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Favorable External Shocks, Sectoral Adjustment and De-industrialization in Non-oil Producing Economies

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Abstract

This paper examines the extent to which a favorable external shock such as the lower price of an intermediate input affects sectoral output and employment, the real exchange rate the wage in an economy where the input has no domestic production at all. The analytical framework is a real, short-run model based on a three-sector, three-factor small open economy. The effect of the shock on the variables concerned depends on the structural characteristics of production and consumption in the economy. In the normal case, the traded sectors initially favored by the shock expand the most among sectors while the other tradables suffer. The real exchange rate may appreciate along with the upsurge of wages. The shock can produce many other possible cases, however: The nontraded sector may grow at the expense of the traded sectors including the favored sector, thus leading to de-industrialization. An extreme case is that the positive effect on output and employment may occur only at the traded sectors that are initially unfavored by the shock. The shock may bring about real depreciation, or a decline in nominal wages, too.

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Non-oil producing developing economies such as Korea were favored by an external shock in 1986 when world oil prices fell by half along with a decline in international interest rates. Such changes in the international environment were beneficial to Korea which was heavily indebted to foreigners and whose structure of production and consumption was highly dependent upon imported intermediate inputs such as oil. From 1986 to 1988, real income grew by over 12% on average, largely led by a strong export growth. Saving surpassed investment for the first time since 1962 when economic development set forth, resulting in substantial current account surplus and eliminating the growing concern about foreign indebtedness.

However, the economic boom, initiated by the external shock, was followed by the symptoms analogous to the Dutch disease experienced by the countries producing the primary products in the 1960s and 1970s. The economic growth rate slowed with reemerging inflationary pressure after 1988. Industrial growth was led by services with manufacturing production being squeezed. The Korean won appreciated in real terms vis-á-vis major trading partners. The upsurge in nominal and real wage rates surpassed productivity growth. Even the favored tradable sectors which mainly consisted of capital- and imported intermediate input- intensive manufactures suffered in export and production activities in 1989-92. In 1990, the current account was reversed to deficit from surplus as saving began to fall short of investment. The price of real estate and housing skyrocketed while the nontradables expanded along with a rise in their relative prices.

The situation where a boom in a tradable good may lead to the squeeze of the other tradables, called the Dutch disease, was the subject of many studies in the 1980s.[1] The Dutch disease has been investigated by static or dynamic specific-factor models: Static models are further divided into an equilibrium model (Corden and Neary(1982)) and a disequilibrium model (van Wijnbergen

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1. For example, Bruno(1982), Bruno and Sachs(1982), Cassing and War(1982), Corden and Neary(1982), Corden(1984), Eastwood and Venables(1982), Kamas(1986), Neary(1980), Neary and van Wijnbergen(1984) and van Wijnbergen(1984). Also see Eaton(1987) and Buffie(1992) for an application of dynamic specific factor models.

(1984a)(1984b)). Recently, endogenous capital accumulation has been incorporated into an overlapping generations model (Eaton(1987)) and an infinite horizon model (Roldos(1992) and Buffie(1992)). However, the literature on the Dutch disease has focused primarily on the economies exporting the primary products such as oil and coffee, and on the effects of the new resource discovery or of the rise in oil price. Little attention has been paid to the effects of a lower oil price on oil-importing economies such as Korea.

The main purpose of this paper is to examine the extent to which the lower price of an imported intermediate input affects sectoral output and employment, the real exchange rate and wages in an economy where the input has no domestic production at all. The simple analytical framework is presented in the first section to show that a favorable external shock may bring about an adverse impact on some (or, all) tradables, real appreciation and the surge of wage rates depending on the structure of consumption and production. It is a real, static equilibrium model based on a three-sector, three-factor small open economy. The analytical framework on supply aspects adopts the specification of Buffie (1984)(1986)(1989) who examined the macroeconomic consequences of the oil price shock, devaluation and trade liberalization in a short-run model which incorporated an imported intermediate input. However, it differs from his model in several respects: First, the economy produces three goods rather than two goods, traded and nontraded goods. Traded goods are further subdivided into the booming sector (B) and the lagging sector (M) following the spirit of the Dutch disease model of Corden and Neary(1982) and Corden(1984). Second, monetary considerations are ignored and thus only the relative price is determined. Income and expenditure are always equal so that there is no trade deficit. Trade imbalances and money can be easily incorporated into the model,[2] which makes the model more complicated without changing the essence of the analysis. Third, prices and wages are flexible so that full employment is always maintained in the economy. Real wage rigidity may also be added to the model, too. However, the main concern in this study is to explore the short-run impact on sectoral

2. Buffie (1984)(1989) employed a monetarist specification to take into account money and trade imbalances.

output and employment of favorable rather than adverse shocks.

Section 2 details the effect on sectoral output of a percentage change in the price of imported input when only one of the traded sectors uses imported input. Section 3 discusses its impact on sectoral output when imported input is also used in the nontraded sector. In section 4, a simulation exercise is carried out to examine a sensitivity of the change in sectoral output for a percentage decline in imported input price for a given set of parameter values. The exercise also explores the accompanied numerical change in sectoral employment, the real exchange rate, the nominal wage rates and real wage rates. Section 5 evaluates the relationship between an external shock and the changes in the variables relevant to the model for the Korean economy in the period 1986-92. The final section concludes the paper.

1. The Analytical Framework

The assumption is of a small open economy producing two traded goods (T=B, M), and a nontraded good (N) by means of variable factors, labor (L_i) and an imported intermediate input (E_i), and fixed, sector-specific capital stocks(K_i). What distinguishes the traded goods is that good B uses an imported intermediate input for production, but good M does not.[3]

The domestic prices of traded goods (P_i , i = B, M) are always equal to the exchange rate multiplied by exogenously given world prices, and the terms of trade is unchanged. The domestic price of imported input (Π) is the exchange rate multiplied by its world price. The price of a nontraded good (P_N) moves flexibly to equalize domestic supply and demand. The good B is the numeraire and units are chosen so that its price is unity (P_B=1) implying that P_N is the relative price of nontraded to traded goods, i.e. the real exchange rate. A rise in P_N corresponds to a real appreciation.

Supply

On the supply side, duality theory is employed to allow general functional forms of technology.

[3]. If imported intermediate input is employed in both traded sectors, the assumption made here refers to the case where the B sector is more imported input intensive in production than the M sector.

Assuming constant returns to scale and perfectly competitive firms, the sectoral factor demands are derived by Shephard's lemma as

$$L_i = Q_i\, C^i_W(W,\ \Pi,\ R_i) \tag{1}$$

$$E_i = Q_i\, C^i_\Pi(W,\ \Pi,\ R_i) \tag{2}$$

$$K_i = Q_i\, C^i_R(W,\ \Pi,\ R_i) \tag{3}$$

where Q_i is output in the *i*th sector (i= B, M, N); C^i is the unit cost function in the *i*th sector; W is the nominal wage; Π is the domestic price of an imported intermediate input; R_i is *i*th sector's rental rate on capital; and a subscript in the cost function denotes the partial derivative with respect to the corresponding argument.

The zero profit condition implies

$$P_i = WC^i_W + R_i C^i_R + \Pi C^i_\Pi \tag{4}$$

Equations (1)-(4) produce a solution for Q_i, L_i, E_i, R_i, as a function of W, Π, and P_i.

After substituting for Q_i in (1) from (3) and logarithmically differentiating the resulting equation, the derived demand for labor in sector i can be expressed as

$$l_i = \theta^i_L(\sigma^i_{LL} - \sigma^i_{LK})w + \theta^i_E(\sigma^i_{LE} - \sigma^i_{KE})\pi + \theta^i_K(\sigma^i_{LK} - \sigma^i_{KK})r_i \tag{5}$$

where $\sigma_{ij} = C_{ij}C / C_i C_j$ is the Hicks-Allen partial elasticity of substitution between factors i and j[4]; θ^i_j is the cost share of factor j in sector i production; and a small letter denotes the log differential of a relevant variable (for example, w = dW/W).

Note that using the envelope theorem, equation (4) can be rewritten as the following log differential of relevant variables:

$$p_i = \theta^i_L w + \theta^i_E \pi + \theta^i_K r_i . \tag{6}$$

Substituting for $\theta^i_K r_i$ in (5) from (6) yields the percentage change in the demand for labor in sector i as a

[4]. See Uzawa (1962).

linear function of p_i, w and π:

$$l_i = a_1^i p_i - a_2^i w - a_3^i \pi . \tag{7}$$

where

$$a_1^i = \sigma_{LK}^i - \sigma_{KK}^i > 0,$$

$$a_2^i = \theta_L^i (2\sigma_{KL}^i - \sigma_{LL}^i - \sigma_{KK}^i) > 0,$$

$$a_3^i = \theta_E^i (\sigma_{KL}^i + \sigma_{KE}^i - \sigma_{KK}^i - \sigma_{LE}^i).$$

The same procedure can be taken to have the percentage change in the demand for imported input as

$$e_i = b_1^i p_i - b_2^i w - b_3^i \pi . \tag{8}$$

where

$$b_1^i = \sigma_{EK}^i - \sigma_{KK}^i > 0,$$

$$b_2^i = \theta_L^i (\sigma_{KE}^i + \sigma_{KL}^i - \sigma_{KK}^i - \sigma_{LE}^i),$$

$$b_3^i = \theta_E^i (2\sigma_{EK}^i - \sigma_{EE}^i - \sigma_{KK}^i) > 0.$$

Strict concavity of the production function guarantees positive a_1^i and b_1^i. a_2^i and b_3^i must also be positive unless either factor is inferior. However, the signs of cross-price terms, a_3^i and b_2^i are ambiguous because of two conflicting forces, output and substitution effects. Suppose that the domestic price of imported inputs lowers ($\pi < 0$). It raises profit, which will increase the level of output and the rental rate on capital. With lower Π and higher R, the net substitution effect on labor demand is positive when imported input is more substitutable for labor than for capital $(\sigma_{LE}^i - \sigma_{LK}^i > 0)$ and negative when it is less substitutable $(\sigma_{LE}^i - \sigma_{LK}^i < 0)$. On the other hand, the expansion of output generates more labor demand, which is represented in the term $\theta_j^i (\sigma_{KE}^i - \sigma_{KK}^i)$ (j = E, L). In the case where labor and imported input are gross complements, a_3^i and b_2^i are positive, which occurs when output effects dominate net substitution effects.[5] On the other hand, when net positive substitution effects are greater than output effects, these two inputs are gross substitutes where a_3^i and b_2^i are negative.

