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Chapter 8

Macroeconomic Relationships and Commercial Policy Variables

In this chapter we use an econometric model to test a number of hypotheses about the effects of commercial policy variables on macroeconomic behavior. Some other relationships are investigated such as the interest rate elasticity of savings and foreign capital imports. The basic model derived in this chapter is used in the next chapter to determine by simulation techniques the effect of commercial policy variables on the growth of the economy.

THE BASIC MODEL

In matrix form, the basic model can be expressed as follows:

$$B \cdot \psi_t + \Delta\psi_{t-\tau} + \Gamma_1\phi_{1t} + \Gamma_2\phi_{2t} + \Gamma_3\phi_{3t} + e_t = 0 \qquad (8\text{–}1)$$

where B is a square matrix, ψ_t is a column vector of endogenous variables, $\psi_{t-\tau}$ is a column vector of lagged endogenous variables, ϕ_{1t}, ϕ_{2t}, and ϕ_{3t} are each vectors of exogenous variables, e_t is a column vector of error terms, and Γ_1, Γ_2, Γ_3 and Δ are matrixes. The exogenous variables ϕ_{1t} are called *basic* commercial policy variables; ϕ_{2t} are *derived* commercial policy variables, and ϕ_{3t} are other exogenous variables.

The endogenous variables of the system are described in Table 8–1. All of them are measured in terms of constant 1965 won. The exogenous variables are shown in Table 8–2 and except for rates and ratios, population, and dummy variables, all are shown in terms of 1965 constant won. Tables 8–3 and 8–4 show the matrix structure of the basic model expressed in equation

TABLE 8–1

Endogenous Variables of the Model

$\psi_{1,t} = YNA_t$:	Nonagricultural value added
$\psi_{2,t} = Y_t$:	Gross national product
$\psi_{3,t} = DTR_t$:	Direct tax revenues
$\psi_{4,t} = INT_t$:	Indirect tax revenues, excluding customs duties
$\psi_{5,t} = SG_t$:	Government savings
$\psi_{6,t} = GC_t$:	Grain consumption
$\psi_{7,t} = IVG_t$:	Investment in grain inventories
$\psi_{8,t} = MG_t$:	Imports of grain
$\psi_{9,t} = ILG_t$:	Level of grain inventories
$\psi_{10,t} = SC_t$:	Corporate savings
$\psi_{11,t} = YDP_t$:	Disposable income of households
$\psi_{12,t} = SH_t$:	Household savings
$\psi_{13,t} = INA_t$:	Nonagricultural gross fixed investment
$\psi_{14,t} = I_t$:	Total gross fixed investment
$\psi_{15,t} = CK_t$:	Foreign commercial loans
$\psi_{16,t} = DC_t$:	Consumption expenditures
$\psi_{17,t} = MC_t$:	Imports of consumption goods
$\psi_{18,t} = MK_t$:	Imports of capital goods
$\psi_{19,t} = XGM_t$:	Manufactured exports
$\psi_{20,t} = X_t$:	Total export of goods
$\psi_{21,t} = MI_t$:	Imports of intermediate goods
$\psi_{22,t} = M_t$:	Total import of goods
$\psi_{23,t} = SK_t$:	Short-term capital movements and changes in foreign reserves
$\psi_{24,t} = IV_t$:	Inventory investment

(8–1). To facilitate discussion of the model the endogenous variables (and therefore equations of the model) are separated into six groups. Group 1 contains two equations, one of which determines nonagricultural output and an identity which involves the determination of total GNP. Group 2 contains three equations relating to direct and indirect tax revenues and government savings. Group 3 contains four equations relating to grain consumption, grain imports, and grain inventories. Group 4 involves equations for household savings, corporate savings, fixed investment, foreign loans, and domestic consumption. Group 5 contains five equations relating to exports, imports, and short-term capital movements. Group 6 contains two identities, one concerning the balance of payments and the other concerning savings and investment.

TABLE 8–2

Exogenous Variables of the Model

Basic commercial policy variables		
$\phi_{1,1,t}$	$= ORD_t$	Official exchange rate on purchasing-power-parity basis
$\phi_{1,2,t}$	$= XPX_t$	Export premium per dollar of exports
$\phi_{1,3,t}$	$= SOX_t$	Subsidies per dollar of exports
$\phi_{1,4,t}$	$= TAM_t$	Tariffs and foreign exchange tax per dollar of imports
Derived commercial policy variables		
$\phi_{2,1,t}$	$= XPM_t$	Export premia per dollar of imports
$\phi_{2,2,t}$	$= SUBM_t$	Tariffs and tariff equivalents per dollar of imports
$\phi_{2,3,t}$	$= SUBX_t$	Subsidies and subsidy equivalents per dollar of exports
$\phi_{2,4,t}$	$= SXDT_t$	Total subsidies on exports in the form of internal tax relief
$\phi_{2,5,t}$	$= TAR_t$	Total tariffs and foreign exchange taxes
$\phi_{2,6,t}$	$= MARDEV_t$	Average rate of devaluation averaged over current year and the two previous years
Other exogenous variables		
$\phi_{3,1,t}$	$= YA_t$	Agricultural value added
$\phi_{3,2,t}$	$= G_t$	Current government expenditures
$\phi_{3,3,t}$	$= IA_t$	Investment in agriculture
$\phi_{3,4,t}$	$= PK_t$	Government capital improvements
$\phi_{3,5,t}$	$= NFI_t$	Net factor incomes from abroad
$\phi_{3,6,t}$	$= MST_t$	Net service imports (including factor payments), and net transfer payments abroad
$\phi_{3,7,t}$	$= RPG_t$	Wholesale price of grains relative to overall wholesale price level
$\phi_{3,8,t}$	$= POP_t$	Population
$\phi_{3,9,t}$	$= GP_t$	Grain production
$\phi_{3,10,t}$	$= RD_t$	Rate of interest on domestic savings deposits
$\phi_{3,11,t}$	$= LR_t$	Rate of interest on domestic commercial bank loans
$\phi_{3,12,t}$	$= RF_t$	Rate of interest on foreign commercial loans
$\phi_{3,13,t}$	$= RINF_t$	Current rate of inflation (GNP deflator)
$\phi_{3,14,t}$	$= RINF_{t-1}$	Lagged rate of inflation (GNP deflator)
$\phi_{3,15,t}$	$= CKDM_t$	Dummy variable used in foreign commercial loan (CK) equation
$\phi_{3,16,t}$	$= MNC_t$	Imports of nonclassified goods
$\phi_{3,17,t}$	$= NTOSH_t$	Transfers from government and corporate sectors to households
$\phi_{3,18,t}$	$= XGP_t$	Exports of primary products
$\phi_{3,19,t}$	$= RT$	Current account transfers from abroad
$\phi_{3,20,t}$	$= 1$	Constant term

TABLE 8–3
B Matrix for Endogenous Variables

	1 *YNA*	2 *Y*	3 *DTR*	4 *INT*	5 *SG*	6 *GC*	7 *IVG*	8 *MG*	9 *ILG*	10 *SC*	11 *YDP*	12 *SH*	
1 *YNA*	1												Group 1
2 *Y*	−1	1											
3 *DTR*		β	1										Group 2
4 *INT*	β			1									
5 *SG*			−1	−1	1								
6 *GC*		β				1							Group 3
7 *IVG*							1		−1				
8 *MG*						−1	−1	1					
9 *ILG*								β	1				
10 *SC*	β									1			Group 4
11 *YDP*		−1	1	1						1	1		
12 *SH*											β	1	
13 *INA*		β			β					β		β	
14 *I*													
15 *CK*													
16 *DC*		−1			1		1			1		1	
17 *MC*													Group 5
18 *MK*													
19 *XGM*	β												
20 *X*													
21 *MI*		β											
22 *M*								−1					
23 *SK*													Group 6
24 *IV*					−1					−1		−1	

THE DATA

The data used to estimate the basic model and its variations are for the most part compiled by the Bank of Korea and published in their annual series, *Economic Statistics Yearbook*. The data for all variables were compiled for the period 1955 to 1970 or for 16 years. Some data date from 1953. Thus all equations, except those containing lagged variables, could be run on 16 annual observations or more.

TABLE 8-3 (concluded)

	13 *INA*	14 *I*	15 *CK*	16 *DC*	17 *MC*	18 *MK*	19 *XGM*	20 *X*	21 *MI*	22 *M*	23 *SK*	24 *IV*	
1 *YNA*													Group 1
2 *Y*													
3 *DTR*													Group 2
4 *INT*													
5 *SG*													
6 *GC*													Group 3
7 *IVG*													
8 *MG*													
9 *ILG*													
10 *SC*													Group 4
11 *YDP*													
12 *SH*													
13 *INA*	1												
14 *I*	−1	1											
15 *CK*		β	1										
16 *DC*				1									
17 *MC*				β	1								Group 5
18 *MK*		β	β			1							
19 *XGM*							1						
20 *X*							−1	1					
21 *MI*							β		1				
22 *M*					−1	−1			−1	1			
23 *SK*			1					1		−1	1		Group 6
24 *IV*		1						1		−1		1	

All of the endogenous variables and most of the exogenous variables are in terms of constant 1965 won. Since many of the variables used in the model (e.g. imports of goods by type, capital imports of various kinds, and tax variables) are not given by the Bank of Korea in constant 1965 won, we deflated the Bank constant price or dollar data in a variety of ways. Exchange rate variables were adjusted by a purchasing-power-parity index. Adjustments were made to other Bank data; for example, domestic savings was adjusted to exclude changes in grain inventories and include transfers from abroad. A

TABLE 8–4

Basic Matrixes of the Macro-model

	Δ Matrix Lagged Endogenous Variables				Γ_1 Matrix Basic Commercial Policy Variables				Γ_2 Matrix Derived Commercial Policy Variables						
	YNA_{-1} 1	YNA_{-2} 2	INA_{-1}* 3	ILG_{-1} 5	*ORD* 1	*XPM* 2	*SOX* 3	*TAM* 4	*XPX* 1	*SUBM* 2	*SUBX* 3	*SXDT* 4	*TAR* 5	*MARDEV* 6	
1 *YNA*	−1		δ												
2 *Y*															Group 1
3 *DTR*												1			
4 *INT*															Group 2
5 *SG*													−1		
6 *GC*															
7 *IVG*				1											Group 3
8 *MG*															
9 *ILG*															
10 *SC*															
11 *YDP*															
12 *SH*															
13 *INA*	δ	δ													Group 4
14 *I*															
15 *CK*														γ_2	
16 *DC*															
17 *MC*					γ_1					γ_2					
18 *MK*					γ_1										
19 *XGM*					γ_1						γ_2				Group 5
20 *X*															
21 *MI*					γ_1					γ_2					
22 *M*															
23 *SK*															Group 6
24 *IV*															

* Logarithm to base *e* of INA_{-1}.

