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International Agricultural
Trade Research Consortium

Do Macroeconomic Variables Affect the Agricultural Trade Sector? An Elasticities Analysis

By

Daniel H. Pick*
and
Alex F. McCalla

Working Paper #85-1

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*The authors are Post Graduate Research Agricultural Economist and Professor, Department of Agricultural Economics, University of California, Davis. Correspondence should be addressed to the senior author at the following address:

University of California, Davis
Department of Agricultural Economics
Davis, California 95616

November 11, 1985

University of California, Davis
Department of Agricultural Economics

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Introduction

The linkages of macroeconomy and the agricultural sector has been a popular topic in the literature in recent years. Schuh (1974) was the first to argue that the over valuation of the exchange rate had a large negative effect on agricultural exports. Since then, many researchers have investigated the effects on trade of macroeconomic variables such as the exchange rate, the money supply, and the interest rate. The results of these studies are sometimes in conflict. The differences in the results often emerge from the model specification. This paper presents some alternative possible model specifications of macroeconomic variables, and discusses their implications. A new model is then presented which shows that the effects of a change in the level of the money supply and the interest rate on agricultural trade is ambiguous. Furthermore, it can be shown that the effect of exchange rate appreciation or depreciation which will follow changes in the money supply and interest rates, on agricultural trade will also be ambiguous.

Existing Model Specifications

Most studies isolate a single macroeconomic variable in their model, and test its effect on the trade flow. Such is the case in the Longmire and Morey study, where an exchange rate variable was inserted in the model to test its impact on international trade. A change in the exchange rate will shift the excess demand function, and thus an appreciation of the exchange rate will decrease world prices and the quantity traded. Chambers (1981) demonstrated the effect of the interest rate on agricultural trade flow. By inserting an interest rate variable in the domestic supply function, a change in the interest rate will shift the domestic supply function, thus shifting the excess supply function. An increase in the interest rate will decrease the

supply, as the cost of borrowing to the farmers increases, and the excess supply function will shift to the left thus reducing the quantity traded and increase the trade price.

Paggi (1984), tried to test the effect of the money supply on agricultural exports. However, the results could not support the hypothesis of increased trade as a result of an increase in the level of the money supply.

All the above models affect the trade sector, since each one tests the effect of individual macro variables in the trade sector. However, when combining the effect of the money supply and the interest rate, the outcome is ambiguous. This is demonstrated in the model in the next section.

The Money Supply and the Interest Rate

One cannot assume that a rise or drop in the interest rate will occur as an independent event. Macroeconomic theory indicates that interest rates respond to changes in the level of the money supply. Thus, causality runs as follows:

$$\downarrow MS \rightarrow \uparrow i \rightarrow \uparrow ER$$

One might assume that there is a very short-run adjustment period between the changes in the money supply and the interest rate, but the response of the exchange rate might be lagged.

This paper attempts to show that changes in the money supply and the resulting change in the interest rate affect the quantity traded and trade prices in opposite ways. Therefore, one cannot determine *a priori* the final effect of increase or decrease in the money supply on the agricultural trade sector. Quantity traded and prices may increase or decrease depending on the relative elasticities (price and income), and the appropriate shifts in the

