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Food Research Institute Studies

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Vol. XVI, No. 1, 1977

Published by the Food Research Institute
Stanford University, Stanford, California 94305
Reprints of articles in this issue may be purchased from the Institute.

Articles in this journal are abstracted or indexed in *Journal of Economic Literature, Agrindex, Bibliography of Agriculture, L'Agronomie Tropicale, Biological Abstracts, Biological and Agricultural Index, Field Crop Abstracts, Nutrition Abstracts and Reviews, Public Affairs Information Service Bulletin, Schrifttum der Agrarwirtschaft, Abstracts on Tropical Agriculture, World Agricultural Economics and Rural Sociology Abstracts*, and the American Economic Association *Index of Economic Journals*. Table of contents in each issue is also listed in *Contents of Recent Economics Journals* (London) and *Current Contents / Agriculture, Biology, and Environmental Sciences*.

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Annual subscription, $12.50. Single copy, $5.00

Food Research Institute Studies

Editor: Walter P. Falcon
Assistant Editor: Linda W. Perry

Vol. XVI 1977 No. 1

THE POPULATION PROBLEM AND THE DEVELOPMENT SOLUTION

Pan A. Yotopoulos

This monograph was prepared by the author under the auspices of the Development Research and Training Service, Policy Analysis Division, Food and Agriculture Organization (FAO) of the United Nations, under project INT/73/PO2, financed by the United Nations Fund for Population Activities (UNFPA). The views expressed in this paper are the author's and do not necessarily represent those of FAO or UNFPA.

FOOD RESEARCH INSTITUTE STUDIES

Volume XVI, Number 1, 1977

CONTENTS

The Population Problem and the Development Solution

by Pan A. Yotopoulos

PAN A. YOTOPOULOS*

THE POPULATION PROBLEM AND THE DEVELOPMENT SOLUTION†

CHAPTER I. INTRODUCTION

The proposition that economic development and population growth are interdependent is almost self-evident. Yet traditionally the tendency has been to consider either factor within the narrow confines of its own scientific discipline, while treating the other as a constraint. As regards development, for example, ". . . economic theory has evolved without much interest in population problems, and some of the difficulties in trying to force them back into economics may be due to this" (*161*, p. 14). More specifically, population has commonly been considered exogenous to the economic system, just as income has been to the demographic system. A basic concern of economics, therefore, has been maximization of common welfare or per capita income, given the population level. On the other side of the coin, demography has been concerned with determining the optimum population size, that is, the one which maximizes per capita income, given the production relationships. Within this framework, only minor concessions have been made in order to take into account the "other discipline." Demography (in the broader sense of "population studies") introduced the theory of demographic transition which originally considered the levels of "socioeconomic development" as determinants of demographic trends—and which was soon metamorphosed into a special case of the more general theory of social change. Similarly, economics made the family's fertility decisions endogenous in the benefit-cost analysis of children.

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†A number of people at FAO headquarters in Rome and at Stanford have greatly contributed to this research and they are hereby gratefully acknowledged: N. Alexandratos, J. Bremer, J. Cairncross, B. Edmonston, W. P. Falcon, D. Kirk, G. Maione, L. Naiken, J. O'Hagen, S. R. Pearson, H. Quaix, W. Schulte, and L. Unnevehr. C. Pinter and S. di Lorenzo cheerfully typed and retyped versions of this manuscript and L. W. Perry fostered it through publication. Finally, the author would like to thank his many other friends in Rome who made successive stays there both successful and enjoyable.

The attenuation of the clash between demography and economics will receive more attention at a later stage in this study. Two questions of immediate interest arise: (a) What has been the result of these partial approaches to economics and to demography, and (b) what has been the cause of such watertight treatment of both fields?

The payoff to making a host of subtle problems external to a field of analysis—by assigning them as charges to a first-cousin discipline—is that one can make unambiguous predictions. Such predictions in relation to population and to betterment of life, have ranged from bust to boom. Malthus, with more respect for arithmetic than for either demography or economics, predicted an increasing state of human deprivation as a result of his postulates on food supplies and on population. The Club of Rome, by parameterizing current population growth, present dietary levels, and yields at twice the current yield levels, concluded that the world would run out of food supplies by the middle of the twenty-first century (*145*, pp. 48-58, 141). On the other side, Revelle estimated that, with appropriate technology and sufficient purchased inputs (equivalent to the inputs used for maize production in Iowa), 50 to 60 billion people could be provided with a high quality diet or almost 100 billion people could be fed at a minimum level of subsistence (*176*).

Economics carries the burden for success or failure in these two latter exercises. But the magnitude of the burden is often left unspecified. Pawley (*167*), for example, would have no difficulty in agreeing with Revelle's cornucopia, since he estimates that, by the year 2070, cultivable area could be quadrupled to 6 billion hectares, given two major technological breakthroughs: first, if humid tropical lands could be fully deforested and cultivated continuously, and, second, if sea water could be desalinized at low enough costs to become available for cultivation. The question which Pawley implies is whether this is likely.[1] In other words, grand, global predictions of this type can not only be wrong; they are also uninteresting. Societies have built-in brakes and shock absorbers which arrest the speed and cushion the fall. But one must search inside the machinery, through a number of intricate parts, in order to discover those instruments. They cannot be observed by simply looking at the external configuration of the social vehicle.

What then are the causes of the watertight treatment of population and development? On the side of economics, at least, there is a clear motivation and an obvious cause for the neglect of the population aspects of development. Population growth takes place within the "family," or the "household," concepts which have fuzzy contours in economics, especially to the extent that they operate mainly outside the market system (*161*, p. 147). To make things worse, the study of the interactions between demography and economics involves two distinct aspects of the household. Children appear mainly on the consumption side of the analysis of the household. They provide utility; they necessitate a readjustment of the basket of goods which a household consumes (including, for example, consumption goods, investment goods, durable goods, and children), and they may change the time horizon within which a household maximizes.

[1] For a sample of other estimates of the population pressure on food supplies, see Abercrombie and McCormack (2), and also Chapter VII.

The determinants of population growth, then, whether they are economic, social, or cultural, should be analyzed in part by studying the consumption behavior of the household.

The change in the consumption side which is introduced with population growth has its impact on the production behavior of the household. It changes the relationships between labor and capital endowments and between leisure and labor, and through these components, it changes the budget constraint of the household. The consequences of population growth thus should also be analyzed by studying the production side of the household. Finally, the interrelationships between economic and demographic variables, that is, the joint set of determinants and consequences of population growth, should be studied by combining the consumption and production side of the household within, say, a utility maximization model. The problem is that such an integrated framework of decision making generally has not been available in economics.[2]

Another analytical deficiency which has hampered the study of economic-demographic interrelations is that general equilibrium analysis, as opposed to partial equilibrium analysis and comparative statics, is not fully developed in economics. (Disequilibrium analysis, which at times would have been more appropriate for the study of the problem, is almost nonexistent.) Partial equilibrium analysis becomes then a poor substitute and it can often lead to empirical results which are not consistent with the findings obtained in a general equilibrium framework. To illustrate the point, the findings of partial regression analysis will be presented in a later chapter in which both income and education are negatively related to fertility rates. Yet, on the basis of Hicksian micro-analysis of consumer behavior, one would have expected income to release the budget constraint and therefore to lead to larger families. The benefit-cost-of-children approach is a lame attempt to explain this conundrum. Within a general equilibrium framework, this oddity may very well disappear. Both income and education become endogenous variables which are interrelated and determined through still another set of exogenous variables. In this context, it is possible that the effect of income on both fertility and education is positive, but the latter variable affects fertility negatively, and so accounts for the inconclusive results obtained through partial analysis. The same problem arises in connection with savings and fertility rates which also yield inconclusive results. Can it be assumed that family size is the exogenous variable which influences savings rates, or might not both variables be endogenous, and along with income, be determined by yet another set of variables including social and cultural variables? If so, the proper approach would call for estimating the reduced form of the economic-demographic model, in which each endogenous variable is expressed as a function of every exogenous variable.

OBJECTIVES

This study will deal with the points of contact between economic development and demography, especially as they come together in the agricultural

[2] For a model of this type which can be used to analyze demographic aspects of development at the micro level, see Lau, Lin and Yotopoulos (*135*).

sector. Development has dealt with population but has blithely ignored demography and demography has repaid the compliment by introducing income but abstracting from development. This is prima facie evidence that a simple relationship between a whole set of economic and demographic variables may not even exist. Indeed, this is the first-pass answer of the theory of demographic transition which is reviewed in Chapter II. Closer analysis, however, will reveal that one can describe the stages of demographic transition in an international cross section with reference to two economic variables alone—per capita income and income distribution—provided that the demographic variables are also refined to reflect age-specific fertility rates, rather than birthrates or rates of increase in population.

An analysis of the determinants of fertility rates follows in Chapter III. The conceptual framework built for that purpose goes from economic development to fertility declines through a set of intermediate variables—physiological, cultural, institutional, and socioeconomic. A review is presented of the state of knowledge with respect to the specification of the relationship between each set of intermediate variables and fertility, along with the hard evidence that exists on that relationship. The conceptual framework is completed in Chapter IV, where the consequences of population growth go from birthrates to economic development. It becomes evident at this point that knowledge about the effects of demographic evolution on socioeconomic factors and development is even more limited than the knowledge of the determinants of demographic growth (*18*).

Chapters II to IV refer to interactions between economic and demographic variables in general. As such, they serve to introduce the remainder of the study which explores in more detail a limited subset of such interactions—those involving agriculture, its structure, organization, and growth.

The first question which arises concerns the need for a special analysis of economic-demographic interactions within the agricultural sector in the process of development. Is it not sufficient to examine the subject within a broader framework including all sectors? The answer to this question is twofold. First, agriculture as a sector embraces the majority of the world's population. As a result demographic developments in agriculture are bound to have substantial repercussions on the other sectors. Furthermore, there are reasons to believe that some of the interactions between demographic and socioeconomic variables are specific to the agricultural sector. The second aspect of the question is that the production of food has always been considered as being at the center of the population problem. In this sense, the ability of the agricultural sector to produce adequate food supplies for the growing number of people must receive explicit attention in any demographic analysis.

The agricultural sector makes a significant contribution to population pressures because of its sheer size. Three-quarters of the world's total population of approximately 4 billion live in the less developed countries (LDCs). Of these, about 60 percent live in non-urban areas, and an equal percentage of population is considered as making a living from agriculture. Furthermore, 90 percent of the annual increase in the world's population of 70-85 million occurs in LDCs, and 75 percent of that increment is thought to take place within agricultural

households. LDC agriculture, in other words, may be responsible for an annual increase in population ranging from 50 to 60 million people. The agricultural sector is thus at the center of the "population problem."

The population problem also appears in the form of a disequilibrium between birthrates and death rates. This disequilibrium is largely associated with exogenous changes in technology which have not worked themselves out into a new equilibrium position. In the twentieth century there has been a dramatic change in the technology of death control. That technology, being cheap and in harmony with the values and institutions prevalent in most countries, has rapidly spread in both developed countries (DCs) and LDCs. More recently, there has also been a radical change in the technology of birth control. This technology has not offset the impact of the technology of death control for three reasons. First, the technology of birth control has followed the advances in medical science by a few decades—which was enough time to create a serious backlog problem of population. Second, unlike the technology of death control which can be effectively disseminated in public health measures applied by the State, the technology of birth control must be applied at the individual level. It so becomes more expensive, and it is more likely to conflict with established value systems which, in response to the high mortality rates that existed in the past, favored high fertility as a means of biological survival. Third, and quite independently of the value system, the economic system may make high fertility a viable proposition at the family level. This is especially the case in agrarian and traditional societies, and appears in the form of growing agricultural populations. The economic, social, and demographic interactions which are specific to the agricultural sector will be analyzed in Chapter V.

There is evidence to suggest that the problem of poverty and unemployment is rapidly becoming more critical. Furthermore, there are reasons to believe that the problem can only be solved on the farms. On the average, the non-agricultural sector employs 20 percent of the labor force in LDCs. This sector could absorb the expected overall increase in the labor force of 3 percent per annum in the period 1970 to 1980 only if industry could create additional employment opportunities at the rate of 15 percent per annum (*210* pp. 9-10). This growth is clearly impossible in any foreseeable circumstances. Furthermore, on the basis of the medium variant of the United Nations population projections and of fairly optimistic assumptions on the expansion of non-agricultural employment, the FAO has projected that the agricultural labor force of LDCs will rise by a further 166 million, or about 25 percent, between 1970 and 2000 (*73*, p. 8).

The concatenation of these circumstances creates the problem of chronic under- and unemployment in agriculture. The technology employed to obtain increases in agricultural productivity can have further employment effects (both positive and negative) in the agricultural sector. Finally, under some conditions of a static occupational structure in the non-agricultural sectors, the employment problem of agriculture can be further exacerbated by the inability of the sector to absorb the residual labor of the economy. Thus, "chronic unemployment in agriculture" is the new aspect of population pressure which will be examined in Chapter VI.

Overpopulation raises the question of whether agriculture can feed the growing numbers of people. This is the "old aspect" of the population problem which has attracted considerable attention since the time of Malthus. An affirmative answer has been based on the historical research of technologically induced increases in agricultural productivity and has been projected to the future with varying degrees of enthusiasm and optimism. In Chapter VII it will be demonstrated that given the demographic and economic realities of the world today, the rate of increase in food production which becomes necessary exceeds the rates historically observed in the recent past.

The strategies for food production and for agricultural growth which are closely related to the demographic developments of the recent years will also be examined in Chapter VII. More food is a necessary, but not a sufficient condition to prevent disaster. After all, if one excludes theft and violence, people can obtain food either by growing it or by buying it. The problem with the second alternative is that the people who are hungry often do not have the necessary money and the poor nations do not have the resources to procure food. In this sense, the world is not confronted with a food crisis. There is at present enough grain to feed the world's population—but there is a financial crisis among the poor. Furthermore, inefficiencies in the food distribution system sometimes make it easier to feed the poor by encouraging their own production than by relying on the marketplace.

The conceptual framework of this study attempts to fashion together the socioeconomic with the demographic aspects of population and development. The specific approach consists of integrating the consumption side (determinants) with the production side (consequences) of a change in population (family) size. The recent historical experience of LDCs has helped to bring population once again squarely into the study of development.

It is ironic, but probably true, that the impetus to stress demography in the study of development might have been missing if the historically unprecedented rates of population growth observed in the last few decades did not happen to coincide with unprecedented rates of growth in gross domestic product (GDP). While the rates of increase in population may not be surprising, the inability of growth in GDP to deliver development was unexpected. Within the operational framework of the orthodox economics of development, growth is inconsistent with the persistence of widespread poverty. Even worse, the agricultural sector in LDCs continued to show stubborn technological backwardness, while the technologically advanced sector displayed a general inability to make a significant contribution in absorbing unemployment. Under these circumstances it was considered axiomatic that the global population explosion hindered the spread of development within LDCs and widened the economic distance between the rich nations and the Third World.

While the existence of a link between population growth and development is generally conceded, a careful examination of the literature suggests that there has been significant variance in opinion as to whether rapid population growth is an absolute deterent or, at worst, a non-trivial retarder of economic and social development (*18*). This divergence of opinion, however, has hardly been reflected in the policy solution that has been emphatically accepted—disseminating

birth-control information and devices. The fact that birth-control technology can be provided at a relatively low price has greatly enhanced its appeal as a policy instrument.

More recent experience throughout the world has led to questioning the population policy approaches that operate exclusively on the demographic side. It has been recognized that families must be provided with the motivation, as well as the means, to limit births. A significant contribution of the World Population Conference, as well as of the World Food Conference was the recognition that the basis for an effective solution of population problems is, above all, socioeconomic transformation. Development planning, as a result, is in search of population policies that combine the socioeconomic side with the demographic side. While this is a laudable objective, two problems must be kept clearly in mind. Although development may induce population control, in many parts of the world relatively high levels of living may be postponed or even thwarted in the face of heavy population pressures. Second, development is a plausible, necessary condition for population control, but it is also an unlikely sufficient condition. Not just any kind of development is likely to be equally effective in reducing the rates of increase in population.

CHAPTER II. THE DEMOGRAPHIC TRANSITION: WHICH ECONOMIC AND DEMOGRAPHIC VARIABLES INTERACT?

The sobering Malthusian predictions have been belied by the secular improvement of the lot of mankind. Increasing human deprivation is the ultimate manifestation of Malthus' laws of food and population. Both the Malthusian mechanisms operating to limit the size of population—the "positive" and the "preventive" checks—are either correlates of, or depend on, human deprivation. The positive checks include "war, disease, hunger and whatever . . . contributes to shorten the natural duration of human life" (*143*, p. 14). The preventive check is abstinence from sexual relations, accomplished either by delay of marriage or by continence within marriage. This latter check was related to human deprivation by the strong assumption that it could never operate without the threat of misery. Therein lie the origins of the dilemma as seen by Malthus. Better living conditions lead to rapid population increases which outstrip the food supplies, until either the positive or the preventive check comes into operation and an equilibrium population is restored.

For the purposes of this study, it is possible to be agnostic about the broader philosophical framework of the Malthusian position which rejects the "idea of progress." The narrow empirical implication of interest is the positive relationship between economic progress, or development, and birthrates, and similarly between economic progress and rates of population increase. This implication turned out to be inconsistent with the demographic history of nineteenth- and twentieth-century Western Europe. By 1800, mortality had declined in the more developed areas of northwestern Europe. This decrease led to a relatively rapid rate of population increase. Gradually, however, sporadic declines in natality appeared. By 1900, the asymptotic decline in both mortality and natality curves was roughly equivalent, and, by the time of the Great Depression the natality in western, central, and northern Europe was low enough to be at the point of long-term equilibrium with mortality (*129*).

The theory of demographic transition was initially formulated as an attempt to explain the European demographic trends which did not accord with the Malthusian scheme.[1] It is a stage theory which basically asserts that a substantial mortality decline precedes, and is followed by, a decline in natality. Since declines in mortality are associated with economic progress, the stages have also been interpreted as part of a model which incorporates important behavioral hypotheses. The chain of causality goes from development to decreases in birthrates.

More recently, attempts have been made to extend the demographic transition theory to other countries and to link it directly with the economics of develop-

[1] For a statement of the theory of demographic transition see Thompson (*206*), Coale and Hoover (*44*), and Leibenstein (*137*). More extensive summaries of the theory are presented by Notestein (*156*) and by Stolnitz (*199*). A far-ranging test of the demographic transition theory in its original European context by the Office of Population Research of Princeton is reported in Coale (*42*). For other examples of demographic research based on this theory, see Coale (*41*), Demeny (*52*), Habakkuk (*84*), Kirk (*119*), Spengler (*195*, *196*), Van de Walle (*216*), and Oechsli and Kirk (*158*).

ment (137).[2] The weight of the evidence, rather unexpectedly, points to a weak positive relationship between economic development (as measured commonly by per capita income) and population growth (131, 132, 60, 48, 205, 49). Kuznets, for example, separately analyzed a sample of 21 Asian and African countries and a sample of 19 Latin American countries, as well as the pooled sample of the 40 countries together (131). The coefficients of the relationship between population growth and growth in per capita product were consistently positive and statistically non-significant. Chesnais and Sauvy analyzed the relationship between demographic and economic growth in the 1960s for a sample of up to 76 LDCs partitioned in various ways (39). The correlations were non-significant and as a rule slightly positive.

As a result of the failure of this purely economic specification of the antecedents of the demographic transition, the concept of economic progress was redefined in such a way as to measure "socioeconomic development." This term includes at least four partially overlapping variables: urbanization, education, non-kinship institutions, and standards of living. As a limiting case, the concept of "culture" is invoked in explaining fertility behavior, and the theory of demographic transition is presented as a special case of the sociological theory of social change. More specifically, this theory relates fertility declines to the social change involved in transforming traditional and agricultural societies into urbanized industrial states.

It is quite conceivable that the demographic transition can best be specified in terms of social-change variables. From the point of view of research strategy, however, it would be convenient if one approached demographic transition by starting from economic change. Social and cultural variables could then be brought in as supplemental and intermediate variables to round out the causal links and to improve the explanation. The reasoning behind such a conceptual framework is that the dramatic economic change in the period since the Second World War has been measured (albeit imperfectly) with concepts such as per capita gross national product (GNP). This measurement contrasts with attempts to measure social change which have been less systematic and successful.

THE SPECIFICATION OF THE DEMOGRAPHIC VARIABLES

The variable of paramount importance in the analysis of the demographic transition is the size of population, and whether the population is stationary, increasing, or decreasing. Stationary population may be the result either of high birth and death rates or of low birth and death rates. In consequence, these two cases define the two extreme stages of the demographic transition. The stage in between is characterized by high birthrates and declining death rates.

The size of population is determined by births, deaths, and net migration, and the rate of change in population is determined by the respective time derivatives of these variables. Thus,

[2] For a summary of the findings from several applications of the theory to non-European experience, see Beaver (14, ch. 3) and Simon (191).

$$\text{Rate of increase in population} = \frac{\text{(total births in a year)-(total deaths in a year)}\pm\text{(net migration in a year)}}{\text{mid-year population}} \times 1{,}000 \tag{2.1}$$

Net migration in itself is determined by a complex set of socioeconomic variables. It is usually not included in the description of the broad sweeps of the demographic transition, and, for the purpose of this review, it will receive only cursory treatment. The rate of population increase is then redefined in terms of the two remaining components as

$$\text{Rate of natural increase in population} = \text{crude birthrate - crude death rate.} \tag{2.2}$$

The crude birthrate (CBR) is defined as the number of births in a year per thousand population at mid-year, and similarly the crude death rate (CDR) is defined as the number on deaths in a year per thousand population at mid-year. These rates are useful as indicators of the general level of mortality and fertility. They also indicate the contribution of mortality and fertility to the overall population growth rate. However, they are not suitable for international comparisons of the levels of fertility and mortality or for measuring the changes in these variables over time.

For certain purposes in the analysis, namely the study of the impact of demographic factors on developmental variables, the rate of increase in population and the corresponding crude birth and death rates are the appropriate variables. Population pressure, for example, determines man/land ratios, and, through these variables (at least partly), the technology which affects development. However, when studying the impact of economic variables on demographic relationships, it is important to examine the family decision-making framework which leads to lower levels of population increase. The specification of the appropriate variables in the latter case may well be different.

It is useful first to consider death rates on the assumption that they are independent of birthrates. In recent history, CDRs have been monotonically decreasing with time. These declines have been attributed to several factors: improved nutrition; the effective expansion of the peace area in the national state, that is, suppression of criminal and factional violence and the maintenance of public order, which in turn has led to improved communications and transportation facilities making it easier to combat the specter of recurring famines; and last but not least, the development, importation, and rapid implementation of modern and relatively inexpensive public health measures and medical technologies. In this sense, declines in CDRs are at least indirect functions of economic and social development. Still, when one searches for control variables which would *decrease* the rate of population *increase*, the manipulation of death rates becomes devoid of real interest. Since most people desire long and healthy lives, conscious manipulation of death rates can lead only to population increases, not to decreases.

The assumption that death rates are independent of birthrates, however, is an oversimplification. The former certainly reflects the historical record of the birthrates. A history of high birthrates tends to produce a low death rate through its effect on the age structure of the population. For example, in the 1950s, China

(Province of Taiwan) and Czechoslovakia had CDRs of 8 and 11, respectively. Yet the expectation of life at birth was 62 for both countries. The number of deaths per thousand population was larger in Czechoslovakia because, with its history of lower birthrates, the country had a higher proportion of older people than China (*121*, p. 57).

A similar problem arises with respect to the birthrates. The birthrate is a result of a combination of several factors: the proportion of women of childbearing age in the total population; the age-structure of the women of childbearing age; the age-pattern of nuptiality; and the age-specific marital (and extramarital) fertility rates. A change in the CBR can be the consequence of a change in any one or more of these variables. However, when the decision making with respect to population is analyzed, that is, when socioeconomic influences are studied, the first two of the above variables—the proportion of women belonging to childbearing age and their age-structure—are parameters fixed by historical experience rather than variables subject to behavioral determination. As a result these parameters do not enter the causal ordering that goes from economic to demographic variables.

In this respect consider the time-profile of a rapidly growing (high fertility, low mortality) population. By definition, it will be a "young" population, with, say, 50 percent under twenty years of age, which is typical of a large number of LDCs. The number of women who enter childbearing age at any point in time increases constantly, and it is greater than the number of women who exit from the childbearing cohorts. In these circumstances, if the birthrate happens to remain constant, a smaller number of births per woman in the childbearing age is implied—fertility rates have decreased. Even if the birthrate is found to increase, fertility could still have decreased, depending on the age structure of the population.

Finally, it is not only CDRs which reflect the experience with CBRs. CBRs themselves partially incorporate the arithmetic of CDRs. If mortality rates are lowered so that more infants survive and other people tend to live longer, the effect is to increase the number of persons outside the childbearing age. Unless there are offsetting changes in fertility rates, this effect will appear as an increase in the denominator of equation (2.1) and therefore as a decrease in the CBR. By analogy, one can also describe the situation with migration. Emigration, for example, usually involves people of working, and most likely of childbearing, age. It so tends to reduce the number of births and therefore the numerator in equation (2.1). The converse occurs with immigration.

The point to be emphasized is that both birth and death rates have two components. One reflects exclusively the momentum of the arithmetic of population growth, and as such refers to the mechanics of constructing a model stable population. No systematic behavioral relationship can be specified to explain this component of CBRs. The other component is related, directly or indirectly, to socioeconomic variables. The problem is then to redefine a demographic variable which excludes the former part of arithmetic inevitability which enters the definition of CBR and CDR. This variable should be able to capture directly the impact of socioeconomic variables on demographic factors. If CBRs and CDRs are used for this purpose, the effects of socioeconomic variables on demographic factors are likely to be masked.

A measure of fertility and mortality which controls for the effect of the age composition of the population offers a better measure of the impact of socioeconomic factors.[3] An indicator of fertility which also considers the age structure is the general fertility rate (GFR), defined as the number of births per thousand women of childbearing age (generally between 15 to 49 years).[4] Another more refined fertility measure is the total fertility rate (TFR) which takes into account the age detail of women within the childbearing age. It represents the sum of the age-specific maternal birthrates (number of births per thousand women in specified age groups) over the whole childbearing period. In other words, a TFR rate of 4.5 per woman means that a hypothetical woman conforming to the age-specific fertility pattern in effect for a current year would have 4.5 children on the average by the time she attained her menopause. In this calculation, the age-specific birthrates for each year receive equal weights.

The corresponding correction of the mortality trends for the age distribution is given by the expectation of life at birth (years), derived from a statistical model known as a life table. The expectation of life at birth is the average number of years which a group of babies can be expected to live if subjected throughout their lives to current mortality risks at each age.

In view of the above discussion, the expectation of life at birth (for both sexes), and the TFR, rather than the CDR and CBR, will be used as indicators for the international comparisons of the levels of mortality and fertility. Data on fertility rates and on life expectancy are available from at least three sources. First, the United Nations has compiled such data for individual countries and has complemented them with projections for the period 1950-2000 (*214*). This source is probably biased for testing behavioral hypotheses since the projections are most likely based on some of the indicators that one would have wished to consider as explanatory variables.[5] Second, the United Nations has compiled data available for several countries as of April 1974 (*213*). Third, a more complete and up-to-date set of actual fertility data has been compiled by the Agency for International Development and covers the period since 1960 for a large number of countries (*10*). This latter source will be used for the analysis, and only when it is necessary to increase the sample of countries will reference be made to other sources.

[3] It has, of course, been stressed in the literature that the age composition of the population, which enters the birthrate, makes that variable less suitable for analysis as compared to the fertility rate: "Unlike age-specific fertility rates, the crude birthrate is influenced by the age composition of the population, and, therefore, is not a pure measure of fertility" (*106*, p. 323). "Like the life expectancy at birth, in the case of mortality it [gross reproduction rate] is the composite expression, in a single measure, of the combined effect of fertility rates prevailing at each age, in complete independence of the composition of the population in regard to sex and age" (*211*, p. 11). This difference, of course, disappears in the case of stable populations. The problem, however, is precisely that the demographic data with which researchers have been working, specifically those of LDCs, do not come from stable populations. The analyses, therefore, of developmental and demographic interactions which utilize birthrates rather than fertility rates are biased. See, for example, Kirk and Srikanta (*122*), and Anker (*10*).

[4] For more detailed definitions and a fuller discussion of these variants of fertility rates, see Baldwin (*11*, p. 36).

[5] The author is indebted to Dudley Kirk for pointing out this bias which had entered a previous draft of the study.

EMPIRICAL ANALYSIS WITH A NEW INDEX OF DEMOGRAPHIC TRANSITION

The definition of the stages of demographic transition is based on observed fertility and mortality rates. For purposes of international comparisons, these rates must be normalized. A convenient normalization procedure is to express the relevant fertility or mortality rates observed in a population in terms of the distance covered by this population in travelling from high fertility (mortality) rates to low fertility (mortality) rates. The four reference points of high and low fertility and mortality can be specified by using the respective countries with the extreme observations in the sample of the international cross section. The standard of comparison then becomes the "composite international population" which started its demographic transition at the point where the maximum fertility (minimum life expectancy) country is currently and which ended at the point of the country with the current minimum fertility (maximum life expectancy). This is defined as the population which has completed its demographic transition.

A fertility index which can be constructed for this purpose is (22)

$$I_F = \left[\frac{\text{max TFR - TFR}}{\text{max TFR - min TFR}}\right] \times 100 \tag{2.3}$$

where I_F is the index of fertility, max TFR and min TFR are the historically (or cross-sectionally) observed highest and lowest total fertility rates, and TFR is the actual total fertility rate of a given population. Correspondingly, the mortality index is

$$I_M = \left[\frac{\text{LE - min LE}}{\text{max LE - min LE}}\right] \times 100 \tag{2.4}$$

where I_M is the index of mortality, max LE and min LE are the historically (or cross-sectionally) observed highest and lowest levels of life expectancy (in years), and LE is the actual life expectancy of a given population. Both indices are expressed in percentage terms by multiplying by 100.

The indices I_F and I_M will both vary between 0 and 100 and will increase with declining fertility and mortality. Having thus reduced the fertility and mortality indicators to a single scale, both rising monotonically as the demographic transition proceeds, one may combine the two indices into a third index which will incorporate the extent of progress in mortality as well as declines in fertility. The average of I_F and I_M suffices for this purpose:

$$I_T = \tfrac{1}{2}(I_F + I_M) \tag{2.5}$$

where I_T is the index of demographic transition which also varies between 0 and 100. The magnitude of I_T will indicate, in percentage terms, the distance which a country has covered in travelling from the highest to the lowest levels of fertility and mortality, as established from international comparisons.

The new index of demographic transition appears in Table 2.1 where 90 countries of the world are ranked in descending order of per capita GNP (1975 figures in current U.S. dollars). For visual identification, the I_T index has been

entered to show in which half of the span of demographic transition a country is located on the basis of its most recent demographic data and its 1975 per capita income. The table suggests a close relationship between per capita GNP and the index of demographic transition. Virtually all the developed countries with a per capita GNP of $1,200 and above have completed at least one-half of their demographic transition. The poor countries, currently defined as having per capita income less than $520, are mostly at the first half of the road to the demographic transition. Thailand and Sri Lanka, well on their way to completing the demographic transition, are the prominent exceptions among the poor countries. A Spearman rank correlation coefficient of 0.88 for these data indicates a positive and significant association between the per capita income and the index of transition.

The results obtained with the new I_T index confirm the hypothesis that the demographic transition is being completed as a country advances economically. Such evidence, based exclusively on a per capita income variable for development, is both novel and comforting for the demographic transition hypothesis. Per capita income has fared rather poorly in the past as an explanatory variable in the investigation of the demographic transition and has often been found to have a positive association with natality (*3*, *89*, *220*). When the sample is restricted to LDCs, the impact of per capita income on natality is either weakly negative or positive, but statistically insignificant. For DCs, on the other hand, the evidence in favor of an "income-reversal" hypothesis seems to be strong (*5*, *79*, *211*). The explanation suggested by the present results is that the demographic component of the transition hypothesis was misspecified previously. The demographic component was generally measured by birthrates, or other such variables that did not control for the age distribution and therefore introduced the bias of the demographic history of a population—most commonly a history of rapid growth. If this explanation is valid, the favorable results for the hypothesis are due to the introduction into the index of transition of the TFR, a measure that controls for the age composition of the population.

ECONOMIC VARIABLES AND FERTILITY DECLINES

It is not surprising that the failure of previous attempts to confirm the demographic transition hypothesis with respect to LDCs was attributed to the inappropriateness of purely economic variables, such as per capita GNP, as indices of economic progress. Admittedly the level of per capita income alone is a most deficient measure of development. It certainly needs to be supplemented by additional measures—the question is which specific indicators. Some clues to the answer are provided by the demography subset of the literature dealing with the demographic transition. Therein, per capita income has been invariably rejected as a measure of development in favor of alternative sets of "socioeconomic indicators." It was specifically found that indicators such as hospital beds, telephones, newspaper circulation, radios, and so forth, generally are better correlates of birthrates than is income (*21*, pp. 134-151; *120*, *158*).

