Income Distribution, Import Substitution, and Growth Strategies in a Developing Country*

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<Content>

I. Introduction

This paper illustrates the application of a new type of planning model to the study of the relationship between trade and industrialization strategy and income distribution.(1) The overall model consists of a static wage and price endogenous, computable general equilibrium (CGE) core model linked to a partially adaptive dynamic model. The CGE model consists of a large

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(1) The work described here is part of a project financed by the World Bank to model the determinants of the distribution of income in South Korea. The full study is described in Adelman and Robinson(1976).

simultaneous system of extremely nonlinear equations. The two sub-models can be considered as black recursive parts of an overall model whose dynamic behavior describes a kind of "lurching equilibrium" growth process. The overall model combines neoclassical substitution possibilities and market clearing equilibrium with non-neoclassical rigidities and disequilibrium growth.

The model is quite large, including something over 3,000 endogenous variables. It has been implemented with data from South Korea and has been validated by comparing its solution to the actual Korean dynamics for the period 1968 to 1972. The model has then been used as a laboratory for experimenting with a number of different growth strategies whose results are described and evaluated in terms of both growth and income distribution.

After a brief description of the model based on flow charts, we discuss its dynamic structure and overall design philosophy. We then briefly describe the data base, parameter estimation, and the results of the basic dynamic run. The dynamic behavior of the model reflects policies designed to achieve fast, export oriented growth based on labor-intensive export sectors. This strategy is compared with two slower growth strategies and with a strategy of import substitution. Our conclusion is that the strategy actually followed is better on both growth and poverty reduction criteria, though one, albeit unlikely, slower growth variant would have had better distributional consequences.

II. Model Summary

The model is designed to permit exploration of the potential impact of development strategy upon the relative and absolute incomes of the poor. It therefore must trace out both the direct and indirect influences of economic growth upon the distribution of income and extent of poverty. The structure of the model is set by the nature of the major economic forces and policy instruments which, in the absence of abrupt structural change, can impinge upon the distribution of income and extent of poverty in the short and medium term.

The model works by simulating the operation of factor and product

markets with profit-maximizing firms and utility-maximizing households. Its distinguishing features are: (1) it is dynamic, with imperfect intertemporal consistency; (2) it solves for prices endogenously in both factor and product markets; (3) its solution is based on achieving a measure of consistency by market clearing processes among the results of individual optimizing behavior by a large number of actors (households, firms); (4) it incorporates income distribution, monetary phenomena, and foreign trade; and (5) it allows for varying principles of market clearing and institutional behavior.

The overall model consists of a static within-period adjustment-model linked to a dynamic intertemporal model. Within each period, the degree of adjustment is constrained by the existence of capital in place of a specific type; by the immobility of the self-employed both in agriculture and in urban production; by rigidities in relative wage structures; and by government constraints on firm behavior, especially in the foreign trade sector. Between periods, a limited degree of flexibility is provided by capital accumulation, population growth, migration, changes in the amount of self-employment, and changes in the size structure of production. Thus, although the model is broadly in the neo-classical tradition, it has a number of disequilibrium, non-neoclassical features.

The model is reasonably disaggregated: it has four firm (or, in agriculture, farm) sizes in each of 29 sectors (about 120 producers); it has 15 consumer categories generating demands in each sector (about 300 consumption decisions); and six skill categories of labor operating in each of the firm sizes and sectors (about 500 wage rates). As a result each period's solution yields over 3,000 endogenous variables.

The model is quite comprehensive in the number of features of the economy which are endogenous and mutually consistent. It goes explicitly from endogenously determined factor payments and employment to household incomes, with savings and expenditure decisions being modelled at the household level and factor employments and returns at the firm level. Accounting consistency is maintained among: household, firm, government, and trade accounts; national income accounts; input-output accounts; the national product accounts; and the labor force and the number of households.[2]

The model incorporates optimizing responses by firms and households to a wide range of policy instruments. It is also capable of portraying a variety of institutional principles in the operation of credit markets and factor markets, the degree of monopoly, and even the objective functions of firms.

A summary description of the overall model follows. For each period, the computation of the model is decomposed into three stages. The Stage I model describes the contracts made between firms and the financial markets to acquire funds to spend on investment goods. Stage II describes how factor and product markets reach an equilibrium constrained by the investment commitments undertaken in Stage I, by rigidities imposed by foreign trade, and by institutional rigidities in the operation of product and labor markets. Money and the average price level enter the Stage II model in an essential way. Stage III serves to generate the expectations on which Stage I decisions are based, to set some of the rules of its operation (e.g., the credit regime), and to "age" the model economy. The main structure of the model is diagrammed in Figures 1-3.

Stage I models the loanable funds markets. Producers form their demands for loanable funds on the basis of expected sales and prices of inputs. Credit is then rationed either by setting an interest rate and allowing the market to clear at the rate or by setting a target rate of expansion of credit and allowing the rate of interest to adjust in order to clear the loanable funds market. The outputs of Stage I are the allocation of loanable funds among firms and sectors, and an overall injection of credit into the economy.

The Stage II model is a general equilibrium model in that prices or supplies are assumed to adjust so as to clear all markets, subject to various constraints on factor mobility that prevent the economy from fully adjusting by means of pure market mechanism. The solution is calculated by means of a tatonnement process which simulates market behavior; no actual transactions take place until the solution is reached. The outputs of Stage II are "actual" production, employment, prices, wages and income distribution for the period.

The Stage II model is itself sub-divided into a number of parts representing different computational phases: supply, demand, wage, income and price determination. In Figure 2, the product and labor markets are pictured.

(2) In its accounting framework, the model integrates different accounts in a manner that fits into the recent work or social accounts. See United Nations (1975) and Pyatt and Thorbecke(1976).

Producers determine their profit-maximizing demands for labor and supplies of products given an initial guess of the solution prices. These demands for labor interact with labor supply functions to determine wages and employment so as to clear labor markets. From the determination of employment, wages and returns to capital, the distribution of income to economically active population is derived. This functional distribution of income is then translated into the household distribution.(3) For each socio-economic category of income recipients the model determines income, taxes, allocation to household groups, transfers, savings and consumption expenditures. The generation of the distribution of income and of product demand is diagrammed in Figure 3. The resulting consumer demands are then fed into the material balance equations together with other sources of demand. For heavily protected imports or non-internationally traded goods, it is assumed that the domestic markets are insulated from the rest of the world and prices are determined so as to clear them. Some traded goods are assumed to sell domestically at the world price plus a fixed tariff (or subsidy) and imports and exports are set so as to clear domestic markets at the world price. Given the initial guess of prices, these calculations determine the excess demands or supplies in all product markets which are then used to revise product prices for the next iteration. The iteration process converges on a set of market clearing product prices and wages.(4)

The Stage III model consists of a set of functions which update the relevant variables and formulate the expectations which enter into the Stage I model for the next period. Stage III can be seen as consisting of a collection of sub-models which specify all the dynamic adjustments and intertemporal linkages for the overall model. The relatively short time horizon of the Korean model led to a fairly simple set of Stage III functions. A number of variables such as population growth are simply assumed to grow at an exogenously specified rate. Rural-urban migration is explicity modelled as a function only of rural-urban income differentials, with an upper limit on the possible annual rate of migration. There are no interactions among the various sub-models.

(3) The technique by which the functional distribution is mapped into the household distribution is described in Robinson (1976).

(4) For a complete description of our solution algorithm and a survey of alternative solution strategies, see Adelman and Robinson (1976).

