EFFECTS OF A DEVALUATION ON AGRICULTURAL TRADE

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Introduction

Nations trade with each other for fundamentally the same reasons that individuals or regions engage in exchange of goods and services; to obtain the benefits of specialization. Since nations like individuals are not equally suited to produce all goods, either because they are differently endowed or for other reasons, all would benefit if each specialized in what it can do best and obtained its other needs through exchange. This idea was introduced over 150 years ago as part of the theory of comparative advantage by Adam Smith and developed in depth by David Richardo.

One of hot issue in international trade is the effect of devaluation on a nation's total exports and imports and terms of trade. The purpose of this paper is to review the theoretical framework that can be used to assess the trade impact of devaluation on any commodity or any subsector of a country's economy. It will review the effects of changes in an exchange rate on commodity production, consumption, trade levels, and prices for any two trading partners. It will also briefly review the impact of devaluation on the balance-of-payments position and the terms of trade of the country. The theoretical mdoel is then used to analyze the possible effects of a devaluation on the agricultural sector in the United States.

For purposes of simplification, the following conditions are assumed: (1) the model consists of a two-country world (Korea and United States), (2) competitive economic systems exist in both countries so that a competitive equilibrium position will be reached, (3) a single homogeneous commodity, wheat, is traded, (4) no transport costs, (5) no trade barriers exist between these two countries, (6) the market for the single homogeneous commodity can be specified by a single downward sloping demand curve and a single upward sloping supply curve for each country, and (7) the United States has a comparative advantage in wheat production.
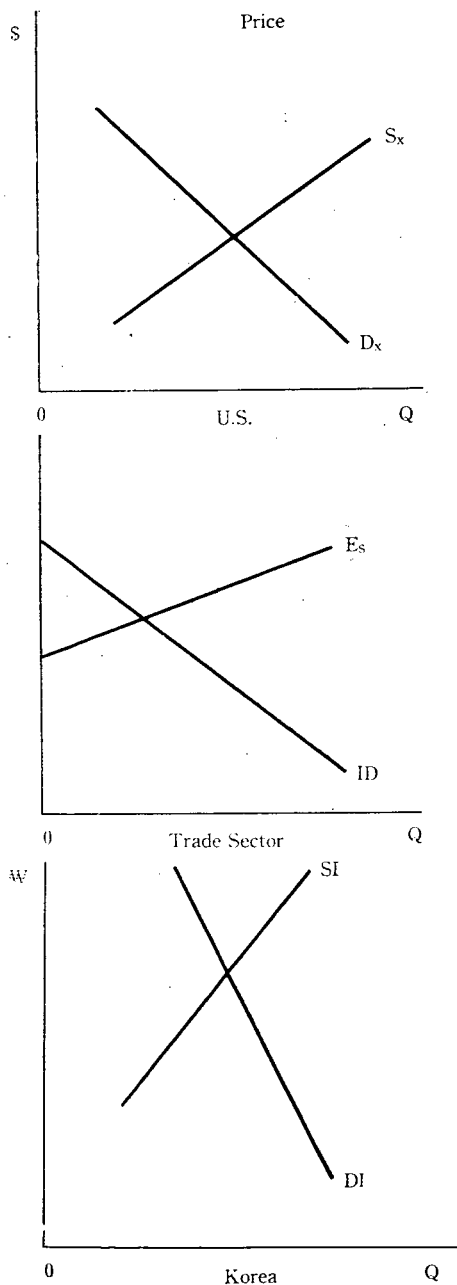
I. Export Supply and Import Demand Curves

Figure 1 shows the domestic supply and demand curves and equilibrium

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price of wheat for the two countries. For the moment we assume that the exchange ratio of the two countries' currency is 1:1.

FIGURE 1   TRADE OF WHEAT BETWEEN U.S. AND KOREA

Trade will take place if the price is different in the two countries. As wheat price rises in the United States, the domestic quantity supplied increases, and the domestic quantity demanded decreases, making more of wheat available for export. Concurrently, as wheat price falls in Korea its domestic quantity demanded increases, the domestic quantity supplied decreases, and Korea becomes more reliant on imports. Equilibrium is reached when wheat prices are equal in the two countries and when the amount available for export from U.S. equals the amount of wheat Korea desires to import.

These trading relationships are summarized in the central panel of Figure 1. The export supply curve (ES) shows the various quantity of wheat that will be supplied to Korea by U.S. at different price levels. The import demand curve (ID) shows the various quantities of the commodity that will be demanded from U.S. by Korea at different wheat price levels.

Trade equilibrium is reached at that point where export supply equals import demand. The trade equilibrium price will be between the domestic equilibrium price of the two countries and depends on the relative elasticities of the export supply and import demand curves.

