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POPULATION AND PRODUCTIVITY

by

Brenda C. H. Gayle

Thesis presented to the Faculty of Graduate
Studies of the University of Ottawa as partial
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CURRICULUM STUDIORUM

Brenda C. H. Gayle was born in Jamaica. She received the Bachelor of Science degree with honours in Economics from the University of the West Indies in 1966. In 1969 she received the Master of Science degree in Economics from the University of the West Indies. She received the Master of Arts degree in Economics from the University of Toronto in 1974.

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CHAPTER I

INTRODUCTION

When issues concerning adverse factor proportions rear a threatening head, population and its rate of growth are often identified as the daemon beneath the head. Strategies for destroying the daemon have not proven successful. With each blow, whether it be measures for rapid industrialization, increases of grants and aid, transfers of technology, or investments in infrastructure, the hydra-headed monster assumes more fearsome proportions.

Some have treated the problem lightly, choosing to see the pressures of population as the means whereby communities will be pushed relentlessly towards development. Others have even overlooked it entirely, claiming that a preoccupation with population is a fault of an espoused political viewpoint. The problem remains however. Large and rapidly growing populations combined with scarcity of arable land and inadequate or inappropriate capital have resulted in extreme poverty in many areas.

The problem becomes demanding of solution when it is observed that juxtaposed to pitiful poverty is wanton wealth. This juxtaposition is not only between one nation and another but within countries and regions. It is reflected, although inadequately, in estimates of per capita gross national product and income distribution indices.

Table I - Per capita gross national product and Gini coefficients for a selection of countries

Country and Level of GNP per capita	GNP per capita 1975	Gini coefficient ¹
Under \$300		
India	140	.48 (1967-68)
Haiti	190	
Sri Lanka	190	.38 (1969-70)
Kenya	220	.64 (1969)
\$301-\$500		
Mauritania	320	
Thailand	350	.51 (1962)
Morocco	470	
\$501-\$1,000		
Guyana	510	.42 (1955-56)
Colombia	580	.56 (1970)
Mauritius	610	
Dominican Republic	720	.49 (1969)
Malaysia	760	.54 (1970)
\$1,001-\$2,000		
Brazil	1,030	.61 (1970)
Mexico	1,050	.58 (1969)
Jamaica	1,110	.67 (1974)
Iraq	1,250	.63 (1956)
Barbados	1,410	.43 (1969-70)
Panama	1,290	.45 (1970)
\$2,001-\$4,000		
Venezuela	2,280	.54 (1962)
Puerto Rico	2,300	.45 (1963)
Gabon	2,540	.64 (1968)
Spain	2,750	.39 (1964-65)
\$4,001 and above		
Japan	4,450	.29 (1971)
France	5,950	.52 (1962)
Australia	5,700	.32 (1967-68)
Canada	6,930	.33 (1965)
United States	7,120	.42 (1972)

Sources: Gross National Product

World Bank Atlas: Population, Per Capita Product and Growth Rates, The World Bank, 1977.

Gini Coefficients

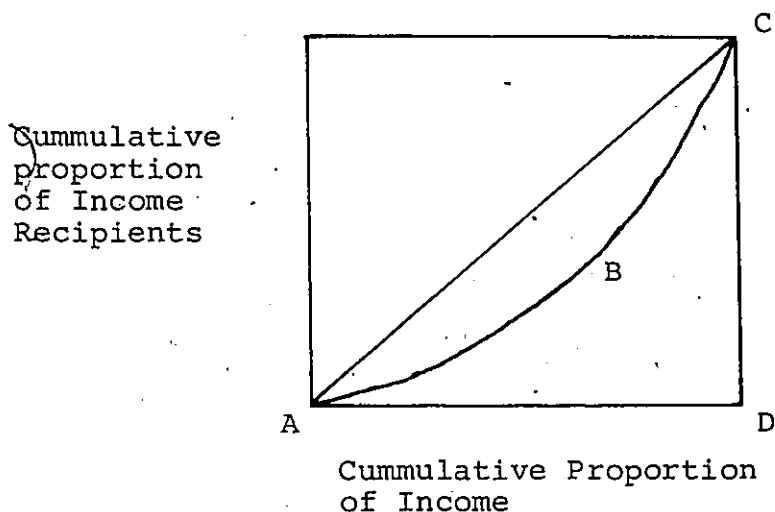
Shail Jain, Size Distribution of Income: A Compilation of Data, The World Bank, 1975.

World Bank Report - Jamaica, 1976.

¹The Gini coefficient, calculated in conjunction with the Lorenz curve (ABC) which relates the proportion of income

The data shown above demonstrate, firstly, a wide discrepancy in per capita gross national product among countries. Some countries enjoy a per capita GNP in excess of US\$6,000 (e.g., the United States and Canada) while for others (e.g., India, Haiti and Sri Lanka) the per capita GNP is less than US\$200. Secondly, the coefficient of correlation between per capita GNP and Gini coefficients is negative and low (-0.499) indicating that while countries with lower per capita GNP tend to display more highly skewed income distributions,

recipients to the proportion of income, is defined as the ratio of the area under the Lorenz curve (ABCD) over the total triangular area under the line of equality (ACD). As a measure of income concentration, the Gini coefficient ranges from 0 to 1, where 0 represents perfect equality and 1 represents perfect inequality.



Jain employs the following estimation of the Gini coefficient:

$$G = 2 \int_0^1 \pi^\alpha (\sqrt{2}-\pi)^\beta d\pi = 2a(\sqrt{2})^{1+\alpha+\beta} B(1+\alpha, 1+\beta)$$
, where $B(1+\alpha, 1+\beta)$ is the Beta function. This estimation is derived by N.C. Kakwani and N. Podder in "Efficient Estimation of the Lorenz Curve and Associated Inequality Measures from Grouped Observations" Econometrica, 44, January 1976, pp. 137-148.

there are countries with higher per capita GNP where the distribution of income is also unequal. The Gini coefficients were estimated to be 0.64 for Kenya in 1969, 0.56 for Colombia in 1970, and 0.54 for Malaysia in 1970, compared with estimates of 0.52 in France in 1962 and 0.42 in the United States in 1972. In poorer countries there are many poverty stricken, but even in wealthy countries only a minority are affluent.

Data on development statistics, shown below, also support the observed difference in welfare that exists among and within countries. Among countries, those with lower per capita gross national products also have lower average life expectancies at birth, lower average daily calorie intakes, fewer dwellings with piped water, fewer physicians per population, and higher rates of illiteracy. Comparing countries at the extremes (e.g. India, Kenya and Sri Lanka versus Australia, Canada and the United States), the difference among countries is evident. The coefficients of correlation between GNPs and life expectancies at birth, average daily calorie intakes, and dwellings with piped water are 0.762, 0.818 and 0.810 respectively. Those between GNPs and population physician ratios and GNPs and literacy rates are, encouragingly, much lower at -0.471 and 0.518 respectively, reflecting efforts to improve levels of health and education in some poorer countries. Within countries, those with only one physician for more than 10,000 persons (e.g., Kenya with 16,000 persons to

Table II - Development statistics for a selection of countries
1975

Country and Level of GNP per Capita	Average Life Expectancy at Birth (Years)	Average Daily Calorie Intake (Calories)	Popu- lation per Physi- cian	Dwellings With Piped Water (%)	Literacy Rate (%)
Under \$300					
India	41	1,971	4,162	..	34
Haiti	50	2,026	8,505	41.9	10
Sri Lanka	66	2,018	4,007	4.4	84
Kenya	49	2,114	16,292	..	20-25
\$301-\$500					
Mauritania	39	1,891	17,746	..	1-5
Thailand	56	2,360	7,971	69.0	82
Morocco	53	2,614	13,802	64.8	15-20
\$501-\$1,000					
Guyana	61	2,350	3,249	36.1	80
Colombia	61	2,182	2,184	41.3	78
Mauritius	63	2,458	4,438	27.1	61
Dominican Rep.	58	2,212	1,866	8.1	68
\$1,001-\$2,000					
Brazil	59	2,515	2,025	33.0	67
Mexico	62	2,725	1,385	38.7	74
Jamaica	65	2,663	3,509	21.6	82
Iraq	53	2,433	2,369	20.8	26
Barbados	65	3,247	1,500	40.0	97
Panama	66	2,419	1,234	26.1	78
\$2,001-\$4,000					
Venezuela	65	2,422	866	72.4	77
Puerto Rico	73	..	848	62.7	89
Gabon	35	2,301	5,190	..	12
Spain	72	3,302	673	45.0	94
\$4,001 and above					
Japan	74	2,835	868	94.9	98
France	72	3,411	681	96.6	99
Australia	71	3,310	721	..	99
Canada	73	3,377	603	98.5	93
United States	72	3,504	622	97.5	99

Source: UNCTAD, Handbook of International Trade and Development Statistics, Supplement 1977, United Nations, 1978.

one physician, or Mauritania with a ratio of more than 17,000), have only a minority of people privileged with medical services.

It is incumbent, therefore, on those who pursue the discipline of political economy to comprehend better the relations between population and productivity in the hope of assuring the well-being of every individual.

Focus of Thesis

The focus of this thesis is an investigation of the interrelations between population and productivity with a view to discovering ways in which population and other factors may be aligned. There is a complexity of interactions. These interactions have been influenced by a constellation of cultural, social, ethical and religious factors which have not simplified the analysis of the relationships.

For the purpose of this investigation it is necessary to isolate first the fact that population provides a factor for the production process and secondly, that the product, in turn, generates changes in population.

Population as a factor of the production process in the form of labour has been so long recognized as to make any restatement banal. Considerations in this respect include the theory of production, marginal productivity theory, the law of variable proportions with diminishing returns, the backward

bending supply curve of labour, and the labour theory of value.

The changes in population generated by production have not had as wide a discourse as the former relationship. Apart from the classicists and world future speculators, only scholars and practitioners of economic development have been much concerned with this aspect. Perhaps differences in the type of organizational structure and the period of gestation required for the production of a consumer product as against a person have led in neo-classical and Keynesian approaches to the neglect of the latter relationship as attention is directed to issues within the shorter perspective. The expected response of population to productivity implied by the demographic transition theory may also have caused a relative neglect of population, since it was believed that, with continued increases in output, population would eventually decline. While demographic transition theory may have been correct regarding the response of death rates to increased output and accompanying modernization, its documented failure to indicate the increases in birth rates following on increased output and the measures that would be required to effect a decrease in birth rates are now well known. Certainly, part of the inapplicability of the theory arose from the fact that the economy was treated as if it were one entity rather than as a dual economy with differentiated sectoral responses.

It has since been established that the first response of birth rates to increases in income is positive. This may be particularly true in the context of the dual economy where higher fertility rates in rural as against urban areas account for the over-all increase. The second response is negative. But this may be observed only in the long run as rural areas are brought within the ambit of development.

This thesis therefore emphasizes an endogenous treatment of population where the positive and negative responses of population to productivity are taken into account, population being the dependent variable. As is apparent, only with the endogeny¹ of population can the interrelations between population and productivity be explained. Further, if the juxtaposition of poverty and wealth is not an adequate reason for the consideration of the interrelationships in the context of the dual economy, then the postulated responses of births to income are demanding of such treatment. The accommodation of excesses of population creates dichotomous structures.

Once duality is accepted as a reasonable setting for the subject under consideration, it is necessary to search for a probable link between the two sectors which can either promote, perpetuate or even prevent and prohibit dualism. The

¹The word endogeny, defined as "the condition of growing or developing from within", is employed throughout in preference to the less precise word endogeneity. The Oxford English Dictionary and the 1972 Supplement to the Oxford English Dictionary provide references.

government is taken as the link. Ultimately all action, if not undertaken by the government, at least comes under its surveillance. The exercise of the allocative and distributive powers of government reflects the values of a society and the valuation of each individual within that society. Through the quality of the programmes for ensuring the provision of basic necessities for every person, the government can hinder or foster transformation and social development. The government, therefore, plays a unique role in the context of duality. Thus the title "Population and Productivity" may alternatively be expressed as "Endogenous Population in the Dual Economy"--dualism being the appropriate setting for an endogenous consideration of population.

Hypothesis

The hypothesis of this thesis is that population growth can be influenced by a certain pattern of government expenditure. The direction of government expenditure towards providing basic needs will cause short run positive and long run negative responses in births. Hence, births and, therefore, population growth can be reduced by sustained need-oriented government expenditure.

The rationale supporting this hypothesis is that strong efforts in the field of social development will bring about a change in the expectations of parents such that the number of births will be reduced. Social development will be facilitated

by improvements in health, nutrition, housing, education and other welfare measures. If basic requirements are provided so that poverty is eradicated, new life styles will be adopted which mirror transformations of the quality of life. The concomitant increase in options for self-realization will be reflected in a reduction in the rate of population growth as additional children are foregone in favour of alternative achievements.

Methodology

For testing this hypothesis a model is constructed in which the central equation relates births to government expenditure. The postulated interrelations between population and output are also incorporated. The model is also representative of the dual economy where behavioural responses, technological and institutional characteristics are dichotomous.

The approach is dynamic. Births are a function of all previous as well as current government expenditures. In addition, the response of labour supply to output is lagged. Dualism has also been treated dynamically. The inclusion of government in the interface between the rich and the poor sectors provides for sectoral interaction over time and an assessment of the vulnerability of each sector to changes in the other at different periods of time.

The aim in the construction of the model has been

towards consistency, that is, the absence of contradiction among the assumptions, and independence, or the impossibility of deducing any assumption from other assumptions as final propositions, with a view to ensuring completeness--the possibility of a solution.

In a topic of this nature the role of family planning normally comes to mind. The issue is yet controversial. Some maintain that family planning is a requirement and is directly responsible for reductions in the rate of population growth. Others hold the opinion that family planning policies are concomitant with but not a causal factor in reducing population growth rates. Admittedly, the effects of family planning policies are intractable of measurement. Moreover, improved standards of living are a prerequisite for the success of programs. The view taken here, therefore, is perhaps a cautious one--that family planning policies need not necessarily result in family limitation and that, even if they do, such policies may be subsumed under the social expenditures of government.

In testing the central equation of the system, government activity is taken to be the aggregate of expenditures for health, nutrition, education and other social expenditures. These expenditures may be viewed as a subset of measures required for meeting basic necessities, and, as such, provide a means for estimating the appropriateness of the basic needs approach in relation to population.



The process of thought is often sufficiently complex as to be irretraceable. Concisely stated, however, the entire approach has been a blending of theory and empiricism. The method involved a continuum of confrontation of theory by empirical fact, each of these elements in turn directing and modifying the search. The outcome and its arrangement here stand independently of the process.

The schema of the study is as follows:

- Chapter II presents a review of economic-demographic literature where population has been treated endogenously, and proposes the dual economy as an appropriate framework for the endogenous treatment of population;
- Chapter III provides a discussion of population in the dualistic framework, giving a theoretical setting to the following chapter;
- Chapter IV presents a dualistic model with endogenous population;
- Chapter V tests the model in the context of Jamaica;
- Chapter VI summarizes and concludes.

Contribution to Knowledge

The model permits, firstly, an assessment of the ability of government to effect a reduction in the rate of growth of population. This ability is seen in terms of activity for

providing basic needs. While testing is confined to government expenditures for health, nutrition, education and other social expenditures, government activity may be extended to include directives and expenditure for community development, changing or enhancing the habitat, increasing output of low productivity agriculture and other rural or traditional industries, creating productive jobs for the unemployed and underemployed, increasing the incomes of low-wage earners, and transforming social, political and economic structures such that fundamental human rights may be attained.

Secondly, a systematic quantitative and dynamic arrangement is provided for understanding the interaction of population and productivity. It is possible to trace the time paths of output, labour, the change in population and hence the extent of residual unemployment under conditions where population first explodes and then diminishes in response to government expenditures for providing basic needs. Thirdly, the model permits an assessment of the type of action that may be taken in the endeavour of directing funds for the improvement of welfare. Four alternatives for action are suggested by the model. It may be determined whether a direct and heavy attack on poverty through the provision of basic needs, rather than the patient watch for the filtration of development, is indicated. The incorporation of the government permits such an assessment. Fourthly, the definition of

parameters for the operation of an economy under the specified conditions of overpopulation and severe unemployment leads to the specification of the impact multipliers which may be useful for an understanding of rectification procedures in such an economy. Fifthly, the model emphasizes and explains supply side phenomena useful for understanding development rather than demand inadequacies of depression economies. Sixthly, the model provides a rigorous framework for an understanding of the way in which dualism may be first generated, then perpetuated and finally remedied. Seventhly, the model provides a theoretical explanation of observed Kuznets' cycles. Eighthly, the model suggests why, even with a measure of development and the attenuation of dualism, high levels of unemployment may be periodically observed.

Usually models are built with a view to providing some guidance for policy priorities. If such an expectation is too great for the basic model presented here, the hope is that the model may determine a basis for the construction of future models which will be even ~~more~~ appropriate for devising policies for implementing development. Nevertheless, the starkness of the model in its present form uncluttered by peripheral parameters provides clarity for understanding fundamental mechanisms.

CHAPTER II
REVIEW OF ECONOMIC-DEMOGRAPHIC MODELS
WITH POPULATION ENDOGENOUS

Population has often eluded political economy. People are recognized as consumers, producers, workers, intermediaries, distributors, entrepreneurs, and as makers and beneficiaries of policy; but the connections between people viewed as population and economic productivity have proven intractable. Population exists and grows; this much is conceded in many models before it is left, unlike capital, to change exogenously.

Despite its elusiveness, a preoccupation with population has always been apparent. Records of ancient cultures and religions give evidence of pre-Malthusian concern with fruitfulness and multiplicity of people whether for perpetuating a clan, populating uninhabited areas, providing warriors for battle, or preserving an optimum balance with other resources. The Malthusian views of the late eighteenth century were not new. They echoed opinions of many French, as well as German, Italian and other English discussants of the same century. Since Malthus, interest in the number of men has arisen with the unemployment problem of depression in advanced countries, the non-employment¹ problem of developing countries, and the prospect for man's existence in the global context.

¹The term "non-employment" is used by Joan Robinson in her introduction to Michael Kalecki's Essays on Developing Economies (Plymouth; Harvester Press, 1978), to distinguish the lack of employment in developing countries from unemployment characteristic of developed economies.

Even with this concern, population was not graciously received within the ambit of political economy. The general theory of employment accorded population a place as a determinant of effective demand. Keynes envisaged the demand for capital to be a function of changes in population in addition to the standard of life and capital technique.¹ Annual changes in the standard of life were considered minimal. Inventions may increase or decrease the amount of capital per unit of output. Hence, large increases in investment and the maintenance of a low level of unemployment with a high level of effective demand were facilitated largely by an increasing population. Keynes' apprehensions concerning a declining population were resounded by Hansen in relation to the prospect for progress.² The rate of population growth was taken to be a major factor contributing to long run autonomous investment. Capital widening in particular, rather than capital deepening, was taken to be a function of an increase in population. Hansen argued that with a rapid increase in population a country will need enormous capital outlays for housing, transportation and facilities for modern living. A stationary population

¹J. M. Keynes, "Some Economic Consequences of a Declining Population", Eugenics Review, 29, April 1937, pp. 13-17.

²Alvin H. Hansen, "Progress and Declining Population", American Economic Review, 29, March 1939, pp. 1-15. Alvin H. Hansen, "Some Notes on Terborgh's 'The Bogey of Economic Maturity'", Review of Economic Statistics, 28, February 1946, pp. 13-17.

requires more personal services with relatively lower investment expenditures. Comparing new residential building construction requirements with personal services, Hansen concluded that it was

not unlikely that a shift from a rapidly growing population to a stationary or declining one may so alter the composition of the final flow of consumption goods that the ratio of capital to output as a whole will tend to decline.¹

"The relationship between investment and population is hard to isolate"² Higgins tersely comments on the Keynes-Hansen theory. "Population growth does correlate so highly with so many other economic variables."³ Moreover, the association between population growth and economic progress is taken to be the outcome of conditions of expansion during the Industrial Revolution and the development of the United States. In underdeveloped countries where labour is an abundant factor

where lack of savings rather than lack of effective demand limits investment and where an addition to the labour supply would lower per capita output and income even if additional workers were fully employed, population growth is a drag on economic development.⁴

Nevertheless, the Keynes-Hansen treatment was not endogenous. Population growth as a determinant only, and not

¹Alvin H. Hansen, "Progress and Declining Population", p. 7.

²Benjamin Higgins, Economic Development: Principles, Problems, and Policies, 2nd. ed. (New York: Norton, 1968), p.136.

³Ibid., p. 136.

⁴Ibid., p. 143.

as a dependent factor, was ill at ease. Neo-Classicists, monetarists and business cycle theorists nearsightedly avoided population. Growth theorists too frequently took a myopic view of the long run. Notable exceptions were the contributions of Haavelmo (1954), Solow (1956), Kaldor (1957), and Niehans (1963) where induced changes in population were permitted so that the rate of growth of population may be made consistent with the warranted growth rate.¹ Davis (1969) sought to discover the optimal savings strategy, taking account of endogenous population in relation to Phelps' Golden Rule of Accumulation. Nevertheless, adjustments for endogenous population were accorded little prominence in view of the focus of growth models on technology and savings. Population was left almost entirely to, or perhaps retained almost entirely by, demographers and sociologists. In Leibenstein's view in 1957:

There is still little evidence of sufficient recognition in current economic literature to imply an award of first-class citizenship privileges of acceptance as an endogenous variable. The best that most economists would seem to offer to population growth are the second-class rights of an independent variable. And the less tolerant confer no more than the third-class recognition of a factor to be mentioned en passant.²

¹Haavelmo considers three cases where, a), the birth rate is given and the death rate is a function of the population per unit of production, b), the birth rate is given and the death rate varies with the level of capital per head, and c), the birth rate varies inversely with the level of education, while the death rate is again a function of population per unit of production. Trygve Haavelmo, A Study in the Theory of Economic Evolution, (Amsterdam: North-Holland, 1954), pp.19, 25-26, 39-44. The models of Solow, Kaldor and Niehans are considered in the section on trap models below.

²Harvey Leibenstein, Economic Backwardness and Economic Growth, (New York: Wiley, 1957), p. 148.

In the face of the chronic problems of underdevelopment and imbalances in wealth among nations and within nations, the multi-disciplinary approach that evolved towards problem solving in economics has provided a warmer welcome for population. Since the late fifties, a number of models have accorded explicit endogenous treatment to population. In these models the links established between population and the economic system have been such that the level and the rate of growth of population are determined by other predetermined variables. In relation to these predetermined variables, population is dependent. The connection which endogenous population models exploit is the relationship generally expressed as that between population and per capita income. In most cases the relationship is taken to be positive. This relationship has been combined with other postulates in various frameworks in an effort to vindicate or invalidate Malthusian pessimism.

This chapter presents a review of models in which population has been treated endogenously. Excluded from coverage, therefore, are models where connections between population and the rest of the system have been recognized but the rate of growth of population remains given. Such is the case in the growth models of Harrod, Domar and von Neumann among others, where population as labour is a factor of production but warranted growth rates must be brought into line with the

exogenously given rate of growth of the labour force for the attainment of a Golden Age. Population trajectory models designed to determine the effects of alternative fertility assumptions on future economic variables--such as those by Coale and Hoover, Demeny, Enke, Walsh and Isbister¹--are also omitted. These models, while economic-demographic in nature, do not treat population endogenously. Causality runs from the demographic sphere to the economic sphere for determining the economic implications of various exogenously given demographic trends.

The starting point is the work of the classical economists--Adam Smith, Malthus and Ricardo--whose assumptions provided the foundation for subsequent constructs. From this point several trends are evident. The works of Leibenstein (1957) and Adelman (1961) who incorporated the demographic stages formulation into the basic classical assumption is one extension. Leibenstein (1954), Solow (1956) and Nelson (1956) by combining the assumption of capital growth as a function of per capita income with the classical assumption developed the controversial trap model which has been supported in

¹The advantages and shortcomings of these models have been discussed by Robert R. Cassen "Population and Development: A Survey", World Development, 4, October-November 1976, pp.785-830, and Geoffrey McNicoll "Economic-Demographic Models" pp. 649-676 in L. Tabah, ed., Population Growth and Economic Development in the Third World, 2 vols. (Dolhain, Belgium: IUSSP, Ordina Editors, 1976) among others.

relation to technical progress by Kaldor (1957), treated as a special case by Niehans (1963) and Enke (1963), refuted by Hagen (1959) and Muhsam (1968), and accorded authenticity by Higgins (1959, 1968) in a unique multi-trap version. Cochrane (1973) has demonstrated relevance between the Malthusian assumption and Ohlin's (1967) specification of static and dynamic optimum populations. The 'world future' models, disposed to recapitulating Malthusian disaster in large scale system simulation, have been countered by the 'new society' model. The Bachue models deal with employment specifically but also consider the issue of supplementing subsistence with basic requirements. The CANDIDE models, large medium-term simulations of the Canadian economy, admit the possibility for an endogenous treatment of demographic variables with income as a determinant. Hence, the subdivisions of this chapter are: the classical approach, demographic stages, the trap theories, optimum population, and large-scale system simulation models. The final section--the dual economy approach and the dependencia rebuttal--provides justification and discussion of the dualistic framework, as an alternative to the previous approaches, and as a prelude to the discussion of chapter III.

The Classical Approach

The classical economists experienced no reluctance regarding the explicit inclusion of population as an endogenous variable. The link for establishing endogeny was not

singular to any one theory. Based on the operation of the laws of supply and demand, population proportionate to the labour force was, in general, a positive function of wages. The rate at which population grew was related to demand, which was in turn a function of capital accumulation and the rate of growth of the economy.

Adam Smith, in "An Inquiry into the Nature and Causes of the Wealth of Nations", regarded the supply of labour to be a function of the demand for labour through a proportional relationship between labour supply and the wage rate.

. . . the demand for men, like that for any other commodity, necessarily regulates the production of men; quickens it when it goes on too slowly, and stops it when it advances too fast. It is this demand which regulates and determines the state of propagation in all different countries of the world¹

Every species of animals naturally multiplies in proportion to the means of their subsistence, and no species can ever multiply beyond it . . . scantiness of subsistence can set limits to the further multiplication of the human species; and it can do so in no other way than by destroying a great part of the children which their fruitful marriages produce.

The liberal reward of labour, by enabling them to provide better for their children, and consequently to bring up a greater number, naturally tends to widen and extend those limits.²

Thus if the actual wage exceeds the subsistence wage, an increase in the birth rate combined with reduced child

¹Adam Smith, (1776) The Wealth of Nations, (New York: Random House, 1937), p. 80.

²Ibid., p. 79-80.

mortality and increased life expectancy will increase the supply of labour. Population is therefore found to be a positive function of the difference between actual wage and subsistence wage.

Moreover, the increase in actual wage above subsistence level is a function of the rate of growth of the economy.

The demand for those who live by wages, therefore, necessarily increases with the increase of the revenue and stock of every country, and cannot possibly increase without it. The increase of revenue and stock is the increase of national wealth. The demand for those who live by wages, therefore, naturally increases with the increase of national wealth, and cannot possibly increase without it.

It is not the actual greatness of national wealth, but its continual increase which occasions a rise in the wages of labour.¹

The Malthusian theory of population is contained in "The Principles of Political Economy" as well as the often quoted "An Essay on the Theory of Population". In the "Essay", Malthus considered conditions which permitted the increase of population to its upper limit. Restating Adam Smith on the role of the means of subsistence, Malthus declared that

1. Population is necessarily limited by the means of subsistence.
2. Population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks.
3. These checks, and the checks which repress the superior power of population, and keep its effects on a level with the means of subsistence are all resolvable into moral restraint, vice and misery.²

¹Ibid., p. 69

²T. R. Malthus (1803), An Essay on the Principle of Population, 2 vols., (London: Dent, 1967), pp. 18-19.

A permanent increase in population would therefore require an increase in the means of subsistence.

It is this aspect of Malthus' theory that is paralleled in contemplations of limitations to growth where super-exponential growth trends replace geometric progressions in multivariate computerized models. If, however, the link for endogenous population is sought prior to the attainment of the upper limit, the "Principles" provides the answer in terms of available employment.

What is essentially necessary to a rapid increase of population is a great and continued demand for labour; and this is proportioned to the rate of increase in the quantity and value of those funds, whether arising from capital or revenue, which are actually employed in the maintenance of labour.¹

An increase in the funds for the maintenance of labour is in turn related to the increase of capital provided that capital is not too rapidly introduced.

. . . if, by the gradual introduction of a greater quantity of fixed capital we could cultivate and dress our soil and carry the produce to market at a much less expense, we might increase our produce very greatly by the cultivation of all our waste lands and the improvement of all the land already in cultivation; and if the substitution of this fixed capital were to take place, that is, gradually, there is no reason to doubt that the value of raw produce would keep up nearly to its former level; and its greatly increased quantity, combined with the greater proportion of the people which might be employed in manufactures and commerce, while it would occasion a very great increase in the exchangeable value of the general produce, would increase at the same

¹T. R. Malthus (1836), Principles of Political Economy (New York: Kelley, 1964), p. 234.

time the value of the funds destined for the maintenance of labour, and thus cause a great demand for labour and a great addition to the population.¹

Contrary to the views of some writers, Malthus does not consider population pressure an impetus to growth over the long period. Increased population may produce a temporary effect by causing reduced wages and increased profits. However a decline in wages below that required for maintenance will in turn cause population to decrease.

It is said perhaps that the increase of population will lower wages, and, by thus diminishing the costs of production will increase the profits of the capitalists and the encouragement to produce. Some temporary effect of this kind may no doubt take place, but it is evidently very strictly limited. The fall of real wages cannot go on beyond a certain point without not only stopping the progress of the population but making it even retrograde; and before this point is reached, the increase of produce occasioned by the labour of the additional number of persons will have so lowered the value, and reduced profits, as to determine the capitalist to employ less labour

It is obvious then in theory that an increase of population, when an additional quantity of labour is not required, will soon be checked by want of employment and the scanty support of those employed, and will not furnish the required stimulus to an increase of wealth proportioned to the power of production.²

In treating endogenous population, Ricardo makes the supply of labour a function of the difference between the market wage and a natural wage rather than an actual wage and subsistence wage. "The market wage of labour is the price

¹Ibid., pp. 237-238.

²Ibid., pp. 312-313.

which is really paid" and derives from "the natural operation of the proportion of the supply to the demand."¹ It is related to capital accumulation "for in proportion to the increase of capital will be the increase in the demand for labour; in proportion to the work to be done will be the demand for those who are to do it".²

The natural price of labour is that price which is necessary to enable the labourers, one with another to subsist and to perpetuate their race, without either increase or diminution.³

The natural wage is not constant.

It varies at different times in the same country, and very materially differs in different countries. It essentially depends on the habits and customs of the people.⁴

If the natural wage is taken to be a subsistence wage, then a variable psychological subsistence is explicitly referred to rather than a physiological subsistence wage.

Thus,

It is when the market price of labour exceeds its natural price that the condition of the labourer is flourishing and happy, that he has it in his power to command a greater proportion of the necessities and enjoyments of life, and therefore to rear a healthy and numerous family.⁵

¹David Ricardo, (1821), The Principles of Political Economy and Taxation (London): Dent, 1969), p. 53.

²Ibid., p. 54.

³Ibid., p. 52.

⁴Ibid., p. 54-55.

⁵Ibid., p. 53.

While the classical economists used varying terminology for explaining changes in labour supply as a function of wages, it was through this means of endogenizing population that the economy was conceived to move from a progressive state towards a stationary state. In the progressive state, a high level of investment would encourage a high level for the market or actual wage, which would consequently encourage high rates of population growth. The high rates of population growth would reduce wages to subsistence level, causing profits to increase and net investment to take place, whereupon the process would repeat itself. Gradually, with a fixed quantity of land, the larger population would result in diminished average returns to labour and a total wage bill that would eventually erode profits after rent. Thus, with no further inducement to invest, the stationary state would be attained.

Demographic Stages

The theory of demographic transition postulates a sequence of changes in the rate of population growth over time due to trends in the vital rates. There are several statements of the theory provided by Thompson (1929), Blacker (1947), Notestein (1960) and Demeny (1968) among others. One often used version describes four successive stages--high fluctuating, early expanding, late expanding and low fluctuating. The first is characteristic of the pre-growth economy where

both fertility and mortality rates are high and fluctuating. Following on economic growth, the mortality rate falls rapidly in the second stage. After a lag the fertility rate follows the mortality rate downwards. Eventually, in the fourth stage, fertility and mortality rates are fluctuating at low levels.

Based on observations of vital trends in certain European countries, the theory was rapidly transformed into a "natural demographic law". Mortality was believed to vary inversely over time with the level of living and natality would effect a balancing movement which would reduce net reproduction to unity.¹ Moreover, urbanization and industrialization were thought to have important roles in stimulating the process of demographic transition.

The inevitability of low growth rates and the automaticity with which this would be achieved were taken to have marvelous policy implications for a country setting out on the path of modernization. The certainty of eventual decline meant that population policy measures may be entirely overlooked. As long as a country could ensure industrialization and increased productivity, then eventual decline of population was assured!

Demographic transition was heartily incorporated into economic-demographic theory. Leibenstein (1957) claims

¹Harold Fredrickson, "Dynamic Equilibrium of Economic and Demographic Transition", Economic Development and Cultural Change, 14, April 1966, pp. 316-322.

economic vitality for the demographic structure in his synchronization of the stages of transition with cost/benefit analysis, the minimum effort criterion, and the relation of population to income. Adelman's (1961) neo-Keynesian model with endogenous population relies on an explanation of demographic changes which parallel those of the theory of demographic transition. The works of both authors depend on the assumption that the demographic transition process provides a framework, in terms of vital trends, for a country's salvation from Malthusian doom.

