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Exchange Rates and Foreign Trade in Korea

Bela Balassa

Korea's exchange rate has had a greater effect than other domestic economic variables on its exports, which have been key to its outstanding economic growth. Thus Korea's use of the exchange rate as a policy variable makes good sense and should be continued as long as domestic and foreign inflation rates differ.

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Korea's exports have made an important contribution to its outstanding economic growth. Its exports, in turn, have been affected by domestic economic variables, including exchange rate policy, and by external influences.

Among domestic economic variables, the exchange rate appears to have had a greater influence on exports than changes in export prices or changes in the prices of competing domestic goods. Taking into account that Korean exports are influenced by external factors, such as foreign export prices and foreign incomes, does not affect this conclusion.

Korean imports are affected by domestic income, the exchange rate, import prices, and the prices of competing domestic goods. Again, the influence of the exchange rate is greater than that of import prices and the price of domestic goods.

The results indicate that Korea can usefully employ the exchange rate as a policy variable. This has been the case during much of the 1965-88 period that Balassa considers, except for 1975-80, when it led to a substantial overvaluation of the currency. Korea should also use the exchange rate in the future as long as domestic and foreign inflation rates differ.

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EXCHANGE RATES AND FOREIGN TRADE IN KOREA

Bela Balassa*

Table of Contents

* The author is Professor of Political Economy at the Johns Hopkins University and Consultant to the World Bank. He presented this paper at the First Washington Symposium on U.S.-Korean Economic Relations, held in Washington D.C. in October 1990. Research assistance by Shigeru Akiyama is gratefully acknowledged.

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Introduction

Korea has been an outstanding economic performer. As shown in the 1990 World Development Report (World Bank), annual rates of per capita income growth averaged 6.8 percent in Korea between 1965 and 1988, compared with an average of 2.3 percent for the upper-middle-income country group, to which Korea belongs. The corresponding figures were 2.3 percent for high-income countries and 2.6 percent for lower-middle-income countries.

Exports importantly contributed to economic growth in Korea. According to the same source, Korean exports grew by 23 percent between 1965 and 1988. The comparable figures were 2 percent for upper-middle-income countries, 6 percent for high-income countries, and 4 percent for lower-middle-income countries.

Rapid increases in exports permitted fast import growth in Korea. The average rate of growth of imports was 13 percent for the 1965-88 period. The comparable figures were 5 percent for upper-middle income countries, 5 percent for high-income countries, and 4 percent for lower-middle-income countries.

This paper will examine the contribution of changes in exchange rates to exports and to imports in a time series framework. This will be done by estimating a system of equations that will include export supply, export demand, as well as import demand.

Sections I and II will provide estimates of export equations on the assumption that Korea is a price taker in the world market, and that it can affect world market prices, respectively. In section III, estimates of import demand will be presented on the assumption the Korea cannot affect the prices

of the goods it imports. In the conclusion, the policy implications of the results will be considered.

I. Estimation of Export Equations: Korea is a Price Taker

In the event that Korea cannot affect the prices of the goods it exports, only an export supply equation is estimated, by the use of ordinary least squares (OLS). This equation includes price as well as capacity variables.

The relative profitability of exports is affected by changes in export prices expressed in terms of foreign currency (P_x), in exchange rates (R), and in the prices of domestic goods (P_d). The relative profitability of exports will improve (deteriorate) if the dollar prices of exports increase (decrease), the exchange rate depreciates (appreciates) and the prices of domestic goods decrease (increase).

It is customary to combine these variables in a single price ratio, that of export prices to domestic prices. This assumes, however, that all three prices affect exports equally. To test the validity of this proposition, we may introduce the three price variables separately in the estimating equation.

The separate introduction of the three price variables may be rationalized by reference to differences in the reaction of exporters to changes in the different prices. Such will be the case, for example, if expectations as regards the reversibility of changes in the various prices differ. Thus, exporters may respond more readily to changes in exchange rates they consider permanent than to changes in export and domestic prices they consider transitory.

Domestic (non-export) goods include non-traded goods as well as import substitutes. Making separate calculations by the use of price indices for these groups of products permits estimating substitution relationships between exports,

on the one hand, and non-traded goods and import substitutes, taken individually, on the other.

