A General Equilibrium Model of Trade Policy and Resource Allocation

Wontack Hong*

One may approximate the changes in sectoral production and trade under different trade policies on the basis of partial equilibrium calculations. However, it is well known that partial equilibrium approach will not permit unambiguous forecasts if changes in, say, government subsidies are being contemplated for many sectors simultaneously. Moreover, policymakers usually do not know the general equilibrium consequences of subsidy intervention. Since every direct act of subsidizing some activity is also an indirect source of taxing others, one must have at least a rough idea of the overall impact of a complex of tax-subsidy scheme.

We will develop a general equilibrium model of trade policy and resource allocation on the basis of L. Taylor's model which is a local method of calculating resource pulls under various tax-subsidy schemes taking general equilibrium effects into account.(1) The model will permit substitution between primary factors of production in response to price differentials, and will show the impact of change in the set of policy instruments (such as tariffs, export subsidies, indirect taxes, exchange rates or foreign capital inflows) upon sectoral outputs, sectoral allocations of capital and labor, volume of sectoral exports and imports, and prices of outputs and primary factors.

(1) Description of the Model

Simply put, Taylor's methodology is just what economists have always

* The author is senior fellow at the Korea Development Institute and part-time lecturer, College, of Commerce Seoul National University. He is indebted to Professors Robert Dorfman and Irma Adelman for their comments on the earlier version of this paper.

(1) L. Taylor and S.L. Black, "Practical General Equilibrium Estimation of Resource Pulls under Trade Liberation, *Harvard Development Research Paper*, July, 1971.

done when they analyze the effects of exogenous parameter changes on a market allegedly in equilibrium. A set of equations characterizing the equilibrium is written down and differentiated, and enough differential changes in exogenous variables are specified to permit inference of differential changes in the endogenous variables by solution of a system of linear equations. Naturally, this works only for "small" changes.(2) Taylor justifies his approach saying that such small changes are relevant because a protectionist country is not likely to remove all its tax-subsidies at once, or even in five years.

Following is a modified version of Taylor's model. Our basic assumptions are as follows:

(i) Demand for goods by consumers can be described by an aggregate utility function, with the convenient property of separability. This permits application of the Frisch method of computing all direct and cross-price elasticities using budget proportion and income elasticity of every good.(3)

(ii) A modified small-country assumption is made about trading possibilities: imports have completely elastic supply, but demand elasticities for exports are less than infinite(though usually quite high).

(iii) We assume that the government imposes tariffs and indirect taxes, gives subsidies to various industries, and has an exogenously fixed expenditure vector. The difference between expenditures and tax revenues is covered by direct taxes on factor incomes, which are not calculated explicitly. Thus, equations linking factor payments, personal savings, and total consumption do not appear.

(2) For non-local effects, Johansen discusses integration of his growth model forward through time in a two-stage procedure: (1) make predictions of new levels of the endogenous variables from exogenous variables as we are doing here; (2) use these predictions as starting points for Gauss-Seidel iteration to determine a new equilibrium configuration for the economy, and continue from there (Taylor argues that there seems no computational reason why such a precedure could not be applied to a trade-oriented model to find the impacts of "large" tax-subsidy changes.). See L. Johansen, "Explorations in Long-Term Projections for the Norwegian Economy," *Economics of Planning*, 8 (1968), pp.70-117.

(3) R. Frisch, "A Complete Scheme for Computing All Direct and Cross Demand Elasticities in a Model with Many Sectors," *Econometrica*, April, 1959.

(iv) We will assume, as L. Taylor does, fixed coefficients for intermediate inputs and Cobb-Douglas functions of primary factors for value added. Taylor works with only one variable primary factor of production, labor, assuming that capital is fixed. He argues that this short run assumption is made necessary by the existence of many goods and only two identifiable domestic factors of production. That is, with two factors and constant returns, only two goods(usually) would be produced after tax-subsidy changes; but with one variable factor and decreasing returns(which result from assuming capital stocks to be non-shiftable among sectors), all goods can continue in production.

Since the model is to examine sectoral resource allocation with changes in tax-subsidy schemes, to fix the capital is to kill half of the usefulness of the model. We will make the allocation of capital endogenous by introducing a third category of primary factor called "specialized entrepreneurial ability" in addition to labor and capital. This "-ability" factor is a rather abstract concept, but since we will assume that this "-ability" factor(instead of capital in Taylor's model) is fixed and nonshiftable among sectors, its unquantifiable character would not make serious problems.(4)

(v) In the spirit of emphasizing on-the-job skill training effects as well as skill supply constraints, we will classify labor into various types of skill groups.

