EFFECTS OF HIGHER OIL PRICES ON RESOURCE ALLOCATION AND LIVING STANDARDS: THE CASE OF KOREA

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I. INTRODUCTION

THE OPEC cartel's spectacular success in raising real world oil prices over the past decade has brought about substantial net resource transfers from energy-poor to energy-rich countries within the world economy. In accommodating these resource transfers, both energy exporting and importing economies have been confronted with adjustment pressures. Of course the intensity and nature of these adjustment pressures has differed substantially between countries according to, among other things, their resource endowment, their net trade position with respect to oil and other energy based products, and the degree of openness of their economies to world trade.

Our concern here is with quantifying the short- and medium-term adjustment pressures on the Korean economy imposed by continued increases in oil prices. In view of its openness to world trade and its heavy reliance on imports for its crude oil requirements to fuel industrial production, we would expect the level and composition of Korean economic activity to be especially sensitive to world oil price increases.[1] Nevertheless, Korea was able to quickly overcome the adverse effects of the first OPEC "oil shock" started in 1973, principally through increased exports of manufactured goods. However, undertaking the resource adjustments to restore economic balance following the larger world oil price increases of the late 1970s is proving a more enduring and difficult task: Korea's second-round attempts to restore external equilibrium through further expansion of traditional export commodities such as textile products are being hampered by the increasingly restrictive import policies pursued in advanced industrialized

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1 Exports constituted 25 to 30 per cent of GNP between 1975 and 1980. Korea's energy consumption increased by about 9 per cent per year from the early 1960s to the mid-1970s (equivalent to the annual growth rate in GNP during the same period). Over the period the share (evaluated in energy equivalents) of coal in total energy consumption declined from around 40 to 30 per cent and the share of firewood from around 50 to 12 per cent. The share of petroleum climbed from 10 per cent to 55 per cent (see [7]). Korea has no domestic oil production. Outlays on crude oil imports constituted 17 per cent of total Korean import expenditure in 1975.

countries. This, together with the failure so far of real labor costs in Korea to respond adequately to the reduction in the marginal product of labor due to the unfavorable shift in the terms of trade, has contributed to the present external and internal disequilibrium in that country's economy. In summary the essence of the problem Korean economic planners are facing in the wake of the second major oil price shock is how to facilitate the necessary resource adjustments to restore external and internal balance given a trade environment of increasing foreign exchange costs for oil imports together with quantitative restrictions on traditional exports in several markets.

In this paper we make use of a multisectoral model of the Korean economy to identify the adjustment pressures imposed by continued increases in real world oil prices. Our focus is on the mid-1980s. Our analysis is based on the World Bank's scenario on real world oil price movements for this period. The analysis pays particular attention to the impact on Korean living standards of this scenario, and to the size and nature of the relative price and ensuing quantity adjustments within the Korean economy and between Korea and overseas that will be required to offset oil price increases of this magnitude.

A feature of the model is its design flexibility and simple solution algorithm. We have exploited this to compare results of several experiments which accommodate different assumptions about the Korean macroeconomic environment, labor market behavior, and Korean export demand. While the numerical results refer specifically to Korea, it is to be hoped that the paper provides some guidance on the sorts of adjustment pressures energy-poor open economies are likely to confront under the influence of continued increases in the world oil prices.

II. ANALYTICAL FRAMEWORK

The projections reported later are derived from a comparative-static general-equilibrium model firmly based on conventional behavioral postulates, i.e., cost minimization by producers and utility maximization by consumers. The structural equations emphasize the role of relative prices in determining trade flows and the sectoral composition of the economy. The model therefore falls within the class of neoclassical price-responsive general equilibrium models, the common feature of which is the determination, around an input-output system of accounts, of commodity and factor prices and quantities in an equilibrating process.[2]

There have been growing interests in recent years in this type of model, which has its emphasis on economic theory, as compared with the more ad hoc time series approach to model building. It is becoming increasingly obvious that while many models can fit available time series data, it is only by paying close attention to theory that models can be made to provide insights into the implications of disturbances, such as higher world oil prices, which carry the economy away from previously established patterns.

Our model contains a detailed treatment of commodity (both imported and

[2] For other examples of this type of model, see [1] [2] [3] [8] [9] [11].

Fig. 1. Schematic Input-Output Data Base for Korean Model

Input \ Output (Number of Categories)		Industries (Current Goods Production)	Industries (Capital Formation)	Household Consumption	Exports	Others (Government and Stocks)	Import Duty	
		10	10	1	1	1	1	
Domestic commodities	10	$\tilde{A}$	$\tilde{B}$	$\tilde{C}$	$\tilde{D}$	$\tilde{E}$		Row sum = total usage of domestic commodities
Competing import commodities	10	$\tilde{F}$	$\tilde{G}$	$\tilde{H}$		$\tilde{I}$	$-\tilde{Z}$	Row sum = total competing imports (c.i.f.)
Noncompeting imports	5	$\tilde{J}$					$-\tilde{Y}$	Row sum = total noncompeting imports (c.i.f.)
Wages	1	$\tilde{K}$						
Payments to fixed capital	1	$\tilde{L}$						
Payments to land	1	$\tilde{M}$						
Other costs	1	$\tilde{N}$						
		Column sum = outputs of domestic industries						

Note: This data base is derived from the 1975 input-output tables compiled by the Bank of Korea. The model distinguishes ten categories of domestic commodities, ten categories of competing import commodities, five categories of noncompeting import commodities and ten domestic industry categories. Each domestic industry produces its corresponding domestic commodity.

TABLE
MAIN EQUATIONS AND VARIABLES

Identifier	Description	Equation	Number
Commodity and factor demands:			
(1)	Domestic commodities for domestic use	$D=f_D(Z, C, P_1, P_2)$	g
(2)	Competing import commodities	$M=f_M(Z, C, P_1, P_2)$	g
(3)	Noncompeting import commodities	$M^N=f_M{}^N(Z)$	n
(4)	Demands for labor, capital, and land	$L=f_L(Z, P_3)$	m
(5)	Export demand	$E=f_E(P_1{}^*, Q_E)$	g
Zero pure profits:			
(6)	in production	$P_1=w(P_1, P_2, P_2{}^N, P_3)$	h
(7)	in exporting	$P_1=\hat{P}_1{}^*\theta S$	g
(8)	in importing: competing	$P_2=\hat{P}_2{}^*\theta T$	g
(9)	noncompeting	$P_2{}^N=\hat{P}_2{}^{*N}\theta T^N$	n
Market clearance:			
(10)	for domestic commodities	$Z=D+E$	g
(11)	for primary factors	$L^*=L$	m
Other equations:			
(12)	Balance of trade	$B=(P_1{}^*)'E-(P_2{}^*)'M-(P_2{}^{*N})'M^N$	1
(13)	Consumer price index	$\alpha=f_\alpha(P_1, P_2)$	1
Total $=6g+h+2n+2m+2$			

Note: The diagonal matrix is denoted by $\wedge$.

domestic) and primary factor flows to current production, capital formation, household consumption, exports, and other (mainly government) final demands. These linkages can be illustrated by reference to the input-output data base shown schematically in Figure 1.