The elasticity of the export supply and import demand curve is a function of the underlying domestic supply and demand curves. The more elastic the domestic supply and demand curves, the more elastic the export supply and import demand curve will be. Mathematically we can derive the import demand elasticity (Φ_m) and the export supply elasticity (Σ_x) from the definition of elasticity as follows.

Elasticity of Import Demand

The elasticity of import demand for a given product is positively related to the domestic demand and supply elasticities, negatively related to the share of imports in domestic consumption and production. Remembering that the volume of imports (Q_m) is the difference between the quantities demanded (Q_d) and supplied (Q_s) at home.

$$\Phi_m = \frac{-P}{Q_m} \times \frac{\Delta Q_m}{\Delta P} = \frac{-P}{Q_m} \times \frac{\Delta (Q_d - Q_s)}{\Delta P}$$
$$= \frac{-P}{Q_m} \times \frac{\Delta Q_d}{\Delta P} + \frac{P}{Q_m} \times \frac{\Delta Q_s}{\Delta P}$$

Next, we multiply and divide the first term of the last expression by Q_d and the second term by Q_s:

$$\Phi_m = \frac{\dfrac{-P}{Q_d} \times \dfrac{\Delta Q_d}{\Delta P} \times Q_d}{Q_m} + \frac{\dfrac{P}{Q_s} \times \dfrac{\Delta Q_s}{\Delta P} \times Q_s}{Q_m}$$

$$= \frac{E_d \times Q_d}{Q_m} + \frac{E_s \times Q_s}{Q_m}$$

where E_d and E_s represent domestic demand and supply elasticities, respectively. Thus:

$$\dot{\Phi}_m = \frac{Q_d}{Q_m} \times E_d + \frac{Q_s}{Q_m} \times E_s$$

Elasticity of Export Supply

The export supply elasticity of a given product is positively related to the domestic demand and supply elasticities and negatively related to the share of exports in domestic production and consumption. Remembering that the volume of exports (Q_e) is the difference between the quantities supplied and demanded domestically $(Q_s$ and $Q_d)$, we can derive the export supply elasticity (Σ_x) from the definition of elasticity, as follows:

$$\Sigma_x = \frac{P}{Q_e} \times \frac{\Delta Q_e}{\Delta P} = \frac{P}{Q_e} \times \frac{\Delta(Q_s - Q_d)}{\Delta P}$$

$$= \frac{P}{Q_e} \times \frac{\Delta Q_s}{\Delta P} - \frac{P}{Q_e} \times \frac{\Delta Q_d}{\Delta P}$$

Next, we multiply and divide the first term by Q_s and the second term by Q_d:

$$\Sigma_x = \frac{\dfrac{P}{Q_s} \times \dfrac{Q_s}{P} \times Q_s}{Q_e} - \frac{\dfrac{P}{Q_d} \times \dfrac{Q_d}{P} \times Q_d}{Q_e}$$

$$= \frac{E_s \times Q_s}{Q_e} + \frac{E_d \times Q_d}{Q_e}$$

where E_x and E_d represent domestic supply and demand elasticities, recalling that the demand elasticity is negative. Thus:

$$\Sigma_x = \frac{Q_s}{Q_e} \times E_x + \frac{Q_d}{Q_e} \times E_d$$

II. Devaluation

To this point, the analysis has been based on the assumption that the exchange ratio between U.S. and Korea is 1:1.

Now let us assume the United States devaluate its currency. The devaluation of United States can be expressed by changing the scale on the vertical axis of Korea's graph. One unit of United States dollar will now buy less units of the Korea's currency (W) than before the devaluation occurred. Thus, in this, a devaluation implies a stretching out of the ver-

FIGURE 2   EFFECT OF DEVALUATION BY EXPORTING COUNTRY EQUILIBRIUM TRADE PATTERN FOR EXPORTS
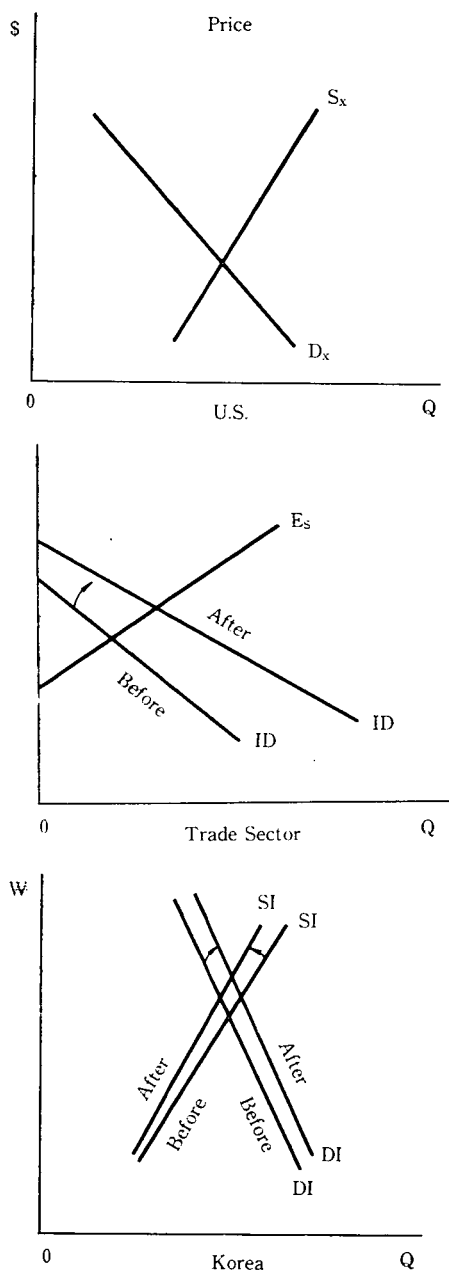
tical axis on the Korea's graph.