The model incorporates all goods that are imported noncompetitively(i.e., not domestically produced) into a single sector(sector 0). We assume q_1 competitively imported goods, q_2 exports, and q_3 goods that are not traded at the base point of time. Thus of our n goods, $n-1(=q_1+q_2+q_3)$ are domestically produced. For brevity, we write equations in the log-differential form. Capital letters denote stocks or flows, primes their log-changes($X'=dX/X$).

M_j: the base year flow level of commodity j imports

(4) We may well make both capital and labor variable without introducing any additional primary factor because, since the model will be dealing with only small incremental changes, we will not get a complete specialization in two goods in practical application of our model.

E_j: the base year flow level of commodity j exports

a_{ij}: a fixed coefficient relating commodity i for intermediate uses to X_j, the base year production in sector j ($j \neq 0$)

C_j: the base year final consumption demand for commodity j

g_{jm}: the price elasticity of demand for C_j with respect to p_m, the price of consumed good m (all domestic producer prices will be assumed to be unity in the base year)

g_{jy}: the consumption elasticity with respect to Y, which represents total consumer expenditures, i.e., $Y=$

$(1-S)\sum_{j=1}^{n-1} p_j(X_j - \sum_{i=1}^{n-1} a_{ji}X_i)$ where S is the average propensity to save.

Z_j: the exogenous government investment and inventory change demand for commodity j

where $j=0, 1, \ldots\ldots, n-1$.

We begin with a flow equation for the non-competitive import sector:

$$M_0M_0' - \sum_{j=1}^{n-1} a_{0j}X_jX_j' - C_0(\sum_{m=0}^{n-1} g_{0m}p_m' + g_{0y}Y') - Z_0Z_0' = 0 \qquad (1 \text{ equation})$$

For the q_1 goods which are competitively imported, we have

$$X_iX_i' + M_iM_i' - \sum_{j=1}^{n-1} a_{ij}X_jX_j' - C_i(\sum_{m=0}^{n-1} g_{im}p_m' + g_{iy}Y') - Z_iZ_i' = 0$$

(q_1 equations)

where M_j is the volume of good j imported; and for the q_2 exports, we have

$$X_kX_k' - \sum_{j=1}^{n-1} a_{kj}X_jX_j' - C_k(\sum_{m=0}^{n-1} g_{km}p_m' + g_{ky}Y') - Z_kZ_k' - E_kE_k' = 0$$

(q_2 equations)

where E_k is the volume of good k exported. Finally, the q_3 non-traded goods have similar balance equations, but lacking import and export and export terms:

$$X_jX_j' - \sum_{j=1}^{n-1} a_{ij}X_jX_j' - C_i(\sum_{m=0}^{n-1} g_{im}p_m' + g_{jy}Y') - Z_jZ_j' = 0 \qquad (q_3 \text{ equations})$$

The log-change of the domestic price of (non) competitively imported good is determined by the log-changes of one-plus-the-tariff (t_j) and of the exchange rate (r),

$$p_j' - t' - r' = 0 \qquad (1+q_1 \text{ equations})$$

Export prices are assumed to vary in the world market, so that

$$p_k' - h_k' - \phi_k' - r' = 0 \qquad (q_2 \text{ equations})$$

where ϕ_k is one-plus-the-subsidy over f.o.b. value for export k; h_k is the world price of export k. The world prices are assumed to be tied to export volumes by constant elasticity demand functions,

$$E_k' - v_k h_k' = 0$$

where v_k is the elasticity of export demand for good k.

Assuming different types of labor, we may specify the Cobb-Douglas production function in the following form:

$$X_j = A_j K_j^{\delta_j} L_{1j}^{\sigma_{1j}} \cdots\cdots L_{sj}^{\sigma_{sj}} U_j^{u_j} \qquad (j=1, \cdots\cdots, n-1)$$

where A_j is the multiplicative factor, K_j is capital employed in sector j, L_{ij} is labor type i employed in sector j, U_j is the "-ability" factor employed in sector j, while δ_j, σ_{ij}, and u_j represent the output elasticity with respect to each primary factor (the Cobb-Douglas exponent). With constant returns to scale, since the total value added will be exhausted by the payments to each factor according to their marginal productivities, we have

$$\delta_j + \sigma_{1j} + \cdots\cdots + \sigma_{sj} + u_j = 1$$

Without loss of generality, we may set unity for U_j, then we get

$$X_j = A_j^* K_j^{\delta_j} L_{1j}^{\sigma_{1j}} \cdots\cdots L_{sj}^{\sigma_{sj}}$$

where A_j^* reflects the impact on A_j of the change in unit of U_j. Since we are interest in short run functions assuming that "-ability" factor is fixed in each sector, this unity conversion simplifies the functional expression.