Matrix $\tilde{A}$ represents the flows of domestic commodities into the production processes of domestic industries. Matrix $\tilde{B}$ represents domestic commodity flows to capital formation while vectors $\tilde{C}$, $\tilde{D}$, and $\tilde{E}$ represent those to households, exports, and other (mainly government) demands respectively. Matrices $\tilde{F}$, $\tilde{G}$, $\tilde{H}$, and $\tilde{I}$ represent the flows (valued in duty-paid domestic prices) of competing import commodities to current production, capital formation, household and other demands respectively. $\tilde{Z}$ represents the negative of import duties paid on these imports. Matrix $\tilde{J}$ represents the flows of noncompeting imports to current production and $\tilde{Y}$ the negative of the duties paid on these imports. Finally the vectors $\tilde{K}$, $\tilde{L}$, $\tilde{M}$, and $\tilde{N}$ represent wages, payments to fixed capital, payments to land, and a residual other-costs category for each industry.

The model contains equations to explain all the commodity and factor flows in Figure 1. The main equation types are depicted schematically in Table I.[3] They may be divided into four groups.

[3] The model is drawn from [3]. A complete algebraic specification is contained in [10].

I

OF THE KOREAN MODEL

Variable	Description	Number
D	Demands for domestically produced commodities	g
Z	Output levels in each industry	h
C	Aggregate real absorption	1
P_1	Local prices of domestic commodities	g
P_2	Local prices of competing import commodities	g
M	Demands for competing import commodities	g
M^N	Demands for noncompeting import commodities	n
E	Exports	g
$P_1{}^*$	Foreign currency prices for exports	g
Q_E	Shift term of foreign export demand curve	g
L	Demands for primary factors	m
P_3	Prices for primary factors	m
θ	Exchange rate (won/foreign currency)	1
S	Rates of export subsidy (1+ad valorem rate)	g
$P_2{}^*$	Foreign currency prices for competing imports	g
T	Rates of protection on competing imports (1+ad valorem rate)	g
$P_2{}^N$	Local prices of noncompeting imoprts	n
$P_2{}^{*N}$	Foreign currency prices for noncompeting imports	n
T^N	Rates of protection on noncompeting imports (1+ad valorem rate)	n
L^*	Factor employment levels	m
B	Balance of trade (in foreign currency)	1
α	Consumer price index	1
	Total: $10g+h+4n+3m+4$	

A. *Commodity and Factor Demands*

Industry demand equations for domestic and imported commodities and primary factors are derived from the assumption that producers choose their commodity and factor inputs to minimize their production costs subject to constant-returns-to-scale production functions of a three-level or nested form. At the first level is the Leontief assumption of no substitution between input categories, e.g., rubber products and textile products, or between them and an aggregate of the primary factors. At the second level are CES functions describing substitution between imported and domestic sources of each input category, e.g., between imported rubber products and domestically produced rubber products. This substitutability is absent in the case of noncompeting commodities. At the third level are CES functions describing substitutability between the primary factors (labor, fixed capital, and land). Household demand equations for domestic and imported commodities are derived assuming that consumers maximize an additive nested utility function subject to an aggregate budget constraint. The nests of commodity categories contain CES functions describing substitutability in consumption between domestic and imported sources of each consumer good.

Domestic demand is represented by equations (1) to (4). Equations (1) and (2) depict an aggregation over the four sources of domestic demands of Figure 1 (current production, capital formation, household demands, other demands). They contain as arguments, vectors of local prices of domestic and imported commodities (P_1 and P_2) and activity variables (represented by Z and C). Z, the vector of industry output levels, appears in the equations to explain demands for intermediate inputs. C is the level of real domestic absorption, i.e., public and private consumption and investment. The inclusion of a single scalar variable to reflect the levels of final demands by domestic users considerably simplifies the model treatment. The equations allow commodity demands to respond to the distribution of aggregate absorption across households, the government, and capital formation by industry.

Equations (1) and (2) contain a set of elasticities describing the extent of substitution between domestic and imported sources of supply in each of the end uses, current production, capital formation, and household consumption.[4] In addition to import-domestic substitution elasticities in consumption, the equations contain household expenditure and own- and cross-price elasticity parameters.[5]

Equation (3), which contains no parameters, indicates a Leontief formulation of noncompeting import demands. These play a major role in the natural-resource-poor Korean economy. Because the production functions allow for substitution between primary factors but not between them and other inputs, the primary factor demands, depicted by (4), are explained only by outputs and factor prices. The equations contain elasticities of substitution between primary factors reflecting the extent to which producers alter their input ratios of land, labor, and capital in response to changes in their relative prices.[6]

Commodity export demand equations (5) contain as arguments, foreign export prices P_1^* and Q_E which compensate for shifts in the foreign demand curve of export commodities. Each export demand equation contains only one parameter, the reciprocal of the foreign elasticity of demand for the respective export commodity. All such parameters have been assigned a value of 20, which is tantamount to assuming that Korea is a "small country" with respect to its exports.

B. *Zero Pure Profits*

The model contains zero pure profits conditions[7] for each of the activities recognized: production (of goods and services and capital formation), exporting, and importing. The first of these, equation (6), implies that domestic prices (P_1), i.e., revenue per unit of activity in each industdy, equal costs per unit of activity.

[4] One of the most difficult task in modelling a country's international trade is to obtain accurate estimates of these elasticities. Here the import-domestic substitution elasticities are set at 2.0 for all commodities and end uses. This value was chosen on the basis of consideration of empirical estimates for these elasticities in other countries. No estimates for these parameters are available for Korea nor has it yet been possible to assemble the data base required for their estimation.

[5] Values for these parameters are based on the estimates in [5], a study of Korean household demands.

[6] Values for these elasticities were obtained from the studies on production functions of Korean industries reported in [4] and [6].

[7] That is, profits accrue only to factors of production. This follows from the assumption of constant returns to scale and competitive behavior.

Assuming constant-returns-to-scale production functions, equation (6) contains no output variables. Note also that equation (6) indicates that the number of domestic industries (h) equals the number of domestic commodities (g). It is this one-to-one relationship between industries and domestic commodities that enables the model to be formulated without explicit reference to commodity supply equations.