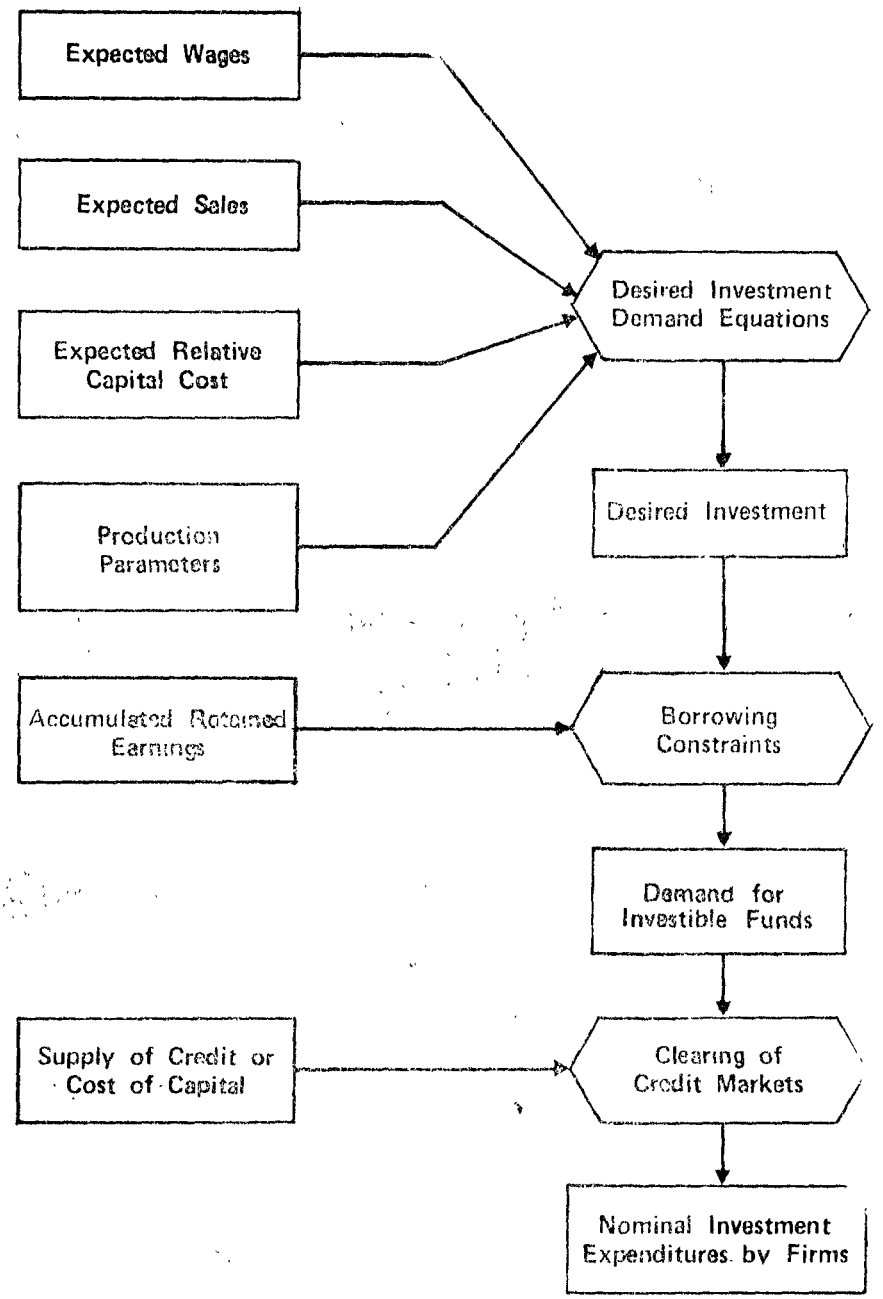
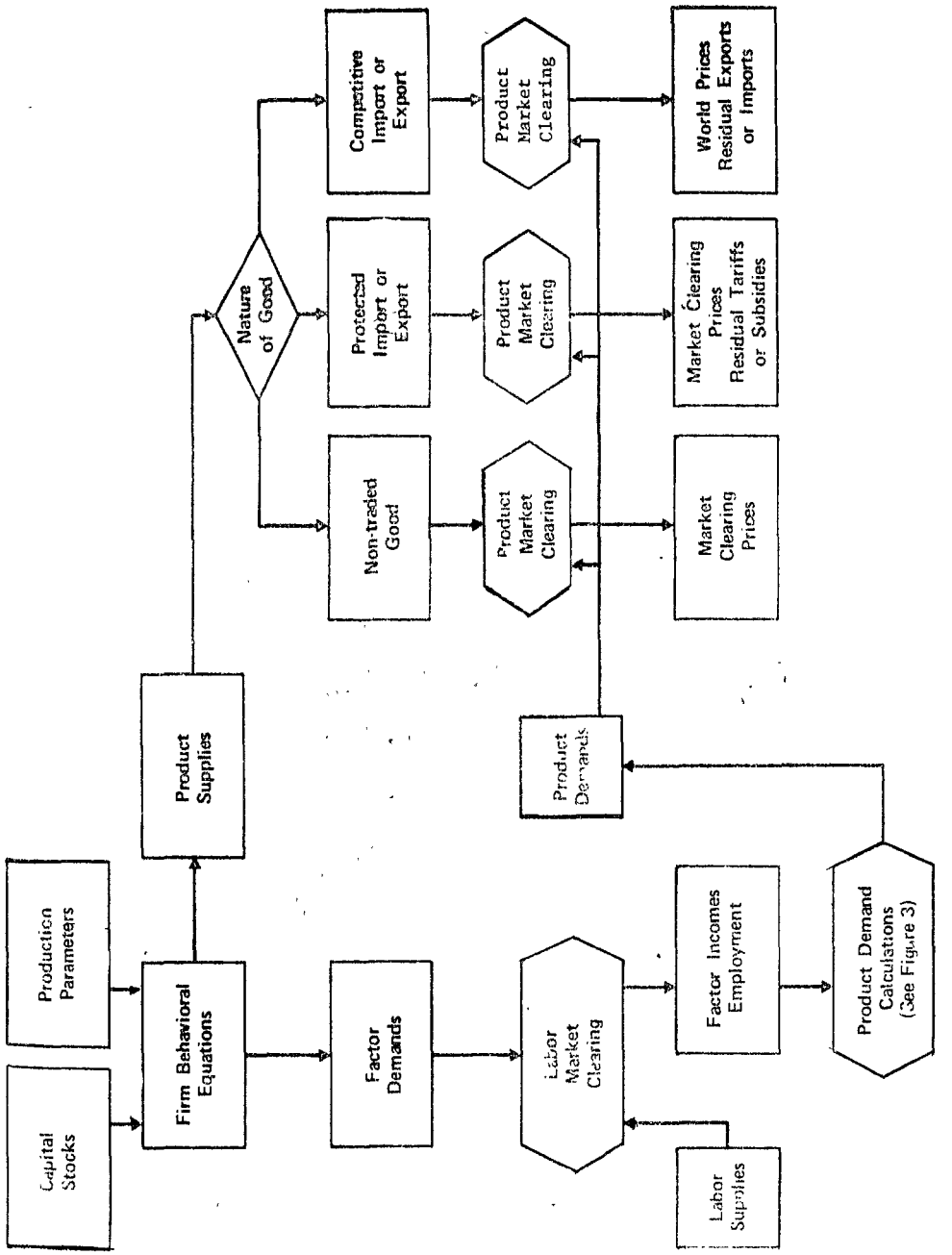


Fig. 1. Stage 1: Determination of investment


Capital Stocks
Production Parameters
Firm Behavioral Equations
Product Supplies
Factor Demands
Labor Market Clearing
Labor Supplies
Factor Incomes Employment
Product Demand Calculations (See Figure 3)
Product Demands
Nature of Good
Competitive Import or Export
Protected Import or Export
Non-traded Good
Product Market Clearing
Product Market Clearing
Product Market Clearing
World Prices Residual Exports or Imports
Market Clearing Prices Residual Tariffs or Subsidies
Market Clearing Prices