TABLE 8–4 (concluded)

24 *IV*

* Logarithm to base *e* of INA_{-1}.

TABLE 8–4 (concluded)

	Γ₃ Matrix																			Error Terms	
	1 *YA*	2 *G*	3 *IA*	4 *PK*	5 *NFI*	6 *MST*	7 *RPG*	8 *POP*	9 *GP*	10 *RD*	11 *LR*	12 *RF*	13 *RINF*	14 $RINF_{-1}$	15 *CKDM*	16 *MNC*	17 *NTOSH*	18 *XGP*	19 Constant	*e*	
1 *YNA*																			γ_3	e_1	Group 1
2 *Y*	−1																				
3 *DTR*																			γ_3	e_3	Group 2
4 *INT*																			γ_3	e_4	
5 *SG*		1																			
6 *GC*							γ_3	γ_3											γ_3	e_6	Group 3
7 *IVG*																					
8 *MG*									1												
9 *ILG*									γ_3										γ_3	e_9	
10 *SC*										γ_3									γ_3	e_{10}	Group 4
11 *YDP*																	1				
12 *SH*										γ_3			γ_3	γ_3					γ_3	e_{12}	
13 *INA*				γ_3															γ_3	e_{13}	
14 *I*			−1																		
15 *CK*											γ_3	γ_3		γ_3	γ_3				γ_3	e_{15}	
16 *DC*					−1																
17 *MC*																			γ_3	e_{17}	Group 5
18 *MK*																			γ_3	e_{18}	
19 *XGM*																			γ_3	e_{19}	
20 *X*																		−1			
21 *MI*																			γ_3	e_{21}	
22 *M*																−1					
23 *SK*				1		−1															Group 6
24 *IV*						−1															

detailed description of the data sources and adjustments to the data is given in the appendix to this chapter.

BASIC HYPOTHESES AND TESTS

Hypotheses tested in fitting the basic model and its variations include the following general types:

(1) exchange rate variables affect savings and investment behavior directly as well as exports, imports, and capital flows;
(2) various types of tariff and tariff equivalents and export subsidies have differential effects on imports and exports;
(3) private savings are sensitive to both nominal interest rate changes and expected rates of inflation;
(4) foreign loans are sensitive to nominal interest rates, expected rates of inflation and expected rates of devaluation.

Hypotheses of these types are tested using the conventional tests of significance. The results are described below. In addition, we tested the general hypothesis that the basic structure of the economy changed after the 1964 devaluation and liberalization. For all equations for which there were enough degrees of freedom, we ran regressions over the sample period 1964 to 1970 as well as over the whole period for which data were available to determine whether the structure was changed. We also tested all our equations using eleven observations from 1960 to 1970 and fourteen observations from 1957 to 1970 when possible. The rationale for the 1960–70 period is that 1960 is the year Rhee was overthrown and the first year of attempted economic reform. The 1957 to 1970 period is used to determine whether the post-Korean-War years 1953 to 1956 were so significantly affected by reconstruction that data from these years bias the results. In choosing what we call our "best results," we chose the longest sample period for which the results seemed to be stable. If the regression coefficients changed markedly, however, when a shorter sample period was used, we chose the results from the shorter sample period.

All of the equations of the model were estimated initially using ordinary least squares or the Cochrane-Orcutt technique if there seemed to be significant autocorrelation of the error terms. Various types of simultaneous estimation were then used to determine whether the simultaneous nature of the model seriously biased the estimated coefficients.

FURTHER DESCRIPTION AND ESTIMATION RESULTS

Group 1: Determination of GNP.

The first two equations of the model concern output in agriculture and nonagriculture. Output in nonagriculture sectors *YNA* is assumed to be related to nonagricultural investment *INA* in previous years.[1] In the estimated relationship, there was strong evidence for decreasing returns to investment. That is, the higher the level of investment, the greater seems to be the net incremental capital-output ratio.[2] The best results among several functional forms tried seem to be for the following equation for nonagricultural output:

$$YNA = \underset{(-2.96)}{-281.8254} + \underset{(10.02)}{0.9413}\, YNA_{-1} + \underset{(2.64)}{80.0668} \log_e (INA_{-1}) \qquad (8\text{–}2)$$

Estimation Technique: Ordinary Least Squares

Sample: 1957 to 1971[3]

$R^2 = 0.9960$

$d = 2.2310$

The t statistics are given in parentheses under each of the coefficients of variables in the equations. R^2 is the coefficient of determination and d is the Durbin-Watson statistic. The strength of decreasing returns in nonagriculture can be indicated by comparing incremental capital-output ratios when nonagricultural investment runs about 50 billion won in constant 1965 prices, as it did in the late 1950s and early '60s, as opposed to investment of about 400 billion won in constant 1965 prices, as in 1970. The capital-output ratio is approximately 1.6 when investment is 50 billion won and about 2.0 when investment is 400 billion won.[4]

The second equation in Group 1 is an identity relating total output Y to agricultural output YA and nonagricultural output YNA.

$$Y = YNA + YA \qquad (8\text{–}3)$$

Group 2: Government Taxation and Savings Equations.

The regression equations for government direct and indirect tax revenues were very well behaved. They exhibited very high coefficients of determination and were generally stable, regardless of the sample period used.

The dependent variable in the direct tax regression was potential taxation. That is, direct tax exemptions for exporters *SXDT* were added to actual direct tax revenues *DTR* to get potential direct taxes. The results were as follows:

$$DTR + SXDT = -63.6088 + 0.1104Y \qquad (8\text{–}4)$$
$$(-7.14) \quad (16.42)$$

Estimation Technique: Cochrane-Orcutt Iterative Technique

Sample: 1953 to 1970

$R^2 = 0.9946$

$d = 0.9741$

$\rho = 0.8808$[5]

For indirect taxes *INT*, excluding tariffs and foreign exchange taxes, the results were:

$$INT = -16.2991 + 0.1193YNA \qquad (8\text{–}5)$$
$$(-3.63) \quad (15.86)$$

Estimation Technique: Cochrane-Orcutt Iterative Technique

Sample: 1953 to 1970

$R^2 = 0.9787$

$d = 1.4114$

$\rho = 0.4968$

The regression results indicate a very high degree of elasticity of both direct and indirect tax revenues over the entire period 1953 to 1970. The average elasticity for direct tax revenues was 2.53 and for indirect tax revenues 1.40. Since direct tax exemptions grew rapidly, particularly in the last half of the 1960s, potential tax revenues (excluding exemptions) were even more elastic. The average for direct taxes was 2.79.[6]

Government expenditure *G* is assumed in our model to be exogenous, and government savings *SG* is specified as an identity.

$$SG = DTR + INT + TAR - G \qquad (8\text{–}6)$$

where *TAR* is tariffs and foreign exchange taxes.

Group 3: The Grain Sector.

Grain consumption was assumed to be dependent on income Y, the relative price of grains RPG, total population POP, and the split between rural and urban population. Since urban population has been growing quite steadily along with total population, any measure of the relative rural-urban population is highly correlated with total population and the usual problems associated with multicollinearity arise. The coefficients on the two correlated variables are extremely sensitive to the sample and the estimation technique used. We finally concluded that the best results could be obtained by using the population variable only. The results are:

$$\begin{array}{ll} GC = 6.5619 + 0.02696Y - 31.3328RPG + 7.8016POP & (8\text{–}7) \\ \quad\quad\; (0.20) \quad\; (1.58) \quad\quad (-2.21) \quad\quad\; (5.18) & \end{array}$$

Estimation Technique: Ordinary Least Squares

Sample: 1955 to 1970

$R^2 = 0.9582$

$d = 1.7957$

The income variable Y and the population variable POP are also quite collinear, and this probably accounts for the lack of significance of the coefficient of the Y variable. Nevertheless, we felt a priori that the income variable should be retained.

The implicit average income elasticity for grain consumption from 1955 to 1970 is 0.1031 and the price elasticity is −0.0422. As one would expect, grain consumption is relatively price and income inelastic. Population growth is the major factor in determining growth in consumption.

Korean domestic savings figures are very much affected by changes in grain inventories. The harvest comes in late in the year and most of the production is held in inventories at the end of the year. Fluctuations in the level of grain inventories are more a function of grain production than anything else. Grain imports also affect the levels of grain inventories, but, for the most part, changes in inventory do not represent conscious savings decisions but are more a function of the effect of weather on the size of the harvest.

Since changes in grain inventories are such an important component of savings, we estimated their level ILG as a function of grain production GP and grain imports MG. The best results are:

$$\begin{array}{ll} ILG = -77.9743 + 0.5782MG + 0.7196GP & (8\text{–}8) \\ \quad\quad\quad (-7.25) \quad\; (7.52) \quad\quad (12.07) & \end{array}$$

Estimation Technique: Ordinary Least Squares

Sample: 1955 to 1970

$R^2 = 0.9607$

$d = 1.9038$

Once the level of grain inventories is determined by the stochastic equation (8–8), investment in grain inventories *IVG* is determined by the identity

$$IVG = ILG - ILG_{-1} \qquad (8\text{–}9)$$

Imports of grain are determined also as grain consumption *GC* plus inventory change *IVG* less production *GP*. Production of grain is assumed to be exogenous.

$$MG = IVG + GC - GP \qquad (8\text{–}10)$$

Group 4: Savings and Investment Behavior.