Since we treat "-ability" factor, U_j, as a fixed factor, an $s+2$ factor production function would give an expression for the log-change of product in the n production sectors of the form

$$X_j' - \sum_{i=1}^{s} \sigma_{ij} L_{ij}' - \delta_i K_j' = 0 \qquad (n-1 \text{ equations})$$

If we define a net price p_j^* as the amount an entrepreneur receives for distribution to factors after deducting intermediate input costs and indirect tax-subsidies (at rate θ_j),

$$p^*_j = p_j - \sum_{i=0}^{n-1} a_{ij} p_i - \theta_j \qquad (j = 1, \ldots\ldots, n-1)$$

then the logarithmic derivatives of his factor demand equations will be

$$(p_j^*)' + X_j' - w_i' - L_{ij}' = 0 \qquad (sx(n-1) \text{ equations})$$

and

$$(p_j^*)' + X_j' - z' - K_j' = 0 \qquad (n-1 \text{ equations})$$

where w_i is the economy-wide wage rate to labor type i (to which sector wages, if different, are assumed to be proportional); and z is the economy-wide return to capital (again sectoral returns may only be proportional to z) and

$$(p_j^*)' = (p_j^*)^{-1}(dp_j - \sum_{i=0}^{n-1} a_{ij} dp_i - d\theta_j)$$

$$= (1 - \sum_{i=0}^{n-1} a_{ij} - \theta_j)^{-1}(p_j' - \sum_{i=0}^{n-1} a_{ij} p_j' - \theta_j \theta_j')$$

on the assumption that base year producer's prices are unity.

If we treat "-ability" as the fixed factor, we may let γ_i represent an independent rate of profits in each sector. Then, the demand equation for "-ability" only relates changes in independent sectoral rates of profits to price changes,

$$(p_j^*)' + X_j' - \gamma_j' = 0$$

Finally, we complete the system by relating change in labor and capital use to total supply (L_i and K),

$$\sum_{j=1}^{n-1} L_{ij} L_{ij}' - L_i L_i' = 0 \qquad (s \text{ equations})$$

$$\sum_{j=1}^{n-1} K_j K_j' - K K' = 0 \qquad (1 \text{ equation})$$

and by the balance of payments constraint,

$$FF' + \sum_{k=1}^{n-1} h_k E_k (h'_k + E'_k) - \sum_{j=0}^{n-1} M_j M_j' h_j = 0 \qquad \text{(1 equation)}$$

where, once again, import prices do not vary, $KK' = SY + FF'$, and F is the foreign capital inflow, exogenously given.

Demand and supply are determined by relative price changes and are linked by the exchange rate which enters as the price counterpart of the capital inflow. In fact the supply change reduces to the familiar formula,

$$X'_j = \frac{\sum_{i=1}^{s} \sigma_{ij} + \delta_j}{1 - \sum_{i=1}^{s} \sigma_{ij} - \delta_j} \cdot (p_j^*)' - \frac{\sum_{i=1}^{s} \sigma_{ij} w_i' + \delta_j z'}{1 - \sum_{i=1}^{s} \sigma_{ij} - \delta_j}$$

where the change in the net price due to tariff and exchange rate changes determines the production response. This supply-side simplicity results in part from the assumption of fixed input-output coefficients.

The following variables are naturally tagged as exogenous: the final government demand changes Z_i', the force of tariffs t_j', the forces of export subsidies ϕ_j', the indirect tax rates θ_j', the total supply of labor L_j' (j=1, ..., s), capital accumulation K' and the capital inflow F'.

Endogenous variables are import changes M_j', exports E_j', production changes X_j', total consumption Y', domestic prices p_i', world prices of exports h_j', sectoral employments L_{ij}' and K_j' and rates of return r_j', w_j', and z'.

Suppose now that we group all the endogenous log-changes in a vector 'a' and the exogenous changes in vector 'b'. Then the system can be written in a general matrix form as

$$Ma + Nb = O$$

which can be solved in the following form:

$$a = -M^{-1}Nb$$

The basic data required are an interindustry flow table including a breakdown of value added, employment data, data on volumes of imports

and exports and their world prices, and some notion of income and price elasticities of consumer demand.

With the type of model described here, one can get local general equilibrium predictions of resource pulls resulting from changes in trade policy with scarcely more computational and data gathering effort than is required for a standard effective protection study.

(2) Empirical Experiments

We tried an experimental application of our model for Korea using the 1968 Input-Output Table and other related data. As a first step, we assumed homogeneous labor without classifying it into various skill groups (i.e., we set s=1), and further, we aggregated the industries into 15 sectors (n=16 if we include the non-competitive import sector). This resulted in an 80×80 M matrix, an 80×50 N matrix and a 50×1 vector b of exogenous variables. The components of the b vector are the rates of changes in: import tariffs (1, ... 5), export subsidies (6, ..., 16), indirect taxes (17, ..., 31), government and other exogenous consumptions (32, ..., 47), total labor supply (48), total capital supply (49), and the foreign capital inflow (50).

