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REAL SHOCKS AND THE EQUILIBRIUM REAL EXCHANGE RATE: IN THE CASE OF WAGE RIGIDITY

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Using a simple exchange rate model, this paper investigates the role of unemployment in determining the effects of different shocks on the real exchange rate. The presence of unemployment in an economy is shown to significantly alter the relationship between real variables and the real exchange rate. This implies that the generally believed traditional propositions concerning real shocks and the exchange rate might not be valid anymore in the economy with unemployment and thus, that ignoring the importance of unemployment in estimating the exchange rate model may lead to a mis-specification problem. Through a simple illustration of the Korea case over the period 1980 Q1 to 1993 Q4, this result is generally supported. Some policy implications obtained from an empirical study indicate (1) that unemployment itself is an important determinant of the real exchange rate of the Korean won and (2) that the presence of unemployment could significantly alter the effects of different shocks on the exchange rate not in sign, but in magnitude. In the presence of unemployment in Korean economy, capital inflow tends to raise the real value of the Korean won, while capital augmentation and a rise in unemployment tend to depreciate the Korean won. Change in government spending would not affect significantly the real value of the won.

I. INTRODUCTION

It is widely recognized that changes in the real exchange rate have real impacts on an open economy through relative price changes.[1] For example, a shift in the real exchange rate is associated with internal resource reallocation and/or with external adjustment. This real role of the exchange rate could be extended to consider the case in which unemployment is present in an economy. In an economy

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[1] The relative prices used often in the literature are the price of the tradable relative to the nontradable or the price of the imported goods relative to the exported goods.

with unemployment, initial relative price changes brought about by real shocks would cause labor demand to adjust between sectors and/or in aggregate. A change in labor demand, in turn, influences each sector's real output and national income. This represents additional wealth and production effects, which play an important role in determining the effect of different shocks on the equilibrium real exchange rate.

This paper purposes to consider the issue of how unemployment in a country can significantly change the effects of real shocks on the real exchange rate. This issue, which has received fairly scant attention, was initially treated by Edwards and Ostry(1990) and Hazari, Jayasuriya and Sgro(1992). However, their works were either too limited to analyze the effects of various shocks on the exchange rate or used an un-realistic assumption on the labor market.[2] Our model is an extension of the equilibrium exchange rate model developed by Neary(1988) and Edwards(1989). In the equilibrium model, the real exchange rate is always at an equilibrium value determined in the system. Real shocks to the system may change the equilibrium value even when the law of one price holds and the goods markets continuously clear.[3]

We investigate the effects of four separate exogenous shocks on the equilibrium real exchange rate - exogenous international capital flows, fiscal policy changes, changes in factor endowments such as capital formation, and labor market changes. In each case the presence of unemployment in a country modifies the magnitude and possibly the sign of the shock effect on the real exchange rate. These changes occur because of additional effects of labor market changes derived by exogenous shocks. The effects of real shocks on the exchange rate are highly dependent on labor market conditions. This implies that the generally believed traditional propositions concerning the real disturbances and the exchange rate might not hold anymore in the unemployment model.

Few empirical studies have been conducted on the proposition that the presence of unemployment significantly alters how shocks affect the exchange rate. In addition to the comparative static model results demonstrating the importance of unemployment, we provide empirical support for this proposition using quarterly Korean data from the period 1980 Q1 to 1993 Q4. We present both the benchmark model and the unemployment exchange rate model in the next section. In

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[2] While a study by Edwards and Ostry(1990) focused only on the distortionary effect of tariff on the real exchange rate in the two-period framework, a recent study by Hazari, Jayasuriya, and Sgro (1992) used Harris-Todaro mechanism of the labor markets, an unrealistic assumption. Harris-Todaro mechanism explains the urban unemployment as a result of the rural-urban labor migration in two-sector analysis even when the levels of wage and prices adjust appropriately. See Harris and Todaro (1970) for details.

[3] According to the disequilibrium model, monetary factors can temporarily cause the real exchange rate to deviate from the equilibrium because of slow price adjustment.

section Ⅲ, we discuss the effects of different real shocks on the exchange rate in an economy with and without unemployment respectively. Supporting evidence and policy implications will be given in section Ⅳ and conclusions will be presented in the final section.