Assuming that the supply of labor is fixed, the full employment condition implies

$$\lambda_L^B l_B + \lambda_L^M l_M + \lambda_L^N l_N = 0 \qquad (9)$$

where λ_L^i denotes the share of employment in sector i and $\sum_i \lambda_L^i = 1$. Combining equation (7) with (9) yields the endogenous change in nominal wage to equilibrate labor market as a function of p_i and π such as:

$$a_2 w = a_1 p_N - a_3 \pi \qquad (10)$$

where $a_2 = \sum_i \lambda_L^i a_2^i$ (i = B, M, N) is the wage elasticity of the aggregate demand for labor; $a_3 = \sum_i \lambda_L^i a_3^i$ denotes the cross-price elasticity of aggregate labor demand with respect to imported input price whose sign and magnitude depend on output and substitution effects in each sector; and is the elasticity of aggregate labor demand with respect to the real exchange rate, given w and π.[6]

Demand

Turning to the demand side, a simple functional specification is employed as follows:

$$D_i = D_i(1, P_M, P_N, Y) \qquad (11)$$

$$Y = Q_B + P_M Q_M + P_N Q_N - \Pi(E_B + E_M + E_N). \qquad (12)$$

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5. This statement is not necessarily true when capital and imported input are strongly complementary such that output effects become negative. The necessary condition for positive output effects is $\sigma_{KE}^i > -\sigma_{KL}^i \theta_L^i / (\theta_K^i + \theta_E^i)$.

6. The zero degree of homogeneity of factor demand stands for $a_1^i = a_2^i + a_3^i$ for sector i. Notice, however, that $a_1 \neq a_2 + a_3$ since $p_B = p_M = 0$ due to no change in terms of trade and $P_B = 1$.

Demand is specified as a function of prices and nominal expenditure, abstracting the role of financial assets in determining demand.

Logarithmically differentiating function (11), the demand for nontraded goods may be written as a function of the change in the real exchange rate and in real income,

$$d_N = \varepsilon_N^* p_N + \eta_N (y - C_N p_N) \tag{13}$$

where ε_N^* and η_N are the compensated own-price elasticity and the income elasticity of demand for nontraded goods, respectively; and C_N is the share of traded goods in total expenditure. The source of a change in real income is the change in imported intermediate input so that equation (12) generates

$$y^* \equiv y - C_N p_N = -\alpha\pi \tag{14}$$

where $\alpha = \Pi(E_B + E_M + E_N)/Y$ is the value of total imported intermediate inputs as a fraction of nominal income. Substituting (14) into (13) and applying the Slutsky decomposition, the demand for nontraded goods may thus be written as follows:

$$d_N = -\tilde{C}_N \varepsilon^* p_N - \alpha\eta_N \pi \tag{15}$$

where $\tilde{C}_N \equiv (1 - C_N)/C_N$ is the relative expenditure share of traded to nontraded goods and ε^* is the compensated cross-price elasticity of demand for nontraded goods with respect to the relative price of traded goods.

Equilibrium

The market for the nontraded sector clears at $d_N = q_N$ through price adjustment. With two variable inputs, the supply of good i may be expressed with a logarithmically differentiable form as:

$$q_i = \theta_L^i l_i + \theta_E^i e_i \tag{16}$$

Substituting (7) and (8) for l_i and e_i in (16) for the nontraded sector and then equating it with (15) generate the equilibrium real exchange rate, p_N as a function of w and π :

$$(\phi^N + \tilde{C}_N \varepsilon^*) p_N = \phi_L^N w + (\phi_E^N - \alpha\eta_N)\pi \quad (17)$$

where $\phi^N \equiv (\theta_L^N a_1^N + \theta_E^N b_1^N)$ is the supply elasticity of nontraded goods, and $\phi_L^N \equiv (\theta_L^N a_2^N + \theta_E^N b_2^N)$ and $\phi_E^N \equiv (\theta_L^N a_3^N + \theta_E^N b_3^N)$ are the elasticity of the supply of nontraded goods with respect to wage and imported input price, respectively. Under the assumption that all goods are priced at cost, $\phi^i = \phi_L^i + \phi_E^i$ (i = B, M, N). Increasing marginal cost implies the positive sign of ϕ_L^i and ϕ_E^i; but, their signs can be reversed in the case where labor and imported inputs are gross substitutes $(a_3^i, b_2^i < 0)$.[7]

Equations (10) and (17) may be solved jointly for the effect of the change in imported input price on p_N and w:

$$Ap_N = -\left[a_3\phi_L^N - a_2\phi_E^N + a_2\alpha\eta_N\right]\pi \quad (18)$$

$$Aw = -\left[a_3(\phi^N + \tilde{C}_N\varepsilon^*) - a_1\phi_E^N + a_1\alpha\eta_N\right]\pi \quad (19)$$

where $A = a_2(\phi^N + \tilde{C}_N\varepsilon^*) - a_1\phi_L^N$. The term $(\phi^N + \tilde{C}_N\varepsilon^*) > 0$ is the compensated elasticity of excess supply of nontraded goods at a given wage rate, while A denotes the same elasticity when the adjustment of the wage rate induced by a change in P_N is taken into account. A must be positive to satisfy the stability condition.

The first two terms in the RHS of (18) and (19) represent the cost effects of a change in Π on the supply of nontraded goods and the third term carries out its income effect on the demand. The second term denotes the direct cost effect of the change in Π while the first term represents the indirect cost

7. For example, ϕ_E^i may have a negative sign in the case where sector *i* is relatively labor intensive and labor and imported input are strongly gross substitutes.

effect which takes place through its impact on the demand for the other factor, labor, in the nontraded sector. The sign of the total cost effects is not unambiguous since the direction of the indirect cost effect depends on whether labor and imported input are gross substitutes $(a_3 < 0)$ or complements $(a_3 > 0)$. A lower imported input price will bring about real appreciation and higher nominal wages only if the income effect dominates the total cost effects.

2. Imported input used only in the B sector

In this section, we examine the possible impact of a lower price of imported input (π < 0) on sectoral output in the case where only the B sector uses imported input $(\theta_E^B > 0, \theta_E^M = \theta_E^N = 0)$. Its impact on sectoral employment shall be discussed in conjunction with the change in sectoral output. From equations (7)(8)(16)(18) and (19), the change in sectoral output due to a percentage change in the price of imported input can be derived as follows:[8]

$$Aq_N = -\phi_L^N \left[- a_3 \tilde{C}_N \varepsilon^* + (a_2 - a_1) \alpha \eta_N \right] \pi \tag{20}$$

$$Aq_M = -\phi_L^M \left[- a_3 (\phi^N + \tilde{C}_N \varepsilon^*) - a_1 \alpha \eta_N \right] \pi \tag{21}$$

$$Aq_B = - \left[A\phi_E^B - \phi_L^B a_3 (\phi^N + \tilde{C}_N \varepsilon^*) - \phi_L^B a_1 \alpha \eta_N \right] \pi \tag{22}$$

where $a_3 = \lambda_L^B a_3^B$ and $\phi^N = \phi_L^N$.

The change in the price of imported input affects sectoral employment and output through shifting supply and demand curves, namely through the supply effect and the demand effect.[9] Consider, first, the supply effect: The supply effect depends crucially on whether labor and imported input are gross substitutes or complements. Suppose they are gross complements where output effects dominate net

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8. Similarly, the percentage change in sectoral employment can be derived from equations (7)(18) and (19).

9. Corden and Neary(1982) called these two effects as the resource movement effect and the spending effect, respectively, in the context of analyzing the dutch disease case.. However, resources also move across sectors due to the spending effect so that more explicit terms are used in the text.

substitution effects $(a_3 > 0)$. A lower price of imported input utilized only in the B sector will raise that sector's profit, which increases the demand for the mobile factor, labor, employed there. This creates excess demand in the labor market and raises the wage rate, thus drawing labor out of both the M and nontraded sector to the B sector.

The movement of labor out of the nontraded sector leads to a fall in the output of that sector, which causes excess demand for nontraded goods at the initial real exchange rate. Thus a real appreciation, that is, the rise in the price of nontraded goods, must occur to eliminate the excess demand, attenuating the fall in the output of that sector caused by labor movement due to a wage increase. However, the output of the nontraded sector cannot be higher than in the initial equilibrium unless the market for nontraded goods is unstable. On the other hand, a real appreciation caused by excess demand for nontraded goods draws labor out of the B and M sector to the nontraded sector, implying the further decline in the output of the M sector.

The first term in (20) represents the change in the output of the nontraded sector due to the supply effect. The term consists of two parts: For π <0, the first one, $-\phi_L^N a_3(\phi^N + \tilde{C}_N \varepsilon^*)$, represents a loss in the output of nontraded goods due to an increase in the wage rate initiated by excess demand for labor that is associated with both real appreciation and a rise in B sector's profit. The second one, $(\phi_L^N)^2 a_3$, describes an output gain attributed to real appreciation. These two terms taken together yield the first term in (20), reflecting that the output of nontraded goods falls absolutely due to the supply effect. On the other hand, the first term in (21) represents the further decline in the output of the M sector because of real appreciation, indicating the role of the real exchange rate in determining labor movement. The intuition behind this is that the rise in the real wage is greater in the M sector than in the nontraded sector since the price of traded goods remains constant.

The first term in (22) refers to the initial positive impact of a decline in Π on the output of the B sector, the magnitude of which relies upon the supply elasticity of B goods with respect to the imported input price. But the initial output effect is mitigated by a higher wage rate due to excess demand for labor, denoted by the second term in (22). In total, however, the positive supply effect cannot be reversed as labor moves out of both the nontraded and M sectors, indicated by the first terms in (20) and (21).[10]

Next, turn to the demand effect of the change in the price of imported input. In order to ignore the supply effect for a while, we assume that all markets are in equilibrium before the shock occurs. A lower price of imported input raises real income, which results in excess demand for nontraded goods at the initial exchange rate. Again, there must be a real appreciation to restore the equilibrium so that the output of nontraded goods rises relative to its initial level, which is represented by the first term of the parenthesis in the second term in (20). On the other hand, the demand shift of the nontraded sector creates excess demand for labor and thus increases the wage rate, somewhat dampening the rise in the output of that sector. The second term of the parenthesis in (20) depicts this dampening effect on the output of nontraded goods. The rise in the wage rate due to excess demand for labor causes labor to move out of both the B and M traded sectors. The last terms in (21) and (22) measure the extent of the contraction of the output of two traded sectors due to this demand effect.

