁵ inheritances will be spread more thinly, and either heads of household will be induced to save more to achieve constant per capita inheritance or children may be induced to save more to achieve a given post-inheritance wealth level (Clark, 1967). To the extent that savings for old age form a significant component of total savings, a growing labor force will generate net increases in such pension-related savings; for the number of contributors to such savings will exceed the number of recipients.

Leff (1969) hypothesized, on the other hand, that the high dependency rates associated with rapid population growth (due to the shifting of the age distribution toward younger ages) might be expected to impose a constraint on a society's potential for saving merely by virtue of the fact that such dependents contribute to consumption but not production. In a cross-section statistical analysis of 74 countries, including 15 from Latin America, Leff determined that dependency rates contributed well to the explanation of variations among nations in savings rates. The higher the dependency rate, especially among the less-developed subset of nations, the lower the rate of saving. Leff's results were challenged by Gupta (1971) and Adams (1971), largely on statistical grounds. Leff's analysis lacked a theoretical model to explain precise saving behavior. López Toro (1970) has suggested that if children are considered substitutes for other consumer goods or leisure time, as in the fertility models above, savings rates per family may be unaffected by the addition of dependents. Singer (1971) argued that in the subsistence sector of an underdeveloped nation a decrease in dependency might produce a *decrease* in savings, for there would be less incentive to produce a commercialized agricultural surplus. Singer also noted that non-monetary savings in subsistence agricultural societies may provide the principal source of capital accumulation. This is because agricultural capital such as terraces, irrigation systems, roads, and dams are amenable to highly-labor-intensive production. If surplus agricultural labor is the principal source of such capital accumulation, increases in population in rural areas will *increase* the rate of capital accumulation.

Statistical analysis reported by Clark (1967), but considerably less detailed than that of Leff, suggested that there was a positive relationship between aggregate savings and rates of population growth. Cabello (1868) noted that for 17 Latin American nations those nations which experienced the greatest rates of increase in GNP in either of two periods 1955–59 or 1960–64 also had the highest rates of population increase during those same periods. And Alejo (1968) suggested that Mexico's rapid economic growth, on balance, is at least as likely to have been aided as to have been hindered by its rapid population growth.

An extensive U.N. report prepared by Ducoff (1960) took a sanguine view of

the relationship between population pressures and development potential for Central America, Panama, and Mexico. Viewing the relationship between rates of population growth in those countries from 1946 to 1966, and the rates of GNP growth achieved over the same period, he suggested that maintaining the standard of living through 1980 should not be difficult for any of them. Achievement of a 6% per year rate of real increase in GNP from 1954 to 1980, furthermore, would double real product and income per worker, effectively doubling the standard of living. He admitted that the quantity of agricultural land cultivated would have to increase substantially in each country and that educational requirements would be high, but he considered that the possibilities for shifting labor from agriculture to industry were good and that the probability of increasing the standard of living to his suggested level was high. Current analyses of the unemployment problem (e.g. Thiesenhausen, 1971) are far less confident that such goals can be met, especially in view of the differences in manpower requirements in industrial and agricultural sectors and the implications which they have for employment.

The opponents of population growth may be viewed, in at least one sense, as starting from Ducoff's point of view. That is, if one can identify what must be done to produce a given increase in the standard of living with substantial population growth, is it not likely that a greater increase in the standard of living over the same period of time would be possible if birth rates were lower? The reasoning behind such an assertion would appear, at first, to be quite conclusive.

If the productivity of each member of the labor force is closely related to the quantity of capital and natural resources with which he or she may work, each increase in the labor force will require an increase in the availability of the other factors of production if output per capita is to be maintained. The pronatalist arguments based on the apparent abundance of Latin America's natural resources implicitly assume that such resources can be made available without significant capital cost (e.g., Mayobre, 1965; Maza Zavala, 1970). The most frequently articulated argument against high birth rates suggests that the investment requirements needed to maintain constant productivity levels increases as a multiple of the birth rate, and considerably more rapidly than the increases in savings most optimistically expected from higher birth rates (Coale and Hoover, 1958). At very high birth rates the investment required "just to stand still" in terms of output per capita may absorb most or all of a nation's investment capacity.