It is, of course, possible that non-income variables are most important in determining demographic stages. An alternative interpretation, however, may be that there exist some income components of development which are not

TABLE 2.1.—RANKING OF COUNTRIES ON THE BASIS OF GNP PER CAPITA (1975) AND INDEX OF DEMOGRAPHIC TRANSITION*

Countries	GNP per capita (*U.S. dollars*)[a]	Index of transition[b]		Year of total fertility rate data
		More than half-completed	Less than half-completed	
Switzerland	8,050	96.1		1974
Sweden	7,880	95.7		1974
U.S.A.	7,060	93.9		1975
Denmark	6,920	96.2		1973
Canada	6,650	94.8		1973
Germany, Federal Republic of	6,610	95.0		1973
Norway	6,540	95.3		1974
France	5,760	91.1		1973
Australia	5,640	90.0		1973
Netherlands	5,590	97.1		1974
Finland	5,100	94.5		1972
Austria	4,720	92.8		1974
New Zealand	4,680	88.6		1974
Japan	4,460	94.1		1974
Germany, Democratic Republic	4,230	97.3		1973
United Kingdom	3,840	94.2		1974
Czechoslovakia	3,710	86.7		1973
Israel	3,580	78.5		1975
Italy	2,940	90.3		1972
Poland	2,910	88.6		1974
Spain	2,700	86.4		1974
U.S.S.R.	2,620	87.3		1972
Singapore	2,510	89.1		1975
Hungary	2,480	87.5		1974
Ireland	2,420	77.9		1972
Greece	2,360	90.0		1974
Puerto Rico	2,300	86.2		1974
Venezuela	2,220	60.9		1973
Bulgaria	2,040	92.0		1974
Trinidad and Tobago	1,900	79.0		1973
Hong Kong	1,720	84.6		1975
Portugal	1,610	83.5		1974
Argentina	1,590	78.9		1970
Yugoslavia	1,480	84.9		1973
Iran	1,440		19.6	1966
Uruguay	1,330	84.9		1973

TABLE 2.1.—RANKING OF COUNTRIES ON THE BASIS OF GNP PER CAPITA (1975) AND INDEX OF DEMOGRAPHIC TRANSITION* (CONTINUED)

Countries	GNP per capita (*U.S. dollars*)[a]	Index of transition[b]		Year of total fertility rate data
		More than half-completed	Less than half-completed	
Jamaica	1,290	65.2		1964
Iraq	1,280		27.3	1965
Mexico	1,190		45.7	1972
Panama	1,060	66.2		1973
Brazil	1,010	52.9		1970
Costa Rica	910	73.2		1974
Turkey	860	50.5		1973
Peru	810		38.9	1969
Cuba	800	76.8		1970
Algeria	780		30.4	1971
Tunisia	760		38.3	1971
Dominican Republic	720	52.7		1974
Malaysia	720	55.7		1973
Nicaragua	720		36.7	1971
Syrian Arab Republic	660		37.1	1970
Guatemala	650		38.8	1973
Albania	600	59.5		1971
Paraguay	570		49.1	1972
Korea, Republic of	550	64.6		1974
Colombia	550	61.0		1976
Ecuador	550		42.8	1968
Zambia	540		18.4	1969
Congo	500		30.8	1961
Morocco	470		25.6	1973
Jordan	460		28.5	1974
Ghana	460		25.2	1971
El Salvador	450		44.4	1973
Liberia	410		24.7	1971
Philippines	370		44.7	1972
Senegal	370		16.6	1976
Thailand	350	52.4		1974
Honduras	350		31.6	1974
Bolivia	320		23.3	1975
Egypt	310		42.1	1973
Mauritania	310		19.5	1965
Nigeria	310		25.4	1965
Togo	270		13.8	1961

TABLE 2.1.—RANKING OF COUNTRIES ON THE BASIS OF GNP PER CAPITA (1975) AND INDEX OF DEMOGRAPHIC TRANSITION* (CONTINUED)

Countries	GNP per capita (*U.S. dollars*)[a]	Index of transition[b]		Year of total fertility rate data
		More than half-completed	Less than half-completed	
Cameroon	270		24.0	1964
Uganda	250		37.7	1969
Kenya	220		19.7	1973
Haiti	180		35.4	1973
Indonesia	180		36.5	1972
Tanzania	170		16.6	1967
Sri Lanka	150	74.4		1974
India	150		37.5	1972
Zaire	150		22.3	1975
Pakistan	140		30.6	1975
Benin	140		14.6	1961
Afghanistan	130		13.2	1973
Chad	120		25.0	1964
Nepal	110		18.0	1976
Bangladash	110		10.1	1975
Ethiopia	100		19.3	1970
Mali	90		6.0	1961

*GNP per capita data are from the World Bank, *World Bank Atlas*, Washington, D.C., 1976; fertility data are from the Agency for International Development, U.S. Department of State, Office of Population, *World Fertility Patterns: Age-Specific Fertility Rates for Countries of the World*, Washington, D.C., 1977; and life expectancy data are from the United Nations, *Selected World Demographic Indicators by Country, 1950-2000*, New York, 1975.

[a]GNP per capita for year 1975 is in U.S. dollars (at market prices).

[b]Index of transition is defined in terms of total fertility rates and life expectancy at birth. See text.

captured by per capita income and are better represented by those socioeconomic variables. An example may be income distribution. Income is an open-ended variable: there is a lower limit of income which a family may have, but not an upper limit. As a result, there may not exist a monotonic relationship between changes in per capita income and changes in the observed income of families. It is still possible for a small number of families to obtain most of the increase in incomes. Certain socioeconomic variables, on the other hand, may be better indicators of income distribution in that they are in an approximate one-to-one relationship with families. After all, a family can use only a limited number of radios or telephones, and an increase in the number of those indicators is most probably associated with their spread among more families. It is useful, therefore,

to supplement per capita income in demographic analysis with economic indicators of the spread of development, such as income distribution.

The empirical analysis that follows is an exploratory attempt to formulate behavioral hypotheses connecting economic variables with fertility declines. The reason that this analysis refers to TFRs, rather than to the index of demographic transition, has already been mentioned. The objective here is to discover intermediate variables which determine the behavior of people with respect to demographic variables. The dependent variable in this case should be fertility, rather than an index which combines fertility and mortality, since most people want healthy and long lives—both for themselves and for others. This does not mean that declines in mortality cannot affect fertility decisions—quite the contrary. Such a formulation would argue, however, for using mortality (with a lag) as an independent variable in the explanation of fertility—as was done—and not for combining it with fertility to construct a dependent variable.

The dependent variable in this analysis is the TFR (per woman) over the period 1970-75 for the sample of countries. Three sets of independent variables are distinguished. The level of development is described by the GNP per capita. The spread of development is described by an income distribution variable—the share of the lowest 40 percent of the population in the GDP, and also by calorie consumption per capita. The latter variable is chosen as a proxy for income distribution because it is not as open-ended a variable as per capita income. Since there is an upper limit in calorie consumption, a significant increase in that variable is likely to imply that development has spread to more people. Calories thus contrast with an increase in per capita income which does not provide any prima facie evidence of the spread of development. The structure of development is described by the share of agriculture in total GDP, by the rate of growth of GDP, by the rate of growth in agricultural GDP, by the percent of agricultural population, and by female labor force participation rates. Rapid rates of growth are known to affect profoundly the economic structure (*232*, chapter 16). The share of agriculture in GDP defines a certain structure of the economy, and the rate of growth in agricultural GDP, in combination with the overall rate of growth, describes the change in structure which takes place under conditions of rapid economic growth. The ratio of agricultural GDP to agricultural labor force is an index of development, while the female labor force participation rate could impart important information on the economic structure.

A number of stepwise regressions were estimated with various sets of these variables and with different groupings of the original sample of countries, depending on data availability. The first attempt to consider all variables, plus a life-expectancy variable, in a stepwise regression indicated clearly that there is a high multicollinearity between GNP per capita and calories per capita and also between GNP per capita and the ratio of agricultural GDP to labor force. It also indicated that the life-expectancy variable might well be introducing a simultaneous equation bias in the regression results. After removing these variables, with a sample size of 66, there was a dramatic change in the results. The maximum step in the regression analysis was reached after the second variable, income distribution, was added to the first variable selected, GNP per capita. These results are shown in Table 2.2. An attempt to remove not only the multicollinear

TABLE 2.2.—REGRESSIONS OF TOTAL FERTILITY RATE ON GDP PER CAPITA AND INCOME DISTRIBUTION: INTERNATIONAL CROSS SECTION AND GROUPS OF COUNTRIES*

Regressions	Constant	Coefficients of GNP/CAP[a]	Coefficients of INCDIS[b]	$\bar{R}^2$	Number of observations
All countries	7.43568 (0.42919)[f]	-0.00058 (0.00007)	-0.12375 (0.03006)	0.664	66
DCs: countries with GNP per capita					
(i) Above $800[d]	7.15174 (0.58620)	-0.00049 (0.00010)	-0.13159 (0.03675)	0.604	39
(ii) Above $500[e]	7.21548 (0.48159)	-0.00050 (0.00008)	-0.13392 (0.03341)	0.639	49
LDCs: countries with GNP per capita					
(i) Below $800[e]	8.87410 (1.02203)	-0.00277 (0.00223)	-0.15867 (0.05969)	0.292	27
(ii) Below $500[f]	9.78200 (1.77597)	-0.00461 (0.00290)	-0.19441 (0.08958)	0.254	17
Latin American countries[g]	7.00747 (0.94036)	-0.00112 (0.00055)	-0.07085 (0.07400)	0.334	16
African non-Moslem countries[h]	8.13364 (1.05695)	-0.00144 (0.00046)	-0.10006 (0.07068)	0.452	15
Asian countries (excluding Near East)[i]	6.93975 (2.15445)	-0.00069 (0.00025)	-0.11798 (0.14123)	0.627	8
Moslem countries of Near East and North Africa[j]	5.91534 (1.95891)	0.00081 (0.00048)	-0.04872 (0.16355)	0.420	7

*Total fertility rates are from the Agency for International Development, U.S. Department of State, Office of Population, *World Fertility Patterns: Age-Specific Fertility Rates for Countries of the World*, Washington, D.C., 1977; or United Nations, *Selected World Demographic Indicators by Country, 1950-2000*, New York, 1975. GNP per capita data are from World Bank, *World Bank Atlas*, Washington, D.C., 1976. Income distribution data are from Montek S. Ahluwalia, "Inequality, Poverty, and Development," *Journal of Development Economics*, 3, 1976, pp.

variables but also the income distribution variable again produced questionable results. The life expectancy variable was picked first, followed by the female labor force participation rate, the GNP per capita, the rate of growth in GNP, the share of agriculture in GDP, and the rate of growth in agricultural GDP.

The complete sample of 66 countries was then partitioned in several subsets: DCs and LDCs on the basis of the level of per capita GNP, and according to region/religion by distinguishing Latin American, African, Asian, and Moslem countries. The purpose of these groupings was to control at least partly for intervening economic, cultural, or institutional factors which may obscure the relationship between the TFR and the set of socioeconomic variables being investigated. The same results were generally replicated for individual groups: the variables of per capita income and of income distribution appeared as the most important and statistically significant exploratory variables for fertility declines. Exceptions occurred typically only when the number of countries in the respective group was radically reduced because of lack of data. This was a problem with the small sample of eight Asian countries and seven Moslem nations in the Near East and North Africa, where the results appeared mostly with the proper sign but were statistically insignificant.

In contrast to the numerous unsuccessful attempts in the literature to discover a definite relationship between fertility declines and economic variables, the results obtained are clearcut—and parsimonious. An increase in per capita income and a decrease in the inequality of income distribution are, among the large number of social and economic variables considered, the two variables which appear sufficient to explain a decline in fertility rates in the international cross-sectional sample. It thus appears that the major cause of empirical failures which dot the literature on the demographic transition was the use of birthrates,

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307-42 or Pan A. Yotopoulos and Jeffrey B. Nugent, *Economics of Development: Empirical Investigations*, Harper and Row, New York, 1976, pp. 240-241.

[a]GNP/CAP is 1975 per capita GNP in current U.S. dollars.

[b]INCDIS is the share in GNP of the lowest 40 percent of population.

[c]Numbers in parentheses are standard errors.

The subsamples of countries are defined as follows:

[d]Above $800: Sweden, U.S.A., Denmark, Canada, Federal Republic of Germany, Norway, France, Australia, Netherlands, Finland, New Zealand, Japan, Democratic Republic of Germany, U.K., Czechoslovakia, Saudi Arabia, Poland, Spain, Hungary, Greece, Puerto Rico, Gabon, Venezuela, Bulgaria, Argentina, Yugoslavia, Iran, Uruguay, South Africa, Jamaica, Iraq, Mexico, Surinam, Lebanon, Panama, Brazil, Costa Rica, Turkey, Peru.

[e]Between $800 and $500: Tunisia, Dominican Republic, Malaysia, Guyana, Republic of Korea, Colombia, Ecuador, Rhodesia, Zambia, Ivory Coast.

[f]Below $500: El Salvador, Philippines, Senegal, Thailand, Honduras, Egypt, Uganda, Kenya, Madagascar, Sierra Leone, Tanzania, Sri Lanka, India, Pakistan, Benin, Niger, Chad.

[g]Latin American: Puerto Rico, Venezuela, Argentina, Uruguay, Jamaica, Mexico, Surinam, Panama, Brazil, Costa Rica, Peru, Dominican Republic, Colombia, Ecuador, El Salvador, Honduras.

[h]African non-Moslem: Gabon, South Africa, Guyana, Rhodesia, Zambia, Ivory Coast, Senegal, Uganda, Kenya, Madagascar, Sierra Leone, Tanzania, Benin, Niger, Chad.

[i]Asian: Japan, Malaysia, Republic of Korea, Philippines, Thailand, Sri Lanka, India, Pakistan.

[j]Moslem of Near East and North Africa: Saudi Arabia, Iran, Iraq, Lebanon, Turkey, Tunisia, Egypt.

rather than TFRs.[6] In addition, the reason why GNP per capita previously appeared with the wrong sign or with insignificant coefficients is probably because the level of development and the spread of development are jointly responsible for the explanation of fertility declines. If so, the lack of an income-distribution variable in the previous works explains the failure of the GNP per capita variable. It also confirms the hypothesis advanced earlier as to why socioeconomic variables, such as the number of telephones, have been better "predictors" of the demographic stages. Since these variables are in roughly a one-to-one correspondence with the number of households, they may give a better description of the spread of development than GNP per capita, which is an open-ended variable.

This tentative hypothesis, which associates fertility declines with development cum distribution, must not be interpreted as ruling out the significance of other structural, cultural, or social variables in explaining the demographic transition. However, it signals the importance of the proper specification of variables for empirical work on economic-demographic interactions. The same hypothesis also serves to explain the phenomenon of countries such as China or Sri Lanka which seem to have reached a stage of low fertility rates despite the fact that they are commonly considered as not having completed the social and economic transformation usually associated with the demographic transition. The specification of this transformation has so far omitted income distribution. It is significant that both countries score highly on the income distribution index. It may well be that a certain degree of equality in income distribution is a crucial precondition for fertility declines.

SUMMARY

The Malthusian prediction of doom was based on a postulated positive relationship between economic variables, food supplies in specific, and birthrates, with the latter being the dependent variable. In contrast, the theory of demographic transition reversed that stage and suggested a negative relationship between economic factors and population increases. Although consistent with the broad sweep of the demographic history of nineteenth- and twentieth-century Western Europe, the theory of demographic transition has not fared particularly well in empirical tests. As a result, the theory was reformulated to broaden its economic scope by redefining the independent variable as "socioeconomic development" which includes a number of partial indicators such as urbanization, education, or standards of living, represented, for example, by hospital beds, telephones, and newspaper circulation.

It is quite appropriate to include socioeconomic indicators among the exogenous variables which explain the facts of demography. But some of the socioeconomic indicators can be interpreted as proxies for omitted economic variables which could have played an important role in the specification of the relationship. For example, indicators such as number of telephones or radios can

[6] As an example of the misspecification of the crucial variable in the analysis of demographic behavior, a sample of 12 studies can be mentioned. Of these only three use the general (*29*, *82*) or the total fertility rate (*29*). Of the rest, six use the CBR (*29*, *55*, *65*, *70*, *158*), four use children ever born (*33*, *77*, *194*, *92*), one the child-woman ratio (*123*), and one the male GFR (*89*).

be viewed as supplementing the per capita income variable by introducing income distribution. Because the income variable is open-ended, a doubling of it need not imply that individual welfare has also doubled since the increase in incomes may have been concentrated exclusively in a specific group. The socioeconomic indicators mentioned, on the other hand, usually have an implicit upper limit, since only a given number of radios can be used by an individual. Doubling the value of such an indicator, therefore, is likely to signify a roughly equivalent increase in welfare. This hypothesis is testable and it has been confirmed in a test in which these indicators were replaced by an index of income distribution.

The literature on the demographic transition also suffers from another defect—the misspecification of the dependent demographic variable. While the birthrates are appropriate for the study of certain kinds of interrelationships—the causality, for example, that goes from population to economic variables—they cannot be used to describe the reverse relationships. Historical parameters, such as the age structure of the population, and behavioral variables, such as the decision to marry or to have children, are reflected in the birthrate. Only the latter type of variable should be included in the search for causality which goes from economic to demographic factors. And the variable which best captures the behavioral aspects while controlling for the legacy of the historical past is the TFR.

These considerations have led to the reformulation of the hypothesis of the demographic transition. A test with an international cross section of countries confirms that the level of per capita income and the index of income distribution are the crucial variables in determining a country's stage of demographic transition.

CHAPTER III. THE CONCEPTUAL FRAMEWORK: ECONOMIC AND OTHER DETERMINANTS OF POPULATION GROWTH

A large number of variables have featured in the literature that discusses the economic-demographic interactions in the development process. The purpose of Chapters III and IV is to clarify the substantive issues and to construct a conceptual framework for their analysis. The emphasis is on the interactions among economic, demographic, and other factors in the process of agricultural development.

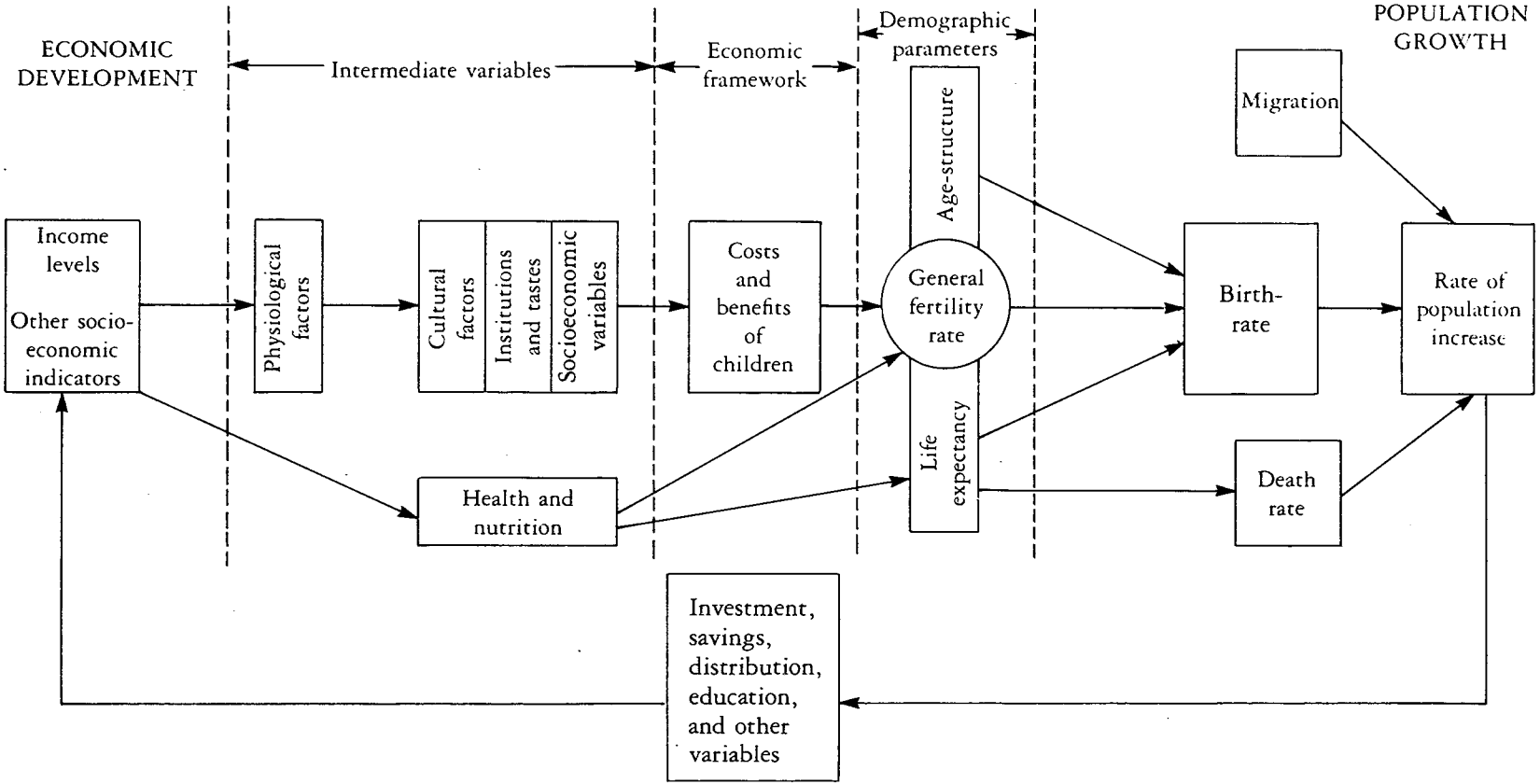
The two reference points for the relationships which will be examined are economic development, on the extreme left side of Chart 3.1, and population growth, on the right side. The discussion of the conceptual framework will follow the arrows from left to right and will then return to the left with the lower loop of the chart. This scheme provides a broad idea of the causality which runs from development to population and conversely from population to development.

Three stages are distinguished between the two extreme sides of Chart 3.1, that is, between economic development and population growth. First, there is a set of intermediate variables through which social and economic factors influencing population must operate. Next, there is the scientific black box which refers to the explanation of changes in attitudes and motivations toward the family and its size. In contrast to the intermediate variables which refer to the observable world, attitudes and motivations are largely unobservable phenomena. In the process of scientific explanation they contribute grist to the mill through which the observed "facts" are put in order to grind out predictions for the future. The predictions, in the specific case of this framework, refer to the fertility rate, which appears at the third stage of Chart 3.1. Two more factors must be considered at this stage in order to arrive at the population growth rate which concludes the chart. The first element is the mortality rate, or life expectancy in general. The second element is a set of demographic parameters which describe the extant age structure of the population at any given moment. These parameters are exogenously determined from the previous demographic history of a population and together with the fertility rate and the mortality rate of stage three determine the rate of growth in population. The return arrows from population growth to economic development are easier to follow. They involve only one set of intervening economic variables, which also happen to be better defined in the literature.

ECONOMIC DEVELOPMENT

The discussion in the literature about the advisability, scope, and approach of population programs and policies has been long, proliferating, and tangled. A recent paper by Teitelbaum which explores the possibility of consensus lists no fewer than 16 positions (204). Distinct as these positions may be, their intersection set is not empty. Indeed, the untrained eye of a non-demographer which may miss much of the detail tends to perceive a broad convergence around a general concept of development. Population control is rarely advocated as a self-rewarding aim. More often, it is associated with the objective of the betterment of human life. This typical position is described by Teitelbaum as "The

CHART 3.1.—A SCHEME FOR ECONOMIC-DEMOGRAPHIC INTERACTIONS



Population-Programs-Plus-Development Position" and is formulated as follows (*204*, p. 753):

1. Social and economic development are necessary, but not sufficient to bring about a new equilibrium of population at low mortality and fertility levels. Special population programs are also required.
2. Too rapid growth of population is a serious intensifier of other social and economic problems, and is one, though only one, of a number of factors behind lagging social and economic progress in many countries.
3. Some countries might benefit from large populations, but would be better served by moderate rates of growth over a longer period than by very rapid rates of growth over a shorter period.
4. An effective population program is, therefore, an essential component of any sensible development program.

When it comes to defining economic development, however, there is much room for discussion, even among economists. Although the level of per capita income at least tacitly has long been considered as only one of the relevant indicators of development, the search for other indicators has often seemed to lead nowhere, least of all to general agreement. For the purposes of Chart 3.1, development is defined in terms of per capita income, plus an auxiliary set of socioeconomic indicators.

The implicit causality of the theory of demographic transition goes from income level to population. At the same time, however, there almost certainly exists an effect of population level upon income. This at a minimum may represent the burden imposed upon society by a rapid population growth. At a further step of analysis, the effect of population on income may involve a set of intermediate variables, as indicated in the clockwise arrow at the bottom of Chart 3.1. The fact remains that most LDCs combined high rates of population growth in the 1950s and 1960s with respectable rates of growth in GDP and general increases in per capita income (*232*, p. 5). Rapid population growth does not preclude economic improvement, although it certainly holds back levels of living and contributes to the gap between the poor and the rich. This consideration alone would have been sufficient to explain the current concern with the interaction of development (and income growth) and population.

The increase in per capita incomes may have a direct effect upon demographic variables. This effect may occur through mortality by decreasing the death rate. It can also occur through fertility if, for example, better nutrition increases the resistance to disease and raises the fecundity of women, or if the increase in incomes works on fertility decisions by making birth control methods more accessible and abortions cheaper. However, the bulk of the impact of increases in income upon demographic variables comes through the operation of the intervening intermediate variables.

To complement the per capita income indicator of economic development, a set of 11 other economic and social indicators is presented in Table 3.1. These have been utilized by a United Nations study and have been associated with the gross reproduction rate in a number of countries (*212*). The 85 less developed and high fertility countries in that table have been classified in three groups on the basis of their range of gross reproduction rate. Cross-country data have been used

TABLE 3.1.—UNWEIGHTED AVERAGE OF SOCIAL AND ECONOMIC INDICATORS IN HIGH-FERTILITY COUNTRIES ACCORDING TO LEVEL OF THE GROSS REPRODUCTION RATE*

	Range of gross reproduction rate		
	2.00-2.49	2.50-3.09	3.10 and above
Number of countries	13	38	34
Economic indicators:			
Income per capita (*US$*)	223	166	154
Energy consumption per capita (*equivalent kilograms of coal*)	486	343	328
Percentage of population in localities of 20,000 or more	33.0	16.9	12.8
Percentage of economically active males in non-agricultural employment	50	39	30
Social indicators:			
Hospital beds (per 1,000 population)	4.6	2.7	2.2
Life expectancy at birth (*years*)	46.5	50.8	47.1
Infant mortality (per 1,000 live births)	124	104	134
Percentage of women married in 15-19 age group	23.5	28.5	29.2
Percentage literate among females 15 years of age and over	40.8	31.6	29.5
Newspaper circulation (per 1,000 population per year)	56	33	26
Radio receivers (per 1,000 population)	42	34	23
Cinema attendance (per person per year)	6	4	4

*Table from United Nations, *The Determinants and Consequences of Population Trends*, *1*, New York, 1973, p. 95.

to estimate the mean value of each socioeconomic indicator in each group. For each of these 12 indicators, the average values of the high-fertility group of countries differ greatly from those of the low fertility group. When taken together as indicators of the level of development, these values suggest that the relationship between development and the gross reproduction rate could have been anticipated. These indicators must be distinguished from the intermediate variables, which will be discussed in later sections.

INTERMEDIATE VARIABLES

Physiological Factors

For every population, a set of physiological factors determines fecundity, that is, the capacity to participate in reproduction (in the birth of a live child). Fecundity is different from fertility, which means the actual reproductive performance, since it is concerned with potential rather than actual fertility.

The literature on the physiological factors which determine the potential fertility is summarized in a United Nations study (*212*, pp. 72-77) and need not be repeated here. The three factors mentioned specifically are (a) the age limits of the reproductive period, (b) the post-partum non-susceptibility to conception (sterility), and (c) the involuntary foetal mortality and other forms of sterility and sub-fecundity. The age limits of the female reproductive period are determined by the age of the onset of menstruation and the age at which menopause occurs. The period of post-partum non-susceptibility to conception is partly determined by sociological factors such as breast-feeding and frequency of sexual intercourse; however, the evidence that a decrease in the duration of breast-feeding tends to decrease post-partum amenorrhea has recently been questioned (*212*, p. 75). Finally, involuntary foetal mortality as well as other forms of sterility and sub-fecundity are associated with the existence of certain diseases, genetic or congenital in origin.

One conclusion drawn from the literature on physiological factors is that the changes which occur during the transitional stage in economic development are likely to result in a net increase, rather than a decrease, in potential fertility (or fecundity), that is, the number of children that a thousand married women could have "under the most favorable conditions" in their reproductive careers. In this situation one would expect also an increase in "natural fertility," that is, the number of children per thousand married women during their reproductive careers if no conscious effort is made to regulate fertility. At a later stage of development, however, the actual fertility is likely to start dropping below natural fertility as births are averted. The remaining discussion of intermediate variables considers the factors which account for the divergence of actual fertility from natural fertility.

Cultural Factors

In this set of intermediate variables a complex of ideological factors is categorized which has been formed around the institution of the family. These factors have found support in "public opinion, moral canons, the rules of marriage, and, lastly, the precepts of religion which, of course, did not create the tradition but only strengthened established national customs" (*126*, p. 158). A detailed classification of these factors is provided by Davis and Blake (*50*, p. 212) who distinguish three groups: (1) factors affecting exposure to intercourse, such as age of entry into marriage, minimum interval between unions when a marriage was terminated by divorce or death (often prescribed by law), or voluntary abstinence (occasionally determined by social taboos on sexual intercourse); (2) factors affecting exposure to conception, such as the availability and dissemination of contraceptive technology and sterilization (often sanctioned or precluded by law

or social systems); and (3) factors affecting gestation and successful parturition, such as abortion laws or health services provided to pregnant women.

Within this framework, Davis and Blake classify 11 variables,[1] of which three are voluntary (voluntary abstinence, voluntary fecundity or infecundity, and voluntary foetal mortality) and one—contraception—is voluntary in use, although not always in non-use.

Among the factors affecting exposure to intercourse, the age of marriage has been singled out as a conspicuous variable. The effect which the delay in age at marriage would have on fertility declines can be shown by using a standard formula and some typical values. The average length of time between conceptions, M, is estimated as

$$M = \frac{1}{p(1-e)} + a \qquad (3.1)$$

where p is the probability of conception in any month, e is the effectiveness of any contraceptive, and a expresses the gestation period in months, plus the post-partum amenorrhea, plus the non-susceptibility to conception during the lactation period (assuming that during this period the probability of conception is zero). Substituting typical values of $p = 0.2$ for the probability of conception[2] and $e = 26$ months, and assuming no contraception, the value of M in Equation (3.1) is equal to 31 months. If marriage is postponed three years (36 months), as from age 15 to 18 because of the need to finish high-school education, the formula gives M = 1.2 conceptions averted. With a five-year delay in marriage the number of conceptions averted is 1.9. Hence a delay of even five years before the start of sexual union could have a substantial effect on fertility.

This conclusion is consistent with a number of empirical studies indicating that the age of marriage has the closest association with completed family size in high-fertility countries (99, p. 25). The effect has been associated with the historical experience of fertility declines in the European countries (85, p. 101):

> The marriage pattern of most of Europe, as it existed for at least two centuries up to 1940, was, so far as we can tell, unique or almost unique in the world. There is no known example of a population of a non-European civilization which has had a similar pattern. The distinctive marks of the "European pattern" were (i) a high age at marriage and (ii) a high proportion of people who never marry at all. The "European" pattern pervaded the whole of Europe except for the Eastern and South-eastern portion.

It is this change in nuptiality patterns toward an increase in the average age at effective marriage of women which is the crucial factor in the decline of the birth-rates in some of the most dramatic recent success stories of population control in LDCs. In the state of Kerala, India, for example, the birthrate in the rural sector in the early 1970s was 26.9 per thousand, compared to 35.9 for all India, 25.9 for Sri Lanka (urban and rural) and to 25.6 for China, Taiwan Province (urban and rural), which are considered as the other two success stories among contemporary

[1] For a detailed discussion of these variables, see United Nations (212, pp. 77 ff).

[2] It is assumed that p = 0.2 is constant between menarche and menopause. For a method of estimating the value of p (which was found to range between 0.18 and 0.31) see Bongaarts (23).

LDCs. Since the rural birthrate for Kerala in 1965-66 was 37.4, the decline in the birthrate observed over the following eight-year period was 28 percent.

When the decline in birthrates is carefully analyzed, the increase in the age of females at marriage emerges as the crucial variable. Table 3.2 presents for 1969 the age-specific marital fertility rate (the number of children born alive per thousand married women in a given age group) for the rural sector of Kerala and India. The Kerala rate is higher than the country-wide rate up to age 24 and lower thereafter. Kerala's general fertility rate throughout is significantly lower than the India rate. Dividing the age-specific fertility rate by the marital fertility rate gives the age-specific nuptial rates for the rural sector, which appear in columns (5) and (6) of the table. The nuptiality rates are consistently lower in Kerala as compared to India and also to the other states. The number of females in the age group 15-19 who were married in 1969 formed a mere 29 percent in the case of Kerala while it was as high as 86 percent for the states of Rajistan and Uttar Pradesh. For the age group 20-24, the percentage of married females was only 72 in Kerala—as against over 90 percent for the other states. Similarly, the percentage of never-married females to total females in the age group 15-44 was 22 for Kerala—the highest for any state in India. It is evident that differences in the average age at marriage and in the universality of marriage are the systematic factors which explain the recent declines in birthrates in Kerala (*128*, *214*).