In the estimation, the GDP deflator for non-traded goods has been used as the price index for non-traded goods (P_{d1}) while the GDP deflator for traded goods has been used as the price index for import substitutes (P_{d2}). Use has further been made of the wholesale price index (P_{d3}) to represent the prices for all non-export goods. In turn, in the absence of a "genuine" export price index, the export unit value index has been used to represent the index of export prices.

Apart from the choice of appropriate price variables, analyzing the influences affecting changes in exports in a time series framework will necessitate introducing changes in capacity in the estimating equation. This has been done by the use of the gross domestic product (Y) in the estimation.

The estimating equation is shown in (1), where X refers to the volume index of exports. Estimation has been done for the period 1973-88, for which all the necessary data are available.

(1) $X = f(R;\ P_x;\ P_d;\ Y)$

Estimating by the use of annual values assumes that no structural changes occurred during the period that would have affected differently the variables included in the equation. This has not been the case as technological change has been more rapid in export industries than in domestic industries. As a result, export prices rose to a lesser extent than domestic prices, irrespective of the choice of the price index. This explains that the supply elasticity estimated by the use of annual data is negative.

Correspondingly, in the estimation we have replaced annual data by rates of change. This has permitted abstracting for structural change that is imbedded in the annual data. The results are reported in Table 1.

In the equations where the relative price variable (the ratio of export to domestic prices) is used, its coefficient has the expected sign, but it is statistically significant at the 10 percent level only in the first equation and not significant in the other two. This may be explained by the fact that the coefficients of the three price variables differ to a considerable extent when these are introduced separately.

The coefficients of the exchange rate variable are between 1.9 and 2.0, depending on the domestic price variable used. In turn, the coefficients of the export price variable range between 0.9 and 1.1. Finally, the coefficients of the domestic price variable are between -0.4 and -0.5.

The coefficient of the exchange rate variable is statistically significant at the 1 percent level in all three equations. The coefficient of the export variable is significant at the 5 percent level, again in all three equations. The coefficient of the domestic price variable has the expected sign, but it is not significant statistically, with t values between 1.0 and 1.5.

The statistical significance of the capacity variable also increases if we disaggregate the relative price variable. It is significant at the 5 percent level in the first two equations and not at all in the third equation if the relative price ratio is used in the estimation. In turn, the level of significance of the capacity variable is 1 percent in all three equations when the relative price variable is disaggregated. Its value varies between 3.2 and 3.8, indicating that changes in exports are severalfold greater than changes in capacity.

The coefficient of determination is also much higher if the price variable is disaggregated. The adjusted R^2 varies between 0.2 and 0.3 if the price variable is introduced in a ratio form. It is between 0.5 and 0.6 if the three price variables are separately introduced.

We have further tested the hypothesis that the regression coefficients of the price variable in the export supply equations are identical. These tests have been performed in regard to pairs of the price variables as well as for all three price variables. The results are reported in Table 2.

The results show that coefficient values are unequal, except for one case when the coefficients of the export price and the domestic price variables are compared and the domestic price variable refers to the prices of non-traded goods, but this result lacks statistical significance. In most cases, the estimates are significant at the 5 percent level.

II. Estimation of Export Equations: Korea is not a Price Taker

It cannot be assumed that Korea is a price taker as far as its exports are concerned. This is because 93 percent of Korea's exports are manufactured goods that are differentiated products. For differentiated products, foreign demand responds to changes in relative prices.

If a country is not a price taker in the market for its exports, single equation estimation will give rise to a bias and use needs to be made of simultaneous equation estimation. This involves introducing an export demand equation, where demand for exports is assumed to depend on the country's export prices relative to the prices of its competitors as well as on foreign income.

The index of export prices of country i's competitors (P_{ec}) may be derived by utilizing equation (2), where a_{ij} is the share of country j in country i's

exports and b_{jk} is the share of competing exports k in country j. As the price index of competing exports k (P_{ek}) use is made of the export unit value index.

(2) $$P_{ec} = \sum_j (a_{ij} \sum_k b_{jk} P_{ek})$$

The export demand equation further includes foreign income defined as the index of GDP of the countries to which country i exports, the weights being country j's share of country i's exports. This is shown in equation (3).