We examined the impact of unit increase in each exogenous variable separately. The response elasticities are presented in Table 1. Since the model has linear relationships, any combined impacts of simultaneous changes in more than one exogenous variables can be computed by simple additions and subtractions of each individual changes. Likewise, the impact of two unit increase in an exogenous variable is twice of the impact of one unit change. We assumed -10 for the price elasticity of export demand for each exported good. Other price elasticities were measured using Frisch method.

In 1968, the tariff rates for imported goods were: 11% for non-competitive imports, 1% for agricultural products, 19% for chemicals, 12% for metal products and 8% for machineries. A 10% increase in tariff rates implies $t_0'=0.01$, $t_1'=0.001$, $t_2'=0.016$, $t_3'=0.011$, and $t_4'=0.0074$. According

to the response elasticities shown in Table 1, these imply that the 10% increase in tariff rate will raise the domestic price of chemicals by 2%, those of non-competitive imports, metal products and machinery by 1% each, and that of agricultural product by almost zero percent. The impact of this extra tariff protection is the increase in outputs of chemicals, metal products and machinery by about 3% each and almost no change in agricultural production. At the same time, the imports of chemicals, metal products and machinery decrease by about 17%, 10%, and 5% respectively. The imports of non-competitive products and agricultural products decrease only by about 1% each.

We have not measured the magnitude of sectoral export subsidies in 1968. We do know that they vary widely among sectors. Since the magnitude of 1968 sectoral export subsides computed by B. Balassa, et al., will be available in near future, we will illustrate the subsidy effects simply by assuming 25% ad valorem export subsidy in base period and then 10% increase in it, implying $\phi_k'=0.02$.

Under these assumptions, the 10% increase in export subsidy raises the producer's price of each export good by 0.2—1.2% except in cases of food, miscellaneous manufactures, and services which have negligible changes. The outputs increase very significantly in textile (2.2%) and non-metallic mineral products (2.3%); moderately in mining (1.8%), transportation (1.2%), miscellaneous manufacturing (0.6%), construction (0.6%) and electricity (0.6%); and negligibly in the rest of the sectors.

The impact of 10% increase in export subsidy on export expansion of each good ranges from 8% to 20% of export increases. The subsidy effect seems to have been exaggerated a little because of the price equation $p_j'=h_j'-\phi_j'-r'$ which we adopted from Taylor's model without modification. The price change in the above equation represents the change to producers and yet applied also to the domestic consumers of each export good. Hence what we observe is the combined result of direct export promotion by 10% increase in export subsidy to producers and indirect export promotion of discouraging

domestic consumption by 10% increase in consumer price.

Since export subsidies are usually handed to producers by the government, and not directly by the consumers themselves, we will add the price equation for consumers (such as $p_j^0 - h_j' - r = 0$) in our next experiment. In any case, we can interpret our result such that the direct export subsidies together with discouragement of domestic consumption work very strongly for export expansion.

In most cases, the increase in tariff rates or export subsidies results in appreciation of exchange rates.

If we introduce a 10% tariff increase on all imported goods or a 10% export-subsidy increase on all exported goods simultaneously, the import substitution and export promotion effects become much smaller than those suggested by individual changes separately. These results simply reflect the limitation of available resources, and the mutually offsetting effect of simultaneous increases in tariffs or export subsidies due to the fact that a subsidy on one sector is in relative sense a negative subsidy on other sectors and a subsidy to every producer and consumer is no subsidy to anybody at all. Therefore, we should be very careful when we would like to have an overall picture of the impacts of various import substitution and export expansion policies all together.

We also experimented the impact of 10% increase in indirect taxes, but most of the sectors show insignificant responses to the change in indirect taxes. These results might be explained by the fact that, although indirect taxes take 12.5% and 8.4% of total input value in food manufacturing and chemicals, in other manufacturing sectors, the indirect taxes usually take less than 2% of total input values.

In order to examine the impact of changes in factor supplies on commodity and factor prices, outputs, imports, exports, exchange rate, and sectoral resource allocation, we also experimented 10% increase in labor, capital and foreign capital supplies. Again, we examined the individual impact separately.

The results are presented inT able 2.

The 10% increase in labor supply reduces the wage rate by 10%, raises the interest rates only by 0.1% and appreciates the exchange rate by 3.9%. The 10% increase in capital supply reduces the interest rate by 9.9%, raises the wage rate only by 0.1%, and appreciates the exchange rate by 0.3%. The 10% increase in foreign capital inflow lowers the wage, interest and exchanges rates by 5.8%, 5.0% and 6.1% respectively.