This change of the price scale (with no change in the quantity scale) will cause a "shift" in both the demand and supply curves for Korea. Since the devaluation causes a stretching out of the price axis, both the demand curve and supply curve will "shift" up from their previous positions.
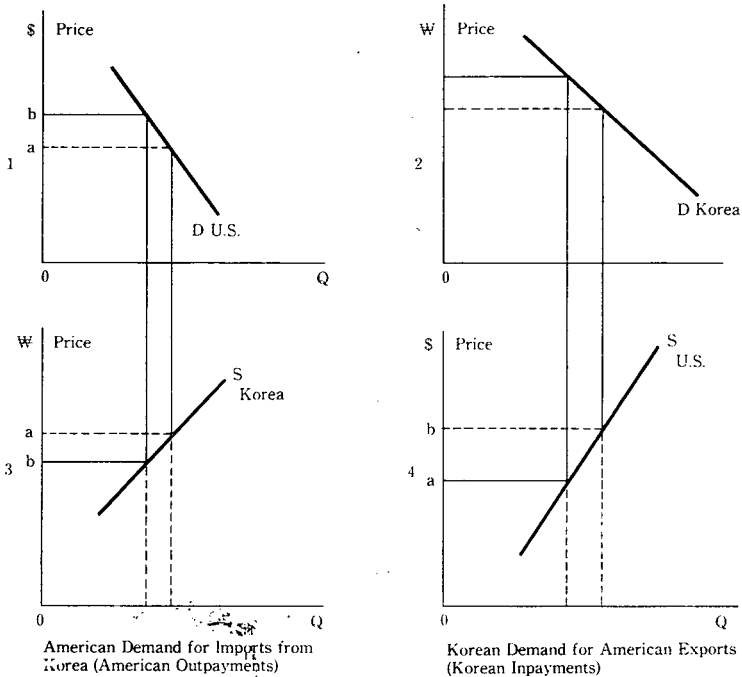
From the point of view of United States which devalues, Korea apperars to have simultaneously increased demand and decreased supply. What seems to be shifts in the supply and demand curves for Korea will result in an actual increase (shift to the right) in the import demand curve (see Figure 2).

The result of devaluation is an increase in import demand. Such an increase will cause an expansion in the quantity exported as well as a rise in the price of wheat (expressed in U.S. dollars). This higher price will stimulate wheat production in the United States, thus increasing the quantity of wheat supplied; and it will dampen consumption, leading to a decrease in the quantity of wheat demanded. Thus, the United States, will produce more, consume less, and export more wheat.

From Korea's viewpoint, since imports are cheaper after the devaluation, the quantity of wheat demanded will rise. With the lower price, more wheat will be consumed and less will be produced domestically. This increased demand in Korea translates into a rise in the price in the United States. The higher price will somewhat dampen the increased demand effect already outlined. The net effect will be to lower the price in Korea, raise it in the United States, and increase the volume of trade.

The apparent shift in the supply and demand curves in Korea and the resulting shift in the import demand curve, each equal the percentage change in the exchange rates. Thus, there is an upper limit on how much the prices and quantities traded can change. The maximum amount of the price rise for the traded goods will be the same percentage as the amount of the devaluation. This maximum price rise will occur only when the export supply curve is perfectly inelastic and the impact of the full shift of the import demand curve is absorbed by the price change. The maximum amount of increase in the quantity traded, also the same percentage as the amount of the devaluation, will occur only if the export supply curve is perfectly elastic. Only then can the full effect of an import demand curve shift be reflected in a quantity change. Any time the export supply curve is less than perfectly elastic or less than perfectly inelastic, devaluation by an exporting country will increase both the price and quantity of wheat it exported. Each of these changes, however, will represent a smaller percentage increase than that for the devaluation.