Savings are classified as household and corporate. Household savings *SH* is expected to be a function of the expected real rate of interest on local savings deposits and disposable income of households *YDP*. The basic specification is:

$$SH = a_0 + a_1 YDP + a_2 RRD^* \qquad (8\text{–}11)$$

Of course, the expected real rate of interest RRD^* is not an observable variable. We assume, however, that the expected real rate of interest is a function of the current *nominal* rate of interest *RD* less the expected rate of inflation. The expected rate of inflation is assumed to be a function of current and past rates of inflation *RINF*.[7]

$$RRD^* = RD - b_0 RINF - b_1 RINF_{-1} \qquad (8\text{–}12)$$

If (8–12) is substituted back into (8–11), we obtain the following result:

$$SH = a_0 + a_1 YDP + a_2 RD - b_0 a_2 RINF - b_1 a_2 RINF_{-1} \qquad (8\text{–}13)$$

This is the equation which was estimated with the following result:

$$\underset{(-4.47)}{SH = -71.5504} + \underset{(4.23)}{0.08578 YDP} + \underset{(2.94)}{193.0218 RD} \qquad (8\text{–}14)$$

$$- \underset{(-2.48)}{44.7071 RINF} - \underset{(-2.87)}{35.0608 RINF_{-1}}$$

Estimation Technique: Cochrane-Orcutt Iterative Technique

Sample: 1955 to 1970

$R^2 = 0.9550$

$d = 3.0033$

$\rho = 0.7070$

The results were only somewhat different for other sample periods, but all sample periods reveal a high degree of significance for the real interest rate. The average interest rate elasticity over the sample period is 1.82, a very high interest rate elasticity.

Corporate savings *SC,* which form the bulk of private savings in South Korea, were assumed to be a function of nonagricultural value added, the expected real rate of interest on savings deposits, the average rate of protection on imports, and the average rate of subsidy on exports.[8] The rationale for including rates of protection or subsidy was that high levels of protection and subsidy should increase profits and lead to higher savings. The level of tariffs and tariff equivalents and subsidies per dollar of export did not seem to affect savings in any consistent or significant fashion. Furthermore, rates of inflation did not seem to possess much explanatory power and frequently carried the wrong sign in the regression. The best results were obtained using only two variables, nonagricultural value added *YNA* and the rate of interest on savings deposits *RD.*

$$\underset{(-0.16)}{SC = -0.5689} + \underset{(10.51)}{0.0730YNA} + \underset{(4.13)}{115.2640RD} \qquad (8\text{–}15)$$

Estimation Technique: Ordinary Least Squares

Sample: 1960 to 1970

$R^2 = 0.9827$

$d = 1.6131$

Both nonagricultural value added and the rate of interest were highly significant for all sample periods and various specifications. For business savings, the average interest rate elasticity is 0.34 over the sample period. Household savings seem to be substantially more interest rate elastic, but the significance of deposit rates for corporate savings is nonetheless substantial (a t ratio of 4.13). The rate of inflation was not a significant explanatory variable. Thus it seems that in Korea, corporate savings depend on the nominal rate of interest rather than on the expected real rate of interest (in contrast to household savings). The reason may be that although inflation reduces real interest costs, it also may be associated with increased profit rates which have a positive effect on corporate savings and investment. The two effects tend to cancel each other so that corporate savings show little sensitivity to the rate of inflation.

Disposable income of households YDP is determined by the identity:

$$YDP = Y - SC - INT - TAR - DTR + NTOSH \qquad (8\text{–}16)$$

That is, disposable income of households is total income less retained earnings, less taxes, and plus net transfers from the government and corporate sectors to households.

Investment in South Korea is financed by four main sources, private savings channeled through the commercial banking system in the form of deposits, government savings channeled through both the commercial banks and a series of development finance institutions,[9] retained earnings, and borrowing from abroad.

The demand for loans from both commercial banks and development finance institutions far exceeds the available supply of loanable funds even at the relatively high interest rates that marginal borrowers must pay.[10] Loans are rationed since legal interest rate ceilings cannot clear the market. The result is that much investment is financed through the unorganized money market and by borrowing from abroad. Since interest rates are controlled and credit is rationed, we decided to include as an independent variable for the nonagricultural investment equation the total level of savings largely available to government or channeled through the banking system. This includes government savings SG, public capital imports PK, corporate savings SC, and household savings SH. It does not include other sources of savings such as foreign commercial loans, reductions in foreign exchange reserves, and inventory disinvestment. The other explanatory variables tried were current and lagged income growth, the real local commercial bank loan rate, the real rate of interest on foreign loans, average tariffs and tariff equivalents per dollar of imports, export subsidies per dollar of export, and effective exchange rates.

Of all these explanatory variables, current and lagged income growth and available savings $(SG + PK + SC + SH)$ seemed to give the only good results. Import tariffs and export subsidies did not seem to have a direct impact on investment demand. The loan rates, foreign and domestic, were not good explanatory variables although the domestic loan rate was nearly significant at the 5 percent level for some regressions. The lack of strong significance of the domestic loan rate is probably due to the wide variety of loan rates at different types of banks and for different purposes. With such a variety of subsidized rates and the prevalence of credit rationing, it is expected that official loan rates would not have substantial explanatory value. The equation which we felt best for purposes of simulation, however, did include the domestic loan rate and was as follows:

$$\begin{aligned} INA = &\underset{(-1.39)}{-19.0111} + \underset{(2.97)}{0.5802}(YNA - YNA_{-1}) + \underset{(3.39)}{0.7525}(YNA_{-1} \\ &- YNA_{-2}) + \underset{(4.44)}{0.7263}(SG + PK + SC + SH) - \underset{(-1.08)}{36.8952}RLR \end{aligned} \qquad (8\text{–}17)$$

Estimation Technique: Cochrane-Orcutt Iterative Technique

Sample: 1957 to 1970

$R^2 = 0.9948$

$d = 1.7044$

$\rho = 0.5643$

where RLR is the expected real rate of interest for domestic loans. The expected real rate of interest is the nominal rate less the expected rate of inflation which is assumed to be approximated by last year's rate of inflation:

$$RLR = LR - RINF_{-1} \qquad (8\text{–}18)$$

Since a large component of nonagricultural investment is available savings, the problem of simultaneity (discussed later) is particularly acute for this equation and requires further investigation.

Total investment I equals nonagricultural investment INA plus investment in agriculture IA.

$$I = INA + IA \qquad (8\text{–}19)$$

The next equation in Group 4 is a demand equation for foreign loans. Although, in principle, foreign loans over three years require approval from the Economic Planning Board, the Board has encouraged investors to borrow abroad. Beginning about 1970, however, concern over the rising level of debt service payments led the IMF to insist on restriction of the flow of foreign capital, and the restrictions imposed seemed to be effective.

The demand for foreign loans is assumed to be a function of the level of total fixed investment I, the expected real rate of interest on domestic loans RLR, and the expected real rate of interest on foreign loans RRF. That is,

$$CK = \alpha_0 + \alpha_1 I + \alpha_2 RLR + \alpha_3 RRF + \alpha_4 CKDM \qquad (8\text{–}20)$$

where $CKDM$ is a dummy variable equal to unity for 1970 and zero for all other years. The expected rate of interest on foreign loans involves not only the expected rate of inflation but the expected rate of devaluation. We assume that the expected rate of devaluation is approximated by the average of the current and two previous years' rates of devaluation. Thus

$$RRF = RF - RINF_{-1} + (RDEV + RDEV_{-1} + RDEV_{-2})/3 \qquad (8\text{–}21)$$

Equation (8–19) was estimated as follows:

$$\underset{(-7.06)}{CK = -23.7637} + \underset{(7.86)}{0.2634I} + \underset{(2.87)}{148.5346RLR} \qquad (8\text{–}22)$$

$$\underset{(-2.02)}{-77.5319RRF} - \underset{(-3.06)}{27.8443CKDM}$$

Estimation Technique: Ordinary Least Squares

Sample: 1959 to 1970

$R^2 = 0.9847$

$d = 2.5668$

The demand for foreign loans is sensitive to both the domestic and foreign loan interest rate. The average elasticities are 0.326 and −0.477. The significance of the dummy variable indicates that the restrictions on foreign borrowing had a significant effect in 1970.

The final equation in Group 4 is an identity for domestic consumption expenditure,

$$DC = Y - SC - SH - SG - IVG + RT + NFI \qquad (8\text{–}23)$$

Consumption equals income less savings, both private and government, less inventory investment in grains, plus net transfers and net factor incomes from abroad.

Group 5: Import and Export Equations.

Group 5 contains three import equations, an export equation, and two identities. Imports of consumption goods are assumed to depend on various components of the effective exchange rate for imports and the level of domestic consumption. Initially, the effective exchange rate for imports was broken up into three components: (1) the official rate, (2) tariffs and tariff equivalents, and (3) the total value of export premia per dollar of import. The coefficients for parts 2 and 3 were not significant and were unstable with respect to the sample used for all of the import equations. Thus parts 2 and 3 were combined into a single variable called *SUBM*. For imports of consumption goods *MC*, the two parts *SUBM* and *ORD* were combined, since there was no significant difference between their coefficients. The best results are:

$$MC = -8.1035 + 0.0596DC - 0.1055(SUBM + ORD) \quad (8\text{–}24)$$
$$(-2.15) \quad (11.75) \quad (-5.43)$$

Estimation Technique: Ordinary Least Squares

Sample: 1955 to 1970

$R^2 = 0.9163$

$d = 1.2058$

where *DC* is domestic consumption. This equation results in an average elasticity of −2.10 for the effective exchange rate of imports, *SUBM* + *ORD*.[11]

For capital goods imports, a somewhat different model must be used. Most capital goods enter duty free and by special channels such as foreign aid loans or loans from abroad. The official exchange rate is the most relevant exchange rate to use. Since most foreign loans are tied to capital goods imports, we would expect the level of foreign borrowing to be an important determinant of capital goods imports. The level of investment is also a determinant of the magnitude of capital goods imports. The best regression results for *MK*, imports of capital goods, are obtained with foreign commercial loans *CK*, investment *I*, and the official exchange rate *ORD* as explanatory variables.

$$MK = 3.881 + 0.3610CK + 0.3311I - 0.0853ORD \quad (8\text{–}25)$$
$$(0.61) \quad (2.22) \quad (6.58) \quad (-2.44)$$

Estimation Technique: Ordinary Least Squares

Sample: 1955 to 1970

$R^2 = 0.9876$

$d = 1.6974$

The elasticity of capital goods imports with respect to *ORD* is −0.36.