Navarrete (1967) calculated that for Mexico in 1967, given the expected rate of entry into the labor force between 1967 and 1975, the total investment required to maintain the 1967 ratio of capital per worker would be 25% of gross national product each year over the eight-year period. The current rate of saving was 18.3%, one of the highest in Latin America. Mexico *could* absorb the entire increase if enormous new savings were generated. But whence would the savings be forthcoming to accomplish that goal, she asked. No evidence existed in Mexico at that time to suggest that the earlier increase in population had altered savings rates to the extent necessary to absorb the lagged increase in labor force.

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Daly (1970) demonstrated the same point with respect to the Brazilian economy by means of a simple Harrod-Domar model of economic growth. If all capital is employed (an important assumption), per capita income can increase only if net savings increase, the capital-output ratio decreases, or population growth decreases. Liserre (1968) suggests that this is a principal explanation for the recent malaise in the Argentine economy.

Quantitative evaluations of these hypotheses with respect to Latin America are, in the words of Schultz (1970), "still in their infancy." The path-breaking study by Coale and Hoover (1958) included brief discussion of the Mexican case as an extended application of a model derived from India. Coale and Hoover introduced specific demographic dimensions into a model of economic growth and, in effect, simulated the impact of alternative rates of population growth. Their model specified that aggregate consumption was a function of "adult-equivalent" population, in addition to aggregate income, and that different birth rates would produce not only different total populations but also varying adult-equivalent populations caused by the age-structure effects. Aggregate income and product were specified to grow in response to the total rate of savings and to the allocation of that saving between directly-productive investment and what one might call "demographically-required" investment. This demographically-required investment—essentially the human resources infrastructure such as health, housing, and educational facilities—was assumed to yield a stimulus to economic growth which was substantially less than that of directly-productive investment.

Using parameters taken from the experience of India (and sometimes contrived rather arbitrarily), Coale and Hoover projected income levels over thirty years for India on the basis of three alternative birth rates, the rate prevailing then, and two substantially reduced rates. They concluded that under most reasonable variations of their sets of parameters, economic growth with low fertility would produce roughly 40% higher levels of per capita consumption than growth with continued high fertility. The basic reason for expecting higher levels of living with reduced fertility as compared with sustained fertility was that lower fertility tended simultaneously to produce faster growth in total product and to produce slower growth in the number of consumers. The labor force remained approximately the same because of the long lag between fertility changes and labor force changes and because of an expected increase in female participation; but the labor force was combined with larger and more productive developmental outlays in the low fertility case (Coale and Hoover, 1958:304).

The extension of the model to Mexico for the 1955–1985 period, although not discussed in nearly such detail as the model for India, was reported to yield strictly comparable conclusions. Assuming that welfare expenditures would rise to the level estimated for India as a share of income, and that public and private investment would rise in proportion to changes in per capita income, Coale and Hoover found that low fertility growth in Mexico would produce a 41% higher level of income than growth with birth rates which continued at 1955 levels.

The capital requirements of rapid population growth were also quantified by Gendell (1965) in his study of Brazil, an investigation which drew from Lyra Madeira (1964). Gendell offered a set of apparently arbitrary age-specific "coefficients of production" and "coefficients of consumption" to explore the differences in savings potential which accompanies differences in the age structure of populations. By applying these coefficients to the Brazilian population and then to the populations of the United States and Sweden (as examples of "older" age distributions produced by lower fertility), he concluded that the differential savings available from lower fertility were highly important and that the differences in required "demographic investment" formed a significant component.

The Coale and Hoover model was limited in several critical dimensions. In the first place it assumed away the possibilities for economies of scale by suggesting that they were relevant only where populations were not already large and where population density was low. They were thus unable to test one of the principal tenets of the pronatalists. The model also suffered from the embarrassing problem of predetermined results. Given their specification, there was no way that the high fertility case could have produced a result that was superior to the result suggested for low fertility.⁶ The model was nonetheless important for demonstrating the magnitude of the differential results. The Gendell approach suffers from rather severe arbitrariness in his choice of sets of age-specific coefficients and the implicitly-assumed required demographic investment.

Singer (1970) and Fucaraccio (1970) have questioned the entire approach of these models on several grounds. They question, most fundamentally, the significance of family savings to Latin American development efforts and the relevance to that savings rate of population limitation. Noting first that family saving constituted as little as 18% of total domestic savings in Venezuela (1965) and that domestic savings was only about two-thirds of total savings, Singer suggests that government and corporate savings are the most important sources of saving and that there is no basis for a *a priori* expectation that their levels will fall with population increase. He then asserts that family savings are much more likely to be affected by income levels and, especially, by the distribution of income than by family size.