The 10% increase in labor supply lowers the output prices by 1.9%~8.8%, lowers the import of agricultural product very significantly(by 24.6%), and raises the exports of fishery by 48.9%. The use of labor in each sector increases by varying degrees. We can also observe intersectoral reallocation of capital. The decrease in capital stock in any sector might be interpreted as non-replaced portion of depreciated capital stock.

On the other hand, the impact of 10% increase in capital stock is rather insignificant. Output prices fall by less than 1%, and outputs, imports and exports change by less than 2—3%, in spite of the fact that capital stock of each sector has increased by 9—12%. This result seems to suggest that we (i.e., 1968 I-O Table) attributed too much portion of value added to entrepreneurial "-ability" factor in the form of profits. We may need narrower definition of entrepreneurial profit and hence increase the contribution of capital to a proper level in our future experiment. We may also experiment two factor model with only wage and interest components, in which both labor and capital are mobile, instead of three-factor model. We may not get complete specialization that Taylor worried.

It seems that, if we properly modify the model-framework and refine the basic data, our model will be able to give us useful informations on the impacts of small changes in policy variables such as tariffs, export subsidies, indirect taxes, and foreign capital inflows (or exchange rate) upon factor and output prices, sectoral outputs, imports, exports, resource allocations and hence upon national income. Furthermore, the model can also examine the impact of change in factor supplies.

Table 1. Response Elasticities

Sector	Import Tariffs						Export Subsidies										
	t_0'	t_1'	t_2'	t_3'	t_4'	sum	ϕ_5'	ϕ_6'	ϕ_7'	ϕ_8'	ϕ_9'	ϕ_{10}'	ϕ_{11}'	ϕ_{12}'	ϕ_{13}'	ϕ_{14}'	ϕ_{15}'	sum
Prices (p')																		
0. Non-Comp. Imports	.96	−.63	−.05	.03	−.08	.26	−.03	−.02	−.05	−.02	.07	−.04	.02	−.01	−.05	−.11	−.01	−.25
1. Agricultural Product	−.01	.37	−.05	.03	−.08	.26	−.03	−.02	−.05	−.02	.07	−.04	.02	−.01	−.05	−.11	−.01	−.25
2. Chemicals	−.01	−.63	.95	.03	−.08	.26	−.03	−.02	−.05	−.02	.07	−.04	.02	−.01	−.05	−.11	−.01	−.25
3. Metal Products	−.01	−.63	−.05	1.03	−.08	.26	−.03	−.02	−.05	−.02	.07	−.04	.02	−.01	−.05	−.11	−.01	−.25
4. Machinery	−.01	−.63	−.05	.03	.92	.26	−.03	−.02	−.05	−.02	.07	−.04	.02	−.01	−.05	−.11	−.01	−.25
5. Fishery	−.01	−.67	.03	.10	.07	−.57	.57	−.01	−.04	.08	.17	−.05	.07	−.01	−.05	−.13	−.02	.58
6. Mining	−.08	−.38	.13	.13	.00	−.20	−.03	.28	−.05	.01	.12	−.04	.04	.00	−.04	−.10	−.01	.18
7. Food	−.03	−.18	.30	.04	.05	−.09	.00	.00	.03	.03	.08	−.02	.04	.00	−.01	−.04	−.01	.10
8. Textile	.03	−.43	.07	.05	−.01	−.29	−.03	−.01	−.04	.40	.08	−.03	.03	.00	−.02	−.08	−.01	.29
9. Non-Metallic	.16	−.51	.00	.06	.00	−.29	−.03	.00	−.04	.01	.44	−.03	.06	.00	−.03	−.08	−.01	.29
10. Misc. Manufacture	.07	−.36	.05	.08	.05	−.11	−.02	−.01	−.03	.04	.10	.05	.04	.00	−.03	−.05	−.01	.08
11. Construction	.03	−.30	.00	.15	.06	−.06	−.03	.00	−.04	.02	.16	−.03	.10	.01	.02	−.07	−.01	.07
12. Electricity	−.11	−.51	.15	.13	.11	−.23	−.02	.03	−.03	.07	.12	−.02	.04	.15	−.04	−.06	−.01	.23
13. Tarde	−.10	−.51	.03	.08	.14	−.36	−.02	−.01	−.03	.07	.11	−.02	.05	.00	.23	−.01	−.01	.36
14. Transportation	−.05	−.43	.05	.05	.04	−.34	−.02	−.01	−.04	.02	.08	−.03	.03	−.01	−.03	.36	−.01	.34
15. Other Services	−.04	−.18	.03	.10	.07	−.02	−.02	.00	−.03	.05	.09	−.02	.04	−.01	−.02	−.05	.00	.03
Outputs (X')																		
1. Agricultural Product	.06	.34	−.06	−.04	−.10	.20	.00	−.01	−.01	−.07	−.02	−.01	−.02	.00	−.03	−.04	.00	−.21
2. Chemicals	−.35	−.49	1.52	−.08	−.15	.45	−.01	−.07	−.02	−.09	−.03	−.02	−.02	−.01	−.07	−.12	−.01	−.47
3. Metal Products	−.21	−1.20	−.41	3.42	−.48	1.12	−.01	−.11	−.04	−.22	−.12	−.05	−.06	−.03	−.23	−.23	−.01	−1.11
4. Machinery	−.21	−1.02	−.32	−.93	3.41	.94	−.01	−.03	−.04	−.19	−.12	−.05	−.05	−.02	−.22	−.21	−.01	−.95
5. Fishery	.06	.05	−.03	−.07	−.03	−.02	.02	.01	.04	−.06	−.08	.03	−.03	.01	.01	.07	.07	.03
6. Mining	−.12	−.72	.30	.05	−.17	−.66	.00	.89	−.01	−.09	.08	−.02	.01	−.01	−.08	−.09	−.01	.67
7. Food	−.03	−.30	.03	−.02	.10	−.22	−.01	.01	.12	.03	.01	.02	.02	.00	.00	.04	.00	.24
8. Textile	−.13	−.42	−.23	−.05	−.08	−.91	.00	−.01	−.01	1.10	−.02	−.01	−.01	−.01	−.07	−.05	.00	.91
9. Non-Metallic	−.37	−.41	−.11	−.08	−.03	−1.00	.00	−.04	−.01	−.06	1.16	−.01	.10	−.01	−.07	−.07	.00	.99
10. Misc. Manufactures	−.12	−.23	−.01	−.05	.07	−.34	.00	.00	.02	.01	.01	.30	.02	.00	−.03	.01	.00	.34
11. Construction	−.01	−.12	−.01	−.04	−.04	−.22	.00	.00	.00	−.01	−.03	.00	.29	.00	−.01	−.01	.00	.23