(3) $$Y_w = \sum_j a_{ij} Y_j$$

The export supply and export demand equations can be written as in equations (4) and (5).

(4) $$X^s = f\ (R;\ P_x;\ P_d;\ Y)$$

(5) $$X^d = g\ (P_x;\ P_{ec};\ Y_w)$$

These formulas correspond to those used by Goldstein and Khan (1978). While these authors had the variable for export prices on the left-hand side of the demand equation, as they also note, this is only a matter of convenience since the estimates of the parameters are invariant with respect to the normalization process employed.

The system of simultaneous equations has been estimated by the use of two-stage least squares procedure (TSLS). This corresponds to the equilibrium model employed by Goldstein and Khan; their disequilibrium model, utilizing the adjustment procedure outlined by Horthakker and Taylor (1970) has not given satisfactory results in the present investigation.

Simultaneous equation estimation affects the results obtained for the export supply equation but little. The relative price variable is not significant statistically in any of the equations. In the same formulation, the capacity variable is statistically significant at the 5 percent level in the

first two equations and not significant in the third equation. The coefficient of determination varies between 0.2 and 0.3 in the equations incorporating the relative price variable.

Again, the results improve to a considerable extent if the price variable is disaggregated. The exchange rate variable is statistically significant at the 1 percent level in all the equations; the export price variable is significant at the 5 percent level in all cases; and the domestic price variable has the expected sign, but it is not significant statistically in any of the equations.

The coefficient values are somewhat higher, however, than is the case of estimation by OLS. The regression coefficient of the exchange rate variable ranges between 1.9 and 2.2; that of the export price variable between 1.0 and 1.3; and that of the domestic price variable between -0.5 and -0.6.

Tests of the hypothesis that the regression coefficients of the price variables are identical are reported in Table 2. Apart from the case when the coefficients of the export price and the domestic price variables are compared, and the domestic price variable refers to the price of non-traded goods, the results show that the coefficient values are unequal. In most cases, the estimates are statistically significant at the 5 percent level.

The capacity variable takes values between 3.1 and 3.8. It is statistically significant at the 1 percent level in all cases. Finally, the adjusted R^2 is between 0.5 and 0.6.

In the export demand equations, the coefficient of the foreign income variable assumes values between 5 and 6 for the different domestic price variables. It is statistically significant at the 5 percent level. The

coefficient of export price ratio takes values between -1.0 and -1.2. The coefficient is not significant statistically, but it has the expected sign.

Finally, the adjusted R^2 is slightly below 0.2 in all three equations. While these are very low values, it should be remembered that using rates of change in the estimation very much reduces the coefficient of determination.

III. Estimation of Import Demand Equations

It can be assumed that Korea is a price taker for the goods it imports. Also, technological change is not likely to cause differential changes in the variables affecting imports. Correspondingly, estimates have been made by ordinary least squares from annual data. The data have been expressed in logarithmic terms.

Imports are affected by domestic income, measured in terms of GDP, as well as by exchange rates, the dollar price of imports (P_m) and the price of domestic goods (P_d). Again, the price variables may be introduced in terms of the ratio of import prices to domestic prices as well as individually. In the latter case, the estimating equation is written as in (6), where M is the volume of imports.

(6) $M = h\ (R;\ P_m;\ P_d;\ Y)$

In the estimated equation incorporating the relative price variable, this variable takes different values and varies in statistical significance, depending on the domestic price variable used. It has a coefficient of -0.4 and it is statistically significant at the 1 percent level if the price index for non-traded goods is used as domestic price variable. The coefficient value is -0.5 and the level of statistical significance remains 1 percent if the price index for traded goods is used instead. However, the coefficient is -0.3 and it is significant at the 10 percent level if the wholesale price index is used as the domestic price variable.

In the same equations, the coefficient of the income variable ranges between 1.1 and 1.3; it is statistically significant at the 1 percent level in all the equations. Finally, the adjusted R^2 is between 0.98 and 0.99.