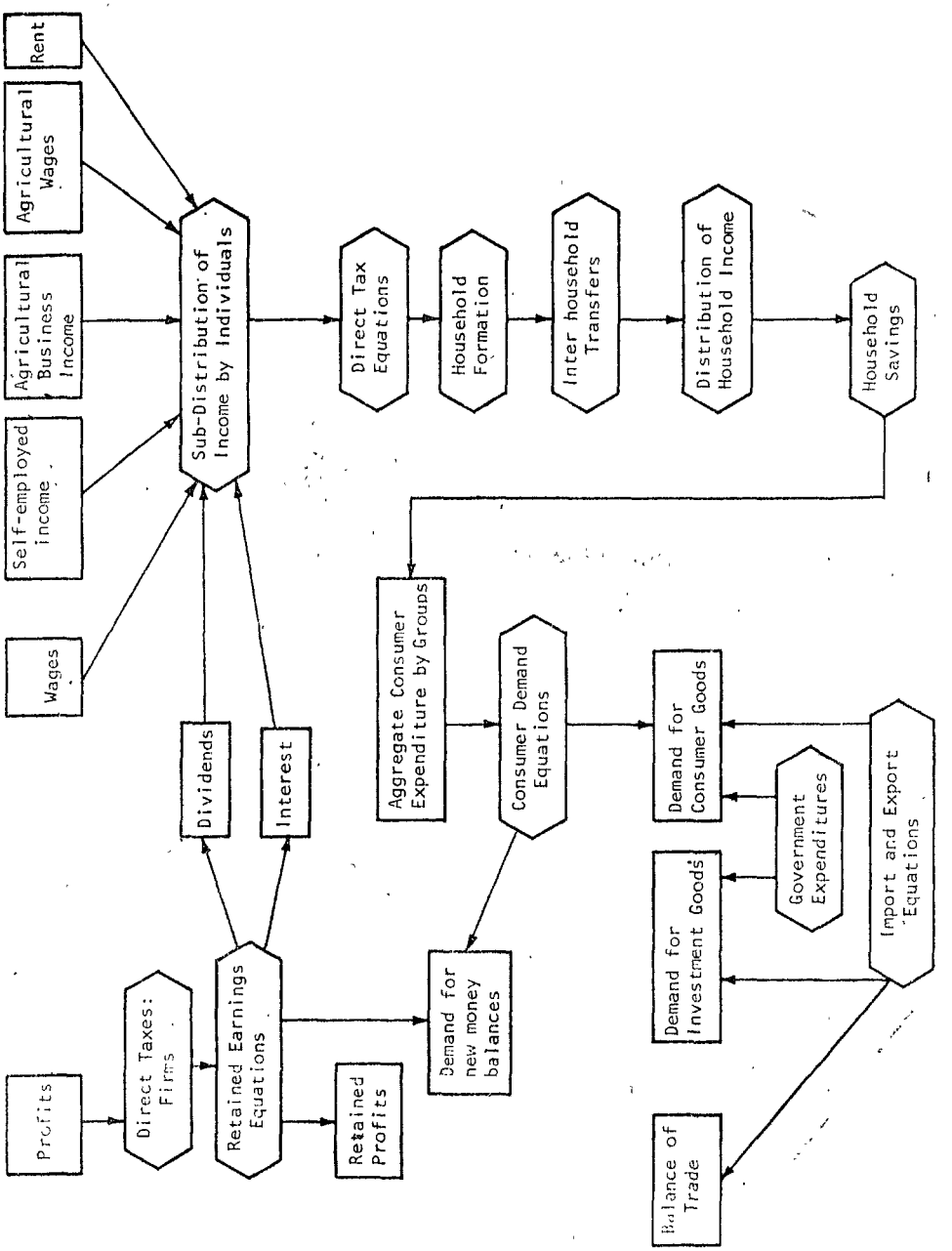


Fig. 3. Stage 2: Demand for Products and Income Distribution

In each period, the three stages are solved serially. Expectations in Stage I, realizations in Stage II and forecasts in Stage III are not necessarily identical. Therefore, the overall dynamic model represents a kind of "lurching equilibrium" which, it is hoped, offers more realistic specification of actual growth than would be provided by some intertemporally efficient equilibrium growth model.

III. Model Structure

Our overall model can be seen as coupling in a recursive fashion time dependent blocks of equations with a static simultaneous block. In our model, Stages I and III together comprise the dynamic time dependent model and Stage II represents the static block. The model is started off by solving Stage I but, after that, the dynamics can be viewed as a sequence of solutions consisting first of the static model (Stage II) followed by the dynamic model (Stages III and I). Thus the overall model consists of a static phase and a dynamic phase which are solved seriatem.

The view that most economic systems are block recursive in time was first propounded by H. Wold, and has been implemented since in the context of both programming models and econometric models. The new element in our model is the nature of the static simultaneous block: it is a computable general equilibrium model with supplies, demands, prices, and incomes interacting in the simultaneous solution of large interdependent blocks of non-linear equations. Unlike econometric models, the simultaneous block involves optimizing behavior by the individual actors. Unlike programming models, there is maximization of individual objective functions and non-linearity in both production processes and objective functions. The dynamic phase differs from most recursive models in that there is a large simultaneous sub-block describing investment and loanable funds markets (Stage I). The Stage III block does not involve any simultaneity.

The broad structure of our model is described mathematically below. Capital letters represent physical quantities (production, employment, etc.) while lower case letters represent monetary variables (prices, incomes, etc.). All variables are vectors or matrices and the functions are all vector or matrix functions. All variables in the static phase are assumed to have the

same time subscript which can thus be omitted.

Static Phase

Product Markets

Sectors have production functions relating supply of output to factor employment.

(1) $X^s=f_1\ (F)$

where X^s is a vector of outputs and F is a matrix of employment of all factors in all sectors. We used Cobb-Douglas or two-level CES production functions for labor (by different skills) and capital. Intermediate goods were required in fixed proportions given by input-output coefficients.

Product demands are given by:

(2) $X^d=f_2\ (p,y)$

where p is the vector of product prices and y is a vector of group incomes. We used a system of price and income responsive demand equations based on the maximization of a different separable utility function by each group. The price and expenditure elasticities were estimated by a technique due to Frisch.[5]

Group incomes are given by:

(3) $y=f_3(r,F,S)$

where r is a vector of rates of factor remuneration (wages, profits), F is the matrix of factor employment and S is a matrix of stocks reflecting the ownership of factors differentiated by type of factor and owner. The amount and distribution of stocks of factors (S) is assumed to be fixed and hence exogenous in the static phase. We specified fifteen different categories of income recipients including seven skill categories of labor, four types of farmers classified by farm size, two types of self-employed, government employees and capitalists. The function f_3 also must include any pure transfer mechanisms.

The vector y gives the mean income of groups and hence, given the

(5) See Frisch (1959).

group populations, reflects the distribution of income by socio-economic groups. We generate the overall size distribution by assuming a specified form for the distribution of income with each group and then aggregate the within group distributions.[6]

Equilibrium in the product markets requires that product supply equal demand $X^d - X^s = X$, or:

(4) $X^d - X^s = 0$

Factor Markets

The supply of factor services during the period is assumed to be a function of factor remunerations (r) and the stocks of factors (s)

(5) $F^s = F_4\ (r, S)$

The elements of S have the units of stocks (machines, people) while the elements of F^s have units of flows (machine-years, man-years), so equation (5) gives the flow of factor services provided by the exogenously given stock of factors. In our model, the capital stock was assumed fixed by sectors within each period with a constant utilization rate. In general, we also assumed the aggregate labor supply to be fixed within periods, although we did do some experiments with labor supply functions.

The functions summarized by f_4 are rather complicated. The vector F^s represents the supply to each factor market which in some cases are differentiated by sector as well as by type of factor, e.g., labor in the agricultural sectors. The matrix S, however, differentiates factors not only by type of factor market but also by type of owner. Thus the functions include aggregation of supply from different sources.

The demand for factors is given by:

(6) $F^d = f_5\ (p, r)$

These functions reflect the behavioral assumptions made about firm behavior. We assume profit-maximizing behavior on the part of all firms with perfect competition in most, but not all, product markets. We also specified four different firm sizes, each with its own production functions and hence

(6) See Robinson (1976).

factor demand equations in each sector. The functions summarized by f_5 thus include aggregation across demanders (e.g., firms) for different types of factors.

Equilibrium in the markets for factor services requires that $F^d=F^s=F$, or:

(7) $F^d-F^s=0$

In the static model, the stocks (S) are assumed to be fixed and the problem is to solve for the market clearing values of r, p, y, X, and F. Given S, the system is a classical Walrasian general equilibrium model with many goods and many factors. Note that the various markets may be differentiated by location or sector as well as by the definition of the good or service being traded. For example, we assume that agricultural labor cannot migrate to urban areas *within* a period and hence the agricultural labor market is treated as a separate market in the static model, with its own separate wage to be determined. A great deal of flexibility is gained by defining many separate markets differentiated not only by the nature of the product or factor service but also by region or sector.

The problem of solving this phase of the model is that of solving a general equilibrium system or of finding a set of market clearing wages and prices. We refer to this general type of model as a computable general equilibrium(CGE) model.[7] There exists a number of different techniques for solving CGE models of varying degrees of sophistication and cost.[8] Our model has twenty nine product markets and seven labor markets for which market clearing prices and wages are sought, in addition to a quite complete description of the household firm, and government accounts. In spite of its size and complexity, we are able to solve the model economically.

Dynamic Phase

Given the initial levels and distribution of stocks of factors, the static

(7) For other examples of this general type, see Johansen (1960), Taylor and Black (1974), Dervis (1975), de Melo (1976), and Ginsberg and Waelbroeck (1976), and Taylor and Lysy (1975)

(8) For a discussion of different solution strategies, see Adelman and Robinson (1976). Different techniques use linear programming, fixed point algorithms, or,as in our case, classical agorithms for the solution if simultaneous algebraic equations.

phase model yields the equilibrium values of wages, Prices, income, employment, and production. This solution represents an "equilibrium" only in an instantaneous or short-run sense since it assumes that all stocks are fixed. For example, in our model, there is no rural-urban migration within periods, the aggregate supply of labor by skill categories is fixed, and capital is assumed to be fixed by sectors and hence immobile. Dynamically, factor stocks are clearly not fixed and it is necessary to model their changes and movement over time. The growth and adjustment of factor stocks is clearly at least partly a function of the time path of variables which are endogenously solved in the static phase. However, we assume that the change in stocks this period is a function of values from previous periods and is independent of current period values. This assumption is fundamental to our modelling approach and permits us to separate the simultaneous equation CGE model from the dynamic adjustment model into two block recursive sub-models.