Leibenstein's viewpoint is as follows:

The difficulty with the stages of demographic evolution doctrine is that it does not explain any critical aspect of the problem. At best, it is a broad description of past demographic events. But it does not shed light on crucial questions, as to why some countries developed while others did not; nor does it indicate how the nature of population growth is related to the vast differences in per capita incomes that are to be found in different countries.¹

Hence, his rationalization explains the four events of subsistence equilibrium with equally high fertility and mortality rates; early growth with falling mortality rates, the "crucial point" where fertility begins to decline, and advanced growth where fertility and mortality are greatly reduced, in terms of cost-benefit analysis. The costs derive from the direct expenses of maintaining a child and the indirect opportunity cost,

¹Harvey Leibenstein, Economic Backwardness and Economic Growth, p. 156.

while the benefits result from the pleasure of parenthood and the utility of the child as a productive agent and a potential source of security. Costs and benefits are affected during the process of development by the income effect, the survival effect, and the occupational distribution effect.

The income effect is treated as indeterminate since consumption utility may increase or decrease as income rises. The marginal utilities to be derived from a child as a source of security or a productive agent diminish as income rises. More time will be spent on the education of the child. Further, parents will have access to alternative sources of income in later years as the level of per capita income rises. It is also expected that the costs of maintaining a child increase as income rises; the style in which a child is maintained is related to his parents' income. Opportunity costs in terms of other consumption activities also increase as parents incomes rise.

The survival effect may be expected to increase the levels of utility. At first a decline in the mortality rate of children will increase the productive value of children. As the "infant mortality hump" is overcome and mortality rates decline less rapidly, the survival effect becomes less important.

The occupational environment that evolves as economic growth occurs allows for a greater degree of social mobility.

The "social capillarity thesis"¹ supports the view that parents will forego additional children in an attempt to improve their social status.

Synchronizing the cost-benefit analysis with the theory of demographic transition, Leibenstein shows that the excess of benefits over costs will encourage high fertility in the subsistence economy at a time when mortality rates are also high. With early growth and the decline of mortality rates, improvements in the chances of survival are realized with a lag so that fertility rates remain high. The shorter the fertility lag, the smaller will be the initial minimum effort required to initiate growth. Eventually the fertility-mortality gap closes at low levels with high per capita income.

Adelman's model describes a sinusoidal growth path through time for population where first death rates decline "due to the rapid drop in both infant and adult mortality", then "birth rates will begin to drop under the impact of urbanization, industrialization, and the higher status of women".² This approach is combined with the classical relation of population growth to wages and distribution of income between two

¹The Theory of capillarité sociale is advanced by Dumont, and stressed in a number of works. United Nations, The Determinants and Consequences of Population Trends, Population Studies, No. 17 (New York: United Nations, 1953), p. 79.

²Irma Adelman, Theories of Economic Growth and Development, (Stanford: Stanford University Press, 1961), p. 111-112.

classes. Hence, the rate of growth of population is related to "the excess of the real wage rate over the subsistence wage level".¹ The subsistence wage level appears to be physiological rather than psychological since "whenever the wage rate rises slightly above subsistence, there is a strong impetus to population growth".² Further,

. . . the dependence of population growth upon the distribution of income is most pronounced at low levels of per capita income. Even when the over-all average standard of living is low, the per capita income of profit receivers is so high that mortality rates within the entrepreneurial class are not particularly sensitive to changes in income. In contrast, at low levels of income the rate of growth of the working class must be quite heavily income-dependent. A higher rate stimulates the growth of the labouring population by reducing mortality rates through the better nutrition, health, and sanitation standards that accompany improved wages. Births also rise, since a larger percentage of live births stems from the better health conditions of women of child-bearing age. As a result, at low per capita incomes a redistribution of income in favor of wage earners generally augments the population growth rate, whereas an increase in the share of profit receivers generally reduces the pace of population expansion.³

In the long run population is a function of the capital-labour ratio. The wage rate, to which population responds, is taken to be positively related to the percentage change in the capital-labour ratio. If the percentage rate of capital accumulation is greater than the percentage increase of the labour

¹Ibid., p. 111.

²Ibid., p. 111.

³Ibid., p. 111.

force, the wage rate will adjust upwards to accommodate the excess of the demand for labour over the supply of labour.

The expansion of the basic relationship between population and income in terms of the demographic transition framework was generally accepted until dissatisfaction was expressed with the theory of demographic transition and its general applicability challenged. Criticisms have exposed its historical invalidity, its malspecification of the interrelationships between vital rates and the process of modernization, its vagueness concerning the relations between fertility and mortality, and its deficient predictive utility. Krause¹ and Petersen,² on the basis of empirical evidence, argue that the populations of certain European countries grew as a result of increasing fertility rather than the onset of a decline in mortality rates. It is Krause's opinion that demographic theory underestimates the potential of births to increase the rate of population growth in pre-industrial societies. The implications are a 'fantastic' increase for birth rates in less developed countries. Van Nort³ supports the view that fertility trends rather than declining mortality stimulated

¹J. T. Krause, "On the Possibility of Increasing Fertility in the Underdeveloped Nations", Comparative Studies in Society and History, 2, July 1960, pp. 485-487.

²W. Petersen, "The Demographic Transition in the Netherlands", American Sociological Review, 25, June 1960, pp. 334-347.

³L. Van Nort, "Some Issues for Transition Theory", Population Index 26, July 1960, p. 209.

population growth in pre-industrial Europe. Wrong¹ emphasizes the fact that few countries conform to the trends for vital rates proposed by the theory. Hence, its adequacy as a descriptive model is limited. Durand,² on the basis of population growth without industrialization in China, demonstrates the absence of causal links between industrialization and demographic transition. Stolnitz³ sees the possibility for population growth where birth rates respond without lags to declines in death rates. Hatt, Farr and Weinstein⁴ report that the transition theory conceals important differences between demographic and economic structures in many countries, making the assumption of a sequence unjustified. Van Nort⁵ sees as a deficiency the failure of the theory to specify independent variables since urbanization and industrialization are summaries of a myriad of complex socio-cultural and economic variables.

¹D. H. Wrong, Population and Society, (New York: Random House, 1961).

²J. D. Durand, "Generalized Demographic Models and Projections of the Population of China", Asian Survey, 1, June 1961, pp. 29-34.

³G. Stolnitz, "Interrelations Between Economic Development, Levels of Living and Demographic Trends", in D. Bogue, ed., Applications of Demography: The Population Situation in the U.S. in 1975, (Oxford, Ohio: Scripps Foundation for research in Population Problems, Miami University, and Population Research and Training Centre, University of Chicago, 1957), pp. 5-13.

⁴P. K. Hatt, N. L. Farr and E. Weinstein, "Types of Population Balance", American Sociological Review, 20, February 1955, pp. 14-21.

⁵Van Nort, "Some Issues for Transition Theory", p. 209.

Tauber¹ discovers that demographic variables were one facet of an entire process of change and neither independent factors nor products of change. Notestein² admits that the theory does not give information either for policy formulation or for prediction. Thompson³ also sees no predictive value for the theory. Cowgill,⁴ Durand,⁵ and Stolnitz⁶ question the validity of the theory regarding the expected population decline and schedule for the downturn of fertility. Davis⁷ states that the transition should not be seen as inevitable.

The Trap Theories

With the Malthusian low level equilibrium in mind, Leibenstein (1954) postulated two opposing responses to an

¹Irene Tauber, "Japan's Demographic Transition Re-examined", Population Studies, 14, July 1960, pp. 28-39.

²F. W. Notestein, "The Economics of Population and Food Supplies", Proceedings of the Eighth International Conference of Agricultural Economists, Oxford University Press, 1953, pp. 16-18.

³W. S. Thompson, "Population", American Journal of Sociology, 34, May 1929, pp. 959-975.

⁴D. O. Cowgill, "The Theory of Population Growth Cycles", American Journal of Sociology, 55, July 1949, pp. 163-170.

⁵J. D. Durand, "Generalized Demographic Models and Projections of the Population of China", pp. 29-34.

⁶G. Stolnitz, "Interrelations Between Economic Development, Levels of Living and Demographic Trends", pp. 5-13.

⁷Kingsley Davis, Fertility Control and Demographic Transition in India, The Interrelations of Demographic Economic and Social Problems in Selected Underdeveloped Areas, (New York: Milbank Memorial Fund, 1954), pp. 67-68.

increase in average income which provided a first approach toward a trap model. The assumption that the invested portion of average income gains would increase capital stock and yield additional increases to future average income was set against the classical assumption that population may be expected to respond positively to increased average income. Hence any improvement in income may be offset by population.

Based on these assumptions Leibenstein showed that the stability of the Malthusian equilibrium depended on the relative strengths of the average income gain multiplier and the population multiplier which respond to the initial increase in average income. But even if the average income gain multiplier exceeds the maximum population multiplier, there will be "a critical minimum positive displacement below which the system is stable; i.e., unless the initial increment in average income is sufficiently large, the deviations from Malthusian conditions are temporary".¹

The essentials of the trap model are also to be found in Solow's (1956) article "A Contribution to the Theory of Economic Growth". Solow, utilizing the assumption of variable proportions with constant returns to scale, moves away from the Harrodian short run and incorporates the classical

¹H. Leibenstein, A Theory of Economic Demographic Development, (Princeton: Princeton University Press, 1954), p. 65.

assumption of endogenous labour and thus variable population growth. With a growth rate of capital that may be expressed as a function of per capita income, Solow combines a rate of growth of population also a function of per capita income. The rate of growth of population originally represented by a ray through the origin is now 'twisted' about the total product curve. Solow demonstrates possible responses of labour supply: first decreasing, then increasing, then levelling off and declining. Stable and unstable equilibria are derived for two levels of capital-labour ratios, the system tending always to return to the stable lower ratio unless it can be "boosted above" the higher "critical level" where a self sustaining process of increasing per capita income would be set off despite a growing population.

Published shortly after was Nelson's (1956) more explicit version of the same dilemma in "A Theory of the Low-Level Equilibrium Trap in Underdeveloped Economies". The 'trap' corresponded to Solow's stable equilibrium where with population again increasing more rapidly than output the economy was forced back towards a low level of per capita output.

The model is based on three equations: 1) a linear homogeneous production function with factors capital and population, labour force bearing a constant relationship to the size of the population, 2) an equation explaining changes in capital as the summation of savings and new land under

cultivation, 3) an equation explaining population growth where at low-income levels changes in death rates, a function of per capita income, are the motivating forces. Birth rates are assumed constant. The low level equilibrium trap is caused by the greater response of population than that of output to per capita income. The social and technological conditions causing the trap are a high correlation between the level of per capita income and the rate of population growth, a low propensity to direct additional per capita income to increasing per capita investment, scarcity of uncultivated arable land, and inefficient production methods.

Escape from the trap may be achieved by changing the social structure with the emphasis of thrift, entrepreneurship and limited family size; changing the distribution of income so that investors may accumulate wealth; directing government investment so that the response of output to per capita income will be greater than that of population; or, alternatively, shifting the rate of change of output upwards with technical change.

Kaldor's (1957) model of economic growth was disposed to demonstrating the possibility of a trap, when endogenous population is related to technological progress. Kaldor specifies a "technical progress function" which takes account of increases in output due to technical progress as well as capital accumulation. Population is made endogenous in that its

growth rate is taken to be a function of the rate of growth of income, the former rate rising until a ceiling is attained at a certain critical value of the latter rate. It is shown that an economy will not attain stable equilibrium growth if the maximum rate of population growth exceeds the rate of technical progress which causes a certain percentage increase in productivity. If the rate of technical progress is itself adversely influenced by the rate of population growth, it may never be possible for the rate of growth of output to exceed the rate of growth of population, thereby permitting escape from the trap of stagnation.

Further theoretical specification of the trap theory reduced its relevance from general to specific applicability. The models of Niehans (1963) and Enke (1963) considered the trap to be a special case only. Niehans' model provides an extension of Solow's contribution by combining endogenous labour with growth theory. Identifying first a two class model where the proletariat "propagates itself but does not save" and the capitalist "is accumulating capital but produces no offspring beyond reproduction", Niehans demonstrates situations where, given positive marginal propensities to proliferate and accumulate along with varying relative wage levels and capital returns, it is possible under conditions of diminishing, increasing or constant returns, to arrive at the "stream of eternal growth", the "current of general decay", or positions of "secular stagnation". Niehans is happier, however, with the

one class model where both accumulation and proliferation are, he considers, more realistically the responsibility of the entire population. In this case, the relative positions of the subsistence minima with respect to capital and population will determine the prospects for growth, stagnation or decadence, the chances for self-sustaining growth being the better and the risk of doom being the smaller, the higher the population minimum in relation to the capital minimum.¹

Traps arise only as special cases of the two class and one class models and, in keeping with Leibenstein's "critical minimum effort", instances are outlined where "big push" requirements are possible and necessary for avoiding an eternal state of decay.

Enke's "general model" of population and development² purports to reconcile the features of the Malthusian and the neo-Malthusian trap models.

On one hand there are the gloomy Malthusian expectations of eventual poverty unless improved technology, increased frugality, or reduced fertility can intervene. On the other, there is Nelson's comparatively hopeful analysis of how nations can evade or escape low per capita income "traps" and avoid a later fate of poverty.³

¹J. Niehans, "Economic Growth and Two Endogenous Factors," Quarterly Journal of Economics, 77, August 1963, p. 364.

²Stephen Enke, "Population and Development: A General Model", Quarterly Journal of Economics, 77, February 1963, pp. 55-70.

³Ibid., p. 55.

Postulating production with the factors capital and labour; constant natural resources so that returns to capital and labour may diminish; savings rates for each level of income so that capital is not fixed in supply; in addition to the assumptions that death rates are a function of per capita income and fertility, frugality, and technology are exogenous; Enke claims to explain "all elements that seem most essential to an economic analysis of population growth and personal incomes". It is found that,

. . . despite Nelson's analysis, per capita income must slowly approach a given level: there is no avoiding this destined income per head unless exogenous changes in frugality, fertility, or technology intervene. Also, despite Malthus' initial and popularized pessimism, it appears that this minimum income per head may be well above any subsistence level in a relatively classless society where many workers also save. What is essential, even though technology and frugality remain unchanged, is a low fertility rate.¹

Enke's policy prescription is that the birth rate be reduced.

Optimistic belief, not only in the capacity of technological change to pull a country out of the low level equilibrium trap, but also in "indefinitely continuing technical progress" is the basis of Hagen's (1959) model of population and economic growth. Hagen outlines a sequence of events where technical change shifts the percentage change of income curve upwards, causing an increase in per capita income. The consequent decline in the death rate allows for increases in the

¹Ibid., p. 56.

percentage change of population. After a lag birth rates fall. The resulting decline in the rate of population increase constitutes a movement downwards of the percentage change of population curve. With percentage change of population less than percentage change of income, per capita income will again increase, the process repeating itself until birth and death rates reach a minimum and a higher level of per capita income is sustained.

Muhsam's (1968) view is that the trap model, while exploiting the effect of population on economic growth, fails to deal adequately with the effects of economic development on population. He finds the assumptions regarding the greater response of population growth to per capita income than the rate of growth of national income to per capita income inconsistent with empirical evidence. Following Muhsam's argument, an increase in per capita income above equilibrium level creates growth of national income of amount y . If the trap argument is conclusive, then population should increase by an amount $z > y$. Now population growth is determined by the excess of birth rate over death rate. In developing countries, only the death rates can fall. If $z > y$, then this can be attained only with a sufficient decline of death rate. Since death rates in most developing countries have been observed to be between approximately 1.5 and 3.5 percent, it is unlikely that they can decline by more than the rise in national incomes.

Muhsam concludes,

Neither is there a position of stable equilibrium nor exists any unescapable trap . . . We are thus left without any theory which helps to understand the effect of population trends on economic growth in developing countries in a satisfactory and relatively complete way.¹

Higgins' (1959, 1968) model explores the relationship between population, capital requirements and savings to arrive at traps applicable to the single sector economy and the dual economy over time. In summary the model is as follows. Endogenizing population in the classical manner, the percentage rates of population growth are taken to be a function of per capita income. With incomes less than subsistence level, population declines, while with incomes greater than subsistence level, population rises rapidly to its biological maximum rate of growth. Aggregate net savings are also a function of per capita income. These savings will be negative at low levels of income but will become positive at a lower level of per capita income than population growth. Capital required or capital "needed to achieve the corresponding level of per capita income" is a function of the ratio of capital to output as well as the rate of population growth. A low level equilibrium trap is found where

¹H. V. Muhsam, Critique of Two Theories on the Population Factor, in Economic Growth of Developing Countries, p. 227 in E. Szabady, ed., World Views of Population Problems (Budapest: Akadémiai Kiadó, 1968).

the rate of capital accumulation is just enough to maintain per capita income slightly above the subsistence level with a modest rate of population growth . . . any "marginal" move toward higher per capita incomes will be thwarted by capital requirements which exceed savings.¹

Applying the analysis to the dual economy, Higgins demonstrates that the curve of capital requirements in the rural sector will shift to the left with increased rates of population growth and the onset of diminishing returns or to the right with improvements in technology. Should investment in the industrial sector cause population explosion in the rural sector, the capital requirements curve will shift to the left so that even if investment in the rural sector is sufficient for escaping the trap, the stable equilibrium position that may eventually be attained will be at a lower level of per capita income than that prior to the population explosion. One possibility considered is the drastic leftward shift of the capital requirements curve so that escape from the trap is impossible. The happiest solution considered depends on the operation of the "Hirschman effect"--accelerated technological progress and large scale agricultural improvement induced by population pressure--and the "Hagen effect"--the built-in habit of technical progress--in effecting technological progress and declines in the rate of population growth such that the capital requirements curve shifts sufficiently

¹ Benjamin Higgins, Economic Development: Problems, Principles and Policies, 2nd. ed., p. 351.

to the right. With savings in excess of capital requirements, the trap is broken and high levels of per capita income may be attained.

In the industrial sector, the capital requirements curve may be expected to shift to the right in the long run due to an increasing "supply of Schumpeterian New Men". With savings in excess of capital requirements, growth in this sector is uninhibited.

The "big push" policy for development must cause shifts in the capital requirements curve in the rural sector, not just movements along the curve, if per capita income in that sector is to be brought closer to that in the industrial sector.

Introducing indivisibilities with respect to the supply of capital and demand, discontinuities in the capital requirements curve allow for a series of traps at various levels of per capita income. A series of planned minimum efforts is required for breaking these multiple traps.

Optimum Population

The concept of optimum population is not easily dealt with. Various definitions have been proposed in terms of the minimum population required for maximizing per capita output, achieving an efficient division of labour, maximizing power, or attaining the coincidence of marginal social benefit of

population growth with marginal social cost. John Stuart Mill (1848) defined an optimum population as follows:

After a degree of density has been attained sufficient to allow the principal benefits of combination of labour, all further increase tends in itself to mischief, so far as regards the average condition of the people.¹

Spengler for instance, states:

The population of a country may be said to be of optimum size when, given the cost of supporting the economically unproductive part of the population, the aggregate population is of the minimum size required to maximize per capita income in a manner compatible with the relevant rate of interest and the assumption that other conditions remain constant.²

Despite these definitions the concept is yet "far short of easy practical application". Robbins (1968), in discussing some of its limitations, emphasizes the assumption of constant technical knowledge and constant capital, the dependence on the degree of openness of an economy such that division of labour with the rest of the world is possible, the index number problem involved, and the accounting only of that part of real income which may be matched with the expenditure of individuals.³ The optimum rate of growth of population, as

¹John Stuart Mill, (1848) Principles of Political Economy, 7th ed., W.T. Ashley, ed. (New York: Kelley, 1961), pp. 191-192.

²J. J. Spengler, "The Population Obstacle to Economic Betterment", American Economic Association Papers and Proceedings, XLI, May 1951, p. 345.

³Lord Robbins, The Theory of Economic Development in the History of Economic Thought (New York: St. Martin's, 1968), pp. 41-43.

distinct from the optimum population, also raises problems since a keen balance must be found between that rate of growth which will stimulate investment and that required for keeping the dependency burden and the reduction of savings capacity minimal. In Malthus' view, positive population maladjustment would inevitably result in misery as the larger numbers of the geometrically growing population strained against the arithmetically increasing food supplies.

The question surrounding the issue of an optimum population has been aptly stated by Simon Kuznets.

The central question may be put sharply by asking why, if it is man who was the architect of economic and social growth in the past and responsible for the vast contributions to knowledge and technological and social power, a larger number of human beings need result in a lower rate of increase in per capita product. More population means more creators and producers, both of goods . . . and of new knowledge and inventions. Why shouldn't the larger numbers achieve what the smaller numbers accomplished?¹

Ohlin's (1967) analysis provides an answer. Explanations of the concepts of optimum population and optimum rate of population growth are provided. Ohlin's approach is designed to overcome the shortcoming of assuming capital constant.

There are many weaknesses in the notion of an optimum population, but from the analytic point of view the most serious one is that it assumes both technology and the supplies of other factors of

¹Simon Kuznets, "Population and Economic Growth", Proceedings of the American Philosophical Society, 111, June 1967, p. 171.

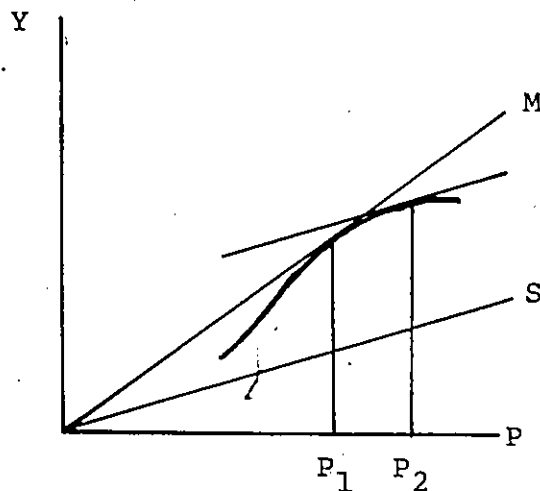
production to be constant. In the context of an underdeveloped country which is attempting to appropriate an existing technology, the first of these assumptions may be acceptable. What is more serious is the treatment of capital. To begin with, the assumption of an unchanged amount of capital immediately makes the vision of a larger population considerably less attractive . . .¹

The approach of Ohlin has been made relevant to this review by Cochrane (1973) in a juxtaposition of these concepts with the Malthusian assumption of the positive relation between population and per capita income. Cochrane's extension of Ohlin's work succeeds in placing the concept of optimum population, where an exogenously given rate of growth of population was often assumed, within the purview of population endogeny.

Looking first at Ohlin's explanations, a "primitive form" of the concept of optimum population is demonstrated as follows, Ohlin's diagrams being reproduced for clarity. With total product as a function of population, in Figure 1 below optimum population is P_1 where per capita output is maximized. If subsistence requirements OS are taken into account, P_2 represents the population of maximum surplus.

¹Goran Ohlin, Population Control and Economic Development (Paris: Development Centre of the Organization for Economic Cooperation and Development, 1967), p. 61.

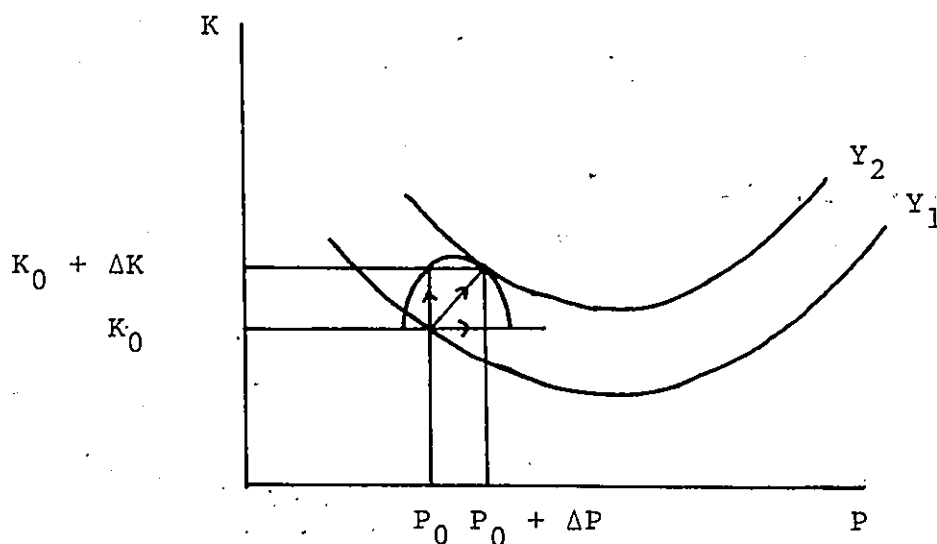
Figure 1



Should there be an increase in capital the production curve will shift upwards. This leads to the diagramatization of the concept of optimum rate of population growth.

The U shaped isoquants of Figure 2 represent combinations of capital and population which leave per capita income constant. With increasing returns to labour the isoquants slope downwards on the left of the diagram.

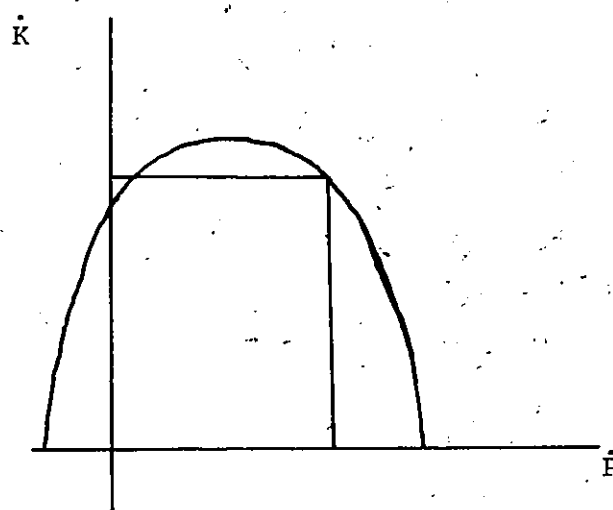
Figure 2



Starting at (P_0, K_0) , an increase of population will cause income to rise, but the increase of income will be greater if capital is increased correspondingly.

The rates of population growth and capital accumulation are taken to be related unidirectionally such that population growth will "up to a certain point" promote investment, after which a larger dependency burden will constrain the capacity to save. In effect, the Keynes-Hansen theory that capital creation is a function of population growth is assumed to operate and to be offset at high rates of population growth. Ohlin represents this by relating net investment ($\dot{K}$) to the rate of population growth ($\dot{P}$) with an inverted U shaped function reproduced below in Figure 3.

Figure 3



Superimposing Figure 3 on Figure 2 so that the origin of Figure 3 coincides with (P_0, K_0) the optimal rate of increase of population is indicated by the point of tangency between the transposed curve and the new isoquant, as shown in Figure 2. The optimal level of population growth is that at which the growth of per capita income is maximum.

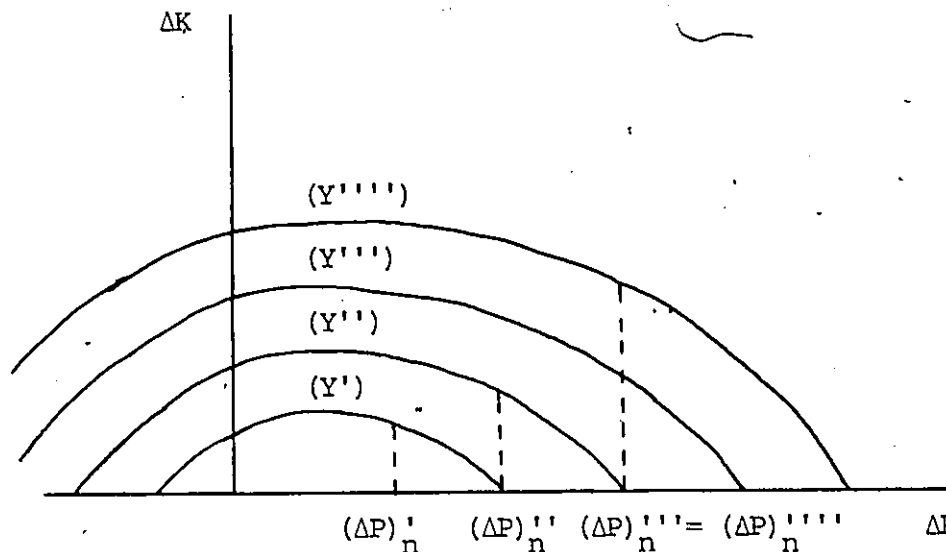
To the above framework, Cochrane adds the assumption that "income in each period affects the growth of population and capital". Thus, not only will the growth of capital be larger the higher the level of per capita income, but natural population increments will vary directly with the level of per capita income. The increases in population are taken to derive from decreases in mortality, as assumed by Nelson and Enke. In Figure 4, Cochrane illustrates that "for any given population increment, capital growth is larger, the larger the level of per capita income" and that "the natural population increment varies with the level of per capita income".¹

Thus $(\Delta P)_n$ increases with the level of per capita income until some income Y''' where no further possibility exists for reduced mortality from increases in income.

Superimposing Figure 4 on Figure 2, Cochrane demonstrates the utility of the model with and without population policies. Without a population policy, the per capita income path may be found if for each income level the corresponding

¹Susan Hill Cochrane, "Population and Development: A More General Model", Economic Development and Cultural Change, 21, April 1973, pp. 418-419.

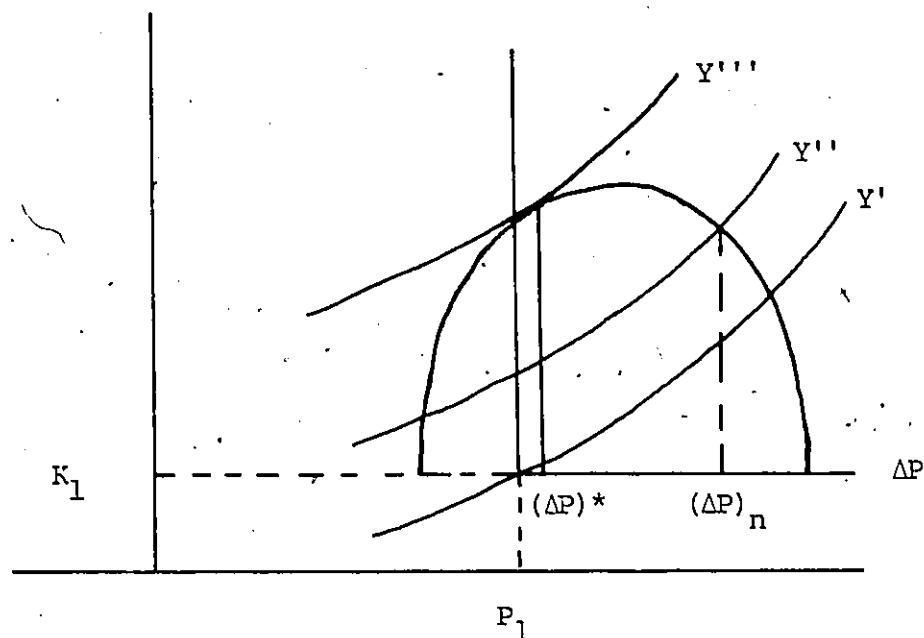
Figure 4



capital-population curve is chosen with its associated natural change in population and amount of capital accumulation. The growth of population and capital determines the level of per capita income attained at the end of the time period. Hence, in the illustration (Figure 5) reproduced below, with Y_1 , P_1 and K_1 as the initial levels of per capita income, population and capital respectively, Y'' will be reached. With a costless population policy, the optimal change in the population would be $(\Delta P)^*$ and Y''' may be attained.

The further complication of a population policy with costs is considered. These costs are netted from capital accumulation which would occur at each level of per capita income. Cochrane finds that the "truly optimal level" of

Figure 5



population growth is likely therefore to vary from Ohlin's optimal rate of population growth. It is emphasized that the 'best policy' must therefore be related to the initial income in that period and that a country may find that postponement of population control until income is sufficiently high to reduce the opportunity cost of control is advisable.

In terms of policy prescriptions, the model is considered by Cochrane to be "More General" than Enke's "General" model which insists on population control for rapid reduction of the birth rate.

The only general policy rule that can be derived from the above model is that there is no generally applicable policy. This contradicts the conclusions

some have drawn from Enke's model . . . the economies resulting from altering the birth or death rate depend entirely on the specific conditions of the country as to resources, savings behaviour, and those factors affecting the cost of implementing population policies . . . no country would find it economical to devote unlimited resources to obtaining that reduction.¹

Large Scale System Simulation Models

Four large scale system simulation models that treat population endogenously are the 'world future' models--Limits to Growth, World2 and World3--of Forrester and Meadows and others of the Massachusetts Institute of Technology research team,² the 'New Society' model of Herrera and others of the Fundación Bariloche group,³ the 'Bachue' models of the

¹Ibid., p. 421.

²Donella H. Meadows, Dennis L. Meadows, Jørgen Randers and William W. Behrens III, The Limits to Growth, (New York: Universe Books, 1972).

Dennis L. Meadows and Donella H. Meadows, eds., Towards Global Equilibrium, (Cambridge, Mass.: Wright-Allen Press, 1973).

Dennis L. Meadows, William W. Behrens III, Donella H. Meadows, Roger F. Naill, Jørgen Randers and Erich K.O. Zahn, Dynamics of Growth in a Finite World, (Cambridge, Mass.: Wright-Allen Press, 1974).

³A. D. Herrera, Hugo D. Scolnik, Graciela Chichilnisky, Gilberto C. Gallopin, Jorge E. Hardoy, Diana Mosovich, Enrique Oteiza, Gilda L. de Romero Brest, Carlos E. Suárez and Luis Talavera, Catastrophe or New Society? A Latin American World Model, work performed at the Fundación Bariloche, Buenos Aires, Argentina (Ottawa: International Development Research Centre, 1976).