Fucaraccio notes that completed family size in six Latin American countries appears, broadly speaking, to be inversely related to the level of the father's professional skills and thus inversely related to income levels. Both Singer and Fucaraccio then conclude that the demographic source of greatest population growth in the economic source of virtually no savings, and that those families which are in the economic classes which generate the majority of family savings already tend to have few children.

Some of these problems were dealt with more successfully in the study by Newman and Allen (1967), which explored the significance of population growth for economic development in Nicaragua, an example of a nation with a small population and low density. They constructed a 16-equation model, generally in the Coale-Hoover tradition, which incorporated major improvements. They used a Cobb-Douglas pro-

duction function, thus permitting the introduction of economies of scale and factor substitution. They introduced demographic effects upon savings not only in terms of a population term in the consumption function, but also in terms of the increased government consumption which is required by population growth and the reduction which that may effect on total saving.

A series of 299 simulations with the model produced results very similar to those of Coale and Hoover. Using projections from 1963 to 2013, a period which permitted greater labor-force changes to materialize, they also considered three alternative fertility possibilities: continuation of the 1961–63 rates, and two alternative rates of reduction over the planning period. Although their results show that substantial differences in production, investment, and consumption appear between the high and medium and between the medium and low fertility rates, they conclude that “there can be no reasonable doubt but that the small population would fare better in a material sense than the medium one, and the medium [better] than the larger one” (Newman and Allen, 1967: 67). For a “typical” simulation run, they reported that the average annual rate of growth of private consumption per capita was nearly $\frac{1}{2}$ percentage point higher for the low fertility case than for the high.

Newman and Allen were able to simulate economies of scale under varying conditions. For wide ranges of variation in many parameters, the greater the economies of scale which they assumed possible the greater the level of consumption possible. Nevertheless, they note that “a reduction in fertility always significantly raises the rate of growth of per capita consumption, and reduces the vulnerability of the economy to severe fluctuations in economic activity” (p. 66).⁷

The detailed nature of demographic impacts upon specific forms of government expenditure has been probed by Arévalo (1968), Cabello (1968), and by Herrick and Moran (1972). Arévalo demonstrated that one implication of shifting age structure in the Latin American population is that educational expenditures will have to increase more rapidly than population increase or else expenditures per student will fall, even at current attendance rates. If both population increases continue and attendance rates rise, expenditures on education will have to rise at a rate continually above that of the rate of population increase.

Herrick and Moran have studied the complementary question with respect to Chile, the effects of declining birth rates, through a third general equilibrium model comparable to those of Coale and Hoover and of Newman and Allen. The model they used, developed by McFarland (1969), was superior to that of Coale and Hoover in that it included a Cobb-Douglas production function with a technological change variable. But it was less complex than the model of Newman and Allen, for it introduced demographic interaction with savings only through an aggregate historical relationship between consumption and population size. Three alternative fertility projections, bracketing the declining rates experienced by Chile, were used to generate alternative projections of population size and age-structure and alternative levels of GNP and per capita consumption.

They note grimly that even if fertility continues to fall as in their mid-range projection, there will be twice as many children enrolled in primary school in 2000 as in 1960 and more than twice as many in high school and college. If fertility continued at 1960 levels until 2000, there would be more than 3.5 times as many enrolled in all levels as were enrolled in 1960. With a small decrease (as planned) in the student/teacher ratio (uniform across different birth rates), by the year 2000 the number of new teachers required under the high fertility alternative would be more than four times those under the low fertility projection. Annual primary school investment and operating costs in 2000 under the low fertility option would be twice their 1970 level. Under the high fertility case they would be more than four times the 1970 level. For secondary education, high fertility costs would again be twice low fertility costs and nearly seven times 1970 expenditures. In general, their research suggests that the high fertility population would have roughly the same level of total GNP in 2000 as the low fertility population, but it would have per capita income one-third lower and educational expenditure requirements more than twice those of the low fertility case. Unfortunately, Herrick and Moran did not feed these considerations back into the model of economic projections in order to derive their full impact in terms of differential final consumption levels.