For imports of intermediate goods, we used the official exchange rate *ORD* and total tariffs, tariff equivalents, and export premia per dollar of import *SUBM* as the commercial policy variables. Other explanatory variables are gross national product *Y* and exports *X*. Manufactured exports *XGM* is used as a separate explanatory variable, since we believe that in general exports of manufactures are more intensive in their use of imports than other elements of expenditure on GNP. The resulting equation is:

$$\begin{array}{l} MI = \underset{(0.42)}{9.9287} + \underset{(3.53)}{0.1772Y} + \underset{(1.67)}{0.3610XGM} - \underset{(-2.53)}{0.3714SUBM} \\ \qquad - \underset{(-2.68)}{0.2197ORD} \end{array} \qquad (8\text{–}26)$$

Estimation Technique: Cochrane-Orcutt Iterative Technique

Sample: 1955 to 1970

$R^2 = 0.9893$

$d = 1.5915$

$\rho = 0.2554$

The average elasticity is −.46 for the official exchange rate *ORD* and −0.80 for *SUBM*. One would expect a higher elasticity for *SUBM* if tariffs and tariff equivalents are levied selectively on commodity items with higher than average elasticity.

As Chapter 6 indicated, the export equation was the most difficult to estimate. The estimation procedures and results were discussed at some length in that chapter and we merely repeat the best results here for sake of completeness.

$$\begin{array}{l} XGM = \underset{(-3.92)}{-241.4847} + \underset{(11.29)}{0.3323YMA} + \underset{(1.70)}{0.2629ORD} \\ \qquad + \underset{(1.27)}{0.1471SUBX} \end{array} \qquad (8\text{–}27)$$

Estimation Technique: Cochrane-Orcutt Iterative Technique

Sample: 1957 to 1970

$R^2 = 0.9900$

$d = 1.3742$

$\rho = 0.8701$

where *XGM* is export of manufactured goods.

The last two equations of Group 5 are identities giving the value of total imports and exports:

$$M = MG + MC + MK + MI + MNC \qquad (8\text{–}28)$$

$$X = XGM + XGP \qquad (8\text{–}29)$$

Group 6: Demand and Supply Balance.

The final group of equations contains two identities. The first is the balance of payments identity relating movements of short term capital and changes in monetary assets *SK* to the demand and supply of foreign exchange.

$$SK = M + MST - X - CK - PK \tag{8–30}$$

where *MST* is net service imports plus net transfer payments abroad. The second identity makes inventory change the equilibrating item for aggregate demand and supply or between savings and investment

$$IV = SG + SC + SH + M + MST - X - I \tag{8–31}$$

SIMULTANEOUS ESTIMATION

So far we have only discussed the results of single equation estimation techniques and have not yet attempted simultaneous estimation. There is some heuristic justification for this. A glance at the B matrix in Table 8–3 reveals a structure that is very nearly triangular.[12] The system is triangular except for one block of equations, the *IVG*, *MG*, and *ILG* equations. (See the block with dotted lines in the B matrix of Table 8–3.) It is well-known that if a structure is triangular (i.e. recursive) and the errors across equations are uncorrelated, ordinary least squares estimation is a consistent estimation technique. A slight generalization of this theorem is easy to prove: if the system is block-triangular and the errors across blocks are uncorrelated, each block may be treated as a simultaneous system and consistent estimation of each block results in consistent estimation for the system as a whole.

With this in mind, we attempted to estimate the block of equations, *IVG*, *MG*, and *ILG*, as a simultaneous system. This system can be written as follows:

$$IVG = ILG - ILG_{-1} \tag{8–32}$$

$$MG = IVG + GC - GP \tag{8–33}$$

$$ILG = \beta MG + \gamma_1 GP + \gamma_0 + e \tag{8–34}$$

where *e* is an error term. If we substitute (8–32) into (8–33) and (8–33) in turn into (8–34) and solve for *ILG*, we obtain the following result:

$$ILG = \frac{\beta}{(1-\beta)}(GC - ILG_{-1}) + \frac{(\gamma_1 - \beta)}{(1-\beta)} GP + \frac{\gamma_0}{(1-\beta)} + \frac{1}{(1-\beta)} e \tag{8–35}$$

This equation can be estimated by regressing *ILG* on the combination variable $(GC - ILG_{-1})$ and on *GP*. The result is

$$ILG = -139.51 + 0.654(GC - ILG_{-1}) + 0.625GP \qquad (8\text{–}36)$$

Estimation Technique: Ordinary Least Squares

Sample: 1955 to 1970

$R^2 = 0.8460$

$d = 1.52$

The original structural coefficients, β, γ_0 and γ_1 can be estimated then by indirect least squares by solving the following equations:

$$\frac{\gamma_0}{(1-\beta)} = -139.51 \qquad (8\text{–}37)$$

$$\frac{\beta}{(1-\beta)} = 0.654 \qquad (8\text{–}38)$$

$$\frac{(\gamma_1-\beta)}{(1-\beta)} = 0.625 \qquad (8\text{–}39)$$

The solution gives the following estimate of the structural equation (8–34):

$$ILG = -79.17 + 0.395MG + 0.773GP \qquad (8\text{–}40)$$

Comparing this result with the ordinary least squares result in equation (8–8), we see that the constant term changes relatively little, the coefficient of *MG* is reduced and the coefficient of *GP* increases.

If all the equations are regarded together as one large system, estimation is impossible because observations are too few. For example, consider the problem with a two-stage least squares approach. There are 35 exogenous and lagged endogenous variables. There are, however, a maximum of 18 observations from 1953 to 1970. Thus it is impossible to regress any of the endogenous variables on all the exogenous and lagged endogenous variables. Some technique has to be found to reduce the number of instrumental variables (exogenous and lagged endogenous).

A method for choosing instruments has been proposed by Fisher (1965). Some exogenous variables of the system of equations may add little causal information to the equation and hence be of little value in reducing the bias in estimation. Thus Fisher suggests the use of a causal ordering system for the set of all predetermined variables.

Our ordering system is similar to Fisher's and works as follows:

(1) The predetermined variables in equation *i* are called zero-order causal variables for equation *i*.
(2) For each endogenous variable in an equation (other than the dependent variable), we may determine the set of predetermined variables in the equation explaining that endogenous variable. Each set of such predetermined variables are first-order causal variables.
(3) For each equation *j* explaining an endogenous variable in equation *i*, there are a set of endogenous variables. The predetermined variables in the equations explaining this set of endogenous variables are second-order causal variables. The predetermined variables in the equation for a lagged endogenous variable contained in equation *i* are also called second-order causal variables.

The causal ordering described here may be defined more precisely in a recursive fashion.

It is very difficult to choose a set of predetermined variables as instruments. If one chooses too few, the simultaneous equations' bias to the estimates is likely to be a problem. If one chooses too many instruments, the endogenous variables, when regressed on the instruments, are nearly predicted perfectly, a problem of lack of degrees of freedom. We decided to run two sets of two-stage least squares estimates, one with the Fisher instruments of zero- and first-order causal variables, and another with a larger set of instruments up to the second order of causality.

In addition to the Fisher instruments, Fair (1970) suggests that when the errors in an equation are serially correlated a consistent estimation procedure requires the addition of all lagged variables in the equation as instruments.

Table 8–5 lists the instruments which are used for each equation. Tables 8–6 and 8–7 give the results using the two different sets of Fisher instruments, the first set using zero- and first-order causal variables and the second set using variables through the second order of causality. Note that for the *YNA* equation, there are no other endogenous variables in the equation. Thus two-stage least squares and ordinary least squares are equivalent. Note also in Table 8–5 that for the *INT*, *SC*, and *XGM* equations, there are no second-order causal variables. Thus the two-stage least squares estimates are identical whether or not second-order causal variables are included. When only the Fisher first-order causal variables are included, the *ILG* equation does not have enough instruments so that the equation is underidentified. It is only possible to estimate with two-stage least squares when second-order instruments are included. Finally, when instruments through the second order of causality are used, it is not possible to estimate the *INA* equation. There are too many instruments and no degrees of freedom.

TABLE 8–5

Instrumental Variables on the Basis of Causal Orderings

Stochastic Equation	Zero- and First-Order Instruments	Second-Order Instruments	Additional Instruments Due to Autocorrelation
YNA	YNA_{-1}, INA_{-1}	INA_{-2}, PK	—
DTR	$SXDT, YA$	YNA_{-1}, INA_{-1}	$(DTR + SXDT)_{-1}$, Y_{-1}
INT	YNA_{-1}, INA_{-1}	—	INT_{-1}
GC	RPG, POP, YA	YNA_{-1}, INA_{-1}	—
ILG	GP	ILG_{-1}, RPG, POP	—
SC	RD, YNA_{-1}, INA_{-1}	—	—
SH	$RD, RINF, RINF_{-1}$, $NTOSH, TAR$	YA, RPG, POP, $SXDT$	$RINF_{-2}, RD_{-1}$, SH_{-1}, YDP_{-1}
INA	PK, TAR, G, RD, $RINF, RINF_{-1}$, YNA_{-1}, INA_{-1}, YNA_{-2}	YNA_{-2}, INA_{-2}, $SXDT, NTOSH$	$PK_{-1}, (SG + SC +$ $SH)_{-1}, YNA_{-3}$, RLR_{-1}
CK	$RLR, RRF, CKDM$, IA	YNA_{-1}, YNA_{-2}, PK	—
MC	$(SUBM + ORD)$, NFI, RT	$YA, RD, RINF$, $RINF_{-1}, TAR, G$, ILG_{-1}	—
MK	ORD, RLF, RRF, $CKDM, IA$	YNA_{-1}, YNA_{-2}, PK	—
MI	$SUBM, ORD, YA$, $SUBX$	YNA_{-1}, INA_{-1}	$SUBM_{-1}, ORD_{-1}$, MI_{-1}, Y_{-1}, XGM
XGM	$SUBX, ORD$, YNA_{-1}, INA_{-1}	—	$SUBX_{-1}, ORD_{-1}$, XGM_{-1}

The results using two-stage least squares with first-order instruments are almost identical to the ordinary least squares results except for the *GC*, *CK*, *MK*, and *MI* equations. When second-order instruments are used, only the coefficient of the *CK* variable in the *MK* equation is substantially different from the ordinary least squares result. Furthermore, all the equations listed in Table 8–7 still have large degrees of freedom except for the *CK* equation. We must conclude that the problem of simultaneity is not great for our Korean econometric model.