In equations, the dynamic model consists of two parts. First, the actual stock adjustment model can be written as:

$$(8)\quad S_{t+1}=g_1(S_t,\ F_t,\ X_t,\ p_t,\ r_t,\ y_t,\ E_{t+1})$$

where F, X, p, r, and y are from the solution to the CGE model; S_t is stocks in the last period; and E_{t+1} is a vector of expectation variables. Expectations may concern both quantities and prices, but must be a function only of past values. In our model, for example, firms in the Stage I model make investment decisions based on expectations about future sales as well as about the future structure of wages and prices. The expectation function can be written as:

$$(9)\quad E_{t+1}=g_2(E_t,\ S_t,\ F_t,\ X_t,\ p_t,\ r_t,\ y_t)$$

The expectations functions provide the major disequilibrium focus of the dynamic model. One could conceive, for example, of iterating over time until one found an equilibrium path where all expectations were met. In such a model, equation (8) would lose its force since the problem then would be to seek a time sequence of stocks such that expectations are always realized.[9] We do not take this approach largely because we do not think

(9) Dervis (1975) presents an elegant dynamic CGE model of Turkey which incorporates full intertemporal equilibrium.

it is a realistic way to model even the long-run behavior of a dynamic economic system. In our system, equation (8) represents the major dynamic driving force of the model.

The system of equations described by (8) and (9) is block recursive with respect to the solution of the CGE model, but is itself a system of simultaneous non-linear equations. In our Stage I model, for example, we solve a simultaneous system for interest rates that clear financial markets under various assumptions. Our Stage III model, however, is recursive within the block.

Some Reflections on Modelling Strategy

The choice of whether a variable is to be included endogenously within the static phase model or within the dynamic phase model represents a major exercise in the art of modelling. The choice clearly depends on the time unit chosen. The shorter the time period, the more important is the dynamic phase relative to the static equilibrium phase. The choice also depends on the modeller's judgment of how behaviorally realistic it is to rely on equilibrium models versus explicit specification of dynamic adjustment behavior. For example, we choose to include rural-urban migration in the dynamic model because we view the process as a "frictional" and hence imperfect adjustment to existing rural-urban income differentials. It would have also been possible to include migration in the static equilibrium model following some variant of the Harris-Todaro approach to specifying an "equlibrium" level of migration.[10] One can also compromise by specifying the dynamic model so that, *ceteris paribus*, it will approach the Harris-Todaro soultion in a sequence of steps over time. The point is that by including a variable in the dynamic phase, one must explicitly specify dynamic responses associated with it. In the static phase, one need not be concerned with how the economy actually reaches equilibrium, but only with the reasonableness of the equilibrium conditions.

IV. Data, Model Estimation, and Validation

The data base in Korea is unusually good and plentiful. The primary

(10) See Harris and Todaro (1970). Ahmed (1974) has estimated and solved a CGE model for Bangladesh incorporating a migration model of the Harris-Todaro type.

data sources used are: national accounts, an input-output table, a capital coefficients table, the census of manufacturing, a survey of the economically active population, a population census, a survey of the financial status of firms, and a special household expenditure survey which also specified the employment status of every household member. Additional specialized data sets employed are: farm management information, retail and wholesale trade census, tax data, flow of funds data, and a world-price survey.

The bulk of the data work consisted of reconciling the information from various sources and years into a mutually consistent social accounting framework. The principle followed was to tie all the flows to the input-output totals for 1968, reconcile them with the national accounts for 1968, and use other sources to break down the relevant totals by firm size, labor categories, household types, etc. Most of the data refer to 1968, but some of the specialized sources were for other years (mostly 1970 or 1972).

Most of the parameters of the model were estimated from the cross-sectional information underlying the data base. Usually, they were ratios or averages scaled to yield the reconciled totals. The major econometric effort was in the derivation of the price and income elastic expenditure functions by each of our fifteen household categories and 29 sectors. Attempts to estimate the production function parameters from time series or cross section data (or combinations of the two) yielded erratic and implausible results at the level of disaggregation (four firm sizes and 29 sectors) required for the model; the production function parameters used were therefore estimated directly from 1968 factor share data, and tested by forecasting and comparing the results with 1970 I-O data. As in most economy-wide planning models, the major estimation effort lay in deriving a consistent data base. Once this was accomplished the estimation process itself was relatively easy.

The model was validated by comparing the model solutions for the endogenous variables with actual data for 1968, 1970 and 1972. The results agree extremely well. For 1968, 95 per cent of the more than 3,000 endogenous variables are within two percentage points of the actual solution. For 1970 and 1972, less detailed comparisons were possible, since less complete data sets were available for these years. However, agreement is still extremely close (see Tables 1-3), and there is no evidence of time drift, even though in updating the model we purposely did not change the input-output

Table 1. Nominal National Income Accounts

	Actual			Basic Run		
	1968	1970	1972	1968	1970	1972
Labor Income	1,068.	1,755.	2,674.	1,098.	1,770.	2,698.
Wages, non-ag.	511.	850.	1,258.	531.	858.	1,256.
Self-employed	214.	348.	546.	219.	320.*	574.*
Agric. Income	343.	557.	870.	348.	592.*	868.
Property Income	184.	293.	370.	185.	292.	367.
Rent	72.	102.	140.	73.	94.*	130.*
Interest	97.	160.	194.	96.	165.	200.
Dividends	15.	30.	36.	16.	33.*	37.
Corporate Savings[a]	36.	45.	85.	39.*	37.**	82.
Direct taxes on Firms	25.	43.	55.	26.	45.	37.**
Govt. Corp. Income[b]	43.	54.	68.	41.	50.*	61.**
Consumer Interest	−8.	−13.	−11.	−8.	−12.*	−18**
National Income	1,349.	2,178.	3,242.	1,381.	2,183.	3,227.

[a] Includes Corporate Transfer Payment:
[b] Net of interest on the public debt (1.81, 4.80, 7.75 respectively).
Source: Actual Accounts: B.O.K., *Economic Statistics Yearbook*, 1975, p.275.
No asterisk: Basic run value differs by less than 5% from the actual value.
* Basic run value differs by 5-10% from the actual value.
** Basic run value differs by more than 10% from the actual value.
Units: billion won.

Table 2. Nominal Domestic Product Accounts

	Actual			Basic Run		
	1968	1970	1972	1968	1970	1972
Private Consumption	1,205.	1,884.	2,844.	1,208.	1,821.	2,746.
Govt. Consumption	175.	282.	438.	172.	281.	441.
Fixed Investment(GDCF)	412.	650.	780.	415.	601.*	693.**
Inventories	16.	54.	25.	19.**	70.**	108.**
Exports	209.	381.	814.	220.*	412.*	830.
Imports(−)	417.	642.	1,013.	416.	557.**	951.*
Statistical Discrepancy	−25.	−32.	−13.	—	—	—
GDP	1,575.	2,577.	3,875.	1,619.	2,628.	3,867.

Source: Actual Accounts: B.O.K. *Economic Statistics Yearbook*, 1975, p.263.
No asterisk: Basic run value differs by less than 5% from the actual value.
* Basic run value differs by 5-10% from the actual value.
** Basic run value differs by more than 10% from the actual value.
Units: billion won.

Table 3. Real Production, 1968 and 1970, by Sectors. Units: Billions Won

Sector	1968		1970	
	Actual	Model	Actual	Model
Cereals	280	286*	339	328*
Other Agric.	299	296	320	333*
Fishery	44	45	47	40**
Proc. Foods	174	172	232	237*
Mining	44	45	50	57**
Textiles	129	134*	156	163*
Finished Text.	109	115**	174	167*
Lumber	42	42	51	54**
Furniture	11	11	10	10
Chem. Intermediate	25	24	41	45**
Chem. Consumer	45	44	114	115
Petrol. Products	40	38	77	78
Coal	29	29	27	32**
Cement	45	45	63	68**
Metal Products	79	78	107	117**
Machinery	22	22	21	21
Elec. Machinery	43	39**	56	50**
Transport Equip.	67	65	76	76
Bev. & Tobacco	100	101	145	127**
Other Consumer	175	172	210	222**
Construction	257	253	344	341
Elec. & Water	41	41	50	58**
Housing	61	60	88	72**
Transport & Comm.	164	165	265	217**
Trade & Banking	332	337	398	413*
Education	54	54	318	291**
Medical	26	26		
Other Services	34	34		
Personal Services	99	99		
Total	2869	2871	3782	3731

Notes: No asterisk means that the model solution value is within 2% of the actual value, or within 2 billion won.

* Solution value differs by 2-5% from the actual value.

** Solution value differs by more than 5% from the actual value.

The 1970 sectoral outputs were deflated using the wholesale price index by sectors adjusted so that the overall index agrees with the implicit GNP deflator.

Sources: Actual from Bank of Korea, Input-Output Tables for 1968 and 1970.

coefficients or the various import coefficients.