The parameters which influence the demand shift of nontraded goods are the share of imported inputs in income and the marginal propensity to consume those goods. Labor will be demanded more in the nontraded sector, as the values of these parameters increase. The actual changes in employment and

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10. For proof, the positive supply effect infers $(a_2 - a_1)\phi_E^B - a_3\phi_L^B > 0$ which is derived from rearranging the first two terms in (22). As the simplest case satisfying $a_3 > 0$, assume a CES production function where the partial elasticities of substitution between factors are identical $(\sigma_{LK}^i = \sigma_{KE}^i = \sigma_{EL}^i = \sigma)$. The function implies $a_2^i = [(1-\theta_E^i)/\theta_K^i]\sigma$, $a_3^i = (\theta_E^i / \theta_K^i)\sigma$, $\phi_L^i = (\theta_L^i / \theta_K^i)\sigma$ and $\phi_E^i = (\theta_E^i / \theta_K^i)\sigma$. After substituting these values into the corresponding terms, the above inequality can be rewritten as $\frac{a_2^B + (\lambda_L^M / \lambda_L^B)a_2^M}{a_3^B} > \frac{\theta_L^B}{\theta_K^B}$; LHS is equivalent to $\frac{\theta_L^B}{\theta_K^B} + (1 + \frac{\lambda_L^M}{\lambda_L^B}\frac{1}{\theta_K^M})$ which is greater than RHS.

output are determined by the real wage elasticity of the aggregate demand for labor, $(a_2 - a_1)$, and the elasticity of the supply of nontraded goods with respect to wage rate, ϕ_L^N. The demand effect on the output of the nontraded sector is always positive despite the negative output effect of a wage increase resulting from the rise in the demand for labor in that sector. The reason is that the real wage rate must rise in the traded sectors since the prices of output remain constant while nominal wages are higher. This leads labor to move out of both traded sectors to the nontraded sector, implying that there should be a real appreciation large enough to lower the real wage rate in the latter sector.[11]

When the supply and demand effects are combined, what is unambiguous is that both contribute to an increase in nominal wage and a real appreciation.[12] Both lead to move labor out of the M sector so that that sector's output falls absolutely after a decline in Π. However, the output response in the nontraded sector is not unambiguous since the supply effect lowers that sector's output while the demand effect raises it. Unlike the Dutch disease, the output response in the B sector, which initiated a boom in the economy, is not clear, either, because of the real income effect on the demand for nontraded goods. The nontraded sector expands at the expense of the traded sectors to the extent that the demand effect dominates the supply effect. The possible case is that even B sector's employment and output may fall below their initial values along with those of the M sector.

To see sectoral differences in output growth rates, equations (20)-(22) can be rewritten as follows:

$$-\left[q_B - \left(\phi_L^B / \phi_L^M\right) q_M\right] / \pi = \phi_E^B \tag{23}$$

$$-\left[q_B - \left(\phi_L^B / \phi_L^N\right) q_N\right] / \pi = \phi_E^B - \phi_L^B \left(a_3 \phi^N + a_2 \alpha \eta_N\right) / A \tag{24}$$

The LHS of (23) denotes a weighted difference between B sector's output growth rate and that of the M sector for a percentage decline in the price of imported input where the weight is the sectoral elasticities

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11. $a_2 - a_1 = (\lambda_L^B a_2^B + \lambda_L^M a_2^M + \lambda_L^N a_2^N) - \lambda_L^N a_1^N = (\lambda_L^B a_2^B + \lambda_L^M a_2^M + \lambda_L^N a_2^N) - \lambda_L^N (a_2^N + a_3^N)$
$= \lambda_L^B a_2^B + \lambda_L^M a_2^M > 0$ since $a_3^N = 0$.

of the supply of goods with respect to wage. For instance, ϕ_{L}^{i} is simply $(\theta_{L}^{i} / \theta_{K}^{i})\sigma$ in the case where the partial elasticities of substitution among factors are identical. If both sectors have identical relative labor intensities, the B sector grows faster than the M sector exactly by ϕ_{E}^{B} for a percentage decline in Π. In this example, $\phi_{E}^{B} = (\theta_{E}^{B} / \theta_{K}^{B})\sigma$, implying that the gap of sectoral growth rates would be greater in favor of the B sector to the extent that this sector is more imported-input-intensive and the elasticity of substitution among factors is larger. According to (24), on the other hand, the gap of sectoral growth rates for the B sector and the nontraded sector becomes smaller as the RHS of (24) has another negative term which reflects the output effect of real appreciation and of the change in real income.

Up to now, the underlying assumption regarding the supply effect has been that labor and imported input are gross complements. The magnitude of the supply effect depends on relative sectoral factor intensities, factor substitutability, relative sectoral shares of employment and the structure of the demand for nontraded goods. As mentioned above, however, the direction of the supply effect rests on the cross-price elasticity of the demand for labor with respect to imported input in sector B. Consider, in contrast, that labor and imported input are gross substitutes $(a_3 < 0)$, for which the outcome of the supply effect may be exactly opposite: A lower price of imported input would create excess supply in the labor market and lowers the wage rate, making labor move to the M and nontraded sectors. The resulting excess supply of nontraded goods would be followed by a real depreciation due to which the output of the M sector increases further with the rise in the nontraded sector's output being dampened somewhat.

Contrary to the previous case, the signs of the change in the nominal wage rate, the real exchange rate and the M sector's output response are not unambiguous when both effects are combined. To the extent that the supply effect exceeds the demand effect, nominal wage rate decreases along with real

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12. Refer to (18) and (19) when $\phi_{E}^{N} = 0$.

depreciation, and M sector's output rises rather than falls after a decline in Π. The difference between B sector's output growth rate and that of the M sector becomes smaller; even the latter sector may grow at a faster rate than the former sector to the extent that the B sector is more labor intensive and the negative cross-price elasticity of labor demand with respect to imported input price dominates the own-price elasticity of the demand for imported input. The reason is that the output response to a given change in Π becomes smaller as imported input is substituted for labor in producing B goods. On the other hand, the growth gap between the B sector and the nontraded sector becomes ambiguous since the B sector benefits from real depreciation due to the supply effect, denoted by the first term of the bracket in (24) which is positive when $a_3^B < 0$. Along with the M sector, however, the nontraded sector which does not use imported input will grow at a faster rate than in the case of gross complementarity, the more substitutable are labor and imported input and the more intensively labor is used in that sector.

To see the condition for gross substitutability more clearly, using the symmetry property and the adding-up condition on the partial elasticities of substitution, $-l_i / \pi = a_3^i$ in (7) can be rewritten as

$$a_3^i = \theta_E^i \left[(1 + \theta_L^i / \theta_K^i) \sigma_{LK} + (1 + \theta_E^i / \theta_K^i) \sigma_{KE} - \sigma_{EL} \right] \tag{25}$$

where the partial elasticities of substitution between factors are assumed to be identical among sectors. Rearranging (25) suggests that the sufficient condition for gross substitutability between labor and imported input should be $\sigma_{EL} > (\sigma_{LK} + \sigma_{KE}) + (\theta_L^i \sigma_{LK} + \theta_E^i \sigma_{KE}) / \theta_K^i$. That is, this condition holds only for an extreme case where the partial elasticity of substitution between labor and imported input is large enough for it to be at least greater than the sum of the partial elasticity of substitution between capital and labor and that between capital and imported input. It may also hold for the case where capital and imported input are strongly complementary.[13] However, this condition may be violated virtually by all of production functions where all factors are Hicks-Allen substitutes

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13. In their estimation of 2-level CES function where labor is separable from capital and imported input, Berndt and Wood (1979) asserts that capital-oil complementarity and labor-oil substitutability are strong

$(\sigma_{ij} > 0,\ i \neq j)$[14]. Which assumption is more realistic depends upon an empirical investigation on the production function that will not be pursued here.

3. Imported input in the nontraded sector

This section allows an imported input to be used in both the B sector and the nontraded sector, but not in the M sector $(\theta_E^B,\ \theta_E^N > 0,\ \theta_E^M = 0)$.

$$Aq_N = -\left[(a_2\phi_E^N - a_3\phi_L^N)\tilde{C}_N\varepsilon^* + \left\{a_2\phi_E^N + (a_2 - a_1)\phi_L^N\right\}\alpha\eta_N\right]\pi \tag{26}$$

$$Aq_M = -\phi_L^M\left[-a_3(\phi^N + \tilde{C}_N\varepsilon^*) + a_1\phi_E^N - a_1\alpha\eta_N\right]\pi \tag{27}$$

$$Aq_B = -\left[A\phi_E^B - \phi_L^B\left\{a_3(\phi^N + \tilde{C}_N\varepsilon^*) - a_1\phi_E^N + a_1\alpha\eta_N\right\}\right]\pi \tag{28}$$

where $a_3 = \lambda_L^B a_3^B + \lambda_L^N a_3^N$ and $\phi^N = \phi_L^N + \phi_E^N$.

To examine the supply effect, assume that labor and imported input are gross complements. What differs from the case where imported input is used only in the B sector is that a lower price of imported input also raises the profit of the nontraded sector at a given real exchange rate. Consequently, the excess demand for labor would be greater as labor is demanded more not only by the B sector but by the nontraded sector. The result is a larger increase in the wage rate which draws more labor out of the M sector.

In contrast with the previous case, there must be a real depreciation since excess supply emerges in the nontraded good market where rising profit induces more nontraded goods to be produced at the initial real exchange rate after the shock. Real depreciation will mitigate the favorable impact of a lower price of imported input on the output of nontraded goods.

The supply effect on the output of nontraded goods, denoted by the first term in (26), consists of two

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enough to make this condition hold.

14. Rader(1968) points out that factors used by the firm are never gross substitutes in the normal case

terms: The first one, $\phi_E^N \left\{ a_2 \tilde{C}_N \varepsilon^* - (a_1 - a_2 - a_3)\phi_L^N \right\}$,represents the output effect due to the change in real price of imported inputs while the second one, $-\phi_L^N \left\{ a_3 \tilde{C}_N \varepsilon^* - (a_1 - a_2 - a_3)\phi_E^N \right\}$, does the same effect due to the change in the real wage rate. With the second terms in braces being canceled out, these two terms add up to the first term in (26). Thus the first term of the parenthesis in (26) which is positive signifies that the net profit of the nontraded sector remains positive after real depreciation is taken into account. Compared with (20), the second term of the parenthesis embraces the larger negative output effect of an increase in the wage rate as the nontraded sector demands more labor, too. An extra term, $(a_2\phi_E^N - \lambda_L^N a_3^N \phi_L^N)$, which is positive,[15] denotes that the positive effect of the lower real price of imported input dominates the additional negative effect of the higher real wage, impling that the negative supply effect on the output of nontraded goods would be smaller than that of the previous case where only the B sector employs imported input. It is possible that the supply effect on nontraded goods becomes positive when the net profit effect exceeds the wage effect.