International Labour Organization, and the CANDIDE models of the Economic Council of Canada.¹

Reminiscent of Malthusian gloom, the 'world future' models explore the constraints of a finite earth on the possibilities for continued economic growth. The model was originally designed to emphasize the imminent catastrophic collapse of the ecosystem on this planet if deliberate limits are not placed on the rates of population and capital growth. Based on the assumption that social variables will follow the same pattern established in the past, the model demonstrates that the system will overshoot and collapse despite a doubling of mineral reserves, unlimited nuclear power, reduction of pollution generation, doubling the average land yield, and increased birth control effectiveness. The model is based on the observed exponential rates of growth of population and capital. These exponential growth rates are being generated by positive feedback loops of high birth rates and investment rates. Negative feedback loops of death rates and depreciation are not sufficiently strong to counter the positive loops. Thus a similar growth curve for resource consumption is generated. The more detailed World2 and World3 also support the forecast

¹Ronald G. Bodkin and Stephen M. Tanny (eds.). CANDIDE Model 1.1, CANDIDE Project Paper No 18, 2 vols., Economic Council of Canada (Ottawa: Information Canada, 1975).

M. C. McCracken, An Overview of CANDIDE model 1.0, CANDIDE Project Paper No 1, Economic Council of Canada, for the Inter-Departmental Committee (Ottawa: Information Canada, 1973).

catastrophic end of the world system if growth is allowed to continue to its "natural" limits.

Rather than treat the issue of our future from the point of view of growth, the 'new society' model adopts the perspective of redistribution. The sectors are not, therefore, population, capital, agriculture, nonrenewable resources and pollution as in the 'world future' models, but nutrition, housing, education, other services and consumer goods, and capital goods. These sectors relate to the criterion of maximizing life expectancy at birth for every individual and thereby attaining an optimum distribution of the resources of the earth.

The method of endogenizing population in the 'new society' model differs significantly from that in the 'world future' models. In the latter models birth rates are related to factors such as desired total fertility, fertility control effectiveness, and family planning services, while death rates are a function of health services per capita, food per capita, crowding and pollution. In the 'new society' model, demographic variables are specifically related to socioeconomic variables. The main demographic variables are taken to be life expectancy at birth, average family size and birth rates. These variables are assumed to respond to factors such as school enrollment, houses per family, caloric and protein intake, population in the secondary sector, population in

agriculture and urbanization. In this way population response to the provision of basic needs is estimated, a fundamental hypothesis of the model being that "the only truly adequate way of controlling population growth is by improving basic living conditions."¹

Thus the 'new society' model opposes the conceptualization and the political ideology of the 'world future' models and reflects a vision of an ideal egalitarian autarchic society.

The Bachue models of the ILO² deal largely with the issue of employment and its relations with population. 'Bachue-1'³, the first model, is comprised of three subsystems--demographic, education and economic. The economic subsystem with ten productive sectors, three of which are traditional, is demand centred. Outputs and value added by sector are generated with the use of a Leontief input-output matrix. A

¹A.D. Herrera, Hugo D. Scolnik, Graciela Chichilnisky, Gilberto C. Gallopin, Jorge E. Hardoy, Diana Mosovich, Enrique Oteiza, Gilda L. de Romero Brest, Carlos E. Suárez and Luis Talavera, Catastrophe or New Society? A Latin American World Model, p. 8.

²ILO, 'Research on Population and Employment under the World Employment Programme,' International Labour Review, 109, May-June 1974, pp. 585-593.

ILO, World Employment Programme: Research in Retrospect and Prospect, (Geneva: International Labour Office, 1976).

³Richard Blandy and René Wery and others, Bachue 1: The Dynamic Economic-Demographic Model of the Population and Employment Project of the World Employment Programme, p. 17-51, IUSSP, International Population Conference, 3 vols., (Liège: International Union for the Scientific Study of Population, 1973).

labour productivity function is defined for each of the modern sectors and employment in each of these sectors is determined by dividing the value added by labour productivity. Excess labour is absorbed in the traditional sectors, the allocation being determined by respective shares of employment of each traditional sector in the initial period. The model thereby reflects the labour surplus aspect of dualism.

Population disaggregated by age, sex, location and activity status is made endogenous through variables which largely relate to employment. Planned births are therefore a function of employment opportunities for women, educational level of adults, the proportion of unpaid family workers in the labour force, the average household income, as well as child mortality. Unplanned births are a function of modern contraceptive technology. Deaths relate to average household incomes.

Later Bachue type models have been prepared for specific countries as well as for evaluating the basic needs strategy, but only as the meeting of needs may be reflected in increased incomes for the poor.¹

¹M.J.D. Hopkins, G.B. Rodgers and R. Wéry, "Evaluating a Basic-Needs Strategy and Population Policies: The BACHUE Approach", International Labour Review, 114, November-December 1976, pp. 261-279.

The endogenous treatment of population in the CANDIDE models may be viewed best in terms of a potential, since actual endogeny is yet limited. One goal of the model builders is to incorporate demographic variables such that they will be explained by behavioural equations which employ values of predetermined variables generated by the model. The dependence of the fertility rate of a group on its relative income position, as emphasized in Easterlin's work, is given as a case in point.¹ While the demographic variables in CANDIDE model 1.0 are entirely exogenous and are not affected by the economic variables generated within the system, CANDIDE model 1.1 has provided for a measure of endogeny.² In this enlarged version, a behavioural equation for net immigration as a function of the unemployment rate--a surrogate for economic conditions--is included. Otherwise, the demographic block is comprised of identities.

The extent of the usefulness of large scale simulation models has been questioned by some discussants. Myrdal

¹Wolfgang M. Illing, CANDIDE Model 1.0: Labour Supply and Demographic Variables, CANDIDE Project Paper No 9, Economic Council of Canada, for Inter-Departmental Committee (Ottawa: Information Canada, 1973), pp. 3-4.

²Ronald G. Bodkin and Stephen M. Tanny (eds.), CANDIDE Model 1.1, CANDIDE Project Paper No 18, 2 vols., Economic Council of Canada (Ottawa: Information Canada, 1975), vol. 1, pp. 267-270.

observes that models should contain many interrelationships to be 'logically consistent' and 'correspond with reality.'¹ In discussing economic-demographic models McNicoll takes the contrary view.

Insight is not always served by the accretion of more and more economic-demographic interaction mechanisms. Indeed, greater attention to the magnitudes of structural elasticities in existing models could well lead to dispensing with much unnecessary gadgetry.²

The preceding review of economic-demographic models covers those with explicit, if sometimes limited, endogenous treatments of population. However, apart from the 'new society' model, which supports the basic needs strategy, and the Bachue model, which aims at increasing employment, these approaches and their policy implications do not appear to have provided effective solutions to the problems of population growth that are evident in many countries. The gradual movement towards the stationary state anticipated by the classicists, where all factors, including population, will be in harmony, has not been realized. (The dispensability of population policies implied by the demographic transition theory, as long as industrialization and urbanization occurs, has proven to be an inappropriate approach. 'Big push' policies for avoiding traps, whether by promoting frugality or faster

¹G. Myrdal, Asian Drama, (New York: Twentieth Century Fund, 1968), p. 2075.

²G. McNicoll, Economic Demographic Models, pp. 662-663.

technological change, have achieved growth without development. Recommendations for changing the social structure have been vague on measures for achieving this, while suggestions by trap theorists for redistributing income towards investors or redirecting government investment have been made with the intention of effecting a sufficiently large initial increment in productivity, not for affecting population. Where population control through increased birth control effectiveness has been advised, no practical means for achieving this has been suggested. Indeed, it has been realized that birth control measures, by themselves, are not an effective means of reducing population growth rates.

The Dual Economy Approach and the Dependencia Rebuttal

The dual economy approach may be regarded as an alternative structure for the treatment of population. Firstly, the framework readily admits the demographic factor. It is possible to treat population and its rate of growth in one sector, in apposition with production and its changes in the other sector, such that the process of interaction between these demographic-economic entities may be clearly delineated and easily understood. Secondly, the approach accommodates endogenous population. Population, the dependent factor, may be specified as a function of output, the predetermined variable. Thirdly, the differential responses of population growth rates

to increases in productivity may be portrayed. It is possible to incorporate the positive 'Malthusian' response, along with the negative response observed over the long run. An increased birth rate in one sector can cause an overall increase in population growth rates, resulting in the positive response. When the birth rate in that sector is brought into line with that of the other sector, the second negative response may be observed. Fourthly, with the motivation, provided by need-oriented public policy, for moving from one response to the other, the dual economy approach suggests workable proposals for resolving the population problem.

A number of authors have recognized that the proper setting for the population problem is duality. Higgins combines both concepts in his discussions in his book "Economic Development: Principles, Problems, and Policies". Of the economic-demographic models with endogenous population reviewed above, those reflecting aspects of dualism are the Bachue models, in relation to the disposition of residual labour, and the two class variants of models where population responses differ.

However, the dual economy approach has adamant opponents. The ineffectiveness of strategies devised for combining development with growth in less developed countries, has led to the acceptance of new schools of thought which discard dualism along with the analytical framework, and sometimes even the

techniques, of 'Western' economics. The writings of Eric Williams, Prebisch, Hla Myint, Myrdal, Clifford Geertz, Paul Baran, Sunkel, Celso Furtado, Anibal Pinto, Andres Bianche, Gunder Frank, Dudley Seers, Best, Levitt and Beckford among others, forerunners and advocates of the structuralist and dependency schools, have served to emphasize the predicament of previously colonized territories which were regulated as sources of primary products and markets for manufactured goods from metropolitan countries. The approach recognizes the predominance of the metropolitan enterprises and the institutional and structural rigidities which supported their operation, and still continue to ensure that the benefits from surpluses and employment revert to the metropolis.

The dependency theory has been expressed in descriptive historical terms, often with a Marxian analytical framework. The analysis has yet to be reduced to a 'model' which can be quantitatively assessed. Higgins (1977) has provided a summary which highlights the main features of the organization of internal capitalism for maximizing profits; the use of technology by the advanced countries and trans-national corporations for attaining ultimate power; the alignment of the elite of the less developed countries with the capitalists, for exploiting the workers and peasants of the less developed countries; the powerlessness of the workers and peasants as governments cooperate with the capitalists; the domination and dependence of the less developed countries for

technology, capital equipment, finance, markets and entrepreneurial administrative and scientific skills; and the disadvantageous trading position of less developed countries exporting raw materials and foodstuffs.¹

Within the ambit of the dependency school, the thesis of the Pure and Modified Plantation economy formalized by Best (1968), Levitt (1968, 1970) and Beckford (1971) shows how the systems of the past have remained as legacies favourable to and supportive of the dominant export sector. Best and Levitt find the origins of the Modified Plantation economy in the triangular trading arrangements of the Pure Plantation economy whereby labour was brought from Africa; management, financial capital, transportation, supplies, and markets were derived in the metropolis; and land was located in the West Indies. The Caribbean remains the locus of production--for raw materials (bauxite and petroleum), services (tourism), and screw driver assembly industries (manufacturing).

Beckford, examining plantation agriculture from the point of view of the necessity for the reorganization of agriculture, highlights the social costs of the distortive arrangements of the plantation economy. Growing unemployment, relatively low levels of national income, concentration of

¹Benjamin Higgins, Development Economics in the United States: Dependency vs. Dualism, Research Paper No 7714, University of Ottawa, Faculty of Social Sciences, Department of Economics, 1977.

income, under-utilization of land and under-consumption are some of the costs. Plantation agriculture causes "dynamic underdevelopment effects" of limitations to the expansion of food supplies, declining terms of trade, absence of linkage and spread effects, rigidities and leakages in regard to factor transfers from agriculture, low skill content of plantation work and inflexibilities of resource adjustment.

The status of the Plantation thesis in the context of the Dependencia school is not yet determinate. Questions may be put forward regarding the generality of the thesis. Frank, perhaps, views the thesis as one of a number of hypotheses on underdevelopment. One "related hypothesis", it is stated, is that

the latifundium, irrespective of whether it appears as a plantation or a hacienda today, was typically born as a commercial enterprise which permitted it to respond to increased demand in the world or national market by expanding the amount of its land, capital, and labour and to increase the supply of its products.¹

Brown and Brewster comment on the supposed generality of the Plantation approach.

Best and Levitt admit of the existence of non-plantation type units within the system. These are not analyzed nor are they even adequately defined. Yet they do form the nucleus for dynamic transformation. It is in the existence of such units that this analysis differs . . . from Beckford . . . who treats the plantation, not as a unit within the system, but as the total system. These analyses are yet to distinguish the trees from the woods. Concentration on the externally defined relationships of the plantation at the macro-economic level has obscured

¹André Gunder Frank, *The Development of Underdevelopment*, p. 14, in Cockroft, Frank and Johnson, eds., Dependence and Underdevelopment: Latin Americas Political Economy, (New York: Anchor Press, 1972)

the need to examine in detail those very units that are not of the plantation; statements about the existence or non-existence of internal dynamic and the possibilities for its development remain merely articles of faith.¹

In the promotion of dependency theory and the plantation thesis, dualism is discarded. Dismemberment into dual sectors is the devastation of capitalism and the multinational corporations and theories of dualism are not thought to provide solutions. André Gunder Frank denounces the dualist theory, claiming the approach false and conducive to the malady it was constructed to cure.

I believe . . . that the entire dual society thesis is false and that the policy recommendations to which it leads will, if acted upon, serve only to intensify and perpetuate the very conditions of underdevelopment they are supposedly designed to remedy.²

Beckford and Girvan take issue with their view of the solution provided by the Lewis-Fei-Ranis type dualistic models.³

¹Aldith Brown and Havelock Brewster, "A Review of the Study of Economics in the English-Speaking Caribbean", Social and Economic Studies, 23, March 1974, pp. 48-68.

²André Gunder Frank, The Development of Underdevelopment, p. 4.

³The Lewis and Fei and Ranis models are discussed in Chapter III, below.

W. Arthur Lewis, "Economic Development with Unlimited Supplies of Labour," Manchester School, 22, May 1954, pp.139-191.

John C. H. Fei and Gustav Ranis, Development of the Labour Surplus Economy: Theory and Policy, (Illinois: Irwin, 1964).

The policies are seen to generate growth without development and on the basis of this the entire dualistic framework is discarded. To quote Beckford:

We need seriously to question the assumption that the plantation (modern) sector provides the dynamic for development and that, therefore, the development problem resolves itself simply into bringing more resources into that sector . . . the development problem would seem to be the reverse of what is suggested by the two-sector models . . . the plantation sector dynamizes development elsewhere than in the plantation economies . . . The two sector models that place the plantation sector at the centre stage of development in the countries with which we are concerned are therefore misleading.¹

It is contended here that the dualistic framework provides a useful and relevant scenario for the understanding of many, including dependant, economies. The solutions permitted are manifold² and need not be confined merely to increasing the output of the enclave sector. Moreover, one may not venture to suggest that advocates of the dualistic formulation, including Lewis, could be so narrow of vision as to envisage only one solution within the range of possibilities. It appears that the alternative proposed by Lewis must be evaluated as having

¹George L. Beckford, Persistent Poverty: Underdevelopment in Plantation Economies in the Third World, (New York: Oxford University Press, 1972), p. 50.

²These solutions will be expanded on in the final section of Chapter V where the dualistic model with endogenous population, presented in Chapter IV, is interpreted in the light of the Jamaican experience.

been appropriate to the political climate and constraints of the time.¹

Dependency theorists have chosen to interpret dualism as a static concept applying only to an initial state of pre-development where modernization confronts traditional patterns.

¹This view is supported by Cumper, in his article "Dependence, Development, and the Sociology of Economic Thought", who adduces that Girvan's "highly selective treatment" in the work--"The Development of Dependence Economies in the Caribbean and Latin America: Review and Comparison", Social and Economic Studies, 22, March 1973, pp. 1-33,--"misrepresents Lewis".

"A true assessment of Lewis' contribution to the economics of development is admittedly difficult because he has operated at so many levels--as a general theorist, as an academic advocate of specific policies, and as an adviser on the execution of these policies . . . anyone surveying the whole of Lewis' writings from his early work on the history of peasant farming in Jamaica to the present, must be aware that his main concern has always been with the strategy of development, in relation to which the policy of developing light manufactures for export was seen by him as a particular tactic adapted to the needs of the Caribbean, while the policy of initiating manufacturing industrialization by offering facilities for foreign investors was even more specific to a particular time and set of institutions--the period when Fomento was making its initial gains, when the West Indian market appeared about to open up under a federal government, and when colonial policy prevented all but the most modest industrial or financial intervention by governments. At the strategic level, Lewis has held firmly to the proposition that ultimately a country's development depends on its own savings . . . From Lewis' point of view, much of the work of recent Caribbean economists must represent a detour--an exploration of the extent to which the fundamental choice between consumption and investment can be pushed back by changes in structure and institutions and an increase in the share of the gains from trade, rather than a refutation of the basic position. Thus Girvan's presentation . . . is so incomplete in its perspective as to be seriously misleading."

G. E. Cumper "Dependence, Development, and the Sociology of Economic Thought", Social and Economic Studies, 23, September, 1974, pp. 465-66.

Many dualists have been conscientious in explaining that dualism has not been conceived in that manner. It is a dynamic historical process where one sector is increasingly invulnerable to changes in the other sector due to the perverse manner of response to the changes. The discussion by Higgins of the population multiplier is a case in point, "population growth being accelerated by the very process of industrialization".¹

This is the response which is further delineated in Higgins' Introduction to Geertz' Agricultural Involution.² Hence,

Putting together the theory of the population explosion with the theory of technological dualism, we obtain a deeper understanding of some of the "characteristics" of underdeveloped countries . . .³

As Higgins has further explained,

Thus dualism is a dynamic concept and not a description of society. One might even say that dualism is the result of the lack of development, rather than the lack of development being due to an initial dualism.⁴

¹Benjamin Higgins, Economic Development: Principles, Problems, and Policies, 2nd ed., p. 306. In the first edition of Economic Development, p. 340, the population multiplier is defined as the increase in total population arising from an increase in industrial population $\Delta L = k\Delta L_i$; k being a constant multiple.

²Clifford Geertz, Agricultural Involution - The Process of Ecological Change in Indonesia, (Berkeley, University of California, 1963), pp. i-xv.

³Benjamin Higgins, Economic Development: Principles, Problems, and Policies, 1st. ed., (New York: Norton, 1959), p. 341.

⁴Benjamin Higgins, Personal Communication with Bert F. Hoselitz, February 22, 1978.

Under these conditions the probability of structural permanence as defined by Dagum and Dagum is one.¹ According to Higgins, dualism may be seen not "as a starting point which makes development difficult" but as "the end product of a particular pattern of development".²

In view of the above, it appears that a lacuna exists for a rigorous treatment of endogenous population in the setting of a dual economy. What may be required, therefore, for a thorough analytical understanding, is a concise, completely dualistic,³ dynamic model in which population is treated endogenously--in that it assumes a dependent relationship to other predetermined variables--and the interrelations between population and productivity are accommodated.

¹This definition of the dual economy, provided by Dagum and Dagum, is explained in Chapter III.

Camilo Dagum, "Structural Permanence", *Zeitschrift für die gesamte Staatswissenschaft*, 125, Band/2, Heft, April 1969, pp. 211-235.

Camilo Dagum et Estela Bee Dagum, *Construction de modèles et analyse économétrique, Economies et Sociétés, Cahiers de l'ISMEA série EM N° 5* (Paris: Institut de Sciences Mathématiques et Économiques Appliquées, 1975), p. 2056.

²Benjamin Higgins, Personal Communication with Bert F. Hoselitz, February 22, 1978.

³The term "completely dualistic" is defined in Chapter III to mean combined behavioural, institutional and technological dualism.

The following chapter reviews dual economy models to determine whether any of the models meet these requirements. A specific assessment is provided of the inadequacies which this thesis attempts to supplement.

CHAPTER III

POPULATION IN THE DUALISTIC FRAMEWORK

In this chapter, it is proposed to set out a possible representation of population as an endogenous factor in the dualistic framework. To begin, the concept of dualism is outlined followed by the consideration of the proper treatment of population in relation to dualism. Existing dualistic models are next categorized according to whether or not the models are truly dualistic and population is endogenous. The view is taken that present models do not satisfy the requirements of demographic endogeneity and dualism combined. It is attempted to specify conditions necessary for supplementing this deficiency, and a formulation which may be utilized for this purpose.

Dualism

At one extremity of the spectrum of models, there exist formulations of the one-sector model. At the other extremity there are multisector models with n sectors where $n \geq 3$. The dualistic model is one case where $n = 2$.¹

¹As explained in the subsequent paragraph the condition $n=2$ is necessary but not sufficient for defining dualism. There are two sector models, for example neo-classical growth models with a consumption goods sector and a capital goods sector, which are not dual economy models. The model of Hirofumi Uzawa presented in his papers "On a Two-Sector Model of Economic Growth", Review of Economic Studies, 29, 1961-62, pp. 40-47, and "On a Two-Sector Model of Economic Growth II", Review of Economic Studies, 30, June 1963, pp. 105-118, is a case in point.

Sectoral dichotomy requires more than a number for adequate representation, however. It implies dissimilarities between the characteristics of one sector when compared with the other. These dissimilarities encompass the behaviour of the agents, the modes of production and the institutional organization of each sector of the economy,¹ and may be expressed in the dissimilar behavioural (demographic and demand), technical and institutional equations which represent each sector. Dualism may therefore be assessed in terms of the combined characteristics of behavioural, technical and institutional dichotomy.

The equations representing these dichotomous characteristics will vary sectorally according to the arguments used as explanatory variables or the parameters employed. Thus demographic dichotomy may be represented by differential birth

¹This approach conforms to the classification of models proposed by Dagum and Dagum (1974).

"Si l'on prend en considération les classes de tous les énoncés économiques possible composant un modèle, nous pouvons définir un modèle économique (Dagum et Dagum, 1971) comme un système déductif théorico-empirique de relations mathématiques exprimant les caractéristiques basilières et essentielles des régularités observées dans:

- i) le comportement des agents économiques;
- ii) tout processus de production, pour une technologie donnée;
- iii) tout relation économique où a été explicitement incorporé un ordre institutionnel et légal. Peuvent également être incluses sous formes complémentaires:
- iv) des équations d'équilibre; et
- v) des identités."

Camilo Dagum et Estela Bee Dagum, Construction de modèles et analyse économétrique, Economies et sociétés, Cahiers de l'ISMEA Série EM N° 5 (Paris: Institut de Sciences Mathématiques et Economiques Appliquées, 1975), p. 1692.

rates and death rates or rates of population increase. The demand dichotomy may be shown by the existence of savings in one sector and its non-existence in the other, or by a proportionately greater demand for goods produced in sector i by sector i . Technical dichotomy may involve the exclusion of a certain factor of production from the production function of one sector and its inclusion as an input in the other sector, or the variation of parameters pertaining to technical progress, the elasticities of substitution, returns to scale, and homogeneity from one sector to the other. Institutional dichotomy will be evident in the variation of the structure pertaining to the relations of production. Hence, a positive tax may be applied to one sector and a negative tax to the other, or payment of factors according to their marginal product may be applicable in one sector as against their average product in the other sector.

Dichotomous behavioural, technical and institutional features permit only a static view of dualism. To be dynamic, it is necessary to specify sectoral interaction such that the activities of one sector over time will be determined as a response to activities in the other sector at different moments of time.¹

¹This is in keeping with the definition of a dynamic model specified by Ragnar Frisch, "On the Notion of Equilibrium and Disequilibrium", Review of Economic Studies, III, 1935-1936, pp. 100-105.

Dagum and Dagum¹ have provided a definition of structural dualism with respect to the concept of "structural permanence" (SP) which formalizes the dynamic perspective of dualism.

Une équation possède la propriété de stabilité structural, si elle conserve sa validité, c'est-à-dire si elle continue à expliquer le comportement des agents économiques, dans un secteur déterminé (sous-secteur, etc.), avec une rigueur et une représentativité analogues, une fois que des changements structurels, qui pourraient même invalider les autres équations de la structure, se sont produits.²

As specified in symbols, where the distinction between partial and total structural permanence is also made:

Using J as a symbol for the set of G integers . . .

- 12) $J = \{1, 2, \dots, G\}$,
- 13) $J_T \subset J$; $J_T^C = J/J_T = J \setminus J_T \neq \phi$,
 ϕ symbolizes the empty set and J_T^C the complement of J_T in J .
- 14) $J_P \subset J$; $J_E \subset J$; $J_P \cap J_E = \phi$,
 $J_P \cup J_E \neq J \Rightarrow J/(J_P \cup J_E) \neq \phi$,
 where J_T , J_P and J_E are subsets contained in J and which fulfill conditions (13) and (14).
 Then;
- 15) $SP[J_P(J_E)] = SP(J_P \mid \text{structural changes in } J_E)$
 Given the structural changes in the subset (subsystem) J_E , (15) symbolizes the degree of partial structural permanence of the subset (subsystem) J_P .
- 16) $SP[J_T(J_T^C)] = SP(J_T \mid \text{structural changes in } J_T^C)$.
 Given the structural changes in any or all of the remaining equations (J_T^C), (16) symbolizes the degree of total structural permanence of the subset (subsystem) . . . J_T .³

¹Camilo Dagum, "Structural Permanence", Zeitschrift für die gesamte Staatswissenschaft, 125. Band/2, Heft, April 1969, pp. 211-235. Camilo Dagum et Estela Bee Dagum, Construction de modèles et analyse économétrique, p. 2056.

²Ibid., pp. 2060-2061.

³Camilo Dagum, "Structural Permanence", p. 214, and Camilo Dagum et Estela Bee Dagum, Construction de modèles et analyse économétrique, pp. 2059-2060.

In terms of probability, if one sector is "vulnerable" to changes in the equations of the other sector, then, assuming values in the interval $[0,1]$, the probability of structural permanence in the vulnerable sector is zero. Where there is complete independence between the sectors, so that the probability of structural permanence is equal to one, the case of structural dualism or the dual economy is observed. Hence, if improvements such as increased productivity in one sector have no beneficial effects on another sector, structural dualism is maintained and the probability of structural permanence is equal to one.

In the context of development, dualism pertains to the distinction between a sector which promotes materialistic well being as measured by per capita income and other welfare indicators, and a sector in which the amenities of life and alternatives for choice are limited and per capita income is low. These sectors have been referred to as modern and traditional, advanced and backward or lagging, industrial or manufacturing and agricultural, urban and rural, capitalist and subsistence, and rich and poor. The nomenclature is appropriate to the extent that each sector is the nexus of the modern, advanced, industrial, manufacturing, capitalist, urban and rich on one hand and the traditional, backward, lagging, agricultural, subsistence, rural and poor on the other hand. If suitable, it is also arbitrary to the extent that 'backward' as the counterpart of 'advanced' implies value overtones, or

export agricultural and capital intensive agriculture belong to the modern sector, or certain labour intensive service activities may belong to the lagging sector, or subdivisions may be applicable in each sector. Arbitrariness may also be observed in the use of the terminology rich versus poor sectors. Not all persons in the traditional, lagging, agricultural, rural sector are poor, and not all persons in the modern, advanced, industrial, urban sector are rich. The incomes of landlords and rural moneylenders may be considerably greater than those of industrial workers. However, the average income in the rich sector can be expected to be greater than the average income in the poor sector. The words rich and poor have been adopted as a shorthand term (as they will be used in this thesis also) for a general, if imprecise, description of each sector.

Rich and poor sectors usually correspond with rich and poor regions or with cities and the countryside. This correspondence between sectors and regions has facilitated corrective planning policies since the focus can be a geographical area or community with a single governing authority for expediting a plan.

The dualistic model is universally applicable. The dichotomic character of the behavioural, technical and institutional features may be applied globally, nationally or regionally at any stage of development. Its general relevance as an analytical tool is supported by Higgins (1956).

... some degree of dualism exists in virtually every economy. Even the most advanced countries, such as Canada and the United States, have areas in which techniques lag behind those of the most advanced sectors, and in which standards of economic and social welfare are correspondingly low.¹

The persistence of dualism, even if attenuated, is counter to the view that dualism is the stage between backwardness and complete modernization and that with steady growth duality will eventually be eliminated.²

The dualistic model has been set in the neo-classical and classical frameworks. Choice of framework rests on whether labour is viewed as a scarce or redundant factor with consequent wage determination in relation to marginal or average productivity. Preference for one setting or the other has sparked some controversy. Jorgenson (1966) outlines the differences and similarities implied by each framework. Buttressed by empirical evidence demonstrating the inconsistencies with the real world of the 'classical' assumption of a constant real wage and of the 'classical' implications of constant labour productivity in the advanced sector, falling capital-output ratio, and increasing rates of growth for manufacturing output,

¹Benjamin Higgins, The 'Dualistic Theory' of Underdeveloped Areas, Economic Development and Cultural Change, 4, Jan. 1956, p. 106.

²"Eventually, the economy is dominated by the development of the advanced sector and becomes more and more like the advanced economic systems described by the familiar Harrod-Domar theory of economic growth". Dale W. Jorgenson, The Development of a Dual Economy, Economic Journal, 71, June 1961, p. 334.

employment and capital, Jorgenson declares his preference for neo-classical duality. Marglin (1966) has evaluated Jorgenson's conclusions in the light of an interpretation of the spirit rather than the letter of classical dualism. It is suggested that the foundation of the labour surplus model is not that the marginal product of labour in agriculture is zero and the real wage constant but that the industrial wage is in excess of the marginal product of the fully or seasonally unemployed worker in agriculture.

. . . the assumption of zero marginal productivity in agriculture is metaphorical. The assumption is designed to reflect the belief that the industrial wage . . . is not an accurate measure of the social opportunity cost of increasing industrial employment. . . constancy neither of the agricultural nor of the industrial wage rate is necessary; it is the gap between the industrial wage and the social opportunity cost that counts.¹

Hence, Jorgenson's conclusions are dispensed with on the ground that his evidence refutes, not the 'essence' of the classical dualistic model, but unfounded and restrictive imputations of the model. Despite the observations by Kelley, Williamson and Cheetham (1972) that empirical investigation is inconclusive²

¹Stephen A. Marglin, Comment on Dale W. Jorgenson's Testing Alternative Theories of the Development of a Dual Economy, pp. 63-64 in Irma Adelman and Erik Thorbecke, eds. The Theory and Design of Economic Development (Baltimore: John Hopkins Press, 1966):

²A case in point is Marglin's demonstration that Jorgenson's conclusion that industrial output and employment grow at the same rate if the industrial wage rate is constant depends on the assumption of a Cobb-Douglas production function. If a CES production function is utilized, a constant wage rate will allow for the differing rates of growth of output and employment observed in Japan.

and that further development of both models is required before valid tests may be conducted, the authors choose to utilize the neoclassical setting in the construction of their dualistic model. Their choice is based on claims of the non-existence of evidence which disproves the applicability of marginal product pricing in developing countries and of precise formulations of the 'institutional' wage.¹

Some degree of confusion and fuel for the attack on the concept of dualism by the radicals of the dependency school has been provided by Boeke's² socio-cultural "dualistic theory". As defined,

Social dualism is the clashing of an imported social system with an indigenous social system of another style. Most frequently the imported social system is high capitalism. But it may be socialism or communism just as well, or a blending of them. Nevertheless . . . the essence of social dualism is the clash between an imported and an indigenous social system of divergent character.³

Boeke's theory supports the view that socio-cultural differences prevent development. Eastern culture is reflected in eastern economics which excludes, in part if not wholly, the tenets of western economics. The fundamental principles of western

¹Benjamin Higgins' analysis in The Employment Problem in Development, pp. 241-275, in Elizer B. Ayal, ed., Micro Aspects of Development (New York: Praeger Publishers, 1970), may be regarded as providing the necessary formulation. Higgins' extension is discussed below in this chapter.

²J. N. Boeke, Economics and Economic Policies of Dual Societies as Exemplified by Indonesia. (New York: Institute of Pacific Relations, 1953).

³Ibid., p. 4.

economics, concerning unlimited wants, money, competition, the growth of enterprises, markets and so forth, may not be assumed to apply to the eastern way of life. Impervious to the influence of western capitalism, eastern pre-capitalism persists, thereby causing dualism.

Dependency theorists have taken this approach to be representative of dualism and have proceeded to denounce the dualistic approach with little regard to the fact that proponents of technological dualism also discount socio-cultural "dualistic theory". The dependency theorists maintain that underdevelopment is the outcome of a devastating holistic, historical process rather than the confrontation between an industrial capitalistic sector and a primitive sector which is resistant to change.¹

Proponents of technological dualism have been careful to disclose the unsatisfactory nature of the socio-cultural theory as an explanation of dualism. Higgins has been the chief protagonist. In his appraisal of Boeke's theory,² he shows that the facts regarding eastern society are not only misrepresentations but also contradictory; that characteristics

¹The attack of dependency theorists on dualism was discussed above in Chapter II.

²Benjamin Higgins, The 'Dualistic Theory' of Underdeveloped Areas. Benjamin Higgins, Economic Development: Principles, Problems and Policies, 2nd. ed. (New York: Norton, 1968), pp. 227-241.

attributed to eastern society are also applicable to western societies; and that western theory is useful for understanding dualistic economies. Socio-cultural differences are admitted, but these are not considered to be obstacles to development.

Population in the Context of Dualism

Demographic duality implies disparate demographic behavioural responses in each sector of the economy. These responses are reflected in the fertility, mortality and migration rates and eventually in the rates of growth of population in each sector. The rate of growth of population is often greater in the traditional than in the modern sector, with a decrease in the disparity as the traditional sector is modernized.