TABLE 8–6

Two-Stage Least Squares Estimates with Fisher's First-Order Instrumental Variables

Equation	R^2	d	Estimation Technique
$DTR = -61.5843 + 0.1092Y - SXDT$	.9944	0.9381	*TSCORC*
(−6.56) (15.26)			
$INT = -17.2787 + 0.1202YNA$	.9792	1.4411	*TSCORC*
(−3.76) (15.84)			
$GC = 111.8904 + 0.0964Y - 40.4563RPG$			
(1.30) (1.81) (−1.78)			
$+2.2082POP$	.9006	0.8621	*TS*
(0.50)			
$SC = -0.5678 + 0.0725YNA + 116.5768RD$	.9827	1.6273	*TS*
(−0.16) (10.41) (4.16)			
$SH = -69.6454 + 0.08412YDP + 192.2094RD$			
(−4.43) (4.16) (2.92)			
$-45.1081RINF - 34.9772RINF_{-1}$	.9549	3.0123	*TSCORC*
(−2.48) (−2.85)			
$INA = -19.0076 + 0.5802(YNA - YNA_{-1}) + 0.7525(YNA_{-1} - YNA_{-2})$			
(−1.39) (2.97)			
$+ 0.7263(SG + SC + SH) - 36.8973RLR$	.9948	1.7044	*TSCORC*
(4.44) (−1.08)			
$CK = -24.9579 + 0.2889I + 115.0503RLR$			
(−6.23) (5.31) (1.50)			
$-52.8461RRF - 32.4248CKDM$	.9834	2.7436	*TS*
(−0.93) (−2.69)			
$MC = -7.3710 + 0.0548DC$			
(−1.84) (7.44)			
$-0.09356(SUBM + ORD)$	.9101	1.0454	*TS*
(−4.02)			
$MK = 0.7415 + 0.2091CK + 0.3637I$			
(0.11) (1.00) (5.60)			
$- 0.0740ORD$	.9861	1.6003	*TS*
(−1.94)			
$MI = 18.0854 + 0.1564Y + 0.4503XGM$			
(0.74) (2.98) (1.99)			
$- 0.3586SUBM - 0.1975ORD$	.9890	1.6074	*TSCORC*
(−2.39) (−2.39)			
$XGM = -242.4649 + 0.3332YNA + 0.2642ORD$			
(−3.94) (11.26) (1.71)			
$+ 0.1480SUBX$	.9900	1.3756	*TSCORC*
(1.27)			

NOTE: *TSCORC* stands for two-stage least squares with Cochrane-Orcutt iterations. *TS* stands for ordinary two-stage least squares.

TABLE 8–7

Two-Stage Least Squares Estimates with Fisher's Second-Order Instrumental Variables

	R^2	d	Estimation Technique
$DTR = -66.2773 + 0.1119Y - SXDT$	.9944	0.9745	*TSCORC*
(−6.46) (15.24)			
$GC = 17.5453 + 0.03193Y - 33.3742RPG$			
(0.47) (1.67) (−2.27)			
$+ 7.3280POP$	.9577	1.7572	*TS*
(4.28)			
$ILG = -92.5178 + 0.6702MG + 0.7853GP$	.9477	1.6311	*TS*
(−6.30) (5.04) (10.15)			
$SH = -72.2550 + 0.08657YDP + 192.7797RD$			
(−4.49) (4.26) (2.93)			
$-44.6751RINF - 35.0964RINF_{-1}$	.9550	2.9992	*TSCORC*
(−2.50) (−2.87)			
$CK = -23.6744 + 0.2615I + 151.0420RLR$			
(−7.02) (7.73) (2.89)			
$-79.3805RRF - 27.5013CKDM$	.9847	2.5466	*TS*
(−2.05) (−3.01)			
$MC = -8.3930 + 0.0597DC$			
(−2.25) (11.67)			
$- 0.1049(SUBM + ORD)$	.9162	1.2160	*TS*
(−5.41)			
$MK = 1.5311 + 0.2117CK + 0.3717I$			
(0.23) (1.15) (6.63)			
$- 0.0846ORD$	.9866	1.6893	*TS*
(−2.33)			
$MI = 10.3928 + 0.1760Y + 0.3672XGM$			
(0.44) (3.50) (1.69)			
$- 0.3700SUBM - 0.2188ORD$	.9891	1.5930	*TS*
(−2.51) (−2.66)			

NOTE: *TSCORC* is two-stage least squares with Cochrane-Orcutt iterations and *TS* is ordinary two-stage least squares.

APPENDIX: DATA USED IN THE ECONOMETRIC MODEL

Most of the data used for the regressions in this chapter are compiled by the Bank of Korea and published in their *Economic Statistics Yearbook*. A description of the raw data and their sources is contained in Table 8–8.

TABLE 8–8

Description of Raw Data and Sources

Data in billions of constant 1965 won		
RY	:	Gross national product; BOK, *ESY 1971*, pp. 10–11[a]
RYNA	:	Value-added in nonagricultural sectors, ibid., pp. 14–15
RI	:	Gross domestic fixed capital formation, ibid., pp. 10–11
RIA	:	Investment in agriculture, ibid., pp. 28–29
RNFI	:	Net factor income from abroad, ibid., pp. 10–11
RGRC	:	Grain consumption, BOK National Accounts Division
RIVG	:	Grain inventory investment, ibid.
RILG	:	Grain inventory level, ibid.
RMG	:	Imports of goods, including freight and insurance; BOK, *ESY 1971*, pp. 44–45
RXG	:	Exports of goods, including freight and insurance, ibid.
RMOS	:	Imports of services, other than freight and insurance, ibid.
RXOS	:	Exports of services, other than freight and insurance, ibid.
RT	:	Net transfer receipts from abroad on current account, ibid.
Data in billions of current won		
CY	:	Gross national product, *ESY 1971*, pp. 8–9
CYDP	:	Personal disposable income, ibid., pp. 36–37
CSH	:	Savings by households and private nonprofit institutions, ibid., pp. 22–23
CSC	:	Gross savings (including capital consumption allowances) by corporations and unincorporated enterprises, ibid.
CGS	:	Gross savings by government, including government enterprises, ibid.
CSTD	:	Statistical discrepancy between savings and gross domestic capital formation, ibid.
CDTR	:	Direct tax revenues, ibid., pp. 38–39
CITR	:	Indirect taxes, ibid.
CGT	:	Government transfers to the private sector, ibid.
Data in current millions of dollars		
DMGS	:	Imports of goods and services, *ESY 1971*, pp. 266–267
DMG	:	Imports of goods, including freight and insurance, ibid.
DCKL	:	Long-term private capital imports, ibid.
DCKS	:	Short-term capital imports, ibid.
DMA	:	Net reduction in foreign assets of monetary institutions, ibid.
DXG	:	Total exports of goods, Ministry of Finance, *Foreign Trade of Korea, MOF, FTOK* annual through 1971
DMGR	:	Imports of grain (SITC 04), ibid.

(continued)

TABLE 8–8 (concluded)

DMC	:	Imports of consumption goods (SITC 0, 1, 732.1,8; excluding 04), ibid.
DMK	:	Imports of capital goods (SITC 7, excluding 732.1), ibid.
DMI	:	Imports of intermediate goods (SITC 2, 3, 4, 5, 6), ibid.
DXGM	:	Exports of manufactured goods, ibid.

Exchange rate and export premia in won per dollar[b]

OR	:	Exchange rate
RXS	:	Export premium per dollar of export

Tariffs, tariff equivalents, export subsidies, and export premia in billions of won, current prices[b]

TM	:	Tariffs and tariff equivalents
PX	:	Total export premiums
SX	:	Total export subsidies
SXTAXD	:	Export subsidies in form of direct tax relief
SXTAXI	:	Export subsidies in form of indirect tax exemption

Price indexes

WPI	:	Wholesale price index, *ESY 1971*, pp. 314–315
WPIG	:	Wholesale price index for grains, ibid.
WPIOG	:	Wholesale price index for commodities other than grains, ibid.
WPITP	:	Wholesale price index for major trading partners, International Monetary Fund, *International Financial Statistics*[c]

Other data

PR	:	Farm population in millions of persons, *ESY 1971*, p. 6
PU	:	Nonfarm population in millions of persons, ibid.
NRD	:	Nominal interest rate on time deposits one year and longer, *ESY 1971*, p. 135 and *ESY 1960*
NRF	:	Interest rate on business loans in United States, United States Department of Commerce, *Survey of Current Business*
NLR	:	Commercial bank lending rate, *ESY 1957–71*

NOTE: BOK—Bank of Korea; ESY—*Economic Statistics Yearbook*, published by BOK; SITC—*Standard International Trade Classification*, manual published by the United Nations.

a. Where series is not continuous to 1953 in *ESY 1971*, it was traced as far back as possible in earlier yearbooks. The revised figures for 1970 were obtained from BOK, *Monthly Economic Statistics*, August 1971.

b. Sources for these items are mainly primary, including files of the Ministry of Finance, BOK, and USAID, Korea Mission.

c. Wholesale price indexes for the United States and Japan were averaged by using weights derived from their respective shares in total trade.