The second condition, equation (7), equates the revenue from exporting (right hand side) to the cost (the domestic commodity price). Finally, equations (8) and (9) equate the selling prices of imported commodities (P_2 and P_2^N) to the cost of importing (which represents the domestic currency equivalent of the foreign currency price, including the tariff).

C. *Market Clearing*

Equation (10) equates demand and supply for domestically produced commodities. Equation (11) indicates that factor demands are satisfied. As illustrated later, (11) does not necessarily impose full-employment assumptions on primary factors.

D. *Other Equations*

Included in the model are equations which define useful summary variables such as GDP, equations which aggregate variables, for example, industry labor demands to the work force level, equations which describe capital accumulation, rates of return and investment allocation across industries, and indexing equations which, for example, index money wages to consumer prices. Table I provides two examples, equation (12) which defines the balance of trade and equation (13) the consumer price index.

E. *Computational Procedure*

Simple matrix methods are used. The equations are first converted to linear percentage-change form. The model can then be represented by

$$\tilde{W}\tilde{x}=\tilde{0}\,, \qquad (14)$$

where $\tilde{W}$ is a $p\times q$ matrix of elasticities,[8] $\tilde{x}$ is the $q\times 1$ vector of percentage changes in variables, p is the number of equations, and q the number of variables. The next step is the choice of $q-p$ exogenous variables. From Table I we see that $q-p=4g+2n+m+2$. A solution is then derived via

[8] The elements of $\tilde{W}$ represent functions of the various elasticity parameters described earlier and a set of cost and sales share coefficients derived from the input-output data base describing the economy's production technology and sales linkages. Production techniques for domestic industries are reflected in the shares in industry production costs accounted for by the costs of domestically produced and imported intermediate inputs and primary factor inputs. Similarly, the disposition of domestically produced and imported commodities is reflected in their sales shares to intermediate usage for current production, capital formation, households, exports and other demands. These cost and sales coefficients are assumed to be constant. That is, the model cannot accommodate technological change.

TABLE II

SCHEMATIC REPRESENTATION OF EXOGENOUS VARIABLES

Variable	Description	Number
P_2^*, P_2^{*N}	Foreign currency prices for competing and noncompeting imports	$g+n$
T, T^N	Rates of protection on competing and noncompeting imports	$g+n$
Q^E	Shift term in foreign export demand curve	g
θ	Exchange rate (won/foreign currency)	1
$(S)_j, j \in H_1$; $(E)_j, j \notin H_1$	A selection of export subsidies and export levels	g
$(L^*)_j, j \in H_2$; $(P_3)_j, j \notin H_2$	A selection of factor employment levels and factor prices	m
C; B	Either aggregate real absorption (C) or the balance of trade (B)	1
	Total: $4g+m+2n+2$	

$$\tilde{x}_1 = \tilde{W}_1^{-1} \tilde{W}_2 \tilde{x}_2 , \qquad (15)$$

where $\tilde{x}_1$ and $\tilde{x}_2$ are, respectively, the $p\times 1$ and $(q-p)\times 1$ vectors of endogenous and exogenous variables, and $\tilde{W}_1$ and $\tilde{W}_2$ the corresponding segments of $\tilde{W}$.

III. ALTERNATIVE SIMULATION EXPERIMENTS AND EXOGENOUS VARIABLES

A feature of the flexible solution algorithm of equations (14) and (15) is that a set of the exogenous variables required to close the model can be chosen in a number of different ways. Here we consider five experiments with different closures which incorporate alternative assumptions about the Korean macroeconomic and trading environment on which the "oil shock" is imposed. The basic types of alternative closures are set out in Table II.

To close the model, $4g+2n+m+2$ variables must be exogenously determined. In each of the five experiments, $3g+2n+1$ variables, i.e., P_2^*, P_2^{*N}, T, T^N, Q_E, and θ, are always exogenous. The exogeneity of P_2^* and P_2^{*N} derives from the adoption of the "small country" assumption on the import side, i.e., that world prices are independent of Korean import demands. The exogeneity of T, and T^N and Q_E is self-explanatory. The exogenous setting of θ is reflected in its use as the numeraire in all experiments. In each experiment the model endogenizes the ratio of the domestic price level relative to the foreign currency price of traded goods. It has nothing however to say about how the projected movements in this ratio are distributed between changes in the exchange rate on the one hand and changes in the domestic rate of inflation on the other.

Selection of the remaining set of $g+m+1$ exogenous variables distinguishes the experiments. As indicated in Table II, the first (g) is a selection between export subsidies and export levels. The set H_1 contains the labels of those commodities for which the model is allowed to explain export levels, i.e., the export subsidy variables for those commodities are set exogenously. For the rest, i.e., $\{j \notin H_1\}$, export levels are exogenous and the model determines the export subsidy (or tax) required to achieve the exogenously specified export levels.[9] The second (*m*) is a selection between factor employment levels and factor prices. The set $\{j \in H_2\}$ contains the factors of which employment levels are to be treated exogenously. The set $\{j \notin H_2\}$ represents the factors of which prices are to be determined exogenously. If the employment level of a factor is exogenous then the corresponding factor price is endogenous and vice versa. Finally either aggregate real absorption (C) or the balance of trade (B) is specified exogenously.

A. *Short-run Adjustment (Experiments 1 and 2)*

Export levels are determined endogenously for the export-oriented commodity categories 3, 4, 5, 6, 7, and 8 (see Table IV for labels). For these commodities the corresponding export subsidy variable is exogenous. For commodities 1, 2, 9, and 10, which have only minor links to exports, exports are set exogenously and the corresponding export subsidy variables are endogenous. Factor employment levels for capital and land are specified exogenously, with their corresponding prices being endogenous. The price of labor is specified exogenously, with industry labor demands being determined endogenously. C is exogenous but B is endogenous. Experiments 1 and 2 differ only in their treatment of wages. In experiment 1, money wages are assumed fixed. In experiment 2, however, money wages are fully indexed to the model's domestic consumer price index. That is, real wages are assumed fixed in the face of higher world oil prices.

These latter assumptions, i.e., (i) fixed industry-specific capital and land stocks, (ii) a slack labor market with demand-determined employment, and (iii) the maintenance of aggregate real domestic absorption independent of increases in world oil prices with an endogenous balance of trade, depict a short-run adjustment environment. Since investment is endogenous but is not allowed to augment the capital stocks, the "short run" cannot be longer than the typical gestation lag on new investment. It is assumed here to be two years.