Ⅱ. THE MODEL

Consider a small country (home) producing and consuming two goods, the nontradable and the tradable.[4] It is assumed that utility and production functions are so well defined that they are homothetic, concave and twice differentiable. A benchmark model in a small open economy is presented in equation (1) through (4). The equation (1) is the home country's resource constraint, which is bounded by exogenous capital flows. Current account deficit, defined as a nation's excess expenditure, is simply determined by capital inflow in a static model.[5] This idea is completely opposite to the elasticity approach in which the possibility of capital flows is assumed away in the model.

$$E(p_1, p_2, G, u) - R(p_1, p_2, G, V) + G = T \tag{1}$$

where $E(\cdot)$ and $R(\cdot)$ are expenditure and revenue functions, which are homogenous degree of one in the goods' prices. p_1 and p_2 are the prices of the nontradable and tradable respectively. u and V are a utility level and factor endowment for the home country. T is exogenous capital flow to home from abroad and is measured in the home country's currency. G is government spending totally financed by a lump-sum tax, which is a use of real resource by government.

However, following Ahmed(1986), government spending provides public services which substitute for a fraction ($\alpha_u^G \times G$) of private spending and for inputs ($\alpha_R^G \times G$) of private production.[6] The effective expenditure and revenue functions are affected by this substitution effect of government spending. The market clearing condition for the nontradable is provided in equation (2). The government spending is assumed not to fall directly on the nontradable, according to Frenkel and Razin(1987). Equation (3) and (4) are trade arbitrage condition for the trad-

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[4] We are abstracting the perfect specialization problems by assuming that the number of factors are greater than those of goods.

[5] See Dixit and Norman(1980) for a reference on characteristics of trade excess demand function. Also see Chipman(1980, p. 160-162) for such a definition of a country's current account as capital constraints.

[6] For example, we can think public services of park, public library, subsidized health program, defense or road. These types of public services provide utility directly and are used as inputs that otherwise should be paid by private sector. Then, the effective consumption is $c^* = c + \alpha_u^G \times G$, where c is a private consumption.

able and a geometric price index for the home country.[7]

$$E_1(p_1, p_2, u) - R_1(p_1, p_2, V) = 0 \tag{2}$$

$$p_2 = \frac{p_2^*}{s} \tag{3}$$

$$(p_1)^{\alpha_1}(p_2)^{\alpha_2} = P \tag{4}$$

where E_1 and R_1 are the Hicksian demand and supply of the nontradable, which are partial derivatives of expenditure and revenue functions with respect to its price. p_2^* is a foreign price of the tradable. The nominal exchange rate, (s), represents foreign currency per unit of the home currency. α_i is expenditure share for good i at home, $\alpha_1 + \alpha_2 = 1$. Totally differentiating equation (2), we can obtain the price changes of the nontradable with respect to the price of the tradable, real income and factor endowment in the benchmark model.

$$\hat{p_1} = \omega\hat{p_2} + \gamma\hat{y} + \delta\hat{V} \tag{5}$$

where $\omega = -\dfrac{\eta_{12} - \varepsilon_{12}}{\eta_{11} - \varepsilon_{11}}$, $\gamma = -\dfrac{\eta_{1y}}{\eta_{11} - \varepsilon_{11}}$, $\delta = \dfrac{\varepsilon_{1v}}{\eta_{11} - \varepsilon_{11}}$

η_{11}, η_{12}; Hicksian own and cross elasticities of demand for the nontradable w. r. t. the tradable's price,

ε_{11}, ε_{12}; the own and cross elasticity of supply for the nontradable w. r. t. the tradable's price,

y, η_{1y}; a real income and the income elasticity of demand for the nontradable,

ε_{1v}; the supply elasticity of the nontradable w. r. t. factor endowment.

A "^" notation denotes a percentage change. We have defined the change in real income (y) as $\hat{y} = E_u\hat{u}$, where E_u is $1/\lambda$, the inverse of the marginal utility of income.

Equation (5) can be used to study the effects of different shocks on the nontradable's price in the fully employed economy. The first and second terms in this expression represent the substitution effect (ω) of change in the tradable's price and the wealth effect (γ) of real income change respectively. A rise in the trad-

[7] The exact price index can be obtained from the assumption of homothetic utility function.

able's price would tend to increase the price of the nontradable, while a rise in real income puts pressure on the demand for the nontradable and thus, its price. The third term is the production effect (δ) of factor endowment change. The production effect tends to increase a good's supply and thus drive down the prices of the goods.