A larger increase in nominal wage, that is, in real wage given the price of traded goods, creates a further decline in the output of the traded sectors, represented by the first term in (27) and by the second term in (28). Compared with (21) and (22), however, a new term, $a_1\phi_E^N \phi_L^i$ (i =M, B), appears in (27) and (28), which reflects the positive impact on the output of the traded sectors for a decline in wage rate associated with real depreciation owing to the supply shift of nontraded goods. Overall, to the extent that the nontraded sector is relatively more labor intensive and has a larger share of employment for given factor substitutability, the real exchange rate depreciates more and the wage rate rises less so that the negative supply effect on the employment and output of the traded sectors would be smaller than that for

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where an increase in the input of one factor increases the marginal productivity of the others.

15. To prove, consider the case where the elasticities of substitution between factors are identical. Then, $a_2\phi_E^N - \lambda_L^N a_3^N \phi_L^N = (\theta_E^N / \theta_K^N)[\sum_i \lambda_L^i (1 + \theta_L^i / \theta_K^i) - \lambda_L^N \theta_L^N / \theta_K^N]\sigma^2$

$$= (\theta_E^N / \theta_K^N)[1 + \sum_{i=B,M} \lambda_L^i \theta_L^i / \theta_K^i]\sigma^2 > 0 .$$

the previous case.[16]

Regarding the demand effect, there is no fundamental difference whether or not an imported input is used in the nontraded sector. As before, a lower price of imported input raises real income which thus brings about a real appreciation. What differs now is that the output of nontraded goods rises further for a given real appreciation since the supply elasticity of these goods is relevant not only to the wage rate but to the imported input price, as shown in the first term of the brace in (26).

Compared with the previous case, the real exchange rate would appreciate less when the supply and demand effects are combined. Though labor is also demanded more by the nontraded sector initiated by a lower price of imported input, it is more likely that real depreciation in the supply side leads to a smaller increase in the wage rate unless the supply elasticity with respect to imported input in the nontraded sector is extremely small. In spite of smaller real appreciation, the nontraded sector would expand more because of a lower price of an other variable factor, imported input, but the change in its employment depends on the substitutability between labor and imported input. The traded sectors would also benefit from the lesser extent of real appreciation and of the rise in the wage rate.

As before, sectoral differences in output growth rates can be explicitly derived from equations (26)-(28). No change is observed in the difference between the B and M sectors. However, the gap between the B sector and the nontraded sector can be rewritten as:

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16. The first two terms in the bracket of (27) and in the brace of (28) represent the change in employment in the traded sectors owing to the change in the wage rate. These terms can be rewritten as $[-\lambda_L^B a_3^B(\phi_L^N + \tilde{C}_N\varepsilon^*)]$ $-[\lambda_L^N a_3^N(\phi_L^N + \tilde{C}_N\varepsilon^*) + \phi_E^N(\lambda_L^B a_3^B - \lambda_L^N a_2^N)]$. The first bracketed term is identical with the first term in (21). The terms in the second bracket denote the additional change in employment of that sector when imported inputs are also used in the nontraded sector. More labor would be drawn out of the traded sectors unless other terms are dominated by $\lambda_L^N a_2^N \phi_E^N$ the magnitude of which is larger as the nontraded sector is more labor intensive and has larger employment share along with greater degree of gross complementarity between labor and imported input. Or, put it differently, suppose the partial elasticities of substitution between factors and employment share are identical for all sectors. In this special case, what matters is only relative factor intensities in the B sector: The second bracketed terms can be rewritten as $-[\{(\theta_E^B/\theta_K^B)-1\}\sigma + \tilde{C}_N\varepsilon^*](\theta_E^N/\theta_K^N)\lambda_L\sigma$. The sign of the bracket shall be positive if the cost share of imported inputs is greater than that of capital in the B sector. The exact condition for the negative sign is $(\theta_E^B/\theta_K^B) > 1-(\tilde{C}_N\varepsilon^*/\sigma)$.

$$-\left[q_B - \left(\phi_L^B / \phi_L^N\right) q_N\right] / \pi = \phi_E^B - \phi_L^B \left[a_3 \phi^N + a_2 \alpha \eta_N + \frac{\phi_E^N}{\phi_L^N}\left\{a_2 (1 + \tilde{C}_N \varepsilon^*) - a_1 \phi_L^N\right\}\right] / A \quad (29)$$

What differs from (24) is that there are new terms in the bracket which represent the difference in growth rates between two sectors due to the additional change in wage rate. The last term in the brace denotes the additional change in output due to a decline in wage rate associated with real depreciation. However, the fact that the nontraded sector may expand more owing to both the supply and demand effects implies that the sign of the brace is positive; that is, new terms in (29) exactly measure an additional growth rate of nontraded sector's output over that of the B sector.

4. Simulation

The preceding two sections demonstrated how the change in sectoral output owing to a percentage change in imported input price was associated with various parameters such as the factor substitution pattern, the relative factor intensities, the relative expenditure share of nontraded goods, the share of imported inputs in income and the income elasticity of goods. A specific production function which characterizes the identical partial elasticities of substitution among factors was employed to prove a rationale for the degree of, and the direction of, the change in sectoral output. In this section, a simulation exercise is carried out to examine the sensitivity of numerical outcome of sectoral output growth rate with no specific functional forms. The exercise also explores the accompanied numerical change in sectoral employment, real exchange rate, nominal wage and real wage for a given set of parameter values.

The following values have been assumed for the parameters that do not vary in the simulation[17]:

$\lambda_N = 0.5$, $\lambda_B = 0.25$, $\lambda_M = 0.25$, $\varepsilon^* = 0.4$, $\eta_N = 1$, $\sigma_{KL} = 0.5$.

The values of other parameters are allowed to vary as follows[18]:

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17. The values assigned to λ_i are based on those of the year, 1985, of the Korean economy discussed in the next section. The values of ε^* and η_N are drawn from Baek(1986, Chapter 5) where aggregate demand functions of traded and nontraded goods are estimated for Korea for the period 1960-80. The estimated values of

C_N = 0.4, 0.2; α = 0.3, 0.15; σ_{EL} = 0.5, 1.5; σ_{KE} = -1.5, 0.5, 1.5; θ_L^i = 0.3 - 0.7.

The partial elasticities of substitution between factors are assumed to be identical among sectors.

First, consider the case where an imported input is used only in the B sector. Based on the above parameter values, table 1 presents the possible changes in sectoral output for a percentage decline in imported input price in the case where the cost share of imported input in the B sector, θ_E^B, is 0.2. As expected, the outcome depends crucially on whether labor and imported input are gross complements or substitutes. Under identical elasticities of substitution between factors ($\sigma_{KL} = \sigma_{EL} = \sigma_{KE} = 0.5$) which guarantee a_3^B>0, a 10% decline in imported input price produces the effect that the output of B and nontraded goods rises by 1.1% and 0.8%, respectively, but M sector's output falls by 2.9%, for $\alpha = 0.3$ and C_N = 0.4, and for case 1 where the relative labor intensity is the highest in the nontraded sector. If the M sector has the highest cost share of labor (case 3), a decline in that sector's output is mitigated to 2.1%. Only B sector's output may have a positive growth with lower α and C_N, which implies that the nontraded sector may also suffer with smaller positive demand effect and larger negative supply effect: When $\alpha = 0.15$ and C_N = 0.2, nontraded sector's output declines by 0.1% but that of B goods rises by 1.7%.

When capital and imported input are more substitutable (σ_{KE} = 1.5), the positive output effect on labor becomes greater, which induces more labor to move to the B sector. The result is the greater

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ε^* and η_N range from 0.34 to 0.45 and from 0.97 to 1.06, respectively.

18. The upper values of C_N and α are the 1985 estimates of Korea. The assigned values of the σ_{ij} base on their short-run estimates of some of the previous studies: According to Burgess (1974) which studied the U.S. case using aggregate time series data for the period 1947-68, σ_{KE} ranged from 2.56 to 3.88 and σ_{EL} from 1.05 to 1.51. Baek(1986) estimated the aggregate two-level CES production functions for traded and nontraded goods for Korea over the period 1960-81, and found that σ_{KL} fluctuated from 0.61 to 0.68 and $\sigma_{VE} = \sigma_{KE} = \sigma_{EL}$ from 0.75 to 2.97 depending on the functional forms. On the other hand, Berndt and Wood (1979) and Berndt (1991) employed the translog specification to estimate the production function for the U.S. manufacturing for the period 1947-71; the estimates of the σ_{ij} are σ_{KL} = 0.97, σ_{KE} =-3.60, σ_{KM} =0.35, σ_{LM} = 0.61, σ_{EM} = 0.83,

expansion of B sector's output which leads to a larger growth gap between that sector and the other sectors. On the other hand, when labor and imported input are more substitutable (σ_{EL} = 1.5), the net substitution effect on labor becomes greater so that less labor is required to produce B sector's output. However, the degree of excess demand for labor may be lessened with higher σ_{EL}, implying a smaller increase in wage rate which leads to the hiring of more labor in all sectors. At the same time, the real exchange rate would appreciate less, which mitigates a decline in M sector's employment and output. To sum up, the output responses of the B and nontraded sectors are ambiguous with higher σ_{EL}; but, all sectors appear to perform better in output growth for higher σ_{EL} in table 1.

Table 3 presents the changes in sectoral employment, real exchange rate and nominal wage rate for a percentage decline in imported input price, which are affiliated with the changes in sectoral output for a fixed C_N = 0.4 in table 1. The real exchange rate and nominal wage rate rise for all sets of parameter values. Their percentage changes become greater for higher σ_{KE} but smaller for higher σ_{EL}, as expected. However, sectoral employment does not necessarily follow the path of sectoral output: As gross complementarity between labor and imported input is getting weaker with lower σ_{KE} and higher σ_{EL}, it is possible that sector B needs less labor to produce more output. The reason is that the wage elasticity of labor demand in sector i (a_2^i) may rule over the elasticity of labor demand with respect to imported input price in the B sector (a_2^B). When all partial elasticities between factors are 0.5 and α = 0.3, M sector's employment falls by 2.1% for a 10% decline in imported input price for case 1; that of the B sector also declines by 0.3% despite a 1.1% increase in its output. For σ_{KE} = 1.5, however, sector B is the one that draws labor the most and whose employment rises by 1.3%. Relative factor intensities are also of concern in that the higher relative labor intensity of sector *i* reflects the larger wage elasticity of labor demand, which causes less labor to be drawn into that sector. For instance, M sector's

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and σ_{EL} = 0.68 where E = energy and M = nonenergy intermediate materials.

employment declines by a further 3.4% for case 3, where the relative labor intensity is the highest in the M sector ($\theta_L^M / \theta_K^M = 2.3$). As σ_{EL} becomes higher (up to 1.5), labor moves to the nontraded sector out of the traded sectors including sector B, except in the case where sector M is relatively more labor intensive. Finally, if the share of imported input in income, α, falls to 0.15, the demand effect becomes weaker and so does nontraded sector's demand for labor. For high σ_{KE} and low σ_{EL}, that sector's employment even declines drawing more labor into the B sector.