B. *Medium-run Adjustment (Experiments 3 to 5)*

The closure of the model in these experiments is designed to reflect a medium-term adjustment period. For purposes of simulation this period is assumed to be five years. The model projections indicate how the state of the economy differs in the fifth year from what it would have been had the changes in world oil prices not occurred. No attempt is made to trace the time path of endogenous variables between the base year and the solution year. The key feature of the medium-term environment is the endogeneity of industry capital stocks. Instead,

[9] Since exports in the model take place according to the differential between world prices and domestic production costs the model is allowed to explain exports for those commodities whose link to exports is such that their domestic currency prices can be regarded as being set by their corresponding world prices. Notice in equation (7) that if $(S)_j$ is exogenous then $(P_1)_j$ will move with $(P_1{}^*)_j$. If $(S)_j$ is endogenous then $(P_1)_j$ will move independently of $(P_1{}^*)_j$. The percentage change in exports for non-export commodities (those with only a small proportion of their sales passing to exports) is set exogenously to zero.

rates of return to capital (endogenous in the short-run experiments) are set exogenously. The justifying paradigm takes the supply prices of capital for investment in Korean industries as being given on world markets. An exogenous shock (such as higher world oil prices) which causes rates of return in Korean industries to deviate from long-term global yields in the short-run is assumed to cause the corresponding industries to grow or decline over the five-year period so that domestic rates of return are once again in balance with world rates in the solution year (year five).[10] The mechanism ensuring this adjustment is the international flow of capital, which is implicit in the model.

The second feature of the medium-run environment of experiments 3 to 5 is that real domestic absorption is endogenous while the balance of trade is set exogenously. The model therefore indicates the change in the level of absorption necessary to meet an exogenously specified balance of trade constraint.

In experiments 3 and 4, the aggregate level of labor demand is set exogenously while the economy-wide real wage is endogenous. This reflects the assumption that changes in world oil prices do not have any necessary medium-term consequences for the real wage/employment mix. They do, however, have impact on the real wage level at a given level of employment. Experiment 5 assumes constant money wages with labor demands endogenously determined.

The difference between experiments 3 and 4 lies only in the treatment of exports. In all experiments except 4, the model determines export levels endogenously for the six commodity categories 3, 4, 5, 6, 7, and 8. In experiment 4, however, the percentage change in exports of commodity 5 (textile products), which amounts to one-third of total commodity exports in the base period, is set to zero.[11] That is, we assume that Korea is unable to increase its exports of textile products to generate the additional foreign exchange required to pay for its higher-priced crude oil imports. By comparing the results of experiments 3 and 4 we seek to capture some of the economic implications for Korea of the so-called "new protectionism," a characteristic of which is the imposition by the more advanced economies of import quotas on textiles and other standard-technology manufactured goods from newly industrialized countries such as Korea.

C. *Values of Exogenous Variables*

Events in the world oil market over the past decade suggest that any projections of oil prices relative to other world commodity prices must be highly speculative. Changes in oil prices will cause changes in other world commodity prices stemming from reactive shifts in supply and demand curves by end users. In particular, oil price changes will have implications for world prices of other energy and energy related commodities, especially those, such as coal, which may substitute oil, and others such as aluminium which require massive energy in

[10] It is implicitly assumed that the response period is sufficiently long enough to accommodate the reconfiguration of the capital stock occasioned by the world price changes. This requires ex post checking.

[11] In terms of Table II, $(E)_j$ (j=textile products) is set exogenously while $(S)_j$ becomes endogenous.

their inputs. The degree of such world price changes depends essentially on estimates of the length of the adjustment period to the initial price disturbance. Here, instead of employing any formal world commodity price model to trace such world price linkages, we simply assume that a 3 per cent annual increase in world crude oil prices will (on the basis that crude oil represents about two-thirds of the total production costs of petroleum products) lead to a 2 per cent annual increase in world petroleum product prices relative to the world prices of all other commodities.[12] This formula is based on the World Bank's working assumption [12] that real world oil prices will, on average, rise at 3 per cent per year over the 1980s. This annual price change is cumulated for two years in the case of the short-run experiments and for five years in the case of the medium-run experiments. In terms of the vector of exogenous variables $\tilde{x}_2$ in equation (15), the elements representing percentage changes in world import prices for crude oil and oil products and the foreign export demand shift term for crude oil[13] are set to these cumulated values. Values for all other exogenous variables are set to zero. These values apply to all experiments.

Assuming fixed commodity weights in import and export prices indexes this scenario is equivalent to an annual terms-of-trade decline for Korea of about 0.5 per cent.

IV. RESULTS OF EXPERIMENTS

Experiment results are compared for some key macroeconomic variables (Table III) and for selected industry and commodity variables (Tables IV and VI). To help interpret these results, Table V contains some additional information relating to production technology with respect to crude oil and oil products, fixed factor intensity, the disposition of commodity sales, import penetration, and projections of value-added changes (for experiment 1).

It is important to emphasize that the model is not being used here to provide forecasts about the likely absolute levels of endogenous variables at some future date. It merely projects the relative changes in the levels of these variables due to the postulated changes in selected exogenous variables. And it does this based on the assumption that the Korean economy is initially in a state consistent with the structural model and data base that gave rise to $\tilde{W}$ in equation (14). Thus the figure in line 4 of column 1, Table III, for example, indicates that, after an adjustment period of two years, aggregate labor demand (i.e., employment) would be 0.15 per cent lower than its level would have otherwise been had world oil

12 While Korea has no domestic crude oil supplies it has developed considerable oil refining capacity. According to the 1975 input-output tables, Korean exports of petroleum products (in terms of producers' prices) constituted 2 per cent of Korea's total exports. The tables also show imports of petroleum products whose landed duty-paid value constituted about 2 per cent of total imports. The existence in this sector of both exports and imports reflects the heterogeneity of products within the oil products classification.

13 In Table II, these variables are given as $(P_2{}^{*N})_j$ (j=crude oil), $(P_2{}^*)_j$ (j=oil products) and $(Q_E)_j$ (j=oil products). Korea does not export crude oil.