The implications of population increase for housing construction are considered by Cabello (1968) in terms of their potential conflict with other development policies. The minimal objective of housing policy, he noted, should be to maintain the current average quality of housing and to prevent the worsening of the quantitative "housing deficit," however defined. But housing expenditures may be inflationary and, in times of resource scarcity, may contain the growth of developmentally more productive sectors. Herrick and Moran note that from 1960 to 1968 in Chile, investment in residential construction constituted only 3.0% of gross domestic product but utilized 48.0% of net domestic saving. Applying their population projections to estimate housing needs in 2000, a "minimal housing goal" (the same proportion in "acceptable" housing as in 1965) would require 3.5 times the 1970 annual outlay under the high fertility assumption and only 2.5 times the 1970 level under low fertility. In terms of net domestic savings, 23% of the estimated level in 2000 would be required for the high fertility case, but only 11% for low fertility.

The suggestion that education and public health expenditures would be reduced by population control measures is rejected as insignificant by Fucaraccio (1970). He suggests that the absolute quantity of funds freed would serve to employ very few additional persons if invested because the capital requirements per non-agricultural employee are so high. He appears to reject the notion that housing deficits would be reduced since such a large proportion of residential construction costs would be attributable to housing for upper income groups.

The neglect of such income distribution considerations is also a basis for criticism applicable to all of the models of economic-demographic interaction considered up to this point. They assume implicitly that distribution of income is unimportant in the analysis of the phenomena they seek to model. Fucaraccio (1970) has noted,

however, that there is an inconsistency in the approach which suggests that reduced birth rates will increase savings when, as noted above, those whose birth rates are most likely to be reduced are least likely to generate much savings since their income levels are so low. He is led, as a consequence, to characterize the "real preoccupation" of those who espouse family planning programs as political, rather than economic. "It takes little to understand," he writes, "that the preoccupation is the impoverishment of a growing mass of population which pressures for higher living standards and, when confronted with the incapacity of the system to produce them, may come to challenge the very existence of the system which is unable to produce them" (p. 61). Maza Zavala (1970) concurs. The ideas of overpopulation or excessive rates of population growth are, he asserts, a "phantom" designed "to distract the attention of the [Latin American] peoples from the true causes of their poverty, dependence, and servitude" (p. 6).

A recent approach to the problem suggested by Isbister (1970, 1973) considers explicitly various dimensions of income distribution in an economic-demographic model applied to Mexico. Isbister's model divides society into peasants, capitalists, and urban workers, each group characterized by a different marginal propensity to save. He then specifies a two-sector Lewis-type growth model in which two contrary forces act upon the urban wage rate and the rate of saving and capital formation as a result of lower fertility. The low-fertility population demands less food; and the urban wage, assumed proportional to the rural wage, tends to fall. Lower urban wages mean higher profits and, assuming that capitalists have the highest savings propensity, higher rates of investment. Gradually, however, the slower-growing rural labor force leads to rising rural—and then urban—wages. The time lags involved and the cumulative effects upon saving were simulated with data on Mexico using two alternative fertility projections. The numerical simulation suggests that here, too, per capital income rises faster with falling fertility than with constant high fertility. Reduction of fertility changes the relative shares of income, worsening the income distribution, until such time as labor becomes scarce in the rural areas.

Saenz (1972) suggests that it was precisely this rural labor scarcity which maintained a relatively equitable distribution of income in Costa Rica prior to 1920, despite high concentration in the ownership of land.

One striking result of Isbister's model which is likely to raise even more suspicion of population control programs is the implication that wages in the urban sector would be lower under declining fertility than under high fertility for the first 35 years of the 45 year projection. Although his model suffers from the same very high level of aggregation which characterizes all the rest, the kernel of similarity to actual conditions makes the model initially attractive for the economies of Latin America.

It is assumed in all of the Coale-Hoover genre of models that existing capital is fully employed and that, therefore, new labor force requires additional capital. Singer (1970) has argued that since there is widespread evidence of under-utilized capital in Latin America, ample opportunity remains to employ additional persons without

additional investment. He argued that such excess capacity would make possible increased output per capita without increased investment per capita (p. 52). The existence of excess capacity is undeniable, but the long run significance of it (its aggregate ability to absorb additional labor force) remains to be demonstrated. The assertion that "a higher level of employment [of excess capacity] could provide a substantial increase in per capita product" (p. 53) would seem appropriate only where one is referring to absorbing the currently unemployed, i.e., those with very low, zero, or negative current marginal product. For, to add new labor force via population growth to a constant stock of capital will increase total output at constant or decreasing output per capita but will not *increase* output per capita unless one also postulates increasing returns to labor inputs. In that case excess capacity is unlikely.