Consider an opposite case where labor and imported input are gross substitutes. With an extreme value, σ_{KE} = -1.5 and other varying parameter values, B sector's output falls by about 3.5% for a 10% decline in imported input price (table 1). The nontraded and M sectors both benefit from the shock. However, M sector's output still falls short of its previous level when the demand effect is relatively strong. When the positive supply effect becomes relatively strong, on the other hand, sector M has a positive growth in its output: With $\alpha = 0.15$ and C_N = 0.2, M sector's output growth outperforms that of the nontraded sector in the case where the latter is relatively less labor intensive.

According to table 3, the degree of real appreciation has been significantly reduced with strong complementarity between capital and imported input, as expected. The nominal wage rate changes little and even declines as α becomes smaller. Labor moves to the nontraded sector mostly out of the B sector. As the demand effect becomes relatively weaker, labor is also drawn into the M sector. Of course, the degree of gaining employment moves positively with the relative labor intensity in that sector.

Next, consider the case where an imported input is also used in the nontraded sector, but less intensively than in the B sector. Tables 2 and 4 present the changes in the variables relevant to tables 1 and 3, respectively, when parameter values remain the same except $\theta_E^N = 0.1$. When labor and imported input are gross complements, the B and nontraded sectors have positive output growth rates while M sector's output suffers for all possible parameter values. Compared with the previous case in table 1, nontraded sector's output grows to a greater extent, and even surpasses that of the B sector for high α

and C_N and for moderate substitutability between factors. Though there is little difference in B sector's growth rates, the degree of a decline in M sector's output is significantly reduced because the real exchange rate appreciates less along with a smaller increase in the nominal wage rate as shown in table 4. The force behind this is the stronger supply effect over the demand effect. For $\alpha = 0.15$, the real exchange rate even depreciates with little change in the wage rate for high σ_{KE} and σ_{EL}.[19] The changes in sectoral employment closely follow the pattern of those of the previous case in table 1, but with smaller magnitude. One exception is that the nontraded sector will draw more labor from the traded sectors for higher α (=0.3) and lower σ_{EL} (=0.5) for which the positive demand effect on labor is larger and the negative supply effect is smaller. Another is that contrary to the previous case, B sector's employment increases due to the stronger supply effect on labor when $\sigma_{KE} = \sigma_{EL} = 1.5$.

In the case where labor and imported input are gross substitutes, what differs from the previous case is, first, that the output growth is significantly diminished for the nontraded sector and even becomes negative following the shock for an extreme value, $\sigma_{KE} = -1.5$ for which the supply elasticity of these goods with respect to imported input price becomes negative. Second, the B and nontraded sectors both reduce their demand for labor so that the nominal wage rate tends to fall. On the other hand, the real exchange rate will appreciate more since excess demand for nontraded goods becomes larger as the negative supply effect increases with greater substitutability between labor and imported input. Third, it is possible that the output of all sectors including the M sector can decline, which occurs for $\alpha = 0.3$, C_N = 0.4 and σ_{EL} =0.5 in table 2. This happens because as the demand effect becomes larger, the

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19. Higher σ_{EL} does not affect ϕ_L^N and ϕ_E^N, but lowers a_3^i by θ_E^i. Thus the first terms in parentheses of (18) and (19) become smaller, implying its negative effect on p_N and w for $\pi < 0$. If the values of σ_{EL} and σ_{KE} are up by the same magnitude (say, $\Delta\sigma_{EL} = \Delta\sigma_{KE} = 1$), $\Delta\phi_L^N = \Delta\phi_E^N$, $\Delta a_3^i = \theta_E^i\,(\theta_E^i / \theta_K^i)$, $\Delta a_2^i = \theta_E^i\,(1 + \theta_L^i / \theta_K^i)$, and $\Delta a_1^i = \theta_E^i / \theta_K^i$. Since $0 < \theta_E^i < \theta_L^i < 1$, the second terms in the parentheses always exceed the first terms for a given change in the elasticities of substitution. Therefore, either higher σ_{EL} or higher σ_{KE} leads to lower real exchange rate and nominal wage in the supply

real exchange rate appreciates so much that labor in the traded sectors moves to the nontraded sector. The more intensively labor is used in the traded sectors, the larger is the extent of a decline in their output, as shown in table 2.

Finally, the changes in the real wage rate for a percentage decline in imported input price are calculated in tables 3 and 4 to examine its impact on income distribution. As expected, the more complementary labor and imported input are, the more income is redistributed in favor of workers. When imported input is also used in the nontraded sector, the real wage moves further in favor of workers. A 10% decline in imported input price raises the real wage rate by as much as 2.7% for high σ_{KE} (=1.5) and low σ_{EL} (=0.5) and for given other parameter values. However, the magnitude of an increase in the real wage is reduced with lower σ_{KE} and higher σ_{EL}. In the case where the traded sectors are relatively labor intensive with the values of σ_{KE} = -1.5 and σ_{EL} = 1.5, the real wage rate even declines by 3.9% when the nontraded sector also uses imported input. The values of α also matter, but its effect on the real wage rate critically depends on the relative expenditure share of nontraded goods.

5. The Korean Economy, 1986-92

This section examines the extent to which the favorable external shock was associated with the changes in the variables relevant to the model for the Korean economy, one of the non-oil producing economies, in the period 1986-92. The first subsection simply analyzes the actual movement of the real exchange rate and wage rates for the pre- and post-shock periods. The second subsection details the relationship between the shock and the changes in sectoral output and employment in the Korean economy.

A. Relative Prices

Table 5 presents the prices of nontraded and traded goods, and their relative prices from 1983 to

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side.

1992 in Korea. Following a traditional classification, the traded goods consist of agricultural (and forestry & fishing), mining (& quarrying) and manufacturing sectors, and the rest of the sectors are grouped as the nontraded goods. In its practical application to the Korean economy, however, transport, storage and communication among service sectors are placed into traded goods since their trade share which is defined as (exports + imports)/gross output was relatively high, about 35% in 1985.[20] The statistical indices of the prices of nontraded and traded goods are not available for Korea. The price indices of gross output of goods do not exist, either. Thus the weighted average of value added price indices are employed to represent the prices of nontraded and traded goods.

According to table 5, the price of nontraded goods never fell short of that of the traded goods since 1986 when a favorable external shock occurred. From 1986 to 1988, the relative price of nontraded goods appreciated only slightly relative to that of pre-shock periods, 1983-85. Starting in 1989, however, real appreciation accelerated until 1992 when the relative price of nontraded goods was higher by 32% than that of 1985. The reason that real appreciation had been relatively lower during 1986-88 may be, first, that the elasticities of substitution in production and consumption are smaller in the short run than in the long run. Second, the prices of some nontraded goods such as electricity, gas and water which are produced by public enterprises had been declining as a response to a fall in international oil prices.

From 1988 to 1992, the construction sector, whose price index rose by 176% in 1992 from the preshock level in 1985, led a sharp appreciation of the relative price of nontraded goods. The demand for real estate and for residential and nonresidential structures soared as there had been growing inflationary expectations and a surge of real disposable income, suggesting the strong demand effect on the economy. As a policy response, the government enforced a law against land speculation, which was brought into effect in 1991, and tried to supply more residential structures through a project in which 2

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20. Sectors can be grouped in the order of their trade shares. However, there is no formal criteria for grouping sectors as nontraded and traded goods. I also tried to define as the nontraded sector the sectors whose trade share is less than 10% in 1985. The magnitude of relative price indices changed little, however.

million housing units planned to be built in the satellite cities of Seoul, and in other cities in the country. However, the project aggravated the excess demand for labor in the construction sector, resulting in accelerating wage hikes for both skilled and unskilled construction workers.

Figure 1 presents terms of trade and the relative prices of nontraded goods from 1972 to 1992 during which Korea experienced both adverse and favorable external shocks. International oil prices quadrupled and doubled in 1973 and 1979, respectively. The second oil price shock concurred with a rise in international interest rates, which is exactly the opposite of what occurred in 1986. The figure shows the co-movement of terms of trade and the relative price of nontraded goods with time lag; the correlation coefficient between two variables is 0.44 for these periods. The relative price of nontraded goods has had an upward trend during the 1970s and 1980s, mainly because of the rising demand for services along with a rapid growth of domestic purchasing power. As expected, however, real depreciation from the trend took place in 1975-76 and in 1981-82 after the two oil price shocks with which terms of trade worsened.

Consider the other measure of relative prices which is the ratio between the foreign price level multiplied by nominal exchange rate and the domestic price level. Korea's exchange rate system changed to a market floating system in 1990 from a basket floating system that had been in effect since 1980.[21] The basket floating system in which the Korean won floated with the currency values of major trading partners had been a managed floating exchange rate regime in practice due to the intervention of the monetary authorities in the foreign exchange market. The new regime was initiated in 1990 to allow the exchange rate to be determined in the market and to minimize government intervention.

In 1986, Korea experienced a sizable surplus in its current account and an appreciation of the won vis-á-vis the U.S. dollar for the first time in its history. As the surplus grew in successive years, the

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21. The exchange rate system before 1980 was the unified floating system in which the Korean won floated with the U.S. dollar and that had been in effect in 1965. However, this system turned out to be a fixed exchange rate regime as government intervened in the foreign exchange market more heavily than with the basket floating system.

nominal exchange rate appreciated by 8% in 1987 and 14% in 1988. The appreciation continued though the size of the surplus sharply declined in 1989. But the nominal exchange rate began to depreciate again in 1990 when the current account reversed into deficits. Despite consecutive depreciation, the value of the won vis-á-vis U.S. dollar in 1992 appreciated by 10% from the preshock level.

The real exchange rate vis-á-vis the U.S. dollar moved closely with the path of the nominal rate after the shock in 1986. On the other hand, the real exchange rate vis-á-vis major trading partners, called real effective exchange rate (REER1), sharply depreciated until 1987 and held above its preshock level in 1988. Evidently, Korea could maintain export competitiveness against its major trading partners. This was largely due to the substantial appreciation of the Japanese yen vis-á-vis the U.S. dollar in this period in which Korea's trade weights with Japan averaged as much as 36%. After a further decline in REER1, the real effective exchange rate gradually depreciated up to 1992 as well. The level of REER1 in 1992 was about the same as its preshock level but appreciated by 12% from its 1986 level. Notice that the nominal exchange rate vis-á-vis major trading partners in 1992 depreciated by 12% from its preshock level while it moved to the direction analogous with the real rate. The movement of the real exchange rate implies that Korea had been more inflationary than major trading partners except the U.S..