Institutions and Tastes

The basic institution at the core of fertility analysis is the family. Fertility rates may well change as the functions of the family change in the development process (*212*, p. 92):

TABLE 3.2.—AGE-SPECIFIC MARITAL AND AGE-SPECIFIC FERTILITY RATES AND NUPTIAL RATES, RURAL SECTOR, KERALA AND INDIA, 1967*

Age (*years*)	Marital fertility rates		Age-specific fertility rates		Female nuptial rates	
	Kerala (1)	India (2)	Kerala (3)	India (4)	Kerala (5)	India (6)
15-19	185.52	139.71	54.30	97.91	0.29	0.70
20-24	300.47	282.87	217.06	261.91	0.72	0.93
25-29	256.77	282.63	217.95	266.92	0.85	0.94
30-34	202.34	246.56	170.90	226.02	0.85	0.92
35-39	165.82	180.85	135.64	158.28	0.82	0.88
40-44	62.85	98.30	46.55	77.06	0.74	0.78
45-49	12.66	49.99	8.05	35.54	0.68	0.71
Women, never-married, ages 15-44 (*percent*)					22.00	7.40

*T. N. Krishnan, "The Demographic Transition in Kerala: Facts and Factors," Center for Development Studies, Working Paper No. 36, Trivandrum, Tables 4, 5, 6, July 1976.

> In most pre-industrial societies the wide range of activities involves interdependence with kinsmen and especially with children. These include production, consumption, leisure activity, assistance in illness and old age and many other activities covered by non-familial institutions in modern societies.

In order to cover adequately this range of activities, the nuclear family becomes subordinate to a wider kinship group and the institution of the extended family emerges. Since the welfare-maximizing unit in this case is not exclusively the nuclear family, there may be a change in the scope of many rational decisions with respect to fertility. While it has often been argued that the extended family system is favorable to high fertility rates, there is a lack of strong empirical evidence for this proposition and there are even some indications (from India) that women living in nuclear families may have a somewhat higher fertility than those living in extended families.[3] The correlations usually observed between declines in fertility rates and the decline in the extended family system may be due to the fact that the whole set of socioeconomic factors ("modernization") associated with the demise of the extended family have not been controlled. A number of these factors such as urbanization and industrialization deprive the extended kinship group of its economic and social function. In an increasingly impersonal society, the family emerges as one of the few loci for personal affective relations, and this role can be effectively played only by the nuclear family.

In many societies, there is a well-defined preference for male children. This preference may be for economic reasons (the institution of the dowry), for social reasons (to perpetuate the family name), or for religious reasons (to perform certain rites). This attitude is expressed in the old Chinese proverb "one son is no son, two sons are an undependable son, and only three sons can be counted as a real son"; or in the traditional wish addressed to the Indian bride "be the mother of eight sons" (*212*, p. 93). Be that as it may, as the preference for males is modified, the fertility rates may decline for reasons of genetic probabilities alone.

Quite often tastes and preferences have economic or social antecedents. Such is the case with surviving male children. While the Hindu religion attaches great importance to the survival of a male child, in Kerala, with the relatively higher mix of Christians and Muslims, this factor did not appear to thwart the other influences which led to the recent decrease in the birthrate. The existence of the matriarchal system in much of Kerala also makes a large segment of the population indifferent to the sex of the children. Similarly, education in general and the education of women specifically lead to a decrease in the preference for male children (*128*, pp. 21, 23).

Socioeconomic Variables

The set of socioeconomic variables which intervene between development and fertility declines is complex, and the effect of many of these variables is mutually reinforcing. Levels of family income and education, social mobility, modernization, urbanization, and industrialization, are closely intercorrelated variables, and attempts to isolate the effect of each upon fertility levels have not yielded

[3] For a detailed discussion, see United Nations (*212*, p. 92).

definite empirical results. The a priori rationale for examining these variables is nevertheless clear. In subsequent chapters certain of these variables will be reexamined in an attempt to sharpen their focus and specify them within the context of the agricultural sector. Those variables within the conceptual framework of antecedents to fertility declines will be discussed here.

Level of Income

The level of family income is invariably considered as an intermediate variable with significant impact on fertility decisions. However, the sign of the relationship, let alone its precise measurement, is open to dispute.

Low per capita income appears to inflate fertility rates in three ways. First, poverty, through poor nutrition and health, leads to higher mortality rates. Parents tend to overcompensate for the expected loss of a child by higher fertility rates. Second, poverty lowers the relative cost of children, since the ambition of the poor is survival. The cost of children at higher levels of income is measured in terms of opportunities foregone and educational expenditures. Third, the benefits from children may be higher at lower levels of living. A child is a source of pleasure for every parent, but a poor farmer's child is also part of the family's working capital and a potential source of profit.

An apparent puzzle arises in relation to income and its impact on fertility decisions of the household. Within the framework of the theory of choice and the application of Hicksian micro-consumption theory to demographic analysis, children must be considered as superior goods—or at least there is no evidence to suggest that they are not. Conversely, one may hypothesize that the size of the family, at the micro-level, is limited by the income constraint of the household. While there exists some micro-economic evidence in support of this hypothesis,[4] the more typical observation is that the poorer households are larger than the wealthier ones. Table 3.3 is representative of such observations.

TABLE 3.3.—AVERAGE HOUSEHOLD SIZE IN LOWEST AND HIGHEST INCOME GROUPS: UNITED STATES, NETHERLANDS, AND INDIA*

Income group	United States, 1959[a]	Netherlands, 1935-36[b]	India, 1967-68[a]	
			Rural	Urban
Lowest	3.24	5.35	5.80	6.05
Highest	3.89	4.20	4.48	2.70

*Jan Tinbergen, "Demographic Development and the Exhaustion of Natural Resources," *Population and Development Review*, 1, September 1975, pp. 23-32.

[a]Data refer to families instead of households.

[b]Data are for 10 percent groups.

[4] Chang who studied Singaporian households found that the fertility desired by married women was positively and significantly related to their assessment of the family's financial capacity to have children (35). Similarly, Encarnación found in the Philippines fertility rising with income at the lower end of the income distribution and falling off at the upper end (66).

From the evidence in Table 3.3 one can conclude either that the poorest households can improve their incomes by limiting family size, or that improved incomes lead to lower fertility rates and less population pressure. Alternative explanations, however, are also consistent with the data. The members of the poorer families, for example, may take longer before they establish their own households. In other words, Table 3.3 cannot be interpreted in terms of lower fertility for the richer households if their number increases more rapidly than the number of poor households. In the present state of knowledge, the safest generalization is that, if one controls for other socioeconomic factors which are correlates of income, the family size is smaller for higher income groups than for lower. This still leaves the puzzle of the children being superior goods—which will be addressed later.

Education

As opposed to income levels which cannot be ranked among the most important intermediate variables, education consistently appears as one of the crucial variables associated with fertility declines.[5] However, one must specify carefully the type and the recipient of education and also isolate the other intermediate variables which may be involved in the relationship between educational attainment and fertility.

In his examination of the socioeconomic factors in the demographic history of Europe, Coale points out a close correlation between fertility declines and the increase in literacy (*41*). He was unable, however, to determine any threshold level as the minimum percent of literate population which may lead to the onset of fertility declines. Other researchers have suggested that a threshold exists around 10 to 14 years of schooling, at which level fertility is sharply reduced. At other levels of education, the relationship with fertility might even be U-shaped, with the highest fertility for the least and most educated households. Similarly, the inverse relationship between education and family size may not always be present at the highest levels of education.

The imprecise effect of education on fertility could be due to the existence of other intermediate variables. The age at marriage is affected by education. The highest ages occur at the extreme ranges of education, that is, among persons with no schooling and among those with four or more years of university education. Education affects the use of contraception and reduces the cost of fertility regulation. Training also interrelates with the cultural factors, for example, by breaking down cultural taboos and increasing the exposure to intercourse. Education also reduces the frequency of marriage. As the level of educational attainment increases, in general fewer women are married between ages 20 and 49. These factors may explain why educational attainment and fertility compose one of the strongest negative relationships in the field of demographic research (*173*, p. xiii).

Education can also be considered as a positive correlate of income, another intermediate variable. As a result, the relationship between per capita income and fertility is expected to be strengthened as the level of education varies. In this

[5] For a review of this literature, see United Nations (*212*, pp. 90, 98 ff.).

sense, high illiteracy rates and high fertility rates may be just the two different sides of the same coin in many LDCs. Indeed, of the 783 million illiterate adults in the world in 1970, 97 percent lived in the LDCs of Africa, Asia, and Latin America (170). A more detailed picture appears in Table 3.4, which presents summary demographic, educational, and economic statistics, by world region and by sex. These data underline the fact that both illiteracy and high fertility are adjuncts of poverty. Fertility rates (and rates of increase in population) are high in LDCs. Illiteracy rates are also high, ranging from 73.7 percent in Africa to 23.6 percent in Latin America. Rural areas, where most of the population of LDCs lives, have on the whole twice as much illiteracy as urban areas. Some factors associated with high illiteracy levels are lower income levels, fewer schools, and fewer incentives for obtaining education. Countries with high rates of rural illiteracy also tend to have high population growth rates (170).

It is relatively easy to determine the extent to which education and demographic change result from development and the extent to which they result from fertility declines. As a by-product of development, literacy rates and educational levels are likely to increase for both males and females. However, the increase in female education is more likely to affect fertility rates.[6] The cause and effect relationships of education, development, and fertility can then be disentangled by analyzing fertility changes in conjunction with changes in sex-specific education.

Education, and specifically female education, has been neglected in the discussion of the delay in the age of marriage and fertility declines in relation to Equation (3.1) above. At least two factors must be considered, and both serve to underestimate averted births in the above calculations. First, the age of marriage is generally higher for literate women than it is for illiterates. In a study of fertility declines in Kerala, India, the increased age at marriage due to increased school attendance was found to be a significant causal factor. The age at marriage was 17.68 for illiterates, 18.68 for literates, and 20.06 for those with secondary education. From 1961 to 1971, female literacy in rural areas rose from 45 to 52.50 percent. During this same period, age-specific nuptial rates declined for those aged 15-24, and age-specific fertility rates also fell. These effects were reflected in a decline in the total fertility rates from 172 in 1958-59 to 117 in 1973 (128). Second, Equation (3.1) assumed that the parameter value for the use and effectiveness of contraception was zero. But the use and effectiveness of contraception is related to literacy and education. A study of Bombay factory workers, for example, showed that the more literate workers had more specific knowledge about contraception and were more in favor of it (170). To the extent that this is correct, the effect of education on averting conception is underestimated in Equation (3.1).

Social Mobility

The aspiration of families to improve their social status has long been considered a factor which decreases fertility. The relationship was first enunciated by

[6] Since the educational levels of women are more closely related to fertility behavior, it is of interest to note that women constitute 60 percent of the world's illiterates. Illiteracy is decreasing faster for men than it is for women and the gap is more pronounced in LDCs (170).

TABLE 3.4.—PER CAPITA INCOME, LIFE EXPECTANCY AT BIRTH, AND ILLITERACY RATES FOR WORLD REGIONS*

Country and region	Per Capita GDP[a] (US$)	Life expectancy at birth (*years*)			Illiteracy rates (*percent of population over 15 years*)			Rate of increase in population, 1970-75
		Total	Males	Females	Total	Males	Females	
Less developed countries	424	53.6	52.6	54.7	56.0			2.3
Africa	343	44.6	43.1	46.2	81.0	71.3	90.4	2.6
Latin America	1,095	61.4	59.2	63.7	33.1	29.5	36.8	2.7
Asia	324	49.0	48.8	49.2	67.7	55.0	81.0	2.5
China	353	61.6	59.9	63.3	45.0			1.7
Developed countries	4,280	71.1	67.7	74.2	6.8			0.9
North America	7,054	71.4	67.7	75.3	2.1	2.5	1.8	0.9
Oceania	5,786	72.3	69.2	75.5	0.5			1.7
Western Europe	4,765	71.8	68.8	74.7	5.9			0.6
Eastern Europe and U.S.S.R.	2,084	70.5	66.7	73.8	10.0			0.9
Japan	4,392	73.3	70.6	76.2	1.0			1.3
Israel	3,833	71.0	69.4	72.6	15.8	9.5	22.3	3.1
South Africa	1,399	51.5	49.8	53.3	59.7	59.3	60.2	2.8
World	1,513	58.8	56.9	60.7	38.6			1.9

*Adapted from Richard Stone, "Demographic Variables in the Economics of Education," in Ansley J. Coale (ed.), *Economic Factors in Population Growth*, John Wiley, New York, 1976, pp. 521-52.

[a]Per capita GDP at 1975 constant market prices.

Dumont (57, pp. 106 ff.), in what he called the "social capillarity thesis." Not unlike a column of liquid which must be thin in order to rise under the force of capillarity, a family must be small in order to rise in the social scale. The rationale for the thesis was provided by economic considerations such as the drain of rearing children on money, time, and effort—which could be alternatively invested to improve one's position in the social scale. In this sense, the argument is a special case of the benefits-and-costs-of-children approach which will be discussed later.

There is some evidence consistent with a priori expectations on the relationship between social mobility and fertility.[7] There are also studies which question the universality of the social capillarity thesis (*173*, pp. xiii-xiv). United States data, for example, indicate that, while couples who displayed intergenerational upward mobility came from smaller families, the impact of mobility on fertility after marriage was rather doubtful. An interpretation of such observations has tended to view the United States' example as a special case since mobility has become so routine and predictable that it has minimized the economic and social costs of bearing children (*76*, p. 60).

The ambivalence in the interpretation of the role of social mobility may well arise because the variable is usually measured through a set of other intermediate variables. These intermediate variables may be economic, such as occupation, family income, education, and rental value of dwelling. Since these variables have multiple, and often offsetting effects on fertility, the role of social mobility is ambiguous.

Urbanization and Migration

A characteristic of structural change which takes place in the process of development is an increasing shift of population from rural to urban areas. Both economists and sociologists have traditionally stressed the implications of increasing urbanization upon fertility (*133*, pp. 425-433; *119*). Historically, lower levels of fertility have been observed in urban than in rural populations. However, there are also in parts of Asia and Africa cases which do not reveal any definite pattern. Such observations have led some writers to stress the "urban mentality" as a constraining factor on fertility more than the place of residence as such.[8] The urban mentality includes, among other characteristics, secularization, secondary group association, increased segmentation of roles, and poorly defined norms which often lead to an increase in the cost of children and a concommitant decline in fertility (62, p. 270). Such changes in family structure, however, occur with a lag. As a result, some studies have found shorter birth intervals among urban than rural families in West Africa, probably resulting from the tendency of urban families to disregard sex taboos and from the fact that urban employment shortens the period of breast-feeding which among traditional societies has been one factor affecting the spacing of births. Another suggestion for the reduced impact of urbanization on fertility limitation is that families which are recent migrants to

[7] See Blau and Duncan (20). For a complete bibliography see United Nations (*212*, pp. 90-91).

[8] "Urban residence per se is not an important factor in reducing fertility . . . The urban/rural differentials that do exist are relatively unimportant in terms of overall high rates of fertility in the developing world" (*184*, p. 230).

the cities are "high risk" families. Since disadvantaged families have higher mortality rates, they may also have higher fertility rates.

Some of the effects of urbanization upon fertility are correlates of the migration patterns. Migration typically involves younger people in earlier reproductive ages. This selectivity of migration may result in increased urban fertility. Where migration discriminates heavily in favor of one sex (for example, the heavy outflow of male labor from Botswana to the South African mines), it has as a side effect the breakdown of traditional marriage patterns. This breakdown, which occurs more easily in the impersonal environment of the city than in the closely knit rural family setting, actually removes one of the societal brakes on fertility. In Botswana, for example, only 13 percent of single women between 30 and 34 years of age are childless, and single mothers average four births in a lifetime.

When studying the impact of urbanization and modernization upon fertility one must control for all these factors. To the extent that more of those uncontrolled and uncontrollable factors operate in LDCs, the impact of urbanization in these countries is in general more unpredictable than in the DCs. As an example, fertility in Egypt and India has not been found to be lower in urban areas (*44*, pp. 16, 155, and ch. 14).

To the extent that migration is from country to town and from the agricultural to the nonagricultural sector, some of its indirect effects on fertility cannot be readily dissociated from the impact of the other factors discussed in connection with urbanization. Both family and worker migration must be distinguished as being relevant to fertility decisions. When the whole family migrates, the impact upon fertility, if there is one, will be determined by the factors mentioned above. The measured fertility, however, is likely to increase in the place of destination and decrease in the place of origin because migration is selective and involves mostly people in their family formative years, in other words, couples who have not yet completed their family size.

The migration of workers is likely to unbalance the sex ratio in both the place of origin and the place of destination, again because of the age and sex selectivity of the process. The large-scale emigration of males in search of employment could have adverse effects upon the family, leading to its dissolution, and thus decreasing the fertility rates. But even if this effect upon the family does not occur, the spacing of children will be affected, with a similar effect on fertility rates. Similarly, in rural areas where men of marriageable age become scarce, women may be inclined to marry older men and this may also be reflected in declining fertility rates.

Another aspect of the selectivity of migration pertains to skill and education. Migrants often are not marginal workers but come from the better-skilled and higher-educated groups. As such, they may already be predisposed to have lower fertility levels. This may also result in lower measured fertility in the urban areas and higher fertility in the rural areas.

THE ECONOMIC FRAMEWORK

The Demand for Children Within the Micro-theory of Consumer Behavior

The purpose of theory is to develop a systematic analytical framework (that is, a framework which identifies *causal* relationships) to explain observed behavior and

to predict as yet unobserved phenomena. In this spirit, several attempts have been made in recent years to explain household decisions concerning family size. The basic foundation is the application of Hicksian micro-theory, combined with certain elements of sociology, to family fertility behavior.

There has been a long history of attempts to provide a theoretical framework for the analysis of fertility behavior, including the theory of demographic transition. However, these frameworks were often "grand historical generalizations buttressed by a variety of ad hoc assertions" (*139*, p. 460). Consistent theorizing within the intellectual mold of microeconomics began in 1960 and has since produced a considerable literature consisting of two initially distinct positions and a few empirical variations. Instead of reviewing the entire literature, only the two positions and the emerging convergence of views will be emphasized.[9]

Becker launched the "Chicago School" venture into the economics of fertility by expanding the theory of demand for durable goods to explain other aspects of household behavior (*15*). The approach resorts to "implicit trade" and analyzes people's fertility behavior as if they maximized utility by trading explicitly in certain goods, including children. Like conventional Hicksian analysis, Becker assumed that (a) there exists a stable and well behaved utility function for the representative household (in other words, change in household tastes is assumed away); and (b) the household's budget constraint is linear in the arguments of the utility function (which implies that the prices of commodities desired by the individual household is unaffected by the household's consumption decisions). Again, much as in the case of the conventional demand theory for durable goods, the conclusion was that, as long as children are not inferior goods, an increase in household income will lead to an increase in the quantity of children demanded, i.e., fertility.

The rival view was being developed at the same time and has been identified with the works of Easterlin (*59*, *61*). Rather like Becker, Easterlin made fertility an increasing function of income if enough variables were held constant. Nevertheless, in order to introduce a mechanism to explain away this positive sign of the relationship he gave up the assumption of the stability of the utility function. He introduced a concept of relative income (*56*) defined as the ratio of the intergenerational income of young married couples to the income which they experienced as adolescents in their parents' household. Tastes are formed and change systematically through the child's upbringing in an attempt to prevent a decline in relative income. This change in tastes is responsible for the decline in fertility which may be observed as real income increases. The introduction of elements of sociology into the economic model amounted to the rejection of the assumption of invariant tastes. However, the second assumption of Becker's model—that prices are independent of the behavior of the household—was allowed to stand.

The empirical work on Becker's and Easterlin's models in the mid-1960s and early 1970s concentrated on adding epicycles to explain observable behavior which was not entirely consistent with a priori theorizing. It culminated in an article by Willis (*221*) and one by Becker and Lewis (*16*) on the one hand, and an

[9] For a review of the literature (although not an entirely disinterested one), see Leibenstein (*139*). For a complete and perceptive analysis of the two opposing views, see Sanderson (*182*) on whose work much of this section is based.

article by Easterlin (63) on the other. In the new generation of Becker-type models the assumption was dropped that household behavior was independent of prices. The mechanism which allowed for prices to change systematically with income constituted a new special assumption—not unlike Easterlin's special assumption which allowed tastes to change systematically with income. Parents are no longer interested solely in their own consumption (which includes as an argument the number of children), but they are also interested in their children's consumption. As a result, as income increases parents want to spend more on themselves and on their children, including each additional child. Parents, in other words, suffer disutility if they cannot spend on their marginal child at least as much as they spent on the previous one. This mechanism of the "quality of children" causes each child to be more expensive for wealthier parents than the previous child (17).

The work by Willis provided another explanation for the increasing cost of children with income (221). Raising children takes both money and time. Raising children to an appropriate standard therefore becomes more expensive, not only as the price and quantity of goods consumed by children change, but also as the price and quantity of time spent on them by parents change. Under certain plausible assumptions the relative cost of raising children increases as parental income rises.

In the meantime, the specific epicycle added on to Easterlin's model (63) returned the courtesy of the Becker group and furthered the convergence of the two once rival views (182, p. 7):

> Easterlin explained the decline in the fertility of rural women in the United States in the nineteenth century by use of a model in which farm families desired to leave as a bequest to each child as much wealth in real terms as their own parents gave them. The addition of a level of desired bequests per child to the Easterlin camp formulation parallels the Becker camp's concept of a desired level of expenditure per child. The two specifications differ now only in that, *holding other things constant*, the Becker group expects that the desired level of expenditure per child would be positively related to parental income, while the Easterlin group expects that desired bequests (and expenditures) per child would be independent of parental income. It is likely that this point will be resolved soon by empirical tests.

Other Economic Approaches to Fertility

This impressionistic composition of the theoretical landscape of fertility behavior centered around the two extreme views and entirely overlooked the numerous other studies in between which have concentrated on other variables. A brief summary will be sufficient to complement the discussion of the treatment of socioeconomic variables which were presented earlier in this chapter.

Schultz built a model focusing on a target number of surviving children (186). His model is fashioned in terms of actual or permanent (life-time expected "average") income. Children are considered superior goods, and their desired number increases with income. The growth of income lowers mortality rates and increases the chance of survival. As a result, fewer births are desired in order to

achieve the same number of surviving children. The postulated relationship between income and number of (desired) children remains. Furthermore, there exists a basic asymmetry in the model which may bias this relationship, strengthening its positive sign. People who plan their family in terms of expected income can always add a child if things go better and expectations are revised upwards. But they cannot subtract a child if expectations are belied and revised downwards.

In reconsidering the expected positive relationship between income and fertility, a number of investigators have introduced a threshold value in income. The relationship becomes negative only after this income (or education) threshold has been reached (*83*, *66*).

The introduction of the change in tastes *à la* Easterlin has also been advocated by sociologists and demographers in the form of changes in socioeconomic status (*12*, *77*). A specific application of this variant was made by Leibenstein (*140*) who introduced the concept of the "social influence group" (SIG). The basic notion is that economic changes influence the social status of families. As incomes change, social status and SIG change, but so do tastes for children and goods competing with children (such as goods and services involved in bringing up children, i.e., the cost of children). This nebulous concept, along with the rerejection of the notion of diminishing marginal utility, can explain why fertility is not a monotonically increasing function of income. Leibenstein thus scuttles utility theory—along with its application to household decision making—on the grounds that it involves "implicit trade." But he does it in terms of SIGs, which seem to be no less implicit.

In summary, the attempts to build a scientific blackbox to explain fertility behavior have been disappointing. They have concentrated on explaining away a supposedly deviant observation which is at the foundation of any economic interpretation of fertility behavior—that fertility generally declines with income levels—instead of increasing as required by microeconomics of consumer demand. The explanations have been ingenious and, with some luck and careful respecification of the variables, "successful." However, as Thurow has remarked, the Newtonian theories of celestial motion would never have been discovered if Newton and his contemporaries had had access to a modern computer (*207*, p. 54):

> Deviant observations kept being made that did not fit into the existing epicycle theory of heavenly motion, but each deviant observation could be explained with the addition to the system of another epicycle. Given enough epicycles, all patterns were theoretically explainable. Eventually, however, the computational difficulties of adding new epicycles forced Newton to rethink the theories of heavenly motion to obtain a simple, calculable set of results.

The extant scientific framework for the explanation of fertility behavior within the model of Hicksian micro-theory of consumer demand consists of a patchwork of epicycles. It does not do justice to Hicks or to consumers' demand theory, and, what is worse, it does not explain well fertility behavior.

The Opportunity Cost of Time for Women and Fertility

A valuable by-product of the "new economics of the household" and of its emphasis on the benefits and costs of children has been the analysis of fertility decisions in relation to the opportunity cost of parents, especially of women. This has thrown new light on some relationships which could otherwise have been assigned to the direct impact of certain socioeconomic variables. The empirical evidence, for example, that educated women have fewer children, can be interpreted as exhibiting a link between education and fertility. Educated women also have higher labor force participation rates. Their fertility behavior can then be interpreted as the result of the increase in their marginal product of labor, because of education, which therefore increases the cost of time foregone from work to raise children. Alternatively, the motivation of educated women may be that time spent on child-rearing provides little opportunity for increasing one's stock of marketable skills (*147*).

Two caveats must be emphasized. First, there may be a systematic relationship between women's employment and fertility which operates through factors other than education. It is clear that women who need additional income and who can also find jobs are more likely to have wage employment. Hence in many countries it is mostly women of middle income who have outside employment, as opposed to women from poor or rich households. However, it is not clear whether women who have fewer children work or whether women have fewer children in order to work. No doubt both processes operate. Women who have fewer children for whatever reasons are freer to take employment, and women who wish to work may deliberately defer marriage or childbearing in order to permit working (*153*, p. 316).

Second, the findings from DCs with respect to education, employment, and fertility are applicable to economies where wage employment is prevalent, most economic activity is channelled through the market, and only few domestic services are provided within the family. In LDCs, and in agriculture in particular, the type of employment may become the deciding factor in fertility behavior. Self-employment or agricultural employment, for example, are less incompatible with maternal and familial roles than is wage employment in the urban or modern sector. It is thus generally assumed that female labor force participation in LDCs will follow a U-shaped curve in the development process. Women participants in family subsistence agriculture are gradually squeezed out of the labor force as the modern sector grows at the expense of the agricultural sector, and they reenter the labor force when the modern sector is fully developed (*58*).

However, Boserup has pointed out inconsistencies in these assumptions (*25*). She breaks the transition from rural-agricultural to urban-industrial employment into three phases. In rural-agricultural employment, women perform, both within and outside the household, many tasks which the market provides in more developed economies. This employment is commonly concealed, since statistics on female labor force participation in agriculture, which vary from country to country, often classify as housewives women employed in the subsistence sector. As development proceeds, the trade and service sectors open up cash employment in both rural and urban areas. Later, workers from this sector move into the modern industrial sector, which is almost always urbanized. In contrast to the

first, these latter two phases of employment transition are more completely captured by labor statistics.

Two variables influence the movement of women from the subsistence sector to the trade sector and eventually on to the modern sector. One is the availability of specialized education in marketable skills. Boserup showed that women in LDCs most commonly receive training exclusively in domestic skills through education, rather than in income-raising vocational or professional skills (26). The second factor affecting the entry of women into the modern sector is the degree to which women are secluded from the outside world in a particular society and discouraged from seeking employment. The extent of this inhibiting factor varies from country to country.

The effect of education on fertility through increased female labor force participation is not likely to be significant in typical households within LDCs. Education in these countries has not focused on increasing female labor productivity. Instead, education has concentrated on home economics and has tended to reinforce the traditional (in Western terms) domestic role. The effect that this focus may have on fertility is likely to be positive because the lag in productivity will mean that more women will be confined to the home and subsistence sector where their time has usually a low opportunity cost. As a result a greater number of children will not mean foregone income.

Instead of education, one might consider the status of women in general as both cause and effect of their reproductive behavior. The larger the family, the more exclusive and demanding the woman's familial role becomes. While evidence on the effect of familial roles upon fertility is contradictory and open to question (173), the fuller integration of women into the development process is likely to lead to fertility declines. The greater participation of women in educational, social, political, or economic activities, along with employment in the modern sector, is likely to be reflected in increased costs of children and in conscious efforts to regulate fertility.

Educational and work status assumes greater importance in the earlier life of women. High literacy rates among teenage women increase the probability of their participation in secondary and higher education. With later marriages and the avoidance of early childbearing, women have the opportunity to develop interests alternative to maternal roles. They may develop new skills enabling them to acquire and maintain more fulfilling jobs in the economy.

DEMOGRAPHIC PARAMETERS

The Impact of Life Expectancy and Mortality Rates on Fertility

Mortality has been largely neglected in the recent literature on demographic developments and this study is no exception. The reason for this omission has been earlier explained. Mortality is open to manipulation in only one way—how to decrease it—and, as a result, it is not a policy variable which can lead directly to checking increases in population. Besides, mortality in nearly all DCs is already at such low levels that no substantial change can be expected in the future for the ages below 50 (200, p. 221). As for the LDCs, with few exceptions, major

declines in mortality have already taken place and have been largely independent of economic or nutritional levels. Declines have been mainly attributed to technological advances in the prevention and control of disease and in public health improvement. Recent evidence from Kerala confirms this view (*128*).

While there appears to be little scope for significant future changes in population size due to changes in mortality rates, the indirect impact of infant mortality upon fertility can be very substantial. This relationship has not yet been fully studied. The conceptual link of introducing child mortality rates into fertility rates is provided by the analysis of fertility through the target-number of surviving children. Schultz who has reviewed this literature finds strong but quantitatively imprecise evidence that the reproductive behavior of parents tends to be affected by the increased number of children reaching maturity (*188*). Furthermore, in LDCs, for a given target of constant surviving family size, the reproductive behavior which follows declines in child mortality is such that this target is overshot. The reason for this situation can be readily explained (*172*, p. 191):

> In most of the score of populations for which data are available, there is a fertility response to an infant or child-death in the family, but in none of the populations is the response given half "complete." That is, most families are unable or unmotivated to replace a deceased child with another live birth . . . The implications of this behavior for population growth are immediate: reductions in child mortality in the population will typically be accompanied by some reduction in fertility because fewer families will need to replace a child that has died; but since most families would not have replaced the child in any event, the fertility reduction will be smaller in magnitude than the mortality reduction, and growth rates will rise.

The conclusion of this discussion is that there is indeed a lag in the response of fertility declines to mortality declines (*137*). Furthermore, the recent dramatic declines in mortality have not yet been fully reflected in the declines in fertility, at least for most of the LDCs.

While the longer-run effects of decreases in infant mortality are likely to lead to decreases in fertility, the immediate effects of decreases in mortality due to improvements in maternal and infant nutrition and health of course will be to increase fertility. Contrary to a somewhat widely held view, it appears likely that the better nutrition of malnourished mothers will increase their fertility, mainly due to the quick resumption of menstruation after childbirth. Breast-feeding appears to be associated with some reduction in fertility, but it is not clear to what extent the reduction is due to the consequent delay in menstruation and ovulation or to sexual abstinence. The impact on fertility of improved nutrition is sorely in need of further research, and it represents an area to which the United Nations has recently been paying great attention (*73*).

Age-Structure Parameters and Fertility Declines

The discussion in Chapter II indicated that the birthrate is an inappropriate variable for the analysis of demographic trends relating to reproductive behavior. Instead, an index was proposed which combines fertility and mortality variables,

adjusted for the age structure of the population. In terms of Chart 3.1, the change in observed birthrates has three components: the change in general fertility rates, the change in the age structure of the population, and the change in the life expectancy of women in the childbearing age. The importance of these components becomes evident when considering the formula which defines the rate of natural increase in population (171):

$$r = BR\text{-}DR \tag{3.2}$$

$$= \int_{a=0}^{\infty} c(a)m(a)da - \int_{a=0}^{\infty} c(a)\mu(a)da$$

$$= \int_{a=0}^{\infty} c(a)\left[m(a)\text{-}\mu(a)\right]da$$

where r, BR, DR = crude annual rates of natural increase, births and deaths,
$c(a)da$ = the proportion of the population between exact ages a and $a+da$, and
$m(a), \mu(a)$ = annual rates of childbearing and death for persons at exact age a.

The components of Equation (3.2) can be decomposed by making the simplifying (and incorrect) assumption that mortality does not change significantly overall, although it is different for each age cohort of the population. Then the birthrates observed depend on the levels of *current* fertility, included in the general fertility rate, and of *past* fertility, as reflected in the age distribution of the population. The effect of past fertility appears through transferral of persons in a population from an age at which the difference of the term in brackets, $\left[m(a)\text{-}\mu(a)\right]$ is low, to an age at which the difference is high. This will result in increases in the total fertility rate and also in the birthrate. This difference in annual rates of childbearing and of death is the highest in the age group 20-29. It is lower for other groups, and negative for, say, ages before 15 and over 45, which are not commonly considered the childbearing ages. Populations which are middle-heavy will have a greater part of this increase attributed to past fertility behavior rather than to present fertility. These are the populations which have experienced high growth rates in the past, and these high growth rates may also have continued after the population reached the stage of declining general fertility rates. The effect of the age distribution further sustains high birthrates until the population ceases being middle-heavy. Preston has estimated that about one-quarter to one-third of the growth of most current high-growth populations is attributed to the non-stationary nature of the age distribution (171).

SUMMARY

The conceptual framework employed in this study explores the links between economic development and demographic behavior. In a partial analysis framework, the problem is separable into two components—how development affects demographic variables and how demographic parameters affect development. A general equilibrium analysis, in contrast, would not assume the separa-

bility of two sides, and the question of the interaction between them becomes more complex.

The study, like the rest of the literature on economic-demographic interactions, shies away from general equilibrium analysis. In the partial context, the present chapter examined the impact of development variables on population, and the next chapter will examine the other side of the loop.