The coefficient of the income variable and the adjusted R^2 change little if the relative price variable is decomposed into its constituent parts. However, the values and the statistical significance of the coefficients vary to a considerable extent among the price variables and in the different equations.

The coefficient of the exchange rate variable takes values between -0.6 and -0.7 in the first two equations, and it is statistically significant at the 1 percent level. It takes a value of -0.6 in the third equation, but it is significant only at the 10 percent level.

The coefficient of the import price variable has the expected sign, with values varying between -0.2 and -0.3, but it is not statistically significant even at the 10 percent level. Finally, the domestic price variable assumes values between 0.4 and 0.5; it is statistically significant at the 1 percent level in the first two equations and at the 10 percent level in the third equation.

Conclusions

This paper has reported on the results of estimation of export equations and import equations. In the case of export equations, conventional estimation from annual data has been replaced by estimation from rates of change, because structural changes affected price variables differentially during the period under consideration. In particular, technological change has reduced export prices relative to domestic prices.

Conventionally, export supply equations are estimated by introducing the ratio of export to domestic prices in the estimating equation. This has not given statistically significant results in the present case, presumably because exporters react differently to various components of this price ratio. In fact, coefficient value are much higher for the exchange rate than for export prices and these are again much higher than the coefficients for domestic prices.

The coefficient of the exchange rate variable takes values between 1.9 and 2.2: it is significant at the 1 percent level; the coefficient of the export price variable ranges between 1.0 and 1.3: it is significant at the 5 percent level. The coefficient of the domestic price variables is between -0.5 and -0.6; it is not significant statistically but has the expected sign. The differences among the coefficient values are statistically significant.

The domestic price variable has been introduced in three different forms (the unit value index for non-traded goods, the unit value index for traded goods, and the wholesale price index) to explore differences in the substitution of various groups of domestic goods for exports. There are no systemic differences among the three cases, although the regression coefficient of the price variable tends to be somewhat higher if the wholesale price index is used.

The regression coefficients of the price variables are also higher in simultaneous equation estimation than in the case where estimation is done by ordinary least squares. The statistical significance of the estimates does not differ, however.

In the export demand equation, the foreign income variable is statistically significant at the 5 percent level. The variable for the export price ratio assumes values between -1.0 and -1.2; it has the expected sign, but it is not significant statistically.

It has been assumed that Korea cannot affect the prices of goods it imports. In the disaggregated formulation, the exchange rate variable assumes values between -0.6 and -0.7; it is statistically significant at the 1 percent level in the first two equations and at the 10 percent level in the third equation. The same significance levels apply to the domestic price variable that takes values between 0.4 and 0.5. Finally, the import price variable has values varying between -0.2 and -0.3 but it is not significant statistically.

These results permit us to consider the policy question as the effects of a devaluation on the Korean trade balance. It should be recalled that the exchange rate variable assumes values between 1.0 and 1.3 in the export supply equation and between -0.6 and -0.7 in the import demand equation; the coefficients of the export price ratio vary between -1.0 and -1.2 in the export demand equation. It appears, then, that a devaluation will improve Korea's trade balance.

It can be concluded that Korea can usefully employ the exchange rate as a policy variable. This has indeed been the case during much of the period under consideration except for 1975-1980 when it led to a substantial revaluation of the currency. The exchange rate should also be used in the future as long as demand and foreign inflation rates differ.

Table 1

Export Supply Equations for Korea, 1973-1988

	const.	Y	$\frac{P_x * R}{P_d}$	R	P_x	P_d	$\bar{R}^2$	D.W.	N
P_{d1}	0.043	1.638	0.758				0.315	1.599	16
	0.62	2.37*	1.85†						
P_{d2}	0.026	1.648	0.486				0.202	1.732	16
	0.35	2.21*	1.04						
P_{d3}	0.081	1.031	0.518				0.220	1.367	16
	0.93	1.16	1.19						
P_{d1}	-0.243	3.635		1.883	0.979	-0.503	0.566	2.108	16
	-2.25	4.16**		3.67**	2.80*	-1.38			
P_{d2}	-0.280	3.792		1.885	0.942	-0.383	0.534	2.277	16
	-2.58	4.19**		3.23**	2.40*	-1.00			
P_{d3}	-0.231	3.180		2.008	1.119	-0.494	0.581	1.910	16
	-2.13	3.44**		3.75**	2.83*	-1.54			