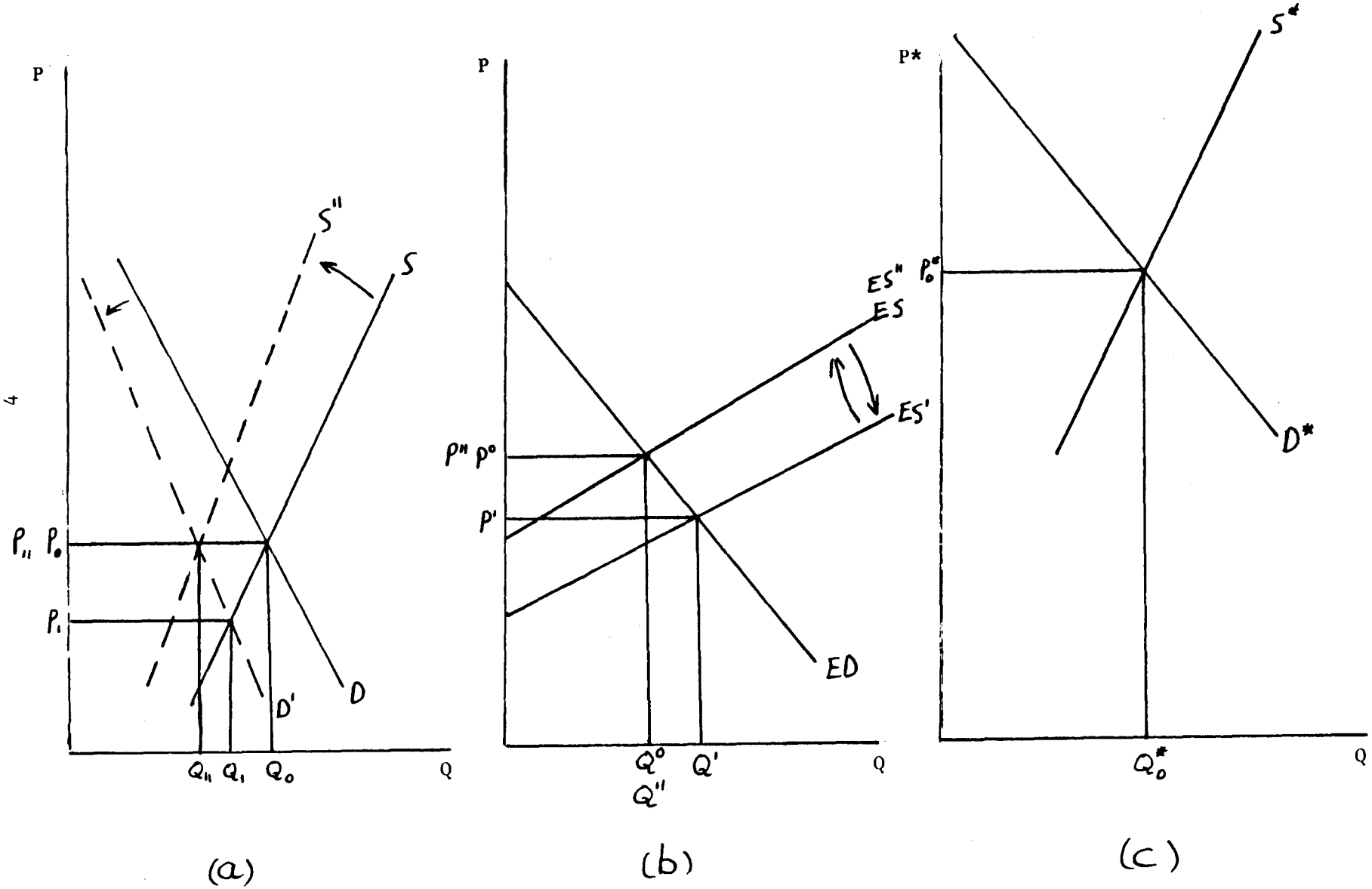
demand and supply schedules. This paper demonstrates why some studies had difficulties in relating agricultural exports to the levels of the money supply.

To show the ambiguity of the effects of changes in the money supply on the trade sectors, the three panel diagram in Figure 1 will be helpful. Panel (a) represents the domestic country, panel (b) the trade sector, and panel (c) the foreign country.

The first step is to show the effect of a decrease in the level of the money supply. A decrease in the money supply is deflationary, since people have less money to spend. The domestic demand falls from D to D' causing a shift to the right of the excess supply function in the trade sector from ES to ES'. This increases the quantity traded and reduces the trading price to Q' and P', respectively.

The decrease in the level of the money supply will be followed by an increase in the interest rate. The increase in the interest will shift the domestic supply schedule to the left from S to S'' as the cost to the farmer of borrowing money for production will increase. The effect on the trade sector is a shift of the excess supply function back to the left from ES' to ES''.

The ambiguity with regard to the total effect on the trade sector occurs after the increase in the interest rate. There are three possible scenarios: a) as a result of the increase in the interest rate, domestic supply will shift far enough to offset the previous shift in demand. This case is demonstrated in Figure 1 where there is no effect on the trade sector and the excess supply function shifts back to its original curve. The effect on the domestic country will be less quantity available $Q_{11} < Q_o$ offered at the original price $P_{11} = P_o$. b) In this scenario the supply schedule shifts such