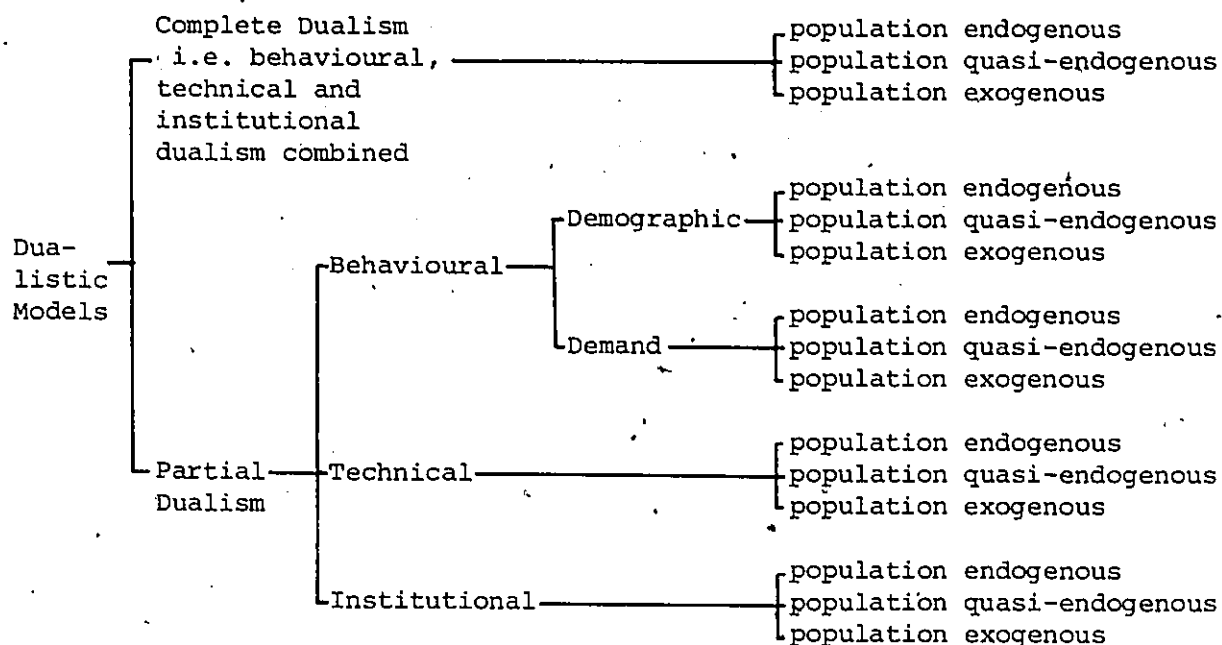
Endogenous demographic duality implies that these disparate rates of growth of population are generated from within the economic system as functions of other variables. Thus the rate of growth of population in sector i , where $i = 1, 2$, is the outcome of fertility, mortality and net migration rates in sector i which are in turn functions of a multiplicity of factors of varying strengths in each sector. Such factors may include income, health, education, housing, general welfare measures, religion, tradition and culture in addition to purely demographic causes. Adelman (1963) measures the response of rates of fertility and mortality to income, industrialization, education, population density, health and urbanization with

statistically significant results. These socioeconomic determinants may in turn be specified as functions of other variables which themselves respond to changes in the rate of population growth. Thus demographic endogeny in the dual framework allows for a thorough interrelation between disparate rates of population growth and other factors the former being a function as well as a determinant of the latter.

Dualistic Models

Existing dualistic models of development may be classified according to whether dualism is complete and whether population is truly endogenous. Complete dualism is taken to mean the combined characteristics of behavioural, technical and institutional dichotomy as specified above; the absence of any one quality resulting in partial dualism. Population in these models may be exogenous, endogenous or only quasi-endogenous. Quasi-endogeny implies endogeny that is partial only, in that it persists only over a limited phase of the operation of the model or with respect to only certain variables.

Figure 1
Classification of Dualistic Models



The dualistic models of Lewis (1954); Jorgenson (1961); Fei and Ranis (1964); Sato and Niho (1971); Kelley, Williamson and Cheetham (1972); and Paauw and Fei (1973) will be assessed and categorized in terms of the above classification.

Behavioural Dualism

Demographic

The sole representation of demographic dualism is found in the Kelley, Williamson and Cheetham model. It is assumed that the labour force (L) resident in the i th sector grows at a rate $n_1 > 0$ and that $n_2 > n_1$, thereby allowing for disparate rates.

of growth in each sector. Hence the rate of growth of the labour force is equal to the summation of the products of the sectoral rates of growth and the proportions of labour within and excluded from the manufacturing sector. The specification is as follows:

$$\frac{\dot{L}(t)}{L(t)} = \frac{dL(t)/dt}{L(t)} = n_1 u(t) + n_2 [1-u(t)]$$

where $u(t) = \frac{L_1(t)}{L(t)}$ or the proportion of the labour force in the industrial sector, and n_1 reflects the natural increase in the population as well as changes in the participation rates in the labour force.

Demographic dualism is mirrored in the assumption of Kelley, Williamson and Cheetham that, with higher fertility rates in the rural than in the urban areas and an absence of great differences in sectoral mortality rates, $n_2 > n_1$.

Demand

Duality in consumption and saving is related in the literature to occupation and source of income. Entrepreneurs and capitalists save and invest while workers consume; profits are invested while wages are consumed.

The Lewis model accords with this pattern.

Practically all savings is done by people who receive profits or rents. Worker's savings are very small . . . the major source of savings is profits.¹

¹W. Arthur Lewis, Economic Development with Unlimited Supplies of Labour, Manchester School, 22, May 1954, p. 157.

Jorgenson¹ and Sato and Niho² also assume that workers and wage earners do not save. The Fei and Ranis³ model varies only to the extent that it allows for "hidden rural savings"--the reallocated surplus agricultural labour.⁴

Consumption duality in the Kelley, Williamson and Cheetham model is based on a dual utility function in which consumption is always positive and never less than subsistence level and consumer preferences in each sector are biased towards goods produced in the respective sectors. The investment function reflects the fact that "savings rates are uniquely determined by the source distribution of income".⁵ Capitalists, whether agricultural or industrial, invest all rental income.

¹"We assume . . . that industrial workers do not save and that property owners do not consume." Dale W. Jorgenson, *The Development of a Dual Economy*, p. 322.

²" . . . wage earners do not save while all profits are automatically saved. Thus, the amount of gross savings is equal to the amount of capital's income in the industrial sector after wages are paid to industrial workers . . ."

Ryuzo Sato and Yoshio Niho, "Population Growth and the Development of a Dual Economy", *Oxford Economic Papers*, 23, November 1971, p. 425.

³"Although not only the entrepreneurs but also wage earners may conceivably save a portion of their respective incomes, it is reasonable to assume, under the existing conditions of low per capita income in the less developed economy, that industrial profits (π_0) constitute the major source of investment funds originating in the industrial sector."

John C. H. Fei and Gustav Ranis, *Development of the Labour Surplus Economy: Theory and Policy* (Illinois: Irwin, 1964), p. 19.

⁴The term "hidden rural savings" is attributed to Nurkse.

⁵Alan C. Kelley, Jeffrey G. Williamson, and Russel J. Cheetham, *Dualistic Economic Development: Theory and History*, (Chicago: University of Chicago Press, 1972), p. 49.

Technical Dualism

Technical dualism is a common feature of dualistic models. Indeed, in some models dualism has been ascribed to this feature alone (e.g., Jorgenson and Sato and Niho), and sectoral delineation rests upon certain combinations of specifications of differing factors of production and differing parameter values in the technical equations.

The path breaking analysis of Lewis (1954) distinguishes between the capitalist sector which uses reproducible capital and the subsistence sector which does not use reproducible capital. Hence "output per head is lower in this sector than in the capitalist sector, because it is not fructified by capital"¹ The unproductiveness of the subsistence sector is underscored by the fact that "the marginal productivity of labour is negligible, zero, or even negative".²

The Jorgenson, Fei and Ranis and Sato and Niho models also utilize the specification of different combinations of factors of production in each sector. The modern sector capital and labour are combined in the production of output while in the traditional sector labour is applied to land only. For Jorgenson this "asymmetry in the productive relations" provides "the special character of the theory of development of a dual economy".³

¹W. Arthur Lewis, *Economic Development with Unlimited Supplies of Labour*, p. 147.

²*Ibid.*, p. 141.

³Dale W. Jorgenson, *The Development of a Dual Economy*, p. 311.

Hence in terms of the Cobb-Douglas formulation the production functions are $Y = e^{\alpha t} L^{\beta} P^{1-\beta}$ and $X = e^{\lambda t} A(0) M^{1-\sigma} K^{\sigma}$ in the traditional and modern sectors respectively,¹ where Y and X are agricultural and manufacturing output, $e^{\alpha t}$ and $e^{\lambda t} A(0)$ represent technical progress with techniques changing at rates α and λ , L is land, P is total population, M is manufacturing labour force, and K is capital stock.

The Kelley, Williamson and Cheetham model varies from the above in that capital as well as labour is a factor of production in both sectors. Dissimilarities between the sectors are provided through the different combinations of the factors within each sector, in addition to different parameter values for each sector. Expressing the production function in a general form

$$Q_i(t) = F[x(t) K_i(t), y(t) L_i(t)] \quad (i = 1, 2)$$

where $Q_i(t)$ is the quantity of the i th good produced, $K_i(t) > 0$, $L_i(t) > 0$ are the amounts of capital and labour employment in the i th sector, $x(t) > 0$ and $y(t)$ are variables of technical progress so that $x(t)K_i(t)$ and $y(t)L_i(t)$ are "efficiency capital" and "efficiency labour" respectively, the elasticity of substitution between capital and labour is less than one in

¹Jorgenson sets out a manufacturing production function in the basic form $x = A(t) M^{1-\sigma} K^{\sigma}$, where $A(t)$ is some function of time, $1-\sigma$ is the relative share of labour in manufacture M , and K is capital stock. He shows that if the rate of growth of A is constant such that $\dot{A}/A = \lambda$, solving this relation as a differential equation gives $A(t) = e^{\lambda t} A(0)$, and the manufacturing production function takes the form $x = e^{\lambda t} A(0) M^{1-\sigma} K^{\sigma}$.

Ibid., p. 321.

industry and greater than or equal to one in agriculture.

Institutional Dualism

Institutional or legal relations in Dagum and Dagum (1974) "explique une activité économique strictement liée à une loi donnée ou à un ordre institutionnel".¹ Dualistic institutional or legal relations will therefore be the dissimilar institutional and legal arrangements for corresponding activities in each sector.

Unlike technical dualism which is explicit in all the dual economy models, and unlike behavioural dualism which has not been specified as central to some models, institutional dualism has either been excluded entirely or entertained only implicitly in the dualistic models.

The assumption of a 'neoclassical' framework as conceived by Jorgenson, maintained by Sato and Niho, and perpetuated by Kelley, Williamson and Cheetham does not permit institutional dualism in the arrangement of the relations of production. Despite this, Kelley, Williamson and Cheetham consider their view of dualism with "differing sectoral characteristics . . . postulated for production, consumption, and demographic behaviour"² as being "broader" and "multidimensional".

¹Camilo Dagum et Estela Bee Dagum, Construction de Modèles et analyse économétrique, p. 1698.

²Alan C. Kelley, Jeffrey G. Williamson, and Russell J. Cheetham, Dualistic Economic Development: Theory and History, p. 10.

However, it appears that the 'neoclassical' framework cannot admit institutional dualism in productive relations since the sole arrangement permitted is the payment of factors according to their marginal products. In this respect the Kelley, Williamson and Cheetham framework is narrow and limiting.

If the 'classical' framework is considered, however, it is found that institutional dualism is provided for through the delineation of an 'institutional' wage equal to the average product in the traditional sector and a wage in the modern sector determined by a combination of the marginal product, trade union activity, and "conventional standards". This latter wage may also correctly be considered institutional.

The Lewis, Fei-Ranis and Paauw-Fei models therefore permit a more comprehensive duality encompassing behavioural (demand only), technical and institutional dualism in so far as productive relations pertaining to wage determination are included.

Nor can average product pricing be dismissed as it has been by Kelley, Williamson and Cheetham, as having yet no precise formulations. Higgins' (1970) elaboration of the Young Sam Cho labour sharing arrangements¹ provides a microeconomic analysis for a wage equivalent to the average product in the cases of the peasant proprietor and the village landlord. As

¹Young Sam Cho, Disguised Unemployment in Underdeveloped Areas, with Special Reference to South Korean Agriculture (Berkeley: University of California Press, 1963).

Higgins states:

It is worth noting that in analyzing the case of peasant proprietors, the average product curve replaces the marginal productivity curve in the Cho diagram. Total income per worker will be equal to average productivity with full employment.¹

Exogenous and Endogenous Treatments of Population

Models of the dual economy have, in general abstracted from population change. This feature creates limitations to the analyses since the basis for surplus labour is, barring immigration, dependent on birth and death rates and their fluctuations. The rate of population growth is not necessarily given. A study of the process of labour absorption into the modern sector from the traditional sector over the long run can properly incorporate fluctuations of population growth that may be generated within the system.

Exceptions exist. These exceptions, reminiscent of Adam Smith and Malthus, utilize a simple endogenous classical treatment making population an increasing function of wage rate or food per capita. Great reliance is placed on the theory of demographic transition and the derived sigmoid curve demonstrating the pattern of population growth observed for certain Western European countries.

Exogenous Population

Population is treated exogenously in the Lewis, Fei

¹Benjamin Higgins, The Employment Problem in Development, p. 263.

and Ranis, and Paauw and Fei models.

Lewis admits population only in so far as the hypothesis of unlimited supplies of labour and the resulting constant real wage may be supported.

Because the effect of development on the death rate is so swift and certain, while its effect on the birth rate is unsure and retarded, we can say for certain that the immediate effect of economic development is to cause the population to grow; after some decades it begins to grow (we hope) less rapidly. Hence in any society where the death rate is around 40 per thousand, the effect of economic development will be to generate an increase in the labour supply.¹

Thus population growth provides an additional source of labour. Otherwise, "population increase is not relevant either to the classical analysis, or to the analysis which follows in this article".² Hence, the possibilities for capital formation are outlined "abstracting from population growth . . ."³

The Fei-Ranis and Paauw-Fei models follow in the Lewis tradition. Again population is exogenous.⁴ The agricultural

¹W. Arthur Lewis, *Economic Development with Unlimited Supplies of Labour*, p. 144.

²*Ibid.*, p. 143.

³*Ibid.*, p. 157.

⁴Benjamin Higgins observed this in relation to the Fei-Ranis model. "Population growth is a factor that seems not to enter into the Fei-Ranis model. Despite the complexity of the diagrams, and the emphasis on innovation, the whole analysis remains essentially neoclassical and static". Economic Development, 2nd. ed., p. 316.

sector is characterized by high rates of population growth, but this is given exogenously, not being a function of any other variable of the system. These models are concerned, as is the Lewis model, with the reallocation of existing surplus population between the industrial and agricultural sectors with a view to encouraging expanded employment and output in industry, the first in the context of the closed and the second the open economy.

Hence, the Lewis-Fei-Ranis-Paauw approach may be considered a short term analysis of the problem of labour reallocation. In the long run, secular swings in population growth may change the nature of labour supply and demand and the reallocation problem.

Endogenous Population

The Jorgenson model is designed to incorporate population endogenously by assuming that

Population growth depends on the supply of food per capita and the force of mortality; the force of mortality is assumed given--it may be altered only by an alteration in medical technique. The birth rate depends on the supply of food per capita; however, it may attain a physiological maximum, or a maximum given by a particular social situation and by the state of medical knowledge provided that the supply of food is sufficient.¹

Endogeny of population is limited or only partial, however.

While population is directly related to food supply, an adequate food supply allows the physiologically maximum population

¹Dale W. Jorgenson, The Development of a Dual Economy, p. 312.

growth rate. Population is then exogenous.

. . . when agricultural output attains the minimum level necessary for population to grow at its maximum rate. From this point forward, population grows at the rate ϵ , the maximum rate of net reproduction.¹

Sato and Niho delimit the endogeneity of population in the Jorgenson model. They assume that "population growth rate continues to be affected by changes in per capita income after the emergence of the industrial sector".² Specifically "an increase in per capita income will have a positive effect (or no effect) on the percentage rate of increase in the total population".³

Quasi-Endogenous Population

In addition to the Jorgenson model, the Kelley, Williamson and Cheetham model may be categorized as quasi-endogenous. The differential rates of population growth for the rural and urban sectors (specified above) allow for a partial endogeneity in that population growth depends on the proportion of the industrial labour force, $u(t)$. Otherwise, population must be considered exogenous since the labour force in the i th sector is assumed to grow at an exogenously given rate n_i .

¹Ibid., p. 324.

²Ryuzo Sato and Yoshio Niho, Population Growth and the Development of a Dual Economy, Oxford Economic Papers, 23, November 1971, p. 419.

³Ibid., p. 422.

Categorization of Existing Models

In keeping with the classification of dualistic models proposed above, the following categorization of the models discussed is attempted.

Figure 2

Categorization of Dualistic Models

Dualism					Complete (combined characteristics of behavioural technical and institutional dualism)
Partial					
Population	Behavioural		Technical	Institutional	
	Demographic	Demand			
Endogenous		Sato & Niho	Sato & Niho		
Quasi-Endogenous	K, W & C	K, W & C Jorgen- son	K, W & C Jorgen- son		
Exogenous		Lewis Fei- Ranis	Lewis Fei- Ranis Paauw- Fei	Lewis Fei- Ranis Paauw- Fei	

It will be observed that the categories of endogenous demographic dualism¹ and complete dualism with population

¹Models which specify two classes with an uneven distribution of income between these two classes and differing population responses to the disparate income levels, such as the models of Malthus and Adelman, could be classified as endogenous demographic dualistic models.

endogenous are empty. In the following section a formulation for endogenous demographic dualism is proposed. An approach toward a model with complete dualism and endogenous population is reserved for Chapter V.

Formulation for Endogenous Demographic Dualism

For the requirement of demographic dualism two sectors are assumed, i.e., $i = 1, 2$ as a necessary condition for duality. This alone is not sufficient. The superscript i appended to the explained and explanatory variables permits the distinction of dissimilarities in demographic behaviour from one sector to another. Diverse demographic responses can therefore be postulated. Hence, the average number of births per family can be assumed greater in the poorer sector than in the richer sector. Likewise, deaths per 1,000 may be higher in the poorer sector when compared with the richer.

The supply of labour in sector i at time t will be a stock representing the accumulated flow of labour arising from changes in population with a lag. (This lag will be related to the average duration of the process of education--perhaps fifteen years). The labour force participation ratio is not essential to this representation and is therefore taken to be constant although a more detailed specification would undoubtedly allow for its variation. The change in population in sector i is identical to births minus deaths and net

migration. Births, deaths, and net migration in each sector are in turn functions of a multiplicity of variables of a socioeconomic nature (some of which were specified earlier) in addition to purely demographic factors. Thus the dependence of population growth on factors representing the level of development would be permitted. To complete the cycle and allow for the complete interrelation between population and development, the dual production functions show output (assumed identical to income) to be a function of labour as one of the productive factors. The notational representation would be as follows:

$$Y^i = f(Ld^i, \dots)$$

$$Ls_t^i = A^i + f(\Delta P_{t-15}^i)$$

$$\Delta P^i = B^i - (D^i + NM^i)$$

$$B^i = f(Y^i, \Delta Y/Y^i, He^i, E^i, Ho^i, I^i, U^i, R^i, \dots)$$

$$D^i = f(He^i, Ho^i, U^i, \dots)$$

$$NM^i = f(Y^i, \Delta Y/Y^i, He^i, E^i, Ho^i, I^i, U^i, PD^i, \dots)$$

where $i = 1, 2$; Y is income, equivalent to output, Ld is labour demand, Ls is labour supply, A^i is a stock representing the accumulated flow of labour arising from $\Delta P_{t-16}^i, \Delta P_{t-17}^i, \Delta P_{t-18}^i, \dots, \Delta P_{t-n}^i$, where $t-n$ represents the year of exit from the labour force, P is population, B - births, D - deaths, NM - net migration, He - health (including nutrition), E - education, Ho - housing, I - Industrialization, U - urbanization, R - religion, and PD - population density; t stands for time, but it is attached as a subscript only to the variables for which time matters.

If the proposed formulation were subjected to estimation it would indicate 1) the strength of the determinants of sectoral changes in population that arise through births, deaths and net migration, 2) the effect of lagged changes in population on labour supply by sector, 3) the extent of labour utilization in each sector, other productive factors assumed given, and 4) the unemployment gap in each sector.

The system may be expressed as two blocks of equations representing completely contained subsectors of a single economy, each block explaining demographic interactions independently of the other. It is in accord with the definition provided by Dagum and Dagum¹ whereby dualism exists if the variables and parameters of one sector, represented by one block of equations, are over time impervious to changes initiated in the other sector. The probability of structural permanence in the poor sector, despite structural changes in the rich sector, is equal to one.

Suppose, however, government is introduced as a further institutional complication such that the variables income or output, the rate of change of income, and those representing social welfare indicators--health and nutrition, education, housing, industrialization, urbanization, etc.,--become functions of government activity. It will become possible to

¹Camilo Dagum et Estela Bee Dagum. Construction de modèles et analyse économétrique, Chapitre XI. Camilo Dagum, "Structural Permanence."

assess the vulnerability of the poor sector to policies designed to eliminate the gap in welfare by, in the context of this model, the reduction of unemployment.

Existing dualistic models rely on improving welfare through the growth of income such that the excess demand for labour in the rich sector will overflow into the poor sector. If population is endogenized so that it grows from within the model, then allowance can be made for affecting unemployment from the supply side. The planning activity of the government becomes the link between both approaches. Comparisons may then be made between the effectiveness, in terms of quantity and direction of expenditure and time span required, of programmes which operate on labour demand, on labour supply, or on both variables together. The degree of structural permanence may be thereby reduced.

Endeavouring to assess the outcome of this supposition, the model presented in the following chapter introduces a dynamic relationship between population growth and government social expenditures as a central equation in a representation of a completely dualistic economy.

The inclusion of government social welfare activity is in accord with the basic needs approach to development. This approach views development in relation to "humanistic

values" rather than "narrow techno-economic notions".¹ Basic needs, as defined by the International Labour Office, are: adequate food, clothing, and shelter; education and health; basic human rights; employment as a means and an end; and improved quality of employment. The basic needs approach is the provision of these essentials of life to the poor as the strategy for development. Other strategies for development such as capital accumulation, the growth of national income, industrialization, export promotion or import substitution are rejected.² Social welfare measures of the government may be viewed, therefore, as a subset of basic needs. Past expenditures for health, housing, education, etc., provide a measure of the anticipated efficacy of the proposed basic needs strategy. While it may be justifiably argued that the requirements of jobs for the unemployed, and increased incomes for the poor, outweigh the need for the provision of general social welfare

¹The 1975 Dag Hammarskjöld Report, "What Now: Another Development" prepared on the occasion of the Seventh Special Session of the United Nations General Assembly (Uppsala: Dag Hammarskjöld Foundation, 1975).

²International Labour Office, Employment, Growth and Basic Needs: A One-World Problem. Tripartite World Conference on Employment, Income Distribution and Social Progress and the International Division of Labour, Report of the Director General of the International Labour Office (Geneva: ILO, 1976), pp. 32-35.

Richard Jolly, "The World Employment Conference: the Enthronement of Basic Needs", Overseas Development Institute Review, 2, 1976, pp. 31-44.

measures by the government, the focus here is on the latter since it has been demonstrated that population growth rates are more readily affected by factors such as education, housing, health and nutrition.¹ Moreover, social expenditures in these areas are themselves employment creating.

In the model presented, the government is the means whereby transfers can be made from the rich to the poor sector. These transfers permit improvements in health, nutrition, education and habitat in communities so that social development may be enhanced. Transfers from one sector to another do not imply handouts. In addition to measures for general welfare improvement, the concept may be extended to include measures for creating jobs for the unemployed and increasing the incomes of less wage workers. Thus the goal of eliminating extreme poverty with the provision of fundamental human requirements

¹"... income is a poor proxy for those features of development which affect fertility and mortality--education, health, female status, modernization, etc. But in poor countries, at least, higher incomes may be a necessary, if not a sufficient, condition for enjoyment of such advantages by low income groups." T. P. Dyson, C. L. G. Bell and R. H. Cassen, "Fertility, Mortality and Income - Changes Over the Long Run: Some Simulation Experiments" Journal of Development Studies, 14, July 1978, p. 41.

"Schooling (has been found) to exhibit a stronger and more consistent relationship to fertility than does any other single variable". Donald B. Holsinger and John D. Kasarda, Education and Human Fertility: Sociological Perspectives, p.156 in R. G. Ridker ed. Population and Development: The Search for Selective Interventions, (Baltimore: John Hopkins University Press, for Resources for the Future, 1976).

The correlation between population growth rates and health and nutrition is supported by William P. Butz and Jean-Pierre Habicht, The Effects of Nutrition and Health on Fertility: Hypotheses, Evidence and Interventions, pp. 210-238 in R. G. Ridker ed. Population and Development: The Search for Selective Interventions.

may be attained. Some measure of social engineering or planning is implied on the part of government so that the desired objective may be achieved. The collection of revenue and the direction of government expenditure becomes the causal link between the sectors by which development may be contrived.

CHAPTER IV

A DUALISTIC MODEL WITH ENDOGENOUS POPULATION

Reality is complicated. Models, to penetrate reality, must be incisive, cutting away the irrelevant and leaving only the essential. Disclosure of the basic, if simplified, elements may allow for a better understanding of the real world.

The model presented in this chapter retains only the essentials for representing complete dualism with endogenous population. This allows for the mathematical reduction of the model and the portrayal of mechanisms which may be expected to operate within the context of the empirically based theoretical assumptions. Admittedly, much is omitted which could, if introduced, reduce the generality and increase the relevance to particular situations. The approach, however, is one of attempting to understand the fundamentals. The policy implications suggested must therefore be viewed with reservations since the absence of detail limits their relevance.

Basic Model

Postulate a dual economy with rich and poor sectors. The poor sector does not participate in national growth. Dissimilarities between the sectors are assumed for the behavioural--demographic and demand, technical, and institutional characteristics of the economy.

Behavioural Equations

Demographic

The change in population is identical to births less deaths and net migration. It is assumed that net migration is given, determined exogenously by the opportunities for emigration provided by other countries and the anti-immigration policies of the government of a labour surplus economy. Deaths are at a minimum exogenously imposed by the influx of health measures.¹ Births, therefore, impel the change in population.

Dualistic asymmetry in demographic behaviour is expressed first in the division of births into those in the rich and those in the poor sector. As a result, the change in population is also divided sectorally. In the rich sector, births, inversely related to income, have declined to a minimum so that population change, ΔP , in that sector is low and fixed in relation to income. Income itself is sufficiently high to maintain the low level of ΔP . The process of demographic transition may have been operative in the demographic

¹This assumption, while convenient for analytical purposes, is not merely a simplifying contrivance. It is applicable to many previously colonized less developed countries. Benjamin Higgins, Economic Development: Principles, Problems and Policies, 2nd ed., (New York: McGraw Hill, 1968), pp. 86-87.

In the case of Jamaica, for example, death rate per thousand declined from 32 in 1861 to 23.5 in 1911 while birth rate per thousand was 39.5 in the latter year. In 1970 death rate was 7.7 compared with a birth rate of 34.4. The effects of health measures should be recognized even if a portion of the reduction in crude death rates may be attributed to the proportion of young people in the population.

change in the rich sector. The poor sector does not experience rapidly growing and high levels of income as does the rich sector. With low levels of income, inversely related birth rate is high and has in fact been pushed towards the biological maximum by the exogenously imposed health measures which reduced the death rate.

The supply of labour in each sector is taken to be a function of the rate of change of population after a fifteen year lag.¹ While the change in population is variable in the poor sector, in the rich sector it has been assumed constant and minimal. In effect, therefore, changes in population and the supply of labour take place in the poor sector.²

Demand

Asymmetry in consumption and savings/investment behaviour is assumed. In the poor sector all income is consumed. In the rich sector income (after taxation) is either saved or

¹A lag of fifteen years is assumed to reflect the average period between birth and entry to the labour force. In more developed countries this period could be longer.

²This is a manipulative device of the model which is in keeping with the labour surplus dualistic representation. The Fei-Ranis model supports this treatment.

"Actually, population growth within the industrial sector constitutes an additional source of labour supply to the industrial sector. However, one can conceptually treat all population increase as occurring in the agricultural or subsistence sector and then being "allocated" to the industrial sector."

John C. H. Fei and Gustav Ranis, Development of a Labour Surplus Economy: Theory and Policy, (Illinois: Irwin, 1964), note 5, p. 17.

consumed, the portion saved being equivalent *ex post* to that invested. Investment itself is a function of profits in the rich sector, which are in turn inversely related to wages.¹ It may be assumed that returns to capital are saved and salaries consumed, but this distinction is not essential to the model.

Technical Equations

It is assumed that production in the rich sector is a function of the two inputs capital and labour. Capital is a multiple of investment.² Labour demanded is a function of output.

Production in the poor sector uses the factors labour and land for subsistence output. Labour is used intensively since it is assumed that labour sharing, or at least output sharing arrangements, accommodate the 'unlimited supplies of labour' which cannot find employment in the rich sector. Land, the "free gifts of nature", is considered fixed, since it cannot be increased without limit. Improvements on land due to changes in seed varieties, fertilization, irrigation, reformed land tenure arrangements, etc., which will increase the output of land, are assumed to be so limited as to be

¹The assumption of an inverse relationship between profits and wages is Ricardian in origin. David Ricardo (1821). The Principles of Political Economy and Taxation, (London: Dent, 1969), p. 64.

²Steady state equilibrium is implied. Note 1 on page 139, below, provides for an alternative assumption.

negligible.¹ It follows that diminishing returns are experienced in the poor sector and output does not exceed subsistence level, while returns in the rich sector may be constant or increasing. Further specification of the parameters of the production functions are not made since these are not deemed to be meaningful complications of the basic model.

Institutional Equations

Two types of institutional dissimilarities are incorporated in the model.

The first pertains to the payment of the factor labour. It is assumed that in the poor sector an abundance of labour (the residual of total labour supplied and labour demanded in the rich sector) causes the marginal product of this factor to be, if not zero, at least considerably less than the wage

¹ Alfred Marshall distinguishes between land, "the material and the forces which Nature gives freely for man's aid", and capital, "those agents of production which are made by man; among which are included improvements made by him on the land itself".

Alfred Marshall, (1890) Principles of Economics, 8th ed., (London: MacMillan, 1920), pp. 115, 444.

While man-made improvements on land are often counted as capital, it is the view of some land economists that improvements are so closely incorporated, particularly over the long run, as to be considered land itself. Once applied, improvements have little salvage value apart from the land, if they can be separated at all. This broadly inclusive view has been maintained by Raleigh Barlowe in Land Resource Economics: The Economics of Real Property (Englewood Cliffs: Prentice Hall, 1972).

The assumption with regard to land, above, is in accord with the classical view.

in the rich sector. Hence, with labour-sharing arrangements, labour is paid its average product.¹

The differential return to labour, located in the rich and the poor sectors may be expected to cause the internal migration of labour from the poor to the rich sector. This migration is assumed to be constrained, however, by the technology of the rich sector. Fixed technical coefficients in the rich sector² prevent the absorption of labour into the rich sector.

In the rich sector, it is assumed that wages are affected by the demand for and the supply of labour, so that the wage level is inversely related to unemployment or the difference between the labour force and labour demanded in that sector.

The second institutional dissimilarity relates to the role of government in the dual economy. Government taxes the rich sector and subsidizes the poor sector, thereby

¹For justification, see argument presented above on pages 78-80 and 89-91.

²Benjamin Higgins, *Economic Development*, 2nd. ed., pp. 299-304.

Higgins describes the rich sector as . . . characterized in fact by relatively fixed technical coefficients (fixed proportions in which factors of production must be combined), or is assumed by entrepreneurs to be so,

hence, industrialization in the form common to underdeveloped countries did not provide a proportionate increase in job opportunities.

accomplishing a transfer of income from one sector to the other.¹ The proportions of income taxed in the rich sector and collections spent in the poor sector are determined by government policy and are not necessarily related to the level of population.² The government subsidy to the poor sector takes the form of expenditures on education, health, housing, nutrition and other general social welfare measures. It is by these means that effective income in the poor sector may be increased above subsistence level.

Endogenous Population

Births are assumed to be a function of income and therefore, in the poor sector, a function of government

¹Refer to pages 98-102 above for substantiation.

²This view is supported by the following statements:
 "Governments do not necessarily make the welfare investments which population growth might seem to imply, a common effect of population growth in poor countries is simply to widen the gap between the desirable provision of services and the actual provision."

"While population growth should lead to increased expenditures, provision can expand slower or faster than population growth, depending on supply and income distribution constraints, available resources, and perhaps most importantly, government policy."

R. H. Cassen Population Growth and Public Expenditure in Developing Countries, International Population Conference, vol. 1, (Liège; IUSSP, 1973), p. 334;

It has been shown that in Mexico government social expenditures were twice, under President Lopez Mateos (1959-63), compared to what they had been under Ruiz Cortines (1953-58). J. W. Wilkie, The Mexican Revolution: Federal Expenditure and Social Change Since 1910, (Los Angeles: University of California Press, 1967).

expenditure.¹ Two effects of government expenditure on births are incorporated in the model--a positive short run effect which is overwhelmed in the long run by a strong negative effect.²

The specification of births as a function of government expenditure is dynamic. Births in the current period are related to government expenditure in previous periods. This is summarized in a model of partial adjustment (See Axioms I, II and III and equations 1', 1'' and 1''' in Appendix to Chapter IV).