Suppose there exists unemployment at home because of a fixed wage ascribed to a minimum wage regulation. It is assumed that labor and capital are perfectly mobile domestically, so that each factor's reward is the same in every sector of the economy. Because of the sticky wage, labor supply becomes perfectly elastic at that level, at least up to the market-clearing employment level. Therefore, the labor force is partly unemployed at the sticky wage. Existence of a sticky wage requires substituting for the revenue function in equation (1) the following restricted function, which is defined as,

$$R'(p_1, p_2, G, \overline{w}; k) = \text{Max}(x_1 p_1 + x_2 p_2 - \overline{w} L') \tag{6}$$

where k is a vector of non-labor inputs and x_i is effective production of good i at home. w represents a fixed wage and L' is the corresponding level of employment such that:

$$L' = R_w(p_1, p_2, \overline{w}) \tag{7}$$

where R_w is the partial derivative of the revenue function with respect to the real wage. Reworking the equation (2) with the restricted revenue function, we have equation (5)′ showing the price changes of the nontradable derived by real shocks in an economy with unemployment.

$$\hat{p_1} = w\hat{p_2} + \gamma\hat{y} + \delta\hat{L} + \delta\eta^1_{LW}\hat{W} \tag{5}'$$

where η^1_{LW} is the labor demand elasticity with regard to change of wage in the nontradable industry. Note in the economy with a sticky wage that the labor demand used in the production is no longer equivalent to labor endowment. The actually used labor demand depends on the relative prices of the nontradable and the tradable, and wage. Compared to equation (5), the additional fourth term in (5)′ is the cost-production effect of wage changes. A rise in real wage causes labor demand used in production to fall in labor market. The production effect of the labor demand change tends to decrease the good's supply and thus drive up the prices of the goods.

Totally differentiating equation (7), we can obtain equation (7)′ showing labor demand changes derived by the prices and wage changes.

$$\hat{L} = \lambda_1 \eta_{LW}^1 \hat{p}_1 + \lambda_2 \eta_{LW}^2 \hat{p}_2 + \eta_{LW} \hat{W} \qquad (7)'$$

where λ_1 and λ_2 are labor income (use) shares of the nontradable and tradable industries out of total labor income at home. η_{LW}^i and η_{LW} are the labor demand elasticities with regard to wage in the sector i and in aggregate. Initial relative price changes derived by real shocks cause labor demand to adjust between sectors and/or in aggregate. A change in labor demand, in turn, affects the real output of each sector and labor income. This represents additional production and wealth effects of labor demand changes in the economy with unemployment.[8] The production effect tends to increase the goods' supply and drive down the goods' prices, while the wealth effect raises the real consumption. A larger production effect than a wealth effect tends to decrease the goods' prices. The exchange rate, facilitating relative price changes, would incorporate this additional effect of change in labor demand in itself. Following is a discussion on the effects of real shocks on the real exchange rate in an economy with the non-market clearing wage.

Ⅲ. REAL SHOCKS, UNEMPLOYMENT AND THE REAL EXCHANGE RATE

1. The Effects of Real Shocks on the Real Exchange Rate in the Benchmark Model

Before discussing the effects of real disturbances on the real exchange rate in the economy with the sticky wage, it is helpful to look over the effects of the same shocks on the real exchange rate in the benchmark model. We assume that initial values of capital flows and government spending are zero. Totally differentiating equation (1) through (4) and using equation (5), we can obtain changes in the real exchange rate derived by real shocks as shown in equation (8).

$$\hat{s}_r = \alpha_1 \gamma \hat{T} - \alpha_1 \gamma \alpha^G \hat{G} + \alpha_1 (\gamma + \delta) \hat{V} \qquad (8)$$

where s_r is the *purchasing power parity* real exchange rate, defined as $s \times (P/P^*)$. P^* is a foreign price level which is constant. The hat calculus of T, G and V represent percentage changes in capital flows, government spending and factor endowment. Capital flows affect the exchange rate mainly through the wealth eff-

[8] In their recent work, Edwards and Ostry(1990) show that the wealth effect due to labor demand change plays a key role in determining the effects of different shocks on the exchange rate in an economy with wage rigidity.