Table 8–9 gives the transformations to the raw data which are required to obtain the values of the endogenous and exogenous variables for the model. Much of the raw data are current price data and must be deflated to obtain values in terms of constant won. Direct and indirect tax revenues, private savings, government savings, government transfers to private sector, and subsidies in the form of direct and indirect tax exemptions are all deflated by a *GNP* deflator (i.e., multiplied by RY/CY as in Table 8–9). Imports of goods of various types are deflated by the overall import price deflator used in determining real *GNP* (i.e., multiplied by RMG/DMG). Capital imports are de-

TABLE 8–9

Transformations of Raw Data

Endogenous variables	
YNA	$= RYNA$
Y	$= RY$
DTR	$= (RY/CY)\cdot CDTR$
INT	$= (RY/CY)\cdot(CITR-TM)$
SG	$= (RY/CY)\cdot CGS$
GC	$= RGRC$
IVG	$= RIVG$
MG	$= (RMG/DMG)\cdot DMGR$
ILG	$= RILG$
SC	$= (RY/CY)\cdot CSC$
YDP	$= (RY/CY)\cdot CYDP$
SH	$= (RY/CY)\cdot(CSH+CSTD)-RIVG$
INA	$= RI-RIA$
I	$= RI$
CK	$= ((RMG+RMOS)/DMGS)\cdot DCKL$
DC	$= Y-SC-SH-IVG-SG+RNFI$
MC	$= (RMG/DMG)\cdot DMC$
MK	$= (RMG/DMG)\cdot DMK$
XGM	$= (RXG/DXG)\cdot DXGM$
X	$= RXG$
MI	$= (RMG/DMG)\cdot DMI$
M	$= RMG$
SK	$= ((RMG+RMOS)/DMGS)\cdot(DMA+DCKS)$
IV	$= SG+SC+SH-I+M+RMOS-RXOS-RT-X$
Basic commercial policy variables	
ORD	$= OR\cdot(WPITP/WPI)$
XPX	$= RXS\cdot(WPITP/WPI)$
SOX	$= ((SX\cdot 1000)/DXG)\cdot(WPITP/WPI)$
TAM	$= ((RM\cdot 1000)/DMG)\cdot(WPITP/WPI)$

(continued)

TABLE 8–9 (concluded)

Derived commercial policy variables	
XPM	$= (PX \cdot 1000/DMG) \cdot (WPITP/WPI)$
$SUBM$	$= XPM + TAM$
$SUBX$	$= SOX + XPX$
$SXDT$	$= (RY/CY) \cdot SXTAXD$
TAR	$= (RY/CY) \cdot TM$
$MARDEV$	$= (RDEV + RDEV_{-1} + RDEV_{-2})/3$
where	
$RDEV$	$= (R - R_{-1})/R_{-1}$
and	
R	$= ORD + (SUBM \cdot RMG + SUBX \cdot RXG)/(RMG + RXG)$
Other exogenous variables	
YA	$= RY - RYNA$
G	$= INT + TAR + DTR - SG$
IA	$= RIA$
PK	$= M + RMOS - RXOS - RT - X - CK - SK$
NFI	$= RNFI$
MST	$= RMOS - RXOS - RT$
RPG	$= WPIG/WPIOG$
POP	$= PR + PU$
GP	$= RGRC + RIVG - (RMG/DMG) \cdot DMGR$
RD	$= NRD$
LR	$= NLR$
RF	$= NRF$
$RINF$	$= (GNPD - GNPD_{-1})/GNPD_{-1}$
where	
$GNPD$	$= CY/RY$
MNC	$= M - MC - MK - MI - MG$
$NTOSH$	$= Y - INT - TAR - DTR - SC - YDP$
XGP	$= (RXG/DXG) \cdot (DXG - DXGM)$

flated by the price deflator for imports of goods and services (i.e., multiplied by $(RMG + RMOS)/DMGS$). Nonclassified imports MNC, consumption DC, inventory investment IV, government expenditure G, public capital imports PK, and net transfers of other sectors to households $NTOSH$ are all defined in terms of the other variables so that the deflation procedures do not alter any of the identities of the model. The basic commercial policy variables are deflated by a purchasing-power-parity index which is the ratio of the Korean wholesale price index to the wholesale price index of major trading partners.

Tables 8–10A through 8–10G give the actual values of the raw data used and Tables 8–11A through 8–11D give the values of the derived endogenous and exogenous variables.

TABLE 8–10A

Raw Data in Billions of Constant 1965 Won

Year	*RY*	*RYNA*	*RI*	*RIA*	*RNFI*	*RGRC*	*RIVG*
1953	421.93	218.60	35.28	4.04	9.42	—	36.13
1954	447.36	228.30	41.66	3.45	7.56	—	3.53
1955	474.54	250.50	48.98	4.53	7.75	162.87	0.95
1956	480.47	268.20	52.77	5.07	7.38	161.04	−11.32
1957	522.73	292.20	61.31	6.48	7.59	156.64	16.90
1958	551.69	305.40	57.79	5.35	7.59	180.61	9.45
1959	575.84	332.20	59.29	5.99	7.75	186.66	−3.73
1960	589.07	345.10	61.71	6.97	7.38	176.40	2.04
1961	613.61	345.10	65.26	8.35	5.79	192.47	6.81
1962	634.97	382.60	84.05	6.72	6.48	194.39	−15.25
1963	693.03	422.50	105.95	10.28	6.79	186.53	22.93
1964	750.31	436.00	93.33	10.66	6.53	218.38	20.85
1965	805.85	494.20	117.64	13.67	7.65	229.01	−0.15
1966	913.82	567.90	190.63	23.16	13.08	235.12	8.40
1967	995.16	668.30	232.09	19.24	21.53	238.91	−12.40
1968	1127.32	796.50	325.63	23.82	22.24	239.97	−12.47
1969	1306.19	935.80	407.76	24.26	23.04	246.20	30.08
1970	1422.33	1055.00	416.76	25.06	10.17	253.51	14.34

Year	*RILG*	*RMG*	*RXG*	*RMOS*	*RXOS*	*RT*
1953	36.13	91.67	10.64	1.83	13.30	49.92
1954	39.66	64.57	6.82	2.12	9.50	34.92
1955	40.61	86.95	4.91	2.57	13.83	39.84
1956	29.29	100.88	6.98	3.69	10.19	74.63
1957	46.19	117.12	7.09	6.61	13.80	83.07
1958	55.64	99.87	5.65	7.25	18.87	75.50
1959	51.91	80.02	6.29	7.85	21.20	54.59
1960	53.95	90.40	9.69	10.24	21.39	61.31
1961	60.76	82.30	11.89	9.00	26.75	46.93
1962	45.51	112.90	15.45	7.43	27.87	63.74
1963	68.44	143.56	23.78	9.98	22.80	66.65
1964	89.29	104.83	32.51	9.93	23.49	50.96
1965	89.14	120.15	47.80	9.44	29.12	53.95
1966	97.54	192.87	69.09	13.54	51.59	58.29
1967	85.14	263.59	87.82	17.73	82.81	59.76
1968	72.67	374.93	133.66	35.56	99.97	63.01
1969	102.75	468.83	183.02	47.40	122.38	64.65
1970	117.09	513.69	252.93	64.85	117.72	45.23

TABLE 8–10B

Raw Data in Billions of Won at Current Prices

Year	*CY*	*CYDP*	*CSH*[a]	*CSC*[a]	*CGS*[a]
1953	48.18	44.14	3.44	2.24	1.11
1954	66.88	60.23	2.97	3.31	0.35
1955	116.06	106.33	3.87	5.00	1.32
1956	152.44	140.25	−3.08	6.57	8.50
1957	197.78	179.63	9.55	8.85	8.18
1958	207.19	183.78	7.85	10.20	7.65
1959	221.00	190.85	3.11	12.35	7.18
1960	246.69	212.69	−2.65	13.11	11.91
1961	296.82	260.16	2.51	17.25	14.10
1962	348.58	295.71	−10.48	25.25	21.62
1963	487.96	421.98	6.15	35.60	24.57
1964	696.79	617.14	11.06	46.44	34.75
1965	805.85	696.87	2.30	62.66	49.74
1966	1032.04	886.32	42.05	76.66	62.19
1967	1242.35	1043.24	11.73	97.59	88.25
1968	1575.65	1286.04	15.26	121.93	133.97
1969	2047.11	1701.32	114.41	149.44	159.51
1970	2545.92	2081.66	84.19	182.85	206.43

Year	*CSTD*[b]	*CDTR*	*CITR*	*CGT*
1953	—	0.99	1.70	0.41
1954	—	1.27	3.29	0.50
1955	—	1.90	5.22	0.50
1956	—	2.32	6.74	0.61
1957	—	4.37	10.42	1.93
1958	—	4.89	12.64	3.08
1959	—	6.02	16.19	2.17
1960	1.92	6.46	18.73	1.51
1961	2.18	8.44	19.98	0.64
1962	2.58	9.09	28.65	3.23
1963	3.62	12.18	30.94	0.0
1964	3.14	16.63	33.92	−1.89
1965	5.06	22.14	47.13	0.35
1966	14.16	38.03	72.31	5.27
1967	22.71	53.46	98.66	3.69
1968	28.36	81.00	147.71	23.22
1969	33.11	115.01	196.90	31.75
1970	45.58	145.01	250.37	7.84

a. Includes current account transfers from abroad.

b. Before 1960, savings were estimated as a residual. Since then separate estimation of savings has resulted in a statistical discrepancy between savings and gross domestic capital formation.