TABLE III

THE EFFECTS OF HIGHER WORLD OIL PRICES: SOME MACRO PROJECTION

Variable	Projections for Five Experiments[a]				
	Short Run		Medium Run		
	1	2	3	4	5
Aggregate real absorption[e]	0(Ex)[b]	0(Ex)	−1.17	−1.24	−13.39
Real wage rate	− 0.20	0(Ex)	−1.80	−1.99	− 0.67
Money wage rate	0(Ex)	0.47	−2.53	−3.10	0(Ex)
Aggregate labor demand	− 0.15	− 0.33	0(Ex)	0(Ex)	−13.01
Price index of consumer goods[f]	0.20	0.47	−0.74	−1.11	0.67
Price index of investment goods[g]	0.23	0.47	−0.37	−0.66	0.89
Aggregate exports (foreign currency value)[h]	− 0.50	− 1.08	2.35	2.16	−10.38
Aggregate imports (foreign currency value)[h]	0.99	0.88	2.35	2.16	−10.38
Balance of trade (billion won at 1975 won/U.S.$ exchange rate)	−52.46[c]	−69.11[d]	0(Ex)	0(Ex)	0(Ex)

[a] All projections are expressed in percentage changes with the exception of the balance of trade.

[b] 0(Ex) denotes an exogenous setting to zero of this variable, that is, the level is assumed to remain constant in the face of the oil price shock.

[c] Equivalent to 0.54 per cent of GNP in 1975.

[d] Equivalent to 0.71 per cent of GNP in 1975.

[e] The proportional composition of this absorption (between aggregate consumption, investment and government expenditure) is specified exogenously. The shares of these components in the aggregate are assumed to be unchanged by the shock. That is, balanced changes in absorption occur in experiments 3 to 5.

[f] Computed as a weighted average of the percentage changes in the domestic prices of consumer goods where the weights are commodity shares in aggregate consumption.

[g] Computed as a weighted average of the percentage changes in the costs of a unit of capital formation in each industry where the weights are industry shares in total investment.

[h] Balanced trade is assumed in the base period by ignoring, in choosing weights for the balance of trade equation, a deficit in the balance of trade present in the 1975 input-output tables. Hence in experiments 3 to 5, the percentage change in exports is forced to equal the percentage change in imports to restore the economy to balanced trade.

prices remained unchanged. Such a projection is of course dependent on numerous theoretical and parameter assumptions. Similarly, the figure in line 2 of column 3 indicates that, assuming the continuation for five years of the real world oil price increases discussed earlier, the economy-wide real wage would be 1.8 per cent lower in year five than it would otherwise have been had no change in world commodity price relativities occurred.

We now discuss in turn the results of each experiment. To avoid an overly complex discussion, detailed explanation of the industry and commodity results is given only for experiment 1. It is hoped that the detail on model structure and key input-output linkages is sufficient to indicate to the reader the key mechanisms underlying the patterns of response in the other experiments.

TABLE IV

PROJECTIONS OF INDUSTRY OUTPUTS AND LABOR DEMANDS

Variable	Projections for Five Experiments				
	Short Run		Medium Run		
	1	2	3	4	6
Industry outputs:					
1. Agriculture and fishery	−0.01	−0.13	−0.23	−0.20	−9.96
2. Mining	−0.23	−0.47	−0.29	0.12	−12.19
3. Processed foods (excl. refined sugar)	−0.13	−0.36	0.07	0.47	−10.89
4. Refined sugar	−0.08	−0.18	0.17	0.95	−9.29
5. Textile products	−0.36	−0.81	3.20	−0.50	−17.00
6. Petroleum products	−0.31	−0.46	−1.33	−1.17	−14.24
7. Rubber products	−0.83	−1.54	1.39	3.94	−15.92
8. Other manufacturing export	−0.48	−0.87	−0.12	1.27	−17.19
9. Other manufacturing import	−0.29	−0.52	−0.75	−0.50	−13.20
10. Services	−0.04	−0.06	−0.93	−0.99	−13.80
Industry labor demands:					
1. Agriculture and fishery	−0.02	−0.17	0.22	0.32	−10.97
2. Mining	−0.34	−0.69	0.25	0.76	−12.47
3. Processed foods (excl. refined sugar)	−0.37	−1.00	1.22	1.78	−10.46
4. Refined sugar	−0.58	−1.35	1.79	2.82	−8.79
5. Textile products	−0.75	−1.71	4.16	0.60	−16.67
6. Petroleum products	−1.43	−2.15	0.16	0.55	−13.81
7. Rubber products	−1.35	−2.51	2.14	4.82	−15.73
8. Other manufacturing export	−1.13	−2.06	0.97	2.52	−16.86
9. Other manufacturing import	−0.66	−1.17	0.25	0.64	−12.82
10. Services	−0.05	−0.08	−0.52	−0.53	−13.61

Note: All projections are in percentage change.

A. *Experiment 1*

The key to understanding the results for this experiment lies in the domestic price level projections. Increases in the world oil price have a direct impact on the Korean economy through higher domestic prices for imported oil, which lead to higher domestic prices for oil products, and then to higher production costs for industries dependent on intermediate usage of oil products. With world non-oil prices more or less fixed[14] in the face of increased domestic production costs, export industries and import-competing industries suffer a decline in international competitiveness. This is reflected in a decline in aggregate exports, an increase in aggregate imports, and a movement toward balance of trade deficit. The increase of the consumer price index by 0.2 per cent implies a corresponding fall in the real wage level. Nevertheless aggregate labor demand still falls by 0.15 per cent reflecting the lower domestic economic activity.

Variations in output response (Table IV) to the domestic cost/world price squeeze imposed on Korea by the oil shock can be explained essentially in terms of industry characteristics such as oil intensiveness in production, export related-

[14] Slight increases in world commodity prices occur as Korean commodity exports contract.

TABLE

SHORT-RUN SUPPLY FUNCTION COMPONENTS, OIL INPUT INTENSITY,

	Industry	Percentage Change in Value Added* $(P^{VA})_j$	$\frac{\sigma_j(S^W)_j\dagger}{1-(S^W)_j}$
1.	Agriculture and fishery	−0.003	4.069
2.	Mining	−0.137	1.669
3.	Processed foods (excluding refined sugar)	−0.298	0.448
4.	Refined sugar	−0.633	0.121
5.	Textile products	−0.492	0.724
6.	Petroleum products	−1.407	0.218
7.	Rubber products	−0.651	1.267
8.	Other manufacturing export	−0.818	0.586
9.	Other manufacturing import	−0.461	0.636
10.	Services	−0.014	2.492

* Derived from model solution.
† $\sigma=1.4$ for agriculture and fishery and 0.8 for other industries.
‡ Derived from input-output data base.