Sector	Import Tariffs						Export Subsidies										
	t_0'	t_1'	t_2'	t_3'	t_4'	sum	ϕ_5'	ϕ_6'	ϕ_7'	ϕ_8'	ϕ_9'	ϕ_{10}'	ϕ_{11}'	ϕ_{12}'	ϕ_{13}'	ϕ_{14}'	ϕ_{15}'	sum
12. Electricity	−.06	−.30	.04	.05	.06	−.21	.00	.02	−.01	.04	.03	.01	.00	.16	−.03	−.02	.00	.20
13. Trade	.01	−.14	−.01	−.01	.04	−.11	.00	.00	.00	.00	.00	.00	.00	.00	.13	−.03	.00	.10
14. Transportation	.02	−.40	−.09	−.03	−.06	−.56	.00	.00	.00	−.03	−.01	.00	.00	.00	−.03	.61	.00	.54
15. Other Services	−.03	−.20	.02	.05	.08	−.08	.00	.01	.01	.01	.00	.01	.01	.00	−.01	.02	0.2	.08
Imports (M')																		
0. Non-Comp. Imports	−.16	−.32	.21	.01	.12	−.14	.00	−.02	.00	.08	.15	.01	.02	−.01	−.05	−.05	.00	.13
1. Agricultural Product	−1.42	−10.91	1.63	.69	3.25	−6.76	.05	.34	.68	1.99	.63	.38	.60	.03	.72	1.25	.09	6.76
2. Chemicals	1.16	1.70	−8.58	.37	1.48	−3.87	.06	.37	.19	1.26	.23	.21	.17	.07	.03	1.02	.04	3.65
3. Metal Products	.18	1.58	.86	−10.39	5.34	−2.43	.02	.34	.08	.35	.24	.12	.53	.07	.30	.35	.03	2.43
4. Machinery	.20	1.29	.46	1.11	−4.64	−1.58	.02	.07	.08	.30	.15	.09	.14	.03	.28	.41	.02	1.59
Exports (E')																		
5. Fishery	.89	.39	−.81	−.71	−1.50	−1.74	4.00	−.04	−.08	−1.01	−.99	.11	−.53	.05	−.02	.20	.05	1.74
6. Mining	.67	−2.49	−1.84	−1.06	−.80	−5.52	.00	7.05	−.05	−.35	−.50	−.06	−.18	−.06	−.16	−.16	−.01	5.52
7. Food	.15	−4.48	−.77	−.15	−1.33	−6.58	−.25	−.12	9.22	−.55	−.15	−.22	−.17	−.05	−.40	−.71	−.05	6.55
8. Textile	−.43	−1.98	−1.22	−.18	−.72	−4.53	−.03	−.06	−.09	5.77	−.12	−.10	−.09	−.03	−.33	−.37	−.02	4.53
9. Non-Metallic	−1.73	−1.21	−.54	−.28	−.81	−4.57	−.01	−.18	−.06	−.25	6.23	−.10	−.43	−.04	−.27	−.31	−.01	4.57
10. Misc. Manufactures	−.81	−2.73	−1.02	−.51	−1.31	−6.38	−.06	−.10	−.16	−.62	−.38	9.09	−.20	−.04	−.50	−.60	−.04	6.39
11. Construction	−.38	−3.29	−.48	−1.24	−1.39	−6.78	−.02	−.13	−.07	−.44	−.88	−.10	9.19	−.02	−.36	−.39	−.02	6.76
12. Electricity	1.00	−1.20	−1.95	−1.05	−1.93	−5.13	−.05	−.41	−.21	−.95	−.55	−.22	−.20	8.42	−.14	−.54	−.04	5.11
13. Trade	.90	−1.25	−.77	−.50	−2.17	−3.79	−.05	−.12	−.23	−.95	−.42	−.25	−.29	−.04	7.21	−1.04	−.04	3.78
14. Transportation	.35	−1.96	−.98	−.19	−1.17	−3.95	−.05	−.07	−.13	−.40	−.14	−.13	−.14	−.02	−.25	5.31	−.03	3.95
15. Services	.34	−4.51	−.76	−.73	−1.53	7.19	−.05	−.14	−.17	−.70	−.24	−.22	−.20	−.03	−.36	−.61	9.89	7.17
Wage (w')	−.08	.09	−.04	.07	.02	.13	−.03	−.01	−.04	.06	.09	−.03	.04	−.01	−.03	−.09	−.01	−.13
Interest (z')	−.18	−.67	.09	.11	.15	−.31	−.03	−.01	−.02	.10	.15	−.02	.05	.01	.13	.13	−.01	.29
Exchange Rate (r')	−.01	−.63	−.05	.03	−.08	−.79	−.03	−.02	−.05	−.02	.07	−.04	.02	−.01	−.05	−.11	−.01	−.20