Summary of the Model

The basic model is summarized in the following equations, grouped according to demographic behavioural, demand behavioural, technical and institutional equations. Identities and equilibrium equations, pertaining to each group are listed accordingly. Exogenous variables are denoted here, as in the Appendix to this chapter, by a "bar" over the variable.

Behavioural Demographic:

- 1) $B^b = f(GE^b)$; $f' > 0 \Rightarrow S.R.$, $f' < 0 \Rightarrow L.R.$
- 2) $B \equiv B^b + \bar{B}^a$

¹This is supported in the section--The Role of Government--below.

²Further explanation is in the section--Differential Population Responses--below.

$$3) \Delta P \equiv B - (\bar{D} + \overline{NM})$$

$$4) \Delta P^b \equiv \Delta P - \Delta \bar{P}^a$$

$$5) Ls_t^a = A^a + \Delta Ls_t^a$$

$$5') \Delta Ls_t^a = f(\Delta \bar{P}_{t-15}^a)$$

$$6) Ls_t^b = A^b + \Delta Ls_t^b$$

$$6') \Delta Ls_t^b = f(\Delta P_{t-15}^b)$$

$$7) Ls \equiv Ls^a + Ls^b$$

Behavioural Demand:

$$8) C^a \equiv Y^a - S^a - GR^a$$

$$9) S^a = I^a$$

$$10) I^a = f(\rho^a)$$

$$11) \rho^a = f(1/w)$$

technical:

$$12) Y^a = f(K^a, Ld^a)$$

$$13)^1 Ld^a = f(Y^a)$$

$$14)^2 K^a = kI^a$$

$$15) Y_{sub}^b = f(Ld^b, \bar{T})$$

Institutional:

$$16) Ld^b \equiv Ld - Ld^a$$

$$17) w = f[1/(Ls - Ld^a)]$$

$$18) GR^a = f(Y^a)$$

$$19) GE^b = f(GR^a)$$

¹Equation 13 is a marginal productivity equation.

²See note 1, page 139, below, for an alternative specification which does not imply a steady state equilibrium.

In addition, the equilibrium equation is specified:

$$20) \quad L_d = L_s$$

The following notation is employed:

- a - rich sector
- b - poor sector
- L_s - labour supply
- L_d - labour demand
- P - population
- B - births
- D - deaths
- NM - net migration
- A - a stock representing the accumulated flow of labour from period $t-1, t-2, t-3, \dots$ arising from $\Delta P_{t-16}, \Delta P_{t-17}, \Delta P_{t-18}, \dots, \Delta P_{t-n}$, where $t-n$ represents the year of exit from the labour force due to retirement or death.
- Y - income
- GE - government expenditure
- GR - government revenue
- C - consumption
- S - savings
- I - investment
- K - capital
- κ - multiple
- L - labour

- sub - subsistence level of output
- T - land
- ρ - profit rate
- w - wage rate
- t - time (it is attached as a subscript only to those variables in equations for which time matters.)
- f - a general functional operator having a different meaning in different equations.

Reduction of Model

The above functional form was represented in an operational linear form and the reduced equations (see Appendix to Chapter IV for reduction)

$$Ld_t = \delta Y_t^a, \text{ and}$$

$Ls_t = \alpha + \beta Y_{t-1}^a$; $\beta > 0 \Rightarrow \text{S.R.}$, $\beta < 0 \Rightarrow \text{L.R.}$, together with the equilibrium equation

$$Ld_t = Ls_t$$

expressed as a first-order difference equation. From this the initial levels, equilibrium levels, and time paths of output in the rich sector, Y^a , labour, L, and change in population in the poor sector, ΔP^b , were determined. The results depend on constant values of the exogenous variables deaths, $\bar{D}$, net migration, $\bar{NM}$, births in the rich sector, $\bar{B}^a$, change in population in the rich sector, $\Delta \bar{P}^a$, and land, $\bar{T}$.

The initial levels of Y^a , in the short run were $\beta/\delta \neq 1$

and $\beta > 0$, and in the long run where $\beta < 0$, were equal to Y_0^a less the constant α divided by the difference, $\delta - \beta$, the coefficients of labour demand and supply. In the short run where $\beta > 0$ and $\beta/\delta = 1$, the initial level remained at Y_0^a .

The initial levels of labour and change of population in the poor sector were equivalent to those of Y^a , modified by δ in the former case and $\gamma\tau$ in the latter, where γ is the response of births to government expenditure, and τ is the proportion of output from the rich sector expended by the government in the poor sector (see Appendix to Chapter IV, pages 140-141).

The equilibrium levels of Y^a , in the short run where $\beta/\delta \neq 1$ and $\beta > 0$, and in the long run where $\beta < 0$, were equal to the constant divided by the difference between the labour demand and supply coefficients, $\frac{\alpha}{\delta - \beta}$.

Again, the equilibrium levels of L and ΔP^b were modified by δ in the case of labour and $\gamma\tau$ in the case of change of population in the poor sector.

The time paths delineated were of particular interest. It was found that in a completely dualistic model with population endogenous and dependent on the role of government in actively transferring income from the rich to the poor sector, single valued unidirectional trends apply only in the short run when $\beta > 0$. Dynamic cobweblike adjustments may be derived over the long run when $\beta < 0$.

The hypotheses basic to this result are that demand for labour is an increasing function of income, supply of labour is a decreasing (increasing) function of income in the long run (short run), and that a lag exists between the increase in population and its availability on the labour market. In addition, demand for labour is generated in the rich sector, while supply of labour is provided by the poor sector.

In the short run, with the supply of labour positively related to income, monotonic time paths are generated for output in the rich sector, labour, and the change of population in the poor sector. In general, where $\beta/\delta \neq 1$, exponential growth will take place when the coefficient of labour supply, β , is greater than the labour/output ratio, δ , i.e., the responsiveness of the lagged labour supply function will be greater than the unlagged labour demand function. Where $\beta/\delta = 1$, the term denoting the time path is equivalent to 1 for any t , indicating an exploding time path.

In the long run, with the supply of labour negatively related to income, oscillating time paths are delineated for output in the rich sector, labour, and the change of population in the poor sector. The paths are explosive where $|\beta| > \delta$, damped where $|\beta| < \delta$ and regular where $|\beta| = \delta$. The reversal of the peaks and troughs in the change of population in the poor sector (arising from $\gamma < 0$ in 46") with the peaks and troughs of labour and output in the rich sector allows for the

deduction of variations between periods of high employment and high unemployment or, perhaps, less unemployment and more unemployment.

Theoretical Background and Mechanism of the Model

The model incorporates features of differential population responses over time, i.e., positive short run and negative long run effects; the role of government in a dualistic economy; and the operation of the cobweb mechanism with resulting economic fluctuations. Each of these features requires substantiation and explanation.

Differential Population Responses

A basic feature of the model is the specification of differential population responses over time to income. It is postulated that births respond positively to income in the short run and negatively in the long run. The fluctuations derived over the long run for the variables Y^a , L and ΔP^b are directly dependent on the negative response.

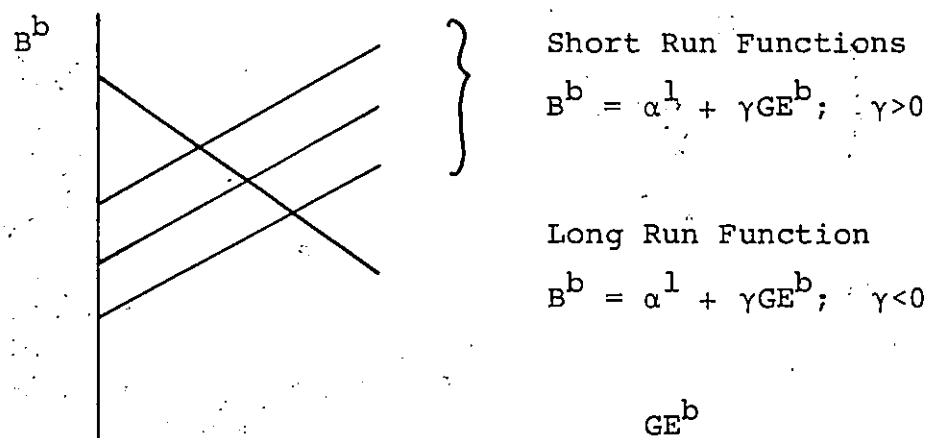
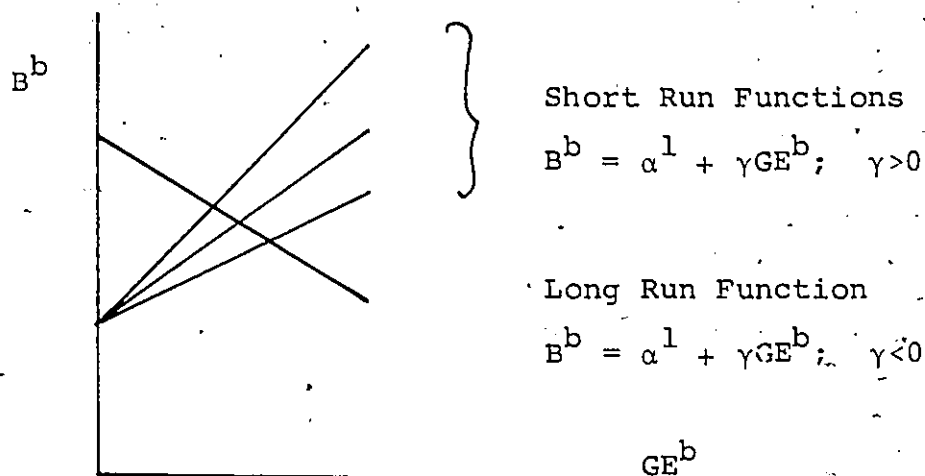
In terms of the model the short and long run distinction and the transition from the first to the second position may be demonstrated in the following ways:

Placing births in the poor sector on the vertical axis and government expenditure in the poor sector on the horizontal axis the equation $B^b = \alpha^1 + \gamma GE^b$; $\gamma > 0 \Rightarrow$ S.R., $\gamma < 0 \Rightarrow$ L.R., may be represented as

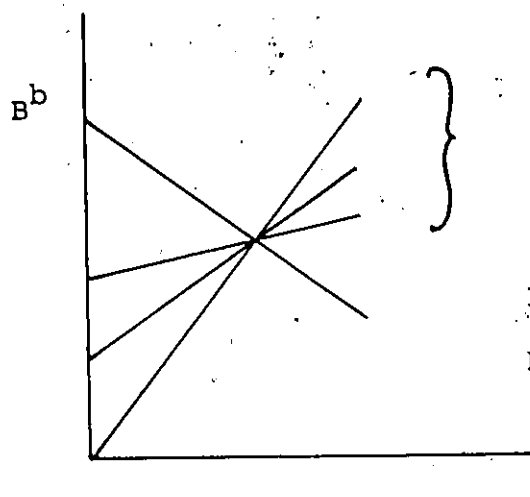
below.¹ The short run functions shown are only three of a possible infinity of such functions,

Figure 3

Population Responses



¹The second and third diagrams parallel the possible explanations of the short and long run responses of consumption to income provided by M. K. Evans, Macroeconomic Activity: Theory, Forecasting, and Control (New York: Harper and Row, 1969), Ch. 2. Shifts in functions due to changing parameters were discussed by Keynes in The General Theory and noted by Alvin H. Hansen in A Guide to Keynes (New York: McGraw-Hill, 1953), Ch. 3, where the consumption function is treated.

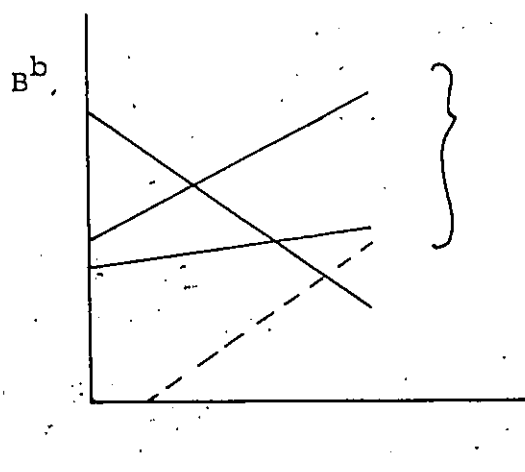


Short Run Functions

$$B^b = \alpha^1 + \gamma GE^b; \gamma > 0$$

Long Run Function

$$B^b = \alpha^1 + \gamma GE^b; \gamma < 0$$



Short Run Functions

$$B^b = \alpha^1 + \gamma GE^b; \gamma > 0$$

Long Run Function

$$B^b = \alpha^1 + \gamma GE^b; \gamma < 0$$

- In the first diagram, with an increase in government expenditure in the poor sector over time, each short run function, having the same intercept, will shift downward to the right. Considering the relevant levels of government expenditure, the points on the short run function trace out the long run function.
- In the second diagram, each short run function having the same slope will shift downward to the right, the intercept being lower as government expenditure increases.

- In the third diagram, if government expenditure remains constant over time, the slopes of the short run functions may decrease eventually becoming negative and merging with the long run function.
- In the fourth diagram, a combined change of the intercepts and the slopes of the short run functions may take place with an increase of government expenditure. The dashed curve indicates the theoretical possibility that the slope of a short run function could increase at higher levels of government expenditure without infringement on the negative long run response, provided that the intercept is sufficiently low.

The short run is taken to relate to the duration of time when everything else, but income and government expenditure, may be assumed constant. The long run relates to a time period of sufficient duration to allow for changes in factors such as education, health and urbanization in addition to tastes and values.

Micro analyses of the response of fertility to income have been conducted in the context of the short run when tastes may be taken as given. Hence the consumption goods approach to children postulates that, as income increases, births will also increase. Observed declines in fertility are accounted for in utility-maximizing micro theories by

cost/benefit (Leibenstein, 1957; Easterlin, 1975) quantity/quality (Becker, 1960), and time budget (Ben-Porath, 1973; De Tray, 1970; and Willis, 1973) distinctions.

Simon (1976) differentiates the short and long run influences on fertility derived, in the macro context, from national income. The short run effects "flow immediately from changes in the family's current income opportunities",¹ while the long run effects allow for changes in the "structural aspects of people's life situations".²

Simon demonstrates that

This distinction between the short-run and the long run effects of income on fertility reconciles the apparent contradiction between the negative relationship usually observed in simple cross-sectional analysis and the positive relationship observed in time series.³

The Role of Government

It is generally conceded that the poor do not participate in economic growth. Per capita income remains low in the deprived sector unless the government transfers income in the form of social welfare measures.

¹ Julian L. Simon, Income, Wealth, and their Distribution as Policy Tools in Fertility Control, p. 42, in R. G. Ridker, ed., Population and Development: The Search for Selective Interventions, (Baltimore: John Hopkins University Press, for Resources for the Future, 1976).

² Ibid., p. 42.

³ Ibid., p. 43.

The assumptions regarding public policy in the model are based on the view that the role of government must include measures for eliminating poverty and increasing the welfare of the uneducated, the malnourished, the ill-housed, and the unhealthy.¹ Public policy may be designed so that basic needs targets can be met. Moreover, it is held that these socio-economic factors, which can be improved by government action, affect demographic variables.² Most investigations of the relationships between population and public policy have concentrated on the influence of demographic factors on the size

¹ Benjamin Higgins, Welfare Economics and the Unified Approach to Development Planning, pp. 91-114, in Antoni Kuklinski, ed., Social Issues in Regional Policy and Regional Planning, (The Hague: Mouton, 1977).

² A. O. Herrera and others, Catastrophe or New Society? A Latin American World Model, work performed at the Fundación Bariloche, Buenos Aires, Argentina. (Ottawa: International Development Research Centre, 1976).

Julian L. Simon, Income, Wealth and their Distribution as Policy Tools in Fertility Control, pp. 33-76.

William P. Butz and Jean-Pierre Habicht, The Effects of Nutrition and Health on Fertility: Hypotheses, Evidence, and Interventions, pp. 210-238, in R.G. Ridker, ed., Population and Development: The Search for Selective Interventions, (Baltimore: John Hopkins University Press, for Resources for the Future, 1976).

Donald B. Holsinger and John D. Kasarda, Education and Human Fertility: Sociological Perspectives, pp. 154-181, in R. G. Ridker, ed., Population and Development: The Search for Selective Interventions, (Baltimore: John Hopkins University Press, for Resources for the Future, 1976).

Dennis N. deTray, Population Growth and Educational Policies: An Economic Perspective, pp. 182-209, in R. G. Ridker, ed., Population and Development: The Search for Selective Interventions, (Baltimore: John Hopkins University Press, for Resources for the Future, 1976).

and disposition of the government budget,¹ rather than on the effects of government allocations on demographic variables.

The Cobweb Mechanism

It can be demonstrated that the negative response of births to income can, in the context of the dualistic model specified, generate cyclical fluctuations. In this section, therefore, an attempt is made to specify the mechanism responsible for these fluctuations. The analysis draws upon the presentation by Mordecai Ezekiel² of the cobweb theorem originated by Schultz, Tinbergen and Ricci.

In the model, increases in the demand for labour are generated in the rich sector, while net additions to the supply of labour arise in the poor sector. Each concept relates to a particular sector, representing, therefore, the demand and supply functions derived from the reduced model in a diagram with ΔY^a on the horizontal axis and ΔL on the vertical

¹A. C. Kelley, Demographic Change and the Size of the Government Sector, ILO Population and Employment Project, Working Paper No 32, (Geneva: ILO, 1976).

F. T. Denton and Byron Spencer, Some Government Budget Consequences of Population Change, Working Paper No 74-01, McMaster University, Department of Economics, 1974.

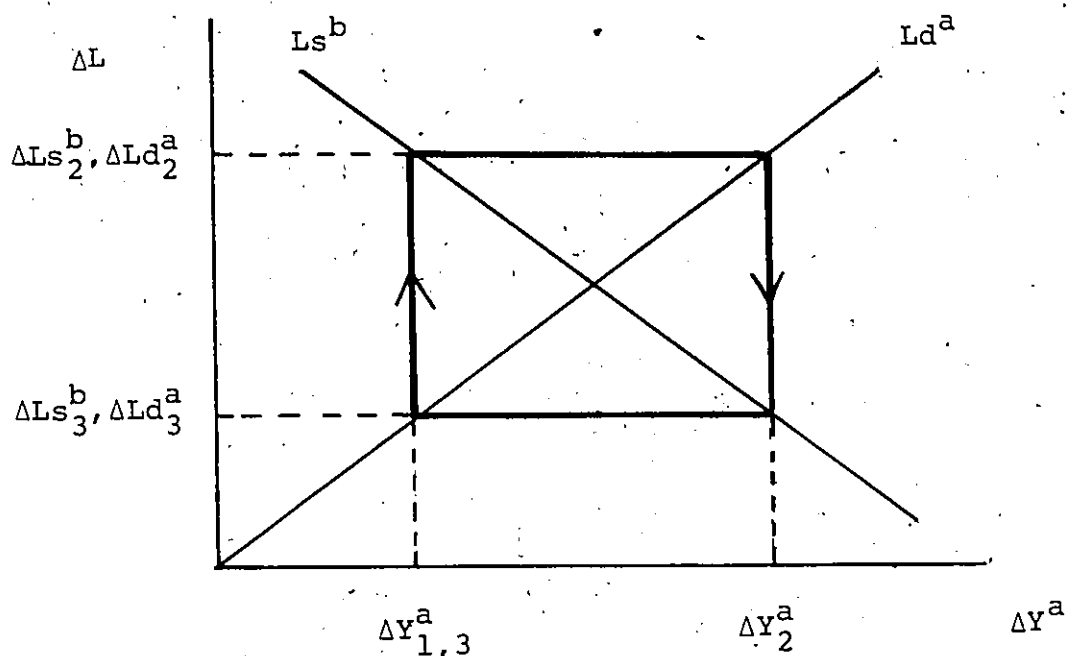
R. H. Cassen, Population Growth and Public Expenditure in Developing Countries, pp. 333-350.

²M. Ezekiel, "The Cobweb Theorem", Quarterly Journal of Economics, 52, November 1937, pp. 255-280.

axis, the following procedure can be described¹ (it is assumed in this case, for expository ease, that $|\beta| = \delta$)

Figure 4

The Dual Economy Cobweb



- i) Starting from any given level with zero growth, introduce an initial small increase in income ΔY_1^a . The increase in labour supply responds with a lag

¹In the dual economy cobweb described here, supply is negatively related to output, rather than demand negatively related to price in the market model generally known as "the cobweb model". The direction of the dual economy cobweb is in a clockwise rather than an anticlockwise direction. As indicated by the labelling of the axes, the relationships are expressed in first differences. The slopes of the curves represent, therefore, rates of change of labour demanded in the rich sector and lagged labour supplied in the poor sector to output in the rich sector.

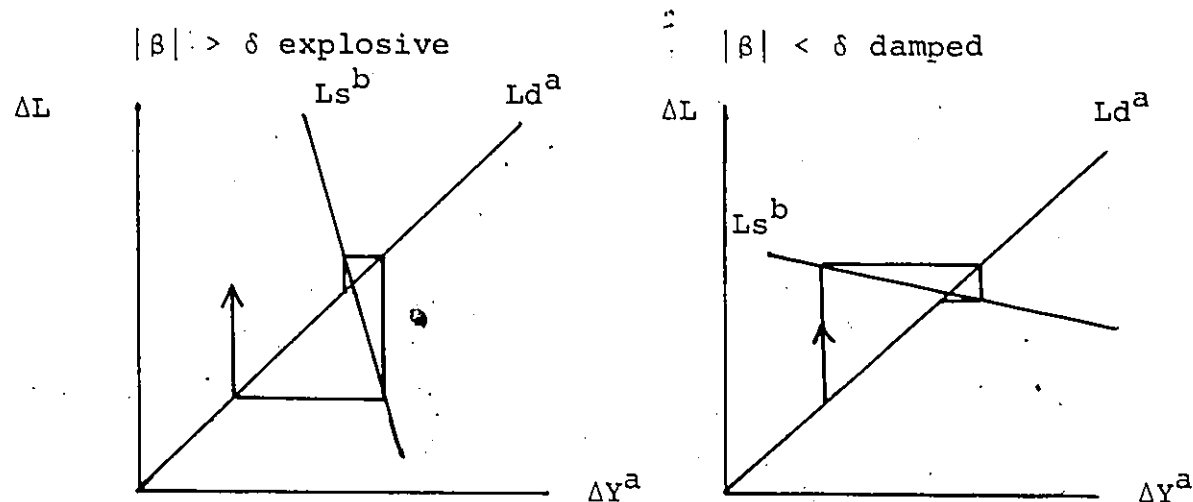
so that in period 2 ΔLs_2^b is generated. The large response of ΔLs_2^b in period 2 is due to the fact that with small increases in Y^a , government transfers (a constant proportion τ of Y^a) have been increased minimally.

- ii) With the increase in labour supply wage rate declines and therefore the rate of profit rises. With the increased rate of profit in the rich sector, investment will increase, culminating in a greater increase in Y^a in period 2 at ΔY_2^a and an increase in labour demanded of Ld_2^a .
- iii) The greater increase in Y^a will cause government transfers to the poor sector to increase also.
- iv) Net additions to labour supply in the poor sector will respond in period 3 by declining to ΔLs_3^b .
- v) The smaller increase, or decline in the growth of the labour supply, will encourage wage rate increases, offset by declining profits and a reduced rate of investment. The change in output will decline to ΔY_3^a , with a decrease in the change of labour demanded to Ld_3^a .

The following diagrams demonstrate the divergent and convergent cobwebs where $|\beta|$ is greater than or less than δ .

Figure 5

The Explosive and Damped Dual Economy Cobwebs



The incorporation of the flexible accelerator within the dual economy cobweb permits an additional supportive impetus for movement from small to large rates of increases in output. Assuming that investment is positively related to the level of output and negatively related to capital stock such that net investment increases at low levels of output and declines at high levels of output when the negative effect of increased capital stock outweighs the positive effect of further increases in output, oscillations of the dual economy will be facilitated.

With the addition of the accelerator mechanism, it becomes possible to compare a population response - accelerator model with the multiplier - accelerator model of Hansen and

Samuelson.¹ In the latter model, government is taken to be exogenous and is given a constant value. In a population response - accelerator model government expenditure assumes an active role, consumption and the Keynesian multiplier being left out of the picture so that the interaction is between the factor labour and investment rather than consumption and investment.

Population and Economic Cycles

The oscillatory time paths derived from the model are in accord with the empirically founded Kuznets' cycles² of fifteen to twenty five years duration. The demographic influences on long swings have been based on observations of United States data. Kuznets finds that "net additions to total population fluctuate from one decade to the next describing over the period since 1870 three long swings from peak to peak, or two complete and two incomplete swings from trough to trough".³ Using data for five-year intervals, swings of twenty years average duration are indicated, with the relative

¹Paul A. Samuelson, "Interactions Between the Multiplier Analysis and the Principle of Acceleration", Review of Economic Statistics, 21, May 1939, pp. 75-78.

²Moses Abramovitz, "The Nature and Significance of Kuznets Cycles", Economic Development and Cultural Change, 9, April 1961, pp. 225-248.

Simon Kuznets, "Long Swings in the Growth of Population and Related Economic Variables", Proceedings of the American Philosophical Society, 102, February 1958, pp. 25-52.

³Simon Kuznetz, "Long Swings in the Growth of Population and Related Economic Variables", p. 26.

amplitude of swings widening over time. Further, it is found that these swings in population increases may be attributable only in part to variations in immigration, since long swings are also found in fluctuations of marriage and birth rates where both parents are native born.

The correspondence, with lags, between the swings in population growth and the waves in the changes of the annual flow of goods to consumers leads Kuznets to suggest a two-way causality between population growth and economic activity. Net additions to population may be expected to act upon residential housing and related commercial facilities and public utilities. Population may in turn respond to periods of high unemployment or employment. If lags are introduced, the long swings may be explained.

Easterlin proposes an analytical model for formalizing Kuznets' observations.¹ A positive relationship between fertility and income is assumed. Cycles are generated as wages and employment respond to excesses or shortages of labour supply brought about by earlier or deferred marriage and household formation.

The Denton and Spencer specification of a macro

¹Richard A. Easterlin, "Economic-Demographic Interactions and Long Swings in Economic Growth", American Economic Review, 56, December 1966, pp. 1063-1104.

Richard A. Easterlin, Population, Labour Force and Long Swings in Economic Growth: The American Experience (New York: Columbia University Press, 1968).

economic neo-classical single sector model¹ for testing East-erlin's analysis generates fluctuations of the duration of Kondratieff (6 decades) cycles rather than Kuznets (15-25 years) cycles. It appears, therefore, that the dual economy model specified above may be more appropriate for a further understanding of Kuznets' empirical observations.

The mechanism specified for the dual economy model is also in keeping with supply theories of the cycle as developed by Mitchell.² In these theories labour costs, profit margins and income distribution are the chief factors through which fluctuations operate. Similarly in the model, the levels of profits and wages are factors contributing to the derivation of economic fluctuations.

It should be observed, however, that the oscillations generated by the dual economy model, as specified here, are intergenerational saw-toothed movements for which periodicity but not amplitude (as in a model generating sine and cosine curves), may be determined.

Relaxable Assumptions of the Model

Models may not be realistically assessed in terms of

¹Frank T. Denton and Byron G. Spencer, Economic-Demographic Interactions and Long Swings: Some Experimental Results, Working Paper No 72-15, Department of Economics, McMaster University, 1972.

²W. C. Mitchell, Business Cycles and their Causes, (Berkeley: University of California Press, 1941).

perfection or complete accuracy of representation. The most that can be hoped for is a relevant, if limited, portrayal of a certain view of reality. More than this would be replication rather than modelling. The model presented here is hopefully relevant, but certainly limited.

There are, nevertheless, degrees of relevance. Often, the relaxation of certain assumptions enhances the extent of relevance. The following relaxable assumptions are noted.

i) The causes of births are manifold. Equation (1) attempts to reflect the response of births to government expenditure on welfare measures. In this context, changes in government expenditure represent more than a measure for the redistribution of income. These changes are cross-correlated with opinions regarding family planning, nutritional requirements, basic health and hygiene levels, facilities for community interaction, tolerable levels of literacy, and so forth. They are symbolic of fundamental social and political changes which facilitate development and reflect revolutions in attitudes such that human resources are not merely a factor of production but also the focus of production.

It is possible to modify this assumption so that births will reflect demographic influences. The effect of government expenditure may then be assessed in relation to the age structure of a population and the transition from a young to a normal age structure where integral replacement occurs.

Assuming a normal age distribution with a unitary net

reproduction rate, the age distribution will no longer impel population changes. The 'pure' effect of changes in income, and hence government expenditure, on births may be isolated and the long run dynamic equilibrium assessed. The 'pure' effect will in part determine whether oscillations explode, diminish towards the Ricardian stationary state, or fluctuate forever.

ii) Deaths cannot always be considered constant as the representation in equation 3) implies. Even where health measures have improved so as to reduce mortality to a minimum for reasons other than age, the variable birth rate will operate through the age structure of the population, causing changes in deaths due to fluctuating crude death rates.

iii) The model does not permit, in this basic form, internal migration. This may be introduced in a variety of ways. The simplest is perhaps the assumption of a constant level of migration from the poor to the rich sector, in which case equations 5') and 6') would be written $\Delta Ls_t^a = \epsilon' \Delta \bar{P}_{t-1}^a + \bar{IM}_t$ and $\Delta Ls_t^b = \epsilon \Delta P_{t-1}^b - \bar{IM}_t$ respectively, where $\bar{IM}$ represents a constant amount of intersectoral migrants all of whom are taken to be in the work force. Summing, the change in labour supply for both sectors $\Delta Ls_t = \epsilon' \Delta \bar{P}_{t-1}^a + \epsilon \Delta P_{t-1}^b$, as before.

With the postulated fixity of technical coefficients in the rich sector, another treatment of internal migrants may be as geographical migrants only who form a pool of

unemployed¹ that remains analytically within the poor sector. One can suppose that the government may provide relief welfare measures or unproductive employment for this pool of labour. Births in the poor sector may then be estimated as a function of the weighted responses of internal migrants and non-migrants to government expenditure. The validity of this approach will depend in part on whether the demographic behaviour of the pool of unemployed corresponds to that of the poor sector or quickly adjusts to that of the rich sector.

A third alternative is the absorption of intersectoral migrants in a tertiary sector. This approach is in accord with the transitional sector elaboration of the dual model proposed by Higgins.²

If technical coefficients in the rich sector are assumed variable (within a range) such that, with a given amount of capital, labour may be increased, then the labour-output ratio or coefficient of labour demand becomes correspondingly variable, allowing for interesting complications of the analysis. The movement of the labour demand curve, swinging upward to the left as the labour-output ratio increases, will affect

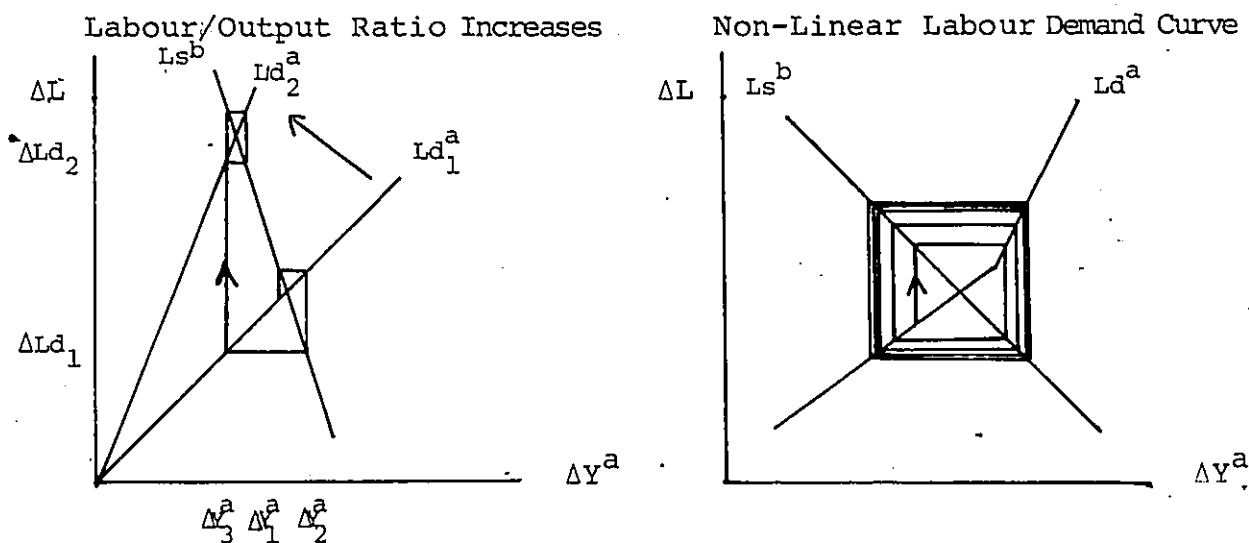
¹The formation of a pool of unemployed labour in urban areas has been developed by M. Todaro, "A Model of Labor Migration and Urban Unemployment in Less Developed Countries", American Economic Review, 59, March 1969, pp. 138-148.

²Benjamin Higgins, The Employment Problem in Development, pp. 241-290 in Eliezer B. Ayal, ed., Micro Aspects of Development (New York: Praeger, 1970).

the equilibrium levels and the monotonic short run or oscillatory long run time paths. Alternatively, the labour demand curve may be non-linear, curving upward to the left as the labour-output ratio increases with an increase of output. This will again affect the time paths. In the case of the negatively sloping long run labour supply curve, unique amplitudes¹ for cyclical fluctuations may result. Non-linear labour demand curves with increasing or decreasing labour-output ratios imply non-homogeneous production functions.