P
S''
S
P'' P₀
P₁
D'
D
Q'' Q₁ Q₀
Q
(a)
P
ES''
ES
ES'
P'' P⁰
P'
ED
Q⁰
Q''
Q'
Q
(b)
P*
S*
P₀*
D*
Q₀*
Q
(c)

that the excess supply schedule settles between ES and ES'. The total impact of both the decrease in the money supply and the increase in the interest rate on the trade sectors will be to increase the quantity traded somewhere between Q^o and Q' and decrease the trading to between P^o and P'. In the domestic market price and quantity both decrease. c) In the final case, the domestic supply will shift in a more drastic fashion than the shift in demand. The result of such a movement will be to shift the excess supply to the left of the original excess supply function ES. The outcome of such a shift is to reduce the quantity traded beyond Q^o and increase the trading price above P^o. In the domestic market, the quantity traded is below Q_{11}, and the price increases above P_o. One must realize that the extent of the shifts in quantities and prices will be determined exclusively by the relative price elasticities of the demand and supply and the income elasticity.

Effects in Term of Elasticities

To show the ambiguity in the results, a model very similar to the one set by Chambers (1981) is used. The difference lies in the specification of the interest rate not as an independent variable but rather as a function of the money supply. The money supply will appear also in the domestic demand function via income. Expansion of the money supply is inflationary as consumer's income rises, thus inducing them to spend more, and shifting the domestic demand schedule upward. The money supply will also affect the domestic supply through the interest rate effect. As the money supply changes, it affects the interest rate, which in turn affects the cost of borrowing to the farmers, thus shifting to the left the domestic supply function.

Let D(P, Y(m)) be the domestic demand where P is domestic price, Y is income, and m is domestic money supply. Notice that the money supply m is not the only variable which affects income, but for our analysis it is the variable interest. Let S(P, r(m)) be the domestic supply function where r represents the domestic interest rate. Let an asterisk denote the foreign country. We assume that the domestic price is related to the foreign price via the exchange rate, P*=eP, where e denotes the exchange rate. The domestic excess demand function is:

$$ED(P, Y(m), r(m)) = D(P, Y(m)) - S(P, r(m)).$$

The trade equilibrium condition, therefore is:

$$ED(P, Y(m), r(m)) + ED^* (P^*, Y^*(m^*), r^*(m^*)) = 0. \tag{1}$$

Assuming the exchange rate is fixed and partially differentiating with respect to the money supply, we obtain the following expression

$$\frac{\partial E}{\partial P}\frac{\partial P}{\partial m} + \frac{\partial E}{\partial r}\frac{\partial r}{\partial m} + \frac{\partial E}{\partial Y}\frac{\partial Y}{\partial m} + \frac{\partial E^*}{\partial P^*}\frac{\partial P^*}{\partial P}\frac{\partial P}{\partial m} = 0 \tag{2}$$

Rearranging (2) in elasticities form:

$$\varepsilon mp = \frac{-\varepsilon_{rE}\cdot\varepsilon_{mr} - \varepsilon_{YE}\cdot\varepsilon_{mY}}{\varepsilon_{PE} + \varepsilon_{P^*E^*}} \tag{3}$$

where ε_{ij} is the elasticity of j with respect to i. Since in this case the exchange rate is fixed, the only macroeconomic variables which enter the above expression are the money supply and the interest rate. εmy is the income elasticity with respect to the money supply, $\varepsilon m\gamma$ is the interest rate elasticity with respect to the money supply, and $\varepsilon\gamma E$ is the domestic excess demand elasticity with respect to the interest rate. The denominator is the

same as Chambers, and is negative. However, the sign of the numerator is undetermined since it captures the effects of the money supply on both the domestic demand and the domestic supply. As ε_{mP} is the price elasticity with respect to the money supply, under the three scenarios described before, the domestic prices might decrease, stay the same, or increase. In the trading sector, it is impossible to determine whether the new excess supply function will lie to the left, right or remain the same as the old excess supply function.

The Exchange Rate Effect

In the above model, changes in the money supply level and the interest rate were considered. The third effect which one might consider in the model is the exchange rate. As the level of the money supply decreases, the interest rate increases. These shifts will cause capital inflow and appreciation of the exchange rate.

The appreciation of the exchange rate will shift the excess demand function (in Figure 1) to the left, decreasing both the price and the quantity traded. However, when combining the previous shifts of the domestic supply and demand as the results of the changes in the monetary base and the interest rate, the results are not always clear.