Going from development to population by following a causality sequence, the demographic variable of interest is the (total) fertility rate. The reason for that, as developed in the previous chapter, is related to the impact of the historical parameters of the age structure of the population. These historical parameters, while they enter into the determination of the birthrate, are largely irrelevant where motivation for demographic behavior is the major interest.

A number of intermediate variables intervene between economic development and fertility decisions. These were classified as psychological, cultural, institutional, and socioeconomic factors. The specific components within each factor were analyzed separately, and the literature relating each to fertility behavior was reviewed. The most unambiguous effect on fertility declines results from the deferral of marriage and from education.

Once the relevant variables have been identified, it is the job of science to provide the analytical link which ties them to demographic behavior. The scientific blackbox for this purpose has been provided by the "new economics of the household" and operates through a benefit-cost analysis of children. This is a rather narrow approach and has required the addition of a number of epicycles on the basic theory in order to explain an embarrassing conundrum: Hicksian micro-theory predicts that as income increases the number of children should also increase, rather than decrease. The efforts to explain this fact away have been valiant but basically unrewarding. The conjecture is that this failure is related to the partial analysis framework which is being used.

CHAPTER IV. THE CONCEPTUAL FRAMEWORK CONTINUED: DEVELOPMENT CONSEQUENCES OF POPULATION GROWTH

Cross-country evidence was presented in Chapter II on the demographic transition which implied a negative relationship between two economic variables—per capita income and equality in distribution—and demographic variables as expressed by fertility rates. These findings did not in any way prejudice the discussion in Chapter III on the interactions which operate from development to demography. Nor should they prejudge the conclusions of the present chapter in which causality is traced in the opposite direction—from population to development. The determinants of population growth (in the previous chapter) and the consequences of population growth (in this chapter) are the two sides of a simultaneously determined system. Unless both are analyzed within such a system, the classical problem of identification arises. Suppose, for example, that the discussion in the previous chapter had led to the unqualified conclusion that economic development causes rates of population growth to decline sharply. A positive relationship between economic development and population growth is still possible so long as low population growth rates activate an intermediate endogenous variable (say deficiency of demand) which causes a more than offsetting decrease in per capita income. This is the common econometric problem of identification bias. At another level, that of policy formation, the study of global correlations, such as those between per capita income and population growth, is also uninteresting. The reason is that global correlations do not help uncover the causal mechanisms which operate from demographic variables to development variables through a set of intervening parameters which are subject to policy control.

In studying the determinants of population growth in the previous chapter, the impact of a number of intervening variables on fertility rates was analyzed. The consequences of population growth in this chapter are studied through the variables which intervene between population (or birthrates) and development. As mentioned earlier, serious reservations exist with respect to using per capita income as a valid proxy for development. An additional problem arises when one uses per capita income to study the consequences of population growth, since the criterion appears to give equal weight to an increase in income and a decrease in population of equal proportions. This direct trade-off between population and income is fundamentally suspect since it implies that population and income are independent of each other. An increase in aggregate income, however, has second-round effects on welfare, modernization, development in general, and perhaps also on population. Therefore an increase in aggregate income cannot be substituted for fully by an equivalent decline in population which would have left the first-round per capita income unchanged. A similar fallacy appears when one uses output per worker as the criterion of development.[1]

[1] Simon, for example, built a model to simulate the effects of population growth on economic development (*191*). He reached the unexpected conclusion that "population growth may be good for LDCs in the long run" because his criterion—output per worker—in the very long-run (120 and 180 years!) is higher for slow-falling population growth rates than it is for fast-falling population growth rates. He apparently overlooked the fact that his results are also consistent with a model that predicts lower per capita income for the slow-falling population growth rate and higher per capita

This chapter will focus on the "production aspects" of population growth by tracing the impact which a certain rate of increase in population may have on incomes. The intervening variables examined include the levels of investment and savings, distribution patterns, and other economic variables, such as employment and education.

THE EFFECT OF POPULATION GROWTH ON INVESTMENT

The relationship between population growth and investment has provided the theoretical linchpin for the majority of the models which predict that an increase in population will have negative effects upon economic development. There are two basic ingredients in this relationship. First, an increase in population is attended by Malthusian diminishing returns to labor, as long as the stock of capital and land remains constant. Therefore, for output per worker to increase so that population growth does not lead to a decrease in per capita income, there has to be "capital deepening." The quantity of capital per worker must increase—or the capital-output ratio must decline. Second, rapid population growth tends to increase the dependency burden: the proportion of population below 15 and over 65 to the population of working age. Additional demand thus is created for infrastructure investments such as housing, education, and health. These investments are characterized by higher capital-output ratios than other directly productive investments. As a result, further "capital widening" takes place as opposed to capital deepening wherein the productive capital stock per worker decreases, and the Malthusian diminishing returns to labor are further accentuated.

Demographic investment is defined as the additional investment requirements to be met if per capita income is to remain constant in the face of population growth (*184*). Demographic investment can be readily estimated if the incremental capital-output ratio is assumed constant and equal to the average capital-output ratio ($b = \frac{K}{Y} = \frac{\Delta K/Y}{\Delta Y/Y}$ where K is the capital stock and Y is income). Then the total capital stock is

$$K = bY \tag{4.1}$$

and the demographic investment (I_d) is

$$I_d = b.Y.p \tag{4.2}$$

where p is the rate of population growth $\left(\frac{\Delta p}{p}\right)$. By expressing demographic investment as a proportion of total income, we can rewrite (4.2) as

$$\frac{I_d}{Y} = bp \ . \tag{4.3}$$

Equation (4.3) involves the simplifying assumption that the capital-output ratio which applies to demographic investment is the same as the overall incre-

income for the fast-falling growth rate since the former population growth rate is associated with a higher ratio of dependents to workers than the latter. In other words, the conventional conclusion that per capita income is lower with high population growth rates can still be correct. It is also true, and immaterial, that a given per capita income is produced with a higher ratio of dependents to workers, the greater the population growth rate.

TABLE 4.1.—PERCENTAGE OF DEMOGRAPHIC INVESTMENT REQUIRED TO MAINTAIN CURRENT LEVEL OF PER CAPITA INCOME*

Country	Rate of population growth, 1965-70	Required demographic investment[a] (*percent of GDP*)	Rate of fixed capital formation, 1966-68	Demographic investment as percent of fixed capital formation
Less developed countries				
India	2.6	7.8	16.5	47.3
Indonesia	2.9	8.7	8.8	98.9
Brazil	2.8	8.4	17.2	48.8
Bangladesh	3.0	9.0	12.3[b]	73.2
Pakistan	3.2	9.6	14.3[c]	67.1
Nigeria	2.5	7.5	12.3	61.0
Mexico	3.4	10.2	15.6	65.4
Developed countries				
France	0.9	2.7	25.4	10.6
Germany, Federal Republic of	0.6	1.8	24.3	7.4
Japan	1.1	3.3	32.9	10.0
United Kingdom	0.5	1.5	19.0	7.9
U.S.A.	1.1	3.3	16.7	19.8

*Data from Timothy King et al., *Population Policies and Economic Development*, Johns Hopkins, Baltimore, 1974, p. 29.

[a]Demographic investment is defined as that part of capital formation required to maintain the current level of per capita income, with an assumed incremental capital output ratio of 3.0.

[b]The figure is an average for the three years, 1966/67, 1967/68, and 1968/69, calculated on the basis of current prices.

[c]The figure represents an average for 1969/70 and 1970/71 and shows fixed capital formation as percentage of gross national product at current market prices.

mental capital-output ratio. To the extent that demographic investment includes a significant component of outlays for infrastructure with a relatively high capital-output ratio, the demographic investment requirements are underestimated. On the other hand, the working assumption that the incremental capital-output ratio is equal to the average capital-output ratio introduces a bias in the other direction. It is plausible, therefore, that the net effect of the two tendencies may yield a satisfactory rough approximation of the magnitude of demographic investment. Table 4.1 presents estimates of the demographic investment for a number of countries based on their recent experience of population growth and compares these estimates with the observed rates for fixed capital formation. For the LDCs listed in the table, the required demographic investment as a percent of the fixed capital formation ranges from a low of 47 percent for India to a high of 99 percent for Indonesia. This investment is lower in the DCs as

a result of both lower rates of increase in population and higher rates of fixed capital formation.

This discussion of the rate of investment required to keep per capita income constant, given a certain rate of increase in population, can be extended to provide a partial approximation to the often-raised question of the "optimum population level." A simplified framework for this purpose has been provided by Ohlin (161). Suppose that the sole criterion for deciding the optimum population is the level of per capita income associated with any level of population. Furthermore, suppose that income is a function of population and capital that the functional relationship between the rate of capital formation and the rate of population growth is known. Diagrammatically, the latter relationship may be assumed as in Chart 4.1a, where $\dot{K}$ is the rate of change (net) in capital stock and $\dot{P}$ is the rate of change in population. The graph shows that the rate of capital formation is an increasing function of the rate of population growth up to a certain point, presumably because of economies of scale, organizational changes, levels of productive utilization of existing capacity, and other such factors which enter the underlying specification of investment as a function of income (to be touched upon later in this discussion). Beyond this level, the rate of capital formation decreases as the rate of population growth increases, presumably because of the factors mentioned earlier in this section. Chart 4.1b shows the "per capita income isoquants"—the combinations of capital and population which leave per capita income constant. If there are constant returns to scale, these isoquants should be straight lines through the origin. Since increasing returns to labor have been postulated here (and a fortiori if there are increasing returns to scale), the isoquants will be downward sloping, and they eventually become upward sloping as decreasing returns to population occur. Next a small increase is considered in capital, ΔK, and in population, ΔP, consistent with the relationship drawn in Chart 4.1a, and we superimpose it on Chart 4.1b, beginning from the origin of K_0 and P_0, the existing combinations of capital and labor. The arrows show alternative combinations of increased capital and population which would lead to higher per capita income isoquants; the tangency of the production possibility curve between capital growth and population growth and the per capita income isoquants, at point A, gives the optimum level of population.

This can be expressed algebraically as follows. Consider per capita income, y, a function of population, P, and capital, K,

$$y = \frac{Y}{P} = \frac{I}{P} f(P, K) \cdot \tag{4.4}$$

The rate of growth of per capita income is then written

$$r = \frac{\dot{y}}{y} = \frac{I}{Y}(f_P \dot{P} + f_K \dot{K}) - \frac{\dot{P}}{P} \cdot \tag{4.5}$$

Differentiating with respect to the population growth rate gives

$$\frac{dr}{d\dot{P}} = \frac{I}{Y}\left(f_P + f_K \frac{d\dot{K}}{d\dot{P}}\right) - \frac{I}{P} \tag{4.6}$$

and, by setting equal to zero and rearranging,

CHART 4.1a—INVESTMENT AS A FUNCTION OF POPULATION GROWTH*

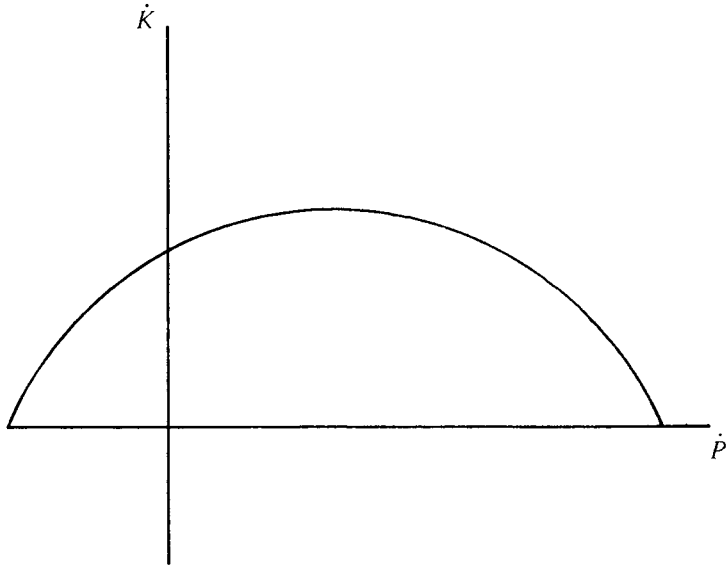
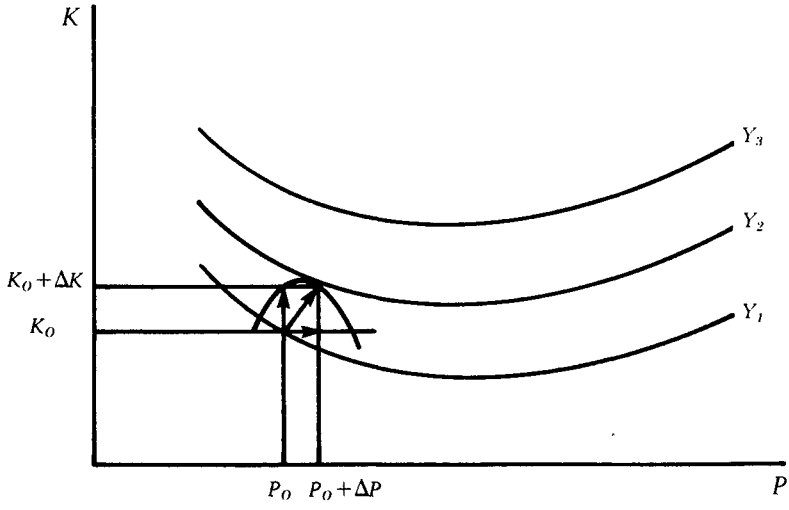


CHART 4.1b—OPTIMUM POPULATION, GIVEN THE INVESTMENT-POPULATION GROWTH FUNCTION*



*Goran Ohlin, *Population Control and Economic Development*, OECD Development Center, Paris, 1967, p. 63.

$$\frac{d\dot{K}}{dP} = \left(\frac{I}{P} - \frac{f_P}{Y}\right)\frac{Y}{f_K} \tag{4.7}$$

$$= \frac{y - f_P}{f_K} .$$

Expression (4.7) shows the maximum rate of capital formation obtainable as a function of population. This maximum is consistent with maximum per capita income if it is tangent to a per capita income isoquant as drawn in Chart 4.1b. For this to happen, the slope of the per capita income isoquants is written as

$$y_P = \frac{y + f_P}{P} \qquad \text{and} \tag{4.8}$$

$$y_K = \frac{f_K}{P} \tag{4.9}$$

or

$$\frac{d\dot{K}}{d\dot{P}} = \frac{y_P}{y_K} = \frac{y - f_P}{f_K} . \tag{4.10}$$

This maximum occurs at point A as Chart 4.1b is drawn, which is the optimum-population point. However, the solution would vary if the isoquants were drawn differently. Under alternative assumptions, different combinations of capital growth and population growth (including maximum population growth through immigration) could produce the maximum per capita income.

The formal framework above provides a simplified approach to the question of optimum population which focuses on the role of investment within a narrowly defined production function framework. On the production side, this framework should be expanded to handle adequately questions such as the effect of population-induced economies of scale upon output, the impact of population-related demand stimulation upon investment, whether it is consumption demand or demand for demographic-type investments, and so forth. On the consumption side, however, population cannot be conceived as an exogenously determined control variable. Instead, as the analysis of Chapter III indicated, population is determined endogenously through a set of intermediate variables which are totally overlooked in this analysis. Finally, the linkage of production and consumption can be done through some type of utility or welfare maximization model. However, maximizing per capita income is the bare minimum which such a model should include. Besides income, leisure should also be an argument in the utility function, and the maximization process should also determine the work-leisure choice combinations associated with alternative values of per capita income.

THE EFFECTS OF POPULATION GROWTH ON INCOME, CONSUMPTION, AND SAVINGS

The previous section emphasized the strains which population growth may place on development through the demand for additional investment. Savings

represents the supply side of the usual investment-equals-savings identity. In a Harrod-Domar framework, for example, the rate of growth in income, y, is determined by the ratio of the savings rate, s, to the capital-output rate, b. Thus, $y = \frac{s}{b} = \frac{S}{Y} / \frac{\Delta K}{\Delta Y}$, where S, K, and Y are savings, capital, and income, respectively. As a result, the impact of population growth upon savings has attracted considerable attention in the literature, but our empirical knowledge on the subject is meager.

The application of macroeconomic models to demographic analysis has made savings a rising function of per capita income of the form

$$S_t = sY_t = P_t \left[\frac{sY_0}{P_0} + \alpha \left(\frac{Y_t}{P_t} - \frac{Y_0}{P_0} \right) \right] \qquad (4.11)$$
$$= \alpha Y_t - \beta P_t$$

where P indicates population size, the subscript 0 the base period, and t time (*44*). Such a specification can readily lead to the conclusion (*44*, p. 19):

> The significant feature of population growth as such is that the higher rate of population growth implies a higher level of needed investment to achieve a given per capita output, while there is nothing about faster growth that generates a greater supply of investable resources.

At the microeconomic level, the impact of family size on savings is examined within a dependency rate-adult equivalent framework (*44*, *67*, *53*, *137*). Again, the hypothesized relationship between family size and savings is negative because a large number of children represents an increase in adult equivalent consumption.

The defect of such approaches is that the impact of population upon income is entirely overlooked. The large number of conceivable alternative links between population and the production function provides a basis for analyzing savings within a simultaneous, rather than a single, equation system. At the macro-level, the Keynesian approach would emphasize the increase in effective demand. Within a production function framework, population growth can provide a stimulus for technological change (*24*). In the same context, the rapid growth of the labor force associated with population growth may provide economic benefits if the new entrants into the labor force are better educated, more adaptable, and easily trainable. In this event new entrants bring to their jobs more "embodied" human capital investment than the workers whom they have replaced (*139*). It is true that the macroeconomic benefits of population growth can become easily exaggerated for LDCs suffering from shortage of supply (rather than deficiency of demand) and from substantial levels of unemployment. For the DCs, however, it is indeed conceivable that Hicks was correct in stating that ". . . perhaps the whole Industrial Revolution of the last two hundred years has been nothing else but a vast secular boom, largely induced by the unparalleled rise in population" (*92*, p. 302).

The empirical analysis of savings at the micro-level, allowing for changes in family size and the effects upon income, has yielded ambiguous results. There are three possibilities of interaction between family size and income. First, children

may contribute directly to family income through their participation in productive activities. Second, children may provide a spur for other family members to increase household income by working harder, increasing capital formation, or increasing their own education and knowledge (60, p. 104). Third, in addition to any effect which the children may have on production behavior, on the consumption side additional consumption by children may be met by reduced consumption by other family members, a decrease in family savings, or both.

These three aspects have not been distinguished sufficiently. Mueller examined the value of children to the agricultural household (152). She found a positive contribution to production, but, after allowing for the other costs of children, their total economic contribution became questionable. Kelley used a three-equation system (estimated with three-stage least squares procedures) to determine the impact of variables such as family income, number of children living at home, and age of the head of the household on the three dependent variables—household savings, household income, and the number of children living at home (116). He found that the number of children has a negative impact upon savings and a positive impact upon household income. Considering these effects as additive, he concluded that the contribution of children in production outweighs their consumption burden.

Obviously Kelley's is a very restrictive framework. Still, it is considerably better than the single equation approaches which have yielded various contradictory results. With international cross-section data both a positive (3, 90, 220) and a negative (5,137) association were found between savings rates and family size or population growth. Similarly, with national cross-sectional data for DCs savings were found to increase slightly with family size, if one controls for income (64). And again controlling for income, family size was found to have only a small effect on total expenditure, and presumably savings (91).

The reason for this disappointing state of empirical results is not the absence of savings hypotheses which incorporate the impact of an increase in family size. Family size and age composition are crucial features, for example, of the life-cycle hypothesis of savings (117, 232). But attempts to relate the variables of economic-demographic interactions (such as fertility, family size, income, savings, and so forth) in a partial analysis, single equation framework inevitably become entangled in the problem of identification. Should one, for example, assume that family size is the exogenous variable which influences savings rates? Or might not both variables be endogenous, and along with income, be determined by yet another set of variables? Such an approach implies a need to estimate the reduced form of the economic-demographic model, in which each endogenous variable is expressed as a function of every exogenous variable. Furthermore, the disentangling of the multiple causal relationships will become much easier if it is recognized that fertility is the variable of interest on the consumption side while birthrates and rates of population increase affect economic variables on the production side.

THE EFFECTS OF POPULATION GROWTH ON INCOME DISTRIBUTION AND OTHER ECONOMIC VARIABLES

The discussion in Chapter II highlighted the inverse correlation in an international cross section between fertility rates and two economic variables—income

per capita and income distribution. The implication was that a more equal income distribution was associated with lower fertility rates. Such an association has also been observed by Ahluwalia (7) who concluded that the rate of growth of population is a significant variable in determining the degree of inequality in the distribution of income, and also by Simon (*191*) and Rich (*179*) who imputed causality as going from equality in income distribution to fertility declines. This section focuses on the effect of demographic variables on economic variables, and on the extent to which high population growth rates may strengthen certain patterns of income distribution.

In the economic literature it is generally assumed that lower fertility contributes to greater income equality (*119*, p. 35). The most likely chain of causality runs through the increase in the supply of labor, the restraining effect which this increase has on the growth in real wages relative to the returns to other factors of production, and the increase in the rate of unemployment which further limits the increase in real wages. Furthermore, if rapid population growth leads to increasing land fragmentation, the depressing effect on wages is reinforced by the more general decrease in family farm incomes through the decrease in the implicit rent from land. If it turns out that the relationship between family income and fertility is indeed negative when one controls for other income correlates within a general equilibrium system, this would tend further to increase income inequality. A certain increase in population would be disproportionately distributed between the low and high income groups, tending to further reduce per capita incomes in the former relative to the latter.

Although the effect of population growth on income inequality may be substantial, it is likely that the main influence of the distribution variable is causally directed the other way. To the extent that equality in income distribution may affect fertility rates, alternative policies of redistribution have a differential and non-neutral impact on fertility. It is reasonable to assume that redistribution by means of land reform or taxation may have different effects on fertility than redistribution provided by making medical care or education more easily accessible to the poor.

The possible effects of population pressure on economic development through pressure on food supplies, unemployment, and education, are among the most important interactions. They will be analyzed specifically in the remaining chapters of this study. At this point, some observations on population and the environment in general will suffice. The problem of resource scarcity is not so much one of population pressure as of income pressure. The energy consumption per person in the market economy DCs, for example, averages 18 times that in LDCs—and parallel but smaller discrepancies exist in the consumption of food (as will be suggested in Chapter VII in relation to grains). The problem of resource exhaustion, as a result, appears serious mainly because relatively small populations with high incomes push against limited resources.

Similarly, the problem of ecology becomes intensified more by income than by population pressures. There are two aspects in the ecological problem, as suggested by Yotopoulos and Nugent (*232*, p. 8):

> First is the despoliation of the environment, which is an external diseconomy in the sense that the actions of some impose a cost upon the community as a whole, which results mainly from effluence. Second is the

> conservation problem, the depletion of natural resources. Both effluence and depletion can be expressed as the product of population times output per capita times waste (pollution) per unit of output. The rate of growth of ecological deterioration is the sum of the rates of growth of the three components. . . . It is true that population growth is more rapid in the LDCs than in the DCs. However, the growth rate of consumption per capita and the growth rate of waste per unit of output would seem to be far more important components than the rate of population increase in explaining the rate of environmental deterioration. If so, the blame for despoiling the world's environment must be laid squarely on the DCs rather than on the development efforts of the LDCs. There is no evidence that the three-quarters of the world's population that live in LDCs have plundered their environment to any degree in order to improve their present lot (if so, they must have been uniquely inefficient in achieving results). Besides, it is not immediately evident that the quality of life, including environmental quality, in DCs or LDCs has deteriorated as compared, for example, to the eighteenth or nineteenth century.

SUMMARY

The basic conclusion of this chapter is that the literature on the economic consequences of population growth has placed undue emphasis on the impact of population growth on capital accumulation and hence on per capita income. Under common assumptions, the impact of population growth is most likely negative. More recently, however, in the literature on the economics of development it is increasingly recognized that the process of economic growth is not so simple as to be encompassed within the confines of a preoccupation with capital accumulation. Ohlin has summarized this view (*162*, pp. 9-10):

> . . . it is surely no exaggeration to say that both the econometric analysis of growth in industrialized countries and the practical experience of development policy in poor countries have left the impression that capital accumulation as such may be the least important element of growth, or at any rate that its role is much more passive than suggested by the production function approach.

There are certainly non-traditional sources of economic growth which may interact with population growth. Additional influences to be considered are the effects of increased demand on investment and on the linkages structure of the economy, the work-leisure choice of the household, economies of scale, the terms of trade between agriculture and non-agriculture, and the intersectoral shifts in labor. With few exceptions, practically no effort has been made to assess the impact of population size or of its rate of growth on these sources of economic growth (*191*).

A limitation of the basic research methodology followed has also contributed to this restrictive approach adopted in the literature. No general framework has been constructed to treat both the consumption and production aspects of population growth in a simultaneously determined system of interactions between exogenous and endogenous variables. Yet only with such a system can the

causality between developmental variables and demographic variables be clearly traced in a manner that is free from identification problems. It seems likely that identification bias is largely responsible for the contradictory conclusions reached in the empirical study of both the determinants and the consequences of population growth.

CHAPTER V. AGRICULTURE-SPECIFIC ASPECTS OF ECONOMIC-DEMOGRAPHIC INTERACTIONS

The discussion in the previous chapters has partially related agriculture to demographic change. LDCs as a rule are agricultural countries. Most of their population increases, therefore, takes place in the agricultural sector. As a result, the analysis of interactions which go from social and economic variables to fertility and population growth in LDCs to some extent reflects the situation in the agricultural sector. Similarly, agriculture is the dominant economic sector in most LDCs. Consequently, the study of the impact of population increase upon economic development also refers to agricultural development.

It is useful to examine in specific the economic-demographic interactions of the agricultural sector for a number of reasons besides the obvious one—the size and importance of the agricultural sector. The demographic patterns observed in agriculture are indeed different from those of the other sectors of the economy. It is conceivable that the higher fertility rates of agricultural households are the result of intervening variables which are agricultural correlates—levels of income and education, female labor force participation, the production contribution of children, life expectancy, death rates, and so forth. The study of these intervening variables would have sufficed to capture the demographic behavior of the agricultural sector. There are, however, more characteristics of the agricultural household than what these intervening variables could possibly describe. The operation of the household as a farm-firm combining production and consumption decisions is a characteristic which becomes crucial for the analysis of demographic behavior. It has specific implications for the organization of the productive process around the members of the family under the direction of the head of household. It carries over to the distribution of the product among the producer-members-of-the-family by rules other than marginal productivity considerations. Lastly, it makes meaningless the definition of functional shares, since the returns to the family's land, labor, capital, and entrepreneurship are inextricably interwoven and can have implications for both production and consumption. It is possible, in short, that the socioeconomic organization of the agricultural sector specifies the direction of the inter-generational wealth flow as going from younger to older generations. This organization, more than any specific set of intervening variables, operates to make fertility rates endogenous to agricultural development (*34*). The sparse evidence connecting the organization of the agricultural sector to demographic characteristics will be reviewed in this chapter.

AGRICULTURAL GROWTH AND FERTILITY

As reported in Chapter II, attempts to relate demographic variables, through the index of transition, to agriculture-specific variables have not proved fruitful. Variables describing the structure of development, such as the rate of growth in agricultural GDP, the share of agriculture in GDP and agriculture's share in total population, do not seem to contribute to an explanation of the index of transition—and therefore to explaining its component parts—the total fertility

rate, and life expectancy at birth. Similarly, no clear pattern emerges in the relationship between food production and population (2, p. 4). This evidence can be interpreted to mean either that there is no relationship between agricultural development and fertility or that, while a relationship exists, it cannot be captured by the rate of growth in agricultural GDP—a variable which should be no better an index of development (and is probably a worse one) than the rate of growth in aggregate GDP.

Neither of these explanations is sufficient, and the problem of discovering economic, social, and demographic interrelationships at the sectoral level becomes complicated by conceptual and methodological considerations and by constraints of data availability. While development in general may well be related to declines in fertility, it is also reflected in a decrease in the relative size and importance of the agricultural sector. At a certain level of aggregation, then, it becomes hard to distinguish whether growth or decline in agriculture should be properly associated with declines in fertility. At the household level, on the other hand, the issue may be more clearcut but for the fact that the relevant household data are not readily available. Furthermore, consider the analysis of population increase which treats several correlates of development as exogenous variables including, for example, per capita income. By adding variables which also refer to agriculture in such an analysis, one further confuses the issue, since the agricultural variables are most probably multicollinear with the development variables. Finally, data on sector-specific fertility rates do not exist. If, on the contrary, one were to associate changes in agricultural population with agriculture-specific socioeconomic variables, the effect of the latter on fertility would be swamped by migration. Without a valid migration model or sector-specific demographic data, including fertility rates, one cannot conduct a rigorous analysis of the demographic-economic interactions at the sectoral level of agriculture. For these reasons the analysis in this chapter will be restricted largely to the conceptual level. Empirical discussion will rely at best on casual quantification.

Agricultural growth sets in motion forces which have multiple and varied implications for social, economic, and demographic development. Depending on the form of agricultural growth, its effects on fertility may also differ and take time to materialize. It would certainly be an oversimplification if one relied on economic changes incipient in agricultural growth to solve the population problem.

Eva Mueller studied some celebrated cases of successful and sustained agricultural growth—including those of Japan, China (Taiwan Province), and the Indian Punjab—and examined their implications for declines in birthrates (*150*, *151*). She concluded that the decrease in birthrates appeared with a substantial lag and mainly as a result of factors other than the increase in farm incomes. In fact, the first manifestation of agricultural growth in all three cases was the release of the income constraint on population growth and an immediate increase in birthrates. The decrease in mortality rates, because of better nutrition and hygiene, occurred first. Rapid rates of increase in agricultural population ensued. Birthrates began to decline, first moderately (for example, in the 1920s in Japan, following with a 50-year lag the onset of the agricultural growth and with a longer lag, in the 1950s in China) and only eventually to a substantial degree. This occurred in the

early 1950s in Japan, in the 1960s in China, and in the late 1960s in the Punjab. There is also micro-economic cross-sectional evidence that birthrates rise initially with income levels and decline only when a "threshold income" is reached (66).

Such observations may be explained away as statistical artifacts. They may be due to errors in measurement, since education and efficiency of public administration are closely correlated with the level of development and with incomes. Therefore the positive relationship between birthrates and agricultural incomes may be due to more complete reporting of births. Furthermore, the persistent increase in birthrates during periods of increasing incomes may merely reflect the age structure of the population resulting from a historical record of high birthrates and the decreases in death rates contemporaneous with development. Evidence on fertility rates during these periods, which would have been the crucial variable, does not exist.

Systematic explanations of the positive relationship between income levels and birthrates are also possible. The income constraint on population growth may become binding, the poorer farmers tending to avert births in order to avoid excessive subdivision of land. A more important factor at the early stages of development may be the role of the physiological factors described in Chapter III. The woman's age at marriage has been found to be a crucial variable. However, the relationship of that variable with income does not seem to be increasing monotonically. There is evidence that marriage age tends to fluctuate with business conditions. Marriages occur earlier in years of prosperity, and later in periods of depression (46, pp. 52-54). Similarly, marriages tend to occur earlier among the poor. On the other hand, it has been found that the rich marry younger wives (126), and also that, where the institution of the dowry is prevalent, marriages may be postponed among the poor until the requisite dowry is amassed. Eventually, as incomes increase, an increase in the average age at first marriage seems inevitable, due primarily but not exclusively to the increase in the years of schooling for women. Poor nutrition, to the extent that it is the result of low income, is related to some of the physiological factors previously discussed. Poor nutrition may result in lower fecundity of women, longer birth intervals, and a larger number of fetal deaths (28, pp. 62-72). Increasing income will result in a net decrease in infant and child mortality, although, at low levels of development, this situation may be offset by the adverse consequences of unhygienic bottle-feeding. Furthermore, the longer breast-feeding and lactation period among the poor will tend to increase the spacing of children. Cultural and institutional factors should be mentioned at this stage. It has been found, for example, that fertility is lower in polygamous than in monogamous households. To the extent that the incidence of polygamy declines with development, fertility rates are bound to increase (126).

The effect of physiological factors is most pronounced at the early stages of agricultural development, and it is the dominant factor which determines whether and when fertility rates will decrease. The effect of development on economic considerations, such as the costs and benefits of children, will appear only later. As mentioned in Chapter II, the economic literature on the utility analysis of children distinguishes the consumption utility, the old-age security utility, and the income utility which parents derive from children. Nothing can be said about the consumption utility which a parent derives from a child as a

function of income growth at the sectoral level. The value of children as old-age security for parents decreases with the level of development. It would be expected to decrease less, however, for agriculture than for non-agriculture, since formal old-age insurance and social security schemes are less widespread in agriculture, and since the family cohesion which guarantees parent-support by children is greater in agricultural and rural households than in their non-agricultural and urban counterparts. The utility of children as a source of future income for parents is also expected to decrease in the process of development because, as incomes grow, other sources substitute for the parental income earned by children.