After 1972, smooth growth rates are assumed for the exogenous variables in order to allow the model to follow a relatively smooth path so as to show up more clearly the effects of policy experiments. Therefore, the solution of the model does not represent a forecast. Rather it represents a reasonable extrapolation of trends between 1968 and 1972 which is conditional upon the particular choice of export growth, import substitution, labor force growth, expectations, and credit, tax and trade policy regimes.

Growth and Structural Change

The basic solution path assumes continuation of the outwardlooking strategy of export oriented, labour-intensive industrialization and growth. Tables 4-6 present the real national accounts, the rates of growth of various aggregate variables, and some miscellaneous statistics. The rate of growth of GDP starts high and then dips in the middle two periods. The model thus reproduces the actual dip the Korean economy underwent in the period 1970 to 1972. In the latter periods, the economy turns around: the rate of inflation declines, the balance of payments improves and the growth rate of GDP gradually increases. The basic dynamic run thus suggests that in the absence of an oil crisis and a general increase in instability in world markets, South Korea could continue to grow rapidly.

Table 8 presents a very aggregated sources-of-growth analysis for the basic dynamic run. The rate of growth of aggregate productivity (the Residual) is the major source of growth followed by capital and labor. In the model, changes in aggregate productivity can come either from productivity changes in the individual production functions or from changes in the structure of production (either by sector or by firm size). Changes in the structure of production by firm size could result in increasing returns to scale at the sector level.

Tables 9 and 10 detail the changes in the structure of production and employment by firm size, sector, and by skill categories of labor. There are moderate structural changes by sector: Agriculture declines both in employment and output while manufacturing gains. Services increase their share of employment but not of output. Thus there is some shift towards the more productive sectors of the economy.

Table 4. Employment, 1968 and 1970, by Sectors. Units : Thousand Workers

Sector	1968		1970	
	Actual	Model	Actual	Model
Cereals	2307	2381*	2445	2488
Other Agric.	2333	2258*	2181	2122*
Fishery	216	225*	178	150**
Proc. Foods	186	182*	188	208**
Mining	111	112	109	98**
Textiles	156	170**	145	191**
Finished Text.	189	209**	227	205**
Lumber	37	40**	34	54**
Furniture	31	34**	21	27**
Chem. Intermediate	11	11	14	20**
Chem. Consumer	33	31	62	83**
Petrol. Products	3	2	4	4
Coal	19	18	14	13
Cement	53	53	57	59
Metal Products	68	65*	69	61*
Machinery	41	40	29	21**
Elec. Machinery	40	32**	39	22**
Transport Equip.	53	50**	45	35**
Bev. & Tobacco	43	45	48	23**
Other Consumer	215	206*	194	263**
Construction	290	286	329	320*
Elec. & Water	15	15	16	19**
Housing	6	6	8	7
Transport & Comm.	232	232	320	340**
Trade & Banking	1044	1049	1131	1064**
Education	229	228	1082	1022**
Medical	95	96		
Other Services	147	147		
Personal Services	377	375		
Total	8582	8600	8989	8923

Notes: No asterisk means the model solution value is within 2% of the actual value or within 2 thousand workers.

* Solution value differs by 2-5% from the actual value.

** Solution value differs by more than 5% from the acutal value.

The 1970 sectoral employments were adjusted so that total employment agrees with the 1970 survey of the economically active population. To make them comparable with the model solution, the employments are given net of government workers and recipients of property income.

Table 5. Basic Dynamic Run: Real National Accounts

Category	Billions of won (1968 prices)					Percentage shares				
	Year1	Year3	Year5	Year7	Year9	Year 1	Year 3	Year 5	Year 7	Year 9
Private consumption	1,212	1,481	1,891	2,186	2,821	75.1%	70.5%	70.6%	66.8%	65.9%
Government consumption	173	228	304	381	527	10.7	10.9	11.3	11.6	12.3
Total investment	435	546	552	618	889	26.9	26.0	20.6	18.9	20.8
Exports[a]	211	294	583	924	1,503	13.1	14.0	21.8	28.2	35.1
Imports(−)[a]	417	449	651	834	1,460	25.8	21.4	24.3	25.5	34.1
Gross domestic product	1,615	2,100	2,679	3,275	4,280	100.0%	100.0%	100.0%	100.0%	100.0%
Wages	533	698	865	1,077	1,665	38.5%	39.3%	38.9%	39.7%	46.1%
Self-employed	219	260	395	535	780	15.8	14.6	17.8	19.7	21.6
Agricultural income	350	482	598	627	576	25.2	27.1	26.9	23.1	16.0
Property income	186	238	253	278	315	13.4	13.4	11.4	10.2	8.7
Other	99	97	112	198	276	7.1	5.5	5.0	7.3	7.6
National income	1,387	1,775	2,223	2,715	3,612	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Some columns in this table and others in the article do not total because of rounding.
[a] Valued in world prices.

Table 6. Basic Dynamic Run: Annual Real Rates of Growth of Selected Variables

(Percent)

Variable	Years:			
	1 to 3	3 to 5	5 to 7	7 to 9
Total consumption	11.1%	13.3%	8.1%	14.2%
Investment	12.0	0.5	5.8	19.9
Exports	18.0	40.8	25.9	27.5
Imports	7.7	20.4	13.2	32.3
Gross domestic product	14.0	12.9	10.6	14.3
Wages	14.4	11.3	11.6	24.3
Self-employed	9.0	23.3	16.4	20.7
Agricultural income	17.4	11.4	2.4	−4.2
Property income	13.1	3.1	4.8	6.4
National income	13.1	11.9	10.5	15.3
Gross output	14.0	14.1	11.2	14.5
Wholesale price index	11.4	9.5	11.0	5.6

Table 7. Basic Dynamic Run: Miscellaneous Rates and Indexes

	Year 1	Year 3	Year 5	Year 7	Year 9
Incremental capital output ratio[a]	—	2.0	1.9	2.0	1.5
Household savings rate	1.5%	4.2%	4.3%	5.8%	6.1%
Household average direct tax rate	4.6%	5.1%	4.3%	5.5%	8.1%
Agricultural terms of trade	99.7	121.3	123.4	108.5	87.3
Wholesale price index	99.7	123.7	148.2	182.7	203.9

[a]Defined as gross investment for the preceding two years divided by the change in GDP, in real terms. Investment for the two years is assumed to be twice the average of the current value and the value two years earlier.

Table 8. Basic Dynamic Run: Analysis of Growth

	Years:			
	1 to 3	3 to 5	5 to 7	7 to 9
Rate of growth(%)				
Gross domestic product	14.0	12.9	10.6	14.3
Capital	18.3	6.0	4.8	4.9
Labor	1.9	3.0	3.1	3.1
Growth elasticities (% shares)				
Capital	31.2	30.0	31.5	35.2
Labor	68.8	70.0	68.5	64.8
Contribution to growth (percentage points)				
Capital	5.7	1.8	1.5	1.7
Labor	1.3	2.1	2.1	2.0
Residual	7.0	9.0	7.0	10.6
Contribution to growth (percent shares)				
Capital	40.7	13.9	14.2	11.9
Labor	9.3	16.3	19.8	14.0
Residual	50.0	69.8	66.0	74.1

Table 9. Structure of Production and Employment by Aggregate Sectors

	Production Shares(%)			Employment Shares(%)		
	YR 1	YR 5	YR 9	YR 1	YR 5	YR 9
Agriculture	20.3	16.2	13.7	53.9	50.9	49.4
Food, Beverages & Tobacco	11.0	10.9	10.4	5.2	3.8	3.3
Shelter & Transport	23.9	24.4	23.6	8.0	8.4	6.5
Manufacturing	25.7	29.4	32.3	10.8	12.3	14.8
Services	19.1	19.1	20.0	22.1	24.6	26.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 10. Production by Firm and Farm Size and Employment by Skiil Categories

	Shares(%)					
	YR 1		YR 5		YR 9	
Production						
Within Agricultural sectors						
Farm Size 1	16.8		16.7		16.5	
Farm Size 2	28.2		27.1		25.9	
Farm Size 3	41.9		40.3		40.3	
Farm Size 4	13.1		15.9		17.4	
Total agricultural sectors		20.3		16.2		13.7
Within Non-Agricultural sectors						
Self Employed Firms	15.2		14.8		14.8	
Small Firms	23.2		18.0		18.8	
Medium Firms	23.5		21.9		22.1	
Large Firms	38.2		45.3		44.3	
Total non-agricultural sectors		79.7		83.8		86.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Employment						
Agriculture	54.0		50.9		49.4	
Self Employed in Manufacturing	2.0		2.1		2.0	
Self Employed in Service	11.8		11.1		19.3	
Skilled & Unskilled Workers	22.5		25.0		26.7	
Engineers & Technicians & White Collar	9.7		10.9		11.6	
Total	100.0		100.0		100.0	

Table 11. Basic Dynamic Run: Distribution of Real Household Income

Decile	Percent Shares			Mean Income (thousands of won)		
	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9
1	2.22%	2.07%	1.68%	44	57	68
2	3.62	3.47	2.99	72	96	122
3	4.67	4.52	4.06	92	125	165
4	5.71	5.56	5.16	113	154	210
5	6.86	6.72	6.36	135	186	258
6	8.21	8.10	7.78	162	224	316
7	9.94	9.88	9.61	196	273	390
8	12.38	12.42	12.99	244	344	499
9	16.46	16.73	17.06	325	463	693
10	29.92	30.52	33.01	591	844	1,341
Gini coefficient	.398	.409	.444			

There is also some change in the structure of production by firm size. Large farms gain relative to small farms and the largest firm size also gains relative to the small and self-employed. There is thus some shifting in favor of the more productive firm and farm sizes.