The failure of these models to disaggregate both production and population into different sectors is also criticized by Singer (1970). He has shown (1971) that there is reason to believe that population increase in subsistence agriculture may have qualitatively greatly different implications from population growth in an advanced urban economy. An increase in subsistence sector population not only may increase rural capital accumulation, as noted above, but it may also serve to conserve available saving in the rest of the economy where substitution of labor for capital is less possible. That is, an increase in rural population may slow the rate of substitution of capital for labor in agriculture and increase the availability of savings for capital formation in industry (1971:219).

The models suffer from one final broad class of shortcomings: the relatively static nature of the structure of output which they assume. Maza Zavala (1970) has noted and Navarrete (1967) has implied that the critical capital constraint might be made less binding in ways other than new investment. Changes in the pattern of production, especially changes which tend in the direction of products which have high marginal product for labor and relatively small capital requirements, would permit the absorption of larger quantities of labor force than that postulated by Navarrete with unchanged average capital requirements. Maza Zavala claims that a reduction in "non-essential" consumption would produce such an effect. But without more evidence it is equally plausible, though admittedly politically unattractive, to suggest that specialization in low quantity, high-skill-content luxury goods will stretch capital further and employ more labor than mass-produced necessary consumption items.

Increased agricultural productivity from redistribution of lands represents another alternative not incorporated in the aggregate models. To the extent that agrarian reform expands production on idle or under-utilized land, average productivity may rise. Maza Zavala contends that this could be done virtually costlessly in terms of scarce developmental resources. The history of agrarian reform programs which consisted of land distribution without accompanying programs of technical assistance and agricultural credit does not strongly support such an assertion. But it is conceivable that under conditions of very low prior marginal productivity of the

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labor involved, the relatively low capital-output ratio of labor-intensive agriculture would imply a capital requirement for labor absorption far below the national average. It remains incumbent upon those who propose to resolve the capital-requirements problems of population growth through social change to demonstrate that the developmental resources freed by such changes will be large enough to cover population growth requirements.

The models of aggregate economic-demographic interaction considered here must either be reformulated to incorporate the objections which have been raised, or alternative approaches must be developed. Two promising reformulations are currently underway in Colombia and Peru. In both cases the models being developed consist of elaborate extensions of the TEMPO model of McFarland (1969).⁸ In Peru, the *Instituto Nacional de Planificación* has designed a model of economic-demographic interaction which contains three economic sectors, each with its own production function (agriculture with constant returns to scale; a services sector with decreasing returns to scale; and a manufacturing sector with increasing returns to scale). The labor force is disaggregated in each period across sectors of employment, age, and sex. The gradual reduction of unemployment and underemployment is introduced by means of an assumed inverse relationship with per capita income. Sector-specific capital stock estimates and sector-specific exogenously-distributed public and private investment are combined with exogenously changing capital-labor ratios to determine labor demand. Savings rates are, somewhat disappointingly, determined entirely outside the model.

A much more ambitious and considerably more promising model is being developed by a team at *Corporación Centro Regional de Población* in Bogotá. That model, dubbed "TEMPO/COLOMBIA," has abandoned the neoclassical production function approach and has adopted in its stead a 10-sector fixed coefficient model with very elaborate demographic, migration, public health, education, and savings sub-models. The economies and diseconomies of scale possible in the Peruvian model are possible here only through parametric variation over time. But virtually every other objection to these models raised here can be met to some degree. Alternative patterns of government consumption and investment, representative of alternative development strategies, will be simulated and their effects on dimensions as discrete as female participation rates will be estimable. Aggregate savings is determined within the model as a function of a full range of economic and demographic factors. Public health expenditures will have the potential for improving productivity. And migration will be induced by labor requirements and fed back through changes in fertility rates. Skill-specific labor supply will be influenced by both educational investment and migration.

4. AN AGENDA

The ambiguities produced by the current state of the debate call for numerous research efforts in both partial-equilibrium analysis of individual dimensions and more-inclusive general equilibrium modeling of fertility, mortality, and economic

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growth. The unadorned quest for knowledge is sufficient to identify hundreds of specific questions about which we have inadequate understanding. It is the urgency lent by policy requirements, however, which permits selection of topics to which priority should be extended.