ect.[9] Capital flow from abroad to home expands the resource constraints and thus, a real income at home. The increased real income puts pressure on the goods' demand and raises the domestic price level. The purchasing power parity real exchange rate is appreciated as a result.[10]

α^G is the net income effect of government spending, which is $(1 - \alpha_u^G - \alpha_R^G)$. Government spending is real consumption by government not available to the private sector. However, government spending substitutes for the private consumption $(\alpha_u^G \times G)$ and for inputs in production $(\alpha_R^G \times G)$. A net real consumption change of a dollar of government spending is negative one dollar (the tax cost), less the two gains α_u^G and α_R^G. Total effect is generally negative but smaller in absolute value than one dollar $(0 < 1 - \alpha_u^G - \alpha_R^G < 1)$.[11] In other words, a dollar of government spending reduces nation's real income by less than one dollar. Thus, a rise in government spending decreases the domestic price level relative to the external price. The real exchange rate tends to be depreciated by a rise in government spending.[12]

Change in factor endowment such as capital formation affects the price level through the production (δ) and wealth (γ) effects. The production effect tends to decrease the goods' prices, while the wealth effect, because of factor augmentation, raises the real income. The larger production effect than the wealth effect of capital augmentation would decrease the price level and depreciate the real exchange rate.

2. Real Shocks and the Real Exchange Rate in the Unemployment Model

As put above, the labor demand used in production is no longer equivalent to labor endowment in the economy with sticky wage. Reworking the system with equation (5)′, (6) and (7)′, we can obtain the real effects of different shocks on the purchasing power parity real exchange rate in the unemployment model. The equation (8)′ includes these relationship between real shocks and the real exchange rate.

$$\hat{S_r} = \Phi[\alpha_1 \gamma \hat{T} - \alpha_1 \gamma \alpha^G \hat{G} + \alpha_1 (\gamma + \delta \eta_{LW}^1) \hat{W}] \qquad (8)'$$

[9] In a more complete model with many periods, both the exchange rate and capital flows would be endogenous. See Backus(1993) for a recent study in the large-country context.

[10] See also Backus(1993) for the ambiguous effect of capital flows on the real exchange rate, defined as the relative price of the nontradable to the tradable.

[11] Let α_u^G and α_R^G be the degree of consumption substitutability and the marginal productivity of government spending as an input. Evidently α_u^G is between 0.2 and 0.4 in the U. S. (Kormendi(1983)). The estimated value of α_R^G is 0.4 in the U. K.(Ahmed(1986)). The Keynesian model assumes away government effects on utility and production so that both values are zero.

[12] Note in the standard model(Branson(1988)) that a rise in government spending would appreciate the real value of the exchange rate.

where $\Phi = \frac{1}{1-(\gamma+\delta)\eta^{1}_{LW}\lambda_1}$

The existence of a non-market clearing wage might add indeterminacy to changes in the exchange rate derived by real shocks. Φ in equation (8)′ represents the labor market constraints. When the production effect (δ) dominates the wealth effect (γ) of change in labor demand and large enough, Φ could be negative. Then, the effects of real shocks on the real exchange rate would be reversed, compared to these real effects in the benchmark model as shown in equation (8). For instance, while capital flow from abroad to home tends to appreciate the real value of the home currency in the benchmark model, it could depreciate the value of the home currency in the negative Φ case under the unemployment model.

Even when Φ is positive, the effects of real shocks on the real exchange rate would differ in magnitude from those effects in the fully employed economy. This implies that the effects of real shocks on the real exchange rate are highly dependent on the labor market conditions. A rise in real wage would cause the labor demand to adjust in aggregate. This change in labor demand affects total real output and labor income. A larger wealth effect than a production effect would tend to drive up the goods' prices and the price level. The real value of the exchange rate would appreciate as a result.[13]

Ⅳ. EVIDENCE

In the previous sections, we emphasized the importance of unemployment in determining the effects of different shocks on the real exchange rate. The presence of unemployment in the economy could cause the exchange rate to move in different direction and magnitude from the exchange rate changes derived by real shocks in the fully employed economy. Ignoring unemployment in estimating the exchange rate model could lead to a mis-specification problem. Many studies have been devoted to investigating the long-run relationship between real variables and the real exchange rate. However, there have been few empirical studies on this relationship in the presence of the sticky wage.[14]

Using quarterly data over the period 1980 Q1 to 1993 Q4, the unemployment model of the exchange rate is estimated for Korea.[15] In this estimation, an effort is made to emphasize the role of unemployment in determining the real shock effects on the equilibrium real exchange rate. Some policy implications are also

[13] See Katseli(1984) for a discussion of the ambiguous effect of change in real wage on the real exchange rate.