In the structure of the labor force there is shifting out of agriculture and in favor of the more highly skilled categories of labor. Agriculture's share of the labor force declines by 4.6 percentage points or about half a percentage point a year. This rate of transfer is large when compared to the rates in other less developed countries.[11] Structural change has clearly contributed to model growth. Clearly, such changes are more important in the long run but they are nonetheless significant even in a nine year period.

Distribution of Income

In the basic dynamic run, the decile distribution of real household income deteriorates through time at a slow but steady rate. Tables 11 to 14 give the relevant statistics. The share of income accruing to the lower quintile drops from 5.84 to 4.67 percent in nine years while the share accruing to the top decile rises from 29.92 to 33.01 percent. Part of the deterioration is due to the divergence over time of the mean incomes of different household categories. For example, the ratio of capitalist income to agricultural labor income rises from 11.4 to 17.3, and the percent of the log variance of total household income due to between group variances rises from 35.1 percent to 48.7 percent. Part of the deterioration in distribution is due to increasing variance of urban incomes, and part is due to the deterioration of the agricultural terms of trade after import substitution possibilities in grains are exhausted (in 1972). As a result, after 1972 rural incomes rise less rapidly than urban incomes and the gap between rural and urban incomes increases.

The deterioration in distribution leads to a substantially lower rate of growth of absolute incomes in the lowest quintile than in the upper decile. While the real incomes of the poorest decile are rising at 5.7 percent a year, those of the richest decile are rising at 9.6 percent. Thus the rich gain overwhelmingly more than the poor from high average growth rates, both relatively and absolutely. Even so, the rise in the absolute incomes of

(11) See Robinson (1972).

the poorest quintile leads to a dramatic reduction in the percentage of households with incomes below a fixed absolute poverty level. The share of households with real incomes less than 120 thousand won per year falls from 38.2 percent to 14.5 percent. However, just as the Gini coefficient is insensitive to changes in the distribution, the share of the population below a fixed poverty line is a measure which tends to be oversensitive to any shift in the distribution.

The composition of the poor and rich is given in Tables 13 and 14. By the end of the period, the overwhelming majority of the poor are in agriculture (over 70 percent). Just over 80 percent agricultural labor and over a third of small farms are below the poverty line. By contrast, at the start of the period, the incidence of poverty was equally spread between urban and rural groups, with urban poor accounting for about 50 percent of the total.

The group composition of the deciles is quite sensitive to the agricultural terms of trade. For example, in year five (1972), when agricultural terms of trade rose to 123, rich farmers accounted for almost a quarter of the households in the upper five percent of the distribution, while in the last period when the terms of trade are 87, they are 3 percent.

The eventual worsening of the terms of trade in the basic run is due almost entirely to changes in the structure of demand. As can be seen from Table 9, the share of agriculture in total output declines over time. The demand for agricultural goods clearly declines even faster, essentially for three reasons. First, the income elasticity of demand for agricultural goods is quite small for virtually all the groups. It is less than one for all groups except for the demand for "other agriculture" (sector 2) by agricultural labor and the smallest two farm sizes. Thus, as incomes rise, the demand for agricultural goods falls relatively. Second, the worsening distribution transfers income away from groups such as agricultural workers who consume relatively more agricultural goods towards the richer groups whose share (and income elasticity) is lower. The effect of this shift is quite large because the worsening relative distribution leads to large absolute income transfers to the rich. Third, migration and upgrading of skills moves people out of groups with relatively high consumption shares of, and income elasticities of demand for, agricultural goods and into groups with lower shares

and demand elasticities. The net result of these shifts is a rather dramatic shift in demand away from agricultural products. All groups except the self employed actually consume less agricultural goods per household in the final period than they did in the first period, although it should be noted that all groups consume significantly more processed food.

Summary

The basic dynamic run thus implies improving growth performance coupled with a steady worsening of the distribution of income. In deciding on the basic dynamic run, we experimented with a number of different sets of reasonable projections for the exogenous variables. All the projection we tried implied the same qualitative performance, and we chose the configuration which appeared most realistic and involved the least worsening in the distribution of income over time. The fact that the basic dynamic solution yields a combination of overall rapid growth and a deterioration in the size distribution is consistent with the cross-section findings of Adelman and Morris.[12]

V. Some Counterfactual Experiments

Introduction

This section is exploring the effect upon poverty and income distribution of alternative development strategies. The basic solution involves a rapid growth, labor intensive, export oriented industrialization development strategy. We have simulated, for comparison, the growth path under alternative strategies: an import-substitution strategy and a slower growth strategy. The experiments are rather pure in that only a few parameters are changed in each one to achieve the desired policy configuration. The statistical results are given in Tables 15 to 20.

Slower Growth Experiments

Description:

Slower growth is achieved by reducing the rate of growth of productivity

(12) See Adelman and Morris (1973).

by 1.5 percent a year. There are two versions of the experiment. In the first (Slow Growth 1), the rate of growth of productivity is lowered uniformly in all sectors. In the second (Slow Growth 2), the rate of growth of productivity in the two agricultural sectors is *not* lowered.

Results:

Both versions lower real outputs. In year 9, total output is 21 percent lower than in the basic run for the first version and 12 percent lower in the second version. The effect on GDP and national income is similar. There are no major shifts in the structure of employment and production. Real investment is significantly higher in the second version, largely because the inflation rate is lower. The unanticipated lower inflation causes investors who set their nominal investment demands in Stage 1 to receive more real investment when they spend the nominal amounts in Stage 2. The balance of trade is similar in the two versions.

On the income side, the differences between the two versions are striking. Agricultural income falls from 22 percent of national income in year 9 in the first version to 5 percent in the second (compared to 16 percent in the basic run). The reason is the dramatic difference in the terms of trade. In the first version, in year 9 the terms of trade are 120 while in the second they are 29! In the first, agriculture's share of total production is 13 percent while in the second it is 16 percent. A shift of 3 percentage points in relative supplies causes an 91 percentage point shift in relative prices.

The reason for the sensitivity of the terms of trade to shifts in relative supplies is rooted in the nature of the demand for agricultural goods. First, the demand for agricultural goods is price inelastic so large changes in prices are required to achieve moderate changes in demand, given incomes. Second, the demand for agricultural goods is income elastic. Thus, as groups become richer they demand significantly fewer agricultural goods. Impact effects that raise group incomes will decrease the relative demand for agricultural goods. Third, the demand for agricultural goods is sensitive to the distribution if income among groups. In general, rural groups spend a larger share of their incomes on agricultural goods so any effect that transfers income to urban groups will cause a decline in the demand for agricultural goods.

The first and third effects interact in a destabilizing manner. An initial

Table 12. Basic Dynamic Run: Mean Real Household Incomes by Group

(Thousands of won)

Household category	Year 1	Year 5	Year 9
Wage earners			
Engineers	504	514	713
Technicians	266	346	649
Skilled workers	143	185	337
Apprentices	102	139	275
Unskilled workers	146	185	280
White-collar workers	295	396	715
Government workers	203	242	369
Self-employed			
1. Manufacturing	198	258	571
2. Services	241	420	912
Capitalists	777	1072	1507
Agriculture			
Laborers	68	89	87
Farm size 1	116	166	162
Farm size 2	143	209	202
Farm size 3	258	379	351
Farm size 4	415	707	685
Average	202	283	418

Table 13. Basic Dynamic Run: Composition of the Poor

Household Category	Group's share of total poor population			Percentage of group in poor population		
	Year 1	Year 5	Year 9	Yeal 1	Year 5	Year 9
Wage earners						
Engineers	0.0	0.0	0.0	0.2	0.7	0.1
Technicians	0.9	1.1	0.4	20.6	14.3	3.1
Skilled workers	12.3	12.2	1.3	43.7	24.3	1.5
Apprentices	0.3	0.5	0.2	71.9	47.1	4.6
Unskilled workers	12.9	19.4	16.1	51.4	40.5	19.7
White-collar workers	4.5	4.2	0.8	17.3	8.9	1.0
Government workers	8.6	11.9	8.9	34.1	25.3	10.1
Self-employed						
1. Manufacturing	3.0	3.2	1.8	38.3	20.4	6.9
2. Services	7.6	2.6	0.2	23.9	6.2	0.4
Capitalists	0.0	0.0	0.0	1.0	0.3	0.1

Agriculture						
Laborers	14.6	19.1	29.1	91.4	80.0	81.2
Farm size 1	18.1	15.2	23.9	63.0	35.5	37.2
Farm size 2	15.3	9.9	16.1	46.3	20.2	22.0
Farm size 3	2.0	0.6	1.3	8.5	1.5	2.2
Farm size 4	0.0	0.0	0.0	0.2	0.0	0.0
All categories combined	38.3%	23.2%	14.5%			

Note: The poor are defined as those households whose annual incomes are less than 120,000 won.