In contrast, when unit labor cost was used as a deflator, the real effective exchange rate, REER2, declined at a faster rate than REER1 starting the latter of 1987 and appreciated by 15.3% in 1991 from the preshock level. Unit labor cost evaluated in dollar terms fell by 5.9% annually in 1983-85, but rose by 5.5% in 1986-92. The sharp rise in wages in the latter period is, first, predicted by equation (19) of the model where the demand and supply effects both are positive when gross complementarity among factors is associated with the low cost share of imported inputs in nontraded goods. In particular, it appeared to be led by the strong demand effect on nontraded goods in Korea. One of the other causes may be attributed to government policy on promoting housing supplies as previously mentioned. Finally, it is closely related to social and political affairs: Starting in 1986, there had been increasingly strong pressure from the students and the educated classes to enlarge the democratic content of government and society. The government's labor policy was forced to eliminate a ban on strikes and barriers to free labor union organizations that had been in effect since President Park Chung-Hee's military regime. The result was widespread labor disputes and strikes which contributed to the upsurge of wages over productivity gains in all sectors in 1988-90.

According to table 5, the average wages of all sectors rose by 168% in 1992 from the 1985 level and their annual percentage change was 18.5% in 1988-90. Such a sharp increase in wages had been led by the manufacturing sectors in which most of labor disputes and strikes took place in these periods. Moreover, excess demand for construction workers culminated the percentage change in their wage rate which was as much as 25.6% in 1990. On the other hand, income had also been redistributed in favor of workers. Real wages in 1991 already doubled their preshock level.

B. Sectoral output and employment

The questions relevant to the effect of an external shock on sectoral output and employment can be summarized as follows: First, is there a positive relationship between sectoral imported input share and output growth rate? Does the B sector expand while the M sector contracts after a decline in the price of imported input? Second, what happens to the nontraded sector's output? Does the nontraded sector grow at the expense of the traded sectors? Is the demand effect strong enough such that even B sector's output growth falls below its trend rate? The same questions can be raised regarding sectoral employment.

Table 6 presents the sectoral average growth rates of traded and nontraded goods in the pre-shock period (1980-85) and in the post-shock period (1986-92). The table also shows sectoral traded shares and imported input shares in total output in 1985, and the percentage changes in sectoral employment in the period 1986-92 in order to examine the extent of resource movement among sectors accompanied with changes in sectoral output.

The first question can be answered by examining the correlation coefficient between imported input share and sectoral growth rate in table 6. The coefficient is 0.10 and 0.36 for the period 1980-85 and 1986-92, respectively. This indicates that the positive relationship between the two variables becomes stronger in the latter period than in the former period. Spearman's rank correlation coefficient is -0.00 and 0.15 for each period, impling that although their relevance becomes weaker, imported input shares are positively associated with sectoral growth rates in the latter period while there is virtually no linkage between the two variables in the former period. When nontraded goods are excluded, the correlation coefficient becomes 0.18 and 0.49 for each period. This shows that their relationship in the traded sectors had been positive in both periods and become even stronger in the latter period.

It may be more interesting to explore the relationship between an external shock and the change in sectoral growth rates from the pre-shock period to the post-shock period: The correlation coefficient between imported input share and the change in growth rates for the period 1980-85 and 1986-92 is 0.37 and the rank correlation coefficient is 0.07. These estimates may show that the sector which had higher imported input share grew at a faster rate after the 1986 external shock. However, there is no clear relationship between the sector's rank in imported input share and the change in growth rate. By excluding nontraded goods, the correlation coefficient becomes higher, 0.52, reflecting that the B sector had grown at a faster rate than the M sector in the latter period. As shown in table 6, the sectors such as chemicals, petroleum and plastic products whose imported input shares were the highest among traded goods experienced the largest gain in growth rates over the two periods.

Regarding the second question, consider the relation between sectoral trade share and output growth rate. The correlation coefficient between these two variables is -0.34 and -0.40 for 1980-85 and 1986-92, respectively, and Spearman's rank correlation coefficient is -0.05 and -0.01. This implies that the larger the sector's trade share is, the lower is its growth rate in both periods, and their negative relationship becomes greater in the latter period. The relevancy between the sector's rank in trade share and growth rate is not clear, but remains to be negative in both periods. In the case of the relationship between trade share and the change in sectoral growth rates between the two periods, the correlation coefficient is -0.13 and the rank coefficient is -0.05. These figures indicate that the nontraded sector expanded at a faster rate than the traded sectors in the latter period. According to table 6, the nontraded sector, in fact, grew faster than the traded sectors as a whole, on average, in 1986-1992, and the gap of the growth rates of the two sectors becomes greater than that in the pre-shock period.

The post-shock period may be divided into the two subperiods 1986-88 and 1989-92 since sectoral growth rates and macroeconomic variables sharply changed their course between these subperiods. In 1986-88, the traded sector grew faster than the nontraded sector, and moreover the sectors with larger traded share tend to achieve higher growth rates. However, most of the sectors in the economy experienced slower growth rates in 1989-92. The average rate of output growth fell by 2.7% for the nontraded sector and by 7.8% for the traded sector between the two subperiods. In particular, the sectors which grew most rapidly in 1986-88 suffered the most in the latter subperiod.

The correlation coefficient between imported input share and growth rate is 0.40 and 0.11 for 1986-88 and 1989-92, respectively, and the rank correlation coefficient is 0.18 and -0.05. This indicates that the positive relationship between the imported input share and the growth rate becomes weaker in the latter subperiod. Moreover, the sector's rank in imported input share is negatively correlated with the growth rate in the latter subperiod although their magnitude is small. That is, the sector with larger imported input share tended to have a lower output growth. in the latter subperiod.

The correlation coefficient between trade share and growth rate is -0.06, -0.56 and the rank coefficient is 0.15, -0.05, respectively, in the two subperiods. The two measures produce opposite estimates in sign in the former subperiod, but the estimated rank coefficient confirms that the traded sectors had a better performance in growth rates in this subperiod. However, both measures suggest that growth patterns become exactly opposite in the latter subperiod during which the nontraded sector outperformed the traded sectors.

As the last excercise, we can examine the relationship between the shock in 1986 and the change in sectoral growth rates between the two subperiods. The correlation coefficient between the change in growth rates and imported input share is -0.29 and that between trade share and the growth gap is -0.26. The figure indicates that the larger the sector's imported input share is, the greater is the slowdown of growth rate in 1989-92, which contradicts their positive correlation between pre- and post-shock period which is 0.37. Moreover, the magnitude of the negative relationship between trade share and the gap of growth rates in the two subperiods is greater than that in the pre- and post-shock period. Such a sudden change in the pattern of sectoral growth rates between the two subperiods may explain the ambiguous relationship between imported input share and the change in sectoral growth rates after the shock in 1986.

In sum, the sectors which employed imported intermediate inputs more intensively grew at a faster rate after the shock in 1986, but their positive relationship had become gradually weaker over time. On the other hand, the negative relationship between sectoral trade share and growth rate became stronger, reflecting that the demand effect had become greater with time after the shock such that the nontraded sector expanded at the expense not only of the M traded sector but also of the B traded sector. As expected, M sector's output growth lagged behind of that of the other sectors.

Turning to resource movement among sectors, the model predicts that labor movement is positively associated with sectoral output growth. The previous discussion on sectoral output growth forecasts that mobile resource may move from the non-booming traded sector to the nontraded and booming traded sectors. Moreover, the nontraded sector may be the one whose employment increases the most.

The correlation coefficient between imported input share and the percentage change in sectoral employment from 1985 to 1992 shown in table 2 and the rank coefficient are -0.06 and -0.03, respectively. The estimated results imply no clear relationship between these two variables; moreover, the signs are negative in contradiction to the positive signs to be expected. With the percentage changes in employment of the traded sectors only being taken into account, the correlation coefficient becomes larger with positive sign, 0.35, suggesting that there is some degree of labor movement from the M sector to the B sector in this period. On the other hand, the correlation coefficient between trade share and sectoral percentage change in employment is -0.50 and the rank correlation coefficient is 0.04. Though their relationship is not clear in rank, there is some evidence that the nontraded sector absorbed mobile resources from the traded sectors in this period. This is why there is an ambiguous relationship between imported input share and the percentage change in sectoral employment; also notice that the nontraded sector had smaller imported input share than the B sector. It is possible that only the M sector lost mobile resource after the shock since labor moved to the nontraded sector and also to the traded sectors which used imported input more intensively.

6. Summary and Concluding Remarks

The model presented in this paper is too simple to predict precisely the extent to which the favorable shock affects real exchange rate and sectoral output and employment in non-oil producing economies. However, the analytical framework can show that the tradable sector initially favored by the shock may grow at the expense of the other tradables, leading to de-industrialization as in the Dutch disease. Unlike the Dutch disease, it illustrates how the effects of the shock on non-oil economies may vary depending on the structural characteristics of consumption and production in the economy.

The model produces the following implications: Suppose that the domestic price of an imported input falls exogenously. In the normal case, the traded sector, the only one that is assumed to use imported input and thus favored by the shock, expands the most among sectors while the other tradables suffer. The output of nontraded goods may have a positive growth rate over its trend value due to the demand effect which basically relies upon the imported input share in income and the income elasticity of goods. However, the extent of positive output growth of the favored traded sector shall be lessened as capital and imported input are more complementary, and labor and imported input are more substitutable. An extreme case is that the output of the favored sector may grow negatively while the nontraded and other traded sectors benefit from the shock. When imported input is also employed in the nontraded sector, its output may grow above that of the favored sector although the former sector uses imported input less intensively than the latter. On the other hand, another extreme case is that a positive growth rate of output may be experienced only by the traded sectors that are initially unfavored by the shock.

Relative factor intensities do not affect the sign of sectoral growth rates, but their magnitude.

The changes in sectoral employment are positively associated with those in sectoral output. The nontraded sector tends to absorb more labor for moderate factor substitutabilities than the favored sector; but, labor may move out of the nontraded sector to the favored sector as the demand effect becomes weak along with the strong complementarity between labor and imported input. It is most likely that the real exchange rate and nominal wages rise after the shock. It is possible, however, that the real exchange rate depreciates when the demand effect is weak, and that nominal wages decline when labor and imported input are strongly substitutable. Income distribution crucially depends on factor substitutabilities and the relative expenditure share of nontraded goods.