Table 2. Impact of a 10% Increase in Supply of Labor, Capital, and Foreign Capital on Prices, Outputs, Imports, Exports and Sectoral Allocation of Capital and Labor

unit: percent (%)

Sector	10% Increase in Labor Supply					10% Increase in Capital Supply					10% Increase in Foreign Capital				
	Price	Output	Im&Ex	Labor	Capital	Price	Output	Im&Ex	Labor	Capital	Price	Output	Im&Ex	Labor	Capital
0. Non-Comp. Imp.	−3.9	—	1.9	—	—	−0.3	—	0.7	—	—	−6.1	—	−0.5	—	—
1. Agricultural	−3.9	4.5	−24.6	10.7	0.4	−0.3	0.1	8.1	−0.3	9.7	−6.1	−0.4	21.3	−1.0	−1.7
2. Chemicals	−3.9	1.3	20.0	6.4	−3.8	−0.3	0.8	1.9	0.6	10.5	−6.1	−1.6	13.3	−5.1	−5.9
3. Metal Products	−3.9	5.3	−3.8	11.3	1.0	−0.3	1.4	0.4	1.7	11.6	−6.1	−2.5	4.1	−4.6	−5.4
4. Machinery	−3.9	4.4	0.4	9.8	−0.5	−0.3	2.7	2.2	2.8	12.8	−6.1	−2.4	5.3	−4.1	−4.9
5. Fishery	−8.8	7.5	48.9	19.4	9.2	0.1	0.2	−4.0	0.3	10.3	−10.2	5.1	41.1	13.1	12.3
6. Mining	−5.5	4.2	16.1	7.3	−3.0	−0.3	0.7	0.1	0.5	10.4	−6.0	−0.9	−1.8	−1.5	−2.3
7. Food	−2.1	4.6	−18.7	17.3	7.0	−0.1	1.0	−2.0	1.6	11.6	−4.4	1.4	−16.9	4.7	4.0
8. Textile	−4.2	2.9	2.1	7.7	−2.6	−0.7	1.3	3.5	0.4	10.4	−5.6	−0.3	−5.8	−0.5	−1.2
9. Non-Metallic	−4.3	2.2	3.5	6.6	−3.7	−0.6	0.9	2.6	0.1	10.0	−5.8	−0.7	−3.2	−1.3	−2.0
10. Misc. Manuf.	−4.4	4.4	4.3	8.7	−1.5	−0.5	1.0	2.3	0.5	10.4	−5.3	0.8	−8.6	1.5	0.7
11. Construction	−6.0	0.9	20.8	1.9	−8.4	−0.4	0.2	1.4	−0.2	9.7	−5.8	−0.1	−3.7	−0.1	−0.9
12. Electricity	−2.3	3.6	−16.0	12.5	2.2	0.0	1.0	−2.7	1.2	11.1	−4.9	0.2	−12.1	0.6	−0.1
13. Trade	−1.9	1.7	−20.4	10.3	0.0	−1.9	1.7	16.3	−0.7	9.2	−4.9	0.1	−12.6	0.7	−0.1
14. Transportation	−3.7	4.9	−24.9	11.2	0.9	−0.1	0.6	−2.1	0.7	10.7	−5.2	0.3	−9.3	0.8	0.0
15. Services	−5.0	4.1	10.3	8.5	−1.8	−0.2	0.7	−1.5	0.6	10.6	−5.1	0.8	−10.8	1.6	0.8
	wage	interest	exchange rate			wage	interest	exchange rate			wage	interest	exchange rate		
	−10.2	0.1	−3.9			0.1	−9.9	−0.3			−5.8	−5.0	−6.1		