Table 14. Basic Dynamic Run: Composition of the Rich (Top 5 Percent)

Household Category	Group's share of total rich households			Percentage of group in rich households		
	Year 1	Year 5	Year 9	Year 1	Yeal 5	Year 9
Wage earners						
Engineers	2.9%	1.5%	0.9%	43.3%	17.1%	12.7%
Technicians	3.0	2.7	4.2	10.9	8.1	13.0
Skilled workers	0.3	0.1	0.3	0.2	0.1	0.1
Apprentices	0.0	0.0	0.0	0.0	0.0	0.0
Unskilled workers	2.5	2.3	1.9	1.5	1.1	0.9
White-collar workers	23.5	22.3	31.2	14.1	10.7	15.0
Government workers	8.5	5.1	5.4	5.3	2.5	2.4
Self-employed						
1. Manufacturing	2.8	1.9	6.9	5.6	2.7	10.5
2. Services	16.8	21.8	31.4	8.2	11.9	25.1
Capitalists	21.4	19.7	14.8	62.1	57.1	51.8
Agriculture						
Laborers	0.0	0.0	0.0	0.0	0.0	0.0
Farm size 1	0.2	0.2	0.0	0.1	0.1	0.0
Farm size 2	0.8	0.6	0.0	0.4	0.3	0.0
Farm size 3	8.5	8.3	0.5	5.6	5.0	0.3
Farm size 4	8.8	13.5	2.5	27.0	37.7	7.2
Mean real income (thousands of won)	720	1070	1692			

Table 15. Strategies Experiments
Real National Accounts, Production, Employment, and Miscellaneous

Category	Basic dynamic run			Slow growth 1			Slow growth 2			Import Substitution		
	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9	Year 1	Yeal 5	Year 9	Year 1	Year 5	Year 9
National accounts[a]												
Wages, nonagricultural	533	865	1665	533	667	1073	533	831	1542	506	853	1843
Self-employed income	219	395	780	219	336	560	219	371	675	214	387	761
Agricultural income	350	598	576	350	625	588	350	465	132	342	516	258
Property income	186	253	315	186	231	239	186	241	265	177	238	281
National income	1387	2223	3612	1387	1969	2725	1387	2032	2927	1344	2123	3443
Gross domestic product accounts[a]												
Consumption	1385	2195	3348	1385	1959	2494	1385	1998	2656	1327	2050	3040
Investment	435	552	889	435	509	684	435	556	861	403	537	861
Exports[b]	211	583	1503	211	500	1100	211	540	1336	190	524	1284
Imports[b]	417	651	1460	417	552	932	417	610	1230	317	503	1070
GDP	1615	2679	4280	1615	2416	3346	1615	2485	3623	1602	2608	4115
Wholesale price index	99.7	148.2	203.9	99.7	166.2	313.9	99.7	151.8	127.4	108.0	161.6	225.2
Agricultural terms of trade	99.7	123.4	87.3	99.7	151.9	119.9	99.7	96.2	28.9	97.2	107.1	45.3
Exchange rate[c]	.277	.387	.438	.277	.387	.506	.277	.387	.462	.277	.387	.447
Production[d]												
Agriculture	581	788	1081	581	678	796	581	787	1072	581	781	1065
Food, beverages, and tobacco	318	530	821	318	439	597	318	502	746	316	529	837
Shelter and transportation	685	1185	1867	685	1080	1481	685	1099	1610	656	1122	1760
Manufacturing	738	1430	2533	738	1298	2154	738	1302	2220	764	1503	2782
Services	550	926	1576	550	842	1232	550	835	1281	542	888	1520
Total	2871	4859	7877	2871	4337	6260	2871	4526	6930	2859	4824	7964
Employment[e]												
Agriculture	4639	4823	5286	4639	4823	5265	4639	4821	5282	4639	4824	5279
Food, beverages, and tobacco	542	361	348	452	344	335	452	395	415	433	368	348
Shelter and transportation	687	799	700	687	792	614	687	775	650	654	731	617
Manufacturing	928	1159	1574	928	1223	1839	928	1214	1732	978	1258	1729
Services	1894	2332	2785	1894	2293	2626	1894	2269	2615	1896	2296	2716
Total	8600	9475	10694	8600	9475	10678	8600	9475	10694	8600	9477	10689
Migration[e]	237	245		237	245		237	245		237	245	

(a) In billions of won, 1968 base price (b) In billions of won, valued in world prices (c) At 1,000 won to the U.S. dollar
(d) Gross production in billions of won, real terms, 1968 base prices (e) Thousands of workers

Table 16. Strategies Experiments
Total Production, Year 9 as a Percent of Basic-Run Values

Sector	Basic Dynamic Run[a]	Slow Growth 1	Slow Growth 2	Import Substitution
1. Rice, barley, and wheat	475	73%	101%	98%
2. Other agriculture	606	74	98	99
3. Fishing	37	62	57	81
4. Processed foods	503	76	94	104
5. Mining	129	87	88	100
6. Textiles	409	89	88	103
7. Finished textile products	550	86	92	93
8. Lumber and plywood	46	113	109	100
9. Wood products and furniture	5	80	80	100
10. Basic chemical products	100	80	92	111
11. Other chemical products	351	82	86	101
12. Petroleum products	155	81	78	86
13. Coal products	45	80	69	84
14. Cement, nonmetallic mineral products	123	78	87	94
15. Metal products	165	84	90	152
16. Nonelectrical machinery	30	90	100	197
17. Electrical machinery	150	73	82	157
18. Transport equipment	123	85	87	123
19. Beverages and tobacco	281	68	90	100
20. Other consumer products	526	87	83	107
21. Construction	507	75	86	86
22. Electricity and water	132	81	86	100
23. Real estate	105	71	85	87
24. Transportation and communication	749	81	87	101
25. Trade and banking	821	81	82	96
26. Education	239	67	85	106
27. Medical services	80	70	76	100
28. Other services	151	79	86	94
29. Personal services	285	82	76	89
Total	7877	79%	88%	101%

[a] Gross production in billion of won, real terms, 1968 base prices.

decline in the terms of trade leads to a decrease in rural incomes and a relative increase in urban incomes. This shift income to urban groups who tend to spend a lower share of their income on agricultural goods. This decline in demand leads, in turn, to a fall in the prices of agricultural goods and so to a second round worsening in the terms of trade. The spiral

stops when the relative price falls enough to induce the necessary increase in demand despite the change in distribution.

The effects of changes in the terms of trade on the distribution are dramatic and can be seen in Tables 18 and 19. When the terms of trade move against agriculture, the extent of poverty increases catastrophically since rural households are initially much poorer than urban ones. The overall relative distribution also deteriorates. The Gini coefficient in year 9 for the first version is .402 compared to .542 for the second (and to .445 for the basic run). The general shape of the distribution changes dramatically. The overall mean income in the first version is 70 percent of that in the second version and 68 percent of the basic run; the mean income of the top decile in the first version is 58 percent of that in the second version and 63.7 of the basic run; and the mean income of the bottom decile is 235 percent of that in the second version and 82 of the basic run.

In conclusion, how much slower growth would have deteriorated welfare depends upon the source of the slower growth. A balanced reduction in growth, evenly shared across producing sectors, would have improved the distribution and increased poverty much less than slower growth achieved by reducing growth incentives in the urban sector (or the industrial sector). The latter would have led to a significant worsening of the overall distribution, increased empoverishment of rural households, and hence much lower incomes of the poor and much higher percentages of poor households.

Import Substitution Strategy

Description:

This strategy was modelled by lowering the import coefficeients by 20 percent initially and also by increasing the degree of import substitution over time by further adjustments in Stage III.

Results:

The effects generally claimed for import substitution are quite evident in the present experiment: slower growth of GDP, higher rate of inflation, and a better balance of trade (by 171 billion won in year 9). There are also 9 percent fewer consumer goods, the value added ratio for the aggregate economy is 2 percent lower, production in manufacturing is more capital intensive and more devoted to producer goods. The capital stock in manu-

facturing is 14 percent larger and the share of manfacturing production in large firms is higher (60 percent compared to 40 percent in the basic run). There is 10 percent less investment overall, although manufacturing investment is greater.