Note: Estimation has been done by ordinary least squares from data expressed in terms of rates of change. For explanation of symbols, see text: .... values are in the second row for each equations. Significance levels: ** 1 percent; * 5 percent; † 10 percent

Table 2

Tests of the Hypothesis that the Regression Coefficients of the Price Variables are Identical in Export Supply Equations for Korea, 1973-88

		OLS	TSLS
P_{d1}	$R = P_x$	not equal*	not equal*
	$P_x = -P_d$	equal	equal
	$R = -P_d$	not equal*	not equal*
	$R = P_x = -P_d$	not equal*	not equal*
P_{d2}	$R = P_x$	not equal*	not equal*
	$P_x = -P_d$	not equal†	not equal†
	$R = -P_d$	not equal**	not equal**
	$R = P_x = -P_d$	not equal*	not equal*
P_{d3}	$R = P_x$	not equal*	not equal*
	$P_x = -P_d$	not equal*	not equal*
	$R = -P_d$	not equal**	not equal**
	$R = P_x = -P_d$	not equal*	not equal*

For explanation of symbols, see text.

Table 3

Export Supply and Export Demand Equations for Korea, 1973-88

Supply	const.	Y	Y_w	$\frac{P_x * R}{P_d}$	R	P_x	P_d	$\frac{P_x}{P_w}$	$\bar{R}^2$	D.W.	N
P_{d1}	0.043	1.638		0.751					0.293	1.601	16
	0.62	2.37*		1.66							
P_{d2}	0.026	1.646		0.445					0.185	1.732	16
	0.35	2.20*		0.84							
P_{d3}	0.078	1.062		0.491					0.205	1.385	16
	0.87	1.16		1.02							
P_{d1}	-0.245	3.646			1.931	1.029	-0.537		0.553	2.087	16
	-2.26	4.17**			3.57**	2.61*	-1.39				
P_{d2}	-0.289	3.847			2.020	1.069	-0.473		0.524	2.264	16
	-2.62	4.20**			3.14**	2.29	-1.12				
P_{d3}	-0.231	3.108			2.171	1.290	-0.600		0.574	1.810	16
	-2.12	3.31**			3.70**	2.78*	-1.69				
Demand											
P_{d1}	-0.022		5.337					-1.180	0.191	0.917	16
	-0.24		2.30*					-1.25			
P_{d2}	-0.028		5.518					-1.284	0.188	0.947	16
	-0.30		2.27*					-1.26			
P_{d3}	-0.014		5.099					-1.042	0.185	0.883	16
	-0.15		2.24*					-1.13			

Notes: Estimation has been done by two step least squares from data regressed in terms of rates of change. For explanation of symbols, see text; the values are in the second row for each equation.
Significance levels: ** 1 percent; * 5 percent; † 10 percent.

Table 4

Import Demand Equations for Korea, 1973-88

	const.	Y	P_m*R	R	P_m	P_d	R^2	$\bar{D}$.W.	N
				P_d					
P_{d1}	1.458	1.136		-0.442			0.986	0.882	16
	1.62	17.28**		-3.07**					
P_{d2}	1.191	1.255		-0.504			0.989	0.926	16
	1.86	33.62**		-3.95**					
P_{d3}	0.038	1.293		-0.280			0.980	0.834	16
	0.05	2.714**		-1.80†					
P_{d1}	1.679	1.128			-0.688	-0.280 0.483	0.990	1.510	16
	1.77	10.34**			-3.48**	-1.43 3.69**			
P_{d2}	1.064	1.258			-0.627	-0.335 0.483	0.990	1.249	16
	1.36	11.22**			-3.47**	-1.64 3.77**			
P_{d3}	0.435	1.333			-0.589	-0.177 0.356	0.984	1.223	16
	0.40	7.92**			-2.02†	-0.63 2.02†			

Notes: Estimates have been done by ordinary least squares from current data Expressed in logarithmic terms. For explanation of symbols, see text. Significance levels: ** 1 percent; * 5 percent; † 10 percent.

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