Table 3. Direct and Cross Price Elasticities of Demand

Sector		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	π_i / g_{iy}	0.00	0.33	0.04	0.00	0.02	0.03	0.00	0.15	0.07	0.00	0.03	0.00	0.01	0.17	0.06	0.10
0.	Non-Comp. Imp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.	Agricultural	0.52	0.00	−0.52	−0.01	0.00	0.01	−0.01	0.00	−0.01	−0.02	0.00	−0.01	0.00	0.00	−0.06	0.00	−0.03
2.	Chemicals	1.57	0.00	−0.38	−1.57	0.00	0.02	−0.03	0.00	−0.02	−0.07	0.00	−0.02	0.00	0.00	−0.18	−0.01	−0.08
3.	Metal Product	1.00	0.00	−0.24	−0.01	−1.00	0.01	−0.02	0.00	−0.01	−0.05	0.00	−0.01	0.00	0.00	−0.11	0.00	−0.05
4.	Machinery	3.15	0.00	−0.76	−0.03	−0.01	−3.15	−0.06	0.00	−0.04	−0.15	0.00	−0.04	0.00	0.00	−0.36	−0.01	−0.32
5.	Fishing	0.52	0.00	−0.13	−0.01	0.00	0.01	−0.52	0.00	−0.01	−0.02	0.00	−0.01	0.00	0.00	−0.06	0.00	−0.03
6.	Mining	0.89	0.00	−0.22	−0.01	0.00	0.01	−0.02	−0.89	−0.01	−0.04	0.00	−0.01	0.00	0.00	−0.10	0.00	−0.04
7.	Food	1.82	0.00	−0.44	−0.02	0.00	0.02	−0.03	0.00	−1.82	−0.09	0.00	−0.02	0.00	0.00	−0.21	−0.01	−0.09
8.	Textile	0.71	0.00	−0.17	−0.01	0.00	0.01	−0.01	0.00	−0.01	−0.71	0.00	−0.01	0.00	0.00	−0.08	0.00	−0.04
9.	Non Metallic	0.82	0.00	−0.20	−0.01	0.00	0.01	−0.02	0.00	−0.01	−0.04	−0.82	−0.01	0.00	0.00	−0.09	0.00	−0.03
10.	Misc. Manuf.	1.22	0.00	−0.29	−0.01	0.00	0.01	−0.02	0.00	−0.02	−0.06	0.00	−1.22	0.00	0.00	−0.14	0.00	−0.06
11.	Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.	Electricity	1.97	0.00	−0.47	−0.02	0.00	0.02	−0.04	0.00	−0.03	−0.09	0.00	−0.02	0.00	−1.97	−0.22	−0.01	−0.10
13.	Trade	0.67	0.00	−0.20	−0.01	0.00	0.01	−0.01	0.00	−0.01	−0.03	0.00	−0.01	0.00	0.00	−0.67	0.00	−0.03
14.	Transportation	1.89	0.00	−0.57	−0.02	0.00	0.02	−0.04	0.00	−0.03	−0.09	0.00	−0.02	0.00	0.00	−0.21	−1.89	−0.09
15.	Service	1.04	0.00	−0.25	−0.01	0.00	0.01	−0.02	0.00	−0.01	−0.05	0.00	−0.01	0.00	0.00	−0.12	0.00	−1.04

* π_i represents the budget proportion of the ith good; g_{iy} is the income elasticity of the ith good.
We assumed −2 for the "money flexibility."