Figure 6

Dual Economy Cobwebs With Variable
Labour/Output Coefficients



¹Paul A Samuelson explores the possibility of unique amplitudes for the market cobweb with curvilinear supply curves in *Dynamic Process Analysis*, pp. 352-387 in Howard S. Ellis, ed., *A Survey of Contemporary Economics*, (Homewood, Illinois: Irwin, 1948).

The diagrams in Figure 6 show, in each case, one of a possible infinity of oscillatory paths. In the case where the labour/output ratio swings upward to the left, at ΔY_3^a it is possible to employ ΔLd_2 rather than ΔLd_1 , thereby varying the oscillatory pattern. In the case where the labour-output ratio is non-linear, the oscillatory path, at first divergent, becomes regular.

iv) No reliance is placed on the creation of an agricultural surplus, as in other dualistic models, for growth. The viewpoint accommodating this treatment is that the agricultural, non-agricultural dichotomy need not be maintained. Efficient mechanized agriculture may be considered part of the rich sector. So that each sector can produce its own agricultural and non-agricultural products; the poor sector producing just enough for livelihood while the rich sector produces the required surplus which may be invested or taxed away.

If the agricultural/non-agricultural dichotomy were maintained, the model would necessarily incorporate trade and relative sectoral prices. These assumptions may not, however, facilitate the purpose of the model.

v) The postulated inverse relationship between the wage rate and unemployment may be affected to the extent that trade unions in the rich sector pressure for wages that bear some relation to productivity or to remuneration for comparable jobs abroad. Firms in the rich sector will attempt to maintain the

postulated relationship, responding by adopting labour displacing techniques. If output is maintained at the same level, a reduction in the use of labour will cause a decline in the labour-output ratio and the demand for labour curve of the rich sector will swing downwards to the right. Oscillations will be modified accordingly depending on whether there are further successive declines or not in the labour-output ratio.

A possible shortcoming, allowing for alternative treatment, is noted. The device whereby B^a is constant, so that changes in population may be generated in the poor sector only, results in the exogeny of demographic behaviour in the rich sector. However, this does not contravene the dualistic approach.

The view is taken that the model provides an approach toward a pertinent portrayal of some of the problems of rapidly increasing population and immiserizing growth. Recognition of the interactions between population and growth provides a not unrealistic representation of unemployment and its possible fluctuations, and identifies certain adjustable coefficients for possible use in guiding an economy towards chosen paths for development.

Appendix

Axiom I

In the poor sector, expected births during period t , B_t^b , are a linear function of government expenditure.

$$1') B_t^b = \alpha + \gamma GE_t;$$

Possible responses of births to government expenditure may be

- i) positive, $\gamma > 0$
- ii) negative, $\gamma < 0$
- iii) a linear function of time, $(\gamma_0 + \gamma_1 t)$
such that $\gamma_0 > 0$, $\gamma_1 < 0$.

etc.

Axiom II

Births are corrected from the preceding period in proportion to the difference between planned births B_t^b and actual births in the preceding period B_{t-1}^b .

Axiom III

Decisions are affected by a margin of error (reflecting other unspecified explanatory variables) with mathematical expectation equal to zero, variance constant, and covariance null.

$$1'') B_t^b - B_{t-1}^b = \phi(B_t^b - B_{t-1}^b) + u_t; 0 < \phi < 1$$

Substituting 1') into 1'')

$$B_t^b - B_{t-1}^b = \phi(\alpha + \gamma GE_t) - \phi B_{t-1}^b + u_t$$

$$1''') B_t^b = \alpha\phi + \gamma\phi GE_t + (1-\phi)B_{t-1}^b + u_t$$

In the dynamic model of partial adjustment specified above, the coefficient of response of births in the poor sector to previous births in that sector $(1 - \phi)$, represents the strength of habit persistence. While of no consequence in the long run, this behavioural inflexibility or resistance to change modifies the postulated relationship of births in the poor sector to government expenditure in the poor sector, making the short run response weaker or the reverse of the long run response.

From (1''') $\frac{\partial B_t^b}{\partial GE_t} = \gamma\phi$

$$\sum_{i=0}^{\infty} \frac{\partial B_t^b}{\partial GE_{t-i}} = \frac{\gamma\phi}{[1-(1-\phi)L]} = \gamma\phi[1-(1-\phi)L]^{-1} = \gamma$$

If i) $\gamma > 0$, and $1 > (1-\phi) > 0$; then $\frac{\partial B_t^b}{\partial GE_t} > 0$, $\sum_{i=0}^{\infty} \frac{\partial B_t^b}{\partial GE_{t-i}} > 0$

and $\frac{\partial B_t^b}{\partial GE_t} < \sum_{i=0}^{\infty} \frac{\partial B_t^b}{\partial GE_{t-i}}$

If ii) $\gamma < 0$, and $1 > (1-\phi) > 0$, then $\frac{\partial B_t^b}{\partial GE_t} < 0$, $\sum_{i=0}^{\infty} \frac{\partial B_t^b}{\partial GE_{t-i}} < 0$

and $\left| \frac{\partial B_t^b}{\partial GE_t} \right| < \left| \sum_{i=0}^{\infty} \frac{\partial B_t^b}{\partial GE_{t-i}} \right|$

If iii) $\gamma = \gamma_0 + \gamma_1 t$, $\frac{\partial B_t^b}{\partial GE_t} = \phi(\gamma_0 + \gamma_1 t)$

$$\sum \frac{\partial B_t}{\partial GE_{t-i}} = \frac{\phi(\gamma_0 + \gamma_1 t)}{[1 - (1-\phi)L]}$$

$$= \phi\gamma_0 [1 - (1-\phi)L]^{-1} + \phi\gamma_1 [1 - (1-\phi)L]^{-1} t$$

$$= \gamma_0 + \phi\gamma_1 [1 + (1-\phi)L + (1-\phi)^2 L^2 + \dots] t$$

$$= \gamma_0 + \phi\gamma_1 [t + (1-\phi)(t-1) + (1-\phi)^2(t-2) + \dots]$$

$$= \gamma_0 + \phi\gamma_1 \left[\sum_{s=0}^{\infty} (1-\phi)^s (t-s) \right]$$

$$= \gamma_0 + \phi\gamma_1 \left[t \sum_{s=0}^{\infty} (1-\phi)^s - \sum_{s=0}^{\infty} (1-\phi)^s s \right]$$

$$= \gamma_0 + \phi\gamma_1 \left[\frac{t}{\phi} - \sum_{s=0}^{\infty} (1-\phi)^s s \right]$$

$$= \gamma_0 + \gamma_1 t - \phi\gamma_1 \frac{(1-\phi)}{\phi^2}$$

$$= \gamma_0 + \gamma_1 t - \gamma_1 \frac{(1-\phi)}{\phi}$$

where, the value t^* of t at which the short run derivative vanishes is: $-\frac{\gamma_0}{\gamma_1}$ and, the value t^{**} of t at which the long run derivative vanishes is: $\frac{-\gamma_0 + \gamma_1 \frac{(1-\phi)}{\phi}}{\gamma_1} = -\frac{\gamma_0}{\gamma_1} + \frac{1-\phi}{\phi}$ that is, t^* and t^{**} are the values of t in the short and in the long run respectively at which the response of births in

the poor sector to government expenditure in that sector shifts from a positive to a negative sign.

The intractability arising from the superimposition of the lag structure of l''') on that of the intergenerational gap specified in the model below may be avoided by the use of the simplified specification of the deterministic form:

Hence,

- 1) $B^b = \alpha^1 + \gamma GE^b$; where $\gamma = \gamma(t)$, $\gamma > 0$ for t_0 and $\gamma < 0$ for t_2
- 2) $B = \bar{B}^a + B^b$
- 3) $\Delta P \equiv B - (\bar{D} + \overline{NM})$
- 4) $\Delta P^b = \Delta P - \Delta \bar{P}^a$
- 5) $Ls_t^a = A^a + \Delta Ls_t^a$
- 5') $\Delta Ls_t^a = \epsilon' \Delta \bar{P}_{t-1}^a$; $\epsilon' > 0$
- 6) $Ls_t^b = A^b + \Delta Ls_t^b$
- 6') $\Delta Ls_t^b = \epsilon \Delta P_{t-1}^b$; $\epsilon > 0$
- 7) $Ls = Ls^a + Ls^b$
- 8) $C^a = Y^a - S^a - GR^a$
- 9) $S^a = I^a$
- 10) $I^a = \pi \rho^a$
- 11) $\rho^a = \mu(1/w)$
- 12) $Y^a = \beta_1 K^a + \beta_2 Ld^a$
- 13)¹ $Ld^a = \delta' Y^a$

¹Equation 13 is a marginal productivity equation.

$$14) \dot{K}^a = \kappa I^a$$

$$15) Y_{\text{sub}}^b = \beta_3 Ld^b + \beta_4 \bar{T}$$

$$16) Ld^b = Ld - Ld^a$$

$$17) w = \sigma [1 / (Ls - Ld^a)]$$

$$18) GE^b = \tau' GR^a$$

$$19) GR^a = \tau'' Y^a$$

$$20) Ld = Ls$$

From 12)

$$21) Ld^a = \frac{1}{\beta_2} (Y^a - \beta_1 K^a)$$

Substituting 11) into 10)

$$22) I^a = \pi \mu (1/w)$$

and substituting 17) into 22)

$$23) I^a = \pi \mu [1 / \frac{\sigma}{(Ls - Ld^a)}] = \pi \mu [(Ls - Ld^a) / \sigma]$$

Substituting 23) into 14)

$$24) \dot{K}^a = \kappa \pi \mu [(Ls - Ld^a) / \sigma]$$

and substituting 24) into 21)

$$25) Ld^a = \frac{1}{\beta_2} Y^a - \frac{\beta_1}{\beta_2} \kappa \pi \frac{\mu}{\sigma} Ls + \frac{\beta_1}{\beta_2} \kappa \pi \frac{\mu}{\sigma} Ld^a$$

¹Equation 14 implies a steady state equilibrium where increments and decrements to capital are assumed equal. An alternative specification could be $\dot{K}_t^a = \kappa (K_{t+1}^a - I_g)$ where $\kappa = \frac{1}{1-\zeta}$. This is derived as follows. $I_g = K_{t+1}^a - K_t^a + \zeta K_t^a$ where I_g is gross investment, $K_{t+1}^a - K_t^a$ is the change in capital and ζK_t^a is depreciation on capital. Hence $I_g = K_{t+1}^a - K_t^a (1-\zeta)$, so that $K_t^a = \frac{1}{1-\zeta} (K_{t+1}^a - I_g)$.

Now substituting 20) into 25)

$$26) \quad Ld^a = \frac{1}{\beta_2} Y^a - \frac{\beta_{1\kappa\pi\mu}}{\beta_{2\sigma}} Ld + \frac{\beta_{1\kappa\pi\mu}}{\beta_{2\sigma}} Ld^a$$

and

$$Ld = \frac{1}{\frac{\beta_{1\kappa\pi\mu}}{\beta_{2\sigma}}} \left\{ \frac{1}{\beta_2} Y^a + Ld^a \left(\frac{\beta_{1\kappa\pi\mu}}{\beta_{2\sigma}} - 1 \right) \right\}$$

Using 13)

$$Ld = \frac{1}{\frac{\beta_{1\kappa\pi\mu}}{\beta_{2\sigma}}} \left\{ \frac{1}{\beta_2} Y^a + \delta' Y^a \left(\frac{\beta_{1\kappa\pi\mu}}{\beta_{2\sigma}} - 1 \right) \right\}$$

$$27) \quad = Y^a \left\{ \frac{\sigma}{\beta_{1\kappa\pi\mu}} + \delta' \left(1 - \frac{\beta_{2\sigma}}{\beta_{1\kappa\pi\mu}} \right) \right\}$$

Let

$$\frac{\sigma}{\beta_{1\kappa\pi\mu}} + \delta' \left(1 - \frac{\beta_{2\sigma}}{\beta_{1\kappa\pi\mu}} \right) = \delta$$

Hence

$$28) \quad Ld = \delta Y^a$$

Now substituting 2) into 3)

$$29) \quad \Delta P \equiv \bar{B}^a + B^b - (\bar{D} + \overline{NM})$$

and substituting 19) into 18)

$$GE^b = \tau' \tau'' Y^a$$

Let $\tau' \tau'' = \tau$, and $1 > \tau > 0$, so that

$$30) \quad GE^b = \tau Y^a$$

Now substituting 1) into 29)

$$31) \quad \Delta P = \bar{B}^a + \alpha^1 + \gamma GE^b - (\bar{D} + \overline{NM})$$

From 5), 5'), 6), 6') and 7)

$$Ls_t = A^a + A^b + \epsilon' \Delta \bar{P}_{t-1}^a + \epsilon \Delta P_{t-1}^b$$

Assuming a constant increase of P_t^a , we have then:

$$A^a + A^b + \epsilon' \Delta \bar{P}_{t-1}^a = \alpha' \text{ so that}$$

$$32) \quad Ls_t = \alpha' + \epsilon \Delta P_{t-1}^b$$

and substituting 4) into 32)

$$Ls_t = \alpha' + \epsilon (\Delta P_{t-1} - \Delta \bar{P}_{t-1}^a)$$

$$33) \quad = \alpha' + \epsilon \Delta P_{t-1} - \epsilon \Delta \bar{P}_{t-1}^a$$

substituting 31) into 33)

$$\begin{aligned} Ls_t &= \alpha' + \epsilon [\bar{B}_{t-1}^a + \alpha^1 + \gamma GE_{t-1}^b - (\bar{D}_{t-1} + \overline{NM}_{t-1})] - \epsilon \Delta \bar{P}_{t-1}^a \\ &= \alpha' + \epsilon \alpha^1 - \epsilon \Delta \bar{P}_{t-1}^a + \epsilon \bar{B}_{t-1}^a - \epsilon \bar{D}_{t-1} - \epsilon \overline{NM}_{t-1} + \epsilon \gamma GE_{t-1}^b \end{aligned}$$

Let $\alpha' + \epsilon \alpha^1 - \epsilon \Delta \bar{P}_{t-1}^a + \epsilon \bar{B}_{t-1}^a - \epsilon \bar{D}_{t-1} - \epsilon \overline{NM}_{t-1} = \alpha$, then

$$Ls_t = \alpha + \epsilon \gamma GE_{t-1}^b$$

and using 30)

$$34) \quad Ls_t = \alpha + \epsilon \gamma \tau Y_{t-1}^a$$

$$\text{Let } \epsilon \gamma \tau = \beta$$

$$35) \quad Ls_t = \alpha + \beta Y_{t-1}^a$$

τ is determined by government policy and may be varied by taxation and subsidy measures.

- γ is behavioural and varies over time but is difficult to influence. Family planning policies in developing countries have been directed towards varying γ . But it is considered that the effects of these policies are elusive and difficult to measure. Moreover, the view is taken that the availability of birth control measures will not necessarily result in family limitation.
- ϵ is the proportion of a birth cohort in the poor sector which will come on the labour market. It reflects labour force participation, school-leaving ages, etc.

Now using equations 20), 28) and 35), the model may be reduced to a first-order difference equation in Y .

$$36) \quad \alpha + \beta Y_{t-1}^a = \delta Y_t^a ; \alpha > 0, \beta \geq 0, \delta > 0$$

where α represents a constant amount of labour supplied
 β is the extent to which the supply of labour will vary with income, i.e., the coefficient of labour supply, and
 δ is the proportion by which labour demand varies with income, i.e., the coefficient of labour demand or the labour/output ratio.

$$37) \quad Y_{t+1}^a - \frac{\beta}{\delta} Y_t^a = \frac{\alpha}{\delta}$$

Considering the case where $\beta > 0$ and the converse where $\beta < 0$:

Equilibrium Level of y^a

Where $\beta > 0$

$$38') \bar{y}^a = \frac{\frac{\alpha}{\delta}}{1 - \frac{\beta}{\delta}} = \frac{\alpha}{\delta - \beta} ; \frac{\beta}{\delta} \neq 1, \delta > \beta$$

The equilibrium level of $\bar{y}^a$ is equal to the constant level of labour supplied, α , divided by the difference between the coefficients of labour demand and supply, $\delta - \beta$. The additional constraint that $\delta > \beta$ is necessary if $\bar{y}^a$ is to be positive.

With $\alpha > 0$, the case where $\frac{\beta}{\delta} = 1$, i.e., $\beta = \delta$, will also be applicable where y^a is increasing over time.

Where $\beta < 0$,

$$38) \bar{y}^a = \frac{\frac{\alpha}{\delta}}{1 - \frac{\beta}{\delta}} ; \quad \begin{aligned} (1 - \frac{\beta}{\delta}) &> 2 \text{ when } |\beta| > \delta \\ 2 &> (1 - \frac{\beta}{\delta}) > 1 \text{ when } |\beta| < \delta \\ (1 - \frac{\beta}{\delta}) &= 2 \text{ when } |\beta| = \delta \end{aligned}$$

Deviations of Time Path

$$39) y_t^a = A \left(\frac{\beta}{\delta} \right)^t$$

Summing the components signifying the equilibrium level of y^a and the deviations of the time path gives--

General Solution

Where $\beta > 0$,

$$40') \quad Y_t^a = A \left(\frac{\beta}{\delta} \right)^t + \frac{\alpha}{\delta - \beta} ; \quad \frac{\beta}{\delta} \neq 1, \quad \delta > \beta$$

$$40'') \quad Y_t^a = A + \left(\frac{\alpha}{\delta} \right) t ; \quad \frac{\beta}{\delta} = 1$$

Where $\beta < 0$

$$40) \quad Y_t^a = A \left(\frac{\beta}{\delta} \right)^t + \frac{\frac{\alpha}{\delta}}{1 - \frac{\beta}{\delta}} ;$$

$$(1 + \frac{\beta}{\delta}) > 2 \text{ when } |\beta| > \delta$$

$$2 > (1 - \frac{\beta}{\delta}) > 1 \text{ when } |\beta| < \delta$$

$$(1 - \frac{\beta}{\delta}) = 2 \text{ when } |\beta| = \delta$$

$$\begin{aligned} \text{When } t = 0, A &= Y_0^a - \frac{\alpha}{\delta - \beta} \text{ from } 40') \\ &= Y_0^a \text{ from } 40'') \\ &= Y_0^a - \frac{\frac{\alpha}{\delta}}{1 - \frac{\beta}{\delta}} \text{ from } 40) \end{aligned}$$

and the definite version is--

$$41') \quad Y_t^a = (Y_0^a - \frac{\alpha}{\delta - \beta}) \left(\frac{\beta}{\delta} \right)^t + \frac{\alpha}{\delta - \beta} ; \quad \beta > 0, \quad \frac{\beta}{\delta} \neq 1, \quad \delta > \beta$$

$$41'') \quad Y_t^a = Y_0^a + \left(\frac{\alpha}{\delta} \right) t ; \quad \beta > 0, \quad \frac{\beta}{\delta} = 1$$

$$41) \quad Y_t^a = (Y_0^a - \frac{\frac{\alpha}{\delta}}{1 - \frac{\beta}{\delta}}) \left(\frac{\beta}{\delta} \right)^t + \frac{\frac{\alpha}{\delta}}{(1 - \frac{\beta}{\delta})} ; \quad \beta < 0$$

Time Path of Y^a

When $\beta > 0$, the time path of Y^a will be non-oscillatory or monotonic, but will be damped if $\beta < \delta$, or explosive if $\beta \geq \delta$.

When $\beta < 0$, the time path of Y^a will be oscillatory,

dampening if $|\beta| < \delta$, exploding if $|\beta| > \delta$ or regular if $|\beta| = \delta$.

Substituting 41'), 41'') and 41) into 28) gives:

Equilibrium Path of L_t

$$42') L_t = \delta \left\{ (Y_0^a - \frac{\alpha}{\delta - \beta}) \left(\frac{\beta}{\delta} \right)^t + \frac{\alpha}{\delta - \beta} \right\}; \beta > 0, \frac{\beta}{\delta} \neq 1, \delta > \beta$$

$$42'') L_t = \delta \left[Y_0^a + \left(\frac{\alpha}{\delta} \right) t \right]; \beta > 0, \frac{\beta}{\delta} = 1.$$

$$= Y_0^a + \alpha t$$

$$42) L_t = \delta \left\{ (Y_0^a + \frac{\alpha}{2\delta}) (-1)^t + \frac{\alpha}{2\delta} \right\}; \beta < 0, |\beta| = \delta$$

The time path of L will vary from that of Y^a by the factor δ .

Substituting 3) into 4)

$$43) \Delta P^b = B - (\bar{D} + \overline{NM}) - \Delta \bar{P}^a$$

Using 2) and 1)

$$44) \Delta P^b = \alpha^1 + \gamma_{GE}^b + \bar{B}^a - (\bar{D} + \overline{NM}) - \Delta \bar{P}^a$$

Substituting 30) into 44)

$$\Delta P^b = \alpha^1 + \gamma_{TY}^a + \bar{B}^a - (\bar{D} + \overline{NM}) - \Delta \bar{P}^a$$

Let $\alpha^1 + \bar{B}^a - (\bar{D} + \overline{NM}) - \Delta \bar{P}^a = \alpha^2$, then

$$45) \Delta P^b = \alpha^2 + \gamma_{TY}^a$$

Substituting 41'), 41'') and 41) into 45) gives:

Equilibrium Path of P_t^b

$$46') \quad \Delta P_t^b = \alpha^2 + \gamma\tau \left\{ (Y_0^a - \frac{\alpha}{\delta - \beta}) (\frac{\beta}{\delta})^t + \frac{\alpha}{\delta - \beta} \right\}; \quad \beta > 0, \quad \frac{\beta}{\delta} \neq 1, \quad \delta > \beta$$

$$46'') \quad \Delta P_t^b = \alpha^2 + \gamma\tau [Y_0^a + (\frac{\alpha}{\delta})t]; \quad \beta > 0, \quad \frac{\beta}{\delta} = 1$$

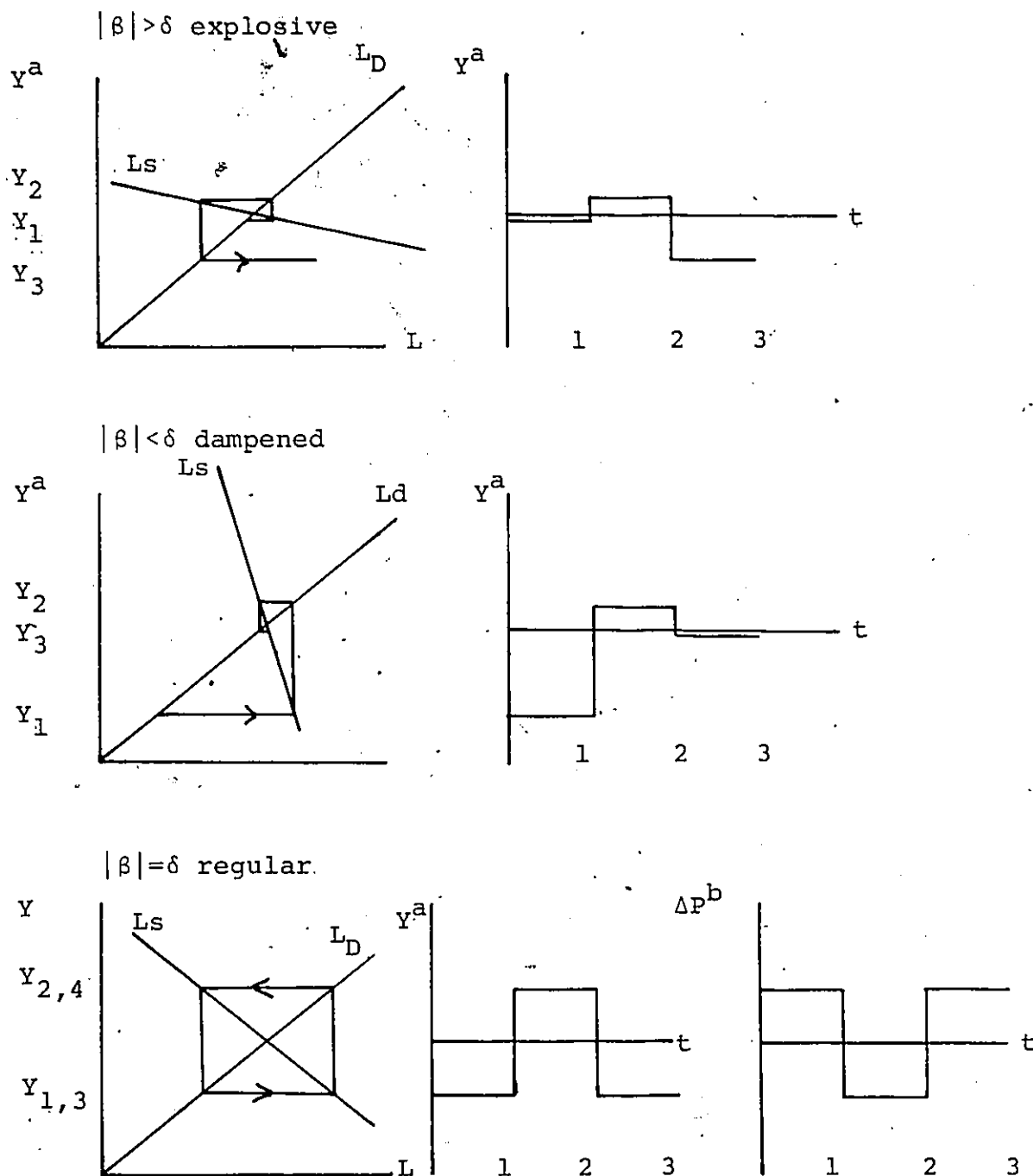
$$= \alpha^2 + \gamma\tau Y_0^a + \gamma\tau \frac{\alpha}{\delta} t$$

$$46) \quad \Delta P_t^b = \alpha^2 + \gamma\tau \left\{ (Y_0^a - \frac{\alpha}{2\delta}) (-1)^t + \frac{\alpha}{2\delta} \right\}; \quad \beta < 0, \quad |\beta| = \delta$$

The time path of ΔP^b will vary from that of Y^a by the factor $\gamma\tau$. The peaks and troughs will be reversed in the case of 46) where $\gamma < 0$.

Figure 7

Time Paths* of Income in the Rich Sector and Changes
of Population in the Poor Sector, When $\beta < 0$



* The axes are reversed when compared with those in the section--
The Cobweb Mechanism, to allow for t on the horizontal.

CHAPTER V

JAMAICA AS A CASE STUDY

It is the purpose of this chapter, to test the dualistic model with endogenous population, presented in Chapter IV, using Jamaica as a case study. In the Jamaican milieu, despite economic growth, economic development has been retarded. Extreme poverty for many and evident wealth for a few are manifest indicators of economic distortions. The estimation of the behavioural equations of the model, using Jamaican data, will determine the relevance of the model for an understanding of the Jamaican example of growth unaccompanied by development.

The first section of the chapter--the Economy of Jamaica--attempts, firstly, to provide an overview of the imbalances in well-being arising from unemployment and income concentration. The efforts of the government to alleviate disparities in welfare are discussed. The section, secondly, portrays succinctly the presence of dualistic features in demographic and demand behaviour, technology and institutions which accompany the disparity in well-being. Policies of the government which perpetrate dualism are outlined. A brief discussion of strategies which have been employed, unsuccessfully, for promoting development is also included. The review

adopts an historical perspective of the contemporary situation. The presentation of a survey of the population of Jamaica and the vital statistics pertaining to births, deaths, and net migration, with a view to demonstrating the existence of long swings in the population is the purpose of the second section--the Demography of Jamaica. These two sections, which review the Economy and the Demography of Jamaica, afford a conspectus in terms of a general survey of the aspects of the economy pertaining to the model, and the tabulation of the data base relevant to the empirical observations. The third section--Testing the Model--discusses the limitations of the data base, describes necessary adjustments to the data, and presents the results of estimation. The fourth section provides an interpretation of the model. It deals, firstly, with births as a function of government expenditure, and, secondly, with the complete system and its indicated time paths. The final section is a discussion of the model in the context of the open Jamaican economy.

The Economy of Jamaica

High levels of unemployment and concentration of income affirm the extent of maldistribution in Jamaica.

Of a total mean population of 2,072,400 in 1976, only 679,100 were employed in October of that year giving a dependency load of 3.1 for every employed person and, with a labour



force of 43 percent of total population, an unemployment rate of 24.2 percent. Job availability has not kept pace with the growth of the labour force. Over four years, from 1972 to 1976,¹ the number of persons employed increased by 11.1 percent while the number of unemployed increased by 89.2 percent. Comparing 1976 with 1960, the corresponding increases were approximately 20.3 percent for employment and 132.6 percent for unemployment (See Table III).

The sectoral distribution of employment shows a declining but still significant role for agriculture.² Over the period 1960 to 1976, the relative importance of employment in agriculture declined from 41.1 percent of total employment to 35.5 percent. Employment in the sectors mining, manufacture, transport, commerce and services (including public administration) showed small compensating increases (See Table IV). The proportion of labour employed in agriculture in 1976, 35.5 percent, may be compared with 14.4 percent in other services, 15.4 percent in public administration, 11.8 percent in commerce, 11 percent in manufacture, 5.6 percent in construction and only 1.2 percent in mining.

¹Averaging the April and October data.

²It would be instructive to have data on employment by sugar estates vis-a-vis persons involved in peasant agriculture. It is noted that average employment on the sugar estates in 1957 was 41,000. In 1964 this had fallen to 25,000. Norman Girvan [et al.] New World Group, Unemployment in Jamaica, pp. 269-278, in Norman Girvan and Owen Jefferson, eds., Readings in the Political Economy of the Caribbean (Kingston: Ebony Printers, 1971).

Table III - Number of persons employed and unemployed in Jamaica. (Average of April and October Surveys for 1960, 1969, 1972, 1976)

<u>Year</u>	<u>Employed</u>	<u>Unemployed</u>
1960	570,000	85,000
1969	617,200	75,000
1972	617,600	104,500
1976	685,850	197,750

Sources: World Bank Report, 1976.
Economic and Social Survey, Jamaica, 1976.

Table IV - Employment by industrial sector in Jamaica. (Percentages, using averages of April and October surveys).

<u>Sectors</u>	<u>1960</u>	<u>1969</u>	<u>1972</u>	<u>1976</u>
Agriculture	41.1	38.1	33.2	35.5
Mining and Quarrying	.5	.8	1.1	1.2
Manufacture	8.1	11.2	12.9	11.0
Construction	7.7	6.9	6.4	5.6
Transport, Utilities, Communication	3.8	3.6	4.2	4.6
Commerce	10.8	11.2	13.3	11.8
Services & Miscellaneous	28.5	28.1	28.8	30.3
Public Administration				15.4
Other Services				14.4
Industry not specified				.5
Total	100	100	100	100

Sources: World Bank Report, 1976
Economic and Social Survey, Jamaica, 1976.

It is of interest to compare employed labour by industry group with percentage contribution of industrial sectors to gross domestic product in 1976. The contribution of agriculture was 8.2 percent, miscellaneous services, households and private institutions 7.8 percent, producers of government services 13.8 percent, manufacture 19.5 percent, construction 9.3 percent and mining 8.7 percent. Distributive trade, financial institutions and real estate combined contributed 27.7 percent (See Table V). Hence agriculture and other services employed almost 50 percent of the labour force but contributed only 14 percent to GDP--a ratio of 3.6. The ratio is only somewhat improved if the entire service sector is accounted for, employment of 65.8 percent and contribution of 26.5 percent allowing a ratio of 2.48. The corresponding ratio for mining was 0.14 and for manufacture and construction 0.6.

On the basis of a comprehensive household expenditure survey taken in 1963-64 and the income data reported in the 1968 employment survey, the pattern of distribution of income has been reconstructed (See Table VI), showing some 78 percent of the labour force earning a weekly income of \$10 or less. Approximately 92 percent earn \$20 or less. Only 0.2 percent earn over \$100 weekly. The Gini coefficient in 1974 was estimated at .67, worsening from .53 in 1968 (See Table VII). While the distribution of income in 1968 was far from equal,

by 1974 inequality had attained a level comparable with the highest estimates for other countries (See Table I in introduction).

Table V - Contribution of industrial sectors to gross domestic product in Jamaica - (Percentage)

<u>Sectors</u>	<u>1969</u>	<u>1972</u>	<u>1976</u>
Agriculture	8.9	7.3	8.2
Mining and Quarrying	14.3	8.4	8.7
Manufacture	14.0	16.6	19.5
Construction	12.1	12.7	9.3
Transport, Utilities, Communication	8.8	7.6	8.3
Commerce	20.7	32.2	27.7
Services & Miscellaneous	21.2	15.2	18.3
Producers of Government Services		9.4	13.8
Miscellaneous Services		6.5	5.8
Households & Private Non-Profit			
Institutions		1.9	2.0
Less Imputed Service Charges		2.6	3.3
Totals	100	100	100

Source: Economic and Social Survey, Jamaica, 1976.

The disparity in income has in a measure been offset by the social welfare expenditure of the government. Since 1865, after considerable neglect resulting in widespread illiteracy and rampant epidemics, the government increased its interest in education and health, supplementing that provided by the grace of the missionaries or at the whim of the planter. Expenditure in these two areas increased from \$56.6 thou or 8.1 percent of expenditure of the central government authority in

1870 to \$740.6 thou. or 18.2 percent of the total by 1930.¹ In 1950 central and local government expenditure on education and research, public health and sanitation, and special welfare services including housing was \$5.66 mn. or 42.2 percent of total expenditure. This increased to \$79.195 mn. or 47.8 percent, in 1970, allowing for an annual average of \$18.111 mn. between 1950 and 1970.²

Looking specifically at the area of education over the fiscal years 1952/53 to 1968/69, public expenditure increased from \$3.4 mn. or 11.9 percent of total government expenditure to \$29.9 mn. or 15.5 percent.³

The levels of expenditure above indicate increases in per capita welfare expenditures by government from approximately 11 cents in 1870 to 74 cents by 1930, again to \$4 in 1950 and \$42.4 in 1970.