According to the "new economics of the household," the changes in tastes and relative prices in the process of income growth account for a shift in consumption patterns away from more children and toward material goods.[1] The mechanism is either through aspirations and taste-formation which lead young married couples to protect their relative income standards (based on the income they experienced as adolescents in their parents' household), according to Easterlin; or through relative prices which change with income, in the sense that parents want to spend more on themselves and on each additional child, according to Becker. When farmers escape from a minimum subsistence level and enjoy sustained income increases over a period of time, an ever-expanding list of unmet desires is created. The list may include improved housing, trips to town, education of children, health services (including fertility control such as contraceptive devices and induced abortions), bicycles, radios, or watches. As a result of such changes in prices and tastes, the marginal utility of income increases, and the opportunity cost of children relative to other forms of consumption is raised (*62*, p. 271; *151*). This hypothesis finds confirmation in a study of consumption aspirations and the "modern goods" component of the consumption basket of certain rural households, in relation to their perception of the ideal family size and their use of contraception (77). After controlling for other factors, such as education, family income per adult, and wife's age, Freedman found that the size of the ideal family decreased and the use of contraception increased, as: (a) aspirations to consume increased; (b) consumption of services increased; (c) the ownership of modern objects in the household increased; (d) the housing quality improved; and (e) an index of financial burden increased.

Controlling for the costs and benefits of children, increases in incomes may lead to declining fertility rates because of the "child-replacement" effect. One may hypothesize that parents plan for a larger number of births than their ideal family size as an insurance against the death of a child when the parents are past their reproductive ages and unable to replace it. Consistent with this hypothesis is evidence from China (Taiwan Province) that children who die are not fully replaced, indicating that many families have more children than they want (*180*). The improvement in nutrition and health care which accompanies rising income levels will lead to lower infant and child mortality rates and to initially higher rates of increase in population. Eventually, however, as the decreased mortality rates are recognized as permanent rather than transitory phenomena, the ideal family target and the total births target are likely to coincide, and this will appear in terms of a fertility decline.

[1] See Chapter III, pp. 36 ff.

MODERNIZATION AND INTENSIFICATION OF AGRICULTURAL PRODUCTION RELATED TO FERTILITY DECLINES

The hypothesis of induced innovation was advanced by Hayami and Ruttan to explain the introduction of chemical-biological agriculture as a result of change in relative prices (89). An equivalent hypothesis was advanced earlier by Boserup (24) and Clark (45) to describe the process of labor intensification and of land expansion (vertical and horizontal agricultural growth) observed in a number of countries. According to this hypothesis, population growth is the exogenous shock which induces more extensive agriculture by bringing into cultivation new lands. More labor-intensive agriculture results by changing the crop-mix so that total output increases without a concommitant decrease in the marginal product of labor. Such agricultural innovations, in turn, make it possible for a country to support a larger population. The agricultural development in Japan, the Punjab, and China fits this model.

The obverse hypothesis was suggested by Mueller on the basis of the cash needs of modern chemical-biological agriculture for the purchase of improved seeds, chemical fertilizers, plant protection materials, tube wells, implements, and so forth (150, pp. 320 ff). In an expansion of the consumption aspirations hypothesis examined in the previous section, Mueller suggests that these externally produced inputs compete with children for the total allocation of household expenditure resulting in a certain downward pressure on fertility. Some evidence from China (Taiwan Province) suggests that, while there is no relationship between family size preferences and farm equipment ownership, there is a strong relationship between farm equipment ownership and contraceptive use, after one controls for income and education.

There are two variants of the "psychological hypothesis" which links agricultural modernization to declines in fertility. One variant suggests that a successful experience with agricultural innovations, for example, of the Green Revolution variety, will make families prone to experiment also in other aspects of life, such as birth control (109, chapter 4; 30). This is a testable, but as yet untested, hypothesis. A parallel hypothesis of psychological linkage has been suggested by Epstein who views some of the new agricultural practices as disruptive to traditional relations and social norms, to the extent that they facilitate certain kinds of modern behavior (68). In her study of two Indian villages, Epstein found that (150, p. 324)

> economic changes which alter the sources of livelihood available to a village [in the case of one of her villages, greater access to non-farm employment in the neighborhood] do produce extensive social change and modernization in the village. By contrast, innovations which raise agricultural income without fundamentally altering people's work situation [in the case of her other village, availability of new irrigation facilities] evoke much less change in traditional norms and ways of life. It may well be that the Green Revolution has an influence similar to the introduction of new irrigation facilities.

In conclusion, one can state that there is no evidence to suggest that the agricultural change introduced through the chemical-biological technology has had any direct effect upon fertility rates in LDCs. One definite impact of the

Green Revolution is that it provides a country additional time to solve its population problem.

AGRICULTURAL DEVELOPMENT, NUTRITION, AND FERTILITY

The purpose of this section is not to discuss nutrition within the context of agricultural development, be it to the extent that better nutrition becomes an objective of development, or, through a nutrition-productivity relationship, a contributing factor to growth. Rather, the purpose is to trace the sequence from growth of agricultural output (and income changes) to improved nutrition, and finally to fertility. To this end, the sparse evidence on nutrition and fertility will be reviewed (*97*, *110*), and next certain relationships between agricultural development and nutrition will be examined.

The view that malnutrition stimulates fertility was put forward some time ago (*51*), but has now been discredited. McNaughton (*145*) quoted the findings of a study of village women in Mexico in which longer than expected amenorrhea after childbirth was observed for the malnourished group, while the group receiving a dietary supplement resumed menstruation earlier (*36*). The same positive underlying relationship between nutrition and fertility seems to be strengthened by findings relating to the health of the mother and the number of pregnancies (*222*). Conversely, repeated and closely spaced pregnancies deplete the maternal stores of calcium and iron, and result in both malnourished mothers and children. An interesting study on preschool children in Colombia found that only after births were spaced with at least three-year intervals did the incidence of malnutrition drop from 40-50 percent to less than 30 percent (*225*).

The conclusion from this sketchy review of the literature is that the direct effect of improved nutrition on fertility is positive. The inclusion of nutrition as an instrument of population control policies—as distinct from nutrition as an objective of development—can only rest on the indirect effects which a decline in infant and child mortality could have on parents' target of children. Because parents recognize the increased probability of survival for children and may not plan for an additional child as replacement, they may achieve lower fertility levels (*203*). The question arising is the time lag between the decrease in mortality and the modification of parents' reproductive behavior. There is some evidence that this lag may be as small as two or three years (*224*, *187*).

While the impact of nutrition on fertility declines is rather indirect, the impact of agricultural development upon nutrition appears strong and unqualified. This is rather surprising, given the fact that the relationship between development in general (and per capita income) with nutrition is rather weak. In international cross-sectional studies, calorie intake generally is more closely related to the level of foodgrain production than to the level of per capita income, and it appears that the variation in per capita calorie intake is much less than the variation in per capita income. More important, some poor countries, which have a relatively sizeable agricultural sector (in terms of labor force therein) and high per capita production of foodgrains, appear to have a higher calorie intake per capita than countries at higher levels of development but with a less important agricultural sector (*214*, pp. 8-9).

Analysis of cross-sectoral data from Indian states provides further evidence that nutritional levels, as measured by per capita caloric intake, are more closely associated with per capita foodgrain production than with per capita income (*214*, pp. 10-11). In Table 5.1 information from 15 states is classified on the basis of the average of state domestic product per capita and of state per capita foodgrain production. The 12 states on the left-hand side of the table had no significant difference in their per capita state domestic product, which was below the average for all India. Yet they had substantial differences in calorie intake per capita, which were related to their statistically significant differences in average food production. The same pattern is repeated for the four states with a per capita state domestic product above the average for India.

Similarly, Farnsworth found that 14 (developed) countries of Western Europe had a substantial range of variation in their per capita calorie consumption, which was not warranted by differences in per capita income (69). In a painstaking and

TABLE 5.1.—PER CAPITA CALORIE INTAKE, STATE DOMESTIC PRODUCT (SDP), AND PRODUCTION OF FOODGRAINS, 15 INDIAN STATES*

	States where per capita SDP is below all-India average	States where per capita SDP is above all-India average
States where per capita production of foodgrains is below all-India average		
SDP (*rupees*)	286.63[a]	450.80[b]
Production (*kilograms*)	146.13	146.80
Intake (*calories*)	2,311	2,213
States where per capita production of foodgrains is above all-India average		
SDP (*rupees*)	287.70[c]	451.31[d]
Production (*kilograms*)	218.24	299.34
Intake (*calories*)	2,640	2,871

*Data from the United Nations, Department of Economic and Social Affairs, *Poverty, Unemployment and Development Policy: A Case Study of Selected Issues with Reference to Kerala*, New York, 1975.

[a]The sub-groups of states are Assam, Bihar, Jammu and Kashmir, Kerala, Karnataka, and Tamil Nadu.

[b]The sub-groups of states are Gujarat, Maharashtra, and West Bengal.

[c]The sub-groups of states are Madhya Pradesh, Andhra Pradesh, Orissa, Rajasthan, and Uttar Pradesh.

[d]The sub-groups of states are Punjab (including Haryana).

meticulous manner, she proceeded to "correct" the data by accounting for a number of cross-country differences which might have affected calorie consumption—environmental temperature, body size, distribution of the population by age and sex, and physical activity. She concluded that adjustments for physical factors were not sufficient to explain the differences in per capita calorie consumption. The variation from country to country is still large—roughly from 115 percent of estimated requirements in Portugal and Norway to 138 percent in Ireland. Farnsworth examined another hypothesis to explain these differences—errors in the data. The consumption figures for more developed countries are likely to be more reliable than those for less developed countries. Similarly, the data for commercially marketed and processed commodities are likely to be better than the data for subsistence and self-consumed commodities. This hypothesis was also dismissed. Jones (69, p. 93) suggested a set of hypotheses which rely on socioeconomic differences such as national incomes (which he tested and rejected), national price structures and subsidies, customs, tastes, and national cuisines (which remain untested).

SELF-SUFFICIENCY AND NUTRITION

The caloric intake behavior described above may be related specifically to the operation of the agricultural sector. One mechanism is through the levels of foodgrain production, via prices, which tend to vary inversely with the quantity of output. The Kerala study controlled for prices without being able to explain the differences in caloric intake (*214*, p. 13). The failure of prices to provide an explanation may be the result of trade restrictions and controls which limit their role. At the international level, import or export prices and quantities may be controlled. Similarly a foreign exchange constraint plus price controls may work to limit caloric intakes when levels of domestic production are low, without a direct impact on prices. This is a case of trade inefficiency at the international level. At the national level, however, free trade usually exists. Then the trade inefficiency is introduced only if the price differentials which apply between grain-surplus and grain-deficit regions are not sufficient to cover the costs of distribution and to provide, on top, sufficient profit margins which would allow for the movement of foodgrains according to the regional disparities in incomes and production (*214*, p. 9). Such domestic trade inefficiencies may exist in many countries where governments attempt to control food prices.

The cases above describe trade inefficiencies which distort the operation of prices and which can be readily remedied by removing price controls. Another type of inefficiency, which is given much less consideration in economic circles, is the inefficiency of exchange. Trade and exchange are not costless since they involve the use of real resources. Consider the dynamics of population movements, as they apply in many contemporary LDCs, with migration from the countryside to the towns—often if only to increase the pool of the unemployed there. Next, real resources must be expended to move grains from the farms (where the people were in the first place) to the towns in order to feed the unemployed. The existence of a real resource cost for this exchange must imply that the same quantity of food would have fed the same people to a fuller extent

had they remained on the farms and had they produced it for their own consumption.[2]

This discussion suggests that caloric intake may be directly related to the volume of agricultural production at the household level and to its distribution across households. Given the volume of agricultural output and a fixed number of agricultural households, the more equal the distribution of agricultural production across households the greater will be the caloric intake per household. This argument of self-sufficiency as an explanation of the relationship between caloric intake and food production can also be reformulated in terms of income distribution.[3]

Suppose that a more equal distribution of income results in a higher level of nutrition. Furthermore, suppose that, in the agricultural sector, incomes were more equally distributed than in the non-agricultural sector, controlling for the fact that incomes are generally higher in the latter than in the former. One would expect to find higher levels of nutrition in regions with a higher food production per capita, on the assumption that these regions also have a relatively larger agricultural sector. If data on distribution were available for the two sectors, the hypothesis would be directly testable. In the absence of such data, the test must be indirect.

Table 5.2 presents state foodgrain production per capita, calorie intakes (separately for rural and urban areas), per capita incomes (agricultural and non-agricultural), and price of cereals for 15 Indian states for the period 1961/62. The discrepancies in incomes and prices between the two sectors are marked, and they are in the direction expected. The caloric intake per capita is consistently higher for rural areas. Furthermore, Table 5.3 provides the same classification as Table 5.1 with respect to per capita urban income and per capita foodgrain production. However, in Table 5.3 per capita caloric intake is correlated with both per capita foodgrain production and per capita urban income. This implies that the relationship which determines caloric intake per capita is different in the rural and urban sectors.

Both prices and the ability to pay (that is, the price and the income elasticity of demand) are significant when it comes to moving foodgrains from producing to consuming areas, or from the rural to the urban sector. The amount of the marketable surplus in the rural areas, on the other hand, is important when surpluses are being created to be moved to the urban sectors. The higher the per capita output of foodgrains, the larger the volume of the marketable surplus. Producers of foodgrains are themselves also consumers of foodgrains. While both large and small producers market a share of their output, the latter are often also purchasers of foodgrains. Since small producers have low incomes, and thus a severe income constraint, the net marketed surplus can be expected to increase with the size of the holding. Therefore one can expect that (a) the greater the

[2] The usual assumption, of course, is that the movement of labor out of agriculture allows the reorganization of farms on a larger scale, with efficiences of scale in production and a net addition to output and to marketable surplus. This may or may not be correct, as the discussion in Chapter VII will suggest.

[3] The following paragraphs draw heavily on the United Nations report (*214*, pp. 16 ff), although the interpretation of some relationships is new.

TABLE 5.2.—RURAL-URBAN DIFFERENCES IN PER CAPITA CALORIE INTAKE, INCOMES AND PRICES OF FOODGRAINS, 15 INDIAN STATES, 1961/62*

State	Per capita foodgrain production (*kilograms*)	Calorie intake per capita per day		Agricultural income per capita (*rupees*)	Non-agricultural income per capita (*rupees*)	Price of cereals (*rupees per seer*)	
		Rural	Urban			Rural	Urban
Andhra Pradesh	211.4	2,184	1,997	198	707	0.51	0.56
Assam	153.0	2,354	2,140	210	1,818	0.52	0.59
Bihar	159.9	2,541	2,330	136	1,137	0.49	0.56
Gujarat	75.9	2,503	2,115	238	841	0.44	0.56
Jammu and Kashmir	173.3	3,033	2,361	222	628	0.39	0.36
Kerala	61.1	1,631	1,554	204	937	0.46	0.57
Madhya Pradesh	287.7	2,910	2,162	198	811	0.39	0.45
Maharashtra	163.3	2,280	1,916	230	681	0.42	0.61
Mysore	174.4	2,758	2,046	222	1,076	0.44	0.54
Orissa	229.9	2,375	2,233	201	593	0.42	0.54
Punjab	310.4	3,076	2,156	313	1,395	0.40	0.50
Rahasthan	277.1	3,147	2,469	203	999	0.34	0.47
Tamil Nadu	169.2	2,147	1,934	208	601	0.52	0.61
Uttar Pradesh	190.0	2,854	2,162	233	736	0.40	0.45
West Bengal	150.4	2,175	2,040	229	1,193	0.58	0.61

*Data from United Nations, Department of Economic and Social Affairs, *Poverty, Unemployment and Development Policy: A Case Study of Selected Issues with Reference to Kerala*, New York, 1975.

TABLE 5.3.—PER CAPITA TOTAL CALORIE INTAKE AND CALORIES FROM CEREALS AND CEREAL SUBSTITUTES, 15 INDIAN STATES, URBAN SECTOR, 1961/62*

	States where per capita urban income is	
	below all-India average	above all-India average
States where per capita production of foodgrains is		
below all-India average		
Cereals (*calories*)	1,337[a]	1,478[b]
Total (*calories*)	1,975	2,040
above all-India average		
Cereals (*calories*)	1,515[c]	1,563[d]
Total (*calories*)	2,118	2,297

*Data from the United Nations, Department of Economic and Social Affairs, *Poverty, Unemployment and Development Policy: A Case Study of Selected Issues with Reference to Kerala*, New York, 1975.

[a]The sub-groups of states are Gujarat, Jammu and Kashmir, Maharashtra, and Tamil Nadu.

[b]The sub-groups of states are Assam, Bihar, Kerala, Karnataka, and West Bengal.

[c]The sub-groups of states are Andhra Pradesh, Madhya Pradesh, Orissa, and Uttar Pradesh.

[d]The sub-groups of states are Punjab (including Haryana) and Rajasthan.

inequality of land distribution, the lower the average calorie intake of producers, and (b) the lower the per capita output of foodgrains, the smaller the volume of marketed surplus. At least in the rural sector, incomes become relevant for the determination of caloric intake only with respect to the landless population, which is smaller, the more equal the distribution of land.[4]

This hypothesis is supported by the regression results estimated for the rural sector of 15 states of India (*214*, p. 18). The basic results are as follows (the numbers in parentheses being standard errors):

[4] The Kerala report proceeds to construct an additional argument of exchange inefficiency (*214*, p. 17). The movement of marketable surpluses to the urban sector, where both prices and incomes are higher than in the rural one, continues to the point where prices drop to the level at which they can no longer cover the costs of production and distribution. Beyond that point, there remain food deficits in the urban sector which are not covered. And, as a result, there remain marketable surpluses in the rural sector which become available to the landless rural population. Therefore, rural prices in surplus states tend to be low and to form higher calorie intake, even among the landless population, while in deficit states they tend to be high and consumption low. This situation reinforces the relationship between per capita food production and calorie intake discussed earlier.

Total calorie intake per capita =

4,216.44	constant
(616.07)	
-0.61	per capita agricultural income
(1.53)	
-580.09	coefficient of variation in land distribution
(150.37)	
-23.96	price of cereals
(9.23)	
+2.37	production of foodgrains per capita
(0.72)	

$$R^2 = 0.86.$$

It appears from these results that 86 percent of the inter-state variation in total calorie intake per capita is explained by the variables in the equation. Furthermore, the statistically significant variables are the production of foodgrains per capita, with a positive coefficient, and the inequality in distribution of land and the price of cereals, both with negative coefficients. The coefficient of per capita agricultural income is surprisingly negative, but the variable is not statistically significant.

The data from Kerala imply that raising the average levels of income may not be sufficient to combat undernutrition. Raising the standards of consumption requires in addition both an increase in the output of food and a reduction of inequities in the distribution of land. In Chapter VII the increase in agricultural production will be discussed with emphasis on the mode of operation around the small farms which is consistent with the land distribution conclusions reached here.

SUMMARY

In this chapter, the focus for the study of economic-demographic interactions is the agricultural sector because of its size and importance. In the typical LDC, most population growth takes place in the agricultural sector. Demographic variables, as a result, influence the growth and structure of the agricultural sector, including employment, output, and productivity. In this perspective, demography is an exogenous variable which interacts with agriculture, and the analysis becomes a special case of the discussion in Chapter IV.

This chapter was devoted to the indirect mechanisms which relate agriculture to population growth by emphasizing the ways in which demographic variables become endogenously determined in the operation of the agricultural sector. Agriculture has been singled out in the literature as the sector which exhibits special demographic behavior. The pattern of fertility rates in agricultural households may simply be the result of intervening variables, such as traditionalism and education, which are agricultural correlates. On this account exclusively, the discussion of economic-demographic interactions in Chapter III would also have covered the agricultural sector. It is suggested, however, that the causal ordering going from agriculture to demography extends beyond the existence of agriculture-specific values of intervening variables. Agriculture is

organized around a family-based way of life in which the agricultural households constitute farm-firm complexes combining both production and consumption decisions. Within this institutional framework, there is a definite intergenerational wealth flow. This characteristic of the sector is probably the basis of the distinct fertility behavior observed for agricultural households.

This special feature of the agricultural sector assumes significance for the study of economic-demographic interactions. It has been emphasized here that the conventional treatment of the topic has suffered from the use of partial approaches which have considered one set of variables—demographic or economic—as exogenous, while analyzing their impact on the other set. The proper approach, however, would be to consider both sets of variables as interdependent and as determined within a general framework. This can best be done by studying these interrelations within the micro-economics of the agricultural household which combines both production and consumption decisions. Unhappily, such an integration of the two sides of the agricultural household for the purpose of studying economic-demographic interactions has not been attempted in the literature.

In this chapter the impact of agriculture-specific variables on fertility declines has been examined and has been found rather weak. This is not because agriculture is irrelevant to population control. In fact, the reason is exactly the opposite. The agricultural sector, by its sheer size in most LDCs, characterizes the whole pattern and structure of development. The interrelationships between development and fertility declines examined in Chapters III and IV are fully applicable to agricultural development as well.

The strongest case made in this chapter for agriculture-specific variables is that of self-sufficiency in nutrition. Food self-sufficiency was approached from aggregate data by considering an index of land distribution along with other explanatory variables of per capita calorie intake. It remains to examine self-sufficiency with micro-analytic data and also at the national level. The latter is an especially arduous task in our times (*160*, p. 355):

> Self-sufficiency is not quite respectable in economic circles. The objective of a greater degree of self-sufficiency is, however, at the heart of national food and agricultural policies. As U.S. Senator Hubert H. Humphrey remarked: "The first duty of any government is to assure an adequate supply of food and fibre for its own people, and, once you have established that policy, then the arguments over exports, humanitarian assistance, and international assistance can take their proper place." First things first. And, in our economically and politically troubled times, what provenance of foods seems more assured to citizens than supplies from the farms of their own country?

The discussion of food self-sufficiency at the agricultural household level brings up the importance of income distribution for demographic policies—although from a partial, sectoral point of view. The implication is that, the greater the extent to which agricultural population participates in development, the greater and the earlier the decline in fertility. This hypothesis is consistent

with the overall importance of income distribution on fertility discussed within the context of the demographic transition in Chapter II. The hypothesis of income distribution, however, has not been tested rigorously for the agricultural sector, although some casual evidence has been accumulated (*125*, *179*).

CHAPTER VI. POPULATION GROWTH AND AGRICULTURAL EMPLOYMENT

Employment is a pivotal issue in the examination of economic-demographic interactions in the process of agricultural development. The level of employment is determined in the chain of causality which goes from demographic to economic factors. If unemployment is the manifestation of deficiency of demand, then population growth would generate more demand, thereby creating more employment. If, on the other hand—and this is more likely for LDCs—unemployment is a question of deficiency of supply and of constraints imposed by the lack of some complementary factors of production such as capital, technology, or natural resources, population growth tends to exacerbate the problem of unemployment. Employment is also a determining factor in the chain of causality which goes from economic to demographic variables.

Rural development affects fertility in at least five ways. First, fertility is affected by the change in agricultural income and in income distribution. Both factors are predicated upon the creation of additional and better employment opportunities in the farms, since employment is often a most effective means of income distribution. Second, the level of fertility is affected by the extent of modernization in the agricultural sector, which is partly reflected in the level of agricultural technology and innovations. Technology becomes viable only if it is adapted in such a way as to reflect the employment needs of a population. Third, development provides additional opportunities of employment for women outside the household, and on a part-time basis outside the agricultural sector. The evidence suggests that fertility is inversely related to the opportunities for paid female employment. Fourth, agricultural development influences fertility through the earning opportunities for children. The contribution of children to productive activities, both in agriculture and in the secondary and tertiary sector, is crucial for this link of development and fertility. Fifth, agricultural development affects fertility through education and modernization. Education is linked to the employment opportunities for the educated and to the availability of educational investment which is curtailed by overpopulation, poverty, and underemployment.

The views on the role of the agricultural labor force within the context of employment creation in the process of development have changed drastically in recent years (*232*, p. 198). The main preoccupation of the literature of the 1950s—the classical theory of labor surplus—was with meeting the need for additional manpower in the non-agricultural sector of a developing economy. In this task, agriculture was thought to play the role of "Custodian of a National Fund." It was assumed that the sector had for some time employed the resources available to it at the wrong factor intensities. More specifically, the sector employed labor to the point at which its marginal product was zero. With a minimum rearrangement of resources, therefore, agricultural labor could be transferred to the modern sector without any significant loss in agricultural output. The mobilization of surplus labor resources by the non-agricultural sector would set in motion an almost painless "up-by-the-bootstraps" process of development.

This basic viewpoint was not substantially changed as the neoclassical view of labor surplus gained prominence in the 1960s. The existence of labor with a zero marginal product in agriculture was dismissed. Instead, emphasis was placed on the divergence in wage rates between agriculture and non-agriculture, and this divergence was interpreted as evidence for the existence of a remediable dualistic disequilibrium. The remedy was the same as that prescribed in the 1950s—the transfer of labor out of agriculture—which would lead to optimality in resource allocation between the two sectors and to the "breakout" of economic development.

More recently, however, economists have come to the painful conclusion that most of the discussion of the two post-war decades has been irrelevant, because it addressed the wrong problem. The real issue is not how to meet the need for additional workers in the modern sector but, rather, how and where productive opportunities for employing the surplus and unemployed labor can be found. In their search for a solution, the Third World countries are gradually coming to the conclusion that their high population growth imposes a burden on the provision of employment—the "demographic investment" burden—which is entailed in taking care of the increase in population. As a result, employment policies are being geared to combining the objectives of "demographic investment" and "economic investment," that is, to contributing to the population's sustenance and also to the development and formation of capital which will improve the standard of living. In this scheme, the strategy of providing employment through integrated rural development holds center stage.

Some preliminary classificatory housecleaning with respect to the sets of employed and unemployed is necessary before proceeding with the discussion of the employment strategies available to the high-population-growth LDCs. It will become clear in this discussion that employment is indeed at the intersection of demographic and economic variables, since the sets of employed-unemployed are determined by demographic factors, such as the age structure of the population and economic factors, such as aspects of labor demand and supply.

CONCEPTS AND MEASUREMENT

It has been observed that some concepts of physics are simple and straightforward in comparison with the equivalent concepts of economics. Work is an example. A work task for a physicist is the utilization of energy to counter the entropy inherent in any system. Any system, left to itself and on the average, becomes less ordered—that is, changes toward a condition of maximum probability and represents a certain loss in information. Work, then, is the utilization of energy to generate order out of disorder, to increase the amount of information, and to decrease the stochastic elements which a system involves.[1]

A work task concept is sufficient for economics to handle labor from the demand side, that is, by describing labor's contribution to the process of production. It is inadequate, however, for describing the supply side of labor.

[1] For a simplified exposition of the second law of thermodynamics (entropy law) see Commoner (47, Ch. 2). For parallels of the entropy law with economics, see Georgescu-Roegen (80).

People do not exist solely for the purpose of providing work in the most efficient manner. On the contrary, work is a means toward living a purposeful and fulfilled existence. As a result, it makes sense for an individual to supply less work than he is physically capable of. And it makes sense, also, for society to allocate the work tasks to more individuals than would be warranted if task efficiency were the sole objective. Furthermore, even on the demand side alone, the relation between people and work task becomes more involved in economics. Tractors operate in fixed proportions between horsepower and gasoline. The British Thermal Unit energy task available from a tractor's horsepower is readily definable, and the only question is whether it was applied efficiently or wastefully. Individuals survive and work on variable proportions of energy inputs—say calories—and their levels of nutrition determine to an extent the energy which they produce in a given work task. The relation between nutrition and work effort has not yet been fully incorporated in the economics of production and the attempts to review that literature from an economist's standpoint are very recent.[2]

Before the detailed discussion of the problems arising in the measurement of employment and unemployment, some data for 1975 which provide a rough idea of the magnitude of the problem are presented in Tables 6.1 and 6.2. The labor

TABLE 6.1.—LABOR FORCE, 1975*
(*in millions*)

Regions	Total	Urban	Rural
Developed countries			
Asia and Oceania[a]	64		
Northern Europe[b]	37		
Western Europe[c]	65		
Southern Europe[d]	67		
North America[e]	104		
Total	337		
Less developed countries			
Asia[f]	461	86	375
Africa[g]	140	28	112
Latin America	97	65	32
Oceania	2	—	2
Total	700	179	521

*International Labour Organization, *Employment Growth and Basic Needs: A One World Problem*, Geneva, 1976, and International Labour Organization and Food and Agriculture Organization, unpublished data.

[a]Australia, Japan, and New Zealand.

[b]Denmark, Finland, Ireland, Norway, Sweden, and United Kingdom.

[c]Austria, Belgium, France, Federal Republic of Germany, Netherlands, and Switzerland.

[d]Greece, Italy, Portugal, Spain, Turkey, and Yugoslavia.

[e]Canada and United States.

[f]Excluding China and other Asian centrally planned economies.

[g]Excluding South Africa, which is included in developed countries.

[2] For a review of the available evidence see Bliss and Stern (21).

TABLE 6.2.—UNEMPLOYMENT AND UNDEREMPLOYMENT, 1975*
(in millions)

Regions	Unemployed						Underemployed						Total					
				Total	Urban	Rural				Total	Urban	Rural				Total	Urban	Rural
	Total	Urban	Rural	(*percent of labor force*)			Total	Urban	Rural	(*percent of labor force*)			Total	Urban	Rural	(*percent of labor force*)		
Developed countries																		
Asia and Oceania[a]	1.3			2.0														
Northern Europe[b]	2.1			5.7														
Western Europe[c]	2.9			4.4														
Southern Europe[d]	2.7			4.0														
North America[e]	8.1			8.1														
Total	17.1			5.2														
Less developed countries																		
Asia[f]	18	6	12	3.9	6.9	3.2	168	20	148	36.4	23.2	39.5	186	26	160	40.3	30.1	42.7
Africa[g]	10	3	7	7.1	10.8	6.2	53	7	46	37.9	25.1	41.1	63	10	53	45.0	35.9	47.3
Latin America	5	5	—	5.1	6.5	—	28	14	14	28.9	22.8	43.8	33	19	14	34.0	29.3	43.8
Oceania	—	—	—	—	—	—	1	—	1	49.0	—	49.0	1	—	1	49.0	—	49.0
Total	33	14	19	4.7	8.0	3.7	250	41	209	35.7	23.3	40.1	283	55	228	40.4	31.3	43.8

*International Labour Organization, *Employment Growth and Basic Needs: A One-World Problem*, Geneva, 1976, and International Labour Organization and Food and Agriculture Organization, unpublished data.

[a]Australia, Japan, and New Zealand.

[b]Denmark, Finland, Norway, Sweden, and United Kingdom.

[c]Austria, Belgium, France, Federal Republic of Germany, Netherlands, and Switzerland.

[d]Greece, Italy, Portugal, Spain, Turkey, and Yugoslavia.

[e]Canada and United States.

[f]Excluding China and other Asian centrally planned economies.

[g]Excluding South Africa, which is included in developed countries.

force estimates of Table 6.1 are based on the age definition (15 to 65) used by the International Labour Organization, and these are given separately for urban and rural areas in the DCs and LDCs. The People's Republic of China and the other centrally planned economies are excluded from the table. Table 6.2 provides estimates of unemployment and underemployment for the same categories as Table 6.1. The concept of the unemployed, as explained below, rests on the objective factor of not having work, and on the subjective factor of "actively looking for work." Underemployment is defined in terms of having a job which is not full time. These definitions, as will be demonstrated, most probably lead to an underestimate of the magnitude of the problem. Still, the ominous extent of unemployment, and especially of underemployment, in LDCs is clear from the data. As expected, unemployment is higher in the urban than in the rural sector, averaging for both the sectors in LDCs 4.7 percent of the total labor force. The same is the case with underemployment, which amounts to a total of 35.7 percent of the labor force in LDCs. The total of unemployment and underemployment in LDCs for the urban and rural sectors averaged a staggering 40.4 percent of the labor force. The discussion of the concepts and of measurement of employment and unemployment which follows suggests that Table 6.2 may represent just the tip of the iceberg.

Dependency Ratios

The inextricable combination of the demand and supply elements of labor for the definition of the labor force and of employment and unemployment and the ambiguities which arise are discussed with the aid of Chart 6.1. It is convenient and customary to distinguish the set of dependents in a population and to define the dependency ratio as the ratio of population under 15 and over 65 to the population in the working age brackets—15 to 65. This is a purely demographic statistic. Since it is the birthrate which largely determines the structure of the population tree, the relationship between birthrates and dependency ratios is direct. Some typical values of this relationship are the following (9):

	DCs	LDCs
Population growth rate (*percent*)	1.0	2.3
Dependency ratio (*per 100*)	57	80

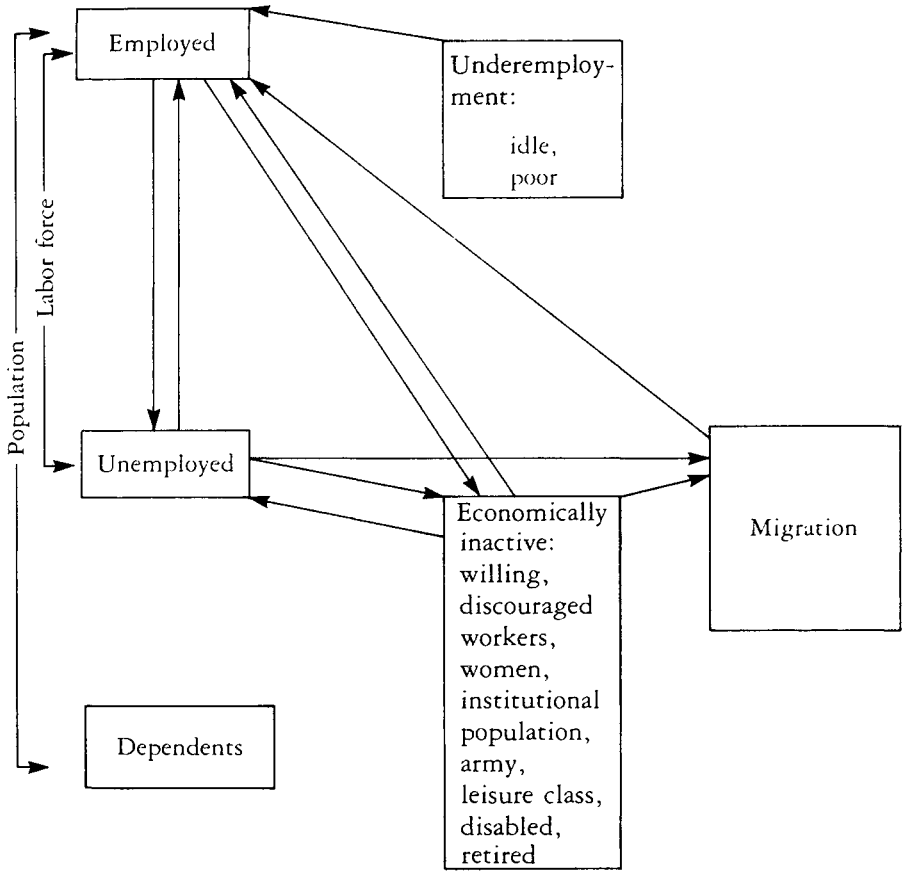
Both high and low birthrates are associated with high dependency ratios—the former because the population is too young (too many people below 15), and the latter because it is too old (too many people over 65).