The Korean experience is consistent with the normal case where labor and imported input are gross complements. An exception is that the output growth of the favored traded sector significantly slowed down over time relative to that of the nontraded sector, reflecting that the positive supply effect became weaker while the demand effect grew stronger over time. One of the reasons may be that factor substitutabilities and the income elasticity of goods vary over time unlike their fixed values assumed in the model. Another limitation of the model is that capital accumulation is excluded. The next step would be to build a long-run model that allows for endogenous capital accumulation within the analytical framework presented in this paper.

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TABLE 1. Sectoral Growth Rates for a Percentage Decline in Imported Input Price

($\theta_E^B = 0.2$, $\theta_E^N = \theta_E^M = 0$)

	$\alpha = 1.5$						$\alpha = 3.0$						
	$\sigma_{EL} = 0.5$			1.5			$\sigma_{EL} = 0.5$			1.5			
	q_N	q_B	q_M	q_N	q_B	q_M	q_N	q_B	q_M	q_N	q_B	q_M	σ_{KE}
C_N=0.2													
Case 1	0.10	-0.36	0.06	0.14	-0.35	0.11	0.13	-0.36	-0.00	0.17	-0.36	0.06	-1.5
	-0.01	0.17	-0.11	0.03	0.19	-0.04	0.02	0.15	-0.16	0.06	0.17	-0.10	0.5
	-0.06	0.40	-0.15	-0.02	0.43	-0.12	-0.03	0.38	-0.24	0.01	0.41	-0.17	1.5
Case 2	0.03	-0.32	0.08	0.05	-0.31	0.15	0.04	-0.33	0.04	0.06	-0.32	0.10	-1.5
	-0.01	0.22	-0.14	0.00	0.27	-0.07	0.00	0.19	-0.17	0.02	0.25	-0.11	0.5
	-0.02	0.42	-0.22	-0.01	0.49	-0.15	-0.01	0.38	-0.25	0.00	0.45	-0.18	1.5
Case 3	0.03	-0.36	0.07	0.04	-0.35	0.12	0.04	-0.36	0.04	0.05	-0.35	0.09	-1.5
	0.00	0.17	-0.09	0.01	0.19	-0.03	0.01	0.16	-0.12	0.02	0.18	-0.06	0.5
	-0.01	0.41	-0.16	-0.00	0.44	-0.10	0.00	0.40	-0.19	0.01	0.43	-0.13	1.5
C_N=0.4													
Case 1	0.11	-0.36	0.03	0.14	-0.35	0.11	0.16	-0.37	-0.09	0.21	-0.36	-0.00	-1.5
	0.03	0.15	-0.18	0.06	0.17	-0.10	0.08	0.11	-0.29	0.12	0.14	-0.20	0.5
	-0.01	0.36	-0.28	0.02	0.40	-0.19	0.05	0.32	-0.38	0.09	0.36	-0.29	1.5
Case 2	0.04	-0.33	0.03	0.06	-0.32	0.10	0.07	-0.35	-0.08	0.08	-0.33	0.00	-1.5
	0.01	0.17	-0.19	0.02	0.23	-0.12	0.04	0.10	-0.28	0.05	0.17	-0.20	0.5
	-0.00	0.35	-0.27	0.01	0.43	-0.20	0.02	0.26	-0.35	0.04	0.35	-0.27	1.5
Case 3	0.04	-0.36	0.03	0.05	-0.35	0.09	0.07	-0.36	-0.05	0.08	-0.36	0.01	-1.5
	0.02	0.16	-0.13	0.03	0.18	-0.07	0.05	0.14	-0.21	0.06	0.16	-0.14	0.5
	0.01	0.39	-0.20	0.02	0.42	-0.14	0.04	0.36	-0.28	0.05	0.39	-0.21	1.5

Note: Case 1: θ_L^N = 0.7, θ_L^B = θ_L^M =0.3 ;

Case 2: θ_L^B = 0.5, θ_L^N = θ_L^M =0.3 ;

Case 3: θ_L^M = 0.7, θ_L^N = θ_L^B =0.3.

TABLE 2. Sectoral Growth Rates for a Percentage Decline in Imported Input Price
($\theta_E^B = 0.2$, $\theta_E^N = 0.1$, $\theta_E^M = 0$)

	$\alpha = 1.5$						$\alpha = 3.0$						
	$\sigma_{EL} = 0.5$			1.5			$\sigma_{EL} = 0.5$			1.5			
	q_N	q_B	q_M	q_N	q_B	q_M	q_N	q_B	q_M	q_N	q_B	q_M	σ_{KE}
$C_N = 0.2$													
Case 1	0.05	-0.35	0.02	0.11	-0.35	0.04	0.07	-0.36	0.01	0.14	-0.35	0.03	-1.5
	0.08	0.16	-0.03	0.17	0.19	-0.01	0.13	0.14	-0.04	0.22	0.18	-0.02	0.5
	0.07	0.38	-0.05	0.17	0.43	-0.02	0.12	0.36	-0.06	0.22	0.41	-0.03	1.5
Case 2													
	-0.14	-0.31	0.03	-0.12	-0.29	0.06	-0.14	-0.31	0.03	-0.13	-0.29	0.05	-1.5
	0.06	0.20	-0.03	0.09	0.30	-0.01	0.08	0.17	-0.04	0.11	0.28	-0.01	0.5
Case 3	0.14	0.36	-0.06	0.17	0.50	-0.03	0.17	0.32	-0.06	0.20	0.46	-0.04	1.5
$C_N = 0.4$	-0.14	-0.35	0.15	-0.13	-0.35	0.25	-0.15	-0.35	0.12	-0.13	-0.35	0.23	-1.5
Case 1	0.08	0.17	-0.12	0.10	0.20	-0.00	0.10	0.16	-0.16	0.12	0.19	-0.04	0.5
	0.15	0.39	-0.24	0.18	0.44	-0.11	0.18	0.38	-0.27	0.21	0.43	-0.15	1.5
Case 2													
	0.07	-0.36	0.01	0.13	-0.35	0.04	0.12	-0.36	-0.01	0.18	-0.35	0.02	-1.5
	0.11	0.15	-0.04	0.17	0.19	-0.01	0.20	0.12	-0.06	0.26	0.17	-0.02	0.5
Case 3	0.11	0.37	-0.06	0.18	0.44	-0.02	0.21	0.33	-0.08	0.27	0.40	-0.04	1.5
	-0.16	-0.33	0.01	-0.14	-0.30	0.04	-0.17	-0.34	-0.01	-0.15	-0.32	0.02	-1.5
	0.08	0.18	-0.04	0.10	0.29	-0.01	0.13	0.11	-0.06	0.15	0.23	-0.03	0.5
	0.15	0.35	-0.06	0.17	0.50	-0.03	0.21	0.27	-0.07	0.23	0.43	-0.04	1.5
	-0.16	-0.36	0.05	-0.14	-0.35	0.17	-0.17	-0.36	-0.04	-0.15	-0.36	0.09	-1.5
	0.09	0.16	-0.15	0.11	0.20	-0.02	0.05	0.14	-0.24	0.16	0.18	-0.09	0.5
	0.16	0.39	-0.24	0.18	0.44	-0.10	0.22	0.36	-0.32	0.24	0.42	-0.18	1.5

TABLE 3. Changes in Real Exchange Rate, Wage and Sectoral Employment for a Percentage Decline in Imported Input Price

($\theta_E^B = 0.2,\ \theta_E^N = \theta_E^M = 0$)

	$\sigma_{EL} = 0.5$						1.5						
	l_N	l_B	l_M	p_N	w	rw	l_N	l_B	l_M	p_N	w	rw	σ_{KE}
<u>α=0.3</u>													
Case 1	0.23	-0.41	-0.06	0.23	0.09	-0.00	0.28	-0.56	-0.00	0.27	0.00	-0.07	-1.5
	0.12	-0.03	-0.21	0.36	0.29	0.15	0.17	-0.20	-0.14	0.30	0.20	0.08	0.5
	0.07	0.13	-0.27	0.42	0.38	0.21	0.12	-0.04	-0.20	0.36	0.29	0.14	1.5
Case 2	0.22	-0.39	-0.06	0.39	0.08	-0.08	0.26	-0.53	0.00	0.37	-0.00	-0.15	-1.5
	0.12	-0.04	-0.20	0.44	0.28	0.10	0.16	-0.17	-0.14	0.42	0.20	0.03	0.5
	0.08	0.08	-0.24	0.46	0.35	0.16	0.12	-0.04	-0.20	0.44	0.27	0.10	1.5
Case 3	0.24	-0.39	-0.08	0.38	0.05	-0.10	0.27	-0.55	0.02	0.37	-0.01	0.16	-1.5
	0.15	0.03	-0.34	0.42	0.21	0.04	0.19	-0.14	-0.24	0.41	0.14	-0.02	0.5
	0.12	0.23	-0.46	0.44	0.28	0.10	0.15	0.04	-0.35	0.42	0.21	0.04	1.5
<u>α=0.15</u>													
Case 1	0.16	-0.34	0.02	0.06	-0.03	-0.06	0.20	-0.48	0.08	0.01	-0.11	-0.11	-1.5
	0.04	0.05	-0.13	0.21	0.18	0.10	0.09	-0.10	-0.07	0.15	0.10	0.04	0.5
	-0.01	0.23	-0.20	0.27	0.28	0.17	0.03	0.07	-0.14	0.21	0.19	0.11	1.5
Case 2	0.15	-0.31	0.02	0.18	-0.03	-0.10	0.19	-0.44	0.07	0.16	-0.10	-0.17	-1.5
	0.03	0.08	-0.14	0.23	0.19	0.10	0.07	-0.05	-0.08	0.22	0.12	0.03	0.5
	-0.01	0.22	-0.19	0.26	0.27	0.17	0.03	0.09	-0.14	0.24	0.20	0.11	1.5
Case 3	0.15	-0.34	0.05	0.18	-0.03	-0.10	0.18	-0.50	0.14	0.16	-0.09	-0.15	-1.5
	0.06	0.09	-0.22	0.22	0.13	0.04	0.09	-0.07	-0.12	0.20	0.07	-0.01	0.5
	0.02	0.29	-0.34	0.24	0.20	0.11	0.06	0.12	-0.24	0.22	0.14	0.05	1.5

Note : rw $\equiv$ w - $C_N p_N$ = Change in real wage rate.