Poverty and unemployment are not recent phenomena. Poverty always existed. Full employment occurred only during slavery. The search for a means of livelihood caused heavy

¹In 1861 only 13 percent of the population were able to read and write. Health measures were a farce, and the population was subject to virulent diseases in addition to tuberculosis, yaws, leprosy, cholera, smallpox, yellow fever and malaria. Gisela Eisner, Jamaica 1830-1930; A Study in Economic Growth, (Manchester: University of Manchester Press, 1961), ch. 15.

²Government of Jamaica, National Accounts: Income and Expenditure, 1950-1960, Department of Statistics, Jamaica. Economic Survey of Jamaica, Jamaica, 1961-1970.

³Owen Jefferson, The Post-War Economic Development of Jamaica, (Jamaica: Institute of Social and Economic Research, University of the West Indies, 1972), p. 267.

Table VI - Pattern of Income Distribution in Jamaica - 1975

<u>Weekly Income J\$</u>	<u>Assumed Mean</u>	<u>Percent of L.F.</u>	<u>Percent of Income Covered</u>
Unemployed	2	20.2	4.4
Employed			
0-10	8	57.8	42.7
10-20	15	13.5	19.4
20-30	25	4.5	10.5
30-40	35	2.1	7.0
40-50	45	1.2	5.3
50-100	75	0.7	5.2
100 +	360	0.2	5.6
Total		100	100

Source: World Bank Report, 1976.

Table VII - Income Distribution and Gini coefficients in Jamaica for selected years

<u>Percentage of Households</u>	<u>Cummulative Income Shares Percentage</u>			
	<u>1958</u>	<u>1968</u>	<u>1972</u>	<u>1974</u>
0-60	19.0	25.0	20.0	16.0
0-80	38.5	47.2	39.3	32.0
0-90	56.5	63.3	57.0	48.3
0-95	69.8	75.0	65.0	60.0
0-100	100	100	100	100
Gini Coefficient	.61	.53	.60	.67

Sources: Primary - The Labour Force, 1974
Department of Statistics, JamaicaData for 1958 from E. Ahiram,
"Income Distribution in Jamaica, 1958,"
Social and Economic Studies, 13,
September 1964, pp. 333-369

Secondary - World Bank Report, 1976.

outflows of migrants over the past century to Cuba, Central America, the United States, the United Kingdom and, more recently, Canada. The governments of Jamaica appear to have relied more on this safety valve, rather than on social services, for attaining a modicum of well-being.

Dualism in Jamaica may be considered behavioural, technological, institutional and therefore complete.

Differential demographic behaviour may be observed in fertility rates by parish for the years 1970 to 1974. The rate for Kingston and St. Andrew, the parish with the largest urban population (some 26 percent of the total population) was consistently below the overall rate, and in the years 1972 to 1974 below all other parish rates (See Table VIII).

Roberts distinguishes between urban-centered parishes and rural parishes and finds that in 1943, the earliest date for which data for completed fertility is available, the urban-centered parishes showed a mean number of children of 5.34 per mother aged 45-54 compared with 6.25 children per mother in the other parishes. Over the period 1943 to 1960, the urban-centered parishes experienced a reduction of 14 percent compared with 10 percent in the other parishes. In the capital, Kingston, a decline of 16 percent was observed (See Table IX).¹

¹G. W. Roberts, "The Present Fertility Position in Jamaica", pp. 259-275 in E. Szabady, ed., World View of Population Problems, (Budapest: Akadémiai Kiadó, 1968).

Table VIII - Estimated fertility rates* by parish in Jamaica, 1970-1974

Parish	1970	1971	1972	1973	1974
1. Kingston & St. Andrew	180	188	178	161	161
2. St. Thomas	203	183	206	218	206
3. Portland	185	210	203	192	177
4. St. Mary	188	195	199	184	197
5. St. Ann	185	195	188	183	170
6. Trelawny	199	219	211	204	187
7. St. James	184	190	198	185	198
8. Hanover	215	197	207	180	176
9. Westmoreland	189	177	181	166	174
10. St. Elizabeth	196	202	202	190	180
11. Manchester	224	220	230	216	211
12. Clarendon	179	180	188	183	176
13. St. Catherine	195	215	224	219	236
Overall	189	195	196	182	182

* per 1000 women aged 15-44 years.

Sources: Primary - Ministry of Health and Environmental Control
Secondary - World Bank Report, 1976.

Table IX - Children per mother (aged 45-54) in Jamaica for 1943 and 1960

Parish	1943	1960	% decrease
Jamaica	5.73	4.94	13.4
Eastern Parishes			
Kingston	3.89	3.26	16.2
St. Andrew	4.58	3.78	17.5
St. Thomas	5.26	4.66	11.4
Portland	5.69	4.94	13.2
St. Mary	5.93	4.97	16.2
Clarendon	6.23	5.43	12.9
St. Catherine	5.78	5.06	12.5
Western Parishes			
St. Ann	6.88	5.91	14.1
Trelawny	6.28	5.83	7.2
St. James	5.78	5.22	9.7
Hanover	6.45	5.72	11.3
Westmoreland	6.32	5.57	11.9
St. Elizabeth	6.10	5.92	2.9
Manchester	5.98	5.28	11.7

Urban-centered parishes are the eastern parishes of Kingston, St. Andrew, St. Thomas, Portland, St. Mary, Clarendon and St. Catherine.

Source: G. W. Roberts, "The Present Fertility Position in Jamaica", p. 262.

Dualism in demand is evident first in the differing consumption goods of the income groups. The rich enjoy one basket of goods which is comprised largely of imports and import substitutes. The poor subsist on another smaller basket of goods, some of which they produce themselves and some of which, even basic staples such as wheat flour, must be imported.

Reliance on imported consumer items by both rich and poor resulted in continued negative balances on current account. Food and non-durables represent some 17 percent of total imports and durable consumer goods another 5 percent. Raw materials (other than fuel) represent over 30 percent of total imports. In the 1950s and 1960s, unfavourable balances were more than adequately covered by capital inflows. Fundamental disequilibrium in the balance of payments was not a problem until the 1970s when political and economic uncertainty caused negative net private capital movements which, with a decline in net official inflows and government guaranteed loans, resulted in a negative balance of \$-240.5 mn for total current and capital transactions in 1976. With gross foreign exchange reserves of \$64.2 mn and foreign liabilities of \$248.0 mn, the net foreign exchange reserve position in 1976 was \$-183.8 mn.¹ This occurred despite recent controls of imports, of the use of foreign currency and of the growth in

¹Gross foreign exchange reserves include holdings of SDRs, the reserve position in IMF, reserves of the Bank of Jamaica, Central Government, other official institutions and commercial banks. Foreign liabilities represent those of the Bank of Jamaica and commercial banks.

factor prices along with measures for stimulating exports.

The highly skewed income distribution makes savings by the poor impossible. They subsist from day to day, any excess being shared with more deprived relatives.

Technological dualism is self-evident in Jamaica. The peasantry with abundant labour but little land eke out a living on the infertile mountainous interior to which escape from the oppression of the plantation, despite emancipation, had long forced them. Norton and Cumper find a very high coincidence of peasant type agriculture "in the less favourable areas such as the lower and less precipitous of the hill slopes and in the river valleys"¹ In the early seventies, 71 percent of all farms were under 5 acres in size, occupying only 12 percent of total farm acreage.² The fragmentation of holdings has been reported on by Eyre.

There are . . . populous centres which are entirely rural. These are associated with zones of small scale farming on the periphery of the cane zone. The important fact about these centres is that while their "subsistence" area has decreased or remained static, the population has in many cases more than doubled . . . Some of these peripheral centres have so increased in

¹A. V. Norton and G. E. Cumper, "'Peasant', 'Plantation' and 'Urban' Communities in Rural Jamaica: A Test of the Validity of the Classification," Social and Economic Studies, 15, December 1966, p. 342.

²George L. Beckford, Persistent Poverty: Underdevelopment in Plantation Economies of the Third World (New York: Oxford University Press, 1972), p. 23.

population that there is not the slightest possibility that without massive depopulation they can ever again be considered basically villages of subsistence farmers. . . . It is quite clear that the nature of the erstwhile "subsistence" districts has changed rapidly as they become increasingly hemmed in by expanding capitalized large-scale monoculture.¹

Increasing population and shortage of land force labour to accept reduced wages for seasonal plantation work or accelerate the flow towards the urban areas where in the service sector 'capital' is a snowball cart, a tray for vending wares on the pavement, or a machete in the government's crash employment endeavour.

The plantations with less than 1 percent of all farms but 56 percent of total farm acreage² occupy the fertile alluvial plains and deltas. Labour is available at low wages. Grouped with the plantations are the multinational branch companies with access to technology from the developed countries and therefore heavily capitalized and labour displacing. The bauxite companies accounted for the rapid growth of capital during the late 1950s and early 1960s. In addition, techniques resorted to by these companies are imported rather than developed locally to be appropriate to indigenous factor proportions.

¹Alan Eyre, *Land and Population in the Sugar Belt of Jamaica* (University of the West Indies, Department of Geography, N.D. [ca. 1966], mimeo), p. 8, cited in George L. Beckford, *Persistent Poverty*, p. 25.

²George L. Beckford, *Persistent Poverty*, p. 23.

Edwards reports that the "volume of research effort directed . . . to the problems of sugar cane and bananas was substantially greater than the average for all other products."¹ In a case study of 26 firms in the food processing industry in Jamaica, Girling shows the disparities between locally-owned and foreign-owned firms. The capital intensity of locally owned firms was found to be lower than that of foreign-owned firms, the former group tending to use more second hand equipment. Subsidiaries of multinational corporations used plants in the home country as a guide for selection of machinery. Moreover, reinvestment of profits was significantly positively correlated with percentage of local ownership, while the proportion of materials imported was negatively related to local ownership. Girling also found the location of research facilities to be positively related to local ownership and the incidence of indigenous research increasing with the percentage of local ownership. Some 79 percent of locally owned firms had developed at least one product principally using indigenous agricultural products, compared with 10 percent of foreign owned firms. In most cases, however, profitability rather than nutritional requirements determined production--the case of frozen food production despite the

¹D. T. Edwards, "An Economic View of Agricultural Research in Jamaica," Social and Economic Studies, 10, September 1961, p. 333.

limitation of electricity and refrigerator ownership to higher income groups was cited.¹

Institutional dualism may be found in legal regulations and socially accepted arrangements which affect such areas as the distribution of income, the pattern of land ownership and the availability of credit. The tax structure permits the distribution of income described earlier. The distribution of land, a legacy of the past, has only recently been marginally affected by increased property taxes and policies for deploying idle estate acres. The 'openness' of the commercial banking system facilitated only manufacturing companies and sugar estates able to meet stringent financial requirements.² With respect to credit availability for peasant agriculture, it was found that for the observed period 1961 to 1968, "Despite the greater contribution made by agriculture other than sugar cane to GDP, commercial banks have accommodated sugar agriculture to a greater extent than all other agricultural products".³ Other agriculture included

¹R. K. Girling, "Technology and Dependent Development in Jamaica: A Case Study," Social and Economic Studies, 26 June 1977, pp. 169-189.

²C. Y. Thomas, Monetary and Financial Arrangements in a Dependent Monetary Economy (Mona, Jamaica: Institute of Social and Economic Research, University of the West Indies, 1965).

³B. C. H. Gayle, The Financing of Sugar by Commercial Banks in Jamaica (University of the West Indies, Department of Economics, 1968, Mimeographed Report), p. 8.

bananas, citrus, dairy and cattle rearing, pigs and poultry, mixed farming and other small crops.

Perpetuating the institutional dichotomy, the state adopts dualistic policies. On one hand, a 'climate' is maintained which ensures the happiness of the foreign investor in Jamaica. He is allowed tax holidays, capital-intensive processes which employ a minimum of labour, and a heavy repatriation of profits, some of which are disguised as intra-company transfers. On the other hand, the voting masses of Jamaica must consider themselves accommodated. So more schools are built, hospital opened, televisions placed in community centres, 'Christmas work' and 'ditch digging' jobs created by 'crash' employment programmes, and minimum wage laws passed for low productivity jobs in the service sector even if the outcome is reduced demand for such labour. Welfare programmes cannot be adequately financed by revenue from taxed profits, and hence the government must resort to financing from expensive 'soft' loans and tied aid. Public policy by facilitating production for exchange rather than need also condones duality in consumption.

Within the context of the dualistic framework as perceived by Lewis, Fei, Ranis and Paauw, a number of policies for transition into development have been suggested. For an open dualistic economy "characterized by coexistence of agricultural and industrial sectors domestically and by a

dominance of foreign trade (primary product exports) externally"¹, policies of import substitution or export promotion and export substitution are advocated. The first strategy emphasizes the development of domestic manufacturing industry; the second relies on continued export of primary products. Both strategies require some intervention through import substitution policies or government controls.

Jamaica has tried both strategies--with limited success. Policies of industrialization by invitation, export promotion, import substitution, the passing of incentive legislation, the granting of tax reliefs, and the establishment of corporations for encouraging foreign and joint enterprise allowed for rapid increases in the national product, particularly in the 1960s. However, social indicators of development showed no corresponding improvement. In 1976 unemployment attained a new high. Despite a per capita GNP of \$1,328 in 1976, the distribution of income showed no reduced concentration (indicated above). Other available welfare indicators showed only 27 percent of the population with access to electricity, 41 percent of rural population with access to piped water, per capita caloric intake of only 93 percent of requirements, per capita protein intake of only 59 percent of

¹Douglas S. Paauw and John C. H. Fei, The Transition in Open Dualistic Economies: Theory and Southeast Asian Experience, (New Haven and London: Yale University Press, 1973), p. 10.

requirements, a population per hospital bed ratio of 261, and a primary school enrollment rate of 85 percent.

It has been argued that this socio-economic schizophrenia is a product of the past. The plantation system established four centuries ago for the exploitation of the economy produced a persistent pattern which has proved pernicious to the welfare of the majority of Jamaicans. The export of the staple sugar set the pace for socio-economic degeneration, not development.¹ Spread and linkage effects occurred without the domestic economy. The conditions of production of coffee and bananas, and later bauxite, manufactured goods and tourism have not varied from the original mould. Jamaica has been left with a form of modernization mirrored in increasing economic product. But with the form there is no substance; the mass of the people remain dispossessed and depressed.

The Demography of Jamaica

The total population of Jamaica at the end of December 1976 was 2,084,500; an increase of 311.8 percent over the

¹The staple 'theory' of growth, which may be viewed as the counterpart of the plantation theory, has not operated in the context of Jamaica. Espoused by Harold Innis and accorded the status of a 'theory' by Melville Watkins, the approach maintains that "staple exports are the leading sector of the economy and set the pace for economic growth . . . Economic development will be a process of diversification around an export base". Melville Watkins, "A Staple Theory of Economic Growth," Canadian Journal of Economic and Political Science, 29, May 1963, p. 144.

estimate of 506,154 in 1871, just over a century earlier. The average annual intercensal growth rate of population has varied over this period with highs of 1.38 percent, 1.32 percent and 1.67 percent observed for 1881, 1911 and 1943 respectively and lows of 0.97 percent and 0.32 percent recorded for 1891 and 1921. The annual rate of growth for 1976 was 1.2 percent (See Table X).

The rate of natural increase also fluctuated over the past century rising, from 12 per thousand in 1871 and 1881, to a peak of 16 per thousand in 1911 after which a decline to 12.3 per thousand was observed in 1921. This was followed by a steady increase to 26.6 per thousand in 1970. In 1976 the rate of natural increase per thousand had declined to 22.4. (See Table X).

Fluctuations in the rate of natural increase have reflected the movements observed in the birth rate. From 39 per thousand in 1871, birth rate declined to 36.7 per thousand in 1891, rose to 39.5 per thousand in 1911, declined to 27.9 per thousand in 1921, rose to a peak 35.3 per thousand in 1960, and subsequently declined to 29.4 per thousand in 1976, the first year less than 30 per thousand has been recorded (See Table X).

Death rates corresponded to the often observed phenomenon in many developing and previously colonial countries. With the exception of an upturn for the period 1891-1921, due

to the 1912 and 1913 hurricanes and the 1918 influenza epidemic, a steady downward trend was recorded from 27 per thousand in 1871 to 7.0 per thousand in 1976.¹ (See Table X).

While births were the dominant factor determining population trends and fluctuations, of importance also were the changes reflecting migration. External migratory movements may be divided into four periods since 1871, determined by the direction of the net flow. Over the years 1871 to 1881 there were positive net flows amounting to some 5,600 persons. The subsequent period 1881 to 1921 was characterized by a heavy net outflow of persons totalling 145,800. In the years 1921 to 1943 external migration was of less importance and a net inflow of 25,800 people was observed. After 1943 external migration again became dominant and heavy net outward movements of 461,000 were recorded up to 1970. Since 1970 net outward flows have declined slightly, totalling 68,900 for the years 1970 to 1976 (See Table X).

Migration flows affected the structure and the rates of growth of the population. During periods of net inflows, the increments to the population, arising mainly from births, were amplified. During periods of net outflows, decrements were recorded in excess of those due to deaths.

Net migratory inflows as a percentage of total

¹This relatively low rate, in relation to a world average crude death rate of 13 per 1000 in 1970, reflects in part the young age structure of the population.

increments were not excessive, ranging between 2.6 and 4.4 percent in the periods of net migration. However, net migratory outflows represented a large percentage of total decrements during the periods of net emigration. After a slight downturn in net emigration as a percentage of total decrements from 15 percent for 1881-91 to 11.3 percent for 1891-1911, with the exception of the period 1921 to 1943, a steady increase was recorded to 63.2 percent for 1960-1970. In effect, for this last period decrements due to emigration exceeded those due to deaths. For the period 1970-1976, 40.9 percent was recorded. These net increments and decrements, due to migration rather than natural increase, modify the fluctuations in the rates of change of population. Their secondary and indirect effects would also affect changes in births and deaths.

Observing the trend in fluctuations in the rate of change of population for the period 1880 to 1976¹, we may identify from peak to peak two long swings and one incomplete swing. The first peak occurs in the interval from 1883-92 to 1884-93; the second in 1919-28 to 1920-29; and the third in 1943-52 to 1944-53 (See Figure 8).

¹This was calculated by means of a 10 year moving average. For the mean population, a stock series, the changes in population increases were found. For births, a flow series, only the change for one ten year average to another was found.

Table X - Population movements in Jamaica

Year of Census	Census Population	Intercensal Increase Annual Rate Percent	Rate per 1000		Natural Increase	Migration Balance
			Births	Deaths		
1844	377,433					
1861	441,264	.92	40	32	8	12,800
1871	506,154	1.38	39	27	12	8,000
1881	580,804	1.38	38	26	12	5,600
1891	639,491	0.97	36.7	23.1	13.6	-24,800
1911	831,383	1.32	39.5	23.5	16.0	-43,900
1921	858,118	.32	27.9	25.6	12.3	-77,100
1943	1,237,063	1.67	33.2	17.9	15.3	25,800
1960	1,609,814	1.56	35.3	11.9	23.4	-195,200
1970	1,861,300	1.46	34.4	7.7	26.6	-265,800
1976	2,084,500	1.2	29.4	7.0	22.4	- 68,900*

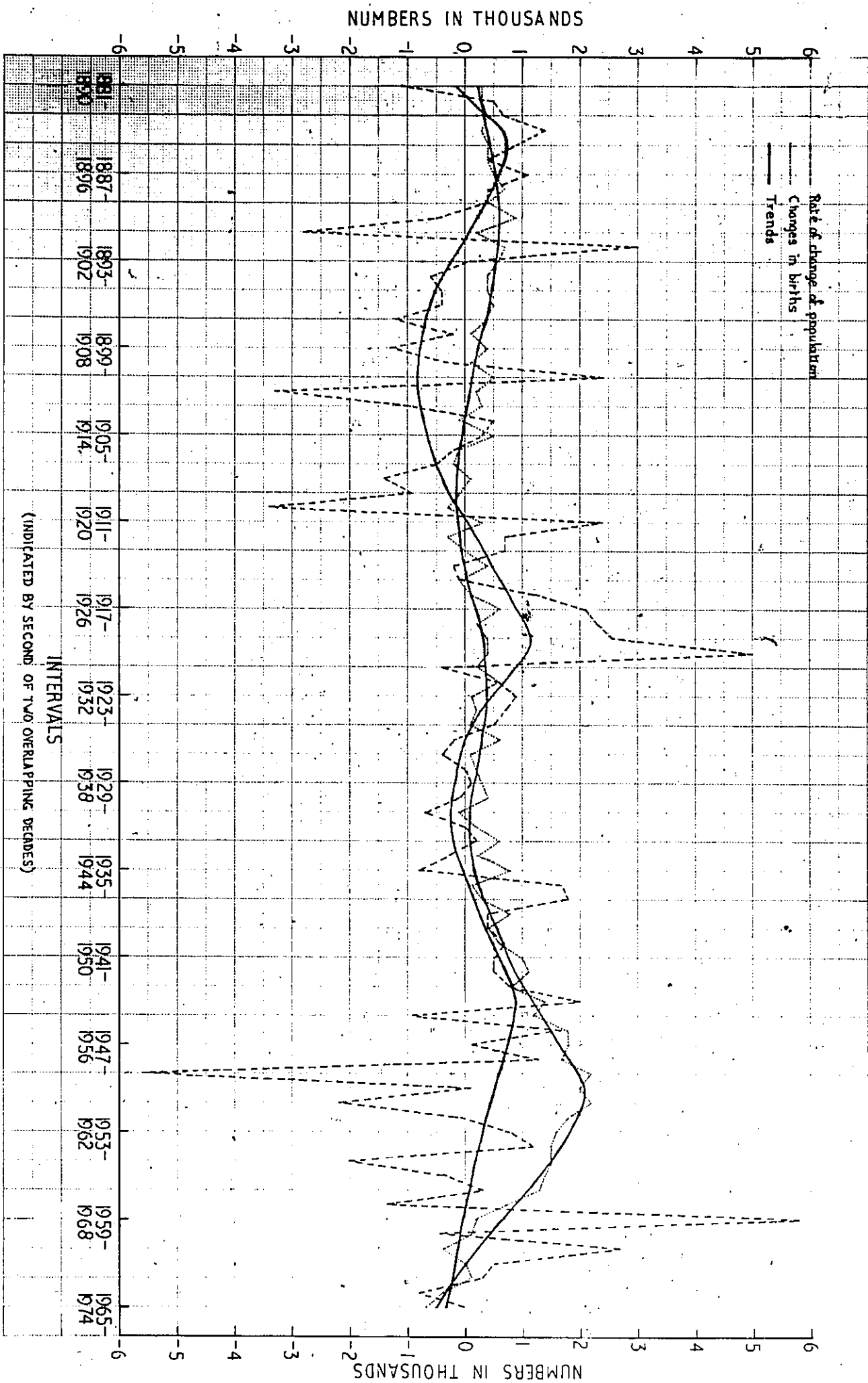
* from 1970 to 1976

Source: Facts on Jamaica, Population and Vital Statistics, Department of Statistics, 1973, based on G. W. Roberts, "The Population of Jamaica" with additions in respect of 1960 and 1970.

Economic and Social Survey, Jamaica, for data from 1970.

Corresponding swings in the trend of changes in births are also observed with peaks occurring somewhat later than those in the rate of change of population. The final incomplete swing in changes in births is in excess of that of the rate of change of population, doubtless reflecting the toll of heavy migration outflows on population balances (See Figure 8).

Figure 8
TRENDS IN THE RATE OF CHANGE OF POPULATION
AND THE CHANGES IN BIRTHS IN JAMAICA, 1880-1974



Testing the Model

The behavioural equations 1, 6, 10, 11, 12, 13, 17, 18 and 19 of the model specified in the previous chapter were tested on available Jamaican data.

Limitations of the data in the context of the model were manifold. Although estimates of the national income of Jamaica have been made as early as 1832, consistent annual tabulations apply only from 1950. Hence, time series data on gross domestic product, investment, and the appropriation of income was limited to approximately twenty five years. Inconsistency of presentation also constrained the span of the time series. Government expenditure, for instance, was disaggregated according to purpose from 1950 to 1970 but this form of presentation was discontinued thereafter, again abbreviating the span over which time series regressions may be applied. Labour force and employment data were available for only seven years, surveys in this area having been conducted for 1968-69 and 1972-76. Compilers of the labour force statistics noted that the high volatility and mobility of the labour force may have affected the estimates.

A major difficulty in utilizing available data for the purpose of this study was the sectoral division of the data. It was necessary to determine output, investment, capital, labour demand, the rate of profit and the wage rate attributable to the rich sector and government expenditure, births, and

change in population pertaining to the poor sector. An informed but possibly sometimes arbitrary allocation was applied. Output in the rich sector was taken to be the gross domestic product of the subsectors export agriculture, mining and quarrying, manufacture, construction and installation, utilities, distributive trades, financial institutions, real estate, and producers of government services, while output in the poor sector included domestic agriculture, miscellaneous services, and household and private non-profit institutions. All investment was assumed to take place in the rich sector. Labour demanded in the rich sector was derived from data on employed labour force by industry group, the labour employed in the rich sector including persons in manufacturing, construction and installation, utilities, commerce and public administration. Labour employed in export agriculture was not available in the published accounts.

Where specific adjustments to the data were required, explanations are provided in the discussions of the equations in the following section.

In evaluating the empirical results, the constraints of the data should be borne in mind.

Empirical Results

Using ordinary least squares estimation the following results were obtained:

$$1.1) \quad B_t^b = 6545.86 - 0.058 GE_t^b + 0.879 B_t^b (t-1)$$

(1.8) (-1.6) (9.4)

$$R^2 = 0.854 \quad \bar{R}^2 = 0.837$$

$$F(2,18) = 52.49 \quad D.W. = 1.99$$

$$h = 0.0253$$

$$1.2) \quad B_t^b = 8023.13 + 0.279 GE_t^b - 0.013 t GE_t^b + 0.775 B_t^b (t-1)$$

(1.9) (0.6) (-0.7) (4.5)

$$R^2 = 0.858 \quad \bar{R}^2 = 0.833$$

$$F(3,17) = 34.22 \quad D.W. = 1.81$$

$$h = 0.7196$$

$$1.3) \quad CPM = 6.409 - 0.567 LE$$

(15.1) (-5.21)

$$R^2 = 0.871 \quad \bar{R}^2 = 0.839$$

$$F(1,4) = 27.097 \quad D.W. = 1.386$$

$$1.4) \quad CPM = 13.008 - 1.875 XE$$

(10.57) (-6.44)

$$R^2 = 0.776 \quad \bar{R}^2 = 0.757$$

$$F(1,12) = 41.515 \quad D.W. = 1.656$$

$$1.5) \quad DCPM = -16.393 + 6.752 XE$$

(-1.75) (3.04)

$$R^2 = 0.435 \quad \bar{R}^2 = 0.388$$

$$F(1,12) = 9.232 \quad D.W. = 1.664$$

$$1.6) \quad CBR = 42.227 - 0.005 PCY$$

$$(25.53) \quad (-9.91)$$

$$R^2 = 0.710 \quad \bar{R}^2 = 0.703$$

$$F(1,40)=98.123 \quad D.W. = 1.498$$

$$6) \quad Ls_t = 608916.599 + 4.909 \Delta P_{(t-15)}$$

$$(14.14) \quad (4.94)$$

$$R^2 = 0.802 \quad \bar{R}^2 = 0.769$$

$$F(1,6)=24.358 \quad D.W. = 2.24$$

$$10) \quad I^a = 0.938 \rho^a$$

$$(26.24)$$

$$R^2 = 0.926 \quad \bar{R}^2 = 0.925$$

$$F(0,22)=688.54 \quad D.W. = 0.259$$

$$11) \quad \rho^a = 0.1047 + 0.0833(1/w)$$

$$(5.5) \quad (9.2)$$

$$R^2 = 0.923 \quad \bar{R}^2 = 0.912$$

$$F(1,7)=84.333 \quad D.W. = 1.199$$

$$12) \quad Y^a = 521.212 + 0.792 K^a - 0.004 Ld^a$$

$$(0.96) \quad (9.98) \quad (-1.51)$$

$$R^2 = 0.993 \quad \bar{R}^2 = 0.987$$

$$F(2,2)=157.608 \quad D.W. = 2.784$$

$$13) \quad Ld^a = 238932.6 + 39.515 Y^a$$

$$(11.50) \quad (2.52)$$

$$R^2 = 0.680 \quad \bar{R}^2 = 0.573$$

$$F(1,3)= 6.365 \quad D.W. = 1.853$$

$$17.1) \quad w = 0.959 - 0.103 \times 10^{-5} (Ls - Ld^a) \\ (4.25) \quad (-1.06)$$

$$R^2 = 0.273 \quad \bar{R}^2 = 0.031$$

$$F(1,3) = 1.127 \quad D.W. = 0.585$$

$$17.2) \quad w = 0.924 - 0.108 \times 10^{-5} (Ls - Ld^a) + 0.015t \\ (8.01) \quad (-2.18) \quad (3.10)$$

$$R^2 = 0.875 \quad \bar{R}^2 = 0.749$$

$$F(2,2) = 6.977 \quad D.W. = 1.831$$

$$18) \& 19) \quad GE^b = -11450.56 + 103.707Y^a \\ (-4.7) \quad (18.9)$$

$$R^2 = 0.957 \quad \bar{R}^2 = 0.995$$

$$F(1,16) = 357.697 \quad D.W. = 0.52$$

The numbers in parentheses are t test statistic values, the ratios of the regression coefficients to their estimated standard errors. R^2 is the coefficient of multiple determination, while $\bar{R}^2$ is R^2 corrected for degrees of freedom. $F(x,y)$ tests the null hypothesis that the slope parameters are zero, where x is the number of parameters to which the value zero is assigned under the null hypothesis, and y is the number of degrees of freedom associated with the residual sum of squares in the unrestricted estimation. D.W. is the Durbin-Watson test for serial correlation. The h statistic, for serial correlation in a model with a lagged endogenous variable, is given for equations 1.1 and 1.2. $h = (1 - 0.5D.W.) \sqrt{n / (1 - n \text{var}(\beta))}$

where D.W. is the Durbin-Watson statistic, n is the number of observations and $\text{var}(\beta_1)$ is the estimate of the variance of the coefficient of the lagged endogenous variable.

Equation 1 is the key equation in the model. Two possible responses of births to government expenditure (deflated) for health, nutrition, education and other social expenditures, were found to be appropriate: ii) $\gamma < 0$ and iii) $\gamma = (\gamma_0 + \gamma_1 t)$ where $\gamma_0 > 0$, $\gamma_1 < 0$, the former giving a better explanation than the latter. Equation 1, where $\gamma < 0$, is represented in 1.1) above. The coefficients have the expected signs, and the fit, as indicated by $\bar{R}^2 = 0.837$, is good. The coefficient for government expenditure, -0.058 , is significant at the 10 percent level,¹ since $t(18, 0.10) = 1.330 < 1.6$. The t value for births lagged by one period, 9.4 , exceeds $t(18, 0.005) = 2.878$. This coefficient, 0.879 , is therefore strongly significant. The F value of 52.49 , in excess of the critical value 6.01 at one percent level of significance, indicates that a measure of real explanation is achieved. The low value of the h test statistic indicates serial independence if the critical value of 1.72 at the 5 percent level is used. However, the sample size constrains the validity of this test. Equation 1, where $\gamma = \gamma_0 + \gamma_1 t$, is represented in 1.2). The coefficients bear the expected sign, and the fit, as indicated by $\bar{R}^2 = 0.833$, is good. The t values for the coefficients pertaining to the

¹A one-tailed test was employed for this, as well as subsequent evaluations.

variables GE^b and tGE^b are within the critical region at the 10 percent level of significance, indicating that the coefficients may not be significantly different from zero. The coefficient for births lagged by one period is significant at the 0.005 level. The F value of 34.22, in excess of the critical value of 5.19 at one percent level of significance indicates the appropriateness of the form of the equation. Again, serial independence is indicated. Analyzing 1.1) in conjunction with 1.2), it appears that:

- i) Government expenditure for general social welfare improvements may have a short run positive influence on current births. In 1.2) an increase of \$1,000 in government social expenditure is associated with an increase in births of 0.279. At the sample means of \$18.111 mn and 43,120 respectively, an elasticity of 0.117 is implied.
- ii) Even if the positive effect of government expenditure on current births is not highly significant, the strong and significant response of births to all previous government expenditure, as represented by lagged births, will support the positive response. 1.2) indicates a response of 0.775 in current births to a \$1,000 increase in all previous government expenditure for welfare improvements, or an elasticity of 0.769 at the sample means. 1.1) indicates a

somewhat greater response of 0.879 in current births to a \$1,000 increase in all previous government expenditure, with an elasticity at the sample means of 0.871.