ness, import competitiveness, reliance on sales to household consumption and to government, and fixed factor intensity. How these affect output results is illustrated with the nested production functions employed by the model which imply short-run supply functions of the form,

$$z_j=\frac{\sigma_j(S^W)_j}{1-(S^W)_j}[(p^{VA})_j-w_j], \tag{16}$$

where for industry j, z_j is the percentage change in output, $(p^{VA})_j$ is the percentage change in the value added per unit of output, w_j is the percentage change in the unit cost of labor, σ_j is the elasticity of substitution between primary factors and $(S^W)_j$ is the share of labor costs in total primary factor costs. In experiment 1, w_j is zero (fixed money wages in each industry). Hence industry j's short-run output response may be divided into a component reflecting essentially its capital intensity $\sigma_j(S^W)_j/[1-(S^W)_j]$ and another the percentage change in value added $(p^{VA})_j$. Values for these components appear in Table V. The two industries with the lowest output responses are industries 1 (agriculture and fishery) and 10 (services). The oil price increase also raises their production costs, but because of their relative insulation from trade, both can pass on these cost increases in the form of increased selling prices for their products. Both have extensive direct sales linkage to household consumption which is assumed fixed in aggregate. This consumption linkage cushions the reductions in value added and hence their subsequent output reductions even though industry 10 suffers cost burdens from its relatively large direct employment of oil products.[15]

[15] Industry 10 also sells 11 per cent of its output to the government (whose real expenditures are assumed constant) and consumes 11 per cent of its output itself. A further 10 per cent of its sales goes into formation of "services" capital. While aggregate real investment is assumed fixed, the investment budget is reallocated as a result of the oil shock away

V

KEY SALES LINKAGES OF PRODUCTS, AND IMPORT PENETRATION

Share of Labor Cost in Value Added‡	Share of Crude Oil Products in Total Production Cost‡	Share of Sales to Household Consumption in Total Sales‡	Share of Exports in Total Sales (for Endogenous Export Products only)‡	Ratio of Imports to Total Domestic Production‡
0.744	0.019	0.655		0.129
0.676	0.028	0.037		0.164
0.359	0.015	0.657	0.062	0.040
0.131	0.009	0.408	0.370	0.000
0.475	0.017	0.222	0.364	0.055
0.214	0.712	0.032	0.063	0.101
0.613	0.030	0.131	0.534	0.022
0.423	0.037	0.130	0.334	0.169
0.443	0.046	0.121		0.468
0.757	0.063	0.314		0.015

The next lowest output responses are exhibited by industries 4 (refined sugar) and 3 (processed foods, excluding refined sugar), both of which, because they are specified as endogenous export industries, have their domestic prices determined by their world prices. Hence both suffer a domestic cost/world price squeeze because the inflationary impact in Korea of the higher oil prices cannot be compensated by increases in their selling prices. The result is a contraction both in value added and output. The contraction in value added is strongest for industry 4 because of its stronger export linkage. Its short-run output response is curtailed, however, due to its very high capital intensity. Since labor costs constitute only 13 per cent of its primary factor costs, the industry cannot easily contract output by reducing its labor inputs (the only option in the short run given the fixed capital stock assumption). For both industries 3 and 4 the strong direct linkages to household consumption offset the loss of demand through exports. Next in line is industry 2 (mining) which is not specified as an export industry. The main explanation for the reduction in its value added lies in its indirect export connection via its linkage (17 per cent of sales) to the export industry 8 (whose output contracts by 0.48 per cent) and its large indirect import linkage (41 per cent of sales) to the import-competing industry 9 (whose output declines by 0.29 per cent). Further, the relatively high labor intensity of mining in Korea (labor costs constitute 68 per cent of primary factor costs) intensifies the short-run output response.

Of the remaining five industries with the largest output contractions, industries 5, 7, and 8 have strong direct export connections and industry 9 is highly import-competing. Exports and hence outputs have contracted in all the four industries

from the trade industries towards those with weaker trade linkages. Thus the boost in investment in services (0.72 per cent) together with the direct link to services capital formation further cushions the overall output contraction experienced by the industry.

TABLE VI

COMMODITY EXPORT AND IMPORT PROJECTIONS: THE EFFECTS OF HIGHER WORLD OIL PRICES

Variable	Projections for Five Experiments					Share in Commodity Exports and Imports: Base Year[c]
	Short Run		Medium Run			
	1	2	3	4	5	
Exports:[a]						
3. Processed foods (excluding refined sugar)	−2.12	−5.43	12.32	18.74	−11.99	0.04
4. Refined sugar	−0.20	−0.43	1.71	3.78	−6.60	0.02
5. Textile products	−0.64	−1.46	6.74	0(Ex)	−16.82	0.34
6. Petroleum products	−2.09	−2.63	−9.90	−7.89	−17.93	0.02
7. Rubber products	−1.44	−2.69	3.27	7.97	−16.97	0.04
8. Other manufacturing export	−1.06	−1.88	0.02	4.72	−20.00	0.31
Imports[b] (competing):						
1. Agriculture and fishery	0.09	0.51	−2.62	−3.08	−11.26	0.11
2. Mining	−0.22	−0.05	−2.25	−2.25	−14.01	0.01
3. Processed foods (excluding refined sugar)	−0.08	−0.07	−1.13	−0.93	−12.47	0.02
5. Textile products	−0.23	−0.49	1.18	−1.55	−15.26	0.03
6. Petroleum products	0.12	0.10	0.07	−0.13	−11.36	0.02
7. Rubber products	−0.22	−0.44	0.13	−0.17	−13.34	0.00
8. Other manufacturing export	−0.26	−0.48	−0.04	0.03	−14.79	0.10
9. Other manufacturing import	−0.08	−0.25	−0.44	−0.63	−12.52	0.33
10. Services	0.49	1.01	−1.81	−2.59	−11.94	0.03
Imports (noncompeting):						
11. Cotton	−0.36	−0.81	3.20	−0.50	−17.00	0.03
12. Raw sugar	−0.08	−0.18	0.17	0.95	−9.29	0.02
13. Rubber	−0.83	−1.54	1.39	3.94	−15.92	0.01
14. Crude oil	−0.31	−0.46	−1.33	−1.17	−14.24	0.17
15. Other noncompeting imports	−0.39	−0.71	−0.13	0.48	−15.32	0.12

a In experiments 1 to 3 and 5 exports are endogenous for commodities 3 to 8. In experiment 4 exports are endogenous for commodities 3, 4, and 6 to 8.
b There are no imports of commodity 4 (refined sugar) in the data base.
c Derived from model's input-output data base.

in the face of the domestic cost/world price squeeze. Industry 6 (oil products) is specified here as an export industry and hence its selling price is set by world price. While the industry suffers big cost increases through its usage of crude oil (which represents 67 per cent of its production costs) and oil products (4 per cent of its production costs) these cost increases are partially offset by the increased selling price of oil products. Nevertheless the decline in value added is substantial. The resultant output contraction is cushioned by the high capital intensity of the industry. Industry 9 (other manufacturing import) has diverse sales linkages throughout the domestic economy. It supplies intermediate inputs to all industries for current production and for capital formation. Its output decline is explained primarily in terms of the shrinking domestic market it supplies. This industry, with a base year import penetration of 47 per cent, would seem particularly susceptible to import competition. Note however from Table

VI that imports by industry 9 show a slight fall though it is considerably less than the average contraction in domestic economic activity. Hence while increases in domestic cost generate pressures for import replacement these are more than outweighed by the shrinkage of the domestic market for industry 9's products. The net result is a relative increase in the overall share of industry 9 (met by increased import penetration) but a slight decline in total imports by industry 9.