[14] Recent studies by Meltzer(1993), Stein(1990) and Zhou(1995) have devoted to investigating the effects of real shocks on the exchange rate in the fully employed economy.

[15] The year 1985 is used as the vase year.

drawn in the latter part of this section. The geometric multilateral real exchange rate (MRER) is used as a real exchange rate index for Korea.

$$MRER_k = \prod_{i=1}^{15} BRER_{ki}^{\sigma_i}, \qquad \text{where } BRER_{ki} = s_{ki}\frac{P_k}{P_i}, \ \sum_{i=1}^{15}\sigma_i = 1 \tag{9}$$

where $MRER_k$ is a multilateral real exchange rate index for Korea. $BRER_{ki}$ is a bilateral real exchange rate of country i's currency per unit of the Korean Won and is simply the nominal exchange rate adjusted for price levels in the two countries, referred to as an absolute PPP version. s_{ki} is the nominal exchange rate of country i's currency unit per unit of the Korean Won and P_i is a price level for country i. We use market rates for the bilateral nominal exchange rates and wholesale price indexes (WPI) for price level which are obtained from International Monetary Fund (IMF), *International Financial Statistics* (IFS). σ_i is the trade weight of country i with Korea.[16] Trade weights based on the year 1990 were obtained from United Nations, *International Trade Statistics YearBook*.[17] Trade shares of the selected 15 countries with Korea cover 75% of total trade volume of Korea.

The polynomial equation (10) is built in such a way that it distinguishes the role of unemployment in determining the effects of different shocks on the real exchange rate.[18]

$$\begin{aligned} LNMRER_t = {} & a_0 + a_1 LNCA_t + a_2 LNGT_t + a_3 LNCP_t + a_4 LNCA \times UN_t \\ & + a_5 LNGT \times UN_t + a_6 LNCP \times UN_t + a_7 UN_t + m_t \end{aligned} \tag{10}$$

where $LNMRER_t$ is the natural logarithm of the $MRER$ in the current period t. $LNCA_t$ and $LNGT_t$ are the natural logarithms of the current account (CA) and real government consumption (GT). Current account is used as a proxy for capital flows. Current account deficit is defined as capital inflow at home in the ba-

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[16] Trade weights of each country with Korea are as follows. The United States(0.36), Japan(0.31), Germany(0.06), The United Kingdom(0.04), France(0.03), Australia(0.03), Canada(0.03), Indonesia(0.03), Singapore(0.03), Italy(0.02), Malaysia(0.02), Saudi Arabia(0.02), Thaliand(0.01), Belgium(0.01), Netherlands(0.01).

[17] Another experiment using a base year of 1985 gave similar results.

[18] The MRER was fairly variable and showed no time trend over the sample period. Assuming an AR(1) process without trend, we identify the MRER by the identification method developed by Box and Jenkins(1976). Estimating the series of MRER reveals that MRER follows a random walk with drift. However, tests for a unit root have low power, especially in small samples (our number of ovservations is 56). If it takes time to adjust to real shocks, a change in the level of the real exchange rate may cause the exchange rate to appear nonstationary or to have a time trend if the time period is too short. As a result, one could detect a unit root (with drift) even if economically significant variables are fundamental determinants of the MRER (Becketti and Hakkio(1992)).

lance of payment accounting identity. We treat negative quantities of CA by using absolute values of CA in logarithms and placing the signs of CA in front of the logarithm values.[19] $LNCP_t$ is the natural logarithm of gross real fixed capital formation (CP) and measures the factor endowment change of capital. The nominal variables of CA, GT and CP are obtained from International Monetary Fund (IMF), *International Financial Statistics* (*IFS*). Nominal values are divided by the price index (WPI) to get real values. UN_t represents an unemployment rate of Korea obtained from Korea Labor Institute, *Quarterly Labor Review*. m_t is an error term.