- iii) For the period covered by the time series data, a negative response of births to government expenditure had already been established. In 1.2), although the level of statistical significance of the regression coefficient for the variable tGE^b is low, the coefficient, -0.013, bears the correct sign, and implies an elasticity of -0.077 at the sample means. In 1.1), the regression coefficient not only bears the correct sign, but is of reasonable size relative to its standard error. An inverse response of -0.058 in births to a \$1,000 change in government expenditure is indicated, implying, at the sample means an elasticity of -0.024. From iii), (see pages 137 - 138), the value of t at which the short run derivative vanishes is 21.38, and at which the long run derivative vanishes is 24.82 (see 1.2, page 173)¹. Hence, it may

¹Using estimated coefficients from 1.2

$$\gamma_0\phi = 0.279; \gamma_1\phi = -0.013; 1 - \phi = 0.775$$

Hence

$$\gamma_0 = 1.24; \gamma_1 = -0.058; \phi = 0.225;$$

$$\text{Short run derivative vanishes at } t = -\frac{\gamma_0}{\gamma_1} = 21.379$$

$$\text{Long run derivative vanishes at } t = -\frac{\gamma_0}{\gamma_1} + \frac{1-\phi}{\phi}$$

$$= 21.379 + 3.444$$

$$= 24.823$$

be expected, on the basis of the estimated coefficients, that the response of births in the poor sector to government expenditure for general social welfare improvement will shift from a positive to a negative sign within two and one half decades. Use was also made of Roberts' (1968) analysis of fertility in Jamaica.¹ The study utilizes cross-section information on fertility and educational attainment and finds a strong negative correlation between the number of children per mother of completed fertility (CPM) and the level of educational attainment of mothers (LE) for the country as a whole in 1960. The coefficient, -0.567 , is significant at the level 0.005 , and the fit is good. An elasticity of -0.451 at the sample mean of 4.42 CPM and the average LE is indicated. Regressing children per mother of completed fertility by parish with an index of educational status of mothers (XE) by parish, Roberts again finds a negative relationship. A positive relationship is found between the percentage decrease of 1960 over 1943 in children per mother of completed fertility by parish (DCPM) with the index of educational attainment of mothers by parish. (Equations 1.3, 1.4 and 1.5 replicate these findings and provide relevant test statistics to demonstrate the significance of the coefficients and the goodness of fit). In support of the negative cross sectional relationship, equation 1.6 shows the significant negative relationship

¹George W. Roberts, "The Present Fertility Position in Jamaica", pp. 262-4.

between the crude birth rates (CBR) and per capita incomes (PCY) of forty-two countries. These results support the finding of a negative long run response of births to general social welfare expenditures.

Equation 6 estimates the relationship between labour supply at t and the change in population at $t - 15$. Periods of heavy out-migration necessitated adjustments to the labour force and population data in order to approximate the actual applicable labour supply. To labour force, as reported for time t , was added 50 percent of net migrants at time t representing persons already in the work force, and 50 percent of net migrants at time $t-15$ representing persons who may have been expected to enter the work force at time t .¹ To population at time t was added net migration at time t . The coefficient, 4.909, is significant at the one percent level ($t(6,0.01)=3.143 < 4.94$), and the fit is good. At the sample means of 818,443 and 42,680 for labour supply and change in population respectively, an elasticity of 0.256 is implied.

Equation 10 estimates the relationship between investment and the rate of profit in the rich sector. The rate of profit was computed as the ratio of operating surplus to capital. A strong relationship is evident. The t value of 26.24 greatly exceeds its critical value of 2.508 for statistical significance at the one percent level. An elastic

¹The age distribution of emigrants indicated that approximately 50 percent of the total were of working age.

relationship of 1.094 is implied at the sample means for investment and the rate of profit in the rich sector.

Equation 11 demonstrates the inverse relationship between the rate of profit in the rich sector and the wage rate. The wage rate was calculated as the ratio of compensation to employees and labour employed. The t value of 9.2 exceeds its critical value of 2.998 at the one percent level. An elasticity of -0.566 at the sample means is indicated. A strong relationship and a good fit are established.

Equation 12 is the production function for the rich sector. The negative coefficient for labour indicates a possible over utilization of labour with diminishing returns. Despite adequate test statistics (the value for labour demanded is on the border line at the 10 percent level of significance, while that for capital exceeds its critical value of 6.965 at the one percent level), caution should be applied in arriving at conclusions since the measurements of labour and capital are incompatible, and quite different coefficients may be computed if a value were applied to labour. At the sample means of \$1,227 mn, \$2,201,000 mn and 287,420 for output, capital and labour respectively, elasticities of 1.420 for capital and -0.937 for labour are implied.

Equation 13 shows the relationship between labour demanded by the rich sector and the output of that sector. The coefficient is significant at the 5 percent level, since

$t=2.52$ exceeds its critical value of 2.353. An elasticity of 0.169 is implied at the sample means.

Equation 17 estimates the inverse relationship between the wage rate and labour in the poor sector. In an attempt to separate the effects of inflation and increased productivity from the effects of labour supply and demand on the wage rate, the average wage was deflated by an index of productivity. Labour in the poor sector was taken to be persons employed and unemployed in agriculture. The unemployed in other sectors were not included as it was assumed that these persons, even where they included sectoral and geographical internal migrants, have a reserve wage which is determined with reference to the rich sector and as such are no longer subject to supply and demand flexibilities. In 17.1) the coefficient has the expected sign. However, the value would be significant only at a level somewhat greater than 10 percent. The low values for F and R^2 indicate that wage may be influenced by other explanatory variables such as trade unions and the demonstration effect, in addition to the fact that labour force statistics may be deficient. However, as specified, a weak negative relationship is indicated. In 17.2) a time trend has been employed to represent other explanatory variables. The results are considerably stronger. The fit, as indicated by $R^2 = 0.749$, is fairly good. The coefficient for labour in the poor sector, -0.108×10^{-5} , is significant at the 10 percent

level since $t(2, 0.10) = 1.886 < 2.18$. At the sample means an elasticity of -0.3546 is implied. The coefficient for the time trend is significant at the 5 percent level. The F value of 6.977 is in excess of that of 1.127 for 1.1). While still low in relation to its critical value at 5 percent level of significance for the sample size under observation, it would exceed the critical value for a slightly larger sample size.

Equations 18 and 19 have been combined as the equation $GE^b = \tau Y^a$ and shows a strong and significant relationship between government social expenditure in the poor sector and output in the rich sector. The t value greatly exceeds its critical value at the one percent level and the fit is very tight. An elastic relationship of 1.375 , at the sample means of \$30.313 mn. for government social expenditure and \$402.716 mn. for output, is implied. While government expenditure data by purpose has been available, no geographical or sectoral allocation of this expenditure is available. However, it is assumed that for the most part the expenditures on education, health, and other social welfare measures are made available to the poor in the form of elementary schooling, public hospitals and clinics. It has been politically expedient to provide such services to the enfranchised masses. Normally, those in the rich sector must pay for such services or at least suffer a net loss through payment of taxes in excess of benefits received.

Interpretation of the Empirical Results

The foregoing empirical results indicate the following.

The population growth rate of Jamaica can be affected by public policy. The first response is likely to be positive.

The estimated 0.279 births in the poor sector arising from a \$1,000 increase in current government expenditure towards the provision of improved health, better nutrition, education and other general social welfare measures in 1.2) indicates this outcome. With the persistent direction of government expenditure towards enhancing the quality of life the rate of population growth will be induced to respond negatively. This result is demonstrated by the negative coefficients of -0.058 and -0.013 for GE^b and tGE^b in 1.1) and 1.2), respectively. The negative response is likely to be hindered by the strength of habit persistence. The estimates show a strong significant positive response, of 0.879 in 1.1) and 0.775 in 1.2), of births to all previous government expenditure. However, the strength of habit persistence should diminish so that the response will shift from a positive to a negative sign within twenty-one to twenty-five years.

No false precision should be read into these estimates.

It is possible, for instance, that with the extension of the time series to include more recent years, that a much stronger negative response to government expenditure may be observed, and the estimated time period for bringing population into line would be reduced accordingly.

The empirical estimation of the behavioural equations of the economic system indicates good explanatory power for the complete model in the context of Jamaica. Assessing the estimation results of equations 1.1, 1.2, 6, 10, 11, 12, 13, 17.2, and 18+19, it is found that the explanation achieved for the dependent variables, as demonstrated by the R^2 values, ranges between 68 percent and 99 percent. When adjustments are made for degrees of freedom, the coefficients of multiple determination, $\bar{R}^2$, range between 0.57 and 0.99. The relationships between labour supply and the lagged change in population (4.909 in equation 6), investment and the rate of profit in the rich sector (0.938 in equation 10), the rate of profit and the wage rate in the rich sector (0.0833 in equation 11), output and capital in the rich sector (0.792 in equation 12), labour and output in the rich sector (39.515 in equation 13), and government expenditure in the poor sector and output in the rich sector (103.707 in equation 18+19) are strong and significant. The response of output to labour demanded in the rich sector (-0.004 in equation 12) is somewhat less strong. The response of the wage rate to labour in the poor sector (-0.108×10^{-5} in equation 17.2) is relatively low but quite significant. F-tests indicate that the relationships are significantly different from zero. Some of the relationships, as between investment and the rate of profit, output and capital in the rich sector, and government expenditure in the

poor sector and output in the rich sector are elastic at the sample means. For the other relationships, a fair degree of elasticity, though less than unitary, is indicated by estimations at the sample means.

In keeping with the stipulated interactions between population and output and the results of the reduced system, the strengths of the coefficients of the empirical estimation indicate the presence of short run monotonic and long run oscillatory time paths for output in the rich sector Y^a , labour L , and the change in population in the poor sector ΔP^b .

The fluctuations in the rate of change of population and changes in births in Jamaica for the period 1888 to 1976, as outlined in the section--The Demography of Jamaica--above, support these findings. If the relationships hold for the first differences of the variables of the behavioural equations, then it may be possible to identify monotonic and oscillatory paths for changes in Y^a , L and ΔP^b . The values of the coefficients indicate that the response of labour supply to output in the rich sector is greater than the coefficient of labour demand, i.e., $\beta > \delta$, in the short run. Explosive monotonic time paths are therefore indicated for the short run. In the long run, with $\delta > |\beta|$ as indicated, dampened long (intergenerational) saw-toothed oscillations are probable.

If a constraining factor on the pattern suggested above is the relatively weaker relationship between the wage rate and labour in the poor sector, then this modification of the time paths may be offset by the operation of the flexible accelerator, as discussed earlier on page 125. This is one of many areas for further study and econometric testing.

Interpretation of the Model in the Context of Jamaica
as an Open Economy

Jamaica is an open economy. As such, an open version of the basic model set out in Chapter IV would be more appropriate for estimation. A closed model is likely to be misleading if not quite erroneous.

There is, however, a sense in which the model presented may be considered 'open' and therefore relevant. Assume that the rich sector is the enclave sector and place the enclave sector outside the national economy.¹ In the

¹This approach is not unique. A similar device was suggested by John Hicks and Ursula K. Hicks in Report on Finance and Taxation in Jamaica (Kingston: Government Printer, 1955), para. 29, pp. 17-18.

"The Bauxite companies, and those hotels which have been set up with overseas capital are in a sense external to the Jamaica economy; it is easier to think of the somewhat peculiar effects which they have had on the economy of Jamaica if we mentally put a fence round them and think of the land which has been sold to the bauxite companies and non-Jamaican hotels as being outside Jamaica, just as their owners are not part of the Jamaican people. If we look at the matter in this way, the whole value of the bauxite export ceases to be a Jamaican export; what is exported from the Jamaican economy in the narrower sense, is no more than the wages paid by the

context of the model there are two types of interactions between the 'rest of the world' or the rich sector¹ and the 'domestic economy' or the poor sector. The first is in terms of the utilization of labour. Investment in the 'rest of the world' is relevant to the 'domestic economy' in so far as it utilizes labour from the 'domestic economy'. The demand for labour from the 'domestic economy' will be affected to the

bauxite companies, and a few purchases of other Jamaican products, together with the taxes which they pay to the Jamaican government."

Benjamin Higgins has utilized the approach in his discussion of dualism and population in Economic Development, 1st ed., p. 343.

"Industrial and rural sectors are not part of the same 'economy' in the ordinary sense. Geographically, the plantations, mines, and oil fields are in the same country, but economically they may be more closely tied to the metropolitan country providing the capital, technical knowledge, and managerial skill than to the underdeveloped country in which the operation is located."

George E. Cumper also supports its use in the estimation of the Keynesian multiplier in an open economy in "Dependence, Development, and the Sociology of Economic Thought", Social and Economic Studies, 23, September 1974, p. 24.

¹ 'The rest of the world' may or may not be thought to include other countries. If other countries are included, then some variations of the model which may arise are:

- i) The variability of net external migration such that emigrants from the poor sector to other countries may be considered to be absorbed in the 'rest of the world.' Emigrants from the rich sector to other countries may be ignored.
- ii) Aid from other countries which is utilized in the poor sector may be combined with government transfers from the rich to the poor sector.

extent that the coefficient of labour demand is labour-using or labour-displacing. More expansively, suppose that changes in capital are more labour-using so that the coefficient δ is increased by the factor κt where $\kappa \geq 1$. The equilibrium level of Y^a will diminish over time as the denominator of the term $\frac{\alpha}{\delta \kappa t - \beta}$ increases. The oscillations of Y^a in the long run are likely to be damped as $|\beta|$ becomes smaller than $|\delta \kappa t|$. Conversely, if the changes in capital are labour-displacing so that the coefficient δ is reduced by the factor κt , where $\kappa \geq 1$, then the equilibrium level of Y^a will increase over time as the numerator of the term $\frac{\alpha \kappa t}{\delta - \beta \kappa t}$ increases. The oscillations of Y^a in the long run are likely to be explosive as $|\beta \kappa t|$ becomes greater than δ .

The second interaction is the extent to which output in the 'rest of the world' will affect government revenues and hence government expenditures in the 'domestic economy' with the resultant effect on population. The coefficient τ may be increased or diminished by the ability of the government to extract revenue in the form of taxes or royalties from the 'rest of the world'. In fact, the retention of the surplus for the development of linkage effects and the redirection of spread effects may all be considered elements of a broadly interpreted τ , which could be made effective through new government policies for effecting institutional changes. Conversely, if τ and therefore β , and also δ are considered given,

the 'domestic economy' will derive benefits from employment and transfers only to the extent that output in the 'rest of the world' may be encouraged to grow. This last solution is the one adopted by the 'industrialization by invitation', 'big push', import substitution and export promotion advocates whom Gunder Frank, Beckford and Girvan among others admonish.

By adopting the nomenclature 'rest of the world' vis-à-vis 'national economy' for the rich versus the poor dichotomy, the dress designed for the dualistic corpus permits, in the context of the present model, several alternatives, which may be employed separately or in combination one with another, for promoting development with growth. They are as follows:

1. Demand side alternatives or the rapid absorption of the poor sector into the rich sector by increasing the demand for labour. This may be achieved by
 - a) increasing Y^a - the solution attributed to Lewis, or
 - b) varying δ by changing the coefficients σ , β_1 , β_2 , π , μ or δ' .
2. Supply side solutions or the contraction of the poor sector by varying β through changes in ϵ , γ or τ .
3. The third possibility is the increase of output in the 'domestic economy' or poor sector, Y^b , above subsistence level. This is the strategy advocated by many economists, including Beckford, who envisage the utilization of labour in the poor sector, L^b , in the growth of Y^b , i.e., the

transformation of agriculture. Expansion of Y^b would also conceivably include the development of indigenous technology suited to local factor proportions, land reform measures, and credit facilities for small farm units and agro-industries producing locally consumed products, in addition to other institutional and structural support systems which will encourage growth of Y^b .

4. A fourth alternative, which has been championed by the radicals of the dependency school, is the elimination of Y^a or nationalization.

These alternatives stand by themselves as primary policy options for development. They may also be evaluated in terms of the focus of this thesis. The first alternative, increasing Y^a or varying δ such that the labour-output ratio is increased, will permit the transfer of non-employed labour from the poor sector and its absorption in the rich sector. With the relatively larger proportion of labour employed in the rich sector and the adjustment of the additional persons to improved standards of well-being, the overall growth rate of the population will decline in the long run. The second alternative, the contraction of the poor sector by varying β , is a direct confrontation with labour supply. Varying ϵ , the proportion of a birth cohort that comes on the labour market by, for example, extending school leaving ages, can only be a temporary measure for postponing the non-employment problem.

Transferring income from Y^a through adjustments in τ , combined with the onset of the negative behavioural response γ , can cause a reduction of population in Y^b such that non-employment will diminish and the well-being of persons will improve. The third alternative, transforming Y^b , will also affect the supply of labour. With job creation, additional employment, increased incomes, and improved well-being, birth rates will also decline over the long run. Development with the fourth alternative, the elimination of Y^a , revolves around the issue of diversion or dissipation of the product. If the product is well deployed for improving Y^b , population growth rates will also be brought into line with other factors in the long run.

The postulated long run time paths will be affected by the policy alternative adopted. Increasing Y^a will trigger new oscillatory paths and long swings from periods of more to less unemployment. Variations of δ in relation to β , or the converse, will determine whether the oscillations explode or dampen. With the restructuring and expansion of Y^b , Y^a and GE^b continue to be important as a source of funds and as a vehicle for transferring these funds whether in the form of financing, fertilizer or factor adapted techniques. The increased utilization of labour in Y^b will affect the relationship between the wage rate and labour in the poor sector modifying the oscillatory time paths through the effect on σ and, hence, δ . Nationalization can result in transferring not merely a

portion of Y^a where $1 > \tau > 0$, but all of Y^a such that a broadly interpreted $\tau = 1$.¹ With no variation in ϵ , the entire effect of γ will be felt.

Ideological considerations aside, in terms of strategies for development, the dualistic framework subsumes the dependency construct. A broader range of alternatives for development are provided by the former analysis, which include the limited possibilities of the latter construct. Even if the solution provided by the latter construct is adopted, it may be assessed in relation to the effectiveness of other alternatives. It appears, therefore, that the dynamic for change lies within the broader dualistic framework. The dualistic analysis provides a comprehensive view of the process of growth without development and a range of possible remedial policies for attaining development.

¹Arguments surrounding this issue have been discussed by M. Bronfenbrenner in "The Appeal of Confiscation in Economic Development" Economic Development and Cultural Change, 3, 1954-55, pp. 201-218, and in "Second Thoughts on Confiscation", Economic Development and Cultural Change, 11, July 1963, pp. 367-71, in response to D. H. Garrick "The Appeal of Confiscation' Reconsidered: A Gaming Approach to Foreign Economic Policy", Economic Development and Cultural Change, 11, July 1963, pp. 353-366. Bronfenbrenner conducts his argument with a constant rate of increase of population.

CHAPTER VI

SUMMARY AND CONCLUSIONS

In summary a scenario may be outlined.¹ The setting is a country with distinct geographical boundaries where, with the technology utilized, all factors are productively employed and proportionate to each other.

Possessing a resource which is financially attractive, the country finds that its equable balance is disrupted due to the development of this resource by an external power. Urban areas or cities² are rapidly established which are supportive to extraction. The increasing output of the cities gives an appearance of growth to the country as a whole as gross domestic product increases.

Development does not accompany this growth. Much of the surplus of the cities is siphoned off to the metropolis. Increased incomes in the cities and opportunities for improving the standard of living if the number of children per family are curtailed, tend to reduce the

¹This scenario provides a verbalisation of the dualistic model with endogenous population of Chapter IV, in the light of a generalization of the conditions applicable to Jamaica highlighted in sections one and two of Chapter V and the empirical verification and interpretation of the model in sections three and four of Chapter V.

²City versus countryside are also shorthand terms. In addition, they reflect regional as well as sectoral dualism.

birth rate. Child labour laws, limited housing and costs of schooling support the downward trend.

In the traditional, rural countryside, only very small amounts of the product of the cities affect the conditions of life as expenditures for improving the health of the country in general are made. With these expenditures, death rates decline. Indeed, the very expenditures for the reduction of death rates tend to have a beneficial effect on the health of the people and their potential for additional births. While the opportunities of life in the city encourage limitations to family size, despite improved health, so that the people tend to reproduce in numbers adequate only for replacement, in the countryside the declining death rates and increasing birth rates cause population growth to accelerate.

A low population-output ratio in the cities permits the saving and investment of a portion of the product. The surrounding areas find that with a high population-output ratio, all output is rapidly consumed and nothing may be withheld with the hope of increasing future output.

Notwithstanding the great disparity in the welfare of persons within and without the cities, the technological constraints of fixed coefficients in the cities prohibits the employment of persons from the countryside. The numbers who converge on the cities in search of employment

either return to the countryside disappointed or join the pool of unemployed and providers of petty services surrounding the cities. In effect, internal migrants remain in the poor sector.

The variable coefficient technology of the countryside allows for the absorption of such quantities of labour that diminishing returns to the fixed land have set in. The marginal product of any additional labour is now zero, or at least considerably below the wage in the cities to which labour is attracted. The wage in the cities bears some relationship to the difference between the total supply of labour in the entire country and labour requirements of the productive cities. In fact, one of the reasons for the existence of the cities was the potential for low wages that the surplus labour permitted. The clarity of this situation has been threatened somewhat by the growth of trade unions and the metropolitan-related aspirations of the workers of the cities. However, responses to pressures for increased wages in the cities have been met by the implementation of techniques which employ even less labour per unit of capital. As a result, some previously employed workers were pushed into the pool of the unemployed.

Forced to find a solution for unemployment and low incomes, the people in the countryside devise means

of work- and product-sharing which will at least permit precarious subsistence.

It was hoped by some that the expanded industrialization of the cities would filter through to the surrounding countryside, thereby improving levels of welfare and eventually causing the enjoyment of a level of living corresponding to the cities. But this did not occur. The benefits of growth were observed only in the metropolis.

Diverse demographic behavioural, demand behavioural, technological and institutional characteristics clearly differentiate the cities from the countryside. Dualism is portrayed.

The state now becomes engaged in transferring funds to the countryside in order to ensure the political support of the dwellers there. The subsidies take the form of expenditures for education in addition to health. There are those who approve these expenditures on humanitarian grounds.

The initial reaction to schools and additional hospitals is even more rapid rates of population growth with the attendant aggravation of existing problems and the reinforcement of dualism.

With a response of labour supply to output in the countryside that is positive and in excess of the response of labour demand to output in the cities, the entrepreneurs

are happy. The downward pressure on wages arising from excessive unemployment means that their profits will rise above normal and that they can continue investing and expanding their businesses. This expansion utilizes very little labour in relation to new capital, for the new techniques employed are even more capital-intensive and labour-displacing. Output grows exponentially in the cities and population, responding positively and strongly to the small amounts transferred by the state, grows even more rapidly than output. Such is the strength of dualism.

But the destitution of the countryside is no longer tolerable. The people of the cities fear for their lives as the incidence of crime and violence increases. Those in want must be provided with some less drastic recourse. So the proportions of output transferred by the state is rapidly increased and the duration of programmes for raising levels of welfare are lengthened to the end of keeping the poor quiescent. The transfers take the form of social expenditures for more education, health and nutrition, housing, electricity, piped water supplies and other very basic necessities. Gradually, the behavioural response of births to these expenditures begins to be one of decline, although habit persistence operates to prolong the process of change.

Noting the wisdom of its strategy, the state transfers are expanded to include fertilizers, irrigation, paved roads, new agricultural techniques, financing of farming, agro-industries and other industries which meet the consumption requirements of the people. Unemployment diminishes. Moreover, the behavioural response of births to the supplemented incomes declines to negative values. While the youthful age structure of the population will maintain a high rate of growth for some time, it appears that, through the action of the state in meeting the necessities of the poor, there is some hope for improving unemployment, eliminating poverty and rectifying dualism. The state may therefore even choose to expropriate the product of the cities, transferring all to the countryside since this strategy, if dissipations are prevented, is likely to result in the most rapid rate of development. Such a strategy would be wisely combined with the discovery and implementation of new techniques of production suited to the factor proportions and consumption requirements of the country.

With the attenuation of dualism, it may be found, however, that the lagged and negative response of labour supply to output causes oscillatory time paths for growth of output, labour and the rate of growth of population. Whether these oscillatory time paths explode, diminish

and approach a stationary state, or assume a perpetual regular pattern depends on the absolute value of the supply of labour coefficient in relation to the demand for labour coefficient. Some periodic increases in unemployment may be unavoidable.

The conclusions are as follows:

1. As hypothesized, population growth can be influenced by government expenditure which is directed towards the provision of basic needs. The initial response of births to government expenditure is likely to be positive. The subsequent response will be negative such that the rate of population growth may be expected to decline. The attainment of negative responses requires sustained need-oriented government expenditure.

This conclusion is supported by the empirical estimation of births as a function of current and previous general social expenditure of government in Chapter V. The regression slope of 0.279 between births and current government expenditure supports the initial positive response. Negative slopes of -0.058 and -0.013 between births and government expenditure in the first instance, and births and government expenditure adjusted to reflect the passage of time in the second instance, support the subsequent negative

response. Positive regression slopes of 0.879 and 0.775 between births and all previous government expenditures indicate the strength of habit persistence which maintains the positive response. With continued expenditures, the effect of habit persistence will diminish and the long run negative response will be realized. On the basis of these estimated regression slopes the time period required for shifting from an adverse positive to a favourable negative population response is twenty-one to twenty-five years.

2. The model constructed as a setting for the central behavioural equation such that output depends on population and population in turn depends on output, when reduced, provides time paths for output, the equilibrium level of labour, and the change in population. The special features of the model are disparate demographic and demand behavioural, technical and institutional equations reflecting duality; the introduction of government in the interface of the rich and poor sectors; and the positive and negative responses of births to government expenditures. The central equation expressing births as a function of government expenditure permits the last two features. In addition, wages are taken to be an inverse function of the difference between total labour supply and labour demand in the

rich sector, profits are inversely related to wages, and investment is directly related to profits. The model is reducible to a first order difference equation where the demand for labour in the rich sector is a current function of output and the supply of labour in the poor sector is a lagged function of output. From this, the equilibrium levels and time paths of output, labour and the change in population may be calculated.

Empirical estimation supports the specification of the system as a relevant view of the real world. The regression slopes derived from the data indicate substantial relationships of 4.909 between labour supply and the lagged change in population, 0.938 between investment and the rate of profit, 0.0833 between the rate of profit and inverted wages, 0.792 and -0.004 between output and capital and labour, respectively, 39.515 between labour demanded and output, and 103.707 between general social government expenditures and output. If the relationship between the wage rate and labour is not strong, as indicated by the relatively low value for the regression slope of -0.108×10^{-5} , then postulated time paths may be modified by the degree of tenuity of this link. That the slope parameters are significantly different from zero is

indicated by fair to more than adequate F values. Over all; the explanatory value of the system is indicated by values of 0.68 and over for the coefficients of multiple determination.

3. The model incorporates dynamic features, firstly, in the response of births to all previous government expenditures such that the strength of behavioural inflexibility or resistance to change may be evaluated; secondly, in the lagged response of labour supply to output, thereby recognizing the intergenerational gap; and thirdly, in permitting an assessment of sectoral vulnerability and the extent of duality through the introduction of government activity.
4. The model provides impact multipliers, δ and β , the coefficients of demand and supply of labour, which summarize the responses of the various variables of the model. δ is the labour-output ratio. This ratio is equivalent to $\{\sigma/\beta_1\kappa\pi + \delta'(1-\beta_2\sigma/\beta_1\kappa\mu)\}$; where σ , estimated to be -0.108×10^{-5} , is the response of the wage rate to labour in the poor sector; β_1 and β_2 , estimated to be 0.792 and -0.004, are the coefficients of capital and labour in the production function, respectively; π , estimated to be 0.938, is the investment profits ratio; μ estimated to be 0.0833, is the response of profits to inverse wages;

δ estimated to be 39.515, is the marginal product of labour demanded with respect to output; and κ is a multiple of investment. In relation to the purpose of the model, $\beta = \epsilon\gamma\tau$ is of particular interest: γ representing the behavioural response of births to government expenditure which may be positive or negative, τ representing the proportion of output of the rich sector that is transferred to the poor sector, and ϵ being the proportion of a birth cohort in the poor sector that will enter the labour force. Estimated values for γ are 0.279 in the short run and -0.013 or -0.058 in the long run. Values for τ and ϵ are 103.707 and 4.909, respectively. In terms of possible policy, it is significant that the values of these parameters may be affected or determined by the government.

Estimation suggests that possible values for δ and β may be such that $\beta > \delta$ in the short run and that $\delta > |\beta|$ in the long run. Hence it may be possible to observe exploding monotonic growth in the short run and damped oscillatory growth in the long run.

5. The model provides a quantitative understanding of the way in which dualism may be created. A positive response of births to income, in the absence of corrective government transfers to the poor sector,

combined with falling death rates, can cause rapid increases in population which, with a scarcity of arable land, will push a country onto the path towards dualism.

6. The mode of production of the rich sector can strengthen the stranglehold of dualism. The technology employed, the exclusive pursuit of the profit motive, and the deposition of the surplus of production without thought of the poor sector can trigger responses in that sector such that dualism is created and maintained.
7. Mild welfare policies of the government can serve to aggravate dualism. The pernicious nature of the population problem due to habit persistence will distort the purpose of programs that are too short and too small. Stingy doses of welfare will create immunity to development.
8. The model shows not only how dualism may be created but how it can be overcome. Only large and repeated doses of welfare can effect a cure. Considerable amounts of funds may have to be consistently transferred to the poor sector for meeting the basic needs of the people. Redistribution of income is not just a requirement which should accompany or evolve from development; it is a prerequisite for development.

9. The dualistic model as an analytical tool is vindicated. The dependency theory may be regarded as one aspect of the dualistic framework with respect to a view of the process contributing to the creation of dualism and a means for dissolving dualism. It is possible that dependency may even be measurable in terms of the strength of dualism.
10. The model provides one possible theoretical explanation for observed Kuznets' cycles and substantiates the existence of oscillatory paths for changes in output, changes in labour, and the rate of change of population. These oscillations are long intergenerational saw-toothed movements and take place in the more advanced economy when births are inversely related to output. They are dependent on supply side rather than demand considerations. Whether the oscillations explode, dampen or fluctuate forever depends on the relative values of the coefficients of labour demand and supply.
11. The model permits, in the context of an open economy, four basic alternatives for the attenuation of dualism. Firstly, the absorption of the poor sector into the rich sector by increasing the output of the rich sector or varying the coefficients of the demand side such that the demand for labour will be increased;

secondly, the contraction of the poor sector by varying the coefficients on the supply of labour side such that the supply will be decreased; thirdly, the increase of the output of the poor sector or sectoral transformation; fourthly, the expropriation of the product of the rich sector and its diversion to the poor sector. These alternatives, which derive from the dual economy framework, yield primary policy options for development. All four options also have varying implications for overall declines in population growth rates.

The entire approach is viewed as one for identifying a structure and determining a process, with the fundamental mechanisms involved therein. The structure is the completely dualistic economy. Inhomogeneous demographic behavioural, demand behavioural, technical and institutional equations define this structure. The process is such that complete dualism is first generated and then attenuated. This takes place with the positive and negative responses of births to government expenditure for the provision of necessities, the lagged response of labour supply to output, and the possibility for sectoral interaction over time.

The main policy implication of the foregoing is that population growth rates need not be left to change exogenously. Planners can expect to bring population into line with other factors within, possibly, three decades if not less. The requirement for this will be the vigorous direction of funds towards the provision of basic needs. Hence, in the context of endogenous population, the basic needs approach may be interpreted as the capturing and ploughing back of surpluses into the traditional sector such that conditions of life may be transformed and fundamental rights attained so that healthy, educated, productive people may have the opportunity to realize their human potential.

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APPENDIX

ABSTRACT OF

Population and Productivity¹

An endogenous treatment of population in an economic framework is the main consideration of this thesis.

A dualistic model is constructed with sectors--labelled poor and rich for convenience--which display inhomogeneity in terms of their behavioural, technical and institutional equations. Intersectoral confrontation is provided for through the medium of government activity. Births in the poor sector are a function of need-oriented government transfers from the rich sector. The dynamic treatment of this central equation such that all previous as well as current government social expenditures affect current births suggests that, although hindered by habit persistence and a possible initial positive response, need-oriented government expenditure will cause a decline in births. This may be expected to take place within at least three generations. Population growth can therefore be reduced by a certain pattern of government expenditure.

In the context of the model, the causality provided

¹Brenda C.H. Gayle, doctoral thesis presented to the Faculty of Graduate Studies, University of Ottawa, Ontario, September 1978, vii-226.

by the central equation such that population is determined by output which itself depends on population as a factor of production, permits the delineation of time paths for output, labour and the change of population which are in the short run monotonic and in the long run oscillatory. It is possible to trace a pattern whereby dualism may be created, perpetuated, and finally resolved. The scenario is that of a population generating sector which responds with rates of growth which outstrip those of the output generating sector. Behavioural inflexibility or habit persistence of the poor sector expressed in the central equation operates to support dualism. With the persistent direction of social expenditures and measures for meeting needs towards the poor sector the behavioural response will eventually be reversed and population growth rates will diminish.

Four basic alternatives for the attenuation of dualism and the generation of growth with development are permitted by the model. The alternatives are, firstly, the absorption of the poor sector into the rich sector by increasing the output of the rich sector or varying the coefficients of the impact multiplier on the demand for labour side; secondly, the contraction of the poor sector by varying the coefficients of the impact multiplier on the supply of labour side; thirdly, the increase of the output of the poor sector above subsistence level through

the transformation of that sector; fourthly, the elimination of the rich sector through expropriation and diversion to the poor sector.

It appears that while short run growth paths are monotonic, exploding if the lagged response of labour supply to output exceeds the response of labour demand to output, in the long run oscillatory time paths corresponding to Kuznets' cycles are unavoidable. These oscillations may diminish with time if the strength of the response of the demand for labour to output exceeds that of the supply of labour.

The model is tested with demographic and economic data of Jamaica. While some equations display a better fit than others--the central equation being among the former--it is found that there is a measure of correspondence between the model and a view of the actual world which makes the approach relevant for an understanding of endogenous population and productivity.