Labor Force

The population of working age is the starting point for determining the labor force. It is combined with the objective circumstance of whether one is holding a job or is seeking work, and, expressed as a ratio of a given population group, it defines the participation rate. Given the size and the age structure of the population, the participation rate determines the labor force.

Participation rates vary according to levels of economic development, the type of economic activity, the age-sex composition of the population, and other such

CHART 6.1.—A CLASSIFICATION OF EMPLOYMENT AND UNEMPLOYMENT



characteristics. On the average these rates range between 0.25 and 0.50 as indicated in Table 6.3, which also shows significant discrepancies between participation rates for DCs and LDCs, and between males and females. This deserves further comment in order to demonstrate the ambiguity of labor force statistics (232, p. 200).

A variety of factors, both economic and non-economic, objective and subjective, combine to explain the variation in labor force participation rates. The younger the population (that is, the higher the proportion of dependents below 15 to total population), the lower the average labor force participation rate. The age composition of the population is, then, a systematic factor which determines the participation rate. The sex composition introduces another systematic factor. Childbearing confines women at home for long periods, so the relationship between female labor force participation and fertility rates is inverse. Non-economic factors, such as social customs and conventions, also tend to reduce the labor force participations of females, especially in LDCs. As incomes rise, more opportunities for female employment will be created outside the household and

TABLE 6.3.—AGE- AND SEX-SPECIFIC PARTICIPATION RATES, ESTIMATES FOR 1965*
(*percent*)

Age group	Males		Females	
	Less developed countries[a]	Developed countries[b]	Less developed countries[a]	Developed countries[b]
0-14	6.5	1.3	4.0	0.8
15-24	78.1	70.2	36.9	47.8
25-54	96.3	96.1	40.1	40.3
55-64	86.8	82.6	29.2	30.1
65+	57.5	30.0	14.5	9.2
Total (weighted)	53.2	58.3	22.9	26.8

*Table from J. N. Ypsilantis, "World and Regional Estimates and Projections of Labor Force," United Nations, Geneva, 1966.

[a]Less developed countries exclude Sino-Soviet countries, OECD countries, and Southern Africa, Australia, and New Zealand.

[b]Developed countries exclude Sino-Soviet countries.

within the structured labor markets, and this will be recorded as an increase in participation rates. Participation rates, therefore, are among the demographic variables which cannot be projected into the future on the assumption that they are exogenous to the level of development. On the contrary, they are determined in the process of interaction between economic and population factors.

THE DYNAMICS OF LABOR FORCE GROWTH AND REPLACEMENT RATES

The rate of increase in population and the participation ratio are the two basic parameters which determine the labor force. With given birthrates, death rates (and therefore the age-sex structure of the population), and age-sex-specific participation rates, the change in the labor force is measured as the net effect of: (a) the new entrants into the labor force at any point in time as a result of the vegetative growth of population; (b) the depletion by deaths of members of the labor force; and (c) the depletion by retirements from the labor force, again as a result of the vegetative growth of population. The result of these three effects defines the replacement rate of the labor force, and the ratio of total entrants (d) to total exists (b + c) can be expressed so as to show the number of workers who replace 100 exits from the labor force at any point in time.

An illustrative example for stable population is given in Table 6.4. In Table 6.4 the effects of two alternative gross reproduction rates—3.0 and 2.0—are traced upon the replacement rate for the male labor force on two different assumptions of life expectancy at birth and assuming two different age-specific participation rates. These rates are representative of LDCs and DCs. The "young" population with a gross reproduction rate of 3.0 is characterized by relatively large numbers of entrants into the labor force (about 25 percent higher

TABLE 6.4.—ANNUAL REPLACEMENT RATES FOR THE MALE LABOR FORCE IN STABLE POPULATION MODELS WITH ALTERNATIVE RATES OF FERTILITY, MORTALITY, AND LABOR FORCE PARTICIPATION*

	Gross reproduction rate	30 years life expectancy at birth		50 years life expectancy at birth	
		Less developed countries participation rates	Developed countries participation rates	Less developed countries participation rates	Developed countries participation rates
1. Entrants into the labor force (*per*	3.0	37.1	37.6	41.0	41.0
1,000 active males)	2.0	27.5	28.8	30.3	31.4
2. Retirements from the labor force (*per*	3.0	0.9	3.3	1.3	3.9
1,000 active males)	2.0	1.7	5.0	2.3	6.0
3. Deaths (*per 1,000*	3.0	22.1	22.1	10.9	10.2
active males)	2.0	26.6	25.1	13.8	12.1
4. Replacement rate	3.0	14.1	12.2	28.8	26.9
(1-2-3)	2.0	−0.8	−1.4	14.2	13.3
5. Ratio	3.0	160.0	150.0	340.0	290.0
$[1 \div (2+3)] \times 100$	2.0	100.0	100.0	190.0	170.0

*Data from United Nations, *The Determinants and Consequences of Population Trends*, New York, 1973, p. 320.

than the "old" population with a gross reproduction rate of 2.0). Correspondingly, the young populations have fewer deaths of members in the labor force and fewer retirements from it. A lower life expectancy is associated with a greater number of deaths of members in the labor force for both high and low reproduction rates and with a decrease in exits by retirement, and also in entries into the labor force. But the latter effects are greater for old populations than for young ones. Finally, the modal participation ratios presented in Table 6.3 show significant differences only at the upper age cohorts of populations of DCs and LDCs. As a result, the main impact of differential participation ratios appears in retirements from the labor force, and is more pronounced for the young populations. The combination of these effects which appears in the replacement ratio at the bottom of the table shows the dramatic impact which the law of vegetative population growth alone can have upon the labor force. For the young population, for example, an increase in life expectancy at birth from 30 to 50 years results in replacing every 100 exits from the labor force with 160 and 340 new entrants, respectively. The populations with a gross reproduction rate of 2.0, on the other hand, exactly replace 100 exits assuming a 30 years' life expectancy, while they replace them with 190 entrants if life expectancy is 50 years.

In the foregoing analysis of the replacement rates, the participation ratio has been treated as a relatively stable parameter, the effects of which were actually swamped by other parameters in Table 6.4. This is not always correct, since, as already indicated, the participation rate should more appropriately be viewed as a variable related to the level of development and to job availability. In fact, the concepts of employed (those who work for a minimum number of hours during the week "in gainful employment") and of unemployed (those who are not working, but are "actively looking for work") involve a great degree of ambiguity and subjective considerations which may make the participation rate meaningless. This is because, in between the dependents (or the economically inactive population) and the labor force, there are three special groups which straddle the fence dividing the already employed and the clearly unemployed. They are: (a) the "willing," people who are not actively seeking employment, but who would be willing to work under the right circumstances; (b) the "idle," people who worked, for example, less than 36 hours in a week; and (c) the "poor," people who are fully employed in a job which does not provide minimum subsistence (*128*). These groups deserve special examination.

The Economically Inactive and the Willing

Between the dependents and the labor force, and outside both of them, lies the category of the economically inactive population. The relevant box in Chart 6.1 lists a number of groups coming under that heading. Toward the bottom of the classification are listed the people who have definitely withdrawn from the labor force—people in institutions, the rich who enjoy idleness, lazybones who have an exclusive taste for leisure, the disabled, those permanently retired from the labor force for reasons of taste rather than age, and so forth. Near the top of the ranking, however, the classification changes in favor of individuals who are economically inactive by forced choice—a situation which is an attribute of the demand side of labor. The people in "hidden unemployment," for example, or the "discouraged

workers," are persons outside the labor force, as commonly measured, but who would be willing to enter if they believed market opportunities were favorable.

The basic reason why discouraged workers are not employed, and are not looking for work, is a gap between the wage rate expected from work and the actual rate in the labor market. It may well be that the labor demand side is mainly responsible for that gap. This is the case for groups which face additional barriers to employment. Mothers with young children to care for would have accepted a suitable part-time job if it were available. It is also possible that the supply-of-labor side is more influential in determining the set of discouraged workers. The mother with young children attaches a high reservation price to her services, one which would enable her to cover at least the cost of the housekeeper or of the nursery that she will have to provide for her children. Most commonly it is the combination of demand and supply elements which operates in the case of discouraged workers.

An important group among the discouraged workers constitutes those who can afford unemployment and also have a good reason to entertain higher expectations from the labor market. They are the young who can still find support within the family, especially those who are overeducated for the jobs which an economy makes available. Turnham reports the results of two sample surveys for urban areas in India and Germany (*210*, p. 42). In the former, 55 percent of the males in age group 16-17, and 26 percent in the group 18-21, declared themselves as "students" and as not having held one or more hour's work during the census week. Among the females, 60 percent in the age group 16-17, and 75 percent in the group 18-21, declared themselves as "homemakers." By comparison, only 17 percent of German males and females in the age group 16-17, and 8 percent in the age group 18-21, classified themselves as students. In a situation of excess supply of school graduates, as in India, the student is a discouraged worker who will at first linger on the fringes of the labor force by prolonging his education.

The discouraged workers deserve special emphasis, because eventually they are likely to enter the labor force and to be counted as employed (by displacing marginal workers, if necessary) or as unemployed. If the latter, measured unemployment will increase. Alternatively, if the discouraged workers enter the labor market and find employment, this is unlikely to be reflected immediately in a corresponding decrease in the unemployment rate. This is shown in Chart 6.1 by the arrows going directly to the employment and to the unemployment set from the box of the economically inactive. The time taken for the discouraged workers to enter the labor force depends on the speed of adjustment of their expectations and on the objective improvement of available employment opportunities. One way for people in hidden unemployment to seek to improve their opportunities for obtaining a job is by migrating to another labor market. The implications of this type of migration—a migration which involves this fringe category rather than the involuntary unemployed—could be profound for the agricultural sector, as will be seen below.

Three conclusions emerge from this conceptual examination of hidden unemployment (*232*, p. 202):

> First, to the extent that the available labor force statistics do not include hidden unemployment, the magnitude and importance of the unemploy-

ment problem may have been substantially underestimated. Second, an improvement in the objective labor market conditions will not be reflected in a decrease in unemployment as long as the new jobs go to people who were previously in the hidden unemployment group. Only the size of the labor force will increase. Third, since the hidden unemployed may consist of individuals with superior education and other background characteristics, it seems likely that it may be these discouraged workers and not the openly unemployed who will migrate. If so, the role of migration as an equilibrating force that would tend to drain the pool of the unemployed and equalize wage rates may have been greatly exaggerated.

Underemployment: The Idle, the Poor, and the Additional Worker

The neat separation of the labor force into the groups of employed and unemployed is obscured by the existence of some special groups among the economically inactive such as the discouraged workers. It becomes even more murky if one also considers the set of underemployment. This is composed of people who are technically employed, but in fact not fully employed, either because of the duration of work, or the efficiency of work, or the income from work. Consideration of criteria other than the dichotomous standard of work-nonwork introduces symptomatic normative elements into the usual "labor force approach" to employment.[3]

From the point of view of the duration of employment, the component of "visible underemployment" may be distinguished which involves the people who are involuntarily working part-time or for shorter than usual periods of work (*100*). This distinction between part-time and full-time employment is especially important in traditional and seasonal occupations such as the large agricultural sector in LDCs. Self-employment within the farm-firm structure of agriculture leads to work sharing and leisure rationing among the family members rather than to open unemployment. Adjustments for the peaks and troughs of seasonal activities are likely to occur by lengthening or shortening the hours of work. An implication of the poverty content of underemployment is the existence of the additional worker, the individual who takes up paid work to supplement family income. A largely untested hypothesis suggests that as job prospects and family incomes improve the additional worker will withdraw from the labor force and participation rates will decline. This is indicated in Chart 6.1 with the arrow which goes from the unemployed set to the economically inactive category.

PROBLEMS OF MEASUREMENT OF AGRICULTURAL LABOR FORCE AND AGRICULTURAL EMPLOYMENT

Problems of measurement of employment and unemployment are compounded when applied to agriculture, and, as a result, ambiguities abound in relation to measuring agricultural employment and underemployment. The following specific sources of confusion can be mentioned (*154*, *185*).

[3] For a summary of the labor force approach, the labor efficiency approach, and the symptomatic approach, see Standing (*198*).

First, macro-data are more easily available for rural than for agricultural populations, and for this reason the two concepts are often confused. Rural population is commonly measured as the residual of total population minus urban population, which is based on the criterion of residence. Agricultural population, on the other hand, is defined as the sum of the persons who have been identified as working or seeking work in agriculture (including forestry and fisheries) and their non-working dependents. The two concepts of rural and agricultural overlap with urban and non-agricultural and their pairwise combinations. It is necessary, therefore, to resort to the concept of employment in order to derive an estimate of the agricultural population.

Second, the concept of employment is itself involved and complex. It becomes even more tenuous when applied to agriculture because the usual mode of operation in that sector is household-firm complexes. Employment is defined in terms of three components: involvement in actual work or an active search for work; involvement in "gainful employment for others or on one's own account" (which includes assisting in the production of marketable goods and services); and involvement which extends over a minimum number of hours in the week preceding the census. Among other things, the usual problems of production, consumption, and social activities, and the problem of how to treat services arise when the concept of employment is applied to the agricultural sector (*110*, Ch. 1). Additionally, given the seasonal nature of agriculture, the duration of work for qualifying one as employed or being within the labor force becomes an issue. Moreover, the treatment of family members arises as a special problem. The international convention is to regard family workers as "unpaid family workers assisting in the operation of business or farm" and belonging to the labor force, with the proviso that they work at least one third of normal hours (*101*). This apparently rules out much of the handicraft and building activity performed within the family system, which, as a result, escapes the market exchange test.

Given the unavailability of data, estimates of the agricultural population can rely only on the sum of employed and unemployed, that is, on the concept of the labor force, no matter how ambiguous and incomplete that may be. Naiken and Schulte have devised a method for the indirect measurement of agricultural population (*154*). It is based on estimating the behavioral relationship between agricultural labor force and agricultural population, and using it as a proportionality constant. The assumption is made that the overall participation rates in agriculture and non-agriculture are equivalent. One may question the validity of such an assumption on the grounds that women and children participate in farm work to a greater extent than they do in non-agricultural activities. However, the effect of that bias on estimates of the overall participation rates may be offset by the fact that there is a high proportion of children in agriculture because of higher fertility rates. Furthermore, in LDCs with commonly large agricultural sectors, the measured overall participation rates are likely to reflect more closely the agricultural participation rates, owing to the considerable weight carried by the sector. In any event, the relative stability of the relationship has been established empirically (*185*). Having obtained estimates of the economically active in agriculture and overall, the authors multiply the inverse of the overall participation ratio (economically active divided by total population) by the economically active in agriculture to obtain an estimate of the agricultural population.

The method solves the problem of estimating agricultural population at the expense of lumping agricultural employment and unemployment together and by taking the participation rate as a constant deduced largely from overall economic variables. While this is the best that can be done with aggregate data, a detailed picture of the agricultural employment situation—which is necessary for the formulation of meaningful employment policy—must ultimately rely on micro-analysis at the household level. The reason is that, given the institutional organization of agriculture, employment and unemployment are the two extremes in a continuum rather than two mutually exclusive alternatives. The following discussion of agricultural underemployment illustrates this point by focusing on the problem of the idle and the poor which assumes special importance in the agricultural sector.

Underemployment in Agriculture: The Idle and the Poor

The problem in the urban areas and in the non-agricultural sector is one of unemployment. In agriculture, the concept of open unemployment becomes tenuous, and its measurement, for groups other than the landless workers, has questionable relevance. The labor force approach commonly applied to measure unemployment has only limited usefulness in agriculture which is organized in farm-firm complexes.[4] In situations of self-employment the nexus between employer and employee, which when broken defines unemployment, does not exist. The condition of actively looking for work which defines the unemployed is hardly ever met. The length of the work week depends more on the seasonal labor requirements than on some normal standards and full employment is less a concern within the household than is the attempt to share work among the able bodied. As a result, a rich literature has developed around the concept and the measurement of labor underemployment in agriculture.

This vast literature will not be reviewed here.[5] Instead selective aspects of the duration and efficiency of work and of the income from work will be highlighted.

The evidence on agricultural underemployment is based either on the labor force approach or on the labor utilization approach, and suggests that visible underemployment on a year-round basis—the situation of people working involuntarily part-time or for shorter periods than they would have wished—is not as serious a problem in family-operated agriculture as was once believed.[6] Underemployment is the inevitable result of the pronounced cyclical pattern of agricultural activities. The pronounced peak labor requirements of the planting or harvesting season can be met by one of four ways (or a combination thereof). First, part of the labor force can be kept in reserve in visible underemployment during the trough seasons of agricultural activities. Second, the economically inactive population can be drawn on to meet the peak season labor demands. Third, the operations involved in the peak season activities can be mechanized. Should permanent employment opportunities exist in other sectors, the social

[4] For a comprehensive discussion of the deficiencies of the labor force approach to LDCs, see Myrdal (*152*, Vol. II, pp. 994 ff.).

[5] For recent reviews of this topic, see Jones (*110*, especially Ch. 2), Singh (*192*), and Turnham (*210*).

[6] For some evidence on this matter, see Turnham (*210* pp. 61 ff).

cost of maintaining underemployed labor in agriculture to handle peak demands is high. But so is mechanization, which leaves specialized capital idle for the whole year in order to handle the peak season work requirements. A fourth possibility would be to reduce the specialization of the work force so that workers from other occupations can help ease the seasonal shortages of agricultural labor. From this point of view, the prototype of the "Maoist Man" serves well the needs of a basically agricultural society—and so do the harvest brigades in Cuba and the bussing of urban workers to the farms in Tanzania. Perhaps by a reduction in labor specialization and compartmentalization, the peak labor demands in different sectors can be met at minimal social cost. The benefits of labor specialization in production, long taken for granted, may deserve more careful study in LDCs.

The efficiency-of-work criterion of underemployment and the income criterion recently have been receiving more attention than the duration-of-work criterion. The low productivity in agriculture or the mismatch of skills may be responsible for workers working full-time without meeting minimum subsistence. In fact, overemployment may be the initial effect of overpopulation and poverty, as people try to assure subsistence or to maintain the conventional standard of living. Boserup observed: ". . . when the growth of population in a given area of pre-industrial subsistence farming results in lower average output per man-hour in agriculture, the reaction normally to be expected would be an increase of the average number of hours worked per year so as to offset the decline in returns per man-hour" (*24*, p. 45).

The evidence that exists on participation rates confirms that at low income levels, there is more likelihood of agricultural overemployment. The negative relationship between participation rates in agriculture and income levels was first documented by Chayanov, who pointed out that the non-participation of women and children in the more affluent households was something which could be afforded (*37*). The converse is true for non-agriculture, where in general the participation of women has been increasing with the secular increase in incomes, especially for DCs (*25*).

A comparison of female labor force participation ratios in agriculture and non-agriculture at different levels of development is especially instructive. Durand has defined five levels of development, based on an index which uses energy consumption per head and percent share of the non-agricultural sector in total employment of the labor force (*58*). Data of female participation ratios for an international cross section reveal that female non-agricultural employment is U-shaped as the level of development increases. Female agricultural participation rates are consistently lower than non-agricultural ones at all levels of development, with the exception of the lowest, where female participation ratios in agriculture are 50 percent higher than in non-agriculture. This research should be further pursued with careful measurement of participation ratios and representative definitions of the levels of development, and it should also be complemented by careful distinctions between the stages of demographic transition. It would then be possible to test not only for the relationship between levels of income and female labor force participation in agriculture, but also for the multiple relationship between participation rates, income, and fertility rates. Boulding has advanced an interesting hypothesis which involves the three variables (*27*, p. 54):

> Most of the material on family planning . . . [has] made assumptions about women as partners in couple relationships, about the presence of families and about male breadwinners, whereas some of our hardest core food and population problems are in areas where women are heads of households. In Africa, up to 70 percent of the farming is done by women. The picture that we have to build up here is of women producers who are not getting the agricultural assistance that male farmers are getting. These are women who, in some areas, have to spend between two and four hours a day simply carrying water; who spend a minimum perhaps of one hour a day carrying wood for fuel. These are women's jobs. During the planting season, women spend 15 hours a day in the fields on top of their other work. There aren't enough hours in the day for the number of things that have to be done. Country by country, there are numbers of farms where women are carrying heavy work loads unaided. They may be widowed; if they have husbands, these men may be working in the cities or in the mines, on plantations, or they may be cash cropping their own farms. But they are not raising the food; the subsistence patch is woman's work. Any way you look at it, this constant hard core of labor to raise food for subsistence is largely being carried out by women unaided . . .
>
> There are areas in Africa where anywhere from one-quarter to 40 or 50 percent of the farms are run entirely by women . . . then you have to look at the need of the women for extra hands to help her. And so this phenomenon of exhausted women breeding malnourished babies should be identified as a systems process that needs help. Women would surely like to bear fewer babies, but they must breed their own helpers. To offer them contraceptives without offering them at the same time help in the shape of seeds, fertilizer, intermediate-technology tools, and advice, doesn't deal with the problem. Women have to get their work done. Therefore the limitation of family size has to be linked to agricultural aid directed at women.

The hypothesis stated goes beyond the relationship between poverty, participation rates, and overemployment. It concentrates on female labor force participation rates and introduces fertility increases as a means to reduce the amount of work which falls on the backs of the women in poverty-stricken agriculture. No solid evidence for this hypothesis is readily available. Yet it deserves careful consideration because it has potentially important policy implications. Should Boulding be correct, it may well turn out that "the best contraceptive is the wheelbarrow"!

Migration Off the Farms and the Economically Inactive in Agriculture

The previous discussion attributed major importance to the economically inactive in agriculture in the process of planning agricultural development. That discussion also signalled the importance of certain groups among the economically inactive, especially the people in hidden unemployment and the discouraged workers, in the dynamic examination of the size of the labor force and in the analysis of the migration flows. Agriculture is par excellence the sector which becomes most sensitive to the existence of such groups. Yet the groups of the

willing and the discouraged workers have been largely overlooked in the study of agricultural development.

The reason for this neglect lies in the traditional model of migration which is posited to link the agricultural with the non-agricultural sector. A number of dual economy models (232, p. 230)

> build on the initial disequilibrium between agriculture and nonagriculture and describe how equilibrium is being restored, primarily through labor transfers.[7] A particular view of how the labor market works underlies this analysis. It is based on assuming that it is the marginal workers who are transferred, that is, who migrate.
>
> Agriculture is assumed to employ large numbers of low-wage workers and nonagriculture small numbers of higher-wage workers. The marginal workers transfer out of agriculture, thus increasing wages and per capita incomes in the low-wage sector. At the same time, they increase the supply of labor to the high-wage sector, decreasing wages and per capita incomes there. Through the operation of the leveling force of migration, the dualistic features of the economy atrophy and agriculture becomes appended to nonagriculture in terms of rates of growth and development potential. This marks the end of the dual economy.

This particular view of migration as a mechanism which tends to restore equilibrium in the long run is not congruent with at least three phenomena consistently observed in recent historical experience. First, there are generally high rates of migration from the agricultural to the non-agricultural sector. Second, these migration flows persist unabated despite the fact that unemployment in the urban areas is tending to increase. Third, and despite the high unemployment rates, the wage differentials between agriculture and non-agriculture are maintained, if not increased, and the sectoral dualism becomes accentuated. Because the willing and the discouraged workers are crucial in explaining these phenomena, the equilibrating role of migration off the farms needs to be re-examined.

Data on the precise magnitude of rural-urban migration flows do not exist and the best available evidence on the matter is indirect. It is usually compiled by comparing size of population by region (and, even better, by age, sex, and other characteristics) for different time periods. The rate of growth of a population is composed of the natural rate of growth (the difference between the birth and death rates) and the migration component. A composite rate of growth of a population which far exceeds the natural rate of growth measured, or the physiologically maximum possible rate of growth (which is placed between 3.5 and 5.0 percent) provides evidence for substantial migration inflows. The general trend for most world regions since 1950 has been for population growth in urban areas to exceed that in rural areas by one and one-half to six times, despite the fact that the natural rate of increase in population in the rural areas is usually greater than that in the urban ones. Such high rates of urban population growth

[7] For examples of models of dualistic development, see Lewis (142), Ranis and Fei (175), Fei and Ranis (71), Jorgenson (111, 112, 113), Paauw and Fei (165), Kelley, Williamson, and Cheetham (117). For a review of the surplus labor literature, see Kao, Anschel and Eicher (114).

could obviously not be achieved except through a massive exodus from rural areas (*32*, *232*, Ch. 13). Similar comparisons of the annual rates of growth of urban population and total population for selected countries, as well as the proportion of urban population born elsewhere, are presented in Table 6.5. On the assumption that the natural rate of growth of urban and total population is the same in the absence of migration, migration is then calculated (from the difference between columns 5 and 4) to account for 30 to 60 percent of urban population growth in the period 1960-70. This estimate is most likely an underestimate, since the natural rate of growth of the urban population is lower than that of the rural population and therefore it should also be lower than the rate of growth in total population.

Comparative data on wage rates in the various sectors are subject to grave measurement problems. The limited comparability of wage rates earned in different sectors under different conditions makes it unwise to present a specific set of estimates lest the numbers be taken too literally. However, the general conclusion from the available evidence is that urban-rural wage differentials are large (*193*), especially in terms of sectoral per capita income, rather than constant over time in relative terms, and slightly increasing over time in absolute terms (*160*, *81*, *209*, *95*). What is perhaps even more remarkable is that the stability or even widening of the wage gap is taking place at the same time as measured (open) unemployment rates are rising dramatically. Another feature consistent with wage inequalities is the persistence of, or even increase in, agricultural and non-agricultural dualism which has been observed in an increasing number of studies on poverty.[8]

An alternative interpretation of migration is proposed here, consistent with the features of increasing disequilibrium which are observed after strong migratory movements. The willing, or the discouraged workers, play an important role in the migration-disequilibrium hypothesis. In this alternative interpretation it is not mainly the unemployed and the marginal workers who migrate, as the traditional approach suggests, but essentially two other categories. The first one comprises those workers who currently hold jobs and would like to improve their lot. In order to do so, they must quit their jobs and move to a labor market which has a relatively greater variance in jobs and in wage distributions. In other words, it is not the mean wage rate but rather the variance around the mean which attracts the migrant, since he wants to take his chances at the upper side of the job distribution. The migrant then will move to the large job markets, since the larger the market the greater tends to be the variance of the job distribution.

The other neglected category of migrants includes the discouraged workers. They are not the unemployed, since they do not belong in the labor force. They migrate in an attempt to close the gap between expectations and realizations, or the gap between their qualifications and the skills required in the jobs available. These are overqualified workers, who also tend to flow to the large job markets characterized by relatively great variance in job and wage distribution.

The first implication of this typology of the migrant is that measured unemployment does not necessarily decrease in the place of origin—at least not to the extent that discouraged workers are involved. Furthermore, the average product

[8] For examples, see Adelman and Morris (*4*) and Chenery et al. (*38*).

of labor in the place of origin is likely to decrease rather than increase as the traditional approach would imply. Currently employed inframarginal workers among the migrants will be replaced by the unemployed marginal workers—thus bringing the average product down. This decrease will also be reflected in lower per capita incomes, but less so to the extent that some of the population decrease is also due to the departure of the discouraged workers among the inactive, who by definition contributed nothing to output.

In the place of destination, the impact of migration is likely to be equally disequilibrating. Unemployment is bound to increase—unless the rate of job creation is greater than the net rate of migration. Furthermore, since the migrants did not come from the unemployed or from the marginal workers of agriculture, they are not the marginal job seekers in the non-agricultural sector either. They are likely to find jobs rather readily, if only by replacing less qualified workers. The latter workers will filter down the job ladder, until the marginal workers lose their jobs. This process, which is triggered by migration, may eventually lead to an increase in the number of unemployed and unemployables in the urban sector.

The migration of inframarginal workers from agriculture leads to an increase in non-agricultural unemployment, yet this increase is unlikely to put pressure upon wage rates. By the same token, it will not lead to a decrease in per capita income which could culminate in the elimination of the dualistic disequilibrium between the two sectors. Most likely, only the income distribution will change, and will become more skewed.

This result of the model relies on the introduction of an alternative view of how the job markets work (207). In the traditional wage-competition model, individuals compete against each other on the basis of wages which are endogenously determined by the marginal productivity of labor. In the job competition model, on the contrary, individuals are considered to compete for jobs, and the wage rates are determined by the marginal productivity of the job, which is largely determined by exogenous factors such as the amount of capital which works with labor on a specific job. More precisely, it is not the marginal productivity of the worker which determines the wage rate carried by the job, but the marginal productivity of the job which determines the wage rate to which a worker will be fitted. Wages are paid according to the characteristics of a job. For example, one characteristic is the amount of capital employed in a job task. Non-marginal increases in the quantity of capital will increase the productivity of a job. As a result, workers who are hired for a capital-intensive job will be brought up to a higher wage rate to match the productivity of that job, rather than workers who are hired for a non-capital-intensive job.

How are workers hired to fill a certain job? And why does competition in the labor market not bring wages of high-paying jobs into equality with wages of low-paying jobs? Workers come into the labor market with a set of background characteristics that determine each individual's relative position in the labor queue. Position in the labor queue in turn determines each worker's probability of finding a job, conditional on the job opportunities for which he competes. The employers, in other words, fill job vacancies from the top of the queue, with the best jobs going to the workers with the best set of background characteristics.

In the job-competition model, workers do not come to the labor market

TABLE 6.5.—URBAN POPULATION GROWTH AS INDIRECT EVIDENCE ON MIGRATION FLOWS IN SELECTED COUNTRIES*

Countries	Ratio to total population: Year (1)	Ratio to total population: Percent (2)	Period (3)	Average annual growth rate: Total population (*percent*) (4)	Average annual growth rate: Urban population (*percent*) (5)	Proportion of urban population born elsewhere: Year (6)	Proportion of urban population born elsewhere: Percent (7)
Mexico							
(1) Urban places 2,500 and over	1970	59	1960-70	3.3	4.8	1970	22
			1950-60	3.1	4.9		
(2) 25 largest cities (100,000 and over in 1970)	1970	37	1960-70		4.9	1970	29
			1950-60		4.9		
(3) Mexico City metropolitan area (8.6 million in 1970)	1970	18	1960-70		5.1	1970	37
			1950-60		5.1		
Brazil							
(1) Urban places (administrative definition)	1970	56	1960-70	2.8	5.0	1970	40
			1950-60	3.2	5.5		
(2) Rio de Janeiro (4.3 million in 1970)	1970	5	1960-70		2.8	1970	42
(3) Sao Paulo (5.2 million in 1970)	1970	6	1960-70		5.1		
Ghana							
(1) Towns 5,000 and over	1970	29	1960-70	2.4	4.8	1960	70[a]
			1948-60	3.6	9.2		

(2) Accra (.6 million in 1970)	1970	7	1960-70		5.0		
			1948-60		8.2		
Tanzania							
(1) Largest towns (19,000 and over 1971)	1967	4	1967-71	n.a.	4.7	1971	84[a]
			1948-67	2.5	6.8		
(2) Dar es Salaam (.3 million in 1971)	1967	2	1967-71		3.3	1971	84[a]
			1948-67		7.5		
Kenya							
(1) Urban places 2,000 and over	1969	10	1962-69	3.4	7.1		
(2) Nairobi (.5 million in 1969)	1969	5	1962-69		15.2[b]	1969	76
Korea							
(1) 32 urban places 50,000 and over	1970	41	1960-70	2.3	5.5	1970	50
(2) Seoul (5.5 million in 1970)	1970	18	1960-70		7.8	1970	57
India							
(1) Urban places 5,000 and over	1971	20	1961-71	2.2	3.3	1961	39
			1951-61	2.0	2.7		
(2) Metropolitan areas 100,000 and over	1971	10	1961-71		4.1		
			1951-61		4.0		
(3) Calcutta	1971	1	1961-71		2.0		
(4) Bombay	1971	1	1961-71		3.7		
Pakistan							
(1) Urban places 5,000 and over	1972	26	1961-72	3.6	4.8		
(2) Metropolitan areas 500,000 and over	1972	10	1961-72		4.9		

*Data from Y. L. Yap, "Internal Migration in Less Developed Countries: A Survey of the Literature," World Bank, Development Economics Department Working Paper No. 215, Washington, D.C., 1975.

[a]Adults (15 and over) only.