The coefficients a_1 through a_3 in (10) represent the pure effects of real shocks on the exchange rate. The coefficients of the interactive terms (a_4 through a_6) show their conditional effects on the level of unemployment. The total effect of real shocks on the exchange rate is the sum of both pure and conditional effects. The coefficient a_7 is the simple direct effect of unemployment on the exchange rate in the model. Tests were done to determine that (1) a_7 is significantly nonzero. This is to determine if unemployment itself is an important determinant of the MRER. We also test whether (2) a_4 through a_7 are jointly significant in determining the MRER. These tests indicate whether the effects of real shocks on the MRER are dependent on the presence of unemployment.

The *generalized two-stage least squares* (G2SLS) technique is used to estimate equation (10) for two reasons: one, the current account and unemployment rate seem to be simultaneously determined in the system and two, the series of the exchange rate is serially correlated over the sample period. The first stage is to estimate (10) using a 2SLS procedure to obtain the consistent estimators for each parameter.[20] The residual from the 2SLS estimation was used to estimate the autocorrelated error terms by assuming AR (4) process.[21] Then the latter were used to transform all variables in (10). A 2SLS procedure was implemented again using the transformed variables.

Equation (11) summarizes the results obtained from the G2SLS using centered independent variables.[22]

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[19] Although this treatment of negative quantities of CA is not valid in case of near zero values of CA, the value of CA for Korea is large enough in absolute value.

[20] Instrumental variables used to estimate CA and UN at the first stage are all the other exogenous variables, real interest rate for CA and real wage index for UN respectively. Three month discount rate was used as a proxy for nominal interest rate. Real interest rate was calculated by subtracting inflation rate from the nominal interest rate. Real wage index was based on the year 1985 = 100. The nominal interest rate and wage index were obtained from International Monetary Fund, *IFS*.

[21] The estimated coefficients and the *t*-statistics of each order of m_t in (10) were 0.6072(3.667), 0.2735(1.531), −0.2390(−1.380), and 0.6611(0.961). Another estimation of (10) with AR(1) process for the error term gave the similar results to, but a little less power than the previous one.

[22] The significant intercept term in (11) could cause the independent variables to exhibit collinearity

$$\begin{aligned} LNMRER_{it} = & -4.4454(-382.16) - 0.0027(-3.15)\ LNCA_{it} + 0.0035(0.04)\ LNGT_{it} \\ & - 0.1899(-2.54)\ LNCP_{it} - 0.0011(-1.70)\ LNCA \times UN_{it} \\ & - 0.1048(-1.58)\ LNGT \times UN_{it} + 0.0450(1.12)\ LNCP \times UN_{it} \\ & - 0.0532(-2.95)\ UN_t \end{aligned} \tag{11}$$

$$F = 14.521(0.0001),\ \text{Adj. } R^2 = 0.7522,\ \text{MSE} = 0.0021,\ \text{DW} = 1.839$$

All variables used in estimation are given in logarithmic terms except unemployment rate, so that all coefficients represent the elasticities of MRER with respect to explanatory variables. The values inside the parentheses to the right of the coefficient of each variable are the t-statistics. The value inside the parenthesis beside the F-statistics is the corresponding p-value, suggesting that all real variables are jointly significant at the convention level. The result provides support for the view that a relationship exists between real economic variables and the real exchange rate. The adjusted R^2 is relatively low because of the significant intercept term (a_0) that represents other unexplained factors in our exchange rate model.

As expected, the coefficient of the unemployment rate (a_7) is significantly different from zero at the conventional level. This indicates that unemployment itself is an important determinant of the MRER in Korea. Thus, our first proposition is moderately supported. A rise in unemployment rate tends to depreciate the real value of the Korean Won. We have also tested the second proposition that a_4 through a_7 are jointly significant in determining the MRER. The value of the F-statistic obtained from the test for the second proposition is given in the last column of table 1. The number in the parenthesis to the right of the F-statistic is the corresponding *p*-value. The value of the F-statistics is significant at a conventional level. This result indicates that the effects of different real shocks on the exchange rate are highly dependent on labor market conditions in Korea.