The effects on production lead to a large change in the structure of prices (see Table 17). The price of manufacturing goods is 30 percent higher than in the basic run, but that of agricultural goods is 37 percent lower. The terms of trade move strongly against farmers (falling to 45 compared to 87 in the basic run). The changes in the terms of trade are responsible

Table 17. Strategies Experiments
Price Indexes, Year 9

Category	Basic dynamic run	Slow Growth 1	Slow Growth 2	Import Substitution
Agriculture	183	362	73	115
Food and beverages	175	263	175	180
Shelter and transportation	203	283	242	241
Manufacturing	219	322	285	284
Services	224	320	273	270
Total	204	314	217	225
Terms of trade (ratio)				
Agriculture to nonagriculture	87	120	29	45
Food to nonfood items	84	106	41	52

Note: All indexes use total production weights. 1968=100

Table 18. Strategies Experiments
Decile Distribution of Real Household Income

Decile	Basic dynamic run			Slow growth 1			Slow growth 2			Import Substitution		
	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9
	%	%	%	%	%	%	%	%	%	%	%	%
1	2.22	2.07	1.68	2.22	2.09	2.02	2.22	2.03	0.61	2.22	2.04	0.97
2	3.62	3.47	2.99	3.62	3.50	3.56	3.62	3.45	1.18	3.64	3.47	1.85
3	4.67	4.52	4.06	4.67	4.55	4.69	4.67	4.53	1.92	4.70	4.55	2.79
4	5.71	5.56	5.16	5.71	5.60	5.78	5.71	5.60	3.28	5.75	5.62	4.02
5	6.86	6.72	6.36	6.86	6.77	6.93	6.86	6.78	5.42	6.89	6.79	5.62
6	8.21	8.10	7.78	8.21	8.16	8.24	8.21	8.16	7.76	8.24	8.16	7.51
7	9.94	9.88	9.61	9.94	9.95	9.90	9.94	9.92	10.29	9.96	9.92	9.78
8	12.38	12.42	12.29	12.38	12.49	12.25	12.38	12.40	13.54	12.39	12.41	12.89
9	16.46	16.73	17.06	16.46	16.73	16.30	16.46	16.59	18.90	16.45	16.64	18.28
10	29.29	30.52	33.01	29.92	30.16	30.33	29.92	30.55	37.10	29.75	30.40	36.29
Gini Coefficient	.398	.409	.444	.398	.406	.402	.398	.409	.542	.396	.408	.511

Table 19. Strategies Experiments

Mean Group Income as a Percent of Basic-Run Values

Household Category	Basic dynamic run[a]			Slow growth 1			Slow growth 2			Import Substitution		
	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9
Wage earners												
Engineers	504	514	713	100%	75%	61%	100%	103%	110%	96%	104%	122%
Technicians	266	346	649	100	72	53	100	101	103	100	105	126
Skilled workers	143	185	337	100	76	67	100	115	134	99	114	139
Apprentices	102	139	275	100	77	67	100	114	131	99	113	137
Unskilled workers	146	185	280	100	73	60	100	108	125	94	103	126
White-collar workers	296	396	715	100	69	51	100	96	100	96	102	126
Government workers	203	242	369	100	84	69	100	102	111	95	98	113
Self-employed												
1. Manufacturing	198	258	571	100	73	62	100	113	128	95	115	132
2. Services	241	420	912	100	72	60	100	99	102	99	100	113
Capitalists	777	1072	1507	100	86	67	100	104	113	96	99	114
Agriculture												
Laborers	68	89	87	100	97	93	100	85	35	98	91	60
Farm size 1	116	166	162	100	102	109	100	83	30	99	91	56
Farm size 2	143	209	202	100	99	99	100	83	29	100	91	56
Farm size 3	258	379	351	100	95	89	100	82	29	98	89	53
Farm size 4	415	707	685	100	89	77	100	81	28	100	88	54
Average	202	283	418	100%	83%	68%	100%	96%	97%	97%	98%	110%

(a) Average real incomes of groups in thousands of won.

Table 20. Strategies Experiments

Analysis of Poverty (Percent composition of households with real incomes of less than 120,000 won)

Household Category	Basic dynamic run			Slow growth 1			Slow growth 2			Import Substitution		
	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9	Year 1	Year 5	Year 9
Wage earners												
Engineers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Technicians	0.9	1.1	0.4	0.9	1.4	1.0	0.9	0.9	0.1	0.8	0.9	0.1
Skilled workers	12.3*	12.2	1.3	12.3*	17.2*	5.0	12.3*	7.6	0.1	12.1*	8.0	0.1
Apprentices	0.3**	0.5*	0.2	0.3**	0.6**	0.5	0.3**	0.4*	0.0	0.3**	0.4*	0.0
Unskilled workers	12.9*	19.4*	16.1	12.9*	20.6*	23.5*	12.9*	16.2*	3.5	13.3*	18.2*	5.2
White-collar workers	4.5	4.2	0.8	4.5	7.1*	4.9	4.5	4.0	0.3	4.5	3.8	0.2
Government workers	8.6*	11.9	8.9	8.6*	11.7	12.5	8.6*	10.6	2.7	9.0*	12.1	3.8
Self-employed												
1. Manufacturing	3.0*	3.2	1.8	3.0*	4.7*	5.3	3.0*	3.2	1.2	3.2*	3.1	1.0
2. Services	7.6	2.6	0.2	7.6	3.8	0.9	7.6	2.6	0.1	7.6	2.7	0.1
Capitalists	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Agriculture												
Laborers	14.6**	19.1**	29.1**	14.6**	14.3**	19.8**	14.6**	19.4**	15.2**	14.3**	19.8**	20.7**
Farm size 1	18.1*	15.2*	23.9*	18.1*	10.6	13.7	18.1*	19.4*	26.8**	17.8*	17.8*	30.7**
Farm size 2	15.3*	9.9	16.1	15.3*	7.3	11.3	15.3*	14.3	29.8**	14.9	12.3	28.9*
Farm size 3	2.0	0.6	1.3	2.0	0.5	1.6	2.0	1.3	19.3	2.1	1.0	9.4
Farm size 4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.1
Percent <90,000 won	23.8%	12.8%	8.0%	23.8%	18.7%	12.3%	23.8%	14.3%	28.7%	24.7%	13.4%	16.8%
Percent <120,000 won	38.3%	23.2%	14.5%	38.3%	31.3%	21.6%	38.3%	24.9%	33.9%	39.4%	23.6%	24.0%
Mean incomes (thousands of won)												
Bottom decile	43.8	57.3	68.3	43.8	48.2	56.1	43.8	53.8	23.9	42.8	55.6	43.2
Next decile	71.5	96.0	121.5	71.5	80.6	98.6	71.5	91.5	46.2	70.2	94.3	82.6
Top decile	591.0	844.0	1341.4	591.0	694.3	840.5	591.0	810.8	1446.0	573.0	827.0	1620.8
Overall	202.2	283.1	418.1	202.2	235.3	284.5	202.2	272.0	403.8	197.1	278.5	461.6

Notes: No asterisk: share represents less than 1/3 of group population; single asterisk, 1/3 to 2/3 of group population; double asterisk, more than 2/3 of group population.

for the major changes in the overall distribution that are observed.

The import substitution strategy is vicious in its effects both on the overall distribution and on the extent of poverty. See Tabls 18 and 19. By year 9, the income share of the bottom decile is 42 percent lower than in the basic run while that of the top decile is 10 percent higher. The share of households in poverty rises to 24 percent, 66 percent more households in poverty than in the basic run. The strategy is also one sided—it benefits urban workers, especially the more highly skilled and empoverishes the already poor rural households. Rural incomes are about 45 percent lower than in the basic run. Over 60 percent of the two smallest farm sizes and 95 percent of agricultural labor have incomes below the poverty line.

The experiment probably understates the detrimental distributive effects of the policy as well as the degree of allocative inefficiency associated with import substitution. The way in which the policy is "implemented" in the experiment does not yield any special benefits to owners of factors of production. In the real world, however, import substitution policies are usually implemented by means of policies such as price subsidies, high tariff protection, and investment subsidies which tend to benefit urban capitalists directly, and lead to a more unequal distribution within the urban sector.

All in all, the import substitution strategy has little to recommend it on either growth or distribution criteria.

VI. Conclusion

Our experiments illustrate the usefulness of CGE models for policy analysis. Despite the size and complexity of our model, the results are readily understandable, and permit the examination of the likely consequences of policy intervention in great detail.

It appears from the experiments that the actual growth strategy chosen by South Korea was a fortunate one. It led to substantially better growth and less absolute poverty. It also probably lead to a better distribution since, in practice, slow growth would have been implemented by reducing the pressure on (and incentives to) the urban manufacturing sector to produce and to export. The results would probably have been similar to those of the second variant of the slow growth experiment (Slow Growth 2).

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