Given the assumption of short-run capital and land fixity, percentage changes in labor demands (l_j) are directly proportional to changes in outputs (z_j). Thus,

$$l_j = z_j/(S^W)_j, \tag{17}$$

where $(S^W)_j$ is the share of labor in total primary factor costs in industry j (see Table V). Table VI indicates that as a result of the oil price increase the reduced aggregate demand for labor is redistributed away from those industries with direct and indirect export linkages toward those whose sales orientation is focused more on the domestic economy.

Projections on commodity exports and imports are shown in Table VI. The reasons for the negative export responses have already been discussed in our explanation of output response for the export industries. Two opposing forces are relevant in explaining the responses of competing imports. The first relates to the size of the domestic market and the second to the import replacement effect, the extent to which domestic users substitute imports for domestic products because of the increased cost of the latter relative to the imported product. Table VI shows that for some competing import commodities, total imports actually fall even though the domestic competing industry is confronted with a cost price squeeze. However, the fall in imports is less than the fall in outputs in the corresponding commodity categories indicating that the contribution to imports of the import replacement effect is outweighed by the decline in the size of the overall domestic market. Consider for example the import projection for commodity category 2 (-0.22 per cent). Industries 8 and 9 absorbs 33 per cent and 64 per cent of imports in this category respectively for current production. The import demand equations for import-competing commodities i used by industry j for current production $x_{(i)j}$ are given by,

$$x_{(i)j} = \underset{\substack{\text{(scale}\\\text{effect)}}}{z_j} - \underset{\text{(import substitution effect)}}{\sigma_i\left[p_{(i,2)} - \sum_s S_{(i,s)j}\, p_{(i,s)}\right]}, \tag{18}$$

where σ_i is the elasticity of substitution between the import and the domestic commodity in current production, $p_{(i,s)}$ is the percentage change in the price of the commodity from sources s ($s=1$ for domestic sources and 2 for imports), and $S_{(i,s)j}$ is the share of the commodity from source s in the total usage of the commodity in industry j in current production. Substituting values for projected variables and model parameters for industries 8 and 9 in (18), we have

$$x_{(2)8} = -0.48 - 2.0(0 - 0.29 \times 0.22) = -0.48 + 0.13 = -0.35\,,$$

and

$$x_{(2)9} = -0.29 - 2.0(0 - 0.34 \times 0.22) = -0.29 + 0.15 = -0.14\,.$$

Note that in both cases the positive contribution to import demand by import substitution (+0.13 per cent and +0.15 per cent for sales of commodity category 2 into industries 8 and 9 respectively) is more than outweighed by the contraction in the size of the domestic market (−0.48 per cent in industry 8 and +0.29 per cent in industry 9). Total imports of commodity category 2 are therefore approximated by;

$$x_{(2)} \simeq 0.33 \times (-0.35) + 0.64 \times (-0.14) = -0.21$$

which is close to the model projection of −0.22.

Finally, we note that imports of all noncompeting import commodities contract. The size of the contraction is identical to the output contractions of the industries into which the noncompeting imports are sold (by definition there is no import replacement effect). Thus, for example, cotton imports (which are absorbed entirely by the textile industry) contract by the same amount as the output for textile products.[16]

B. *Experiment 2*

In experiment 1, the inflation of 0.2 per cent implied a corresponding reduction in real wages. In experiment 2, however, real wages are independent of world oil price increases. With wages in Korea constituting about 60 per cent of total production costs, the effects of the world oil price increase on the domestic inflation observed in experiment 1 are exaggerated. This leads to a more intensive domestic cost/world price squeeze on trade (principally export) industries with correspondingly sharp adverse effects. Note however that the economy gains some respite on the import side, principally through its heavy reliance on noncompeting imports, the demands for which contract in line with the export and output prospects of the respective processing industries. Thus although the percentage decline in aggregate exports in experiment 2 is double that in experiment 1 the percentage increase in aggregate imports is actually slightly lower. This greatly modifies the short-run increase in the balance of trade deficit and hence the size of the national income decline.

C. *Experiments 3 and 4*

The basic mechanism deriving the results in these experiments is the balance of trade constraint. The initial effect of the higher foreign currency cost of imported crude oil is a deterioration of the balance of trade. However, given the assumptions of a constant balance of trade and constant employment, this tendency toward deficit must be eliminated by a reduction of the domestic price level relative to world prices sufficient to cause a redirection of resources from the domestic to the international account. As noted earlier the model has nothing to say about whether the return to balance-of-trade equilibrium comes about via a lowering of domestic inflation (reflecting for example the deflationary effects of a reduced money supply) or by an exchange rate devaluation, or by both.

16 Raw sugar is consumed entirely by industry 4, rubber by industry 7, and crude oil by industry 6. "Other" noncompeting imports are absorbed, however, by a number of domestic industries.

Whatever the combination of these two methods the effect is to increase the prices of tradeable goods, relative to the prices on nontradeables. The competitive position of the traded goods sector is therefore enhanced. The redirection of resources is accompanied by a fall in the level of domestic absorption which reflects the deteriorated terms of trade for Korea. This decline in the economy's terms of trade brings a reduction in the productivity of labor, which is translated into lower real wages at the constant employment level. Thus in experiment 3, for example, reductions in the domestic prices of all commodities except crude oil and oil products are sufficient to cause a 0.7 per cent decrease in the consumer price index.[17] To restore external balance and maintain employment, the higher world oil prices must be accompanied by a reduction in real national income of 1.2 per cent and a reduction in real wages of 1.8 per cent.