Note that the conditional effect of a real shock may oppose the pure effect. Then, the total effect of a shock on the MRER could be opposite in sign to its pure or direct effect. This means that the relationship between real variables and exchange rate are highly sensitive to the presence of unemployment and that ignoring the effects of unemployment in estimating the exchange rate model may lead to a mis-specification problem. The effects of real shocks on the MRER need to be interpreted as a total rather than a pure effect. The second column in table 1 summarizes the total effects of real shocks, calculated by adding the pure

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due to a significant intercept term when (11) is estimated. To overcome this problem, each independent variable is centered by subtracting its mean (Belsley(1984)). Centering variables makes all independent variables orthogonal to the intercept column and, hence, removes any collinearity involving the intercept column. The mean values used in estimating the model are LNCA(−7.6513), LNGT(23.6772), LNCP(3.9551) and UN(3.5436).

[Table 1] Total Effects of Real Shocks on the Real Exchange Rate of Korea

	Total Effects	H_0: $a_1 = a_4 = 0$	H_0: $a_2 = a_5 = 0$	H_0: $a_3 = a_6 = 0$	H_0: $a_4 = a_5 = a_6 = a_7 = 0$
LNCA	−0.0066	5.9022(0.0059)			
LNGT	−0.3679		1.1555(0.2244)		
LNCP	−0.0304			4.6533(0.0151)	
UN	−2.3086				6.3115(0.0005)

effects to the conditional effects multiplied by the mean value of unemployment rate. The mean values of independent variables are provided in footnote (22). The 3rd through 5th column in table 1 represent the F-statistics and their corresponding p-values for the total effects of each variables on the real exchange rate. The total effects of real variables were statistically significant at a convention level except that of government spending in Korea.

Some policy implications can be drawn from the above total effect analysis. *First*, the real exchange rate of the Korean Won is negatively related to capital flows and their association is statistically significant. That is, capital inflow appreciates the real value of the Won. The conditional effect of capital flows reinforces this relationship in Korea. *Second*, a change in government consumption would not significantly influence the real exchange rate in Korea, although a rise in government consumption would tend to depreciate the real value of the Korean won. This result is in sharp contrast to the popular view that a rise in government spending causes the interest rate to rise relative to the foreign rate and consequently results in capital inflow. The nominal and thus the real exchange rates appreciate as a result.[23]

This contradictory result could arise from the following two facts: One is that the effect of government spending in our model is considered in the economy with the levels of capital flows and the interest rates held constant. This assumption on capital flows and the interest rates could break down the linkages between the exchange rates, capital flows and the interest rates. Two, as Stockman (1987) pointed out, is that change in the nominal exchange rate does not necessarily require the real exchange rate to change. The real exchange rate itself is endogenously determined in the system. *Third*, the effect of capital formation on the exchange rate is negative and statistically significant in Korea. This indicates that capital augmentation is associated with real exchange rate depreciation.

It is notable in the above policy discussions to find that the total effect of each variable on the exchange rate has the same sign as that of the pure effect. According to theory (equation (8) and (8)′), we can deduce the fact that Φ is positive, as long as $\gamma > 0$. This fact indicates that the presence of unemployment in

[23] See Branson(1988) for discussions of a popular view.

Korean economy would alter the relationship between real shocks and the real exchange rate not in sign, but in magnitude.

Lastly, in our theory, a rise in wage and thus a rise in unemployment should appreciate the real value of the Korean won in a positive Φ case. However, our empirical result reports that unemployment would depreciate the real exchange rate in Korea. This reverse effect of unemployment could arise from the reason that unemployment has not the one-to-one relationship with wage change. Unemployment would be influenced by the goods' prices and the economic structure as well as wage changes.

V. CONCLUSIONS

Using a simple illustration of the Korea case over the period 1980 Q1 to 1993 Q4, this paper emphasized the importance of unemployment in determining the effects of different shocks on the real value of the Korean won. The results obtained from the G2SLS method indicate (1) that unemployment itself is an important determinant of the real exchange rate of the Korean won and (2) that the presence of unemployment could significantly alter the effects of different shocks on the real value of the Korean won not *in sign, but in magnitude*. In the presence of unemployment in Korean economy, capital inflow tends to raise the real value of the Korean won, while capital augmentation and a rise in unemployment tend to depreciate the Korean won. Change in government spending would not affect significantly the real value of the won.

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