TABLE 8–10C
Raw Data in Millions of Dollars, Dollar Prices

Year	*DMGS*	*DMG*	*DCKL*	*DCKS*	*DMA*	*DXG*
1953	—	345.40	—	—	—	40.10
1954	—	243.30	—	—	—	25.70
1955	337.30	327.60	0.0	−0.90	15.30	18.50
1956	394.00	380.10	0.0	−3.20	−18.70	26.30
1957	466.20	441.30	0.0	−2.90	4.10	26.70
1958	403.60	376.30	0.0	7.00	−45.30	21.30
1959	331.10	301.50	0.80	−0.60	−15.10	23.70
1960	379.20	340.60	2.60	0.60	−14.50	36.50
1961	344.00	310.10	0.20	−2.00	−30.30	44.80
1962	453.40	425.40	2.80	−6.70	56.50	58.20
1963	578.50	540.90	42.60	18.40	55.80	89.60
1964	432.40	395.00	10.30	−3.30	2.70	122.50
1965	488.30	452.70	19.10	−2.50	−16.20	180.10
1966	777.70	726.70	177.20	6.40	−119.20	260.30
1967	1060.00	971.90	233.40	45.20	−118.20	345.40
1968	1546.60	1412.60	383.10	13.20	−3.00	503.60
1969	1945.00	1766.40	372.10	56.50	−95.00	689.60
1970	2149.60	1940.00	292.10	122.40	29.20	922.80

Year	*DMGR*	*DMC*	*DMK*	*DMI*	*DXGM*
1953	—	—	—	—	0.90
1954	—	—	—	—	1.20
1955	6.36	25.42	57.02	189.81	1.40
1956	31.19	32.54	42.81	238.16	1.50
1957	84.33	40.98	41.94	235.57	3.10
1958	51.05	30.56	36.25	234.21	2.40
1959	17.53	16.08	41.81	209.75	3.00
1960	20.56	17.00	40.07	217.15	5.50
1961	30.21	15.65	42.39	195.80	8.50
1962	33.55	20.10	68.56	291.56	10.60
1963	107.23	24.14	113.17	314.54	39.60
1964	60.78	13.27	69.17	259.87	58.50
1965	54.44	16.28	73.23	319.66	107.00
1966	61.30	25.17	168.35	461.60	153.80
1967	76.57	40.48	305.27	573.79	215.40
1968	129.35	93.93	517.58	721.57	338.40
1969	250.33	129.84	571.64	870.90	481.60
1970	244.78	140.55	572.46	1025.44	651.50

TABLE 8-10D

Exchange Rate and Export Premia, Won per Dollar

Year	*OR*	*RXS*
1953	6.50	0.0
1954	18.00	8.50
1955	30.00	48.10
1956	50.00	52.90
1957	50.00	58.90
1958	50.00	64.00
1959	50.00	84.70
1960	62.50	83.90
1961	127.50	14.60
1962	130.00	0.0
1963	130.00	39.80
1964	214.30	39.70
1965	265.40	0.0
1966	271.30	0.0
1967	270.70	0.0
1968	276.60	0.0
1969	288.20	0.0
1970	310.70	0.0

TABLE 8-10E

Tariffs, Tariff Equivalents, and Export Subsidies in Billions of Won at Current Prices

Year	*TM*	*PX*	*SX*	*SXTAXD*	*SXTAXI*
1953	0.30	0.0	0.0	0.0	0.0
1954	0.84	0.22	0.0	0.0	0.0
1955	1.15	0.89	0.0	0.0	0.0
1956	1.50	1.39	0.0	0.0	0.0
1957	2.38	1.57	0.0	0.0	0.0
1958	4.39	1.36	0.02	0.0	0.0
1959	8.29	2.01	0.03	0.0	0.0
1960	10.20	3.06	0.04	0.0	0.0
1961	5.56	0.65	0.35	0.0	0.0
1962	6.93	0.0	1.18	0.31	0.26
1963	6.71	3.57	1.70	0.53	0.57
1964	8.51	4.86	3.26	0.99	1.20
1965	12.85	0.0	6.86	2.84	2.69
1966	18.00	0.0	12.93	5.02	5.33
1967	25.41	0.0	20.88	7.72	8.22
1968	37.88	0.0	37.78	11.13	19.26
1969	44.72	0.0	49.45	17.21	22.55
1970	50.92	0.0	76.48	26.50	34.70

TABLE 8–10F
Price Indexes

Year	*WPI*	*WPIG*	*WPIOG*	*WPITP*
1953	—	—	—	93.10
1954	—	—	—	94.70
1955	27.80	25.70	28.10	92.40
1956	36.60	41.10	34.30	96.70
1957	42.50	47.20	40.10	100.40
1958	39.90	38.70	39.60	97.20
1959	40.80	33.90	42.60	97.70
1960	45.20	40.60	46.10	97.90
1961	51.20	50.30	51.40	98.30
1962	56.00	53.30	56.50	97.60
1963	67.50	84.50	64.20	98.30
1964	90.90	106.70	87.80	98.50
1965	100.00	100.00	100.00	100.00
1966	108.80	105.00	109.40	102.80
1967	115.80	117.00	115.70	104.00
1968	125.20	130.00	124.50	105.60
1969	133.70	152.70	130.80	108.80
1970	145.90	168.60	142.50	112.80

TABLE 8–10G
Other Data

Year	*PR*	*PU*	*NRD*	*NRF*	*NLR*
1953	—	—	0.0480	0.0369	0.1830
1954	—	—	0.0900	0.0361	0.1830
1955	13.33	8.09	0.1200	0.0370	0.1830
1956	13.45	8.85	0.1200	0.0420	0.1830
1957	13.59	9.36	0.1200	0.0462	0.1830
1958	13.75	9.86	0.1200	0.0434	0.1830
1959	14.13	10.17	0.1120	0.0500	0.1750
1960	14.56	10.43	0.1000	0.0516	0.1750
1961	14.51	11.19	0.1210	0.0497	0.1750
1962	15.10	11.34	0.1500	0.0500	0.1640
1963	15.27	11.92	0.1500	0.0501	0.1570
1964	15.55	12.41	0.1500	0.0499	0.1590
1965	15.81	12.94	0.1790	0.0506	0.1850
1966	15.78	13.59	0.2640	0.0600	0.2600
1967	16.08	13.99	0.2640	0.0599	0.2600
1968	15.91	14.84	0.2610	0.0668	0.2580
1969	15.59	15.82	0.2390	0.0821	0.2400
1970	15.35	15.96	0.2280	0.0848	0.2400

TABLE 8–11A

Endogenous Variables

Year	*YNA*	*Y*	*DTR*	*INT*	*SG*	*GC*
1953	218.60	421.93	8.67	12.26	9.72	—
1954	228.30	447.36	8.50	16.39	2.34	—
1955	250.50	474.54	7.77	16.64	5.40	162.87
1956	268.20	480.47	7.31	16.52	26.79	161.04
1957	292.20	522.73	11.55	21.25	21.62	156.64
1958	305.40	551.69	13.02	21.97	20.37	180.61
1959	332.20	575.84	15.69	20.58	18.71	186.66
1960	345.10	589.07	15.43	20.37	28.44	176.40
1961	345.10	613.61	17.45	29.81	29.15	192.47
1962	382.60	634.97	16.56	39.56	39.38	194.39
1963	422.50	693.03	17.30	34.41	34.90	186.53
1964	436.00	750.31	17.91	27.36	37.42	218.38
1965	494.20	805.85	22.14	34.28	49.74	229.01
1966	567.90	913.82	33.67	48.09	55.07	235.12
1967	668.30	995.16	42.82	58.68	70.69	238.91
1968	796.50	1127.32	57.95	78.58	95.85	239.97
1969	935.80	1306.19	73.38	97.10	101.78	246.20
1970	1055.00	1422.33	81.01	111.43	115.33	253.51

Year	*IVG*	*MG*	*ILG*	*SC*	*YDP*	*SH*
1953	36.13	—	36.13	19.62	386.55	−6.00
1954	3.53	—	39.66	22.14	402.88	16.34
1955	0.95	1.69	40.61	20.44	434.76	14.87
1956	−11.32	8.28	29.29	20.71	442.05	1.61
1957	16.90	22.38	46.19	23.39	474.76	8.34
1958	9.45	13.55	55.64	27.16	489.36	11.45
1959	−3.73	4.65	51.91	32.18	497.28	11.83
1960	2.04	5.46	53.95	31.31	507.88	−3.78
1961	6.81	8.02	60.76	35.66	537.82	2.89
1962	−15.25	8.90	45.51	46.00	538.66	0.86
1963	22.93	28.46	68.44	50.56	599.32	−9.05
1964	20.85	16.13	89.29	50.01	664.54	−5.56
1965	−0.15	14.45	89.14	62.66	696.87	7.51
1966	8.40	16.27	97.54	67.88	784.79	41.37
1967	−12.40	20.77	85.14	78.17	835.67	39.99
1968	−12.47	34.33	72.67	87.24	920.11	43.68
1969	30.08	66.44	102.75	95.35	1085.55	64.05
1970	14.34	64.81	117.09	102.15	1162.96	58.16

TABLE 8–11A (concluded)

Year	*INA*	*I*	*CK*	*DC*	*MC*	*MK*
1953	31.24	35.28	—	421.81	—	—
1954	38.21	41.66	—	445.49	—	—
1955	44.45	48.98	0.0	480.47	6.75	15.13
1956	47.70	52.77	0.0	524.69	8.64	11.36
1957	54.83	61.31	0.0	543.14	10.88	11.13
1958	52.44	57.79	0.0	566.35	8.11	9.62
1959	53.30	59.29	0.21	579.19	4.27	11.10
1960	54.74	61.71	0.69	599.76	4.51	10.64
1961	56.91	65.26	0.05	591.83	4.15	11.25
1962	77.33	84.05	0.74	634.20	5.33	18.20
1963	95.67	105.95	11.31	667.14	6.41	30.04
1964	82.67	93.33	2.73	705.08	3.52	18.36
1965	103.97	117.64	5.07	747.69	4.32	19.44
1966	167.47	190.63	47.03	812.47	6.68	44.68
1967	212.85	232.09	61.94	900.00	10.98	82.79
1968	301.81	325.63	101.68	998.27	24.93	137.38
1969	383.50	407.76	98.76	1102.62	34.46	151.72
1970	391.70	416.76	78.62	1187.75	37.22	151.58