[b]African population only.

endowed with labor skills that allow them to enter directly in the production process. Most cognitive skills—knowledge of where to report for work, how to use the tools, and how the specific work establishment functions—are acquired through formal or informal on-the-job training. Employers use the background characteristics—previous experience, education, sex, age, and intelligence tests—to judge the trainability of the worker. By hiring workers with the best set of background characteristics, the employer minimizes his training costs. And the lower the training costs, the more skill characteristics, general or specific to the job, the employer will be able to generate with the given worker. Since the marginal product of capital depends on the quantity and quality of labor with which it is employed, employers will want to generate more job skills than workers will want to buy (for example, by paying for on-the-job training by accepting lower wages). As a result, employers will undertake on-the-job training even if they have to pay for most of it. And they will also try to minimize the cost of such training.

The willing and the discouraged workers, in a process of self-selection, have become the prime candidates for migration out of the agricultural sector. Since they are the inframarginal individuals, the people with superior background characteristics, they will land at the top of the labor queue of the non-agricultural sector. They will be the first to fill the vacancies available, or they will displace workers who are less qualified in terms of their set of background characteristics. And yet the availability of these new entrants to the non-agricultural labor force will not depress wages. On the contrary the labor market will match those trainable individuals with training opportunities. And the amount of on-the-job training required to bring these workers up to the marginal productivity of their jobs will be endogenously determined.

The test of this alternative view of migration lies in identifying the migrants and the unemployed in the cities. With respect to the former question, the implication of the traditional hypothesis is that the marginal workers migrate. As a result they are also likely to be found at the fringes of the urban sector and in informal activities. Yap presents evidence that questions this prediction (*228*). After defining the informal sector through a number of alternative criteria it was found that the proportion of migrants there does not exceed that of the non-migrants.[9]

With respect to the latter question, it is commonly assumed that the newly arrived migrants constitute the bulk of the unemployed in the cities. The probability of employment variant of the traditional hypothesis views migration as a two-step process, from the rural sector to urban unemployment and then to an urban job. However, evidence summarized by Yap and presented in Table 6.6 suggests that this is not the case (*228*). Most migrants find jobs remarkably quickly, and some jobs are even prearranged. This is true for both city-wide migrant samples, and for samples drawn from the marginal fringe of the city. In the poor sections of Santiago, for example, 47 percent of migrants found jobs immediately and 91 percent found jobs within three months of their arrival. Similar patterns are also noted for Buenos Aires and Rio de Janeiro in the table.

[9] For example, see Zachariah (*234*, Table 12.1) and Merrick (*146*) for Brazil, Webb (*218*) for Peru.

TABLE 6.6.—TIME REQUIRED FOR MIGRANTS TO FIND FIRST JOB IN CITY*

City	Sample description	Cumulative percentage finding work within: Percent		Time period
City-wide samples				
Santiago, Chile[a]	Economically active migrants who arrived in Santiago within previous decade	43		Immediately (2 days)
		66		1 month
		85		6 months
Brazil: six cities, including Rio and Sao Paulo[b]	Adult migrants	*Male*	*Female*	
		85	74	1 month
		95	90	less than 6 months
Seoul, South Korea[c]	Household heads, of whom 80 percent are migrants	26		Immediately (pre-arranged)
		64		Soon
		76		6 months
Lima, Peru[d]	1967 survey of migrants	Over 75		3 months
Rural-urban sample				
Tanzania: urban areas[e]	Males who moved from rural areas to urban areas after the age of 13	80		3 months
		Over 90		6 months
Poor sections of city				
Santiago, Chile[f]	Family heads or their wives in a *callampa* settlement, 85 percent manual laborers or self-employed artisans	47		Immediately
		91		3 months
Buenos Aires, Argentina[g]	Residents of a *villa miseria*, mostly recent migrants, 61 percent day laborers or unskilled workers	74		2 weeks
		85		1 month

TABLE 6.6.—TIME REQUIRED FOR MIGRANTS TO FIND FIRST JOB IN CITY* (CONTINUED)

City	Sample description	Cumulative percentage finding work within: Percent	Time period
Rio de Janeiro, Brazil[h]	Residents of three *favelas*:		
	(a) those with experience in unskilled urban or rural work	85	1 month
	(b) those with previous skilled jobs	65	1 month

*Data from Lorene Y. L. Yap, "The Attraction of Cities: A Review of the Migration Literature," *Journal of Development Economics*, 4, September 1977, pp. 239-64.

[a]B. Herrick, *Urban Migration and Economic Development in Chile*, Massachusetts Institute of Technology Press, Cambridge, 1965.

[b]B. Hutchinson, "The Migrant Population of Urban Brazil," *America Latina*, 6, 1963, pp. 41-71.

[c]M. G. Lee, "The Facts Behind Seoul's Exploding Population," Seoul National University, unpublished paper, n.d.

[d]Organization of American States, Inter-American Committee on the Alliance for Progress, *Urbanization in Metropolitan Lima-Callao*, 1969.

[e]H. Barnum and R. H. Sabot, "Education, Employment Probabilities, and Rural-Urban Migration in Tanzania," unpublished paper, n.d.

[f]Economic Commission for Latin America, Santiago, 1963.

[g]G. Germani, *Inquiry into the Social Effects of Urbanization in a Working Class Sector of Greater Buenos Aires*, United Nations Economic and Social Council, 1958.

[h]J. Perlman, "The Fate of Migrants in Rio's Favelas: The Myth of Marginality," unpublished Ph.D. dissertation, Massachusetts Institute of Technology, 1971.

Moreover, the aggregate unemployment rate for migrants is usually lower than for urban natives (*155*, p. 16). Finally, the earnings of migrants, after controlling for age, education, sex, and race, are at least equal and in some cases significantly higher than the average earnings of their urban-born counterparts (*227*).

The difference between the two alternative views of migration is fundamental when their respective implications are considered for migration policy and for evaluating the social effects of migration. According to the traditional approach, migration is an equilibrating process and thus should be encouraged (or at least treated with benign neglect) as benefiting both sectors. But according to the competing view, migration becomes the source of persistent disequilibrium and thus should be planned and controlled to prevent increases in existing inequities and distortions. If migration is indeed a disequilibrating factor, the parallel which Hirschman has drawn with connoisseur goods and quality deterioration becomes apposite (*93*, Chap. 4). When general conditions in a neighborhood deteriorate, for example, the residents who will move out first are those who valued most highly such qualities as cleanliness, safety, schools, and neighborhood character. These residents have many alternatives, and they will seek the lost qualities in other high-priced neighborhoods. By analogy it may be precisely the inframarginal workers—the professionals with high opportunity cost—who are the first to leave the traditional sector of a dual economy. Hirschman has taken the analogy one step further. Remedial mechanisms in a number of situations, such as quality deterioration, require the articulation of customer disaffection by politically powerful, quality-minded consumers. Should the analogy be correct, the migration of relatively well trained individuals who could otherwise also exercise political pressure may contribute to further increasing the cleavage between development in the advanced sector and in the traditional ones. The more upward the social mobility, and the freer the migration, the more marked the economic and social dualism may become.

The inevitable policy conclusion drawn from this disequilibrium view of migration favors investment in the "rural turf" by keeping especially well-qualified workers in place. This can only be done by fragmenting and damming up the economy (as will be suggested in Chapter VII). As a policy approach, this is diametrically opposed to the investment-in-the-human-agent view of migration which entrusts the spread of development to the operation of the "invisible foot" (*86*).

SUMMARY

There are three main themes in this chapter. First, rural development affects fertility significantly through employment creation. Second, employment in general and agricultural employment par excellence are at the intersection of demographic factors (such as the age-sex composition of the population) and economic factors (such as objective and subjective considerations of labor demand and labor supply). Third, migration, a salient feature of the agricultural sector, is related to agricultural employment in a way which has definite disequilibrium characteristics. Instead of contributing to growth and to the spread of development across sectors, migration may be contributing to increasing dualism and inequalities.

The conceptual analysis of the labor force and of the measurement of employment and unemployment signalled the importance of some groups which are considered among the economically inactive and, as such, are excluded from the labor force. The willing and the discouraged workers are, however, only temporarily out of the labor market, that is, until the objective opportunities of obtaining a job improve or until there is a change in their subjective considerations with respect to a desirable job. The existence of these groups, which seems to be substantial both in DCs and LDCs, introduces certain disequilibrium characteristics into the operation of the labor markets. This mechanism explains how it is possible, controlling for population, to observe both the level of employment and unemployment increasing simultaneously, a phenomenon which is becoming more common in recent years.

The existence of the willing and the discouraged workers can also explain the disequilibrium features which recently have been observed in connection with migration. As long as it is not the marginal workers who migrate in search of jobs, but either inframarginal workers or individuals better qualified who come from the fringes of the labor force, there is no a priori reason to expect that migration will insure the spread of development or lead to the elimination of dualism. Precisely the converse would be predicted by a disequilibrium migration model. The policy implication of this hypothesis is that development will be promoted by damming up the economy, not by fostering free and unlimited movement of resources.

The discussion of employment, and especially of the economically inactive in relation to agriculture, highlights certain special problems in the sector which may become the source of persistent disequilibria. A final conclusion is that micro-analysis is crucial for the study of development and demographic interactions in agriculture.

CHAPTER VII. AGRICULTURAL CONSTRAINTS ON POPULATION GROWTH

The previous chapter examined the indirect mechanisms relating agriculture to population growth. This chapter is devoted to the "old aspect" of the population problem, wherein agriculture checks population growth through starvation and famine. Another way of viewing the Malthusian dilemma is to consider an increase in food supplies as a self-rewarding aim—the only means of averting famine. This approach is the direct analogue to the analysis in the previous chapter, wherein agricultural growth is considered as a means of achieving fertility declines.

The first part of this chapter is devoted to gauging the recent record of world agriculture against the record of population pressure. This assessment of the "World Food Crisis," however, does not propose to provide yet another complacent or alarmist exercise in futurology. It is intended, on the contrary, as an introduction to a critical evaluation of the views which have long considered agriculture as the handmaiden of industry. It also serves as a springboard for discussing certain radical changes which might have to be considered lest agriculture turns in the long-run into the calamitous Malthusian positive check to population. Discussion of these changes in the second part of this chapter is related to the self-reliance findings presented in Chapter V and to the discussion of agricultural employment in Chapter VI.

A GLOBAL VIEW OF FOOD BALANCE

A convenient and analytically manageable way to examine the balance between world agricultural development and population growth is to concentrate on grains. Except for the poorest countries of the tropics and sub-tropics where starchy root crops are the staple commodity, grains are the major source of caloric intake in most LDCs. In fact, at a relatively low level of subsistence, grain consumption is a good proxy for nutritional adequacy. In DCs, grains again feature prominently in the human diet. The only difference is that (coarse) grains are consumed indirectly, having been fed to a rather inefficient protein converter—the ruminant stomach.[1]

To further simplify the analysis the food (grain) balance sheets will be employed here. The distinct disadvantage of the balance sheet approach, which is cast in terms of food availabilities and requirements, is that it ignores the role of prices by assuming implicitly that the price elasticity of demand is very low, or even zero. This assumption may be sufficiently realistic at low levels of income where adequate nutrition is barely attained by the direct consumption of grains. At higher income levels, however, where there is substantial indirect consumption of grains in the form of meat, milk, or eggs, an increase in the price of grains would lead to lower animal protein production and consumption, and thus to a decrease in grain requirements. The role of price elasticities, which may have been rather important in the 1973-75 food episode in the United States and other

[1] The "shrinkage" of cereals in the process of conversion to animal protein is substantial. A kilogram of choice beef requires 7 kilograms of grain and a kilogram of chicken, 3.5 kilograms of grain.

DCs, will be largely neglected. On the other hand, the income elasticity of demand will be at least partly recognized, as long as increases in incomes result in substitution of indirect for direct grain consumption.

A convenient way to compose a picture of the world grain balance sheet is to begin with population figures and consumption requirements, as adjusted to reflect the income elasticity of demand for grains. A comparison of consumption with production figures gives an idea of grain stocks, which represent a contingency reserve. Food crises occur when stocks are depleted to a critically low level. As grain prices rise sharply, the situation becomes a matter of serious political concern. The crisis is invariably forgotten with a good monsoon.

The world's population is currently about 4 billion, of which three-quarters live in LDCs. Annual population growth in LDCs increased from 1.9 percent in 1950 to 2.5 percent in the mid-1960s, and has continued at that level. In the DCs, on the other hand, population growth was relatively stable at 1.3 percent per year in the 1950s, but declined in the 1960s to 0.9 percent. The world's total population is increasing annually by about 70-85 million, or at an average rate of about 1.8 to 2.0 percent.

The annual grain requirements of the additional population can be estimated fairly easily. They may be called "hold-the-line" requirements, since they have nothing to do with eliminating malnutrition or improving diets. Annual grain requirements simply maintain the status quo, and they are different for LDCs and DCs, since the current levels of grain consumption differ. The estimates for LDCs can be carried out by using 165 kilograms of grains per year as a baseline figure for per capita consumption. This represents a minimum for adequate nutrition of 1,620 calories (or 450 grams of grain) per day. As an alternative baseline figure, 180 kilograms of grains per year is employed, which is the best per capita consumption that the LDCs have achieved, on the average, in the recent past (1969-71). The hold-the-line annual incremental requirement for LDCs, based on these calculations, is anywhere from 10.0 to 13.5 million metric tons, as shown in Table 7.1.

Per capita consumption of grains in the DCs is higher because of the greater indirect consumption in the form of animal protein. Estimated on the basis of the average figure of 550 kilograms per year, the DC hold-the-line incremental requirement amounts to another 5.0 million metric tons.[2] The global annual requirement is therefore shy of 20 million metric tons.

The hold-the-line requirements estimated so far refer exclusively to feeding additional mouths. They do not account for the increase in grain consumption which attends the general improvement in income levels—which will be called the "affluence requirement." For basic foods in general which have relatively low income elasticities of demand, this may be considered negligible. But grains are a basic food only when consumed directly. At higher income levels, improvements in diet take the form of a shift from carbohydrates to animal protein consumed as meat, dairy, or poultry products, a shift which is reflected in an increase in indirect consumption of grains. A value of 0.5 is considered as a reasonable

[2] The variance in per capita consumption in DCs is significant. For example, the average per capita consumption of grains in the United States is 850 kilograms, five times the amount necessary for adequate nutrition if grain is eaten in the form of cereals.

TABLE 7.1.—ESTIMATES OF INCREMENTAL ANNUAL GRAIN REQUIREMENTS, 1970S
(millions of metric tons)

	Level of per capita grain consumption (*kilograms/year*)	Hold-the-line requirements at rates of growth of population			Affluence requirements[a] at rates of growth of			
					GDP[b]		GDP per capita[c]	
		2.5	2.0	0.9	4.4	5.6	1.9	4.3
Less developed countries[d]								
High	180	13.5	10.8	—	11.8	—	5.1	—
Medium	172	12.9	10.3	—	11.3	—	4.9	—
Low	165	12.4	9.9	—	10.6	—	4.7	—
Developed countries								
High	850	—	—	7.6	—	23.8	—	18.3
Medium	550	—	—	5.0	—	15.4	—	12.1
Low	400	—	—	3.6	—	11.2	—	8.6

[a]Income elasticity of demand for grains of 0.5 was assumed for both DCs and LDCs.
[b]The rates of growth of GDP of 4.4 and 5.6 for LDCs and DCs, respectively, are the 1960-69 averages, weighted by population.
[c]The rates of growth of per capita GDP of 1.9 and 4.3 for LDCs and DCs, respectively, are the 1960-69 averages, weighted by population.
[d]The population of 3,000 million was used as a base for the calculations.
[e]The population of 1,000 million was used as a base for the calculations.

estimate of the income elasticity of demand for grains (*31*, p. 4; *181*, p. 506).

The choice of an estimate for the expected annual rate of growth in income may pose more problems. Still, as a working estimate, the population-weighted average rate of growth for the period 1960-69 can be employed which was 4.4 and 5.6 percent for the LDCs and the DCs, respectively (232, p. 5). A more conservative estimate is based on the observed per capita rate of growth for the same period, which was 1.9 percent for LDCs and 4.3 percent for DCs. As shown in Table 7.1, the alternative assumptions employed suggest an affluence requirement on the order of 20 million metric tons per year for both LDCs and DCs.

These admittedly rough estimates are intended to give an impressionistic picture of the order of magnitude involved in the world food balance. They provide two important benchmarks for short-run policy making. The hold-the-line minimum necessary to feed the annual increase in population is 20 million metric tons of grains. At the production levels of the early 1970s, it represents an increase of about 2 percent per year. If the annual increase in grain output were to fall below that figure, a "food crisis" would ensue—unless the shortfall could be made up from stocks. A more generous estimate also includes the affluence requirement of 20 million metric tons, or another 2 percent of output per year. This figure is more flexible than the hold-the-line requirement, since shortfalls in supply can be cushioned, for example, by diverting coarse grains from animal feed to human consumption, and thereby decreasing the affluence requirement.

It must be emphasized that these estimates are conservative, since they involve projections from past trends, and they are based on assumptions which would maintain the status quo. Eliminating severe malnutrition which, according to the estimates of the United Nations Food and Agriculture Organization, affects 500 million people, would require further increases in grain supplies plus redistributive schemes between DCs and LDCs and between income groups within each country.

THE INGREDIENTS OF FOOD CRISES

In Table 7.2 and Chart 7.1 what at first glance appears a reassuring picture is presented. Since 1961 world grain output has been increasing at the rate of 2.5 percent each year. This is higher than the average rate of population growth, and it has been reflected in the increase in per capita production of 0.92 percent per year for DCs and 0.20 percent per year for LDCs. It would seem that the hold-the-line minimum requirements in grain production which are necessary to feed the world's increasing population have been met, with a small margin to spare. This margin provides a rather narrow contingency reserve to cushion the world against periodic food crises.

Since 86 percent of the annual increase in population takes place in LDCs, most people are born in countries where there is only a slight improvement in per capita production. Furthermore, disaggregation within the LDC group would suggest that some countries have been achieving less than the average figure of 0.2 percent of the annual increase in per capita production. A supply of food per capita close to the low levels of the previous years (on which the 1961-65 index in Chart 7.1 is

TABLE 7.2.—WORLD PRODUCTION, CONSUMPTION, TRADE, AND STOCKS OF MAJOR GRAINS, 1970-77*
(million metric tons unless otherwise indicated)

Marketing year	Area harvested (*million hectares*)	Beginning stocks[a]	Production	Total exports	Total consumption[b]	Ratio of stocks to exports
1960/61	660.8	168.1[c]	854.0	76.4	842.8	2.40[c]
1961/62	653.0	180.3[c]	825.1	87.5	850.5	2.26[c]
1962/63	659.0	153.9[c]	880.4	85.5	877.2	1.96[c]
1963/64	664.7	157.1[c]	872.2	102.5	883.5	1.66[c]
1964/65	675.5	151.9[c]	931.6	100.4	928.1	1.65[c]
1965/66	669.2	155.4[c]	928.0	116.7	963.8	1.42[c]
1966/67	670.2	129.8	1,005.2	108.0	977.6	1.20
1967/68	681.1	157.4	1,031.8	104.7	1,013.8	1.50
1968/69	687.8	175.4	1,070.9	96.6	1,038.7	1.82
1969/70	687.8	207.6	1,038.6	110.2	1,092.1	1.88
1970/71	675.9	193.5	1,094.6	117.7	1,132.8	1.64
1971/72	682.4	155.3	1,182.4	121.6	1,165.9	1.28
1972/73	675.6	171.8	1,151.2	149.4	1,195.7	1.15
1973/74	699.6	127.3	1,251.5	159.2	1,247.3	0.80
1974/75	702.7	131.4	1,213.3	145.7	1,209.6	0.90
1975/76[d]	722.6	121.7	1,217.2	160.8	1,215.5	0.76
1976/77[e]	734.7	123.5	1,289.8	152.6	1,261.5	0.81

*Data from United States Department of Agriculture, Foreign Agricultural Service, "Foreign Agricultural Circular," 1976.

[a]Data on stocks are not available for some important countries such as the People's Republic of China and parts of Eastern Europe. The aggregate stock levels have been adjusted for estimated year-to-year changes in U.S.S.R. grain stocks, but may not include the entire absolute level of stocks for that country.

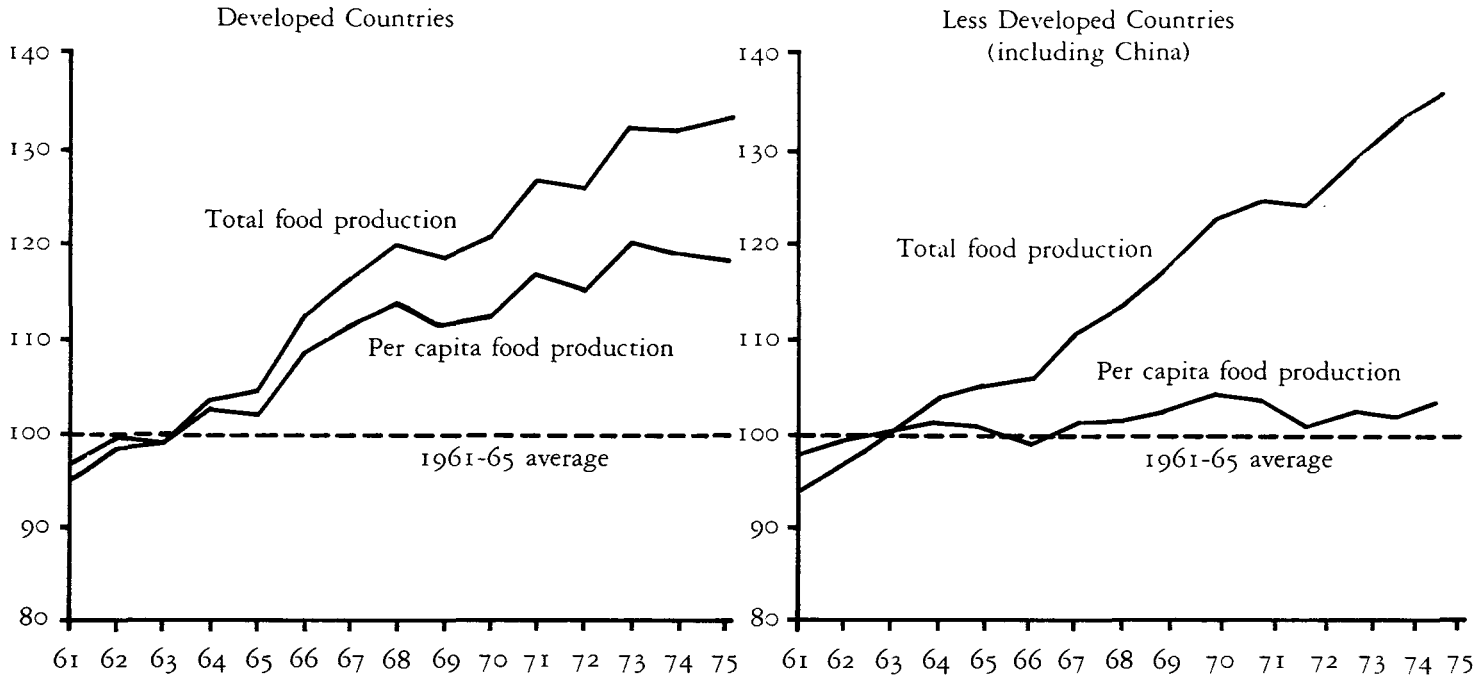
[b]For countries for which stock data are not available, or for which no adjustments have been made for year-to-year changes, consumption estimates assume a constant stock level.

[c]Stocks figures and stocks-to-exports ratios do not include rice and are therefore underestimates.

[d]Preliminary.

[e]Projection.

CHART 7.1.—TOTAL AND PER CAPITA FOOD PRODUCTION IN DEVELOPED AND LESS DEVELOPED COUNTRIES, 1961-75*



*Data from Data Bank of United Nations, Food and Agriculture Organization, Rome, n.d.

based) can turn into real hunger or famine for some groups.[3] To avert that situation, some LDCs have been relying progressively more on grain imports to meet their systematic food gaps.

Periodic production shortfalls could also lead LDCs to rely on imports in order to meet their minimum hold-the-line grain requirements. If there is a random shock in production (because of weather or other factors) affecting a number of countries simultaneously, the slim margin of the annual improvement in production may turn into a global deficit which could place heavy demands on trade.

On the basis of the calculations in Table 7.1 more than one-half (and perhaps as much as two-thirds) of the annual affluence incremental requirement of 20 million metric tons originates in DCs. The balance of the affluence requirement coming from LDCs also originates in countries and in groups whose incomes are growing. This makes the affluence requirement qualitatively different from the hold-the-line requirements which mainly originate in LDCs. In situations where the annual increase in production is not sufficient to cover both the minimal requirements and the affluence requirement at stable prices, is it possible for rising affluence to impose restricted diets on the poor by crowding out their demands? And, conversely, is it possible that foregoing meat by the rich would free grains for the hungry?

The answers to these questions are not simple. Whether the crowding-out argument has any validity depends in part on the relevant price elasticities of demand. Suppose that the poor, who can hardly further reduce their caloric intake, have a low price elasticity of demand for grains; while the rich, who can readily reduce indirect grain consumption, have a high price elasticity of demand. Under these assumptions, the affluence incremental requirements will be less fully met in years of short supply, as compared to the hold-the-line requirements. In this event, famine is averted at the price of changing the grain consumption mix of some in favor of direct consumption and against the consumption of meat, milk, or eggs. On the other hand, if the poor, with their severe budget constraint, have a unitary price elasticity of demand for grain or, even a higher elasticity than one, while the rich in their determination to improve their diets have inelastic values, the affluence requirement is satisfied relatively more fully, while the consumption of the poor declines. In this case, crowding out does indeed occur.

An analysis of the record of the last few years suggests that the factors identified above are in fact operative. First, a number of LDCs have become increasingly dependent on imported grains, signalling a growing inability to hold the line and to produce enough food for their growing numbers. Second, given the slim margin of contingency reserves, a random shock in production can grow into a veritable food crisis. Third, some crowding out has occurred which, when combined with a random shock in the levels of production, has roused the specter of famine.

A manifestation of the disproportionate growth in per capita food production in the world is found in Table 7.3. North America and Oceania emerge as the

[3] In 53 out of a total of 86 LDCs, the increase in food production was less than that in domestic demand in the period 1952-72. Furthermore, in 34 of these countries, the increase in food production failed to keep up with population growth (19, p. 3).

TABLE 7.3.—NET TRADE IN CEREALS BY WORLD REGIONS, 1934-74*[a]
(*millions of metric tons*)

Region[b]	1934-38	1948-52	1961-65	1970-74
Developing regions	+13.6	− 2.2	−15.5	−29.4
Asia	+ 4.2	− 2.8	−14.0	−22.2
Africa	+ 0.4	− 0.2	− 3.7	− 7.3
Latin America	+ 9.2	+ 0.8	+ 2.2	+ 0.4
Developed regions	−12.6	+ 2.3	+18.4	+32.1
North America	+ 5.4	+23.4	+48.8	+70.6
Oceania	+ 2.8	+ 3.4	+ 6.7	+ 9.4
Western Europe	−23.0	−22.0	−26.0	−21.3
Eastern Europe and U.S.S.R.	+ 5.0	+ 2.0	− 4.0	−14.0
Japan[c]	− 2.0	− 3.0	− 7.9	−17.7

*Table from Walter Pawley, "Population Aspects of Agricultural Development and the Impact of FAO on Population Policy Issues," Rome, 1976, mimeograph.

[a]Net exports (+) and net imports (−) of all grains excluding rice.

[b]Not all regions are included, so that: (i) totals for developing and developed regions do not add to zero; (ii) totals for individual regions do not add to totals of regional groups.

[c]Includes a small figure for Israel.

predominant sources of imported grain for the LDCs of Africa and Asia, as well as for Western Europe and the U.S.S.R. While the LDCs were slight net exporters of grain in the early 1950s, they rapidly became substantial net importers, and imports averaged 20 million metric tons annually by 1969-71 rising to 30 million metric tons in a difficult year, such as 1973 (*217*, p. 526).

The review of the grain record of the last 20 years from the point of view of trade and stocks indicates the factors that can turn a shortfall in production into a food crisis. There have also been periodic shocks in world production of grains in the past, and these are identified in Table 7.2. For instance, there was a shortfall in the grain crop in the Soviet Union in 1963 (of roughly 30 million metric tons) and another in 1965 (of 24 million metric tons). There was also in India a drought in 1965-67 which led to a serious crop failure. The world food situation became momentarily tense, but world grain prices remained relatively stable. The Russian shortfall was met largely by cutting consumption, and the Indian failure by importation of grains on a concessionary basis. An important buffer in the 1960s was the accumulation of substantial grain stocks in the United States, Canada, and Australia (Table 7.2), as a result of the attempts to maintain farm incomes in these countries by providing agricultural price supports.

The experience of managing serious shortfalls in production without visible effects on price, plus the optimism about the potential of the Green Revolution, created a climate of general euphoria about the world food situation which permeated the late 1960s and continued into the early 1970s. The world grain stocks were more than twice the levels of annual world grain trade of the early

1960s. Stocks began to decline slowly as the DCs, primarily the United States and Canada, adopted policies to eliminate food surpluses by severely cutting acreage. In the early 1970s, the stocks-to-trade ratio was approaching one, and since 1973 the annual grain stocks have been lower than the annual grain exports.

The simultaneous timing of serious crop failures and the conscious efforts to reduce grain stocks was uncanny. The 1972 droughts lowered world grain production by 3 percent. This decline was the first serious (absolute) decrease in a decade. Grain production fell by about 32 million metric tons, of which 16 million metric tons were the result of the Russian shortfall. In contrast to the policies in the 1960s, the U.S.S.R. this time decided to make up the deficit through imports which, combined with those of Eastern Europe, rose to 28 million metric tons as compared to the approximate 4 million metric tons of normal years. This crowding out of the LDC hold-the-line requirements in order to satisfy the incremental affluence requirement in the U.S.S.R. resulted in a decline of carry-over stocks in major countries and a doubling of the price of grains.

The same situation was repeated in 1974/75. Droughts led to a decline in output by 40 million metric tons, most of it in the United States and the U.S.S.R. Given the low levels of stocks, wheat prices rose from $60 to $200 per ton, and rice prices from $130 to more than $500 per ton between 1972 and 1974. This price picture, oddly enough, was one silver lining in the situation. The other was that about two-thirds of the shortfall was in coarse grains. Because of the price increase, the coarse grains fed to livestock in the United States fell by 32 million metric tons in 1974/75, and a good deal of it was shipped overseas for direct consumption in order to avert famine (87). As a result, the crowding out did not occur.

This brief foray into the historical record of world grain supplies suggests three lessons. First, food supply for LDCs in general is rather precarious. The hold-the-line increment in grain requirements is met on the average by domestic production, but, since the contingency margin left to meet the incremental affluence requirement is very small, several large LDCs have turned to heavy reliance on imports to meet their grain requirements. Second, when shortfalls in production occur on a global scale, as in the mid-1960s and early 1970s, the precarious balance can turn into food crises. In these cases, the LDCs' hold-the-line increments in grain requirements can easily be crowded out by the incremental affluence requirement of the DCs. Third, given the present levels of grain stocks and the annual necessary hold-the-line and affluence requirements, significant grain shortfalls in large LDCs or in those DCs who are important producers and traders cannot be readily met without leading to a food crisis.

The final point to be emphasized is that the periodic food crises of the recent past do not indicate an inability of the world to produce sufficient amounts of grain on a global scale. Rather, they are associated with the increasing reliance on trade to supply the grain needs of a larger number of countries and with the unwillingness of large grain-exporting countries to maintain at high cost grain contingency reserves in large quantities and on a permanent basis. As a result, the ratio of grain reserves to exports has been declining to a level where substantial shortfalls in production cannot be readily met without serious price disruptions.

In this sense, the renunciation of meat by the rich would not provide a solution to the problems of the poor, unless the rich were also willing to add the grain so released to their stocks. Food foregone by the DCs can reach the LDCs only through increased trade or massive relief operations, either of which would involve a transfer cost and, more important, the cost of maintaining larger contingency reserves of grains. The solution, therefore, must not be sought so much in cutting consumption by the rich as in increasing production by the poor. This would call for a substantial restructuring of agriculture in the LDCs.

It must be emphasized that total self-sufficiency in food is neither desirable nor feasible in all LDCs. Nevertheless, the failure of food production to keep up with domestic demand has led to very rapid and generally burdensome increases in food imports—imports of the kind which many LDCs cannot afford. The development of domestic agriculture must therefore be encouraged, not only as the major determinant of the availability of food supplies, but also because of the role which it plays in the overall economic and social development, including the earning and saving of foreign exchange and the provision of employment to the growing population.

A CHALLENGE OF THE PERCEIVED ROLE OF AGRICULTURE IN ECONOMIC DEVELOPMENT

There has been a time-honored tendency among economists to associate development with industrialization. Long-established dogmas make strange bedfellows. No less than three patriarchs in the literature of development, Baran (*13*, p. 77), Nurkse (*157*), and Lewis (*142*), who occupy vastly different positions, politically and analytically, among development economists argue that industrialization alone can raise agricultural wages, modernize agriculture, and provide employment for labor displaced by machines.

This perceived doctrine on agricultural development can be formulated in terms of three specific propositions which have had a profound influence on agricultural development policies since the 1950s. The three, taken together, specify the role of agriculture as the handmaiden of industrial development.

Proposition I

Agriculture must make a positive contribution to economic development by accumulating and transferring to the non-agricultural sector investable surpluses.