Although there remains much research which could be undertaken without substantial increases in the availability of data, the first priority may be the improvement in both the quantity and the quality of data, as Kiser has noted repeatedly (1971). The fact that so many of the recent, well-organized, well-funded, large scale survey research efforts have omitted the relatively few additional questions which might have yielded a wealth of new data on the economic demography of the region is cause for both disappointment and encouragement. Fertility studies such as those of CELADE and ASCOFAME (Asociación Colombiana de Facultades de Medicina) have tended to omit details of the economic status of respondents; general purpose surveys such as the 1971 Peruvian national survey (30,000 individuals in 5,000 households) provide a wealth of socioeconomic data but virtually no demographic information. The omissions may be ultimately encouraging, for they suggest that substantial quantities of new data may be forthcoming at relatively low cost if these oversights are corrected.

Given additional data on mortality and fertility patterns in a larger set of the nations of the area, the questions which merit early attention are relatively clear. The fact that they are so fundamental is further indirect testimony that we have not progressed far to date.

1. How generalizable are the Da Vanzo conclusions with respect to the determinants of the levels of fertility in Chile? That is, to what extent is fertility affected to the same degree in other nations by the form of marriage, educational opportunities, and occupational possibilities for women?
2. To what extent do changes in economic factors explain the changes in levels of fertility in those nations experiencing fertility change, and to what extent are those factors generalizable to other Latin American nations?
3. To what extent are changes in the level of fertility related to specific patterns of economic change or specific patterns of economic development?
4. What influence, specifically, are policies of income redistribution likely to have on fertility levels?
5. What relationship exists among income levels, fertility, and savings rates for families in the middle, upper-middle, and upper income groups?
6. What benefits and what costs may be associated with programs aimed at mortality reduction?
7. More specifically, will greater life expectancy tend to induce greater aggregate savings and greater lifetime net productivity?
8. Is life expectancy distributed more equally or less equally than income?

If the models which attempt to quantify the cumulative impact of population

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growth on economic growth and development are to move from "infancy" to some level of "maturity," several changes in orientation must be made explicit. It must be recognized that economic conditions and patterns of development vary greatly across the nations of Latin America. It must also be recognized that models drawn from the literature concerned with showing how and why population growth is deleterious will be less well received than models which begin from more neutral grounds. To that end we may need to ask the more difficult analytical question:

9. Under what combination of development conditions will population growth at present rates be beneficial to growth and development processes?

Antinatalist conclusions would demonstrate that the set of conditions is so stringent that few, if any, contemporary Latin American nations possess them. Pro-natalist research might seek to establish that realistic development programs are capable of generating (or current development programs have generated) appropriate sets of conditions.

Within the framework of that reorientation, numerous subsidiary inquiries emerge. For example:

10. To what extent is increased utilization of existing capital stock feasible as a solution to the labor absorption problem?

11. Are the economies of scale and rates of capital-augmenting technological change which are feasible in Latin America sufficient to avoid diminishing returns to labor at current population growth rates?

12. To what extent does rural population growth stimulate industrialization through continuance of the supply of low-wage labor?

13. How sensitive a relationship exists between rural fertility, urban unemployment, and the urban industrial wage rate?

14. To what extent are corporate and government savings rates influenced by rates of population growth in Latin America?

15. To what extent is the rate of non-monetized saving in agriculture affected by rural population growth?

The tone and direction of these last six questions reflect the two most prominent facets of the state of economic demography in Latin America in the mid-1970s. Antinatalist conclusions continue to be reinforced, but they are encountering increasingly articulate and incisive criticism. The burden of proof, however, still rests upon the critics.

NOTES

1. The reviews by Morse (1965 and 1971) have already exhaustively covered some dimensions of this area.
2. Here, as in the rest of this review, we shall omit those studies undertaken solely with respect to Puerto Rico, such as Nerlove and Schultz (1970).

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3. It may be that antinatalist sentiment never took root anywhere but in certain levels of the planning technocracy. Daly (1972) and Vaz de Costa (1970) found little more than lip service to population policy in Brazil. Lenero Otero (1968) noted that of 240 national leaders surveyed in Mexico, 92% knew that Mexican population growth was very rapid, but 58% of them felt that the rate increased the potential for economic growth.
4. For a concise summary of the antinatalist consensus, see Robinson and Horlacher (1969); for a discussion of both sides of the issue as they apply to Latin America, see López Toro (1970).
5. They could also be produced by earlier and more rapid achievement of a given family size.
6. I am indebted to Peter Newman for noting this. It may be seen almost immediately in the reduced-form equations of the model.
7. Italicized in original.
8. Details of these two models, which are still in preliminary stages of analysis, were obtained through documents provided courtesy of Dr. William McFarland of the G.E.TEMPO Center for Advanced Studies, a consultant in their formulation.

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