FIGURE 3

American Demand for Imports from
Korea (American Outpayments)

Korean Demand for American Exports
(Korean Inpayments)

III. Effect of Devaluation on the Terms of Trade

Terms of trade can be defined as the ratio of the export price index to the
import price index. To see the effect of devaluation on the terms of trade,
consider an American devaluation from $1 = W3 to $1 = W2, and ob-
serve the two sets of diagrams in Figure 3.

The left hand charts (Part 1 and Part 2) refer to American import
demand for and Korean export supply of American imports, where each
schedule is shown with respect to prices expressed in terms of the country's
own currency. Thus, while the price axes of one and two are different,
for they show different currencies, the quantity axes are common to both.
What American imports Korea exports and vice versa. The predevalua-
tion price is $\overline{oa}$ on both diagrams, reflecting the ratio $1 = W3, while
the post-devaluation price $\overline{ob}$ reflects the ratio of $1 = W2. American
import prices rise in terms of dollar and decline in terms of won (W),
the two changes adding up to the degree of devaluation. Clearly, the size
of the two changes depends on the relative elasticities of the export supply
and import demand schedules.

The right-hand set (part three and four) refers to Korean (foreign)
demand for and American supply of exports, where each schedule is ex-

pressed in terms of the country's own currency. The quantity axes are common to both. As a result of the devaluation, the price changes from the pair of values $\overline{oa}$ (reflecting a $1 = ₩3 exchange rate) to $\overline{ob}$ (reflecting $1 = ₩2 exchange rate). Won import prices decline while export price with dollar rise, the two changes adding up to the degree of devaluation. The size of the two changes depends on the relative elasticities of the export supply and import demand schedules.

To assess the effect of devaluation on the terms of trade, we must properly compare Diagrams 1 and 4, which show, respectively, the rise in American import and export prices (by $\overline{ab}$), both expressed in terms of dollar. Alternatively, we can compare Diagrams 2 and 3, which show, respectively, the decline $\overline{(ab)}$ in American import and export prices, both xpressed in terms of Won. In each case, export prices can change by more or by less than import prices, and the effect of devaluation on the terms of trade is indeterminate. It all depends on the constellation of the four elasticities in question. In his algebraic derivation, Yeager (1966) shows that devaluation improves the terms of trade if the product of the demand elasticities exceeds the product of the supply elasticities ($\eta_m\eta_x > e_m e_x$) and vice versa, where η_m as the import demand elasticity of devaluing country, η_x as the foreign demand elasticity for its exports, e_x as the devaluing country export supply elasticity, and e_m as the foreign elasticity of export supply facing that country (each elasticity is expressed with respect to price in the country's currency). Alternatively stated, given a devaluation of dollar, the condition for improved terms of trade are $\dfrac{\eta_x}{e_x} > \dfrac{e_m}{\eta_m}$ which carriers the following meaning:

> A high elasticity of Korean demand for imports, η_x, ensures that American prices will not decline much in terms of Won; they will rise almost in proportion to the devaluation in terms of dollars.

A low American supply ealsticity e_x, ensures that American prices will rise (in terms of dollars) almost in proportion to the devaluation. These are the conditions that ensure a high η_x/e_x ratio.

A high American import demand elasticity, η_m, ensures that American import will delcine considerably, depressing their Won prices. A low Korean export supply elasticity, e_m, ensures that as American demand for Korean products decline, Korean export prices also come down. These are the conditions for a small e_m/η_m ratio.

Clearly, if supply elasticities are assumed to be infinite, then $e_m e_x > \eta_m\eta_x$, and the terms of trade of the devaluating country detriorate. In fact, in this case they deteriorate by precisely the degree of devaluation. For, in terms of dollar, American import prices rise by the degree of devaluation while export prices remain unchanged. In terms of Won, American export prices delcine by the extent of the devaluation and

import prices remain unchanged.

IV. Implications for Agricultural Trade

The impacts of exchange rate changes on trade and prices for both agricultural and other commodities, depend on the magnitude of the exchange rate change and the elasticities of the export supply and import demand curves. The extend of the exchange rate change determines the magnitude of the shift in the import demand curve. The elasticity of the import demand curve depends on the equilibrium trade price and the quantity exported. As the export supply curve becomes more elastic, the quantity traded will increase and the price rise will decrease, for any given shift in the import demand curve. This export supply elasticity depends on the domestic supply elasticity, the elasticity of demand in the exporting country, and the relative importance of the export sector. The effect on imports of a change in the exchange rate is similar.

The elasticity of both supply and demand is very low, particularly in the short run, for United States agricultural products. Consequently, a devalution would generate relatively larger changes in price than in quantity traded for agricultural products than for industrial goods. Also because of the extreme inelasticity of the agricultural market, it is very like that the effect on agricultural prices will be larger than the effect on quantity. Thus, to the degree that the agricultural sector is inelastic and the industrial sector elastic, we can conlude that a devaluation would be relatively inflationary within the agricultural sector.

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