Again, three possible cases can be analyzed. Assuming there is some fixed shift in the excess demand function as the result of the appreciation of the exchange rate, (1) The shifts in domestic demand and supply are equal. In this case it is clear that both quantity traded and the price will decrease in the trade sector. (2) The shift in the domestic demand function exceeds the shift in the domestic supply function. In this case it is clear that the price in the trade sector will decrease. However, the quantity traded might

increase or decrease depending on the difference in the shifts, and (3) The shift in the domestic demand function is smaller than the shift in the domestic supply function. This case implies a drop in the quantity traded, but ambiguous results with respect to the traded price as it might increase or decrease depending the magnitude of the domestic shifts.

One must be careful in interpreting these cases. It is very unlikely that an exchange rate appreciation resulting from a decrease in the money supply and an increase in the domestic interest rate, will increase the quantity traded. It takes large shift in the domestic demand and small shift in the domestic supply to cause an increase in the trade flow, as described in Case (b) on page 3.

Effects of Exchange Rate in Elasticities Form

The algebraic derivations of the impact of a flexible exchange rate, we use the same model as before with the exception that the exchange rate is a function of the relative domestic and foreign interest rates:

$$e = e(r(m)/r^*(m^*))$$

Using this notation in (1), and partially differentiating with respect to the money supply, we obtain:

$$\frac{\partial E}{\partial P}\frac{\partial P}{\partial e}\frac{\partial e}{\partial r}\frac{\partial r}{\partial m} + \frac{\partial E}{\partial Y}\frac{\partial Y}{\partial m} + \frac{\partial E}{\partial r}\frac{\partial r}{\partial m} + \frac{\partial E^*}{\partial P^*}\frac{\partial P^*}{\partial P}\frac{\partial P}{\partial e}\frac{\partial e}{\partial m} = 0 \tag{4}$$

Rearranging (4) in elasticities form we derive at:

$$\varepsilon_{eP} = \frac{-\varepsilon_{YE}\cdot\varepsilon_{mY} - \varepsilon_{rE}\cdot\varepsilon_{mr}}{\varepsilon_{PE}\cdot\varepsilon_{re}\cdot\varepsilon_{mr} + \varepsilon_{P^*E^*}\cdot\varepsilon_{me}} \tag{5}$$

The above term is complicated, but it captures all the macro variables effects at once, as the causality flows from the money supply to the interest rate and then on to the exchange rate.

Under the third case in the previous section where the shift in the domestic demand function is smaller than the shift in the domestic supply function, the sign of ε_{ep} is unknown. However, under the second case where the shift in domestic demand exceeds the shift in the domestic supply function, the sign of ε_{ep} is known, but the overall effect on the quantity traded is unknown.

Conclusion

In the above paper a new model specification was presented which is unique in the way all three macroeconomic variables were used. When considering all the consequences of a change in the money supply (i.e., change in the interest rate and exchange rate), the results might be ambiguous.

When analyzing the effect of each macroeconomic variable on the agricultural trade flow, the outcome is known and clear. However, when combining the impacts of all three variables together, the outcome is not necessarily known.

It was the intention of this paper to alert other researchers about the possible outcomes of using different model specifications. When considering only the effect of the money supply on the trade sector, the outcome might be deceiving as there are other macro variables which should be considered as the above model has suggested.