TABLE 4. Changes in Real Exchange Rate, Wage and Sectoral Employment for a Percentage Decline in Imported Input Price

($\theta_E^B = 0.2$, $\theta_E^N = 0.1$, $\theta_E^M = 0$)

	$\sigma_{EL} = 0.5$						1.5						
	l_N	l_B	l_M	p_N	w	rw	l_N	l_B	l_M	p_N	w	rw	σ_{KE}
<u>α=0.3</u>													
Case 1	0.27	-0.40	-0.03	0.34	0.07	-0.07	0.26	-0.50	0.07	0.24	-0.09	-0.18	-1.5
	0.15	-0.02	-0.23	0.24	0.28	0.18	0.12	-0.11	-0.10	0.12	0.11	0.06	0.5
	0.10	0.14	-0.31	0.23	0.37	0.27	0.06	0.06	-0.18	0.11	0.20	0.15	1.5
Case 2	0.25	-0.37	-0.02	0.79	0.06	-0.26	0.23	-0.46	0.08	0.75	-0.09	-0.39	-1.5
	0.13	-0.03	-0.20	0.31	0.27	0.15	0.10	-0.06	-0.10	0.27	0.13	0.02	0.5
	0.09	0.09	-0.27	0.18	0.34	0.27	0.04	0.08	-0.17	0.14	0.21	0.15	1.5
Case 3	0.26	-0.38	-0.15	0.78	0.03	-0.28	0.23	-0.50	0.05	0.75	-0.08	-0.38	-1.5
	0.17	0.04	-0.29	0.29	0.27	0.15	0.13	-0.08	-0.09	0.26	0.08	-0.02	0.5
	0.13	0.23	-0.35	0.16	0.27	0.21	0.08	0.11	-0.15	0.12	0.15	0.10	1.5
<u>α=0.15</u>													
Case 1	0.18	-0.34	0.04	0.15	-0.04	-0.10	0.17	-0.42	0.14	0.06	-0.18	-0.20	-1.5
	0.05	0.06	-0.15	0.10	0.18	0.14	0.02	-0.02	-0.04	-0.01	0.02	0.03	0.5
	-0.01	0.23	-0.24	0.10	0.27	0.26	-0.04	0.15	-0.12	-0.00	0.09	0.10	1.5
Case 2	0.16	-0.30	0.05	0.51	-0.04	-0.25	0.15	-0.38	0.14	0.48	-0.17	-0.37	-1.5
	0.04	0.08	-0.14	0.12	0.19	0.14	0.00	0.05	-0.05	0.09	0.06	0.02	0.5
	-0.01	0.22	-0.21	0.02	0.27	0.26	-0.06	0.21	-0.12	-0.02	0.14	0.15	1.5
Case 3	0.16	-0.34	-0.02	0.51	-0.04	-0.25	0.13	-0.45	0.16	0.49	-0.14	-0.34	-1.5
	0.07	0.10	-0.17	0.11	0.13	0.08	0.03	-0.02	0.01	0.07	0.02	-0.01	0.5
	0.03	0.29	-0.23	0.00	0.20	0.20	-0.02	0.18	-0.05	-0.03	0.09	0.10	1.5

TABLE 5. Prices Indices

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Prices[a]										
Traded (P_T)	94.5	96.9	100.0	101.8	104.3	110.0	114.3	119.3	127.9	131.4
Nontraded (P_N)	90.2	95.6	100.0	102.6	107.7	113.7	121.7	139.1	161.2	173.7
Relative Prices(P_N/P_T)	95.5	98.7	100.0	100.8	103.3	103.4	106.5	116.6	126.1	132.2
Nominal exchange rate										
U.S. dollar	89.2	92.6	100.0	101.3	94.5	84.1	77.2	81.3	84.3	89.7
Trade weighted[b]	91.4	93.8	100.0	118.7	119.8	105.9	97.3	101.1	106.7	112.0
Real exchange rate										
U.S. dollar	88.0	92.6	100.0	101.4	96.2	85.3	81.1	86.1	86.4	91.2
Traded weighted[b,c]										
REER1	91.1	94.4	100.0	114.1	114.6	100.2	94.3	96.9	98.3	100.3
REER2	88.9	93.8	100.0	119.9	117.4	97.8	80.8	82.3	84.7	NA
Nominal wage[d]	84.2	91.6	100.0	108.2	119.2	137.6	166.7	198.1	232.7	268.1
Real wage[e]	85.8	92.0	100.0	107.9	117.7	135.8	162.6	186.3	212.1	239.8

[a]The weighted average of value added price indices.

[b]Using as weights each year's trade volume of seven major trading partners (U.S., Japan, U.K., Germany, France, Canada and Netherlands).

[c]REER1 = wholesale price index as a deflator; REER2 = unit labor cost as a deflator.

[d]Average wage in industries.

[e] $W/(P_N/P_T)^{C_N}$.

Source: National Statistics Office, ROK, Major Statistics of Korean Economy, 1994;
Bank of Korea, Economic Statistics Yearbook, various issues;
IMF, International Financial Statistics, May 1995.

TABLE 6. Sectoral Growth Rates, Trade Share, Imported Input Share and Employment

	1980-1985 (A)	1986-1992 (B)	A-B[a]	1983-1985	1986-1988	1989-1992	Trade[b] share	Intermediate[c] input share	employ-[d] ment
Nontraded	8.5	11.2	2.7	11.2	12.8	10.1			
Electricity, gas & water	17.3	12.8	-4.5	22.2	15.8	10.5	0.5	8.8	39.2
Construction	7.2	11.6	4.4	10.4	9.1	13.5	1.1	3.2	24.4
Social & personal services	10.6	9.6	-1.0	14.1	9.4	9.8	1.9	5.3	53.0
Finance, Insurance, real estate & business services	10.4	13.1	2.7	12.8	14.7	11.9	2.6	1.2	105.1
Wholesale & retail trade, restaurants & hotels	6.1	9.5	3.5	8.5	14.2	6.1	16.1	1.8	67.5
Traded	6.8	8.5	1.7	10.0	13.0	5.2			
Transport, storage and communication	6.9	11.1	4.2	8.7	11.5	10.8	34.7	12.0	20.2
Manufacturing	9.3	11.1	1.8	13.3	16.8	6.8			16.1
Food, beverages & tobacco	6.0	7.0	1.0	8.5	9.2	5.3	8.1	9.3	30.3
Non-metallic mineral products	7.3	10.4	3.3	12.4	13.9	7.8	17.3	10.7	18.9
Wood & wood products	2.5	6.8	4.4	7.7	11.0	3.7	18.2	39.9	5.4
Paper, printing & publishing	6.7	10.1	3.4	6.4	13.8	7.4	18.6	13.5	36.2
Chemical & petroleum products	6.8	13.4	6.6	11.8	15.4	11.9	36.2	40.2	15.6
Basic metals	12.4	8.9	-3.5	8.7	6.6	10.6	38.5	18.2	38.0
Textiles, apparal & leather	6.4	2.0	-4.4	4.7	10.5	-4.4	51.5	16.6	-1.7
Transportation equipment	16.0	17.6	1.6	21.8	21.6	14.7	55.3	17.8	65.1
Others	6.9	6.5	-0.4	9.5	23.2	-6.1	69.7	9.1	-30.4
Fabricated metal products, machinery & equipment	18.5	16.0	-2.5	20.4	28.2	6.8	72.5	20.8	40.2
Fabricated metal products	13.2	12.2	-0.9	14.0	23.2	4.0	56.3	14.5	13.4
machinery ex. electrical	14.9	19.5	4.6	25.2	33.7	8.9	77.7	16.4	56.9
electrical & electronic machinery	13.2	17.4	4.2	22.2	34.6	4.5	82.3	27.4	39.6
professional & scientific equipment	4.0	15.4	11.4	6.9	32.5	2.6	134.1	23.1	13.6
Agriculture (forestry & fishing)	2.1	0.9	-1.2	3.3	1.9	0.1	20.8	1.8	-19.0
Mining & quarrying	-0.4	-3.2	-2.8	4.2	2.1	-7.2	498.4	0.7	-42.6

[a] Some gaps of growth rates between two periods can be calculated for an arbitrary range of traded share (TS) and imported input share (IS) as follows: A-B = 1.9 for TS $\leq$ 20, 2.1 for 21 $\leq$ TS $\leq$ 40 and -1.7 for 41 $\leq$ TS; A-B = -0.9 for IS $\leq$ 10, 0.6 for
11 $\leq$ IS $\leq$ 20 and 21 $\leq$ IS.

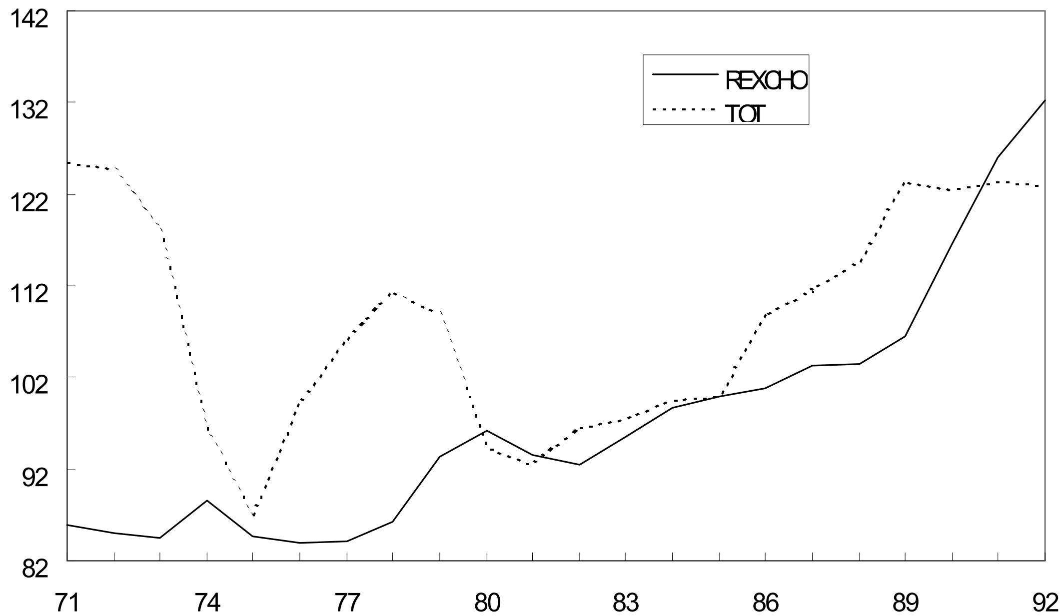
[b] (Exports + imports)/gross output.

[c] Imported intermediate input/gross output

[d] Change in sectoral employment during 1958-92.

Source: National Statistical Office, Major Statistics of Korean Economy, 1994; BOK, Economic Statistics yearbook, various issues; 1985 I-O Table, 1990; Department of Labor, Labor Statistics Yearbook, 1994.

Figure 1. Relative Price of Nontraded Goods and Terms of Trade



REXCHO = Relative price of nontraded goods; TOT = Terms of trade