Year	*XGM*	*X*	*MI*	*M*	*SK*	*IV*
1953	0.24	10.64	—	91.67	—	—
1954	0.32	6.82	—	64.57	—	—
1955	0.37	4.91	50.38	86.95	3.82	22.67
1956	0.40	6.98	63.21	100.88	–5.81	9.11
1957	0.82	7.09	62.52	117.12	0.32	11.81
1958	0.64	5.65	62.16	99.87	–10.17	8.29
1959	0.80	6.29	55.67	80.02	–4.17	9.22
1960	1.46	9.69	57.63	90.40	–3.69	2.50
1961	2.26	11.89	51.96	82.30	–8.57	8.16
1962	2.81	15.45	77.38	112.90	13.22	15.46
1963	10.51	23.78	83.48	143.56	19.69	10.76
1964	15.53	32.51	68.97	104.83	–0.16	–3.66
1965	28.40	47.80	84.84	120.15	–4.96	0.99
1966	40.82	69.09	122.51	192.87	–29.94	1.13
1967	54.77	87.82	155.62	263.59	–19.37	7.69
1968	89.81	133.66	191.52	374.93	2.71	14.99
1969	127.82	183.02	231.15	468.83	–10.22	–0.40
1970	178.57	252.93	271.52	513.69	40.80	21.54

TABLE 8–11B

Basic Commercial Policy Variables

Year	*ORD*	*XPX*	*SOX*	*TAM*
1953	—	—	—	—
1954	—	—	—	—
1955	99.71	159.87	0.0	11.67
1956	132.10	139.77	0.0	10.43
1957	118.12	139.14	0.0	12.74
1958	121.80	155.91	2.29	28.42
1959	119.73	202.82	3.03	65.84
1960	135.37	181.72	2.37	64.86
1961	244.79	28.03	15.00	34.42
1962	226.57	0.0	35.34	28.39
1963	189.32	57.96	27.63	18.07
1964	232.22	43.02	28.84	23.35
1965	265.40	0.0	38.09	28.39
1966	256.34	0.0	46.93	23.40
1967	243.12	0.0	54.29	23.48
1968	233.30	0.0	63.28	22.62
1969	234.53	0.0	58.35	20.60
1970	240.21	0.0	64.08	20.29

TABLE 8–11C

Derived Commercial Policy Variables

Year	*XPM*	*SUBM*	*SUBX*	*SXDT*	*TAR*	*MARDEV*
1953	—	—	—	0.0	2.63	—
1954	—	—	—	0.0	5.62	—
1955	9.03	20.70	159.87	0.0	4.70	—
1956	9.67	20.10	139.77	0.0	4.73	—
1957	8.42	21.16	139.14	0.0	6.29	—
1958	8.83	37.25	158.20	0.0	11.69	—
1959	15.94	81.79	205.85	0.0	21.60	0.106
1960	19.47	84.34	184.10	0.0	24.36	0.165
1961	4.05	38.47	43.03	0.0	11.49	0.200
1962	0.0	28.39	35.34	0.56	12.62	0.076
1963	9.60	27.67	85.59	0.75	9.53	0.006
1964	13.34	36.69	71.86	1.07	9.16	0.004
1965	0.0	28.39	38.09	2.84	12.85	0.060
1966	0.0	23.40	46.93	4.45	15.94	0.088
1967	0.0	23.48	54.29	6.19	20.35	−0.002
1968	0.0	22.62	63.28	7.96	27.10	−0.035
1969	0.0	20.60	58.35	10.98	28.53	−0.024
1970	0.0	20.29	64.08	14.80	28.45	0.001

TABLE 8–11D
Other Exogenous Variables

Year	*YA*	*G*	*IA*	*PK*	*NFI*	*MST*
1953	203.40	13.84	4.04	—	9.42	−61.39
1954	219.10	28.16	3.45	—	7.56	−42.30
1955	224.10	23.71	4.53	27.12	7.75	−51.10
1956	212.20	1.77	5.07	18.58	7.38	−81.13
1957	230.60	17.47	6.48	19.45	7.59	−90.26
1958	246.30	26.31	5.35	17.27	7.59	−87.12
1959	243.70	39.16	5.99	9.74	7.75	−67.94
1960	244.00	31.71	6.97	11.25	7.38	−72.46
1961	268.50	29.60	8.35	14.25	5.79	−64.68
1962	252.40	29.36	6.72	−0.69	6.48	−84.18
1963	270.60	26.35	10.28	9.31	6.79	−79.47
1964	314.30	17.01	10.66	5.23	6.53	−64.52
1965	311.60	19.53	13.67	−1.39	7.65	−73.63
1966	345.90	42.63	23.16	10.35	13.08	−96.34
1967	326.90	51.16	19.24	8.36	21.53	−124.84
1968	330.80	67.78	23.82	9.46	22.24	−127.42
1969	370.40	97.24	24.26	57.64	23.04	−139.63
1970	367.40	105.56	25.06	43.24	10.17	−98.10

Year	*RPG*	*POP*	*GP*	*RD*	*LR*	*RF*
1953	—	—	—	0.0480	0.1830	0.0369
1954	—	—	—	0.0900	0.1830	0.0361
1955	0.91	21.42	162.13	0.1200	0.1830	0.0370
1956	1.20	22.30	141.44	0.1200	0.1830	0.0420
1957	1.18	22.95	151.16	0.1200	0.1830	0.0462
1958	0.98	23.61	176.51	0.1200	0.1830	0.0434
1959	0.80	24.30	178.28	0.1120	0.1750	0.0500
1960	0.88	24.99	172.98	0.1000	0.1750	0.0516
1961	0.98	25.70	191.26	0.1210	0.1750	0.0497
1962	0.94	26.44	170.24	0.1500	0.1640	0.0500
1963	1.32	27.19	181.00	0.1500	0.1570	0.0501
1964	1.22	27.96	223.10	0.1500	0.1590	0.0499
1965	1.00	28.75	214.41	0.1790	0.1850	0.0506
1966	0.96	29.37	227.25	0.2640	0.2600	0.0600
1967	1.01	30.07	205.74	0.2640	0.2600	0.0599
1968	1.04	30.75	193.17	0.2610	0.2580	0.0668
1969	1.17	31.41	209.84	0.2390	0.2400	0.0821
1970	1.18	31.31	203.04	0.2280	0.2400	0.0848

(continued)

TABLE 8–11D (concluded)

Year	*RINF*	*MNC*	*NTOSH*	*XGP*	*RT*
1953	—	—	−7.79	10.40	49.92
1954	0.309	—	−8.16	6.50	34.92
1955	0.636	13.00	−9.77	4.54	39.84
1956	0.297	9.40	−10.84	6.58	74.63
1957	0.193	10.21	−14.51	6.27	83.07
1958	−0.007	6.43	−11.50	5.01	75.50
1959	0.022	4.33	−11.49	5.49	54.59
1960	0.091	12.16	−10.27	8.23	61.31
1961	0.155	6.91	−18.63	9.63	46.93
1962	0.135	3.09	−18.43	12.64	63.74
1963	0.283	−4.83	−18.09	13.27	66.65
1964	0.319	−2.15	−18.67	16.98	50.96
1965	0.077	−2.90	−22.95	19.40	53.95
1966	0.129	2.73	−36.55	28.27	58.29
1967	0.105	−6.57	−40.53	33.05	59.76
1968	0.120	−13.23	−43.66	43.85	63.01
1969	0.121	−14.95	−73.73	55.20	64.65
1970	0.142	−11.45	−63.67	74.36	45.23

NOTES

1. The implicit production function which we use is

$$YNA_t = f(INA_{t-1}, INA_{t-2}, \ldots, INA_{t-T})$$

where INA_t is the investment in nonagricultural sectors in period t. We also assume that depreciation takes place at a rate γ with respect to earlier years investment and that investment enters the function f in a logarithmic form, i.e.,

$$YNA_t = \alpha + \beta\,[\log_e(INA_{t-1}) + \gamma \log_e(INA_{t-2}) + \ldots + \gamma^{T-1} \log_e(INA_{t-T})]$$

Defined recursively, this becomes (approximately for very large T)

$$YNA_t = (\alpha - \gamma\,\alpha) + \gamma\, YNA_{t-1} + \beta \log_e(INA_{t-1})$$

The estimate of the coefficient γ is the estimated depreciation rate.

2. The test for an increasing incremental capital-output ratio was suggested by Albert Fishlow.

3. The sample period was extended to 1971, since preliminary data for 1971 were available for *YNA*.

4. This is the incremental capital-output ratio on a net basis, i.e., allowing for estimated depreciation.

5. ρ is the coefficient of autocorrelation as estimated in the terminal iteration of the Cochrane-Orcutt technique.

6. These elasticities are estimated from the regression equations by multiplying the coefficient of *Y* by the ratio of the means of *DTR* and *Y* or *INT* and *YNA* as the case may be.

7. The current rate of inflation and the rate of inflation lagged once were sufficient

to explain expected rates of inflation. The rate of inflation lagged more than once had little explanatory power.

8. Several readers of the draft manuscript commented that they did not understand how corporate savings could be affected positively by the interest rate. It is sometimes argued, for example, that marginal efficiency of investment is the relevant variable because corporations save only to invest in productive capacity. This is a common fallacy and represents a failure to understand the concept of reservation demand. Self-financed investment by a tightly controlled corporation, typical in Korea, represents a decision not to distribute profits for the purpose of increased consumption and a decision not to seek outside financing, but rather to retain profits for financing investment. As for the substitution effect, a higher interest rate makes self-financing more attractive than outside financing for both working and fixed capital and saving a better choice than consumption. Of course the income effect works in the opposite direction so that the coefficient of the interest rate has no a priori sign and must be determined empirically.

9. For example, the Medium Industry Bank and the Korea Development Bank.

10. Loan rates of commercial banks were more than 24 percent over the latter 1960s which corresponds to a real interest rate of more than 10 percent.

11. These elasticities were determined with respect to percentage changes in the total effective exchange rate, i.e., $ORD + SUBM$.

12. We made no attempt to specify the structure so that the system would be triangular. After the model was specified a priori we attempted to triangularize the matrix.