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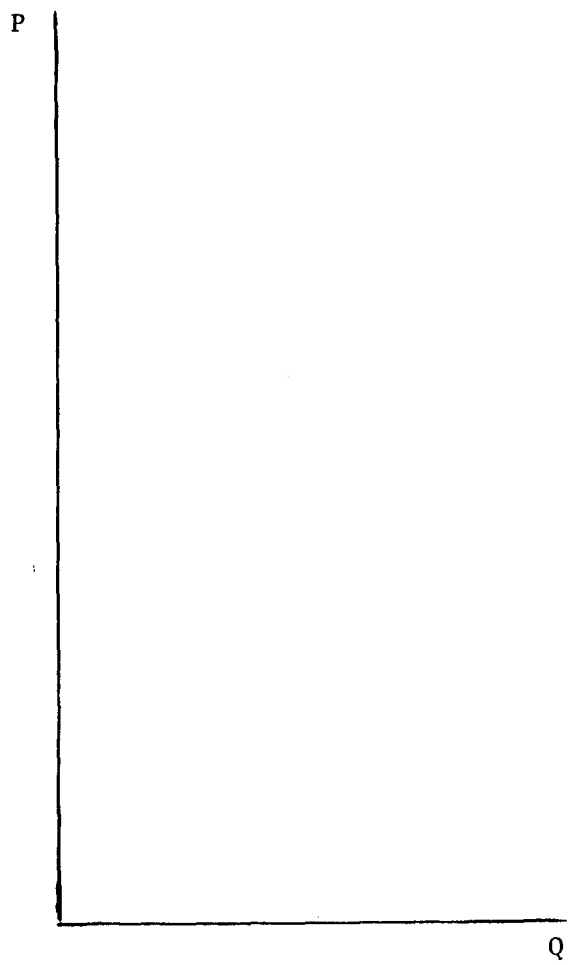
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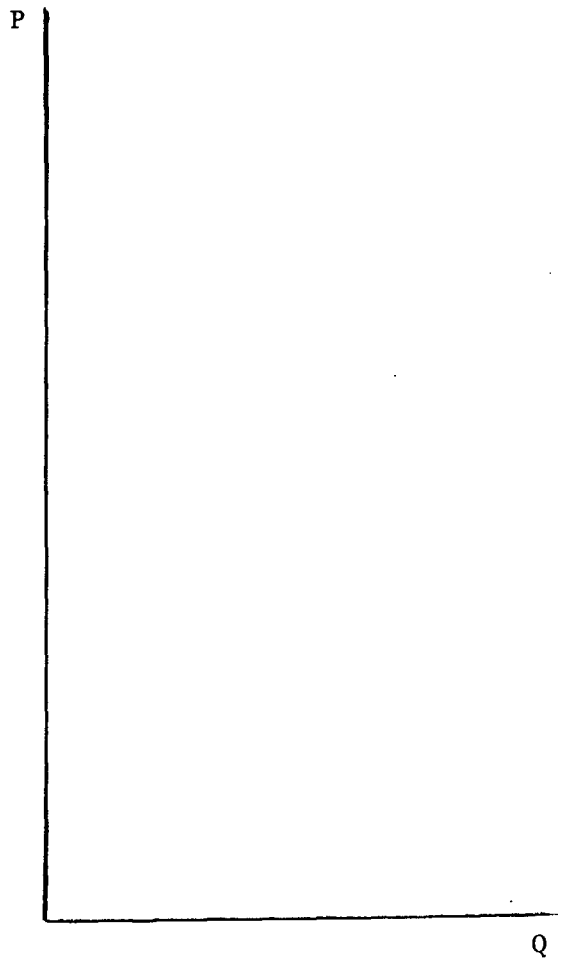
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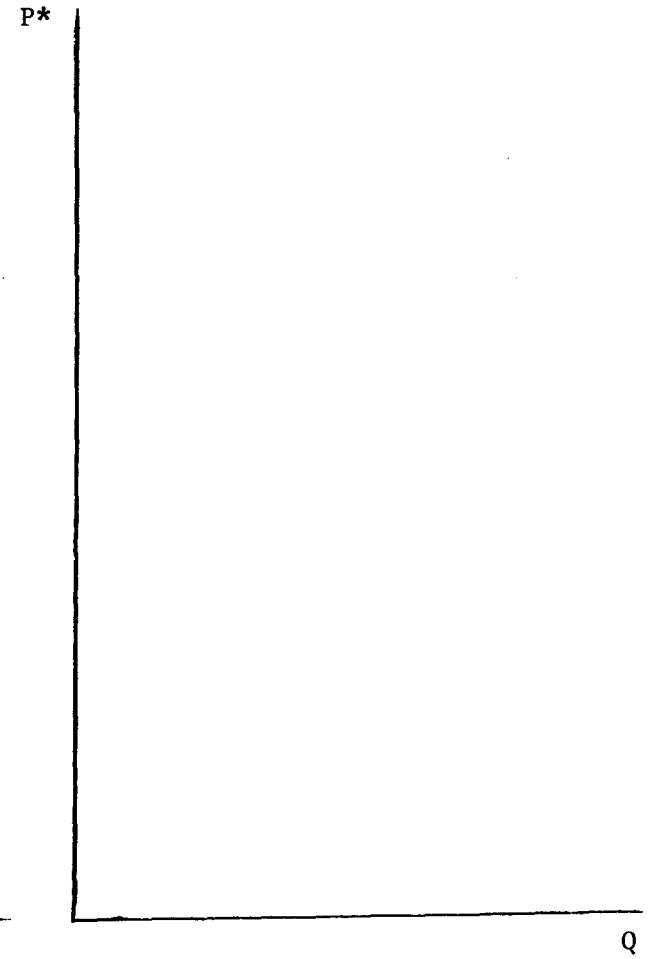
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