The industrial composition of GDP and the pattern of labor demands is biased toward the trade (especially export) industries, reflecting their enhanced international competitiveness. Thus outputs of export-oriented industries 3, 4, 5, and 7 expand. Within this group a combination of such demand side factors as the size of linkages to exports, household consumption and to intermediate input demands, as well as such supply side factors as the intensity of oil products use are important in explaining the variation in output response. Note that industry 8 (other manufacturing export), although export-oriented, shows an overall output contraction. Being intensive in its inputs of both oil products and the products of industry 9 (whose domestic price increase is second only to that for oil products), industry 8 gains less from the general cost reductions in the economy than do most other export industries. Further, it suffers from a sharply contracting domestic market for its product (21 per cent of its base year sales are absorbed by industries 9 and 10). The remaining export industry (oil products) still finds itself in a cost/price squeeze. The reduced domestic costs of its non-crude oil inputs together with the increased selling price for its product is insufficient to offset the greatly increased costs of its crude oil inputs. Further, the domestic demand for oil products falls. Note that while the strongly import-competing industry 9 gains a competitive advantage over the corresponding imported good in domestic markets this is more than offset by the strong reduction in the size of the domestic market it supplies. Output contractions in the remaining industries which are domestic-oriented result from the decline in domestic economic activity. The export-led growth in the outputs of the processing industries is responsible for the increased import demand for the noncompeting imports, i.e., cotton, raw sugar, and rubber. In the case of competing imports for categories 1, 2, 9, and 10, the negative effect on import demand by the contraction in the size of the domestic markets is reinforced by the import substitution effect which follows from the lower domestic price of the domestically produced good relative to its imported counterpart.

Consider now the differences in results between experiments 3 and 4. Recall that these experiments differ only to the extent that in experiment 4 the percentage change in exports of commodity 5 (textile products), which constitute

[17] Since world prices for crude oil and oil products are increasing, the fall in the domestic price level relative to world prices is somewhat greater than this.

nearly one-third of Korea's total commodity exports in the base year, is set to zero. With Korea no longer able to offset its increased foreign exchange requirements for imported crude oil with increased export earnings from textile products it is forced to redirect resources heavily into other major export sectors (principally industry 8). In addition Korea saves foreign exchange by a process of import substitution (principally in industry 9). The macroeconomic cost of this forced redirection of domestic resources toward other export- and import-competing sectors is a further reduction in domestic absorption and real national income together with a reduced real wage rate to sustain employment.

Finally, in experiments 3 and 4 the decline in real returns to labor (real wages) is considerably greater than the decline in real national income. This reallocation of factor returns away from labor can be understood in terms of the well-known theorem of Stolper and Samuelson. In experiment 3, for example, the terms-of-trade decline associated with the higher oil prices causes an expansion of the outputs of industries 3, 4, 5, and 7 and a contraction in the outputs of 1, 2, 6, 8, 9, and 10. We see from Table V that these expanding industries have an average labor intensity (labor share in value added) of 0.39 compared with an average for the group of contracting industries of 0.54. Experiment 4 tells a similar story. The five industries (2, 3, 4, 7, and 8) whose outputs expand have an average labor intensity of 0.44 compared to 0.53 for the five contracting industries. That is, in accordance with the theorem, the real reward of the factor (capital) employed relatively intensively in these expanding industries increases at the expense of the real reward earned by labor.

D. *Experiment 5*

The results of this experiment indicate the severe deflationary consequences for the domestic economy should real wages not be allowed to respond fully to the deterioration in the terms of trade due to world oil price increases. Assuming fixed money wages, Korea can only meet its foreign exchange constraint at the expense of a severe contraction in economic activity and sharply increased unemployment in all sectors. The sharp decline in overall economic activity is accompanied by a slump in both commodity exports and imports.

V. CONCLUDING REMARKS

The overwhelming impression from the projections is that the amount of adjustment required of the Korean economy to accommodate the World Bank's scenario for real world oil prices for the first half of the 1980s seems relatively minor.[18] Nevertheless, in view of the openness of the Korean economy and its total reliance on imported oil, the results indicate the importance of reductions

[18] Of course, the world price increases envisaged in the 1980s scenario are much lower than those which actually occurred during the 1970s. Since the model is linear in percentage changes of its variables, readers who wish to obtain some idea of what the model would imply about the size of the adjustment pressures associated with the much larger shocks of recent years can do so by multiplying the results by a scale factor which represents the ratio of the oil price increase which actually occurred to that assumed in this analysis.

in real labor costs to mitigate the adverse effects of higher world oil prices on aggregate labor demand, the balance of trade, and the contractionary perssures on trade industries. The noncompetitiveness of many Korean imports (as reflected in the high share of raw materials not produced in Korea) is an important factor in reducing the deterioration in economic activity, employment, and the balance of trade.

Assuming that over the medium term the Korean economy faces a balance of trade constraint, the domestic price level must be reduced relative to world prices, to generate, through export expansion, the additional foreign exchange needed to pay for the higher priced oil imports. For Korea to avoid both domestic employment and balance of trade problems due to increasing world oil prices, real wage cuts must be accompanied by cuts in real domestic expenditure to facilitate the necessary release of resources from the domestic to the international account. A government policy response to the higher oil prices which reduces both aggregate expenditure and wage bills while simultaneously assisting the flow of resources into key export industries could do much to speed the adjustment process and hence preserve employment. External trade barriers which prevent Korea from expanding exports of key commodities such as textile products force Korea to engage in import substitution and expansion in export industries with reduced comparative advantage, thus increasing the size of the real wage and domestic expenditure cuts necessary to simultaneously maintain employment and meet its balance of trade constraint.

As with any applied study, the projections given here are conditional on the assumptions underlying the economic structure of the model. For this reason projections have been "justified" in terms of the underlying causal mechanisms which follow from structural characteristics of the Korean economy together with aspects of economic theory. Nevertheless, the question of the sensitivity of projections to changes in model parameters remains. The scope for sensitivity analysis with a model so heavily dependent on parameters as this one, is of course enormous. Of the key model parameters, only values for the import substitution elasticities lack econometric support from the available Korean data. Sensitivity analysis suggests that overall results are relatively invariant to moderate increases (to 3.0) and decreases (to 1.0) in the values assigned to these parameters. The very high role of noncompeting imports in Korea's import bill is of course the main factor behind this.

A second concern is that the production technology in 1975 is assumed to be fixed over the projection period. The fact that the base-year production technology is a little dated is unlikely to matter much. The crucial factor underlying the results is Korea's net import dependence on imported oil. While the share of oil in total imports fell from 17 to 15.4 per cent between 1975 and 1979, Korea's reliance on imported energy of all types actually increased from 58 per cent to 73 per cent, principally through intensified coal imports, the world price of which has tended to follow world oil prices.

The constant technology assumption over the projection period does set a limit on the plausible projection horizon. To the extent that a reduction in dependence on imported oil and/or the achievement of a relative improvement in domestic production techniques over this period, would help offset the extent of the terms of trade decline associated with the increased world oil prices and the size of the subsequent resource adjustments and decline in Korean living standards.

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