The specific process in which this transfer is carried out has been detailed in the literature of the "double developmental squeeze" of agriculture (*163*). The "production squeeze" can be managed through a wide arsenal of policy instruments, ranging from the Marx-Leninist approach of direct requisition of crop quotas to the Mill-Marshallian variant which relies on the intersectoral transfer of the profit from technological change through the deterioration of agriculture's terms of trade. The range between these two extremes is spanned by an array of administrative controls embracing various aspects of government intervention such as price policies, acreage allotments, or control over the distribution of farm inputs and new technologies.

Proposition II

The production contribution of agriculture to development can best be discharged by modernizing agriculture, that is, by increasing the productivity of farmers so that they free their brothers to work in the cities (*189*). This emphasizes the "vertical expansion" of agriculture which involves increasing output per man by applying greater quantities of modern inputs, including irrigation and drainage, energy, new seed varieties, fertilizers, and other inputs. These inputs are the basic ingredients of the new chemical-biological agriculture of the Green Revolution variety.

Proposition II has been incorporated in the "expenditure side" of the double developmental squeeze of agriculture. This is the description of the contribution of agriculture by providing migrants off the farms—a transfer of human investment whose breeding, raising, and education expenditures are underwritten by agriculture. The same proposition has also constituted the analytical kernel in the dualistic development model. As indicated in the previous chapter, the stampede of the "invisible feet" going from agriculture to the rest of the economy is the mechanism which leads to the "break-out" point of development and to the elimination of dualism. Unbridled optimism about the possibilities of industrial development and of the labor absorptive capacity of industry and basic faith in migration as an equilibrating mechanism of marginal adjustments have led to policies which have condoned, if not directly encouraged, massive transfers of labor from the farms to the cities—and to levels of unemployment which may be economically depressing and socially and politically explosive. And yet the income disparities between agriculture and the rest of the economy have not diminished. Furthermore, within agriculture itself disparities have grown between regions and types of farms.

Proposition III

Certain production technologies—especially those associated with chemical-biological agriculture—are scale-neutral. It makes little difference to the total output of chemical-biological agriculture whether farms are large or small, farmers are organized or unorganized, tenants or wage laborers cultivate the land, landowners are absentee or peasant cultivators.

This proposition has been crucial in establishing the overall equivalence of technologies which increase output per unit of land and those which increase output per unit of labor. As a result, it is an important complement to Proposition II. Whether agricultural production involves maximizing value added, the return to the primary factors of production (mostly labor), or heavy purchases of modern produced inputs, the decision is to be made with criteria extraneous to the size of the farm, the initial endowments of the farmer, or the interpersonal distribution of power in the economy. If family farms do not adopt modern technologies, it is not because the technology is biased in favor of size, but because governments follow incorrect policies in connection with the dissemination of information and the pricing of inputs.

These three propositions can be challenged on the grounds that they are ill-suited for solving the problems of agricultural development which have been

emerging in the 1970s. In many countries, massive rural underemployment is accompanied by high rates of urban unemployment and by growing inequality in the overall distribution of income. The poverty of many who live on the land and the increasing pressure on land through rapid population growth in LDCs highlight the new challenge in agricultural development: how to raise productivity and income in agriculture, while absorbing more labor in that sector. The problems of employment and income distribution would have been sufficient grounds for questioning the three propositions. The two new problems which have recently emerged—the potential shortages of food and energy supplies—make it necessary to question them even more vigorously.

Capital Investments for Agriculture

Under the post-war conditions of rapidly expanding population, cultivable land is steadily becoming a more scarce resource. Most of the easy additions to arable land that could be made have already been made. Most of the easy improvements have already taken place. There still remain, however, potentially rich agricultural lands which can be tapped, and a quantum jump in agricultural investment is likely to bring handsome returns. The situation is summarized in Table 7.4. Arable land is defined as land with a sufficient water supply. In the Far East and Near East, the possibilities of expanding crop area have almost been exhausted. In contrast, in Africa and Latin America, there are still substantial reserves of potential arable land, although the cost of development and settlement is relatively high. Southern Sudan, the Indus-Ganges-Brahmaputra plain of northern India and Bangladesh, the Niger basin in West Africa, and certain areas in Latin America are examples of areas where substantial increases in high quality arable land are possible with heavy investments in reclamation. For Southern

TABLE 7.4.—POTENTIAL AND ACTUAL ARABLE AREA IN DEVELOPING MARKET ECONOMIES, 1970*
(millions of hectares)

Region	Total land area	Estimated potentially arable land		Actually arable land	
			Percent of total land		Percent of potentially arable land
Far East	880	310	36	259	84
Near East	1,154	95	8	85	89
Africa	2,289	505	22	226	44
Latin America	2,021	595	30	167	28
Total	6,344	1,505	24	737	49

*Data from Walter Pawley, "Population Aspects of Agricultural Development and the Impact of FAO on Population Policy Issues," Rome, 1976, mimeograph.

Sudan, in particular, ambitious plans have been made to combine Arab oil money and western technology to create a new international foodbasket (*94*, p. 9; *72*, pp. 9, 19, 24). The Indus-Ganges-Brahmaputra development, if it ever materializes, would require substantial investment—estimated at present at $15 to $20 billion, or twice India's GNP.

It is not only the increase in cultivable lands which requires significant capital investment in agriculture. Land improvement, irrigation, mechanization, building fixed assets, and the provision of an adequate livestock inventory are expected to absorb heavy capital outlays. When the full gravity of potential food crises was still largely unrecognized, the Food and Agriculture Organization Indicative World Plan called for a cumulative net investment in the agriculture of LDCs of $110 billion between 1963 and 1985 (*102*, p. 11). Underinvestment in the recent past and world inflation must both have increased this figure by now—and the world food situation has made the need more urgent.

While western development theory has consistently emphasized the goal of draining agriculture of investible resources for promoting industrialization, Chinese development praxis, at least since 1958, has followed the opposite course. The economic policy of "walking on two legs" distinctly has favored agriculture over the other sectors. First, unlike the profits of urban industries, the profits of agricultural enterprises are not remitted to the state. The funds remain with the communes for the purpose of investment in agriculture or in agricultural industries. Besides financing a wide array of rural industries producing mostly for farm use—tractor and tool repair shops, fertilizer plants, brick kilns, water pumps, and power generating units—this capital has also financed irrigation, drainage, and land leveling to such an extent that water control currently extends over 40 percent of the irrigated area. Second, the terms of trade have favored agriculture. Government procurement prices for grains and other major crops have been rising moderately since 1960, while the prices of manufactured goods have declined. Third, compared to the other sectors, agricultural taxation is moderate, taking about 6 percent of the gross agricultural product. Since this tax is based on "normal yields" which are not consistently revised to reflect technological advances, the real agricultural assessment has declined over time (*178*, *197*). Under this system, agricultural output has been growing at a rate of 3 percent per year, as compared to an annual population growth rate of less than 2 percent. This favored treatment of agriculture has probably been possible only because Chinese agriculture has maintained its share of population in the process of rapid economic development. The 80 percent of the people living in the countryside have to feed, besides their numbers, only the remaining 20 percent of the total population in the cities. What this might imply for restructuring agriculture in other countries will be dealt with in the next two sections.

Labor Intensification of Agriculture

As already noted, increasing scarcity of land calls for quantum increases in capital investment in land reclamation and improvement projects if world grain supplies are to keep up with demand. This scarcity also implies a growing pressure on existing land resources to increase yields. This and the following section are devoted to two alternative (although not mutually exclusive) ap-

proaches to increasing output per hectare. One is an increase in the use of modern intermediate inputs; the other is a change in the pattern of land ownership.

It is fortunate that the explosion of population has coincided with the explosion of agricultural technology—no matter whether this was mere happenstance or the reflection of a law of technological advance, as Hayami and Ruttan (*88*) would have argued. The advent of the Green Revolution represents the most dramatic change in modernizing agriculture. The basic breakthrough consists of the development of high yielding varieties (HYV) of wheat and rice. These HYVs are characterized by: (a) short stems which can absorb large quantities of fertilizer without lodging (becoming top-heavy); (b) responsiveness to fertilizer at high levels of application; (c) adaptability to a broad range of latitudes; (d) early maturation (ripening in 120-125 days compared with 150-180 days for traditional varieties); and (e) insensitivity to the length of daylight, which makes them plantable at any time of the year if the prevailing temperature and water supply permit. The aspect of the Green Revolution that has had the greatest popular appeal is its promise to significantly increase yields (as much as sevenfold) which created a wave of euphoria about the quantities of world food supplies to come. Exaggerated promises about the potential of the Green Revolution have been belied, and the euphoria has been followed by renewed concern about world starvation.

The Green Revolution represents a technology of production that is compatible with Proposition II: it is based on the vertical expansion of agriculture through the intensive utilization of modern inputs, and especially of operating capital in the form of energy and fertilizers. The question that arises is whether it is also compatible with the resource endowments of LDCs so that poor countries can realistically anticipate the HYVs to make a substantial contribution to their indigenous food supplies. The usual diagnosis of underdevelopment is based on a shortage of capital relative to labor and thus militates against the use of technologies involving heavy doses of capital. To the extent that such inappropriate technologies—and the Green Revolution is only one example—have been adopted in LDCs, a paradox arises which may have two possible explanations (*97*). First, it is possible that the market prices of modern agricultural inputs in general, and their prices in LDCs in specific, do not reflect actual factor proportions because of the distortions created by fiscal, monetary, labor or trade policies and controls. Second, over a large range of production, especially where modern technology is involved, there is little scope for departure from the "best practice" techniques evolved in DCs and geared to the requirements of capital-rich economies. Capital scarcity in LDCs may also constrain the research and development effort necessary to adapt the imported fixed technology.

The importance of both the price and the fixity of technology can be illustrated by reference to examples from the experience with HYVs of rice in the context of the Green Revolution. The typical fertilizer response of the HYVs of rice is between 5 to 10 kilograms of rice per kilogram of fertilizer (nitrogen). Given this technical parameter, the rice-to-fertilizer price ratio becomes the crucial factor for the adoption of HYVs. At price ratios approaching 1:1, as was the case until recently with Japan, the Republic of Korea, and the Philippines, the HYVs are widely adopted (50 percent of the total area in rice for the Philippines). However,

in countries such as Thailand, where the price ratio has ranged in the recent past from a low of 0.28 to a high of 0.52, the adoption of HYVs is very limited. Only 2 percent of the total area in rice was affected (229). It is too facile to concentrate on price distortions at the national level and to blame the abortive case of the Green Revolution in countries such as Thailand on inappropriate government policies.

There is evidence, however, that there has also been until recently a global price distortion favoring the adoption of certain modern inputs. In the pre-oil crisis period of temporary international oversupply of fertilizer, that input was readily available to certain LDCs on concessionary terms or was financed through aid (98). Importing countries could selectively apply fertilizer at the recommended proportions of 60 to 120 kilograms per hectare (229, 104). This rate of application represents a quantum jump from the 5 kilograms per hectare usually applied on traditional varieties of rice. The question arises whether the global factor proportions could ever sustain the broad dissemination of the Green Revolution. Is there perhaps a more general distortion of market prices associated with world agriculture?[4]

The question can be placed in a more general context by examining the three cases, extreme in many respects, of high productivity agriculture in Table 7.5. The United States, China (Taiwan Province), and Egypt are all examples of highly developed, productive agriculture with yields of 3,570, 3,721, and 3,940 kilograms of basic food grains per hectare, respectively (164). The dissimilarities in the three countries are evident from Table 7.5. Judged from the average size of holdings, U.S. farms are giants in comparison to the small farms of Taiwan and Egypt. Mechanization is employed heavily in the United States, much less so in Taiwan, with Egypt in between. The converse is true for the labor intensity of production.

A striking similarity is also revealed in the table. The use of fertilizer per hectare in all three countries is rather high in comparison to other countries of the world. Fertilizer is only one of a set of high-energy inputs intensively used in all three countries, and especially in the United States. Other high-energy inputs are machinery, irrigation, insecticides, herbicides, drying, electricity, transportation, and so forth.[5]

The energy-intensive mode of agricultural production, as represented by the examples of the United States, Taiwan, and Egypt, has certainly been the beneficiary of the low relative prices of energy that prevailed until recently. Will the future prices, of energy in general and of fertilizer in particular, prove equally conducive to high-technology chemical-biological agriculture? Compared to the historical low levels of 1972, world fertilizer prices roughly tripled by early

[4] Johnson has made the case eloquently for the agriculture of the United States and the European Economic Community (107).

[5] In U.S. agriculture, the use of energy inputs has more than tripled since 1945, amounting to 7.1 million kilocalories per hectare of corn in 1970 (169). This amount of energy is equivalent to 200 gallons of gasoline per hectare of corn. About 37 percent of this total represents fertilizers, the use of which has increased seven-fold since 1945. An even greater proportion of energy use is represented by the fertilizer utilization in the other two cases.

TABLE 7.5.—COMPARATIVE AGRICULTURAL STATISTICS, THREE COUNTRIES*

Country	Average holding (*hectares*)	Economically active persons (*per hectare*)	Irrigated area as percent of arable land	Tractors (*per thousand hectares*)	Fertilizer nutrients (*kilograms per hectare*)	Yields of basic food crops (*kilograms per hectare*)
Egypt	1.60	1.67	98.80	53.84	111.90	3,940
China (Taiwan Province)	1.30	2.21	57.60	5.00	256.70	3,721
United States	122.50	0.01	8.50	110.47	64.10	3,570

*Data from Edward F. Szczepanik, *Agricultural Policies at Different Levels of Development*, Food and Agriculture Organization, Rome, 1975.

1974.[6] The price of rice also initially tripled but subsequently declined. This change alone may at best imply that the utilization of fertilizer for rice production may not have decreased. Where its use is warranted by the level of its marginal product, fertilizer will still be applied. The same change, however, might imply that fertilizer could not be relied upon for further increasing the world food supplies, as would be the case if the relative price of fertilizer and rice decreased. Is there a prospect of such a price decrease in the future?

Crystal-ball gazing about future fertilizer trends is a treacherous occupation. Only four points will be timidly made in passing. First, world fertilizer use more than doubled in the period, 1962 to 1972, reaching 80 million tons. Nitrogen use more than tripled in the same period (*54*). Second, projections suggest that the increase in fertilizer availability in the future will be much slower, rising by 25 percent in 1980 over the 1975 levels (75, pp. 96-100). Third, it is also predicted that the heavy concentration in fertilizer use among a few countries will continue. Developed countries which accounted for 84 percent of total fertilizer consumption in 1972 will absorb 74 percent in 1980 (*54*). Furthermore, two-thirds of the fertilizer share of LDCs by 1980 will be accounted for by six countries: India, Brazil, Turkey, Pakistan, Mexico, and Korea (*104*). Finally, LDCs relied on imports for 69 percent of their fertilizer requirements in 1975, and will remain heavy importers in 1980 (75).

This composite picture suggests that while fertilizer will continue to contribute to future increases in yields, it cannot be relied upon to provide dramatic increases in food supplies where they are most needed—in the majority of LDCs. This raises the question of the availability of intermediate technology and of the appropriateness of international technological transference. To an economist, at least, steeped in the Heckscher-Ohlin tradition of comparative advantage, it appears surprising that the United States, China (Taiwan Province), and Egypt—countries with vastly differing endowments and levels of wealth—use a similar, energy-intensive mode of agricultural production. Can high yields be obtained by means other than intensive use of fertilizer? What is the optimal trade-off between increasing yields and increasing energy consumption?

Technological Bias in Favor of Large Size

Substantial evidence has been accumulated to suggest conclusively that the productivity of land, defined as yield per hectare, is generally higher on smaller holdings than on larger ones.[7] There have been both pedestrian and exotic explanations of this phenomen.[8] The dominant view, consistent with the applica-

[6] Despite this sizable increase, fertilizer use was still benefiting from substantial subsidies in 1974/75. Of nine countries reviewed, only three were subsidizing the urea price by less than 33 percent. The subsidies in the others exceeded that level, and one-third of the countries subsidized the price of fertilizer by more than 50 percent (75, p. 80).

[7] Some of this evidence is systematically presented in (*103*). See also Paglin (*166*) and Yotopoulos and Kamphol (*229*) for evidence at the micro-level.

[8] Among the latter, there is the one proposed by Sen (*190*) wherein the rights of inheritance on land should operate in such a way that a holding is subdivided until it reaches the limits of its productive capacity to support a family. This results in smaller holdings being of superior quality of land than the larger ones. For a review of the relevant explanations, see Lau and Yotopoulos (*134*), and for an analytical framework consistent with the phenomenon see Yotopoulos, Lau, and Somel (*231*).

tion of Occam's razor, maintains that these productivity differentials are real, indeed they are a truism. Consider this explanation in the context of cross sections reflecting the dissemination of the Green Revolution technologies (*232*, pp. 101-102). The new seeds, fertilizers, and insecticides which have constituted the basis for increased yields in recent years have become selectively available mainly to large farms. This factor, if not counterbalanced by other technical efficiency advantages of small farms, would tend to produce higher output-input ratios for large farms, other things being equal. In addition, small farms are likely to operate with relatively cheap labor (since the opportunity cost of family members in a rural sector with few alternative employment opportunities is extremely low), relatively expensive capital (because of limited or no access to credit from official sources or institutions subject to interest rate ceilings), and, by definition, little land. In contrast, large farms have more land and also access to credit on more favorable terms, although they are hampered by having to pay the relatively high market wage rates for hired labor. These characteristics are sufficient to establish the observed inverse relationship between productivity and size. In the extreme case where labor is free for small farms and land is free for large ones, the maximization rule would lead the former to maximize output per unit of land and the latter to maximize output per unit of labor.

It is now clear that efficiency comparisons cannot be based on partial productivity indexes. Instead, a production function framework is necessary, within which one must also be able to control for differences in prices (of both inputs and outputs) among farms. The profit function has been applied to such an analysis, and the comparison definitely favors the small-to-medium-size holdings (less than 10 acres) as opposed to large ones (*134*). Furthermore, the advantage of small farms seems tentatively to be associated with the quality of their labor force (*230*). It is conceivable, then, that the supervisory role of the owner-manager and the superior effort of diligent and motivated family members are instrumental in explaining the efficiency advantage of the smaller farms.

At the present stage of our knowledge, the conclusion of relative efficiency in favor of small farms must still be considered as tentative. Whether it proves correct or not, the probative hypothesis that there exist physical diseconomies of scale in agricultural production which favor small size has absolutely no implication for the goal of vertical expansion in agriculture—increasing output per unit of land. An increase in yields can be achieved either by applying more labor (labor intensification) or by applying modern inputs (technological intensification), since the inputs of modern chemical-biological agriculture (apart from some cases of non-divisibility of mechanical technology) are perfectly divisible and neutral to scale.

While no choice needs to be made in favor of labor intensification versus technological intensification in a real world of the Walrasian type, this is not the case in a money economy. The basic argument of the growing literature on the economics of disequilibrium is that the real Walrasian world may become distorted when money prices are superimposed.[9] This is precisely what happens

[9] For various applications of the economics of disequilibrium, see Clower (*40*), Leijonhufvud (*141*), Thurow (*207*), Minsky (*148*), and Yotopoulos and Nugent (*232*).

in agriculture too. On the production side, and irrespective of whether there exist physical economies or diseconomies of scale, the small producer is certainly hampered by financial factors. In a money economy certain market prices, and especially those for modern technological inputs, are systematically biased at the microlevel against small size. As a result, technological intensification, which is neutral to scale in the real world, within a market context may become subject to financial bias in favor of large size.

The small farmer suffers from being able to purchase only small quantities of inputs and sell only small quantities of output at a time. Market institutions are strained to the breaking point when it comes to collecting from and distributing to small farmers. The cost of collecting milk from one cow each is prohibitive, and government distribution shops and road networks are necessary to deliver fertilizer to the small farmer. The small farmer's inadequate security for loans makes it difficult to obtain credit on reasonable terms. Small farmers are thus undercapitalized in storage capacity, and have to sell their produce at harvest time when prices are low. These are conventional costs of market operation which are reflected in market prices and which the small farmer must bear. A Marxist would have added that prices in general are distorted in a systematic way to favor those who have power and who exercise control. The small farmer is bound to lose in playing the market game.

The combination of diseconomies of scale in production with financial economies of scale may make the small farm, left to its own devices, nonviable. While small farmers may be unexcelled in eliciting the maximum quantity of output from a unit of land and other resources, they may be handicapped if they are to deliver to the marketplace output at minimum cost per unit. Their real advantage in production and in the labor market is offset by their financial disadvantage in the markets for capital, technological inputs, and output.

This distinction between production and financial (dis)economies of scale and between technical and financial bias of technology is not usually made explicitly in the literature, probably because the production function is a technical-engineering concept and is not conducive to economic analysis incorporating firm-specific prices and imperfect markets. The policy implications of this distinction, nevertheless, are often noted. They can be summarized in five alternative recommendations.

First, let nature take its course. Some small farmers will fall prey to the biological function of the market wherein, as Galbraith puts it (mockingly), the old and the senile are continuously replaced by the young and the vigorous. Value added in the economy, or total GNP, may increase in the process (for example, if large farms buy out the small ones) but the total volume of agricultural output will decrease (because of the postulated diseconomies of scale in production).

Second, try to improve the markets so that financial considerations do not militate against the small size. This is a counsel of perfection which economists have blithely dispensed, especially since it places the blame for failure not on economics but on politics. Thus, governments and politicians are usually held responsible for not "setting the prices right," not making cheap credit available to small farmers, or failing to organize cooperatives to provide modern inputs to small farmers at low cost. This view overlooks that it is in the nature of markets to

be imperfect and that creating perfect markets may be a hopelessly expensive endeavor.

Third, try to compensate for the financial handicap of small farmers by supporting the price of output and subsidizing the price of inputs. There is by now sufficient experience on price support and subsidy schemes to have established that it is almost impossible to administer them selectively to small farmers. As a result, the large farmers, with the bulk of output and purchased inputs, profit most from these schemes.

Fourth, place more emphasis on intermediate technologies. Properly used, the term must mean technologies which are better adapted to the existing factor proportions, that is, to the endowments of the small farmer in the present context. The small farmer has abundant family labor, which is relatively cheap, and he has scarce capital and few purchased technological inputs. Intermediate technology, then, in the context of LDCs means two things: labor intensiveness and bypassing the market which to a certain extent creates financial biases operating against the small farmer. There still seems to be room left for imaginative application of intermediate technology in LDC agriculture. But the market is not the most likely purveyor of it, since such technology largely bypasses the market. Chemical fertilizers to a large extent can be replaced by organic fertilizers.[10] For instance, in cattle-rich countries such as India where animal dung is used as a fuel, the new price configuration of energy inputs may give impetus to the adoption of plants which will provide the fuel value, and will also preserve the dung slurry to be used in place of chemical fertilizers (*183*, p. 29).[11] Labor intensiveness can also replace greater application of fertilizer to some extent, as is the case with "mud balling" which greatly improves the utilization of a given quantity of fertilizer. The costly HYV fertilizer technology could be replaced by a simpler seed-inoculant approach which would also overcome the transportation and distribution constraints of fertilizer which are most binding to the small farmer. Nitrogen fixation in the plant would also overcome the transportation and distribution constraints of fertilizer. Green manuring can similarly replace large quantities of fertilizer, although it is land-extensive to a certain degree and may not be well adapted to the requirements of small farms (*219*, pp. 184-88). Finally, relay planting is ideally suited to certain LDCs since it is extremely labor- and land-intensive, and five crops can be raised per year on one piece of land.

[10] Pimenthal points out that the current fertilizer requirements of corn in the United States, which amount to 94 kilograms per hectare (of total nitrogen, phosphorus, and potassium nutrients) can also be provided by one year's production of manure by either one dairy cow, two young fattening beef cattle, nine hogs, or 84 chickens. Pimenthal elaborates (*169*, p. 446):

> In addition to the nutrients manure adds to the soil, it adds organic matter which increases the number of beneficial bacteria and fungi in the soil, makes plowing easier, improves the water holding and percolation capacity of the soil, reduces soil erosion, improves the ratio of carbon to nitrogen in the soil.

[11] According to Ramachandran and Bhatnagar (*174*, p. 29):

> If all the animal dung is used in biogas plants in India, about 10^{11} million m^3 of British Thermal Units of gas can be generated per year, which can meet all the energy needs for cooking for the entire population and at the same time provide about 4 million tons of nitrogenous fertilizers which is about twice the nitrogenous fertilizer presently being produced from oil products [in India].

Fifth, since financial bias is market-induced, it can be overcome to a certain extent by restricting the operation of the market mechanism. This would involve promoting (rather than trying to eliminate) dualism, breaking up some market lifelines of prices and communication, inducing market imperfections, and damming up the economy. This approach would involve creating two distinct sectors—the commercial and the paracommercial. The former operates within the market framework, on principles already well established, and bears the major burden of producing marketable surpluses to feed the population of large cities. The latter is mostly responsible for itself. It is composed of smaller groups, and it is based on autarky and self-sufficiency perhaps at the village, the regional, or the commune level. Its market connections with the advanced sector are severed, or at least limited, while the market links with the other components of the paracommercial sector are strengthened. Local markets develop, and exchange in the paracommercial agriculture is channeled through periodic fairs at which households can sell eggs, fruit, and so forth in small quantities, and at which itinerant merchants shoe animals, sell pottery, or engage in construction work. Rural fairs are an important component of the scheme and should be encouraged. However, the small size of the family farm and the magnitude of transport costs will limit the degree of specialization among various farms, and will prevent rural suppliers of non-agricultural rural activities from being undersold by the salesmen and other agents of the urban sector. Subsidy schemes have been advocated to link the paracommercial farmers with the urban sector, for example, by subsidizing pickup and delivery of small amounts of milk or produce which the small farmers can market, or by subsidizing the use of modern sector inputs and techniques by the small farms. Such schemes are likely to be uneconomic, and should be resisted. In any case, the people who profit from such schemes are often not the rural poor but rather the sellers and producers of transport and other services in the modern sector.

This damming up of the economy must be viewed only as a holding action to tackle the most immediate problems of poverty and destitution. It is inspired by the principle that, when threatened, societies—not unlike the amoeba—fragment into small groups in order to survive. Small size, with no important lifelines to the rest of the world, can be a better means of absorbing the shocks of social derailments. However, as development takes hold and employment increases in the spectrum between the paracommercial and the commercial sector—in the traditional agricultural and the traditional industrial sector, the public sector, and finally the modern agricultural and industrial sector—the lifelines connecting the various sectors can be restored. Factor movements such as the exodus from the paracommercial small farms into commercial activities can then be encouraged. The purpose of damming up the economy is to develop the local turf, instead of prematurely transferring the benefits of development to the advanced sectors.

This list of alternative policy approaches serves to outline alternative strategies of agricultural development. Conventional orthodox strategies, based on the neoclassical dualistic development model, place major emphasis on policies which are at the top of the list and rely heavily on perfecting the markets. The example of China (Taiwan Province) comes readily to mind as a successful

prototype and most other countries are more or less compatible with it—although they may have had consistently less success in development. On the other hand, the development strategy of the People's Republic of China is based on policies at the bottom of the list (*178*). Some countries, such as Israel with both an integrated agricultural sector and dammed up kibbutzin represent interesting mutations of the two strategies.

SUMMARY

The normative aspect of the study of interactions between agriculture and population growth refers to an implied imbalance between population and resources. Within this context means are sought for moderating population growth, both direct, by operating on the demographic side exclusively, and indirect, by operating through interactions with other social and economic factors. It is appropriate therefore to conclude this discussion by looking at the problem from the other side—to determine to what extent the imbalance can be restored by stimulating agriculture.

The reference point for the study of the imbalance between population and resources is the recurring concern with food crises. The survey of the historical record has suggested that the grain balance in the world is rather precarious. The annual incremental hold-the-line and affluence requirements cannot be fully met without recurring food crises unless the annual rate of growth of grain supplies increases. This increase should not be expected to come primarily from the DCs for two reasons. First, most of the ill-fed and malnourished people and most of the annual increase in population are in the LDCs. Transfers of food from the DCs may put heavy strains on trade and place heavy demands on the balance of payments of many LDCs. A second and more speculative reason is that it is not entirely clear at present whether the DCs, mainly North America and Oceania, will be able to maintain their comparative advantage in food production in the post-energy crisis era.

To meet the demands for grain, the LDCs will have to accord a primary role to agriculture in their development plans. LDCs and DCs alike will have to commit capital heavily to agricultural development. This is a reversal of roles in the traditional approach to development wherein agriculture is considered the handmaiden of industry.

Furthermore, three-quarters of the world are poor and half of mankind are peasants[12]—family producers who own their small plots of land, rely exclusively on family labor, organize agriculture around the consumption needs of the family, and only secondly produce marketable surpluses where money is required to buy the few items outside the ambit of self-sufficiency. Agricultural development then has to be designed around the small farm unit. This may be just as well because it appears that there are important diseconomies of scale in agricultural production, as distinct from financial economies of scale, which favor the small farm.

[12] A total of 78.8 percent of all landholdings in the world are below 5 hectares in size, and they occupy 20.7 percent of the total cropland (*103*, p. 59).

It is doubtful that development of small-scale agriculture can rely much longer on increasing output per man by applying greater quantities of modern inputs. This might be just as well because modern agricultural technology, including the chemical-biological variety, is not neutral to scale, but involves a considerable financial bias (as opposed to *technical*) in favor of larger units. These two propositions are also contrary to the generally accepted views on agricultural development.

The distinction between real and financial economies of scale and technical neutrality and economic bias of technology is usually not made operational in the literature. Nevertheless, its implications work mostly against the small farms. Remedies have been suggested. They range from the orthodox alternative of improving the operation of the market mechanism to the radical suggestion that "gravity models" of trade and development have not worked, and hence the damming up of the economy should be considered. The development of adaptive technology is an intermediate position between the two extremes.

The imbalance between food supplies and population is not due exclusively to the recent patterns of high population growth rates. Agricultural growth has been shackled by conventional views that the sector must serve as a handmaiden to industry and by policies which have not appropriately reflected the factor endowments created after the population explosion. Emphasis should be placed on agricultural development which would remove the first constraint, and on the development of adaptive, labor-intensive technology which would ease the latter. There is enough room for both in development strategies around the world. In this way, agriculture would contribute directly to restoring the demographic balance by providing more food for more people.

CHAPTER VIII. CONCLUSIONS

This study has focused less on identifying the magnitude and origins of the population problem—an area where there is a broad concensus of opinion—and more on highlighting the lacunae in our own knowledge. It has been sufficiently emphasized and broadly understood that the world population problem is potentially explosive and that it appears more ominous in LDCs and among the poor. What has not yet been fully understood is that agriculture in the LDCs is both the problem and the potential solution of population pressure.

The three-quarters of the world's population who live in LDCs contribute to the population increases at a rate three times as high as the natural rate of increase of population in the DCs (2.4 versus 0.8 percent per annum). Furthermore, two-thirds of the population of the LDCs are employed in agriculture and have substantially higher birthrates than those in other sectors. Every day one-third million people are born in the world and roughly one-quarter million people are born each day on farms. This is why the population problem is rooted in agriculture.

The approach to the population problem in the past has relied rather heavily on the availability of the means for birth control. It has more recently been recognized, however, that the modern technology of birth control and its dissemination are perhaps necessary but by no means sufficient conditions for the solution of the population problem. Families must be provided with the motivation, as well as with the means, to limit births. As a result, population control becomes a part of the process of socio-economic transformation, and the operational question becomes the extent to which development can contribute to achieving population objectives.

As the views on population control have been changing, so have the approaches to development and to socioeconomic transformation. Urbanization, for example, seems today a less appropriate type of transformation for achieving population control than it did 20 years ago. The population problem is not solved by creating an "urban problem." Furthermore, development today has acquired a different meaning, one that is more selective. Mere growth in GNP is no longer enough, since it is basically an index of the growth of the upper 40 percent of the population in LDCs who typically receive 75 percent of all income. The concept of development today is becoming more oriented to the conditions of the majority of the people and especially of the 40 percent of the population who collectively receive 10 or 15 percent of the total national income. To a large extent, the subsets of the poor, the agricultural, and the high-birthrate population intersect. Agriculture must become the major component in the solution of the population problem.

The basic theme of this study is that agriculture is fundamentally related to world population growth—both as the major part of the problem and as an important component to its solution. The question arises as to the type of agricultural development and socioeconomic transformation that is most appropriate and effective for achieving demographic objectives. The literature on economic-demographic interactions referred to in this study has not specifically addressed the question of agricultural development strategies as they relate to population growth. Still, the discussion has served to flag certain components

which are likely to become parts of population-sensitive agricultural development strategies.

A number of determinants and some of the consequences of population growth that featured in this study lend themselves more easily to policy control within the context of the agricultural sector. The modal characteristic of agriculture in LDCs is the organization of production around the family-household complex. To the extent that income distribution appears to be an important control variable for population policies, it becomes desirable to redistribute income among households by operating on both production and consumption sides, for example, by land redistribution plus income supplements, if necessary. Furthermore, income redistribution of this type would also convey the benefits of the agricultural operation of the smallholder household, taking advantage of the "physical diseconomies of scale" and thus further adding to food supplies. In other words, the consequences of population growth are more easily internalized when one operates within the agricultural sector. Furthermore, better nutrition and health become determinants of fertility declines. Still, the link between increases in agricultural productivity and nutritional improvements was found to be more direct than the relationship between increases in incomes and nutrition. The returns to a nutritional improvement program would therefore be more direct if that program took place within the agricultural sector. Women's education and work status are also related to fertility declines. There is certainly more room for operating on these variables within agriculture if only because of their current abysmally low levels.

Agriculture, and especially the agriculture of the LDCs, is the stage on which the world drama of population is being played. The problem is that the plot has not yet been fully understood nor the dramatis personae fully identified. This is the most urgent task of the study of population and development.

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